TITLE PAGE

EFFECT OF *MORINGA OLEIFERA* LEAF POWDER ADDITIVE ON THE GROWTH OF LAYERS, EGG PRODUCTION AND NUTRITIVE VALUE OF EGGS IN AGRICULTURAL EDUCATION FARMS

BY

UGWUOKE CAJETHAN UCHE
PG/Ph.D/13/66441

A THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL AND BIO-RESOURCE EDUCATION, FACULTY OF VOCATIONAL AND TECHNICAL EDUCATION, UNIVERSITY OF NIGERIA, NSUKKA IN FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY IN AGRICULTURAL EDUCATION

PROF. E. C. OSINEM
SUPERVISOR

MAY, 2017

APPROVAL PAGE

THIS THESIS HAS BEEN APPROVED FOR THE DEPARTMENT OF AGRICLUTURAL AND BIO-RESOURCE EDUCATION, UNIVERSITY OF NIGERIA, NSUKKA

BY

.....
Prof. E.C. Osinem
(Supervisor)

.....
External Examiner

.....
Dr. F. M. Onu
(Head of Department)

.....
Internal Examiner

.....
Prof. E. E. Agomuo
(Dean, Faculty of Vocational and Technical Education)

CERTIFICATION

UGWUOKE, CAJETHAN UCHE, a postgraduate student in the Department of Agricultural and Bio-resource Education with Registration number PG/Ph.D/13/66441, has satisfactorily completed the requirements for the award of degree of Doctor of Philosophy in Agricultural Education. The work embodied in this thesis is original and has not been submitted in parts or in full for any other diploma or degree of this or any other university.

....

Prof. E. C. Osinem
(Supervisor)

Cajethan Uche Ugwuoke
(Student)

DEDICATION

This research work is dedicated to my lovely family.

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Abstract

The study was carried out to determine the effects of *Moringa oleifera* leaf powder additive on the growth of layers, egg production and nutritive value of eggs. Specifically, the study sought to determine among others the effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the growth of layers, effects of different inclusion rates of *Moringa oleifera* leaf powder on the growth of layers, effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the egg production of layers and effects of different inclusion rates of *Moringa oleifera* leaf powder on the egg production of layers. A completely Randomized Design (CRD) was adopted for the study. The study was carried out in the Agricultural Education poultry farm located in the Department of Animal Science mini-livestock farms. The population for the study consisted of 252 Isa Brown day-old chicks and 25 students of Agricultural Education, University of Nigeria, Nsukka. Simple random sampling technique was used to select 240 chicks which were also randomly allotted to 12 pens and 12 students of Agricultural Education participated in the study. Weighing scale, spectophotometer and psycho-productive multiple choice test (PMCT) were used to collect data to answer research questions and test null hypotheses. On the procedure of the experiment, 240 chicks were randomly selected from 252 Isa Brown day-old chicks bought from day-old chicks distribution centre in Nsukka urban area. The chicks were equally randomly allotted to 12 pens with 20 chicks each. The pens were randomly assigned to 4 different treatment groups with 3 replicates each. The 4 treatment groups were Treatment (T) 1, Treatment (T) 2, Treatment (T) 3 and Treatment (T) 4. T1 was fed with control feed, T2 was fed with feed fortified with 2.5% *Moringa oleifera* leaf powder, T3 was fed with feed fortified with 5% *Moringa oleifera* leaf powder while T4 was fed with feed fortified with 7.5% *Moringa oleifera* leaf powder. Each of these 4 treatment groups had 3 replicates representing T1A, T1B, T1C, T2A, T2B, T2C, T3A, T3B, T3C, T4A, T4B and T4C. The chicks were fed with uniform feed up to week 4. From week 5, experimental feeds were given. The layers were placed on the same treatment conditions such as provision of heat during brooding, provision of clean drinking water, vaccination, deworming, treatment of diseases, regular changing of litters, among others except different experimental feeds given to different groups. The feeds were formulated using feedwin software and produced in Chidera Feed Mill located at Onuiyi, Nsukka. Data on the average weight, average weight gain, average feed intake and average egg weight were collected using weighing scale. Nutritive values of eggs were

determined by the Central Research and Diagnostic Laboratory located in Ilorin, Nigeria using proximate analysis, Atomic Absorption Spectrophotometry (AAS) and Gas Chromatography-Mass Spectrometry (GC-MS) methods. Similarly, the extent which students who participated in the study acquired skills in feed formulation and layer production was determined using PMCT developed by the researcher. Data collected were analyzed using mean, bar charts and pie charts to answer research questions while Analysis of Variance and t-test were used to test the null hypotheses at 0.05 level of significance and at appropriate degrees of freedom. Test of significance between means was done using Sceffe Test. A null hypothesis was accepted when the probability value was greater than 0.05 at the appropriate degrees of freedom and rejected when otherwise. The average weights of all the treatment groups were equal from week 1 to week 4. Little variation in average weight started in week 5 with T2 topping the groups. However, there was no significant difference in the average weight of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. The layers fed with control feed consumed the highest amount of feed in most of the weeks under study. It was recommended among others that farmers should include *Moringa oleifera* leaf powder at the rate of 2.5% to improve the weight of layers and sho not include *Moringa oleifera* leaf powder in layer feeds during egg production period.

CHAPTER ONE

INTRODUCTION

Background of the Study

Poultry are domesticated birds kept for meat, table egg or fertile egg production. They can be raised using extensive, semi-intensive or intensive management systems. Whichever system that is adopted, poultry rearing serves as a good subsidiary occupation that supplements the income of smallholder farm families and rural households in most developing countries (Anang, Yeboah and Agbolosu, 2013). According to the authors, greater proportion of poultry production in Nigeria is still at the subsistence level and managed by backyard poultry farmers. However, Ekunwe, Soniregun and Oyedeji (2006) noted that poultry production has assumed an important role as a commercial activity with enormous potentials for rapid economic growth. This is in line with National Bureau of Statistics (NBS) (2010) which reported that poultry industry in Nigeria has witnessed a great leap in the population of birds as well as of poultry establishments. According to NBS, there was an upward trend in the population of birds from 158,216,684 in 2006 to 166,127,481 in 2007,

representing an increase of 2.35 percent. In 2010, the figure rose to 192,313,325 or 7.72 percent compared to 2006. This signifies that Nigeria is making significant positive shift in poultry production to feed the population. The types of poultry that are commonly reared in Nigeria are chickens, ducks, guinea fowls, turkeys, pigeons, quail and more recently ostriches. Those that are of commercial or economic importance given the trade in poultry industry are fowls, guinea fowls, and turkeys, amongst which fowls predominate (Food and Agricultural Organization, FAO, 2006).

Poultry farming is an important agribusiness enterprise that has a great potential for providing additional income to farming communities and educated unemployed persons. In addition to its contribution to the Gross Domestic Product (GDP) and provision of employment opportunities, poultry productio[1] ıajor source of protein supply to the increasing population of the country (Ohajianya, Mgbada, Onu, Enyia, Ukoha, Chendo and Ibeji, 2013). Though poultry production is an important agribusiness, the authors noted that it is faced with a lot of problems. The authors outlined the problems of poultry production in Nigeria to include low capital base, ineffective management, technical inefficiency, economic inefficiency, diseases and parasites, poor housing, high cost of feeds, poor quality of feeds, poor quality of day old chicks, inadequate extension and training, among others. Some poultry businesses, both commercial and non-commercial, find it difficult to cope due to these enormous challenges in the production systems.

There are two distinct poultry production systems in Nigeria: the commercial poultry production and rural poultry production (Food and Agricultural Organization, FAO, 2006). Food and Agricultural Organisation stated that the commercial system is capital and labour intensive and demands a high level of input and technology while rural poultry production is

by convention a subsistence system which comprises stock of non-standard breeds or mixed strains, types and ages. It is usually small-scaled, associated with household or grassroots tenure and little or no veterinary inputs.

Consequently, many people in Nigeria keep poultry as a family business enterprise. Family poultry according to Food and Agricultural Organization (FAO) (2014) encompasses the wide variety of small-scale poultry production systems found in rural, urban and peri-urban areas of developing countries. It is a production system that is practised by individual families as a means of obtaining food security, income and gainful employment. Family poultry production can be categorized as extensive scavenging, semi-intensive and small-scale intensive (FAO, 2014). The conditions and requirements of these systems and the resulting performance differ significantly, as a result of the type of genetic resource used, feeding practices, prevalence of diseases, prevention and control of diseases, the management of flocks and the interactions among these factors. The main outputs from family poultry production are food for home consumption, either in the form of poultry meat or eggs, and income from the sale of these products. Poultry raised for meat production is called broilers while the poultry for table egg production is termed layers.

Layers in Nigeria are reared under free range, deep litter system or battery cage system, with battery cage system being more prominent. Management in terms of feeding, vaccination, medication, egg collection, control of cannibalism, among others, is more efficient in battery cage system. However, this system is capital intensive and does not allow the hens to move around. The European Commission according to Leenstra, Maurer, Galea, Bestman, Amsler-Kapalaite, Visscher, Vermeij and Van Krimpen (2014) recognises non-cage system, which can be categorized as barn system, free range system or organic system. The

authors noted that in barn system, hens are kept in houses that might have multiple tiers (aviaries) with nests boxes and perches. The floor is covered with litter material while a maximum of nine hens per m^2 usable area is recommended. In free range system, inside the house is identical to barn system but access to pasture of 4 m^2 per hen is provided. In organic system, not more than six non-beak-trimmed hens per m^2 useable area are kept, and the hens have access to pasture like free range hens. Besides, the hens receive feed according to organic standards. The feed ingredients are grown without synthetic fertilizers, no free amino acids are added to the feed and genetic modified soya is not used either (Leenstra et al, 2014).

Laying hens need a completely balanced ration (Clauer, 2009). The author noted that feeding table scraps or whole grains can decrease the feed intake, body weight and consequently production. The feed intake capacity of laying hens is determined by the body weight, laying performance, ambient temperature, conditions of plumage, energy content of the feed, consistency of feeding, genetic potential, health status and developmental stage of the birds. Pullets need to be fed appropriately to build much muscle and strength that will help them adapt to a protracted duration of egg production stage. Malnutrition, diseases and retarded growth may set in if the birds are not fed with balanced diet during the growing stage. Growth of layers can be measured in terms of the body weight, weight gain, feed conversion ratio (FCR), among others. The performance of laying hens at the production stage is largely dependent on the health status and growth during the growing stage (Clauer, 2009). Laying hens have 18-21 weeks of growing (rearing) stage and 65-72 weeks of egg production stage. Production of table eggs by layers could be dependent on the breeds, prevailing climatic conditions, feed and feeding (nutrition), management of layers, among others.

Table eggs are usually unfertilized but are meant for human consumption or use in food industry and not for day old chicks (DOC) production. A whole-egg according to Stadelman in Ahmadi and Rahimi (2011) consists of the yolk (30-33%), albumen (approximately 60%) and the shell (9-12%). Eggs are highly nutritious, excellent source of high-quality protein, and several vitamins and minerals (American Council on Science and Health, 2002). The Council stated that eggs are inexpensive, tasty, convenient, easy to prepare, easy to chew and safe to eat. They play important roles in a wide variety of recipes. According to Brufau and Tacon (1999), eggs represent an important source of phosphorous, iron and vitamin, however it is deficient in glucides, calcium and Vitamin C. The authors reported that egg as a whole is considered to be low-calorie source. From egg yolk lipid, only one third is saturated fatty acids and eggs are rich in linolenic acid, essential in human nutrition. Narahari (2003) stated that egg is the most nutritious, unadulterated, yet relatively inexpensive natural food, with a high digestibility coefficient. Egg protein according to the author is the best protein available in nature for human consumption, with a well balanced amino acid profile, having the highest biological value, protein efficiency ratio, net protein utilization and net protein value. Narahari (2003) noted that the nutritive value of eggs can be determined by the amounts of protein, energy, lipid, minerals and vitamins contained in them. It is a common belief that eggs are high in cholesterol, which could lead to hypercholesterolemia. The relationship of cholesterol to eggs was supported by the American Council on Science and Health (2002) which reported that eggs are the largest single source of cholesterol among the foods commonly eaten. The author noted that a large egg contains about 215 milligrams (mg) of cholesterol which is found in the yolk. Pérez-Vendrell, Llauradó, Brufau and Hernández (2004) stated that the levels of vitamins and minerals in eggs

are directly linked to the levels in the feed of the hen, contributing to make the egg such a nutritive food product. The authors maintained that an optimum level of vitamins in feed is essential to allow birds to achieve their full potential and enhance health, welfare and productivity.

In the view of Casartelli, Filardi, Junqueira, Laurentiz, Assuena and Duarte (2006), feed costs higher than any other input in poultry production, and often accounts for 60-65% of total cost of commercial egg production. The authors explained that soybean meal is the major conventional protein source for egg laying feed and costs higher than any other protein source. Increasing feed ingredient prices remain the greatest single item that determines profit margins in layer production. The best strategy to reduce costs is the development of feed formulation using alternative, locally available feed ingredients (Casartelli et al, 2006). Akpantaku, Oluwalana and Adepegba (2006) observed that own-mixed feeds cost less than the commercially mixed feeds, because feed manufacturers raise the prices of the feeds to be able to pay wages, maintain their machinery, and also make profits. To this end, many farmers try to reduce feed cost by compounding their layer's feed.

Layer feed is a compound feed composed of several feed ingredients which include maiz, soybean meal, groundnut cake, animal by-product meals, fats, vitamins and minerals. A complete layer feed is expected to contain a balanced mixture of metabolizable energy, crude protein, minerals and vitamins for optimum growth and production. Oladokun and Johnson (2012) noted that the most easily available sources of energy are the carbohydrates contained in common grains, grain by-products and plants generally. Such ingredients include maize, sorghum, millet, wheat, barley, oat, maize bran, wheat bran, rice bran among others. This is in line with Sinurat (1998) who explained that the feeds for layers are mainly composed of

maize, rice bran, wheat bran, soybean meal, fish meal, coconut meal, palm kernel meal, coconut oil, crude palm oil, meat meal, bone meal, minerals and vitamins. The author stated that cassava meal is produced locally in large quantities but not commonly used in commercial ration formulation due to its low concentration of nutrients other than energy. In the view of Chiba (2014), calcium, phosphorous and vitamin D are important in layer feed for egg shell formation. Grits can improve feed efficiency slightly, but not when finely ground feeds are fed. Phase feeding helps to reduce the wastage of nutrients caused by feeding more than necessary. Feed intake decreases as the temperature increases over 85 to 90°F. Thus, it may be necessary to increase crude protein to 18 or 20% when temperature exceeds 100°F for an extended time (Chiba, 2014).

The American Soybean Association (ASA) (2006) explained that since the requirement for energy far exceeds the requirement for any other dietary nutrient, the energy level of the feed is the main factor influencing feed intake. For this reason, most other dietary nutrients are required in relation to the energy level of the diet. Since cereal grains make up the majority of the dietary ingredients in most layer diets, and account for a large portion of the energy, it is important to have reasonable and reliable estimates of their energy values (ASA, 2006). American Soybean Association observed that a similar situation exists for vegetable protein supplements, as they often make up the majority of the supplemental protein and thus they also make a significant contribution to energy content of a diet. Nutritive value of layer feed ingredients can be improved by grinding, processing and pelleting and can as well be supplemented with minerals. Pelleting helps to make the minerals present in the feed available for the layers.

Mineral supplement according to Hafeez, Mader, Ruhnke, Röhe, Boroojeni, Yousaf, Männer and Zentek (2015) is an important aspect for optimal egg production. The authors explained that minerals play major roles in vital physiological functions, bone development and egg formation in laying hens. Mabe, Rapp, Bain and Nys (2003) noted that the provision of optimum mineral content in the feed is essential for the production of quality eggs by layers. Egg production by layers can be determined by the number of eggs per layer, laying percentage, egg size, egg defects among others. Feed that is short of some minerals and vitamins may lead to the production of defect eggs such as thin shelled eggs, hair-line crack, star cracks, among others. Poor quality feed can as well lead to decreased egg production, immunity compromise, disease inversion and many more. Feed quality can be improved by the addition of mineral supplements and additives. Feed additives are the non-nutritive substances, preparations and micro-organisms that are added to poultry feed to improve growth performance, feed intake and the efficiency of feed utilization for healthy, economic and eco-friendly poultry production. Khan, Sarder and Anjum (2007) observed that for many years, feed additives have been widely used to increase animal performance and recently it is used in poultry industry to improve growth, feed efficiency and layer performance. Some of the organic additives that can be added to layer feed include garlic, Moringa, among others.

Moringa oleifera is a perennial tree that is grown in many parts of the tropics. *Moringa oleifera* according to Beeker and Sidhuraju in Animashaun and Toye (2013) is a relatively inexpensive source of nutrition packed food and supplement for humans and animals. It is rich in health-promoting phytochemicals, various vitamins and minerals. The authors stated that *Moringa oleifera* leaves have a distinctive, strong, mustard-like taste; they are good source of provitamin A, vitamin B and C, minerals (particularly iron) and the

sulphur containing amino acids, methionine and cysteine. *Moringa oleifera* leaves contain both phytate and tannins which have the capacity to bind proteins in the gut and depress protein digestibility as well as intestinal uptakes of dietary and endogenous nutrients (Moyo, Masika, Hugo and Muchenje, 2011). In the view of Anwar, Latif, Ashraf and Gilani (2007), the leaves of *Moringa oleifera* act as a good source of natural antioxidant due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids. According to the authors, inclusion of *Moringa oleifera* in broiler and pig feeds has been known to increase growth and enhance feed conversion ratio due to the high protein, Vitamins A, B, C and amino acids compositions of the product. One hundred grammes of dry matter of Moringa leaf contain 29 ± 6g of protein, 28 ± 6g mg of iron, 1,924 ± 288mg of calcium, 15, 620 ± 6,475 1U of vitamin A and 773 ± 91mg of vitamin C (Broin, 2012). The author noted that it is at least twice the protein in milk and half the protein in egg, with more iron than that in beef, more calcium than that in milk, equal vitamin A to that in carrot and more vitamin C than that in orange. Optimum nutrients in *Moringa oleifera* can be realized through the processing of leaves under hygienic conditions.

During processing of Moringa, the leaflets are stripped out of the petiole and washed thoroughly with clean potable water to remove dirts (Sauveur and Broin, 2010). The leaflets are dried indoors and ground when dry. Ugwuoke and Ochiaka (2013) explained that Moringa powder can stay for a long period of time without losing its efficacy provided it is stored dry and under normal temperature. Production and processing of Moringa leaves into powder do not require extra-ordinary procedure and can be done in individual farms, commercial farms, Agricultural Education farms, among others.

Agricultural Education according to Egbule in Ugwuoke (2013) is the type of education that is employed in training learners in the improved agricultural production processes, as well as in the techniques for the teaching of agriculture. Agricultural education also refers to the teaching of skills, values, attitudes and related knowledge in production, processing and marketing of agricultural and related products. Agricultural Education needs school farms to help students acquire the necessary agricultural skills that will enable them engage in productive work after graduation.

A school farm is a piece of land or structure where students demonstrate classroom theory in agriculture practically. A school farm according to Osinem (2008) is a piece of land, water or building used for the cultivation of crops and/or rearing of animals or fishes/other aquatic organisms in the school. The author noted that schools establish farms to enable students receive practical experience and instruction in agriculture. Therefore, a school farm can be in the form of maize farm, cassava farm, poultry farm, pig farm, cattle farm, fish farm among others. One of the major objectives of school farms is the development of agricultural knowledge and skills in students by their continuous involvement in farm practices. Unfortunately, agricultural education students after graduation still lack the requisite skills in agriculture especially poultry production. This was attested by Onu and Ugwuoke (2010) that school farms available in some schools were not functional for skills acquisition in Enugu State due to the high cost of poultry feed and as well scarcity of quality poultry feed. The cost of feeding layers exceeds every other cost encountered in layer production. This was the reason Katongole, Nambi-kasozi, Lumu, Bareeba, Presto, Ivarson and Lindberg (2012) reported that the high cost of quality layer feed has led many egg producing farmers in urban and peri-urban areas to adopt feed cost-saving mechanisms, particularly own-feed formulation

and mixing. Hence, the need to explore the potentials of moringa leaf powder as cost-saving quality feed additive for inclusion during layer feed formulation for better layer and egg production.

Statement of the Problem

Food insecurity is of universal and national concern. The population of Nigeria is fast increasing, endangered by high cost of food production and also high cost of poultry products. The population of Nigeria was 186 million people with population growth rate of 2.44%. This population is alarming and agricultural production in the country is low. Protein supply to the teeming population is grossly inadequate due to high cost of production of food especially poultry products. Feed was the main cost of layer production, and often accounts for 60-65% total cost of commercial egg production. Feed cost had often been reported as the major element in the total cost of rearing layers compared to the rearing of other livestock species. High cost of quality feeds limits egg production by disengaging some people who would have gone into egg production to ameliorate protein inadequacies in the country. Moreover, the problem of poor protein supply through egg production was complicated by training Agricultural Education students without exposing them to rearing poultry using school farms.

When students graduate without exposing them to practical training in rearing layers using school farm, the graduates will only be loaded with theoretical knowledge in layers devoid of practical layer production skills. School farms available in some schools were not functional for skills acquisition in Enugu State due to the high cost of poultry feed and as well scarcity of quality poultry feed. When students are practically trained in egg production using *Moringa oleifera* leaf powder additive to produce layers in school farm, they will contribute

their quota in alleviating the problem of poor protein supply to the Nigerian population after their graduation.

Moreover, inclusion of *Moringa oleifera* in broiler and pig feed has been known to increase growth and enhance feed conversion ratio due to the high protein, Vitamins A, B, C and amino acids compositions of the product. Hence, the need to determine with the students, the effect of locally produced *Moringa oleifera* leaf powder additive on the growth of layers, egg production and nutritive value of eggs.

Purpose of the Study

The major purpose of the study was to determine the effects of *Moringa oleifera* leaf powder on the growth of layers, egg production and nutritive value of eggs in Agricultural Education farms. Specifically, the study sought to determine the:

1. effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the growth of layers.
2. effects of different inclusion rates of *Moringa oleifera* leaf powder on the growth of layers
3. effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the egg production of layers.

4. effects of different inclusion rates of *Moringa oleifera* leaf powder on the egg production of layers.

5. effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the nutritive value of eggs produced by the layers.

6. effects of different inclusion rates of *Moringa oleifera* leaf powder on the nutritive value of eggs produced by the layers.

7. cost effectiveness of eggs produced with *Moringa oleifera* leaf powder fortified feeds and the control feed.

8. cost effectiveness of eggs produced with different inclusion rates of *Moringa oleifera* leaf powder.

9. extent students that participated in the research work acquired skills on feed formulation and layer management.

Significance of the Study

The findings of the study would have practical and theoretical significance. Practically, the findings of the study would be of immense benefit to Students of Agriculture, poultry farmers (Layers), poultry feed manufacturers, researchers and egg consumers.

The study would provide information to students of Agricultural Education on the productive skills in feed formulation and layer husbandry. The students would be part and parcel of the research and by so doing would acquire the practical skills in feed formulation, layer production and research operations. The students will utilize the information to establish their own layer production enterprise (Brood and sell enterprise, point of lay enterprise or egg

production enterprise) on graduation and the research skills would help some of them overcome their research challenges.

Poultry farmers (Layers) would benefit from the results of the research by utilizing the information to articulate materials and organize workshop to train farmers on the inclusion of certain quantity of *Moringa oleifera* leaf powder into layer feed to get desirable result in egg production. The materials articulated from the findings would also help to train feed manufacturers on the correct quantity of *Moringa oleifera* leaf powder that can be used to fortify a known quantity of layer feed to obtain known result.

The result of the study would help to articulate materials for conference and workshop to redirect the egg consumption pattern of egg consumers. It is generally known that egg has a high composition of cholesterol. Though the high protein and iron contents of egg are beneficial to children, high cholesterol content of egg is not beneficial to adults. If eventually the inclusion of *Moringa oleifera* leaf powder lowers the cholesterol content of egg, the consumption of eggs by the adult would increase as the barrier limiting the consumption by adults would be reduced.

This study would serve as a tool in the hands of teachers for training in formal agricultural education setting in poultry feed formulation and layer production. It would provide a body of knowledge to researchers and layer farmers who may wish to investigate further into Moringa and layer production and applications. It would give them the insight in the area that was not researched and as well provide foundation for further studies.

The study was anchored on the theory of vocational education which stipulated that effective vocational training can only be given where the training jobs are carried on in the

same way with the same operations, tools and machines as in the occupation itself. The result of this study helped to validate the theory since part of the study was aimed at investigating the extent students that participated in the research work acquired skills on feed formulation and layer management.

Research Questions

The following research questions were formulated to guide the study.

1. What are the effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the growth of layers?

2 What are the effects of different inclusion rates of *Moringa oleifera* leaf powder on the growth of layers?

3. What are the effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the egg production of layers?

4 What are the effects of different inclusion rates of *Moringa oleifera* leaf powder on the egg production of layers?

5. What are the effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the nutritive value of eggs produced by the layers?

6. What are the effects of different inclusion rates of *Moringa oleifera* leaf powder on the nutritive value of eggs produced by the layers?

7. What is the cost effectiveness of eggs produced with *Moringa oleifera* leaf powder fortified feed and the control feed?

8. What is the cost effectiveness of eggs produced with different inclusion rates of *Moringa oleifera* leaf powder?

9. To what extent do students participated in the research work acquire skills on feed formulation and layer management?

Research Hypotheses

The following null hypotheses were formulated and were tested at 0.05 level of significance and appropriate degrees of freedom

HO_1: There is no significant difference in the mean growth of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.

HO_2: There is no significant difference in the mean growth of layers fed with different inclusion rates of *Moringa oleifera* leaf powder.

HO_3: There is no significant difference in the mean egg production of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.

HO_4: There is no significant difference in the mean egg production of layers fed with different inclusion rates of *Moringa oleifera* leaf powder.

HO_5: There is no significant difference in the mean nutritive value of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.

HO_6: There is no significant difference in the mean nutritive value of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder.

HO_7: There is no significant difference in the mean cost of eggs produced with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.

HO_8: There is no significant difference in the mean cost of eggs produced with different inclusion rates of *Moringa oleifera* leaf powder.

HO_9: There is no significant difference in the mean skills acquisition of participating students on feed formulation and layer husbandry before and after the research work.

Scope of the Study

The study was limited to the effects of *Moringa oleifera* leaf powder additive on the growth of layers, egg production and nutritive value of eggs in Agriculrual Education farms. The Moringa oleifera additive was included at the rate of 2.5%, 5% and 7.5% respectively. On the growth of layers, the study focused on the average weight, average weight gain, Feed Conversion Ratio (FCR), feed intake and mortality of layers. On the egg production of layers, the study investigated the quantity of eggs produced, average egg weight, average egg mass and laying percentage of layers. Similarly, on the nutritive value of eggs produced by the layers fed with *Moringa oleifera* leaf powder and the control, the study investigated the proximate composition of the eggs - Metabolizable energy, crude protein, crude fibre, Total fat; Vitamin profile - Vitamin A, Vitamin B1, B2, B3, B5, Vitamin C, Vitamin D and Vitamin E; Mineral profile - Calcium, Iron, Phosphorous, magnesium, potassium, sodium, copper, manganese, selenium, chromium and Zinc; Amino acids profile – arginie, aspartate, serine, cysteine, glycine, Isoleucine, lysine, histdine, proline, methionine, alanine, tyrosine, threonine, phenylalanine, leucine, glutamate, asparagine, tryptophan, valine and glutamine; lipid parameters – total cholesterol, triglyceride and free cholesterol. On the cost of eggs

produced with and without *Moringa oleifera* leaf powder, the study investigated the cost of feed/kg produced.

The study was restricted to Agricultural Education poultry farms located in the Department of Animal Science mini-livestock farms, University of Nigeria, Nsukka with deliberate attempt to include students in the study. Other Vocational Education students were not involved in the study as they do not have sufficient fundamental knowledge in scientific poultry husbandry and animal feed formulation research like dosing, weighing, accurate measurement, among others.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter deals with the review of related literature. The review was organized under the following sub-headings:

Conceptual Framework

- School Farm Agricultural Programme
- Layer Husbandry and Egg Production
- Feed and Feed Formulation
- *Moringa oleifera* Processing
- Nutrient Composition of Poultry Egg

Theoretical Framework

- Theory of Vocational Education

- Experiential Learning Theory

Review of Related Empirical Studies

Summary of Literature Reviewed

Conceptual Framework

School Farm Agricultural Programme

School farm is a fixed agricultural facility where students carry out practical exercise on the theories studied in the classroom. School farm according to Olaitan and Mama (2001) is an area specifically earmarked for agricultural activities by a school. The authors noted that school farm may be in the school or at a fairly walking distance to the school. The qualities that make an area acceptable as a school [illegible]ding to Olaitan and Mama (2001) include accessibility to the school and the com[illegible] and favourableness to the growth of many arable crops and rearing of animals, among others. In the view of Egbule (2002) school farm is a piece of land located within or around the school and used for cultivation of crops and/or rearing of animals. The author explained that school farms are geared towards helping students acquire necessary farming skills and ensuring that classroom theories are backed up with facts and practice. A well organized school farm according to Egbule (2002) can serve the following purposes: provides students with opportunity of acquiring knowledge, skills and needed competencies in agriculture; opportunity to demonstrate farm practices and conduct farm experiments for students; opportunities to practise what is learnt in classroom; encouragement of group efforts and competition among students and schools in agricultural production practices and programmes; stimulation of students' interest in agriculture as well as their mobilization for effective agricultural production through voluntary participation; enables juvenile farmers embrace modern farming early in their lives and grow up with it,

opportunity for carrying out some farming and cropping systems; opportunity for individualized and group projects located on school farm and also well managed school farm are often used to generate funds for students and also to improve school programmes.

School farm in the view of Olaitan and Alaribe (2010) is a piece of land selected for agricultural activities by the school. According to the authors school farm is used for teaching students practicals in crop, fish, ruminants and poultry production. In a study conducted by Olaitan and Alaribe (2010) it was found that teachers need some improvements in planning for the school farm, implementing school farm activities and evaluating school farm activities.

School farm is very vital in developing requisite agricultural skills in students. The importance of school farm according to Osinem (2008) include: acquisition of skills that are useful and applicable to community needs by the students; production of individuals who will be able to put into practice, what they had learnt; more food is produced through encouraging youths to get more interested in agriculture; innovations are adopted and skills are acquired and transferred to youths in modern techniques of agricultural production; scientific findings and innovation can be tried thoroughly and adjustment made in school farm before feedback is sent to researchers for improvement; it is a training ground where learners are exposed to saleable skills in agriculture; training jobs are carried out in the school farm in the same ways as in the specific occupation; concepts, principles and theories in the classroom situation are made real and easily comprehensible, among others.

In the view of Onu and Ugwuoke (2010) school farm was not available in some schools for agricultural skills acquisition in Enugu State except arable crop demonstration farms. The authors found out some measures for optimizing the utilization of school farms for

agricultural skills acquisition which include: mapping out practical agriculture period in the school timetable; formulation of school farm committee; formulation of young farmers club in the school; engaging students in field operation and field trips; taking students to school farm for practical operations; encouraging farm competition among students; mapping out separate areas for crop, poultry and cattle; mapping out separate funds for farm development; allowing each student to have a portion of land in the school farm and supervising students' farm operations from time to time. Ejiofor and Osinem (2010) stated that agricultural practicals in school farm offer every student the opportunity to be exposed to real life experiences thereby promoting learning by doing which can engender enough interest to make them enter production and marketing of crops and livestock products after graduation. The authors emphasized that there is a great need for the teachers of agriculture to acquire managerial skills and initiative concerning the usage of school farm.

Layer Husbandry and Egg Production

Layers are generally the type of fowls that lay table eggs for human and industrial consumption. Over the years layers have been genetically improved to lay more eggs than they would naturally do under normal condition. Laying hens according to Leenstra, et al (2014) are kept in different systems, among which loose housing system (non-cages) is of increasing importance in European countries. The European Commission (EC) recognizes as non-cage systems the following categories; barn, free range and organic systems. According to European Commission (EC) (2008) in Leenstra, et al (2014), hens are kept in houses that might have multiple tiers (aviaries) with rest boxes and perches in barn system. The floor is covered with litter materials and a maximum of 9 hens per m^2 useable area are kept in barn system. The authors stated that free range systems are identical to barn system, but access to a

pasture of $4m^2$ per hen is provided. Leenstra, et al (2014) noted that organic system is specific form of free range system organized in accordance with the requirements of organic production. No more than 6 non-beak-trimmed hens per m^2 useable area are kept inside, and the hens have access to a pasture like free range hens. Besides, the hens receive feed according to organic standards. The authors explained that ingredients for the feed are grown without synthetic fertilizers, no free amino acids are added to the feed and genetically modified soya is not used either.

According to Cuxhaven (2005) deep litter, perchery and free range systems are the recommended housing systems. The classic form of deep litter system design is 80-90cm dropping pit covered with wooden, wire mesh or plastic slats on which feeders, drinkers and nests are mounted on 2/3 of the floor space and litter scratching area takes 1/3 of the floor space; stocking density is 9 hens per m^2 of usable floor space; while raised perches and rails are provided to encourage good dispersal of the hens across the building and as well provide resting areas. Cuxhaven (2005) noted that percheries are systems where the birds can move around on several levels. The author stated that the levels are covered with wooden, wire mesh or plastic slats, and manure belt ventilation can be installed if desired. As a rule, feeders and drinkers are positioned on the lower levels while the upper levels are mostly used as resting areas for the hens. The author explained that the nest boxes can be located either within the system or outside the perchery, but hens are kept at a density of 18 hens per m^2 of the ground floor space. Controlled lighting and variable feeding times should be encouraged in perchery system to allow the hens move around the different levels.

Under free range system, Cuxhaven (2005) explained that it can be deep litter or perchery system where birds have additional access to free range. The author stated that there

is a provision for wintergarden for crossing area which can be cleaned after each flock but there in a stocking density of $4m^2$ per bird in the range area. In brooding layer chick, Hy-line (2015) recommended that chicks should be brood in group; pre-heating the brooding houses prior to chick placement; establishing proper house temperature of 33-36^oC and 60% humidity 24 hours before chicks placement; bright light of 30 -50 lux during 0 – 7 days, reduce the temperature by 2 - 3^oC weekly until reaching 21^oC, modify temperature as needed to meet chicks' comfort; finding optimum balance of temperature, humidity and ventilation rate for chicks' comfort and for every 5% point increase above 60% relative humidity, reduce brooding temperature by 1^oC. Thiele and Tierzuch GmbH (2008) stated that pullets should be transferred to laying houses in good time before the anticipated on set of production and 17 or 18 weeks of age in recommended. The movement of pullets from the rearing to the layer house should be handled with care but speedily. The author noted that capture, transportation and vaccination are stressful to the hens and therefore, gentle transfer and careful adaptation of the flock to the new surroundings are crucial for good production result.

According to Clauer (2009) completely balanced ration should be given to layers. The author stated that feeding table scraps or whole grains decreases production. The author recommended 18 – 20% protein starter for the first 6 to 8 weeks, then 14-15% protein grower or developer to 20 weeks of age. After 20 weeks of age, 16 to 18% protein layer ration should be given. Feed grits and oyster shells free choice in separate feeder. Cuxhaven (2005) noted that the feed intake capacity of laying hens is determined by body weight; laying performance, ambient temperature, condition of plumage, energy content of the ration, consistency of the feed; genetic potential; health status and development of intestines. Clauer (1990) maintained that clean and cold water should be provided to laying hens. The author

noted that drinkers should be cleaned and fresh water provided daily. The drinkers should be placed so that the lip is level with the birds back and 1cm of water space per bird should be provided. Tierzucht (un) explained that lighting programme controls the onset of lay and affects the performance. The author stated that rearing birds in closed houses and producing eggs in light-tight houses enable the producer to maximize performance. The author stated the basic principles of lighting programme to include: never increase hours of light during the rearing period, never decrease hours of light during the production period and finally always keep in mind that natural day light can influence the lighting programme in open houses. Feather pecking and cannibalism are common in layers and they are typical management problems in laying hen production.

In the view of the Department for Environment, Food and Rural Affairs (DEFRA) (2005), feather pecking is an abnormal behaviour whereby some laying hens peck others sometimes removing feathers, which can result in poor plumage, patches of feather loss, skin damage and even death. Where feather pecking develops into injurious pecking and the protective function of the bird's plumage is lost, it can trigger cannibalism which is a serious animal welfare problem. The traditional method of alleviating the problem has been to beak trim laying hens (DEFRA, 2005). Beak trimming is the removal of not more than one –third part of both a bird's upper and lower beaks measured from the tip towards the entrance to the nostrils and the operation is normally carried out between 7 – 10 days old. A sudden onset of abnormal behaviour in layers can have a variety of reasons which may include: nutrition and health, stocking density, house climate, light intensity and light source, ecto and endoparasites, feed consistency, dietary protein/amino acid content, calcium and sodium deficiencies among others (Cuxhaven, 2005).

Soft wood shavings or straw make suitable litter in layer house and these should be from untreated wood only in order to avoid poisonings and residues in the egg (Tierzucht). Keep 3-6 inches litter deep, remove wet litter as needed, and prevent leg problems by not starting chicks on slippery surfaces, like newspaper (Clauer, 2009). Vaccination of layers is an important disease preventive mechanism. Tierzucht emphasized that only healthy flocks should be vaccinated, expiration of the vaccine should be checked, and records of all vaccinations and vaccines serial numbers should be kept. The author listed some of the diseases of layers that should be vaccinated against. They include: Marek's disease, Newcastle, Gumboro, Infectious bronchitis, Avian encephalomyelitis (AE), Fowl pox, Mycoplasmosis, pasteurellosis, Inflectious coryza, Salmonella, Infectious Laryngotracheitis (IL) and Egg Drop Syndrome (EDS). Hy-line (2015) noted that biosecurity is the best method of avoiding diseases, and a good biosecurity programme identifies and controls the most likely ways a disease could enter the farm. The author explained that human and equipment movement into the farm should be restricted, visitors to the farm should be limited, visits should be documented in a logbook, and visitors and workers should shower at a central location before entering the layer farm.

Induced molting of the layers has been used extensively as a management tool for extending flock performance and in avoiding the annual cost of replacing pullets, vaccines, medicine and feed (Amer, Khan, Abbass, Abbass, Iftikhar, Anwar, Amin and Anjun, 2013). The authors noted that high mortality of the replacement pullets during the rearing period is also a major problem faced by farmers as it affects the egg production and economic performance. Molting can be done in several ways which include the feed withdrawal up to

ten days; water withdrawal for two days; photoperiodic reduction; feeding low calcium or low sodium diets; and feeding dietary minerals (Amer et al, 2013).

Layers are the type of chicken that are raised purposely for table egg production for human and industrial uses. Renema, Robinson, Feddes, Fasenko, and Zuidhof (2001) noted that selection for egg production has greatly increased ovulation frequency in commercial egg-type hens with current stocks reaching sexual maturity at earlier ages. In the view of Jacob and Pescatore (2012) egg production in layers typically begins when the pullets reach 18-22 weeks of age, depending on the breed and season. The authors stated that egg production as a percentage of hens housed rises sharply until it reaches its peak about six to eight weeks later. Peak production levels of 90 percent or more are common with some of the egg laying breeds such as leghorns. Production gradually declines, eventually reaching a level at which the hens are consuming more money in feed than they are producing in eggs. Rajendran, Selvaraju, Rao, Dineshkumar, Verma, Parthipan and Kannan (2014) reported that supplementation of organic chromium in disease affected birds could relieve the stress quickly and improve egg production and immunity. The authors further noted that an increase in egg production in Newcastle disease affected birds, and enhancing the immunity by means of supplementation of chromium yeast to layer feeds could be a useful strategy.

With proper management and husbandry skills along with nutritional know-how, egg producers can influence the size of eggs produced by the modern and efficient laying hen (Oderkirk, 2013). According to the author, basic information essential for the egg producers to make proper decision concerning pullets and layers are the body weight; flock uniformity; feed intake; level of energy, protein and calcium in the feed; light period and intensity; and pen temperature. Molt induction to rejuvenate the egg laying performance of commercial

laying hen flocks is an important practice in many parts of the world, often being necessary to make a flock profitable under certain market scenarios (Amer et al, 2013). In the induced molting experiment carried out by the authors, it was discovered that the rate of egg production was significantly improved by molting treatments when compared to control group. The authors concluded that the improved performance of the post-molt layers was due to body weight loss.

In the view of Renema et al (2001) threshold light intensity for a complete morphological response to photostimulation was between 1 and 5 lux, with I lux intensity resulting in inferior ovary development and egg production. According to the authors, body weight gain was also affected by light intensity, indicating the strong possibility of a light effect on feed intake thereby affecting egg production, egg size, and shell quality. One of the most common causes of drop in egg production according to Jacob and Pescatore (2012) is improper nutrition. Hens require a balanced diet in order to sustain a high level of production. Feeds are formulated to meet all the daily nutritional requirements of laying hens in the typical amount of feed consumed for maximum egg production.The phase feeding programme for layers should be based on egg size or egg mass but not percentage production (Oderkirk, 2013). Minerals in layer diet like calcium and phosphorous must be adjusted as the laying hen ages, to compensate for the decrease in calcium utilization in aging birds especially after 40 weeks of age.

Many times the imbalances in the diet of the laying hens result in a drop in egg production or an increase in the incidence of problems such as prolapse (egg blow-outs) (Jacob and Pescatore, 2012). Prolapse according to the authors is a condition where the reproductive tract of a hen is too fat and/or the egg being too large. Permanent damage is

common with the prolapsed. Opinephrine, a stress hormone, will cause a delay in oviposition and cessation of shell gland cuticle formation in layers which can cause pale shelled eggs to be produced and stressors may include, amongst others, high cage density, loud noise, transportation and handling (Butcher and Miles, 2008).

High temperatures (above 25°C) result in smaller eggs produced by layers and reduce shell quality through a number of physiological processes occurring within the hen (Ahmadi and Rahimi, 2011). The authors noted that heat stress reduces feed intake and limits the availability of blood calcium for egg shell formation. In the study conducted by Kralik, Radišic, Cirčević and Kralik (undated), it was discovered that the keeping system of laying hens had significant influence on egg weight, yolk weight, shape index, shell thickness and yolk colour. The authors reported that eggs from free range hens had significantly greater weight and yolk, as well as more intensive colour of yolks while eggs from hens kept in cages had higher shape index and thicker shell.

Feed and Feed Formulation

Feed is one of the most important factors to put into consideration before embarking on poultry production either for egg or meat. This is in line with Casartelli et al (2006) who stated that feed is the main cost in layer production, and often accounts for 60-65% of total cost of commercial egg production. Feed cost according to Kasule, Katongole, Nambi-Kasozi, Lumu, Bareeba, Presto, Ivarsson and Lindberg (2014) is the major element in the total cost of rearing layers compared to the rearing of other livestock species. Katongole et al (2012) noted that high cost of feed is limiting layer production in urban and peri-urban areas of Kampala. Feed cost alone accounts for over 70% of the total variable costs of layer production (Walker

and Gordon, 2003). The high cost of layer feed has led many egg producing farmers in urban and peri-urban areas of Kampala to adopt feed cost-saving mechanisms, particularly own-feed formulation and mixing (Katongole et al, 2012).

Some of the common techniques employed in the formulation of layer feed include the Pearson square method, linear programming, non-linear programming, and trial and error method (Oladokun and Johnson, 2012). The authors noted that the Pearson square method is a simple, well established and popular method of determining the correct proportion of two feed ingredients necessary to obtain a desired level of a particular nutrient. In a study to determine the effect of feeding and feed formulation methods, Ahmad and Roland (2003) noted that lysine-based diet is formulated by keeping lysine and TSAA ratios constant and allowing the protein level to vary. Hen feed is supplemented with synthetic methionine. In the protein method of feed formulation, the authors noted that the ration is formulated by keeping protein level constant and allowing lysine level to vary. Linear programming is the common method of least cost feed formulation which compares the nutrients required by the animal to the nutrients supplied by the available feed ingredients, and combines them to obtain a balanced diet at the least possible cost (Oladokun and Johnson, 2012). In trial and error method, the authors maintained that the formulation is manipulated until the nutrient requirements of these birds are reached. Over the past several decades, the poultry industry has moved from formulation of diets based on a crude protein basis to a least-cost and total amino acid (TAA) basis, in part due to the introduction of affordable computing power (Firman, 2006). According to the author, farmers have begun to switch to newer concepts that may prove cost effective and these include digestible formulation, precision feeding, ideal proteins and modeling.

In feed ingredients for layer feed formulation, Chiba (2014) stated that corn and soybean meals are mostly plentiful and used as lowest-cost sources of energy; fish meals and meat meals are good sources of protein and amino acids; limestone and bone meal for calcium and phosphorous; salt added at 0.2-0.5%; supplemental lipids up to 5% of the diet; yellow pigmentation such as yellow corn plus sources of xanthophylls such as alfalfa meal or corn gluten meal; non-nutritive additives such as antibiotics, antiparasitic compounds, antioxidative and antifungal compounds are also used in feed formulation. The diet for layers are mainly composed of maize, rice bran, wheat/pollard, soybean meal, fish meal, coconut meal, palm kernel meal, coconut oil, crude palm oil, meat and bone meal, minerals and vitamins (Sanurat, 1998). The author stated that cassava meal is produced locally in large quantities but not commonly used in commercial ration formulation due to its low concentration of nutrients other than energy. Oladokun and Johnson (2012) noted that layer diets are primarily made up of a mixture of several feed-stuffs such as cereal grains; soybean meal; animal by-product meals; fats; vitamins and mineral premixes. The authors stated that a good layer diet is expected to contain three essential nutrients of protein, vitamins, and minerals as well as adequate metabolizable energy. Energy is very critical in poultry feed as the more the energy is loaded in the ration, the less feed the birds would consume.

When ingredient quality shortfalls are detected prior to feed manufacture, the cost of the shortfall can be calculated by the cost of any remedial action e.g. reformation, supplementation, rejection and organization of alternative supply, treatment or insurance strategy (eg mycotoxin binder) (American Soybean Association, 2006). The author stated that these exercises tend to be far less expensive than the situation where the quality shortfall is

undetected and is unwittingly incorporated into the feed and goes on to compromise livestock production or the market value of the product.

Chiba (2014) noted that in feed stuffs selection, certain factors such as nutrient availability; palatability; content of growth inhibitors; cost and market availability of the feed stuffs need to be considered. The author explains that nutrient availability of feed stuffs is affected by the fibre content; fat content and amino acid balance. However, some feed manufacturers include additives in layer feed to improve the quality and increase layer performance. Feed additives according to Elagib, El-Amin, Elamin and Malik (2013) are non-nutritive substances used in poultry feed including antibiotics, enzymes, antioxidants, pellet-binders, antifungal, coloured pigments and flavouring agents. Feed additives have been widely used to increase animals' performance and recently it is used in poultry industry to improve growth, feed efficiency and layer performance. Iji, Saki and Tivey (2001) stated that the use of antibiotics as growth promoters is facing serious criticism particularly among the European countries. The use of antibiotics was criticized on the basis of the growth of drug resistant bacteria and drug residue is meat (CAFA, 1997). However, the use of natural additives gained the acceptance of the people. Inclusion of garlic (*Allium sativum*) as an organic additive can increase egg production, reduce cholesterol content of serum and yolk and improve immune response in layers (Saki, Aliarabi, Sayed, Salari and Hashemi, 2014). Garlic is considered as a plant with antibiotic, anticancer, antioxidant, immunomodulatory, anti-inflamatory, hypoglycemic and cardiovascular preventing effects (Saki et al, 2014). The leaves of *Moringa olifera* also have antioxidant property due to the higher amount of polyphenols (Sreelatha and Padma, 2009). Antioxidants according to Hamid, Aiyelaagbe, Usman, Ameen and Lawal (2010) are substances that protect cells from the damage caused by

unstable molecules known as free radicals. Antioxidants interact with and stabilize free radicals and prevent some of the damage free radicals might otherwise cause when included in layer feed in the form of additive. *Moringa oleifera* leaf powder can be included in starter feed, grower feed or layer feed to promote certain qualities in layers.

This is in line with Chiba (2014) who outlined the categories of layer diet to include starter diet, growing diet and laying diet. According to the author, starter feeds are given from 0-6 weeks old, growing feeds are given to the pullets from 6 weeks of age to sexual maturity while laying feeds are given to mature egg laying hens. Blake, Hess and Macklin (2007) also reported that complete starter feed is given until 6 weeks old, complete growing mash is offered to pullets between 16 and 20 weeks old, while layer feed in given at 20-22 weeks when egg production begins. The primary concern in formulating a diet is to meet the birds' nutrient requirement (Blake et al, 2007). A bird will eat to satisfy her energy need and therefore, all other dietary nutrients must be provided based on the amount of energy that the chicken will consume and should have the proper balance of energy to other nutrients. It is interesting to note that all nutrients in a feed ingredient are not available for utilization by the bird (Jiang, 2006). The author stated that only those nutrients that can be digested, absorbed, and metabolized (utilized) by the hen for maintenance, growth, and/or production represent the true feeding value of that ingredient. When formulating feeds using total amino acids for example, one has to rely on subjective techniques such as using a large safety margin and/or using minimum/maximum limitations to exclude or restrict the use of some ingredients that are known to have low or variable amino acids digestibility coefficients. Feed manufacturers should examine thoroughly each of the feed ingredients to select those ones that can meet up with the nutrition requirement of the hen.

Nutrient requirements as recommended by Oladokun and Johnson (2012) for layer production include: Chicks starter – 20% Protein (min), 3.5% Fat (min), 5% Fibre (min), 1.0% Calcium Extract; 0.45% available Phosphorous; 1.0% Lysine (min); 0.40 Methionine (min) and 2640 kcal/kg ME. Grower's mash require 16% Protein (min), 3.5% Fat (min); 7.5% Fibre (min); 1.0% Calcium Extract; 0.35% available Phosphorous; 0.80% Lysine (min), 0.27 Methionine (min) and 2475 kcal/kg ME. Layer mash - 16.5% Protein; 3.7% Fat (min); 6.5% Fibre (min); 3.5 Calcium Extract; 0.45% available Phosphorous; 0.70% Lysine (min); 0.27% Methionine (min) and 2530 kcal/kg ME. Blake and Hess (2007) recommended the nutritive requirements for the following: starter feed (0-6weeks) – 1290 to 1315 kcal/lb ME; 20-22% Crude Protein; 0.85% - 1.00% Calcium and 0.40 to 0.45% available Phosphorous. Grower feed (6-14 weeks) – 1290 to 1315 kcal/lb ME; 16-18% Crude Protein; 0.80 – 0.95% Calcium and 0.35 to 0.42% available Phosphorous. Developer feed (14 – 20 weeks) – 1250 to 1290 kcal/lb ME; 14 to 16.0% Crude Protein; 0.75% to 0.92% Calcium and 0.30 to 0.38% available Phosphorous. Layer mash (> 20 weeks) – 1290 to 1315 Kcal/lb ME; 15 to 19.0% Crude Protein; 3.60 to 4.20% Calcium and 0.32 to 0.45% available Phosphorous.

Chiba (2014) stated that calcium, phosphorous and vitamin D are important for egg shell formation but calcium requirement varies with age of the layer, ambient temperature, rate of lay, and egg size, while a general recommendation is 3.4g Ca/d and 3.8g Ca/d after 40 weeks of age. Supplementation of organic chromium in disease affected birds could relieve the stress quickly and improve egg production and immunity (Rajendran et al, 2014). The authors reported that increase in egg production in Newcastle disease affected birds and enhancing the immunity by means of supplementation of chromium yeast to layer feeds could be useful feeding strategies.

Proper processing conditions of layer feed ingredients (moisture content, heating time, and temperature) inactivate anti-nutritional factors in soybeans (i.e. trypsin inhibitor, hemagglutinins, lectins etc) and this results in much improved growth and egg production when fed to layers (Rhee, 2006). The heat treatment must be controlled carefully because overheating can result in deterioration of protein quality by destroying heat-sensitive amino-acids (Methionine, Lysine and Cystine) and by causing maillard reaction. Until recently, Phytic acid was considered primarily as a factor limiting phosphorous availability from plant derived feed stuffs (Heindl, 2006). Today, there is evidence that the deleterious effects of Phytic acid go much beyond just limiting phosphorous availability. The author stated that in its native stage, Phytic acid forms complex with various cations (Ca, Fe, Zn, Cu), protein and amino acids but also lipids and starch. Supplemental Phytase has been shown to have the capacity to counter these anti-nutritional effects on protein and energy utilization. Phytase supplementation improved feed consumption, egg production and egg weight in hens fed low levels of available phosphorous compared to an unsupplemented treatment (Heindl, 2006).

Moringa oleifera Processing

Moringa oleifera is a tree crop grown by different people for different reasons. This is in line with Zayed (2012) who stated that *Moringa oleifera* is a typical multipurpose tree of significant economic importance because of its several industrial and medicinal applications and various products to be used as food and feed which can be derived from its leaves and fruits. *Moringa oleifera* is a medium-sized (about 10 meters high) tree belonging to the Moringaceae family (Maroyi, und). The author noted that Moringaceae is a single family with 14 known species. Of these only *Moringa oleifera* is the most widely known species and is planted in the tropical and sub-tropical belts.

According to Animashaun and Toye (2013) it is a multipurpose food plant, which originated from India, and is produced and used in many African countries, South America (Nicaragua and Bolivia), and New Zealand. Akhouri, Prasad and Ganguly (2013) reported that *Moringa oleifera* leaf extract can be beneficially used as an effective feed supplement in poultry for its encouraging results in relation to total body weight gain and feed conversion efficiency in the broiler chicks. The authors noted that it can as well be used potentially before mass vaccination of chicks for its property of immunomodulation. Moringa leaves have a characteristic distinctive, strong, mustard-like taste. They are good sources of Provitamin A, Vitamins B and C, Minerals (particularly Iron) and Sulphur containing amino acids-Methionine, and Cystine, and are eaten as a supplement to the major staple food (Animashaun and Toye, 2013). *Moringa oleifera*, a highly valued plant distributed in many countries of the tropics and sub-tropics has an impressive range of medicinal uses, including growth promotion, antimicrobial and antioxidant effect (Moyo, Masika, Hugo and Muchenje, 2011). The authors reported that ten of the nineteen observed amino acids in *Moringa oleifera* are categorized as essential: Threonine, Tyrosine, Methionine, Valine, Phenylalanine, Isoleucine, Leucine, Histadine, Lysine and Trytopharn; and 17 fatty acids, including α-linolenic acid, Heneicosanoic, g-linolenic, Palmiteic and Capric acid.

However, the presence of oxalates and Phytic acids in Moringa leaves are likely to reduce the bioavailability of minerals in the leaves (Foidl, Makkar and Becker, 2001). In a study carried out by Nkukwana, Muchenje, Pieterse, Masika, Mabusela, Hoffman and Dzama (2014), it was reported that growth performance, digestibility and yield results indicated that supplementation of *Moringa oleifera* leaf meal significantly improved feed utilization efficiency and tissue accretion in broiler chickens. The seeds serve as good source of protein

and cooking oil (Aviara, Power and Abbas, 2012). The seed oil, which is also known as ben oil, finds its use as raw material in the cosmetic industry and as lubricant for machinery. The authors stated that the seed cake remaining after oil extraction can be used as fertilizer or as flocculants in water treatment. *Moringa oleifera* leaf is a good source of antioxidant compounds such as ascorbic acid, Flavonoid, Phenolics and Carotenoids (Anwar, Latif, Ashraf and Gilani, 2007). The authors stated that the presence of β-Carotene, Vitamins A, C and E in *Moringa oleifera* leaves further explain their reducing potentials albeit the mode of action is yet to be elucidated. Vitamin C is known to act as a scavenger of free radicals, while it indirectly regenerates Vitamin E. The leaves of *Moringa oleifera* are excellent source of Vitamin A (four times the amount in Carrots), rich in Vitamin C (seven times the amount in Oranges), good source of Vitamin B and other minerals, outstanding source of Vitamin B and other minerals, outstanding source of calcium (four times the amount in milk), protein (twice the amount in milk) and potassium (three times the amount in bananas) (EW-Awady, 2003). The author noted that the Iron content is very good and the content of amino acids such as Methionine and Crystine is also high.

Moringa oleifera leaves with high content of phenolics and flavonoids show greater antioxidant activity, anti-radical power, reducing power, inhibition of Lipid peroxidation, Protein oxidation and hydroxide-induced deoxyribose degradation, and scavenging power of superoxide anions and nitric acid radicals, than do its fruits and seeds (Wangcharoen and Gomolmanee, 2011). The antioxidant activity of Moringa leaf extract was found to be higher than that of standard Vitamin E and remains unaffected at PH 4 and PH 9 in the dark at 5°C and 25°C respectively for 15 days, although the activity significantly decreases when heated to 100°C for 15 minutes (Arabshahi-D, Devi and Urooj, 2007).

In the processing of *Moringa oleifera* leaves, Ugwuoke and Ochiaka (2013) reported that leaflets should be stripped out of petiole, diseased leaves removed, leaves washed clean, leaves should be spread on mashed tray, and dried in a ventilated room. The leaves should be spread thinly, ceiling fan should be used to circulate air, leaves should be turned over at least once daily, pound dry leaves in mortar or kitchen blender, sieve the leaf powder and dry the leaf powder at 50°C for 30 minutes. After stripping off the leaflets from the leaf petiole, wash in trough using clean potable water to remove dirts (Sauveur and Broin, 2010). The authors noted further that the leaves should be washed again in 1% saline solution for 3-5 minutes to remove microbes and finally washed again with clean water before draining for drying. Draining can be done by spreading leaves in sunlight for a brief period till the removal of water present on the leaf surface is complete (Mishra, Singh and Singh, 2012).

The authors reported that only 20 - 40% of Vitamin A will be retained if leaves are dried under direct sunlight, but 50-70% will be retained if leaves are dried in the shade. High temperature may decrease the amount of protein present in the leaves. The authors recommended shade drying by spreading the leaflets on the sterile clean green net in a well ventilated room, and mosquito net may be used for this purpose. Leaves should be dried in an area protected from light to prevent loss of Vitamins, protected from dust and pest contamination (Doerr and Cameron, 2005). The authors suggested drying methods which include spreading cleaned leaves on a cloth inside the house or other protected structure, spreading cleaned leaves in hanging trays made with mosquito nets, and hanging leaf bunches from roof or porch with string (similar to tobacco drying).

In small quantity, dried leaves can be ground by mortar and pestle or pulmonizer machine can as well be used for fine grinding (Mishra, Singh and Singh, 2012). Dried leaves

can be made into powder using a mortar and pestle, local grain grinders, burr mills (hand crank or motor driven), or simply by rubbing the dried leaves against a fine screen (Doerr and Cameron, 2005). The authors reported that the powder is sifted to remove any remaining stems once the dried leaves have been transformed into a powder. Sauveur and Broin (2010) reported that *Moringa olifera* leaf powder strongly attracts moisture and the product can reabsorb humidity during or after milling. The authors recommended that Moringa leaf powder should be dried at 50ºC for 30 minutes to reduce moisture content considerably below 7.5%. Moringa leaf powder should be stored in air-tight containers protected from heat, humidity and light (Doerr and Cameron, 2005). Mishra et al, (2012) stated that *Moringa oleifera* leaf powder can be stored for up to 6 months under the following conditions: clean, dried powder stored in air-tight containers, protected from light and humidity, and kept below 24ºC.

Nutrient Composition of Poultry Egg

Egg is a reproductive product of mature female bird. This is in consonance with Ahmadi and Rahimi (2011) who noted that egg of laying hen is the end product of a complicated series of processes which started from the ovulation of the ovum from the left ovary into the left oviduct. The formation of egg is a remarkable process that takes just only one day, from ovulation to oviposition (Latour, Meunier and Stewart, (un). The authors stated that the reproductive process begins with a mature ovum, which is a bare yolk and germinal disc, complete with its own protective membranes and the necessary nutrients for the developing embryo. The formation of egg occurs in the ovary and oviduct. The follicular membrane ruptures and releases that follicle at the time of ovulation (Halls and Gain, 2005) and usually takes about 30 minutes after the hen has laid an egg. The authors stated that the

yolk is captured by the infundibulum after ovulation where fertilization takes place in breeding birds. The albumen is deposited when the yolk is in the magnum before continuing to the isthmus where the outer and inner shell membranes are formed at approximately 1½ hours. The shell which consists of roughly 95% calcium carbonate and 5% organic material is formed in the shell gland and deposited on the egg before a protective coating called the cuticle covered the shell (Halls and Gain, 2005). The authors stated that the laying of the egg or oviposition is induced by hormonal contractions of the uterus where the egg passes through the vagina and exits through the cloacae.

Egg is one of the most complete and versatile foods currently available, being an excellent source of high quality and easily digestible protein as well as good source of certain Vitamins and Minerals (Pérez-Vendrell et al, 2004). The authors noted that the levels of Vitamins in eggs are directly linked to the levels in the diet of the hen. Narahari (2003) stated that table egg is the most nutritious, unadulterated, yet relatively inexpensive natural food, with a high digestibility coefficient. According to the author, egg protein is the best protein available in nature for human consumption, with a well balanced amino acids profile, having the highest biological value, protein efficiency ratio, net protein value, net protein utilization and chemical score.

According to Vilà (1999) the average cholesterol content of commercially produced eggs in substantially lower than the estimated content of 274mg/egg. The author noted that several nutritional approaches to decrease the cholesterol content of the egg have been reported without achieving drastic results. The author further explained that feeding of diet with 8% safflower oil did not increase the level of egg yolk cholesterol; however, 8% hydrogenated coconut oil did increase significantly those levels, a significant reduction in

cholesterol levels of both serum and egg yolk was obtained when 2% soysterols were added to diets containing either safflower oil or hydrogenated coconut oil. With diets including barney or a filtrate of *trichoderma viride* culture, egg yolk cholesterol concentrations were lowered, however, total egg yolk cholesterol was higher than control for the filtrate fed hens (as a result of a higher egg and yolk weight) and lower than control for the barley fed hens (lower concentration as well as lower egg and yolk weight) (Qureshi et al in Vilà, 1999). If it were not for cholesterol, eggs would not be controversial. Eggs are the largest single source of cholesterol among the foods commonly eaten in the U.S (Meister, 2002). The author reported that a large egg contains about 215 milligrams (mg) of cholesterol – more than two-thirds of the daily value of 300mg and more specifically, the yolk of an egg contains the cholesterol while the albumen contains none.

In further discussion of nutrients in eggs, Narahari (2003), reported that an egg will supply about 11.5% of Protein, 11.7% of PUFA, 23.0% of MUFA, 100% of Phospholipids, 83.5% of Vitamin A, 19.0% Vitamin D, 13.1% Vitamin B_{12}, 160% Vitamin B_{12}, 40% Biotin, 91.1% Choline, 17.9% Phosphorous, 15% Magnesium, 4.3% Iron, 8.8% Calcium, 20% Copper, 8.9% Zinc, 20% Iodine and several other nutrients per adult person per day. The author maintained that on an average, an egg will supply nearly 25.5% of the total nutrients required per day at a cost of 6.25% of the total expenditure on food, for an individual per day. Vila (1999) explained that egg represents an important source of Phosphorous, Iron and Vitamins; however, it is deficient in Glucides, Calcium and Vitamin C. The author further stated that only one-third of egg yolk lipids are saturated and also eggs are rich in Linolenic acid, essential in human nutrition. The lipids present in the yolk are in emulsified form which favours their almost completely digestion by man. Eggs are significant source of Iron,

Riboflavin, Folate and Vitamins B_{12}, D and E (Meister, 2002). According to the author, the Iron in egg yolks is highly bioavailable, egg yolk may therefore be valuable in diets of individuals who may need iron, such as infants. In discussing the importance of egg yolk, the author noted that most of the nutrients in eggs are found in the yolk as it contains all the fat-soluble vitamins (A, D and E) and most other Vitamin and Minerals as well as part of the proteins. Detailed nutrient content of whole egg, egg white and egg yolk by egg nutrition centre is shown in Appendix 1. In addition to the nutritive value of eggs, Meister (2002) explained that eggs help to thicken custards, puddings, and sauces, emulsify and stabilize mixtures such as mayonnaise and salad dressings, coat or glaze breads and cockiers, bind ingredients together in dishes such as meat loaf and lasagna, classify soups, retard crystallization in boiled candies and frostings, and leave some types of backed goods such as soufflés and sponge cakes. The author added that eggs are used for these purposes both in home-prepared recipes and in processed foods.

Calcium and phosphorus are essential macro minerals with calcium forming a significant component of the shell and phosphorus playing an important role in skeletal calcium deposition and subsequently availability of calcium for egg shell formation (Gerber, un). Egg quality can be affected by egg size, age of hen, stress, temperature, nutrition, and water quality. Egg quality according to Koelkebeck (2003) is a general term that relates to various external and internal standards that are imposed in the egg. Egg quality has an influence on egg acceptance or rejection by the consumer (King'ori, 2012). The author stated that egg quality defects are deviations in external and internal standards of the egg that affect the general quality. External quality includes egg weight, egg shape, colour, shell thickness, shell weight, shell density, texture, egg surface area and cleanliness while internal egg quality

are air cell size, yolk colour, yolk shape, odour, status of the albumen, among others (Yohannes, Habtamu, Abreha, Endale and Habtamu, 2014). Older hens tend to lay bigger eggs and have a higher egg output, which impacts on shell strength (Gerber, un). Very young birds with immature shell glands may produce shell-less egg or eggs with very thin shells, and also delaying the onset of sexual maturity by one or two weeks will prevent this defect in egg shell (Coutts and Wilson, 1990).

In all European Union countries, eggs are classified as class A or class B (European Commission, 2003) and only eggs graded class A can be sold for direct human consumption. Class A eggs are known to have no defect such as meat spot, blood spot, shell cracks, among others. Internal quality of egg begins to decline as soon as the egg is laid (Gerber, un). The author stated that even though factors associated with the management and nutrition of the hen play a role in internal egg quality, egg handling and storage practices have a more significant impact on the quality of the egg reaching the consumers. Though the shell provides a unique package for the distribution of the egg contents to the consumers, it is the internal quality of the egg that is most important to the consumer. This is in consonance with Yohannes et al, (2014) who explained that eggs are readily exposed and susceptible to various microbial contaminations along all the way from formation down to the consumption, vertically from infected reproductive tract of laying hens and horizontally from the environment after and during lay. Egg borne infectious diseases have been a great public health concern worldwide, and the extent of egg spoilage due to effect of micro-organisms is very high (Howard, O'Bryan, Crandall and Ricke, 2011). More than one million cases of Salmonellosis occur each year in US (Scallan et al, 2011). Some strains of salmonella developed the ability to colonize the ovaries of healthy hens and contaminate eggs from the

inside before the eggs are laid (Meister, 2002). The author explained that the bacteria do not make the hens sick and do not spoil the eggs but, they can make people sick if a contaminated egg is not properly cooked before it is eaten. The risk is increased if the egg is stored at room temperature because bacteria multiply quickly in a warm environment. Salmonella bacteria cause intestinal infection to humans and more severe in young children, elderly people, pregnant women or people with impaired immune system.

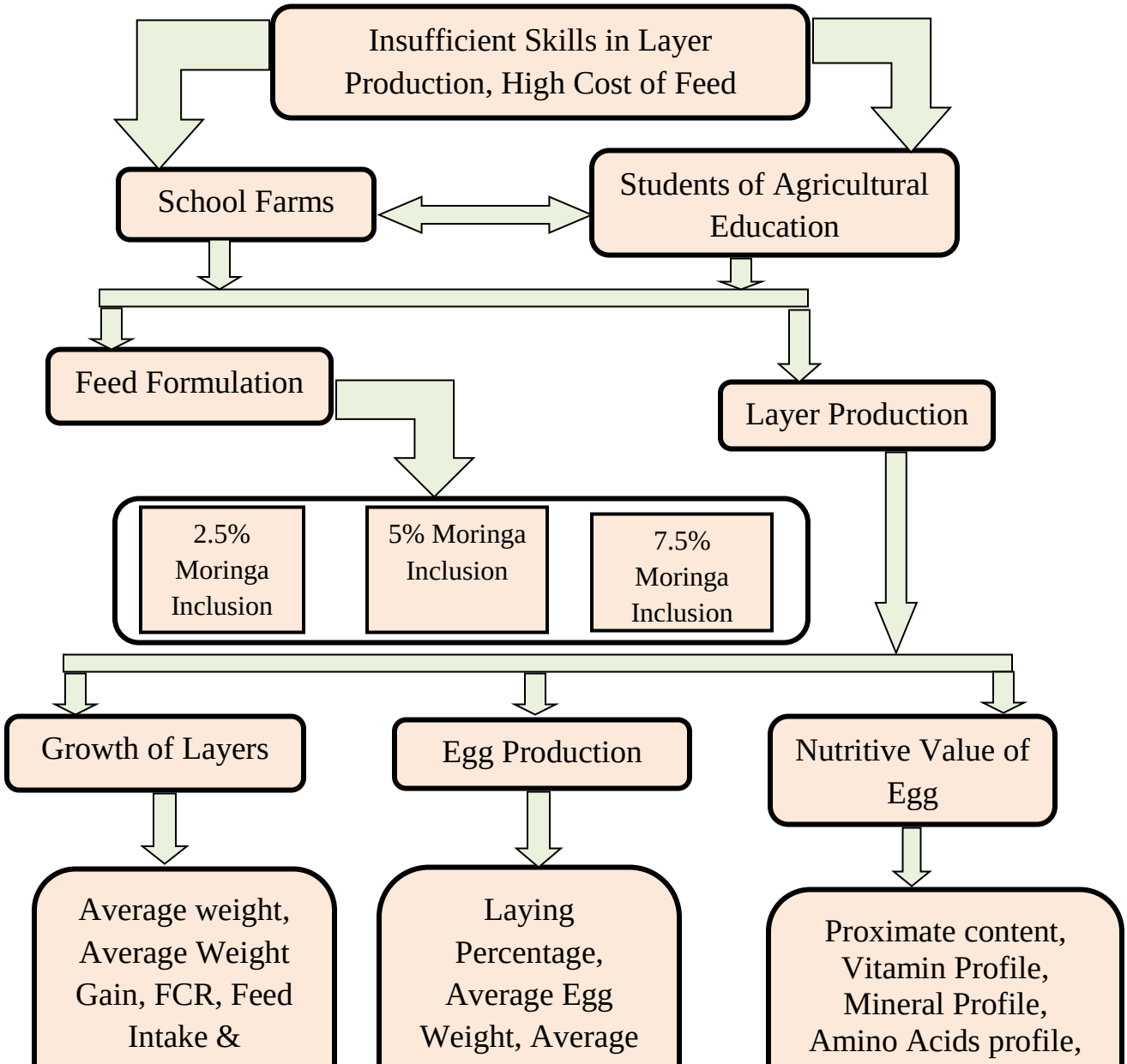

Figure 1: Schema on the Effects of *Moringa Oleifera* Leaf Powder Additive on the Growth of Layers, Egg Production and Nutritive Value of Eggs in Agricultural Education Farms

Agricultural Education students of University of Nigeria, Nsukka did not have sufficient skills in feed formulation and layer production. This was mainly due to the absence of Agricultural Education poultry farm in the past. High cost of layer feed also discouraged people from going into layer production.

The insufficient skills among students made it necessary to go into the study using Agricultural Education farm and also involving students. Leaves of *Moringa oleifera* were harvested and processed to include into layer feed at the rate of 2.5%, 5% and 7.5% respectively. The *Moringa oleifera* fortified feeds were used to feed layer birds. Data on the growth of layers and egg production were collected. Eggs produced by the layers were also collected and subjected to laboratory test to determine the nutritive value. In the end, students that participated in the study were assessed to determine their levels of skills acquisition on feed formulation and layer production.

Theoretical Framework

The theoretical framework of this study was based on the following theories.

Theory of Vocational Education

The theory of Vocational Education propounded by Charles A. Prosser (1949) stated that effective vocational training can only be given where the training jobs are carried on in the same way with the same operations, tools and machines as in the occupation itself. According to the author, the type, kinds, amount, use and arrangement of space, materials, equipment and supplies for a preparatory programme must be a replica of those in employment. When vocational training is carried out in an area where the tools, materials, equipment and machines are available as obtained in the occupation, the graduate of the programme will acquire job, retain the job and advance in the job as well.

This theory is in line with the present study as students will participate in research involving school poultry farm, layers and other facilities as obtained in the farm outside the school. When students acquire poultry production skills in the school farm where birds exist and materials for rearing the birds are present, such students can easily establish private poultry farm when employment seems difficult after graduation. The idea of including students in the present research was to enhance their skill acquisition in layer management in school farm so that transition from school to the job after graduation would be easy.

Experiential Learning Theory

Experiential learning theory was propounded in 1984 by David Kolb. David Kolb was a Professor of Organizational Development at Case Western Reserve University, Cleveland, Ohio. According to Kolb in Kolb and Boyatzis (1999), experiential learning theory (ELT) defined learning as the process whereby knowledge is created through the transformation of experience. The author maintained that knowledge results from the combination of grasping and transforming experience. The ELT portrayed two dialectically related modes of grasping

experience – Concrete Experience (CE) and Abstract Conceptualization (AC); and two dialectically related modes of transforming experience - Reflective Observation (RO) and Active Experimentation (AE). Kolb stated that in four-stage learning cycle, immediate or concrete experiences are the basis for observation and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn. These implications can be actively tested and serve as guides in creating new experiences. Kolb and Boyatzis (1999) stated that in grasping experience some of individuals perceive new information through experiencing the concrete, tangible, felt qualities of the world, relying on the senses and immersing oneself in concrete reality. Others tend to perceive, grasp or take hold of new information through symbolic representation or abstract conceptualization - thinking about, analyzing or systematic planning, rather than using sensation as a guide. In transforming or processing experience, some persons tend to carefully watch others who are involved in the experience and reflect on what happens, while others choose to jump right in and start doing things. The watchers favour reflective observation while the doers favour active experimentation.

The idea of engaging the students of Agricultural Education in the present study was to give them the opportunity to observe, touch and reflect on the practical operations in layer husbandry and feed formulation. In line with the ELT, the concrete experience aspects of the tasks was demonstrated by touching, feeling and manipulating in concrete terms, the different aspects of the skills they were learning which would in turn promote reflection to enhance their agricultural skills acquisition.

Review of Related Empirical Studies

Empirical studies related to the present work were reviewed as below.

Growth performance and survival rates of weaner grasscutters fed *Moringa oleifera* and *Gongronema latifolia* leaves supplements was studied by Ifedibia (2014). The specific objectives of the study were to determine the growth performance of weaner grasscutters fed with only *Moringa oleifera* dried leaves supplement, determine the growth performance of weaner grasscutter fed with only *Gongronema latifolia* leaves supplement, determine the growth performance of weaner grasscutter fed with a mixture of 5% *Moringa oleifera* and 5% *Gongronema latifolia* dried leaves supplements, find out feed intake of grasscutter fed only *Moringa oleifera* dried leaves as supplement, find out the feed intake of grasscutter fed with only *Gongronema latifolia* dried leaves as supplement, assess the survival rate of litter of grasscutter fed with only *Moringa oleifera* dried leaves as supplements, among others. True experimental design with randomization was adopted. The population was thirty grasscutters of six colonies and simple random sampling technique was used to select twenty grasscutters divided into four groups of five members each. The four groups represent three treatment groups and one control group. The parameters measured were the weight gain, feed intake and survival rates of weaners. Mean and percentages were used to answer the research questions while t-test and ANOVA were used to test the null hypotheses at 0.05 level of significance using SPSS. The findings of the study among others indicated that the mean weight gain of grasscutter fed with *Moringa oleifera* supplement performed better than the mean weight gain of grasscutter fed with the control diet, the weaner grasscutters fed with only *Gongronema latifolia* dried leaves had higher mean weight gain than those in control group while grasscutters fed with a mixture of 5% *Moringa oleifera* and 5% *Gongronema latifolia* performed better than others fed with the control ration. It was recommended that government should sponsor seminars and workshops for grasscutter farmers and the public who are

interested in the farming; extension agents and some agricultural agencies should embark on massive sensitization of grasscutter rearing especially in the rural areas where poverty is prevalent, among others. This study was similar to the present study in the area of design. Both studies adopted true experimental design. Both studies had growth performance as one of the parameters to measure and both studies as well utilized *Moringa oleifera* for supplementation. However, while Ifedibia (2014) studied *Moringa oleifera* and *Gongronema latifolia* leaves supplements in grasscutter, the present work studied *Moringa oleifera* leaf powder on layers. Furthermore, while the former work studied on the growth performance and survival rate, the present work studied on the growth performance, egg production and nutritive value of egg.

Djakalia, Guichard and Soumaila (2011) studied the effect of *Moringa oleifera* on growth performance and health status of young post-weaning rabbits. The study was conducted on 270 New Zealand breed of rabbits. Three types of feed formulations were made and distributed to 3 groups of rabbits which include standard batch, Moringa batch and mixed batch. The Moringa supplement was added at 3% in the basic feed. The standard supplement used at 3% was made of 0.12% oxyboldine, 0.25% lysine, 0.1% methionine, 0.6% vitamin premix and 0.6% of dibasic calcium. The mixed supplement was composed of 1.5% Moringa supplement and 1.5% of the standard supplement. ANOVA 6 was used to compare weight gain, the index of consumption and the average weight obtained from each of the feed. The comparisons at 5% were made with Duncan test. The result indicated that the highest average weight was recorded by the Moringa supplement (820.62g) followed by the mixed supplement (658.75g) and the standard supplement (632.75%). The growth rates were 126.19, 69.85 and 68.66g/week respectively for rabbits fed with Moringa, mixed feed and standard

feed. The Moringa supplement feed showed the highest apparent fecal digestibility (85%) compared to the mixed and standard feeding formulations that were respectively 80% and 81%. Djakalia, et al (2011) study was related to the present study as both studies involve the adoption of experimental design. The study under review also investigated the effect of Moringa on the growth performance of livestock. On the difference between the two studies, the reviewed study dwelt on the effect of Moringa on growth performance and health status of rabbits while the present study focused on the effect of Moringa on the growth of layers, egg production and nutritive value of eggs. The study by Djakalia, et al (2011) also compared the effect of three different feeds on rabbit performance while the present study compared the effects of different levels of Moringa inclusion in feed on the layer performance.

Evaluation of nutritional quality of Moringa (*Moringa oleifera* lam.) leaves as an alternative protein source for Nile tilapia (*Oreochromis niloticus L.*) was studied by Richter, Siddhuraju and Becker in 2003. A group of 210 Nile tilapia fingerlings were kept in 200 litre tanks. Three experimental diets were formulated to contain Moringa leaf meal at levels 10%, 20% and 30% of the total dietary protein (Diets 2, 3 and 4 respectively) and one diet acting as a control (diet I) which included only fish meal and wheat meal as protein sources. A 7-week feeding trial was carried out on triplicate groups of seven fish (9-11g) in 45-L aquaria connected to a recirculating system. The daily fish ration was calculated at 15-g feed metabolic body weight ($kg^{0.8}$) per day. One way ANOVA was used to analyze data obtained and the significance of the difference between means was tested using Duncan's multiple range test. Differences were deemed to be significant of $P < 0.05$. The software used was Statistical® Version 5%. The result indicated that diets with higher inclusion levels of Moringa leaves (Diets 3 and 4) significantly depressed growth performance of the fish

compared to Diets 1 and 2. In the study, the high relatively total phenolics (0.7% and 1%), nonhaemolytic saponin (1.5% and 2.3%) and phytic acid (0.5% and 0.8%) in Diets 3 and 4 respectively, as well as NDF (3.8% and 5.7%) and ADF (3.0% and 4.5%) in the aforementioned diets may have contributed to the poorer growth performance in these groups. It was recommended that Moringa leaf meal can be used to substitute up to 10% of dietary protein in Nile tilapia without significant reduction in growth. The reviewed study was related to the present study in that both studies included different levels of Moringa in livestock feed. Both of the studies used ANOVA for data analysis. Both differed in the type of livestock used in the study. The reviewed study investigated the effect of Moringa on Nile tilapia but the present study worked on Moringa and layers. Richter et al (2003) studied Moringa as alternative protein source while the present study used Moringa as an additive.

Mehta, Balaraman, Amin, Bafina and Gulati (2003) studied the effect of fruits of *Moringa oleifera* on the lipid profile of normal and hypercholesterolaemic rabbits. Healthy male adult rabbits weighing between 1.5 and 2.5kg were used for the experiments. The animals were divided into six groups of six animals each. Group 1 was the control and was fed with Standard Laboratory Diet (SLD) daily for 120 days. Group 2 was fed with SLD plus Lovastatin (6 mg/kg/day, p.o) in banana pulp for 120 days. Group 3 was fed with SLD plus *Moringa oleifera* powder (200 mg/kg/day, P. O.) in banana pulp for 120 days while group 4 was fed with hypercholesterolaemic diet (HCD) daily for 120 days. HCD contains 5% cholesterol, 5% coconut oil and 90% SLD. The mean ± S.E.M values were calculated for each group. In order to determine the significance of intergroup difference, each parameter was analyzed separately by using one-way ANOVA with Huynn-feldt Epsilon modification of degree of freedom to correct the departure from sphericity. Result of the experiment showed

that *Moringa oleifera* and Lovastatin were found to lower the serum cholesterol, phospholipid, triglyceride, VLDL, LDL, cholesterol to phospholipid ratio and atherogenic index, but were found to increase the HDL ratio (HDL/HDL-total cholesterol) as compared to the corresponding control groups. Treatment with *Moringa oleifera* or lovastatin in normal rabbits decreases the HDL levels. However HDL levels were significantly increased or decreased in *Moringa oleifera* or lovasatin treated hypercholesterolaemic rabbits respectively. Lovastatin or *Moringa oleifera* treated hypercholesterolaemic rabbits showed decrease in lipid profile of liver, heart and aorta while similar treatment of normal animals did not produce significant reduction in heart. *Moringa olifera* was found to increase the excretion of faecal cholesterol. It was concluded that Moringa oleifera possesses a hypolipidaemic effect. Mehta, et al (2013) was related to the present work in the area of design as both of them involved the use of true experimental design. Both studies as well involved the investigation of the effect of *Moringa oleifera* on the nutritive value (cholesterol level) of animal product. The areas of differences between the two studies include that Mehta et al (2003) investigated the effect of *Moringa oleifera* on rabbits, while the present study investigated the effect of *Moringa oleifera* on layers. The work under review dwelt on lovastation and *Moringa oleifera* treatments while the present study worked on the different levels of Moringa inclusion in layer diets.

Igwilo, Ogoke, Ogbu, Igwilo, Obi and Abdulsalami (2013) investigated the effect of soaked *Moringa oleifera* seeds on growth rates and the levels of some biochemical parameters in Albino Rats. Fifteen (15) Wistar albino rats were used in the experiment and were grouped into 3 sets: one experimental group and two control groups. Each group contained 5 rats and were fed for 21 days. The experimental group was fed on diet compounded with the processed

Moringa seeds while the first control group was given commercial rat pellets. On the other hand, the second control group received a Cesilan diet. The weights of the rats were measured at 2 days interval within the 21 days of feeding. After the feeding period, the animals were slaughtered and their sera collected for enzyme analysis. The analysis of aspartate (AST), alanine transaminases (ALT), alkaline phosphate (ALP) and bilirubin levels were determined using Vitros 350 Automated Chemistry Analyzer. The growth rates of rats fed with the commercial rat pellets, Casilan diet and the processed Moringa seed diet had a range of 80.06 to 100.98; 66.70 to 55.23 and 52.99 to 35.47 respectively. The parameters assayed for the group that received the processed Moringa seed diets showed 144.00 (AST), 41.00(ALT), 66.50 (ALP) and 12.45 (Total Bilirubin). The one-way ANOVA statistical analysis indicated that there was no significant change in the parameters of all the groups at 95% significance level ($P < 0.05$). Hence, the soaked *Moringa oleifera* seed did not support growth in the animals and also did not pose a threat to the liver. Igwilo et al (2013) study was similar to the present work in that both studies were interested in the effect of Moringa on the growth performance of animals. Both studies also share the same statistical tools of one-way ANOVA for statistical analysis. The reviewed study investigated the effect of *Moringa oleifera* on albino rats while the present study focused on the effect of *Moringa oleifera* on layer performance. Still on the differences between the two studies, the study reviewed used soaked *Moringa oleifera* seed while the present study used *Moringa oleifera* leaf powder.

Nkukwana, Muchenje, Pieterse, Masika, Mabusela, Hoffman and Dzama (2014) studied the effect of *Moringa oleifera* leaf meal on growth performance, apparent digestibility, digestive organ size and carcass yield in broiler chickens. A total of 2400 one-day-old cob-500 broiler chicks of mixed sex were randomly allocated to five dietary

treatments in six replications of 80 birds per pen. Fresh, green and undamaged mature *Moringa oleifera* leaves were collected from a number of trees from the same village to avoid variations in soil micronutrient content, and ground to produce *Moringa oleifera* leaf meal (MOLM). Five dietary treatment groups were produced from the basal feed as follows: positive control (+C) with 668g salinomycin and 500g zinc bacitracin per kg of feed, $MOLM_{Low}$ (ML; 1, 3 and 5g); $MOLM_{Medium}$ (MM, 3, 9 and 15g); $MOLM_{High}$ (MH, 5, 15 and 25g) per kg of feed; and a negative control (- C; without supplementation). All diets from starter to finisher were pelleted. Diets were fed for 35days in starter, grower and finisher phases, and birds were provided feed and water ad libitum. At 35days of age, 12 birds per treatment, two from each replicate pen, were randomly selected, electricity stunned at 70V and killed by cervical dislocation for determination of carcass and organ weights. Bird weights at 7 and 21days of age, birds fed MH had the highest Body Weight, while +C had the lowest ($P < 0.05$). No significant differences were observed in Feed 1ntake between treatments during periods from 0 to 21days and 0 to 35days, FCR was the highest ($P < 0.05$). Gizzard erosion score was the lowest in MH and the highest in MM ($P < 0.001$). Mortality rate was the highest ($P < 0.05$) in MH from day 22 to 28 and was the lowest in ML and MM (1.3% VS 0.21%), and was mainly due to sudden death.

There were no significant differences in apparent digestibility for ash, ether extract (EE), crude fibre (CF), crude protein (CP), acid detergent fibre (ADF) and neutral detergent fibre (NDF) among others. It was concluded that supplementation of *Moringa oleifera* leaf meal up to 25g per kg of feed did not impair nutrient utilization efficiency, but enhanced the birds' genetic potential for growth performance. The study under review was related to the present study in that both studies dwelt on the supplementation of *Moringa oleifera* for the

growth of birds. Both studies involved the adoption of true experimental design. However, Nkukwana et al (2014) studied the effect of *Moringa oleifera* leaf meal on broiler while the present study dwelt on the effect of *Moringa oleifera* leaf powder on layer production.

The effect of drumstick tree (*Moringa oleifera*) leaf meal on the average weight gain of domestic rabbits (*Oryctolagus cuniculus*) was studied by Ufele, Ebenebe, Igwe, Mogbo, Akunne and Aziagba in 2013. Thirty-six rabbits of 40 days old and approximately 480g were used. The rabbits were kept in wood cages for one week to acclimatize before commencement of the experiment. Four rabbits were randomly assigned to each cage that represents different experimental groups. The rabbits were divided into three groups: T1, T2 and T3. T1 received millet mash residue 98%, soybean meal 0%, Moringa leaf meal 0%, calcium phosphate 1%, vitamin-mineral premix 0.5% and salt 0/5% serving as the control group. T2 received millet mash residue 78%, soybean meal 20%, Moringa leaf meal 0%, calcium phosphate 1%, vitamin-mineral pre mix 0.5% and salt 0.5%. T3 received millet mash residue 78%, soybean meal 0%, *Moringa oleifera* meal 20%, calcium phosphate 1%, vitamin-mineral premix 0.5% and salt 0.5%. The experiment was replicated three times. Data collected were analysed using ANOVA and the specific differences in treatment means were determined using least significance difference.

Results indicated that there was significant difference ($P < 0.05$) among all the treatments in average weight gain (256.25g, 365.00g and 483.75g) respectively. T3 had the highest percentage 81.48% followed by T2 (78.95%) with the least being T1 (52.69%). No mortality was recorded during the experimental period. The study revealed that diet three, T3 (20% *Moringa oleifera* leaf meal) is rich in nutrients. It also showed that the *Moringa olerifera* leaf meal could be used as total replacement for soybean meal in rabbit diet without

any adverse effect on the weight gained. Furthermore, the result showed that rabbits cannot perform well when fed only millet mash residue without supplemental protein source. The work reviewed was related to the present study for studying the effect of *Moringa olerifera* on the growth of livestock. Both studies also employed ANOVA for data analysis. On the differences between the two studies, Ufele et al 2013 studied the average weight gain of rabbit by feeding Moringa leaf meal supplementation, while the present study worked the effect of growth, egg production and nutritive value of eggs supplemented with varying ratio of *Moringa oleifera* leaf powder.

Gadzirayi, Masamba, Mupangwa and Washaya (2012) carried out a study on the performance of broiler chickens fed on mature *Moringa oleifera* leaf meal as a protein supplement to soybean meal. Five different graded levels of *Moringa oleifera* leaf meal were used in formulating the diets. Ration formulation using soybean, yellow maize and *Moringa oleifera* meal as ingredients for broiler starter (20% crude protein) and broiler finisher (18% crude protein) diets was done using Pearson square method. Twenty-five day old Habbard chicks were randomly allocated to the five treatment diets T1 (0% *Moringa oleifera* leaf meal), T2 (25% *Moringa oleifera* leaf meal), T3 (50% *Moringa oleifera* leaf meal), T4 (75% *Moringa oleifera* leaf meal) and T5 (100% *Moringa oleifera* leaf meal) in a completely randomized design. Birds were managed under the deep litter system with five compartments each with five birds for a period of 6 weeks. Weekly weight gain, feed intake and feed conversion ratio were recorded throughout the period. Evisceration of carcasses was done after 6 weeks and the different body parts were weighed and recorded. Proximate analysis of Moringa leaf meal, broiler starter and broiler finisher diets were done and the results were tabulated. Statistical analysis was done using Genstat Software Version 12. No significant

difference was noted in the amount of feed taken by broiler birds under different treatments of *Moringa oleifera* meal. However, significant differences in fed conversion ratios were noted. It was therefore concluded that inclusion of *Moringa oleifera* meal as protein supplement in broiler diet at 25% inclusion level produces broiler of similar weight and growth rate compared to those fed under conventional commercial feeds ($P < 0.05$). Gadizrayi et al (2012) study was related to the present study in that both studies involved the investigation of *Moringa oleifera* inclusion in diets of chicken. Both studies were experimental studies. The difference between the two studies dwelt on the fact that the study reviewed investigated the supplementation of *Moringa oleifera* leaf meal in broiler diets while the present study investigated the supplementation of *Moringa oleifera* leaf powder in layer diets.

Effect of *Moringa oleifera* leaf meal on finisher pig growth performance, meat quality, shelf life and fatty acid composition of pork was carried out by Mukumbo, Maphosa, Hugo, Nkukwana, Mabusela and Muchenje in 2014. A six-week feeding trial was conducted with 24 Large White X Landrace gilts aged 14 weeks. Each pig was housed individually and randomly allocated to one of four dietary treatments containing 0%, 2.5%, 5% and 7.5% MOLM, with six replicates per treatment. Feed intake was measured daily, pig liveweight was measured weekly, and average daily gains (ADGs) and FCR were calculated. Pigs were slaughtered at 20 weeks old and measurements of back fat thickness, PH_{45Min} and PH_{24h} were taken, *muscularis longissimus tharacis et lunborum* muscle samples from each carcass were analysed for physic-chemical quality. Muscle, subcutaneous fat and feed samples, were analysed for Fatty Acids composition and lipid indices of atherogenicity (A) and thrombogenecity (IT) were calculated. A 10-day shelf life study was conducted, during which instrumental and sensory meat colour and odour were assessed. Results indicated that pigs fed

7.5% MOLM had significantly higher average daily feed intake (3.56kg/dg) than pigs fed 0%, 2.5% and 5% MOLM (3.05, 3.14 and 3.07kg/day, respectively). The FCR of pigs fed 0%, 2.5% and 5% MOLM did not differ significantly (3.34, 3.44 and 3.22, respectively).

However, the FCR of pigs fed 7.5% MOLM was significantly poorer (3.78%). No significant differences were observed for carcass and physcio-chemical quality traits. MOLM inclusion improved shelf-life, as meat samples from MOLM-fed pigs exhibited significantly prolonged acceptability of colour and odour during 10 days of refrigerated storage. Although, the n-6: n-3 FA ratios of the dietary treatments containing MOLM were significantly improved (T1 = 35.45, T2 = 22.08, T3 = 14.24, T4 = 15. 90), no significant differences were observed for this ratio in the fat composition of the meat or subcutaneous fat samples between treatments. A significant reduction in intramuscular fat and stearic acid content was observed with increasing levels of MOLM. However, all other FA profiles, ratios and health lipid indices did not differ significantly across treatments. In conclusion, up to 5% MOLM may be included in finisher pig feed with no negative effect on feed conversion efficiency, carcass and meat quality traits, and may improve shelf life of pork. However, inclusion level of 7.5% MOLM may lower FCR. The MOLM inclusion significantly improved the FA composition of the feed, but did not produce the desired improvements in FA composition of meat, probably because of the prominence of fat deposition by *de novo lipogenesis* in finisher pigs rather than direct incorporation of dietary fatty acids. The study of Mukumbo et al (2014) was similar to the present study for investigating the effect of *Moringa oleifera* on the growth of livestock. However, the study reviewed used *Moringa oleifera* leaf meal while the present study used *Moringa oleifera* leaf powder. Similarly, the reviewed study investigated the effect of

Moringa oleifera leaf meal on finisher pig but the present study investigated the effect of *Moringa oleifera* leaf powder on layers.

Study on the cost of production, gross return and net profit in commercial egg production was carried out by Farooq, Zahoor-ul-Haq, Mian, Durrani and Syed in 2003. The study was carried out in Pakistan by collecting data from randomly selected 109 flocks. Data were collected on various parameters which included flock size, stocking rate, strains of chicken, system of housing (cage vs. Floor), rearing system (brood-grow-lay, brood-grow, lay and brood, grow, and lay), hygienic measures, vaccination practices, egg production and cost of feed, among others. The data were analyzed using weighted means and General Linear Model (GLM) procedures. To account for the wide variability in flock size, weighted means were calculated instead of averages. Majority of the buildings in the study area were rented, therefore, rent per layer was added to the total cost of production instead of depreciation on buildings and equipment. Result indicated that the overall total cost of production, gross return and net profit per layer was Rs.393.88 ± 5.36, 432.14 ± 8.01 and 38.26 ± 6.66 respectively. Rate of return over the invested capital was 27%. Mean feed cost per layer was Rs.302.23 ± 5.01 including Rs.10.27 ± 0.24, 29.19 ± 0.42 and 262.77 ± 5.08 for starter, grower and layer ration respectively. Feed cost was the major component contributing 76.73% of the total cost of production. Determining the effect of different parameters on the cost of production and net profit, it was found that large flocks, Hisex strain, brood-grow-lay system of rearing, good hygienic conditions of the farm, normal stocking rate and cage system of housing gave maximum gross return as well as net profit. Farooq et al (2003) was related to the present study in that both studies had interest in finding the cost of egg production which would determine profit or loss of the farm business. Conversely, the former study also

investigated the gross return and net profit but the present study dwelt on finding out the cost of production by using different feed compositions. The former study was conducted in Pakistan but the present study was conducted in Nigeria.

Competency improvement needs of teachers in school farm management for teaching students practicals in crop production in secondary schools in Abia state was studied by Olaitan, Alaribe and Eze in 2010. Three research questions guided the study. Population for the study was 768 teachers of Agricultural Science while sample of 153 teachers of Agricultural Science was drawn using proportionate (20%) stratified random sampling technique. A 26 competency item questionnaire which has two types of scale responses of required and performance was used to collect data. The questionnaire was validated by three experts and was subjected to reliability test using split-half technique and Pearson product correlation which yielded a coefficient of 0.84. Data obtained were analysed using weighted mean and Improvement Needs Index (INI). It was found that teachers need improvement in all the 26 competencies identified by the study and was recommended that re-training programmes in the form of workshop, seminar or short duration courses should be organised for teachers to enable them use school farm effectively in teaching agricultural practicals to their students. Olaitan et al (2010) was similar to the present study in that both dwelt on the use of school farm for teaching and learning practicals in schools. Conversely, the former study investigated the competency needed in the use of school farm for effective teaching while the present study dwelt on the use of school farm for effective learning by students. The former study adopted survey research design while the present study adopted pure experimental research design.

Onu and Ugwuoke (2010) investigated the utilization of school farm for promoting skills acquisition among secondary school students in Enugu State. The specific objectives of the study were to find out the availability of school farm in secondary schools; determine how best to manage school farm in secondary schools and the ways of optimizing the utilization of school farm in secondary schools for skills acquisition. Descriptive survey research design was adopted. Three research questions and three research hypotheses guided the study. A structured questionnaire was used to collect data from the population of 255 respondents. The entire population was used in the study. The data collected were analyzed using percentage and mean to answer the research questions and t-test statistic to test the null hypotheses at 0.05 level of significance. The findings among others revealed that some secondary schools do not have school farm. It was recommended that every secondary school student should have a small portion of land in the school farm where agricultural practicals can be conducted. Onu and Ugwuoke (2010) was related to the present study since both studies had the aim of investigating the contribution of school farm to the agricultural skills acquisition of students. However, both studies differ in terms of design. The former study adopted survey research design while the present study adopted pure experimental research design.

Managerial skills initiatives required by primary school teachers of agriculture in utilizing school farm as educational facility was studied by Ejiofor and Osinem in 2010. Survey research design was adopted. Two research questions and two null hypotheses guided the study. A structured questionnaire was used to collect data from 42 respondents comprising 31 teachers of agriculture and 11 headmasters. Data were analysed using mean to answer research questions and t-test statistic to test the null hypotheses at 0.05 level of significance. The findings of the study identified 25 managerial skills and 15 initiatives required by

primary school teachers of agriculture in involving students and other stakeholders in the management of school farm. Based on the findings, it was recommended among others that the teachers of agriculture in primary school should be well trained in the use of school farm for training students in agriculture. The former study was related to the present study in that both studies shared the same idea of utilizing school farm as educational facility to achieve learning among students. However, the former study adopted survey research design while the present study adopted pure experimental design. Secondly, Ejiofor and Osinem (2010) investigation was the utilization of school farm as educational facility by primary school teachers but the present study was on training of Agricultural Education students using school farm.

Summary of Literature Review

Many studies related to the present study were reviewed. Some authors wrote on the importance of school farm in agricultural skills development. The authors agreed that school farm provides students with the opportunity of acquiring knowledge, skills and needed competencies in agriculture. School farm according to the authors helps students to demonstrate theories in poultry production learnt in classroom into practicals thereby acquiring the practical competencies needed in poultry production after graduation. Some literature reviewed also discussed layer husbandry. The experts asserted that layers are kept primarily for egg production and can be reared under different management systems. The authors believed that feeding layers with balanced ration will enhance growth and improve production. Chick starter feed, grower feed and layer mash are some of the feeds needed at different stages of layers development. Consequently, these feeds have different nutritional requirements. The size of eggs produced by the modern and efficient laying hen can be

influenced by egg producers with proper management and husbandry skills along with nutritional know-how.

The authors agreed that feed is the major cost in layers production and accounts for 60 – 70% of total cost of commercial egg production. In layer feed formulation, the authors suggested some common techniques to include Pearson method, Linear programming technique, non-linear programming technique and trial and error method. Some of the feed ingredients used in formulation of feed according to some authors are the maize, soybean meal, bone meal, rice bran, wheat bran, groundnut cake, palm kernel cake, limestone, among others. In the view of the authors, *Moringa oleifera* is a medium-sized tree grown in tropical and sub-tropical belts. *Moringa oleifera* according to the authors has antimicrobial and antioxidant properties and as well rich in protein, Vitamins A, B, C, and several minerals. The authors maintained that protein in egg is the best protein available in nature for human consumption, with a well balanced amino acids profile, having the highest biological value, protein efficiency ratio, net protein value, net protein utilization and chemical score. However, some authors explained that if it were not for cholesterol, eggs would not be controversial, as eggs are the largest single sources of cholesterol among the foods commonly eaten.

The theoretical framework of the study was also reviewed. Two theories related to the study found to be relevant are the theory of vocational education and experiential learning theory. Consequently, the study was anchored on the vocational education which postulated that effective vocational training can only be given where the training jobs are carried on in the same way with the same operations, tools and machines as in the occupation itself. The review also covered some related empirical studies. The related empirical studies reviewed

revealed that *Moringa oleifera* improves the growth performance of weaner grasscutter, post-weaning rabbits, albino rats, broiler chicken, among others. The studies also revealed that *Moringa oleifera* leaf meal improves the average weight gain of domestic rabbits, meat quality and shelf life of pork. However, there was no identified study that investigated the effects of *Moringa oleifera* leaf powder additive on the growth of layers, egg production and nutritive value of eggs produced by the layers. Hence, the present study was geared towards filling this gap.

CHAPTER THREE

METHODOLOGY

This chapter describes the method that was adopted in conducting the study. The chapter is presented under the following sub-headings: design of the study, population for the study, sample and sampling technique, experimental procedure, management of experimental birds, processing of M*oringa oleifera* leaf powder, feed formulation, validation of the instrument, reliability of the instrument, method of data collection and method of data analysis.

Design of the Study

This study adopted a pure experimental design based on Completely Randomized Design (CRD). Completely Randomized Design in the view of Obi (2002) is an experimental design used when the experimental units are homogenous such as same animal breed, where environmental effects are homogenous such as animal house and treatments are assigned to experimental units at random. This design was therefore appropriate for the study since the

investigation involved experimental study, and the subjects and environment were homogenous.

Area of the Study

The study was carried out in Agricultural Education poultry farm, University of Nigeria, Nsukka. The poultry farm is located in the Department of Animal Science mini-livestock farms, which are situated at the southern part of the University. Production of feed used for the study was equally done in Nsukka. Nsukka is located in the South Eastern Nigeria and lies between longitude $7^0\,13^{/N}$ - $7^0\,35^{/N}$ and latitude $6^0\,43^{/E}$ - $7^0\,35^{/N}$ - $7^0\,00^{/E}$ (Ezeh and Ugwu, 2010). It covers an area of about $48km^2$ and a population of 309,633 people.

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Population for the Study

The population for the study was 252 Isa Brown day-old chicks (DOC) and 25 Agricultural Education students, University of Nigeria, Nsukka. The chicks were purchased from day-old chick distributors in Nsukka urban area. However, the chicks came from Agrited Hatchery located in Ibadan, Nigeria. Similarly, all the Students of Agricultural Education, University of Nigeria, Nsukka comprising four students in final year, four students in third year, nine students in second year and eight students in first year were part of the population (Agricultural Education Class List, 2016).

Sample and Sampling Technique

The sample consisted of 240 chicks and 12 Students of Agricultural Education, University of Nigeria, Nsukka. Twelve groups of 20 chicks each were drawn from the population of 252 chicks using simple random sampling technique. There were four treatment

groups representing one control group and three experimental groups. All were in three replicates thereby representing 12 groups of 240 chicks.

Purposive sampling technique was used to select 17 students of Agricultural Education of Year 1 and 2 as the have no experience in poultry rearing and feed formulation. Final year students of Agricultural Education were occupied with their project work while Year three students had earlier worked in the Departmental Poultry farm during their student apprenticeship programme in broiler production and had acquired some skills in poultry rearing. Random sampling technique was therefore used to select 12 out of 17 Agricultural Education students of Year 1 and 2 who had not embarked in poultry keeping for the first time. The 12 students were selected to keep the 12 treatment groups, one student for each group. Simple random sampling technique was as well used to allocate the 12 selected students to the 12 treatment groups.

Instrument for Data Collection

Weighing scale, Laboratory test and Psycho-productive multiple choice test (PMCT) were used to collect data to answer research questions and test hypotheses. Data on the average weight of layers and feed intake were collected using weighing scale. Similarly, data on the average egg weight were collected using Mettler Toledo electronic weighing machine which measures in grammes. Information on the nutritive value of eggs (Metabolizeable energy, crude protein, fats, crude fibre, Vitamins, Minerals, amino acids, lipids, among others) were obtained from the laboratory analysis of the eggs produced with and without *Moringa oleifera* leaf powder fortified feed. A 58-item Psycho-productive multiple choice test (PMCT) was developed by the researcher to collect data on the students' level of skills

acquisition before and after the research work. The psycho-productive multiple choice test was developed (Appendix 17; Page 260) based on Elizabeth Simpson (1972) psychomotor domain of educational objectives taxonomy which has seven levels and include perception, set, guided response, mechanism, complex or overt response, adaptation and origination (See Appendix 16; Page 259). Each item had four response options of A-D.

Validation of the Instrument

The psycho-productive multiple choice test items developed by the researcher was content validated by adopting Simpson (1972) taxonomy of psychomotor objectives for the development of the table of specification (Appendix 16; Page 259). Similarly, the instrument was face validated (Appendix 136, Page 294) by three experts, two from the Department of Agricultural Education and one from the Measurement and Evaluation unit of Science Education Department, all from the University of Nigeria, Nsukka. The experts were requested to scrutinize each item in order to identify grammatical and spelling errors, ambiguity, inconsistency and inappropriateness which need to be corrected. The suggestions and comments of the experts were effected to produce the final version of the instrument. The instrument had 88 items before the validation and 80 items after the validation.

Reliability of the Instrument

The PMCT was pilot tested on 20 Year one and Year two students who were randomly selected from Agricultural Education Department, Enugu State University of Science and Technology which was not part of the study to determine the stability using test-retest method. The test-retest was carried out in two separate administrations within two weeks interval. The test-retest method was determined using Pearson Product moment correlation

coefficient which yielded a coefficient of 0.71 (Appendix 18, Page 270). Similarly, the internal consistency of the items was established using Kuder-Richardson 20 which yielded a value of 0.81. This was in line with Nworgu (2006) who noted that Kuder-Richardson 20 is a good method of estimating the internal consistency of an instrument when items have multiple choice options. Therefore, KR-20 was appropriate for determining the internal consistency of the instrument since it was multiple choice test items.

Method of Data Collection

Data were collected by the researcher with the help of 12 research assistants (Appendix 19, Page 271) who were Agricultural Education Students, University of Nigeria, Nsukka. Data on the weight of hens, feed offered, feed consumed, weight gain, egg weight, among others were collected with the help of students. The students were instructed on how to measure the quantity of feed offered, keep records, conform to the bio-security measures required, and every other procedures needed in the management of layers. Similarly, the PMCT test was administered by the researcher on the 12 Agricultural Education students who participated in the study. The same instrument was used for pretest and post test. Pretest was administered a day before the arrival of the day old chicks while the post test was administered on the day of completion of the study.

Experimental Procedure

A total of two hundred and fifty two Isa Brown day old chicks were purchased from day-old chick distributors in Nsukka and 240 chicks were selected by simple random sampling technique and placed into 12 groups. The twelve groups were also randomly allotted to four different treatment groups on the 5th week of rearing. Uniform feed was given to them at the 1st, 2nd, 3rd and 4th weeks to place them at the same condition and to ensure uniformity. The groups were:

T1: Control group (No *Moringa oleifera* supplement feed was given).

T2: 1st experimental group (2.5% *Moringa oleifera* supplement feed was given).

T3: 2nd experimental group (5% *Moringa oleifera* supplement feed was given).

T4: 3rd experimental group (7.5% *Moringa oleifera* supplement was given).

The four treatment groups were in 3 replicates which gave a total of 12 groups. This was adopted to eliminate experimental errors. Through simple random sampling technique, T1, T2, T3 and T4 were assigned to the 12 groups. Egg collection was done daily.

Management of Experimental Birds

The experimental birds were purchased from day-old chick distributors and placed in brooding pen at the temperature of 34^0C. Before the arrival of the chicks, the feeders, drinkers and brooding pen were washed and disinfected. Litter materials in the form of wood shavings were placed on the floor at 5 - 10 cm thickness. The brooding pen was heated to 34^oC one day earlier. Clean and cold drinking water was provided. Chick starter feed was also provided. On arrival at the farm, the chicks were vaccinated against Newcastle disease. Anti-stress powder (Super Mibrovite) was included in clean drinking water to condition the chicks.

Thermometer was placed on the floor of the brooding pen to monitor the temperature fluctuations. Temperature was reduced by 2^0C weekly until 21^0C was reached. Light was provided for 24 hours for 0-7 days to give them maximum opportunity to feed. This was decreased gradually. Kerosine stoves were placed to provide heat.

Prior to the transfer of the pullets to the rearing pen, the pen was cleaned, washed and disinfected with Vinkokill disinfectant. Litter materials of 5-10 cm thickness were placed on the floor after drying. Feed and cool clean water mixed with anti-stress powder (Super Mibrovite) were provided. There was no further transfer of pullets from rearing to laying pen rather rearing pen also served as laying pen. This helps to reduce stress of layer transfer. Laying nests were placed at the dark corners of the laying pens. Layer mash was given at the age of 20 weeks old; deep litter system was used during the laying period. Routine vaccination programmes were carried out as followed:

- Lasota vaccine was administered on the 1st day.
- Livacox vaccine was given on the 5th day.
- IBD, Gumboro disease vaccine was administered on the 2nd week.
- Lasota vaccine for Newcastle disease was repeated on the 3rd week.
- Gumboro vaccination was repeated on the 5th week.
- Komorov vaccine was administered on the 5th week.
- Fowl pox vaccine was administered on the 6th week.
- Lasota vaccination was repeated every 2 months.

Treatment of diseases particularly Newcastle and fowl pox diseases erupted in the farm was done as follows:

- Combination of Protozine DVP Coccidiosis penicillin and antibacterial given 5 days on the 13th week for treatment of varying ranges of bacterial diseases.
- Pox proline was administered 4 days in week 14.
- Intramuscular administration of Tridox LA on the 14th week.
- Levadex dewormer was administered in week 14
- V-OX was given 3 days on the 15th week for Newcastle and Fowl pox treatment.
- Virucine was given three days on the 15th week for treatment of Newcastle and Fowl pox.
- NCO MIX was given 10 days that ran from 16th week into 17th week.
- Amprolline anticox was given 3 days in week 19.
- Intramuscular injection of Tridox LA was given in week 20. The administration was done on the 1st day and repeated after 3 days.

  Among the drugs used, Tridox LA proved to be the most effective in the control of Newcastle and fowl pox diseases.
- Rambo insecticide was administered in week 21 to control ecto-parasite.

Post morterm examination of the dead layers was done by a veterinary doctor to confirm the outbreak of Newcastle and fowl pox disease in the farm on week 14.

Note: Mineral/vitamin supplements were used very often. Those used include- Super mibrovite, Vitalyte, Hygrovite and Agrivit

Processing of Moringa oleifera Leaf into Powder

The harvested *Moringa oleifera* leaves were washed and drained of water. The water drained leaves were spread on a clean room floor lined with mosquito net. Windows and

doors were opened to facilitate indoor drying. The dried *Moringa oleifera* leaves were ground using grinding machine to get the powder. The powder was kept in a black polythene bag and stored in a cool and dry room where there was no direct sunlight prior to the usage.

Feed Formulation

Four different feeds were formulated to feed T1, T2, T3 and T4 groups. The feeds were formulated using feed formulation software called FeedWin developed by PTC+, located in Barneveld, the Netherlands. T1 which was the control group received a balanced ration formulated with conventional feed ingredients such as maize, rice bran, soybean meal, wheat bran, bone meal, groundnut cake, Methionine, lysine, limestone and salt (See Appendixes 4, 8 & 12; Pages 247, 251 & 255). T2 which was the experimental group 1 received feed formulated with the conventional feed ingredients but was supplemented with 2.5% *Moringa oleifera* leaf powder (See Appendixes 5, 9 & 13; Pages 248, 252 & 256 respectively). Similarly, T3 which was the experimental group 2 received feed formulated with the conventional feed ingredients but was supplemented with 5% *Moringa oleifera* leaf powder (See Appendixes 6, 10 & 14; Pages 249, 253 & 257 respectively) while T4 which was the experimental group 3 received feed formulated with the conventional feed ingredients but was supplemented with 7.5% *Moringa oleifera* leaf powder (Appendixes 7, 11 & 15; Pages 250, 254 & 258 respectively). Dosing, grinding and mixing were done in Chidera Feed Mill located in Onuiyi, Nsukka urban area.

Determination of Average Weight

The Average Weight (AW) was the ratio of the Total Weight of subjects (TWS) in a given batch to the Number of Subjects (NS) in the batch.

AW(g) = $\frac{TWS\ (g)}{NS}$

Determination of Average Weight Gain

The Average Weight Gain (AWG) was represented as the difference between the Average Weight of the current week (AW_C) and Average Weight of the previous week (AW_P).

AWG(g) = AW_C(g) – AW_P(g)

Where

AWG = Average Weight Gain

AW_C = Average Weight of the Current week

AW_P = Average Weight of the previous week.

Determination of the Average Feed Intake

The Average Feed Intake (AFI) was the ratio of the total Quantity of Feed Consumed (QFC) on a given period to the Number of Subjects Fed (NSF) on the same period.

AFI (g/d) = $\frac{QFC\ (\frac{g}{d})}{NSF}$

Determination of Mortality Rate

The rate of mortality was the ratio of the number of birds that died to the initial number of the subjects in the batch multiplied by 100.

Mortality (%) = $\frac{Number\ of\ birds\ died}{Total\ Number\ of\ Intial\ birds} \times 100$

Determination of Feed Conversion Ratio (FCR)

The Feed Conversion Ratio (FCR) for each week was the total feed intake for the week divided by the total weight for the same week.

FCR = $\frac{TFI\ (Kg)}{TW\ (Kg)}$

Where

FCR = Feed Conversion Ratio

TFI = Total Feed Intake

TW = Total Weight

OR

Feed conversion ratio (FCR) was also calculated as the ratio of feed intake per bird per day to the egg mass.

FCR = $\frac{\frac{F}{\frac{b}{day}}(g)}{EM\ (g)}$

Determination of Average Egg Weight

This was the ratio of the Total Weight of a given Number of eggs to the Number of eggs measured.

AEW (g) = $\frac{TEW\ (g)}{NE}$

Where

AEW = Average Egg Weight

TEW = Total Egg Weight

NE = Number of eggs

Determination of Egg Mass

Egg mass was determined by multiplying laying percentage by the Average Egg Weight (AEW).

EM (g) = Laying % × AEW (g)

Determination of Laying Percentage

Laying percentage was the ratio of the total Number of Eggs Produced (NEP) in one week to the Number of Hens Present (HP) within the week and Number of days (ND) multiplied by 100.

Laying % = $\frac{NEP}{HP \times ND} \times 100$

Where

NEP = Number of eggs produced/week.

HP = Number of hens present/week.

ND = Number of days.

Determination of the Nutritive Value of Eggs

This was done by the Central Research and Diagnostic Laboratory located in Ilorin, Nigeria. Samples of eggs from each of the treatment groups were selected and sent to the laboratory, which carried out the test using proximate analysis to determine the carbohydrate, moisture, crude protein, metabolizeable energy, crude lipid, ash and crude fibre contents. Similarly, Atomic Absoption Spectrophotometry (AAS) was used to determine the mineral contents, Gas Chromatography-Mass Spectrometry (GC-MS) was used to determine the cholesterol and vitamin profile while amino acids analysis was used to determin the amino acids of the eggs.

Method of Data Analysis

Mean, bar charts and pie charts were used to answer the research questions while one-way Analysis of Variance (ANOVA) was used to test the null hypotheses 1-8 at 0.05 level of significance and at the appropriate degrees of freedom. Similarly, one sample t-test was used to test hypothesis 9 at 0.05 level of significance and at the appropriate degree of freedom using Statistical Package for Social Sciences (SPSS) software. Any null hypothesis whose p-value was less than 0.05 level of significance at the appropriate degree of freedom was rejected and therefore regarded as significant. Conversely, any null hypothesis whose p-value was equal or greater than 0.05 level of significance at the appropriate degree of freedom was upheld and therefore, was not regarded as significant. Test of significance betwee
done using scheffe.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

This chapter presented and analysed data generated for the study.

Research Question 1: What are the effects of *Moringa oleifera* leaf powder fortified feed and control feed on the growth of layers?

The data for answering research question 1 are presented below.

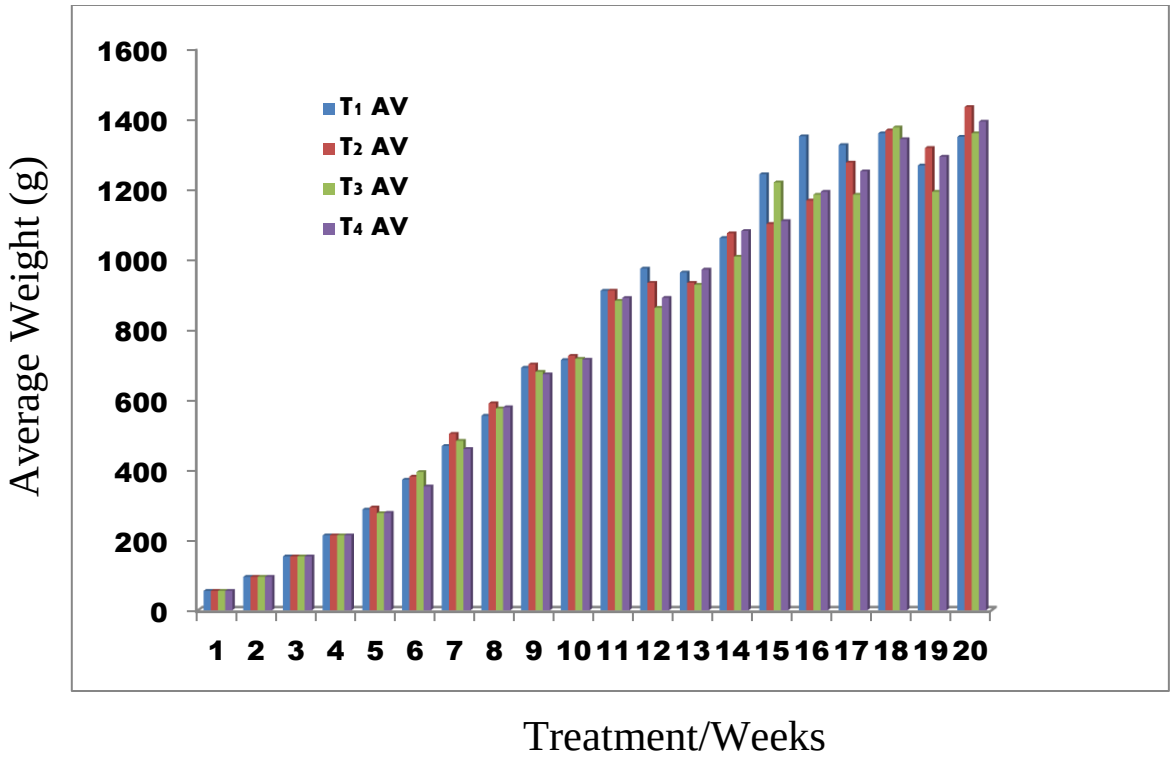

Figure 2: Average Weight of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those fed with Control Feed

Key: $\overline{X}$ *- Mean; T1: Treatment 1 – Control; T2:Treatment 2 – group fed with 2.5% Moringa fortified feed; T3:Treatment 3 – group fed with 5% Moringa fortified feed; T4:Treatment 4 – group fed with 7.5% Moringa fortified feed; AV - Average Weight*

75

Data presented in Figure 2 (Appendix 20, Page 272) shows that the average weights of all the treatment groups were equal from week 1 to week 4. Little variation in average weight started in week 5 with T2 topping the groups. In weeks 11, 12, 13, 15, 16 and 17, T1 had more predominant average weight than others. Similarly, T2 had more average weight than other treatment groups in weeks 5, 7, 8, 9, 10, 19 and 20 thereby making feed produced by inclusion of 2.5% *Moringa oleifera* leaf powder more efficient in improvement of weight.

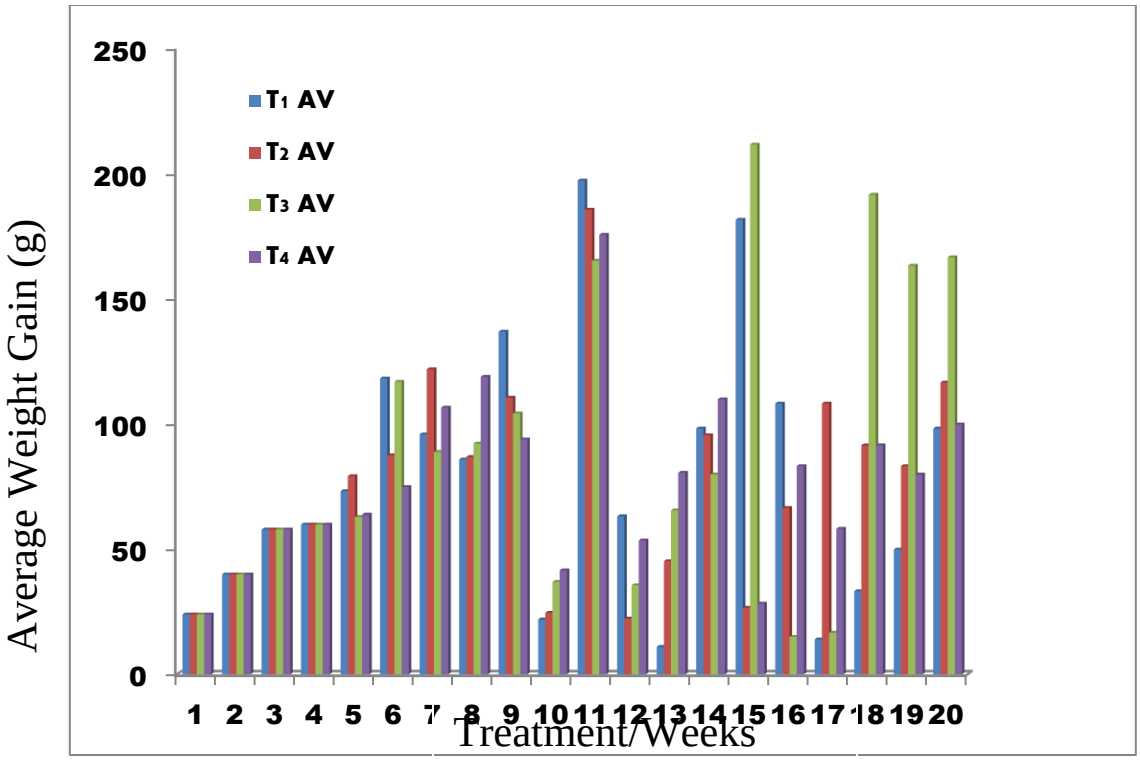

Figure 3: Average weight Gain of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

Data presented in Figure 3 (Appendix 21, page 272) indicate that T2 gained more weight than other treatment groups in weeks 5, 7 and 17. Treatment 1 gained weight most in weeks 6, 9, 11, 12 and 16, and gained the least weight in weeks 8, 10, 13, 17, 18, 19 and 20. Similarly, Treatment 3 gained most weight among the groups in weeks 15, 18, 19 and 20, and the least weight in weeks 5, 7 and 14 respectively. Therefore, T1 gained more weight than others

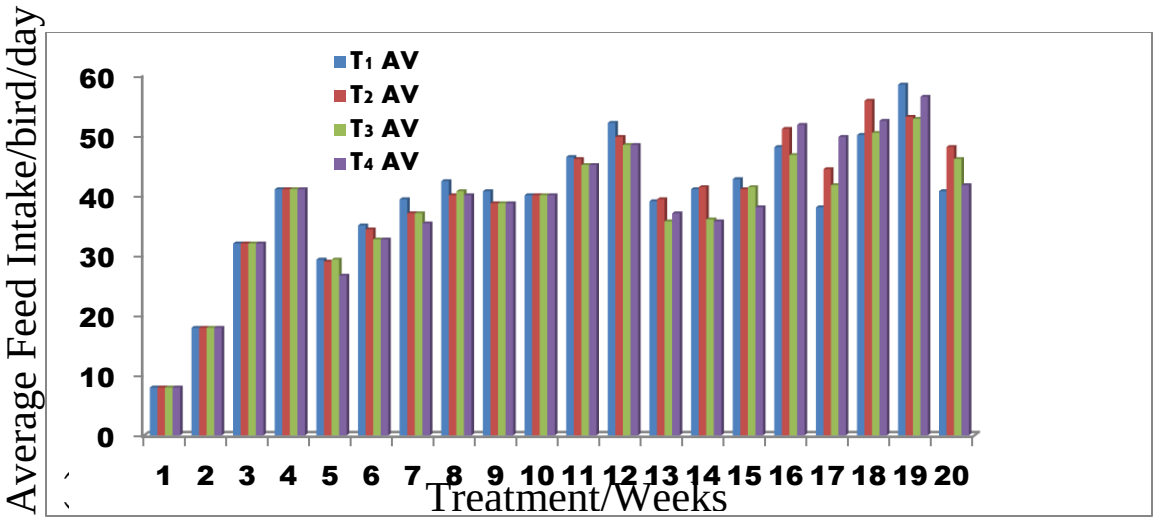

Figure 4: Average Feed Intake/bird/day of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

The layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed consumed equal amount of feed in weeks 1, 2, 3 and 4. Data presented in Figure 4 (Appendix 22, Page 273) further indicate that T4 consumed less feed in almost all the weeks. Similarly, T1 had higher feed intake in weeks 6, 7, 8, 9, 12, 15 and 19. T2 consumed most in weeks 16, 18 and 20. Treatment 3 had the least feed intake in weeks 13, 16 and 19 respectively. Therefore, T1 consumed more feeds than others in most of the weeks.

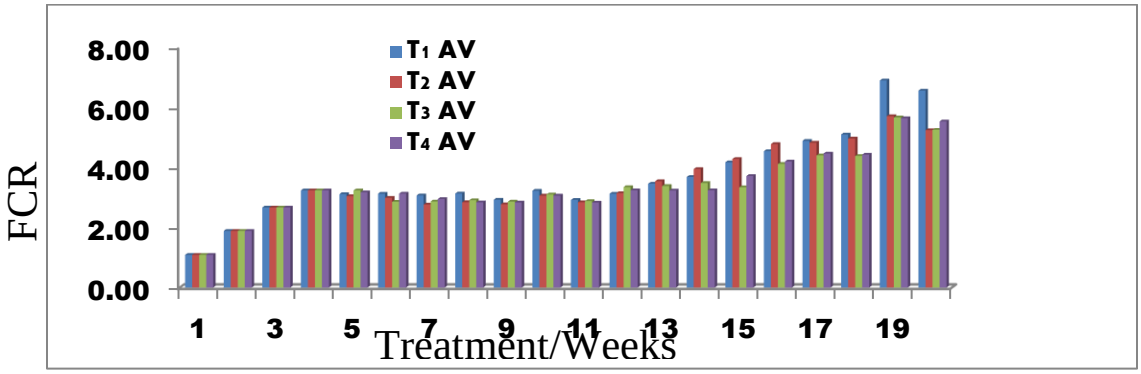

Figure 5: Average Feed Conversion Ratio of Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The average feed conversion ratio (FCR) of the layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed were equal in the first four weeks. Treatment 2 showed the least FCR in weeks 5, 7, 9, 10, 11 and 20 respectively. According to

the data in Figure 5 (Appendix 23, Page 274), treatment 3 had the least FCR in weeks 6, 15, 16, 17and 18 respectively and therefore better feed efficiency in those weeks. Treatment 4 had the least FCR in weeks 13 and 14. Similarly, Treatment 1 had the least FCR in only week 12. Data presented above equally showed that T1 had the highest FCR in weeks7, 8, 9, 10, 11, 17, 18, 19 and 20 respectively and therefore depicts the worst feed efficiency. Treatment 2 had the highest FCR in weeks 13, 14, 15 and 16 respectively.

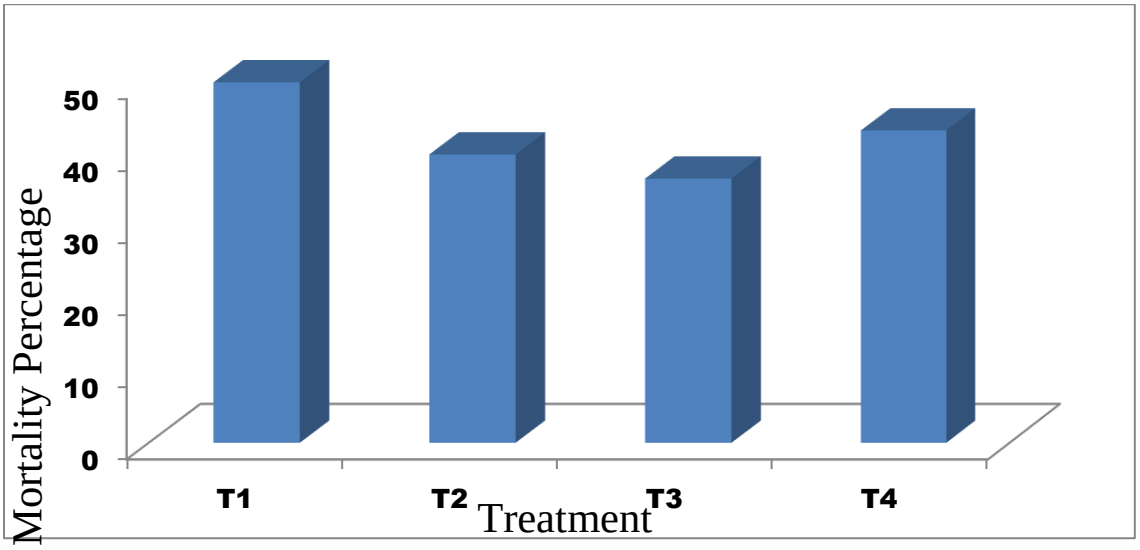

Figure 6: Percentage Mortality of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feed and those Fed with Control Feed

Data presented on the mortality ratio of layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed show that T1 had the highest mortality of 50% (Figure 6, Appendix 24, page 274). Similarly, T3 had the least mortality of 37% and therefore show the most resistance to diseases.

Hypothesis 1

There is no significant difference in the Mean growth of Layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control Feed

The data for testing hypothesis 1 are presented in tables 1 – 4.

Table 1: ANOVA Analysis of Average Weight of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8902.438	3	2967.479	.014	.998
Within Groups	15642235.450	76	205818.887		
Total	15651137.888	79			

Table 1 shows that the probability value was 0.998 which was greater than 0.05. This showed that there was no significant difference in the average weight of layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed. Therefore, the hypothesis of no significant difference was upheld.

Table 2: ANOVA Analysis of Average Weight Gain of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2313.737	3	771.246	.328	.805
Within Groups	178795.650	76	2352.574		
Total	181109.387	79			

Data presented in Table 2 indicates that the probability value was 0.805 which was greater than 0.05. This showed that there was no significant difference in the average weight gain of layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed. Therefore, the hypothesis of no significant difference was accepted.

Table 3: ANOVA Analysis of Feed Intake/bird/day of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.

Between Groups	19.237	3	6.412	.051	.985
Within Groups	9584.250	76	126.109		
Total	9603.488	79			

The ANOVA table presented above on the feed intake/bird/day of layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed shows that the probability value was 0.985 which was greater than 0.05. This signifies that there was no significant difference in the mean feed intake/bird/day of layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed. Therefore, the null hypothesis was accepted.

Table 4: ANOVA Analysis of Average Feed Conversion Ratio (FCR) of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19.237	3	6.412	.051	.985
Within Groups	9584.250	76	126.109		
Total	9603.488	79			

Data in Table 4 shows that the probability value was 0.985 which was greater than 0.05. This shows that there was no significant difference in the average feed conversion ratio of layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with the control feed. Therefore, the null hypothesis was upheld.

Research Question 2: What are the effects of different inclusion rates of *Moringa oleifera* leaf powder on the growth of layers?

The data for answering research question 2 are presented in figures below.

erage Weight (g)

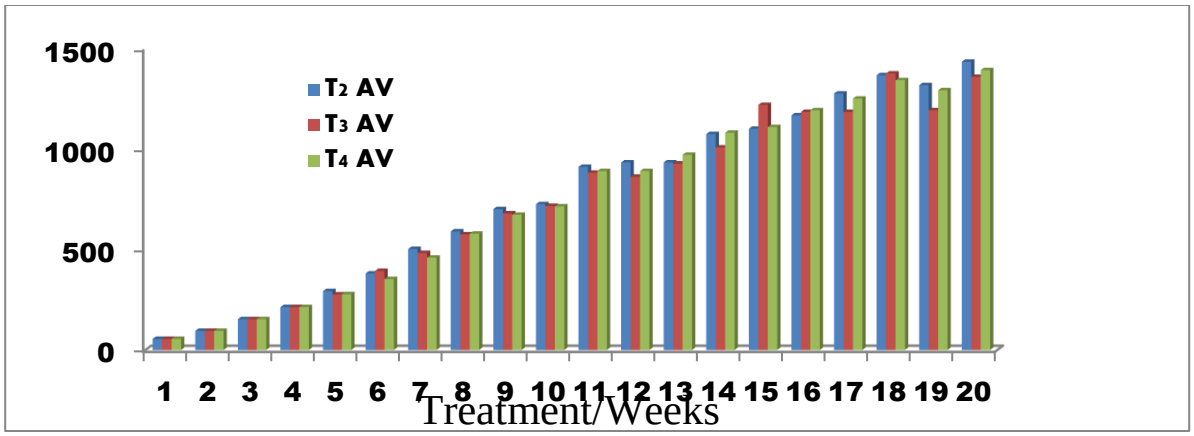

Figure 7: Average Weight of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

Data presented in Figure 7 (Appendix 25, Page 274) on the average weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder show that T2 had the highest weight in weeks 5, 7, 8, 9, 10, 11, 12, 14, 17, 19 and 20 respectively. Similarly, T3 had the highest weight in week 15 and least weight in weeks 5, 12, 13, 14, 17, 19 and 20. Treatment 4 had the least weight in weeks 6, 7, 9 and 10 respectively. Treatment 4 had never assumed highest weight within the period of study while T2 performed better than other treatment groups in virtually all the weeks under study.

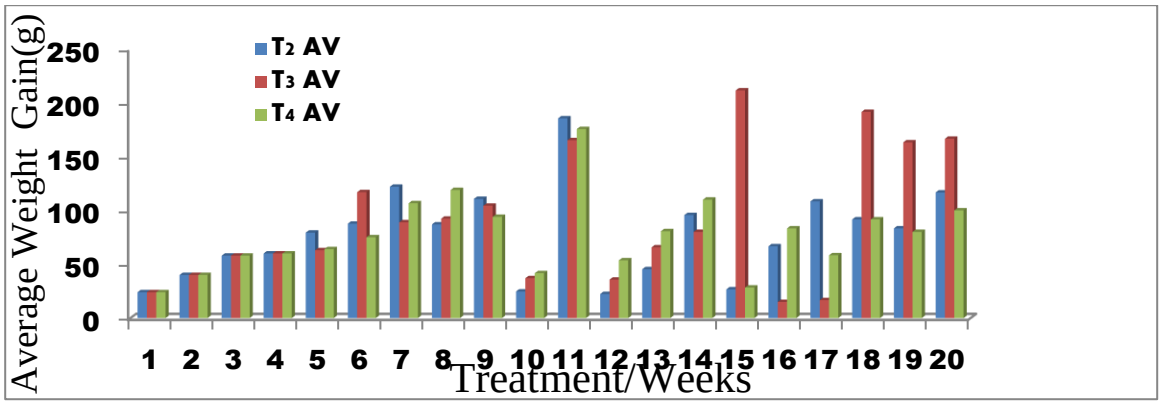

Figure 8: Average Weight Gain of Layers Fed with Different Inclusion Rates of *Moringa Oleifera* Leaf Powder

T2 recorded the highest weight gain in weeks 5, 7, 9, 11 and 17, and as well gained the least weight in weeks 8, 10, 12, 13 and 15 respectively (Figure 8, Appendix 26, Page 275).

Similarly, layers in T3 gained the highest weight in weeks 6, 15, 18, 19 and 20, and gained the least weight in weeks 5, 7, 14, 16 and 17. Layers in T4 gained the highest weight in weeks 8, 10, 12, 13, 14, and 16 respectively thereby performing generally better than others

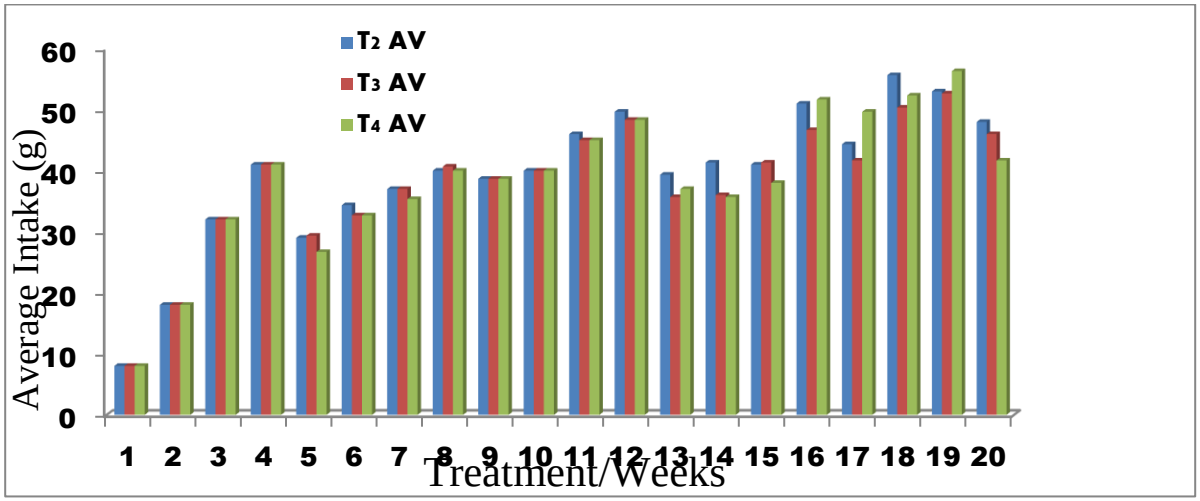

Figure 9: Average Feed Intake/bird/day of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

Data presented in Figure 9 (Appendix 27, Page 275) on the feed intake/bird/day indicate that T2 consumed the highest feed among the others in weeks 6, 11, 12, 13, 14, 16, 18 and 20, and never consumed the least feed in comparison with others within the period of study. Similarly, T3 had the highest feed intake in comparison with others in weeks 5, 8 and 15, and consumed least in weeks 13, 16, 17, 18 and 19 respectively. T4 had the highest feed intake/bird/day in relation to others only in weeks 16 and 19, and consumed least in weeks 5, 7, 8, 15 and 20 respectively. Therefore, T2 had more feed intake than other treatment groups.

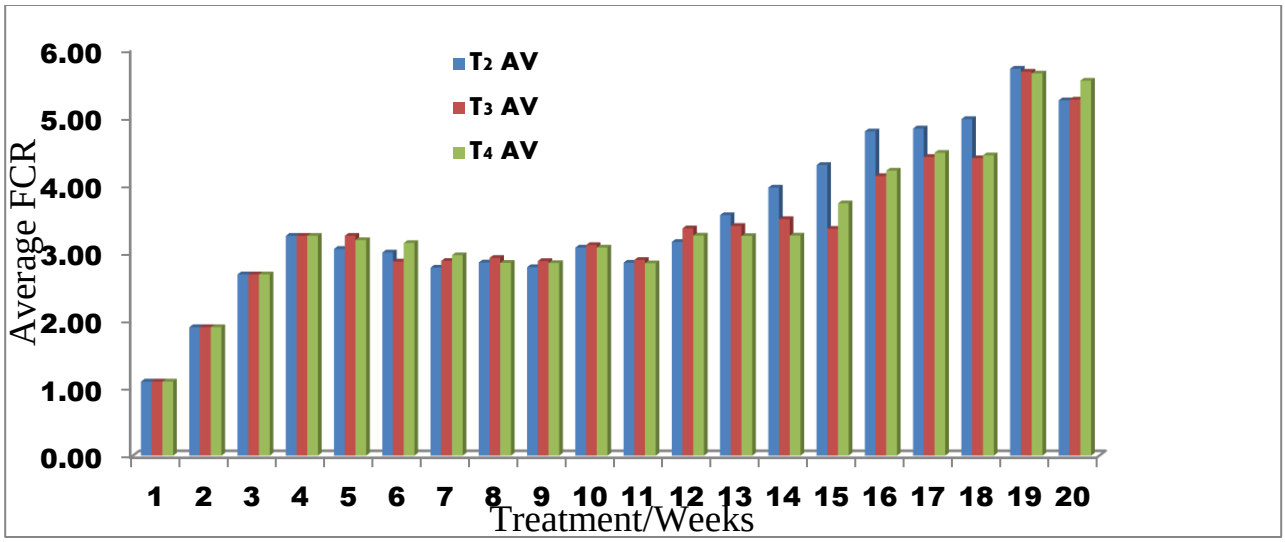

Figure 10: Average Feed Conversion Rates of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

Figure 10 (Appendix 28, Page 276) shows that T2 had the highest FCR in relation to other treatment groups fed with different inclusion rates of *Moringa oleifera* leaf powder in weeks 13, 14, 15, 16, 17, 18 and 19, and least FCR in weeks 5, 7, 9, 12 and 20 respectively. Similarly, T3 had the highest FCR in weeks 5, 8, 9, 10, 11 and 15, and recorded the least FCR in weeks 6, 15, 16, 17 and 18 respectively. Layers in T4 had the highest FCR values in comparison with others in weeks 6, 7 and 20, and least in weeks 8, 11, 13 and 14 respectively.

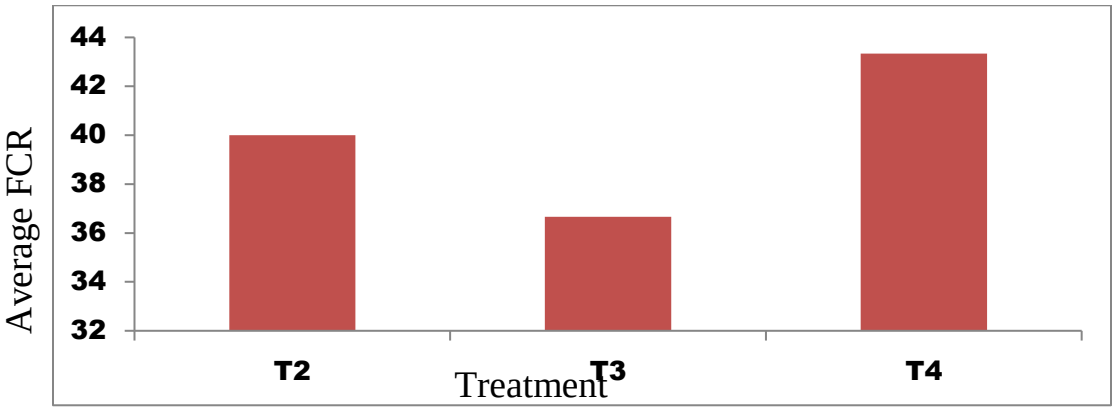

Figure 11: Percentage Mortality of Layers Fed with Different Inclusion Rates of *Moringa* oleifera Leaf Powder

Figure 11 (Appendix 29, Page 277) shows that mortality rate was highest on the layers fed on the feed formulated with 7.5% inclusion rate of *Moringa oleifera* leaf powder. Similarly, the data showed that mortality rate was lowest on the layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder thereby, being more resistant to diseases than others.

Hypothesis 2: There is no significant difference in the mean growth of layers fed with different inclusion rates of *Moringa oleifera* leaf powder.

Tables 5 - 8 present the data for testing hypothesis 2

Table 5: ANOVA Analysis of the Average Weight of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2771.733	2	1385.867	.007	.993
Within Groups	11466514.450	57	201166.920		
Total	11469286.183	59			

Data presented in Table 5 which represents the ANOVA analysis of average weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder indicates that the probability value was 0.993 which was greater than 0.05. This signifies that there was no significant difference in the average weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Therefore, the hypothesis of no significant difference was accepted.

Table 6: ANOVA Analysis of the Average Weight Gain of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2186.133	2	1093.067	.491	.614
Within Groups	126788.850	57	2224.366		
Total	128974.983	59			

ANOVA analysis of the average weight gain of layers fed with different inclusion rates of *Moringa oleifera* leaf powder presented in Table 6 shows that the probability value was 0.614 which was greater than 0.05. This implies that there was no significant difference in the average weight gain of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Hence, the null hypothesis is accepted.

Table 7: ANOVA Analysis of Average feed Intake/bird/day of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	16.633	2	8.317	.066	.936
Within Groups	7193.300	57	126.198		
Total	7209.933	59			

The ANOVA presented above shows that the probability value of Table 7 is 0.936. This implies that there is no significant difference in the average feed intake/bird/day of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. The hypothesis of no significant difference was upheld for this variable.

Table 8: ANOVA Analysis of the Average Feed Conversion Ratio (FCR) of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.208	2	.104	.086	.918
Within Groups	68.980	57	1.210		
Total	69.188	59			

The data presented in Table 8 indicates that the probability value was 0.918 which is greater than 0.05. This signifies that there was no significant difference in the average FCR of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Hence, the null hypothesis was accepted for this variable.

Research Question 3: What are the effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the egg production of layers?

The data for answering research question 3 are presented in the figures below.

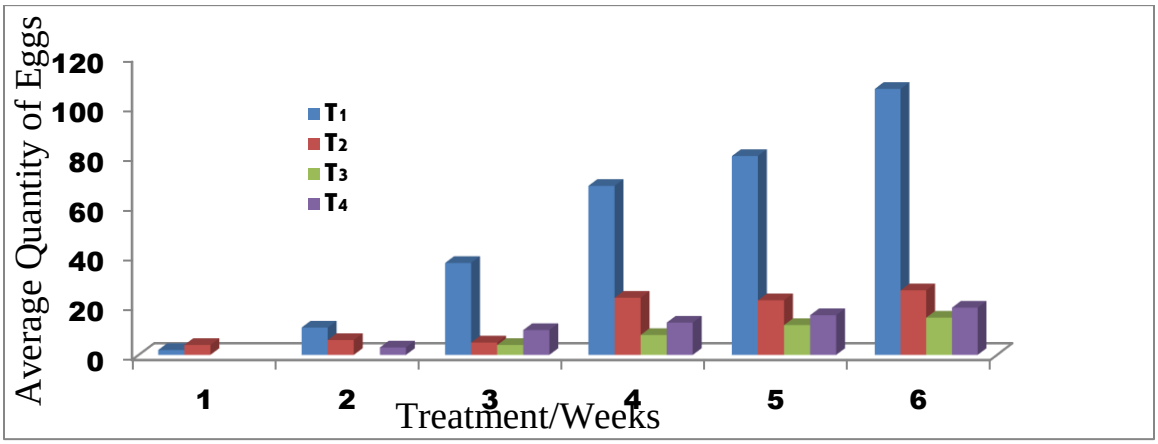

Figure 12: Average Quantity of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 12 (Appendix 30, page 277) show that the average quantity of eggs produced by layers in control group is dominantly greater when compared with the average quantity of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds. The average quantity of eggs produced by layers in T3 is the least among the

eggs produced by the other groups. A cursory look at the data presented in the above figure will notice that layers in control group and layers fed on 2.5% *Moringa oleifera* leaf powder fortified feed started production earlier than others. Layers that consumed feed fortified with 7.5% *Moringa oleifera* leaf powder started production a week later and those received 5% *Moringa oleifera* fortified feed started production two weeks later. Therefore, T1 produced more eggs than other treatment groups

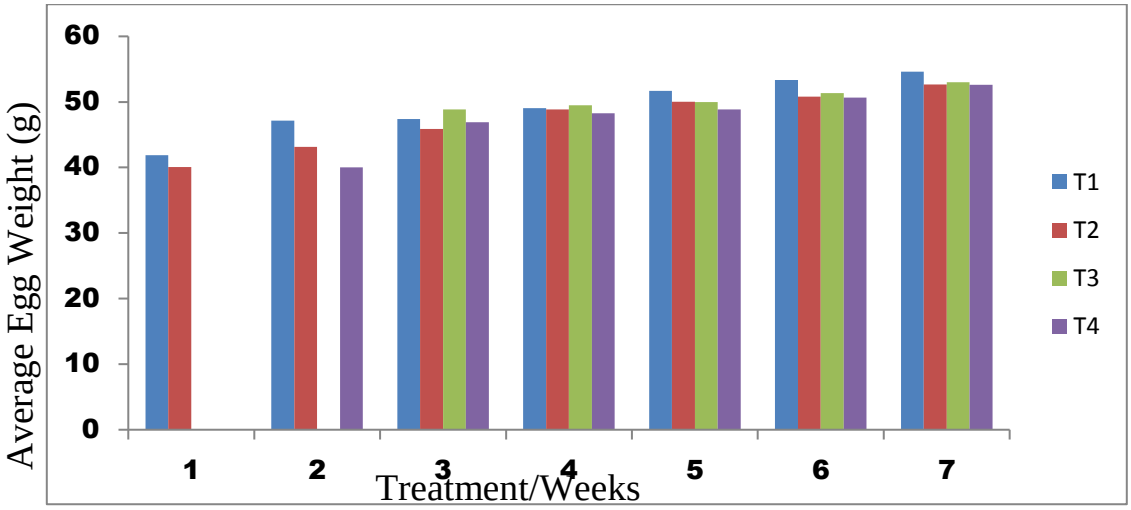

Figure 13: Average Egg Weight of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

On the average egg weight of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control group, Figure 13 shows that the average egg weight of layers in control group dominated the others in Weeks 1, 2, 5, 6 and 7 respectively (Appendix 31, Page 277). The average weight of eggs produced by layers in T3 dominated the others in weeks 3 and 4. Similarly, layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed had the least average egg weight in weeks 2, 4, 5, 6 and 7 respectively. In the same vein, layers fed with 2.5% *Moringa oleifera* fortified feed had least average egg weight in weeks 1

and 2 when compared with others. Therefore, eggs produced by layers in T1 had better average egg weight.

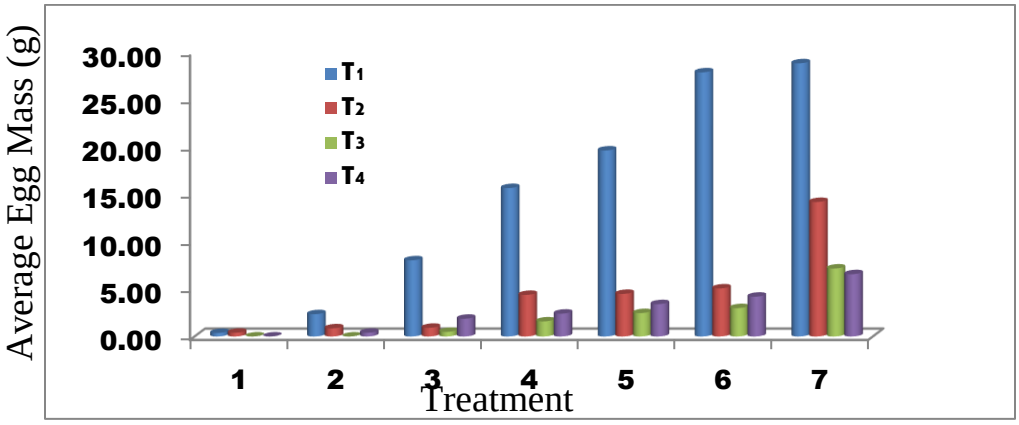

Figure 14: Average Egg Mass of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

Data presented in Figure 14 (Appendix 32, Page 277) indicates that T1 which is the control group had the highest average egg mass in all the production weeks when compared with the average egg mass of the layers fed with *Moringa oleifera* leaf powder fortified feed. Similarly, T3 which is the layers fed with 5% *Moringa oleifera* leaf powder had the least average egg mass in weeks 3, 4, 5 and 6 respectively.

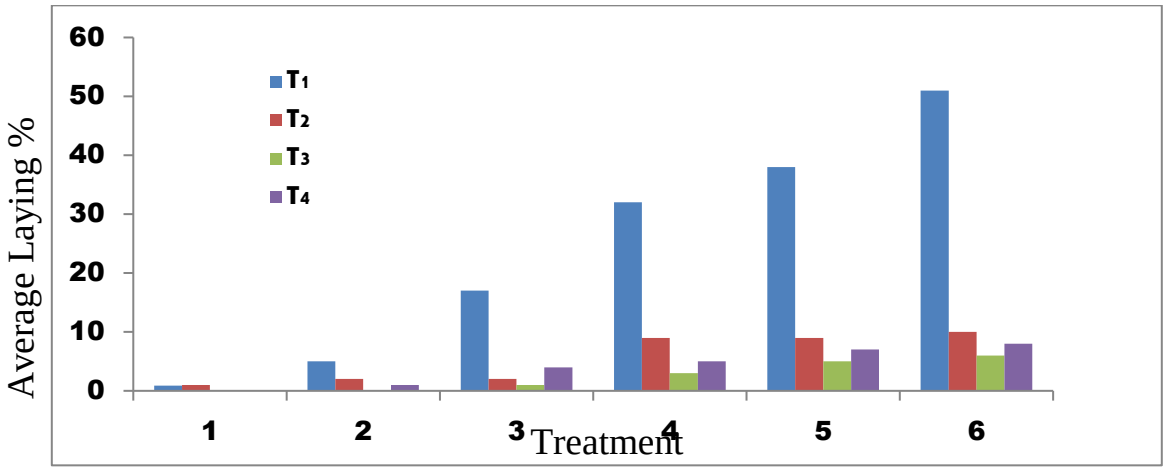

Figure 15: Average Laying Percentage of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

On the average laying percentage of layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed, Figure 15 (Appendix 33, Page 277) shows that layers in the control group (T1) had the highest average laying percentage in all the weeks when compared with those layers fed with *Moringa oleifera* leaf powder. Similarly, layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the average least laying percentage when compared with others.

Hypothesis 3: There is no significant difference in the Mean egg production of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed

Data presented in the tables 9 - 15 are used for testing hypothesis 3.

Table 9: ANOVA Analysis of the Average Quantity of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7565.458	3	2521.819	5.328	.007
Within Groups	9466.500	20	473.325		
Total	17031.958	23			

The data presented in Table 9 reveals that the probability value of the table was 0.007 which was less than 0.05. This implies that there was a significant difference in the average quantity of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed. Therefore, the null hypothesis for this variable was rejected.

Table 10: Test of Significant Difference Between the Average Quantity of Egg Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feed and those Fed with Control Feed Using Scheffe Test

(I) TREATMENT	(J) TREATMENT	Mean Difference (I-J)	Std. Error	Sig.
CONTROL	2.5% MORINGA	36.50000	12.56085	.065
	5% MORINGA	44.33333*	12.56085	.019
	7.5% MORINGA	40.66667*	12.56085	.035
2.5% MORINGA	CONTROL	-36.50000	12.56085	.065
	5% MORINGA	7.83333	12.56085	.941
	7.5% MORINGA	4.16667	12.56085	.990
5% MORINGA	CONTROL	-44.33333*	12.56085	.019
	2.5% MORINGA	-7.83333	12.56085	.941
	7.5% MORINGA	-3.66667	12.56085	.993
7.5% MORINGA	CONTROL	-40.66667*	12.56085	.035
	2.5% MORINGA	-4.16667	12.56085	.990
	5% MORINGA	3.66667	12.56085	.993

Data presented in the Table above shows that the difference existed between the eggs produced by layers in control group and eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed. This was shown as having the highest positive mean difference of 44.33 when considered using pair-wise comparison.

Table 11: ANOVA Analysis of Average Egg Weight of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	764.467	3	254.822	1.027	.398
Within Groups	5954.794	24	248.116		
Total	6719.261	27			

On the average egg weight of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, Table 11 indicates that the probability value was 0.398 which was greater than 0.05. This signifies that there was no significant difference in the

average egg weight of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. Hence, the hypothesis of no significant difference was accepted.

Table 12: ANOVA Analysis of Average Egg Mass of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	644.566	3	214.855	5.757	.004
Within Groups	895.733	24	37.322		
Total	1540.299	27			

The data presented in Table 12 shows that the probability value was 0.004 which was less than 0.05. This implies that there was statistically significant difference in the average egg mass of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. Hence, the null hypothesis was rejected.

Table 13: Test of Significant Difference Between the Average Egg Mass of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed Using Scheffe Test

(I) TREATMENT	(J) TREATMENT	Mean Difference (I-J)	Std. Error	Sig.
	2.5% MARINGA	9.62714	3.26550	.056
CONTROL	5% MARINGA	11.86143*	3.26550	.013
	7.5% MARINGA	11.26571*	3.26550	.020
	CONTROL	-9.62714	3.26550	.056
2.5% MORINGA	5% MARINGA	2.23429	3.26550	.925
	7.5% MARINGA	1.63857	3.26550	.968
	CONTROL	-11.86143*	3.26550	.013
5% MORINGA	2.5% MARINGA	-2.23429	3.26550	.925
	7.5% MARINGA	-.59571	3.26550	.998
	CONTROL	-11.26571*	3.26550	.020
7.5% MORINGA	2.5% MARINGA	-1.63857	3.26550	.968
	5% MARINGA	.59571	3.26550	.998

Data presented in the table above shows that significant difference which existed between the average egg mass of eggs produced by layers fed with *Moringa oleifera* leaf

powder fortified feeds and those fed with control feed occurred between the mean of eggs produced by layers in control group and mean of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed. This was shown as having the highest positive mean difference of 11.86 when compared to every other pair.

Table 14: ANOVA Analysis of Average Laying Percentage of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1814.135	3	604.712	5.742	.005
Within Groups	2106.442	20	105.322		
Total	3920.576	23			

ANOVA analysis of average laying percentage of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed presented in Table 14 shows that the probability value was 0,005 which was less than 0.05. This implies that there was a statistically significant difference in the laying percentage of layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed. Hence, the null hypothesis was rejected.

Table 15: Test of Significant Difference Between the Average Laying Percentage of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed Using Scheffe Test

(I) TREATMENT	(J) TREATMENT	Mean Difference (I-J)	Std. Error	Sig.
CONTROL	2.5% MARINGA	18.48333*	5.92515	.044
	5% MARINGA	21.48333*	5.92515	.016
	7.5% MARINGA	19.81667*	5.92515	.028
2.5% MARINGA	CONTROL	-18.48333*	5.92515	.044
	5% MARINGA	3.00000	5.92515	.967
	7.5% MARINGA	1.33333	5.92515	.997
5% MARINGA	CONTROL	-21.48333*	5.92515	.016
	2.5% MARINGA	-3.00000	5.92515	.967
	7.5% MARINGA	-1.66667	5.92515	.994
7.5% MARINGA	CONTROL	-19.81667*	5.92515	.028
	2.5% MARINGA	-1.33333	5.92515	.997
	5% MARINGA	1.66667	5.92515	.994

The data presented in the table above shows that the significant difference that existed between the average laying percentage of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed occurred between average laying percentage of layers in control group and the average laying percentage of layers fed with 5% *Moringa oleifera* leaf powder fortified feed. This was shown as having the highest positive mean difference of 21.48 when compared to other pairs.

Research Question 4: What are the effects of different inclusion rates of *Moringa oleifera* leaf powder on the egg production of layers?

Data presented in the figures below are used to answer research question 4.

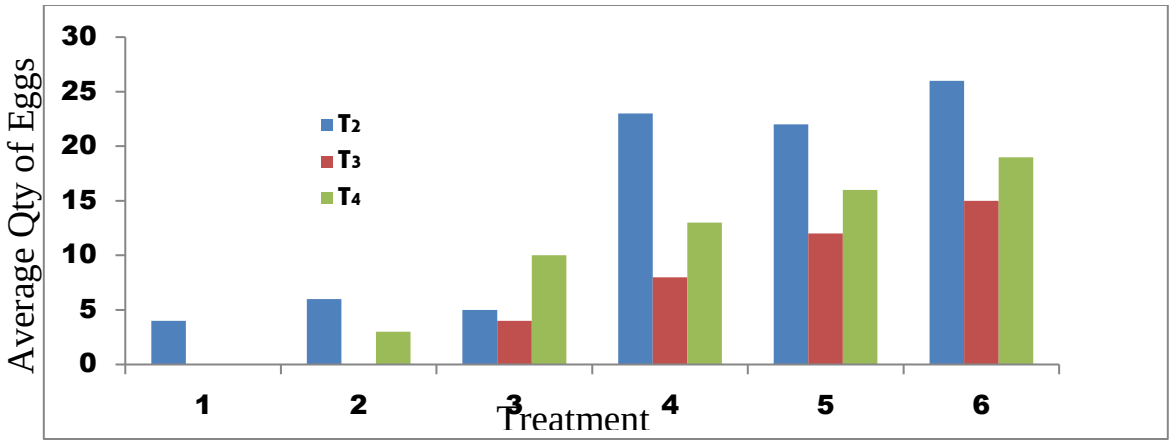

Figure 16: Average Quantity of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

Data presented in Figure 16 (Appendix 34, Page 278) shows that layers fed with 2.5% *Moringa oleifera* leaf powder (T2) produced the highest average number of eggs when compared with other layers that received different inclusion rates of *Moringa oleifera* leaf powder. Similarly, layers that received 5% *Moringa oleifera* leaf powder (T3) produced less number of egg in comparison with others that received different inclusion rates of *Moringa oleifera* leaf powder. The figure further shows that layers in T2 started egg production earlier than layers in other treatment groups, then followed by layers in T4 and lastly by layers in T3.

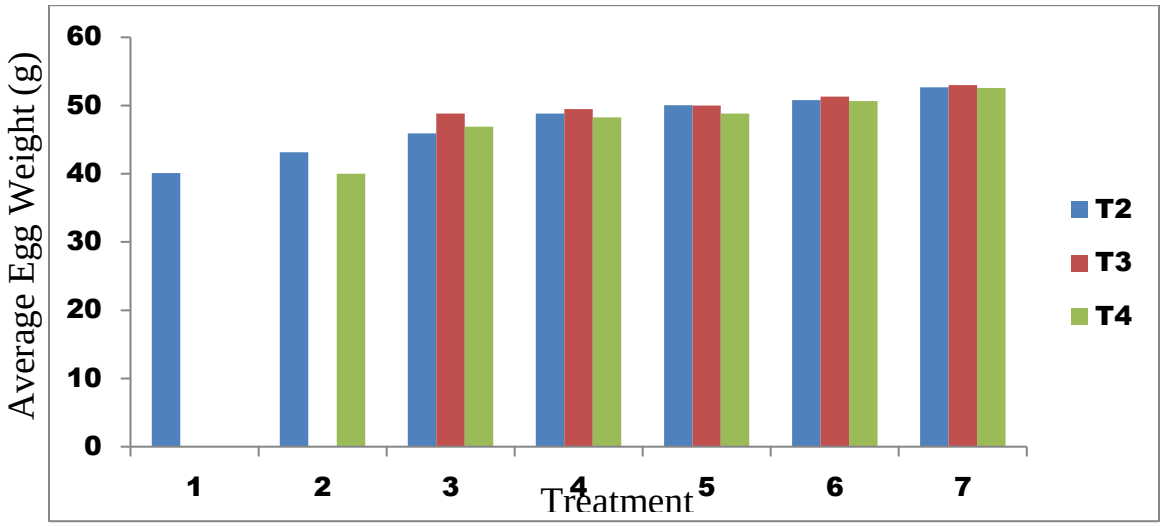

Figure 17: Average Egg Weight of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

On the average weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 17 shows that layers fed with 5% *Moringa oleifera* leaf powder (T3) had the highest average egg weight than layers in other treatment groups in weeks 3, 4, 6 and 7 respectively (Appendix 35, Page 278). Similarly, layers received 2.5% *Moringa oleifera* leaf powder (T2) produced eggs with highest egg weight in weeks 2 and 5 when compared with other layers that received different inclusion rates of *Moringa oleifera* leaf powder. The figure further shows that layers in T4 produced eggs with the least average egg weight in relation to other layers that received different inclusion rates of *Moringa oleifera* leaf powder

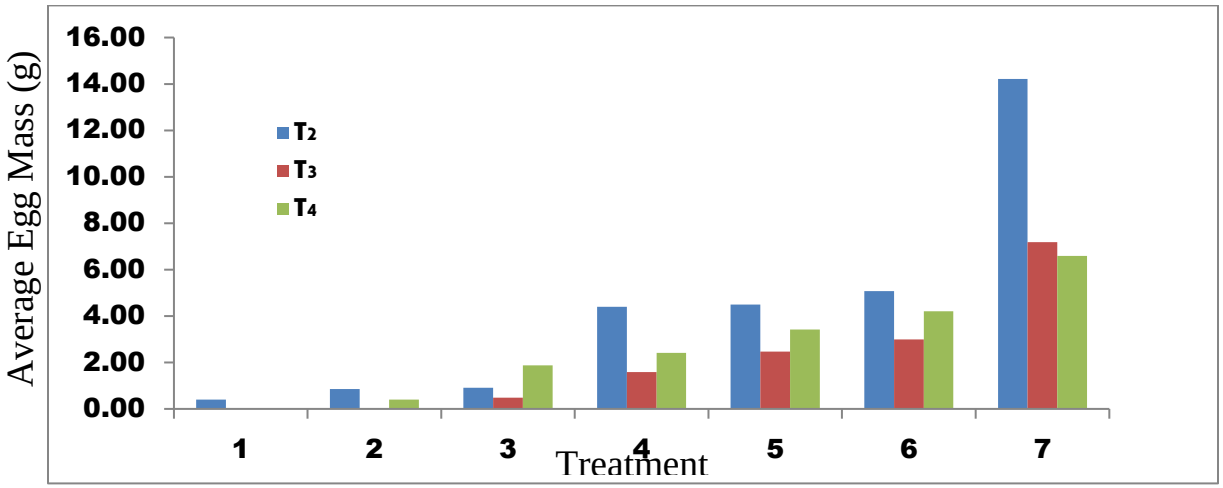

Figure 18: Average Egg Mass of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

On the average egg mass of the layers received different inclusion rates of *Moringa oleifera* leaf powder, Figure 18 (Appendix 36, Page 278) shows that layers that received 2.5% *Moringa oleifera* leaf powder (T2) recorded the highest average egg mass in all the weeks when compared with other layers received different inclusion rates of *Moringa oleifera* leaf powder. Similarly, layers received 5% *Moringa oleifera* leaf powder (T3) recorded the least average egg mass in relation to layers in other treatment groups.

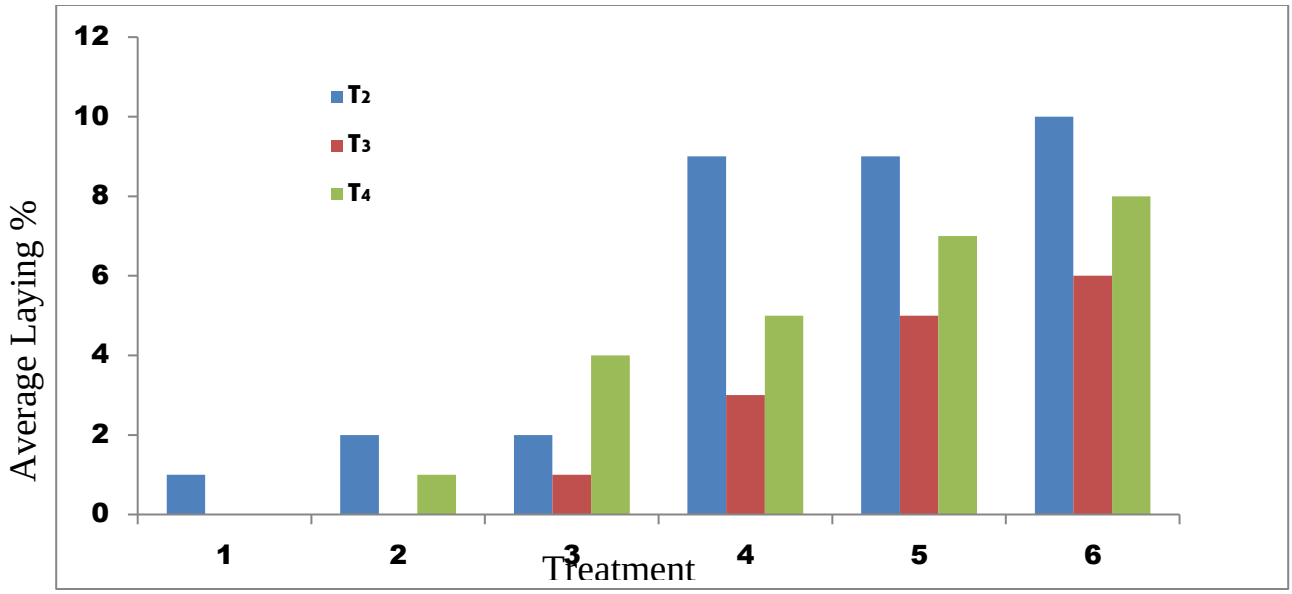

Figure 19: Average Laying Percentage of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

Data presented in Figure 19 (Appendix 37, Page 278) shows the average laying percentage of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Layers fed with 2.5% *Moringa oleifera* leaf powder (T2) had the highest average laying percentage in relation to other layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Similarly, layers received 5% *Moringa oleifera* leaf powder (T3) consistently had the least average laying percentage when compared with other layers fed with different inclusion rates of *Moringa oleifera* leaf powder.

Hypothesis 4: There is no significant difference in the Mean egg production of layers fed with different inclusion rates of *Moringa oleifera* leaf powder

Data for testing hypothesis 4 are presented in the tables 16 – 19.

Table 16: ANOVA Analysis of the Average Quantity of eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	184.333	2	92.167	1.377	.282
Within Groups	1003.667	15	66.911		
Total	1188.000	17			

Data presented in Table 16 shows that the probability value of the table was 0.282 which was greater than 0.05. This implies that there was no significant difference in the average quantity of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Hence, the hypothesis of no significant difference was upheld for the variable.

Table 17: ANOVA Analysis of the Average Egg Weight of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	445.914	2	222.957	.687	.516
Within Groups	5840.915	18	324.495		
Total	6286.830	20			

The ANOVA analysis of the average egg weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder presented in Table 17 shows that the probability value was 0.516 which was greater than 0.05. This implies that there was no significant difference in the average egg weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Therefore, the null hypothesis was accepted.

Table 18: ANOVA Analysis of the Average Egg Mass of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18.741	2	9.370	.814	.459
Within Groups	207.316	18	11.518		
Total	226.057	20			

On the average egg mass of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Table 18 reveals that the probability value was 0.459 which was greater than 0.05. This implies that there was no significant difference in the average egg mass of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Therefore, the hypothesis of no significant was accepted.

Table 19: ANOVA Analysis of the Average Laying Percentage of Layers Fed with Different Inclusion Rates of Moringa oleifera Leaf Powder

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	27.111	2	13.556	1.170	.337
Within Groups	173.833	15	11.589		
Total	200.944	17			

Table 19 on the ANOVA analysis of the average laying percentage of layers fed with different inclusion rates of *Moringa oleifera* leaf powder show that the probability value was 0.337 which was greater than 0.05. This indicated that there was no significant difference in the average laying percentage of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Hence, the null hypothesis was upheld for this variable.

Research Question 5: What are the effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the nutritive value of eggs produced by the layers?

Data presented in the figures below are used to answer research question 5.

Proximate Analysis of the eggs

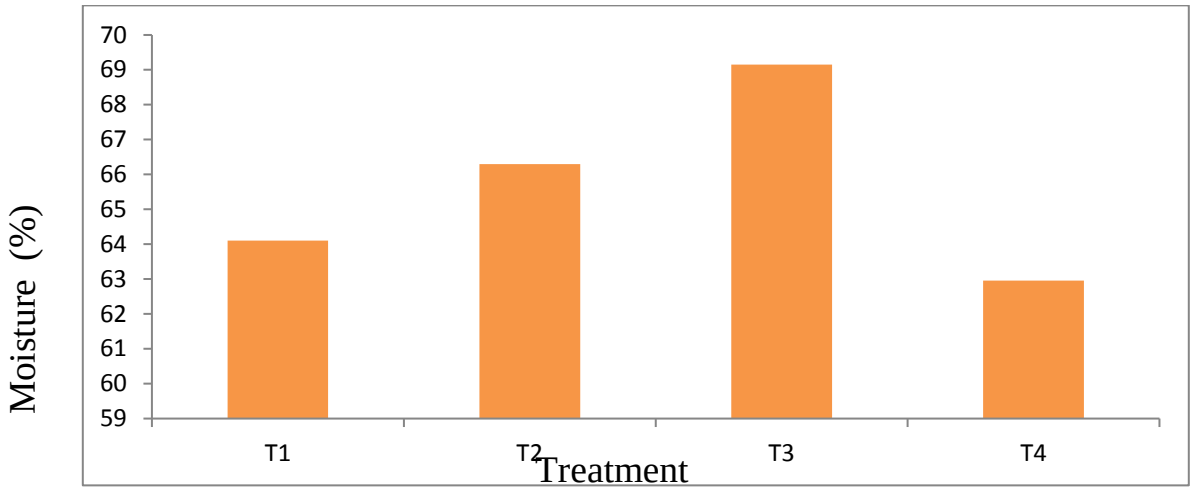

Figure 20: Bar Chart Analysis of the Moisture Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 20 (Appendix 38, Page 279) show that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) have the highest amount of moisture (69.15%) when compared with others. Similarly, the figure shows that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the lowest moisture content (62.69%) in relation to others. The moisture content of eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (T1) was higher than the moisture content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) but lesser than the moisture content of eggs produced by layers fed with 2.5% and 5% *Moringa oleifera* leaf powder fortified feeds (T2 & T3) respectively. T3 therfore had the highest quantity of moisture content.

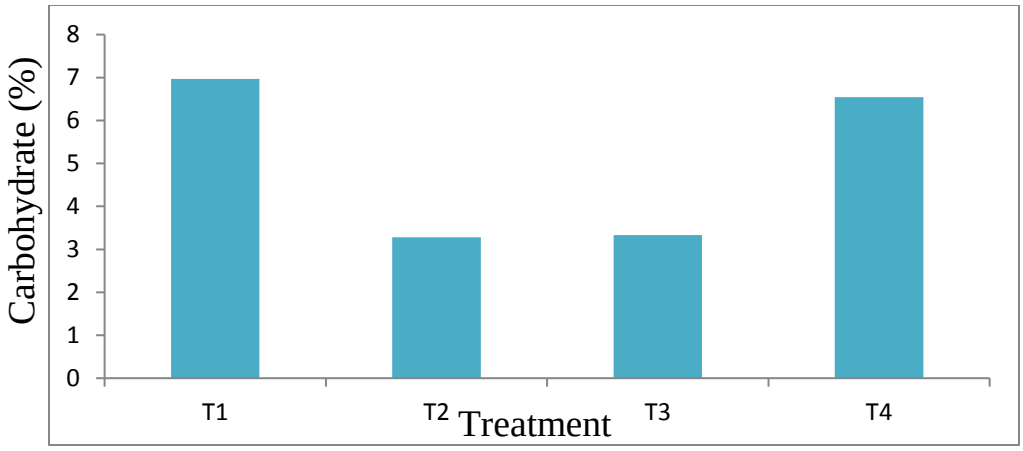

Figure 21: Bar Chart Analysis of the Carbohydrate Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 21 (Appendix 39, Page 279) reveals that eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (T1) had greatest amount of carbohydrate (6.97%) when compared with other eggs produced by layers that received *Moringa oleifera* leaf powder fortified feeds. Furthermore, the figure indicates that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder (T2) had the least amount of carbohydrate (3.28%) when compared with others

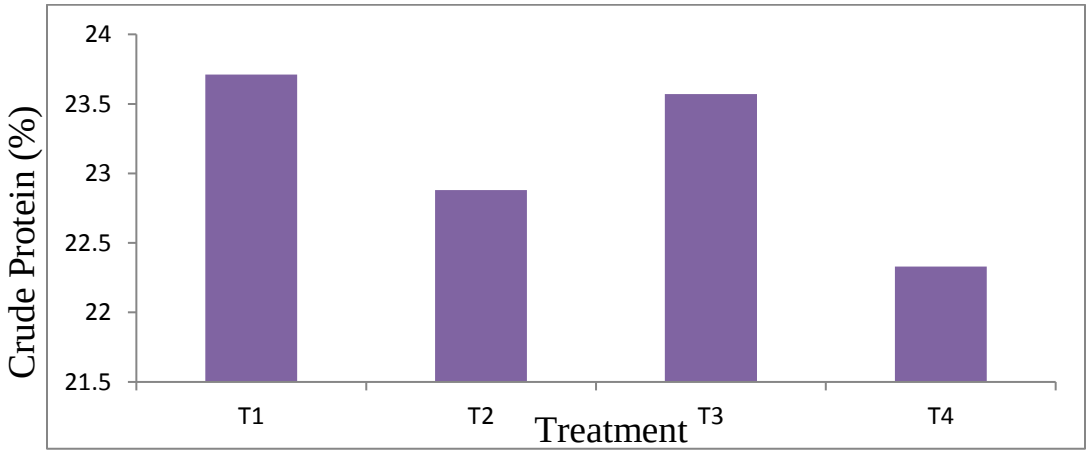

Figure 22: Bar Chart Analysis of the Crude Protein Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the crude protein content of eggs, Figure 22 (Appendix 40, Page 279) shows that eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (T1) had the highest amount (23.71%) when compared with the eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds. Similarly, eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the lowest amount of crude protein (22.33%) in relation to others

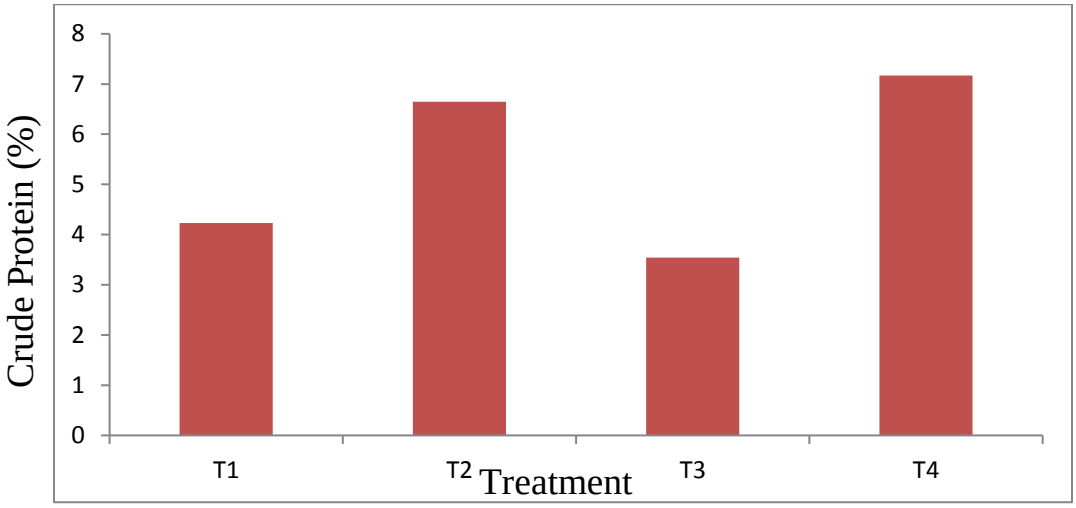

Figure 23: Bar Chart Analysis of the Crude Lipids Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Information presented in Figure 23 (Appendix 41, Page 279) indicated that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the lowest amount of crude fat (3.54%) when compared with others. Furthermore, the figure above shows that the crude fat content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) was the highest (7.17%) when compared with others. Eggs produced by the control group (T1) had more crude fat content (4.23%) than eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) but lesser

amount of crude fat content than the eggs produced by layers fed with 2.5% and 7.5% *Moringa oleifera* leaf powder fortified feeds (T2 & T4) respectively.

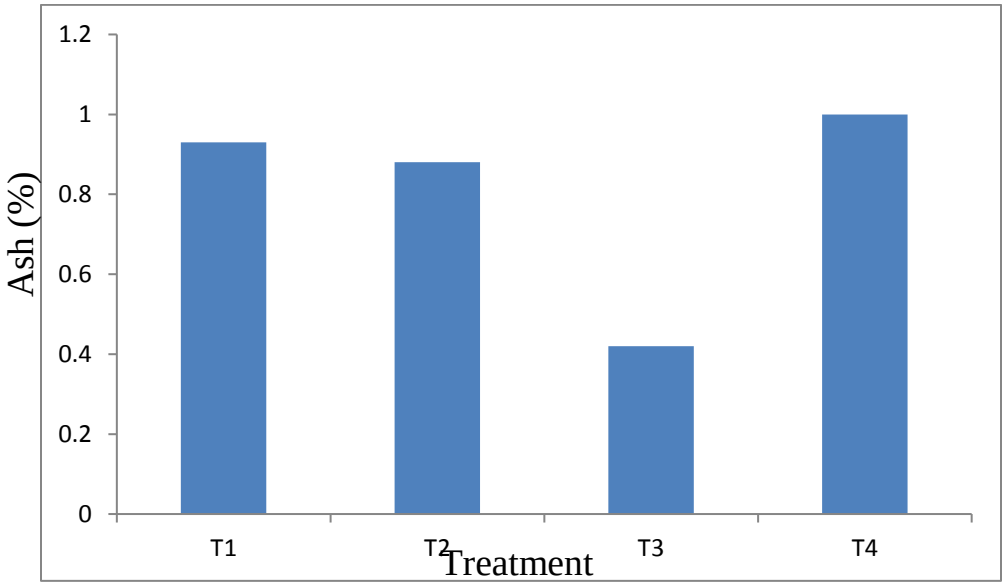

Figure 24: Bar Chart Analysis of the Ash Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the ash content of eggs, Figure 24 (Appendix 42, Page 279) shows that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the greatest amount (1.00%) when compared with others. The above information also indicates that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the lowest amount of ash in relation to others. Furthermore, the percentage ash content of eggs produced by the control group (T1) was greater (0.93%) than the percentage ash content of eggs produced by layers fed with 2.5% (0.88%) and 5% (0.42%) *Moringa oleifera* leaf powder fortified feeds (T2 & T3) respectively but less than the ash content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed.

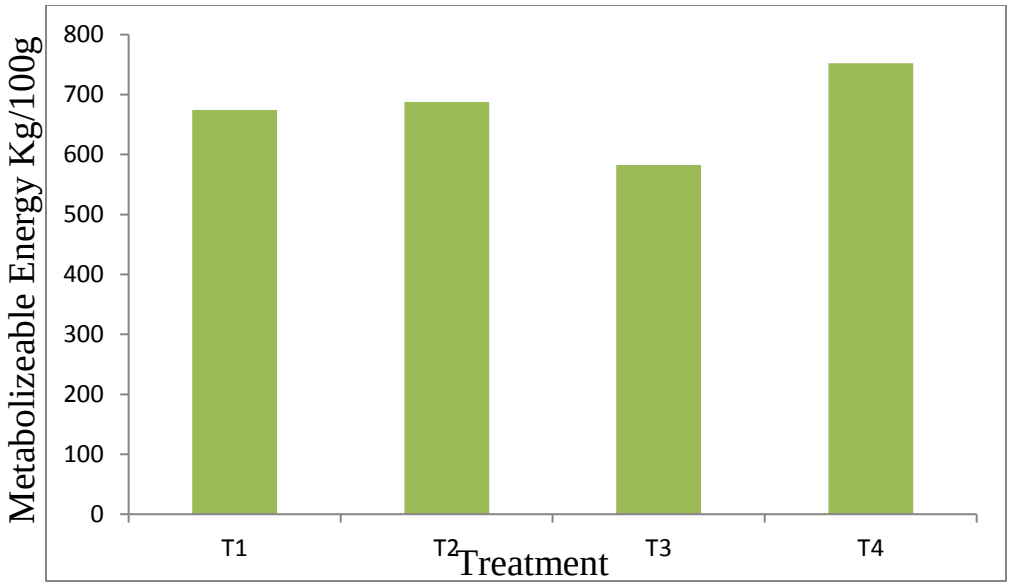

Figure 25: Bar Chart Analysis of the Metabolizeable Energy Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 25 (Appendix 43, Page 279) shows that the metabolizeable energy content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) was the highest (752.46 Kg/100g) when compared with others. Similarly, the metabolizeable energy content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) was the lowest (582.72 Kg/100g) in relation to others. Furthermore, the above figure shows that the metabolizeable energy content of eggs produced by the control group (T1) (674.25 Kg/100g) was greater than the metabolizeable energy content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) (582.72 Kg/100g) but lesser than the metabolizeable energy content of eggs produced by layers fed with 2.5% and 7.5% *Moringa oleifera* leaf powder fortified feed (T2 & T4) (687.74 Kg/100g & 752.46 Kg/100g) respectively. Eggs produced by T4 treatment group therefore had the highest amount of Metabolizeable energy.

Vitamin Profile

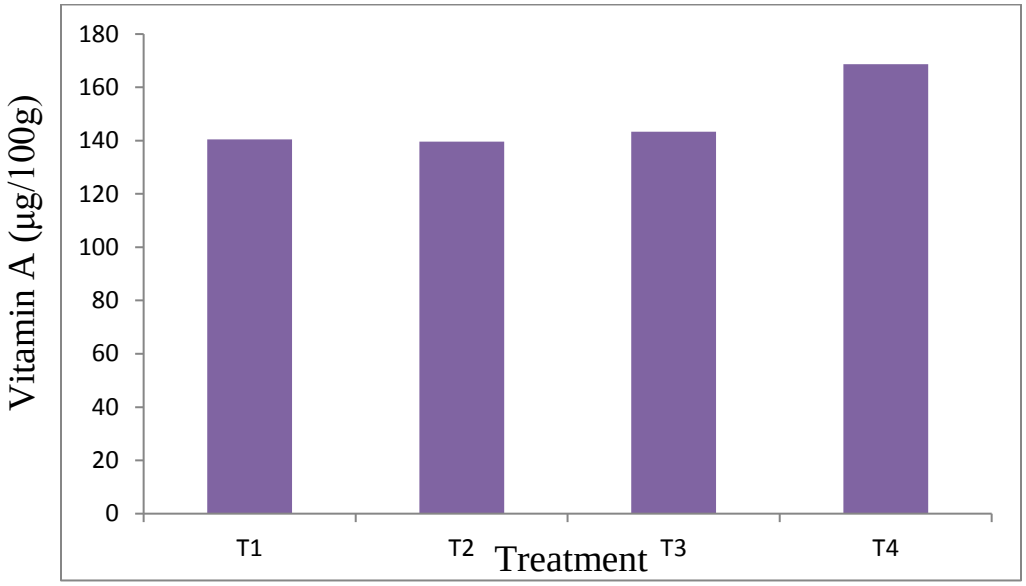

Figure 26: Bar Chart Analysis of the Vitamin A Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Vitamin A content of eggs, the data in Figure 26 (Appendix 44, Page 279) reveals that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) was the highest (168.66µg/100g) when compared with the rest of the groups. Furthermore, the figure shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the lowest Vitamin A value of 139.57µg/100g. Egg produced by layers fed with no *Moringa oleifera* leaf powder (T1) had the Vitamin A value of 140.45µg/100g which was less than the Vitamin A content of eggs produced by layers fed with 5% and 7.5% *Moringa oleifera* leaf powder fortified feeds (143.32µg/100g and 168.66µg/100g) respectively. T4 therefore, had the highest amount of Vitamin A.

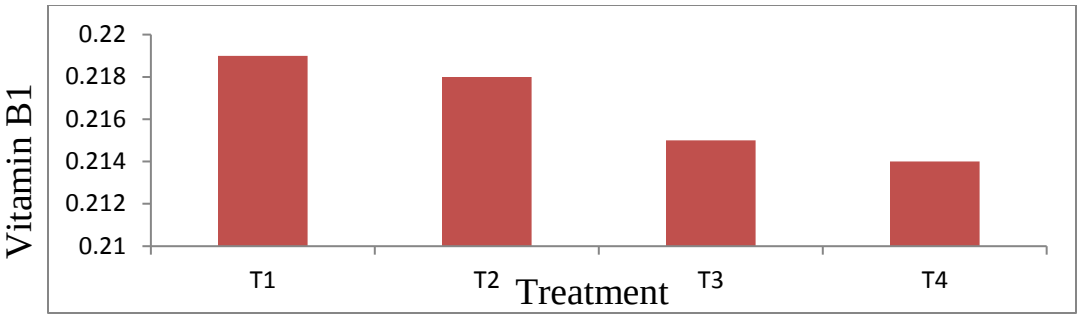

Figure 27: Bar Chart Analysis of the Vitamin B1 Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data in Figure 27 (Appendix 45, Page 280) shows that eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (T1) had the highest Vitamin B1 content (0.219µg/100g) than the eggs produced by layers fed with 2.5%, 5% and 7.5% *Moringa oleifera* leaf powder fortified feeds (T2, T3 & T4) (0.218µg/100g, 0.215µg/100g & 0.214µg/100g) respectively. Similarly, the information in the above figure reveals that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the lowest Vitamin B1 value (0.214µg/100g) when compared to others.

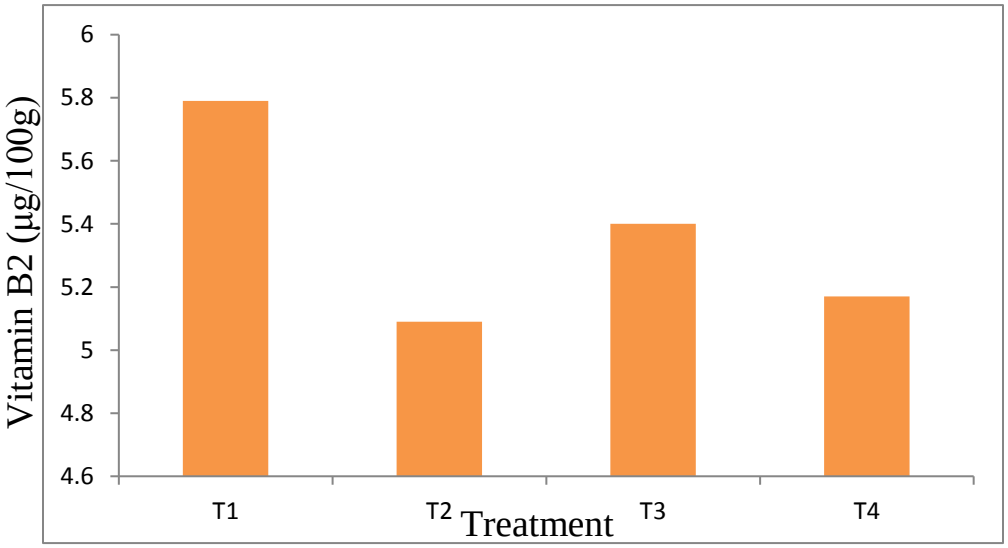

Figure 28: Bar Chart Analysis of the Vitamin B2 Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Vitamin B2 content of eggs, Figure 28 (Appendix 46, Page 280) indicates that eggs produced by the control group (T1) had the highest value of 5.79µg/100g when compared with the others. Similarly, the figure shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the lowest Vitamin B2 value of 5.09µg/100g.

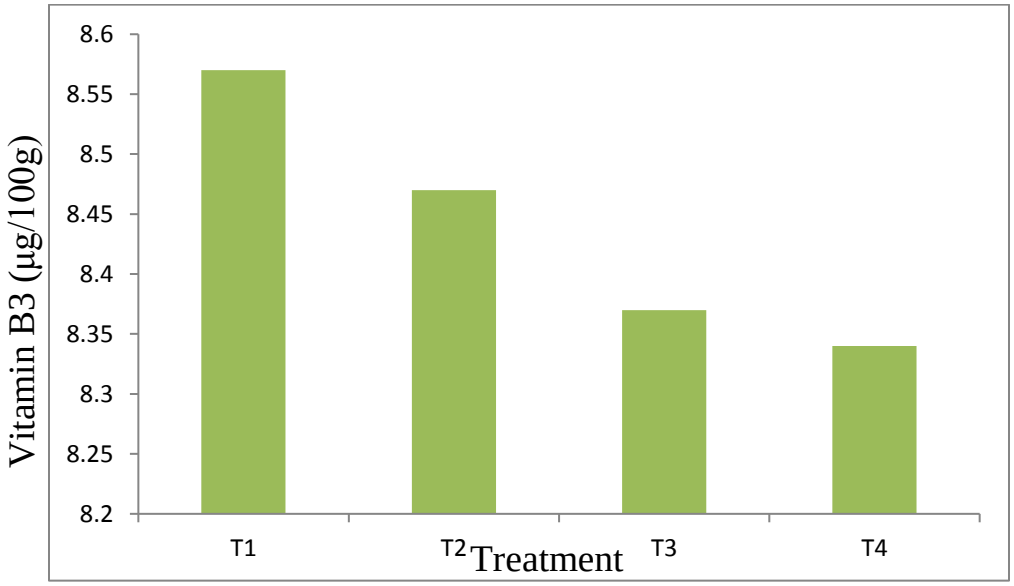

Figure 29: Bar Chart Analysis of the Vitamin B3 Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 29 (Appendix 47, Page 280) indicates that eggs produced by layers received feed fortified with no *Moringa oleifera* leaf powder (T1) had the highest Vitamin B3 content of 8.57µg/100g than eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds (T2, T3, & T4). Furthermore, eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) produced the least amount of Vitamin B3 (8.34µg/100g) when compared to others.

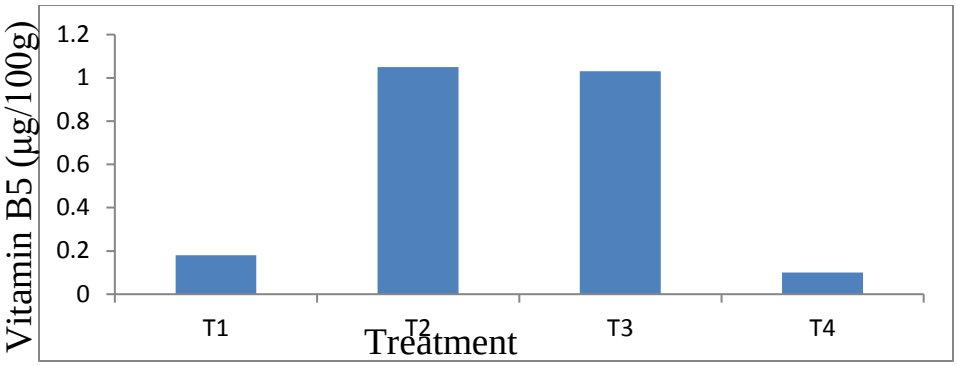

Figure 30: Bar Chart Analysis of the Vitamin B5 Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Data on the Vitamin B5 content of eggs presented in Figure 30 (Appendix 48, Page 280) above reveals that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the highest value of 1.05µg/100g when compared to others. Similarly, eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the lowest Vitamin B5 content in relation to others. Vitamin B5 contained in eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (0.18µg/100g) was lower than that contained in eggs produced by layers fed with 2.5% and 5% *Moringa oleifera* fortified feeds (T2 & T3) (1.05µg/100g & 1.03µg/100g) respectively.

Figure 31: Pie Chart Analysis of the Vitamin C Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 31 (Appendix 49, Page 280) shows that eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (T1) had the highest Vitamin C content (0.27µg/100g) when compared with eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds (T2, T3 & T4) (0.13µg/100g, 0.07µg/100g & 0.13µg/100g). Moreover, the figure above reveals that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the lowest Vitamin C value (0.07µg/100g). Therefore, eggs produced by T1 treatment group contained the highest amount of Vitamin C.

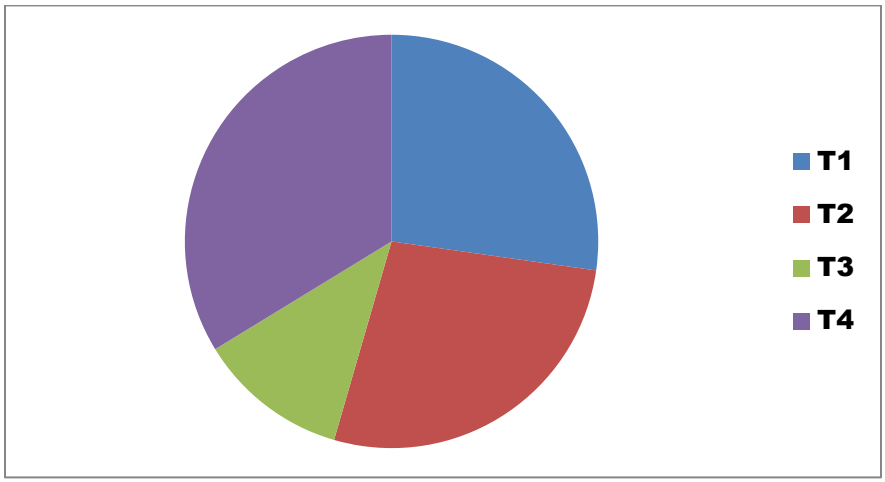

Figure 32: Pie Chart Analysis of the Vitamin D Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Vitamin D content of eggs presented in Figure 32 (Appendix 50, Page 280), eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the highest value (3.12µg/100g) when compared to eggs produced by the other groups. Similarly, data in the same figure reveals that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed had the lowest Vitamin D value (1.09µg/100g). The Vitamin D content of eggs produced by layers fed with control feed (T1) was the same as

contained in eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) (2.52µg/100g) but higher than the Vitamin D content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) (1.09µg/100g).

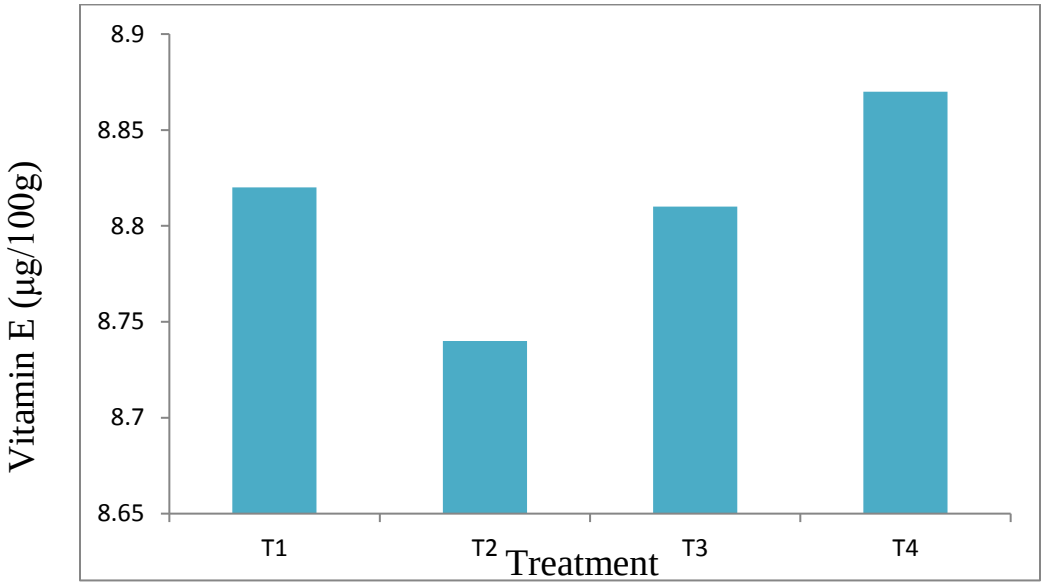

Figure 33: Bar Chart Analysis of the Vitamin E Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 33 (Appendix 51, Page 278) shows that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the highest Vitamin E value of 8.87µg/100g when compared to eggs produced by layers fed with other groups of feed (T1, T2 & T3). Similarly, eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the lowest Vitamin E value (8.74µg/100g) in relation to others. Eggs produced by layers in control group (T1) had Vitamin E content (8.82µg/100g) lower than that contained in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) (8.87µg/100g) and higher than eggs produced by layers fed with 2.5% and 5% *Moringa oleifera* leaf powder fortified feeds (T2 & T3) (8.74µg/100g & 8.81µg/100g).

Minerals

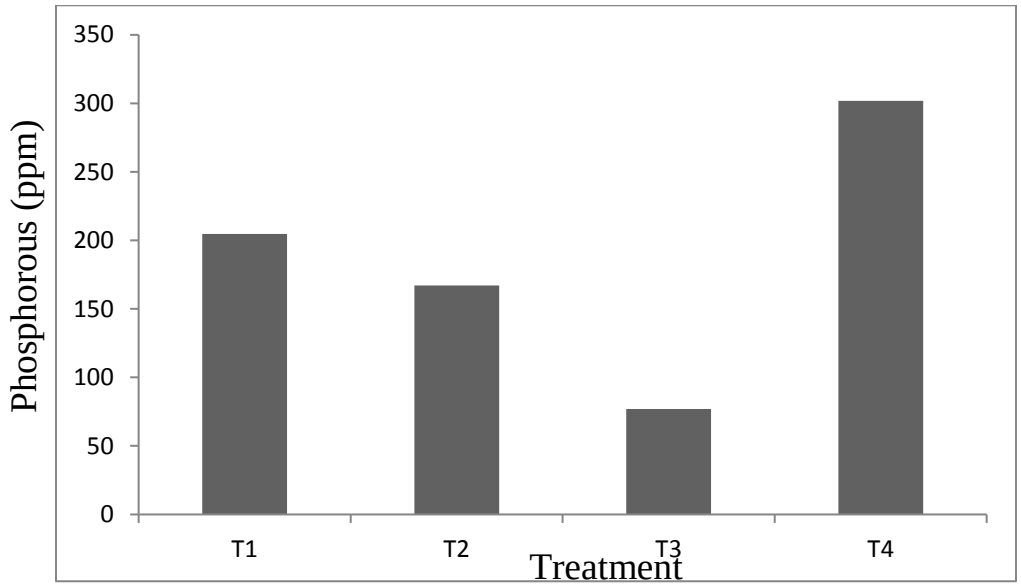

Figure 34: Bar Chart Analysis of the Phosphorous (P) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Phosphorous (P) content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, Figure 34 (Appendix 52, Page 281) shows that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the highest value of 301.95ppm. The figure further shows that the phosphorous content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed was the least when compared with eggs produced by the layers in other groups. The phosphorous content of eggs produced by layers in control group (T1) (204.69ppm) was higher than those produced by layers fed with 2.5% and 5% *Moringa oleifera* leaf powder fortified feeds (T2 &T3) (167.03ppm & 76.90ppm) respectively but lower than that produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) (301.95ppm).

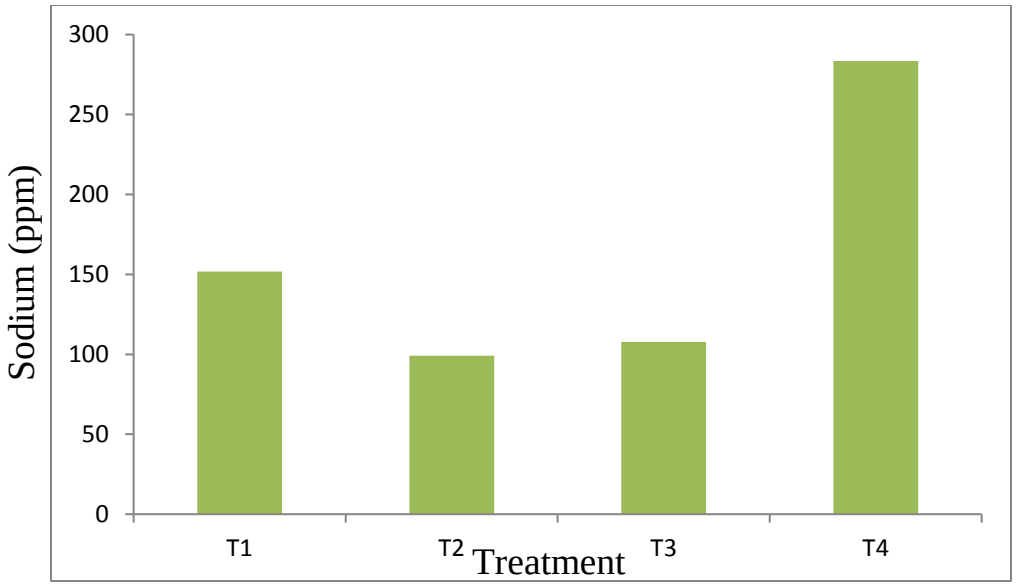

Figure 35: Bar Chart Analysis of the Sodium (Na) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 35 (Appendix 53, Page 281) above reveals that the Sodium (Na) content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the highest value of 283.43ppm when compared with others. The figure further shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the least Sodium content (99.17ppm) in relation to others. Similarly, the Sodium content of eggs produced by layers fed with control feed (151.74ppm) was lower that the Sodium content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (283.43ppm) but higher that the Sodium content of eggs produced by layers fed with 2.5% and 5% *Moringa oleifera* leaf powder fortified feeds (T2 & T3) (99.17ppm & 107.69ppm).

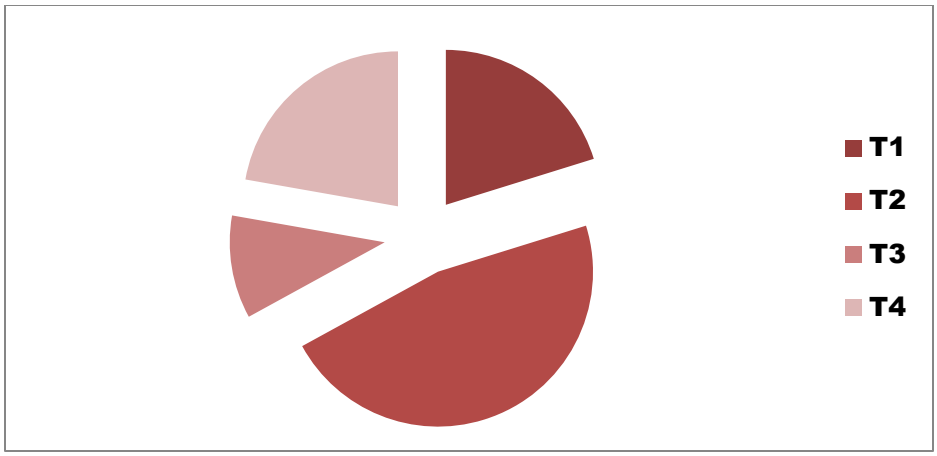

Figure 36: Pie Chart Analysis of the Magnesium (Mg) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 36 (Appendix 54, Page 281) indicates that the magnesium (Mg) content of eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the highest value of 37.97ppm when compared to others. The figure further reveals that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the least magnesium content in comparison with others eggs. The magnesium content of eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (T1) (16.38ppm) was higher than the magnesium content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) (8.72) and lower than the magnesium content of eggs produced by layers fed with 2.5% and 7.5% *Moringa oleifera* leaf powder fortified feeds (T2 & T4) (37.97ppm & 18.03ppm)

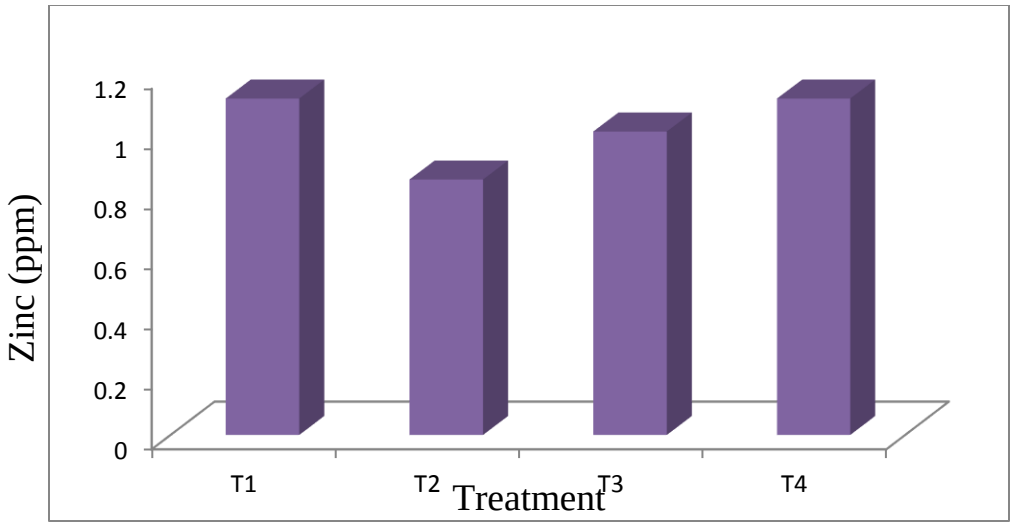

Figure 37: Bar Chart Analysis of the Zinc (Zn) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Zinc content of eggs, Figure 37 (Appendix 55, Page 281) shows that eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (T1) and eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the highest value of 1.12ppm each. Similarly, the figure also shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the least amount of Zinc.

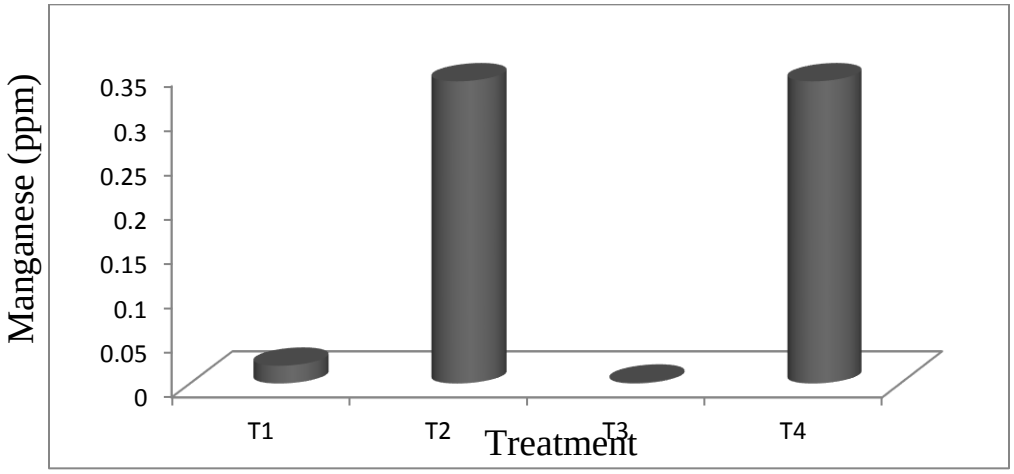

Figure 38: Bar Chart Analysis of the Manganese (Mn) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Data presented in Figure 38 (Appendix 56, Page 281) indicates that eggs produced by layers fed with 2.5% (T2) and 7.5% (T4) *Moringa oleifera* leaf powder fortified feeds had the highest amount of Manganese content (0.34ppm each). The Manganese content of the eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) (0.001ppm) was very insignificant. Moreover, the Manganese content of eggs produced by layers in control group (T1) was lesser (0.02ppm) than the Manganese content of eggs produced by layers fed with 2.5% (T2) and 7.5% (T4) *Moringa oleifera* leaf powder fortified feeds but higher than the Manganese content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed(T3).

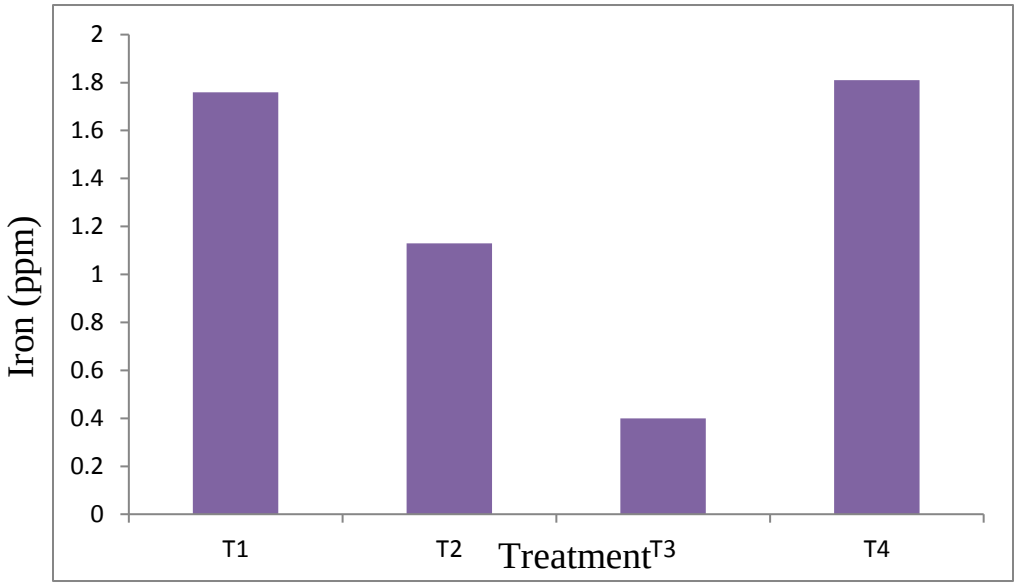

Figure 39: Bar Chart Analysis of the Iron (Fe) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Iron content of eggs, Figure 39 (Appendix 57, Page 281) reveals that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the highest value of 1.81ppm in relation to other eggs. Furthermore, the figure shows that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the least

value of Iron content (0.40ppm). The Iron content of eggs produced by layers in control group (T1) (1.76ppm) was higher than the Iron content of eggs produced by layers fed with 2.5% (1.13ppm) and 5% (0.40ppm) *Moringa oleifera* leaf powder fortified feeds but lesser than the Iron content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) (1.81ppm).

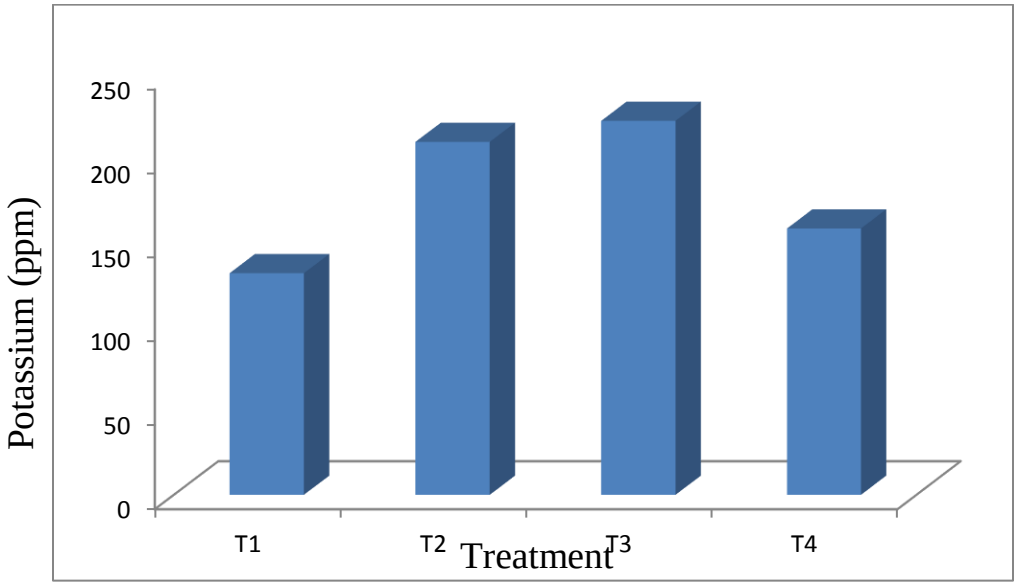

Figure 40: Bar Chart Analysis of the Potassium (K) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Data presented in Figure 40 (Appendix 58, Page 282) reveals that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the highest Potassium content (222.76ppm) than other eggs. Similarly, the figure shows that eggs produced by layers in control group had the least potassium value (123.01ppm) in relation to other eggs.

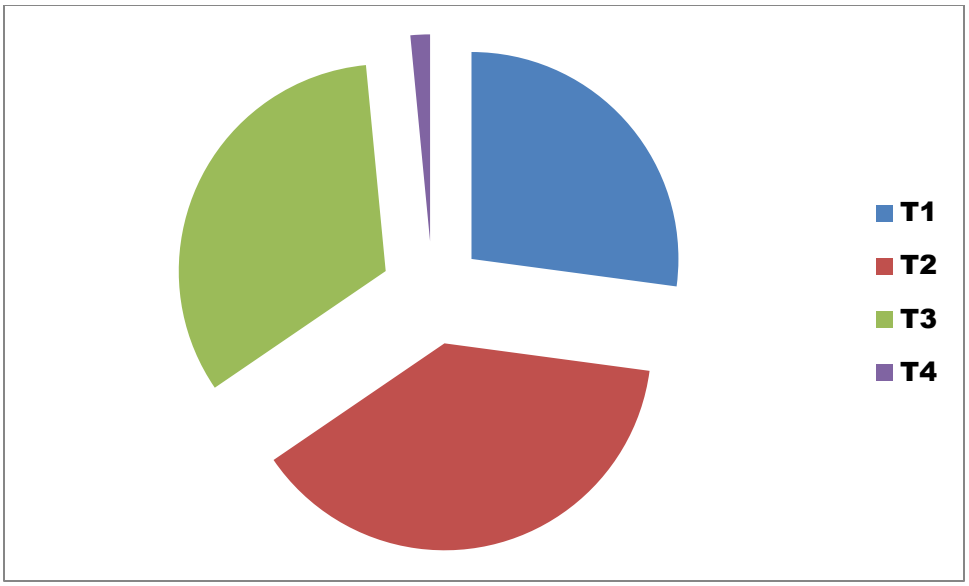

Figure 41: Pie Chart Analysis of the Calcium (Ca) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the calcium content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, Figure 41 (Appendix 59, Page 282) shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) dominated the other eggs (96.79ppm). Moreover, the calcium content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed had the least value of 3.85ppm. The calcium content of eggs produced by layers in control group (T1) (68.47ppm) was lesser than the calcium content of eggs produced by layers fed with 2.5% (T2) (96.79ppm) and 5% (T3) (83.32ppm) *Moringa oleifera* leaf powder fortified feeds but higher than calcium content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) (3.85ppm).

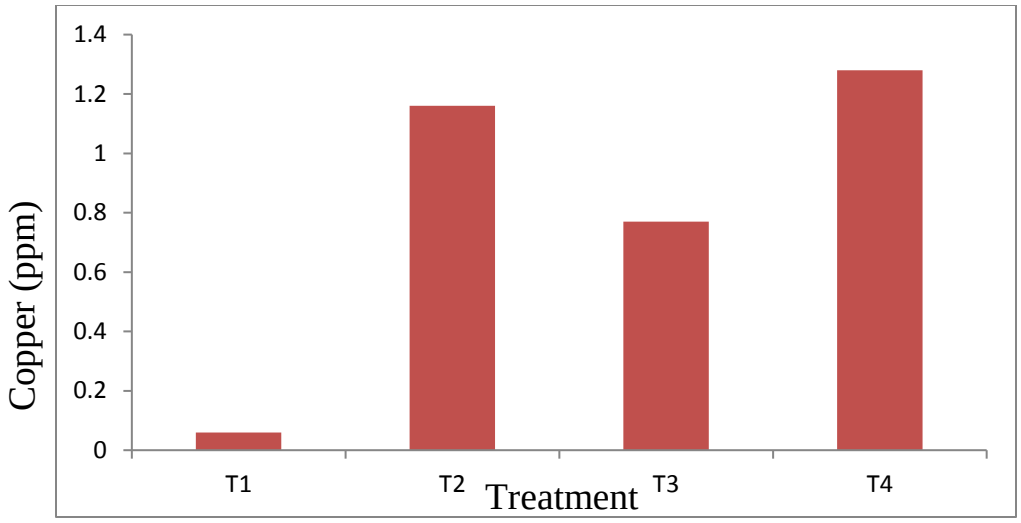

Figure 42: Bar Chart Analysis of the Copper (Cu) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

According to the data presented in Figure 42 (Appendix 60, Page 282), eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the highest amount of Copper content (1.28ppm) in comparison to other eggs. Furthermore, the figure reveals that eggs produced by layers fed with control feed (T1) had insignificant Copper content value of 0.06ppm which was the least of all the copper contents of the entire groups.

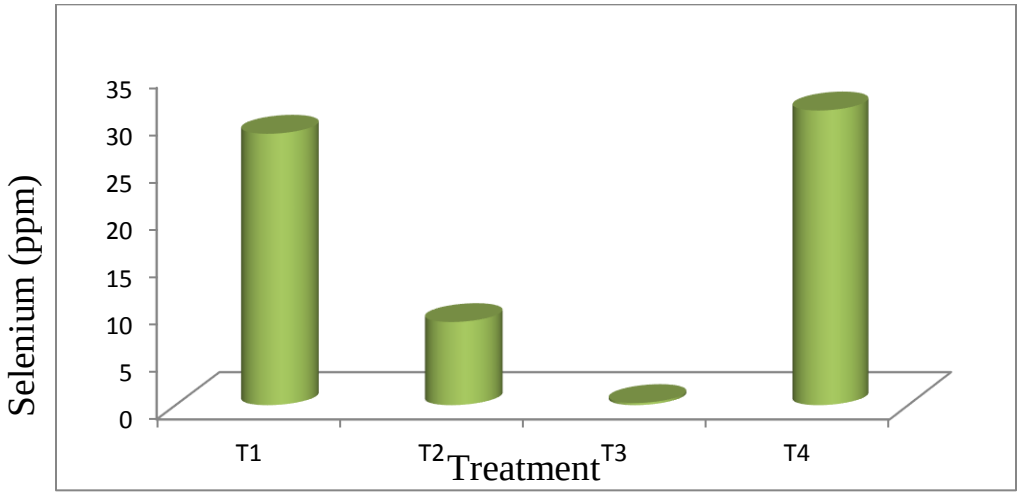

Figure 43: Bar Chart Analysis of the Selenium (Se) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

According to the information presented in Figure 43 (Appendix 61, Page 282), the Selenium content of eggs (31.11µg/100g) produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) was the highest of all the other eggs. The eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the least Selenium content of 0.23µg/100g. Similarly, the Selenium content of eggs produced by layers fed with control feed (T1) (28.66µg/100g) was higher than the Selenium content of eggs produced by layers fed with 2.5% and 5% *Moringa oleifera* leaf powder fortified feed but lesser than the Selenium content of eggs produced by layer fed with 7.5% *Moringa oleifera* leaf powder fortified feed.

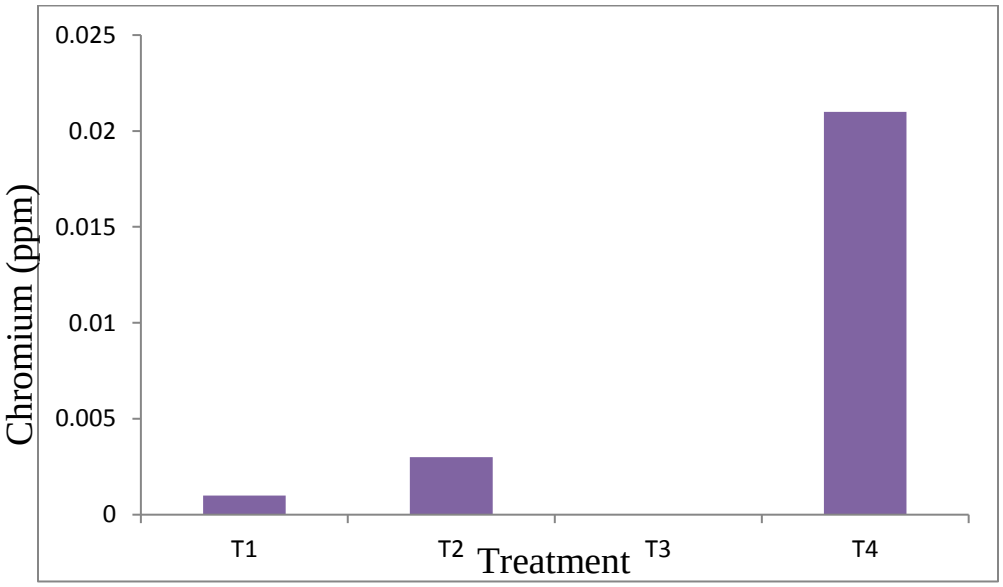

Figure 44: Bar Chart Analysis of the Chromium (Cr) Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Chromium content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with the control feed, Figure 44 (Appendix 62, Page 282) shows that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed

(T4) had the dominant value of 0.021µg/100g when compared to others. The same figure shows that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) did not contain Chromium at all. The chromium content of eggs produced by layers fed with control feed (T1) was very low (0.001µg/100g) and much lower than those produced by layers fed with 2.5% and 7.5% *Moringa oleifera* leaf powder fortified feeds.

Amino Acids Profile

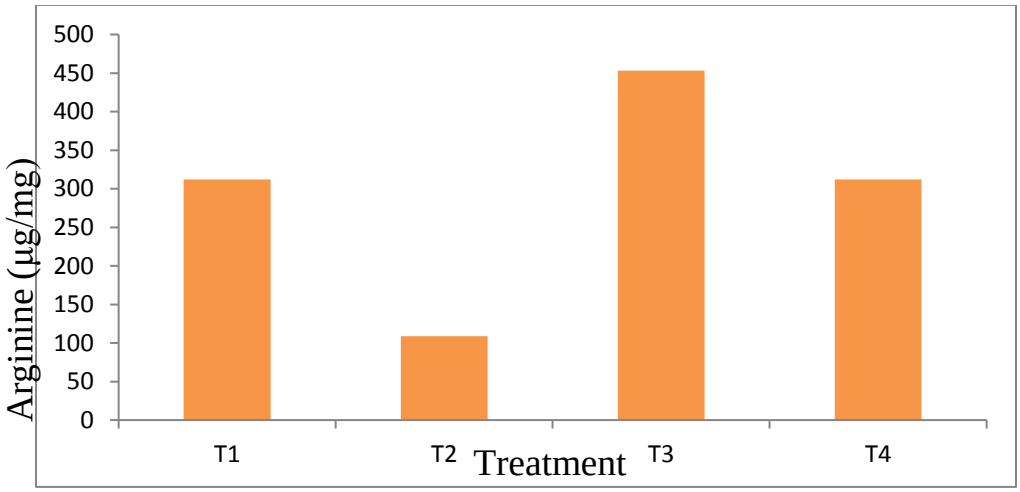

Figure 45: Bar Chart Analysis of the Arginine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Information presented in Figure 45 (Appendix 63, Page 282) reveals that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed had the Arginine content of 453.02µg/mg representing the highest value when compared with the Arginine content of other eggs. Furthermore, the figure shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the lowest Arginine content value of 108.67µg/mg in relation to others. Similarly, the Arginine content of eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed was 312.04µg/mg, and this was greater than the Arginine content of eggs produced by layers fed with 2.5% and 7.5%

Moringa oleifera leaf powder fortified feeds but lower than the Arginine content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed.

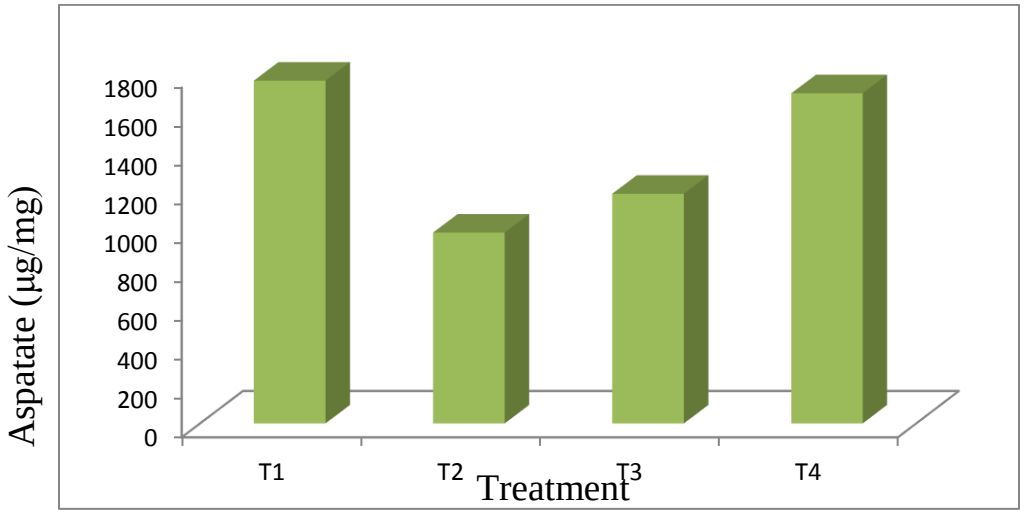

Figure 46: Bar Chart Analysis of the Aspartate Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Aspartate content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, Figure 46 (Appendix 64, Page 282) shows that eggs produced by layers fed with control feed (T1) had the highest value. Similarly, the figure indicated that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) recorded the lowest result

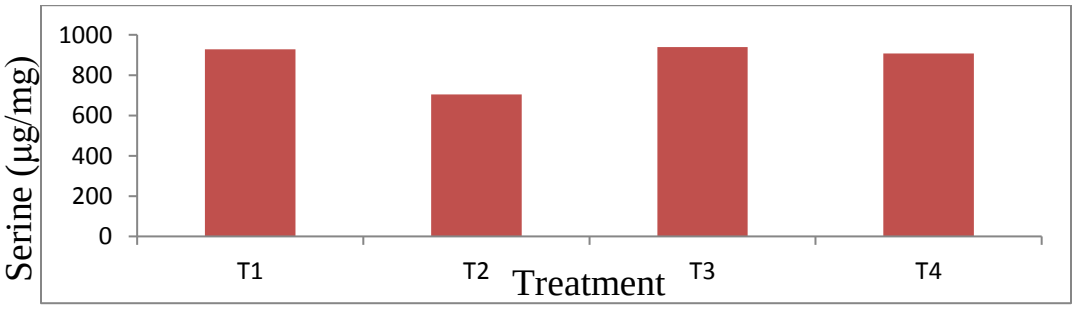

Figure 47: Bar Chart Analysis of the Serine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Data presented in Figure 47 (Appendix 65, Page 283) reveals that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the highest Serine content value of 938.73µg/mg when compared to other eggs. The figure further shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the least Serine content when compared to others. Eggs produced by layers fed with control feed had the Serine content value of 928µg/mg which was greater than the Serine content of eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) (704.66µg/mg) and 7.5% *Moringa oleifera* leaf powder fortified feed (T4) (906.65µg/mg) but lesser than the Serine content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) (938.73µg/mg).

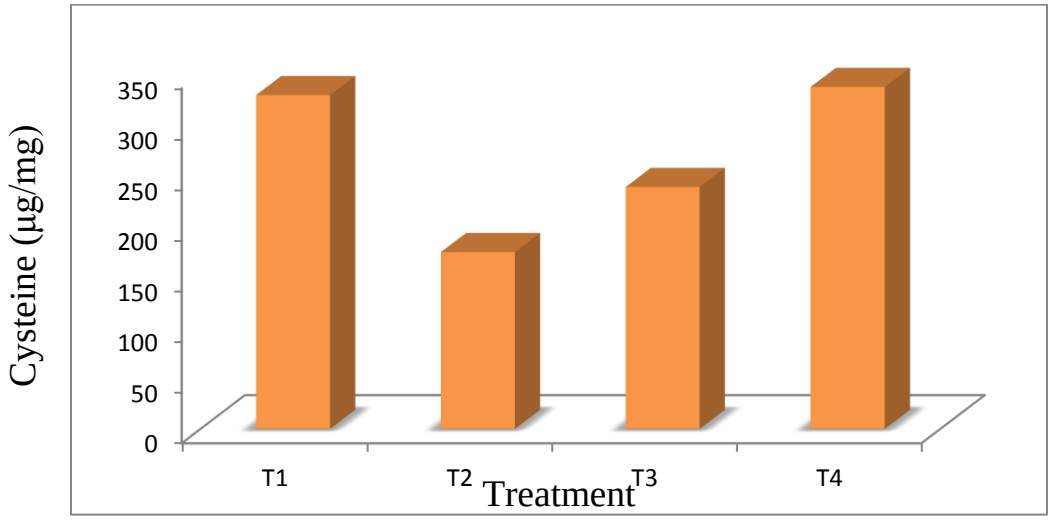

Figure 48: Bar Chart Analysis of the Cysteine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the highest Cysteine content value of 337.02µg/mg when compared with other eggs (Figure 48, Appendix 66, Page 283). The figure also reveals that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the least Cysteine content

value of 173.99µg/mg. Similarly, eggs produced by layers fed with control feed (T1) had the Cysteine content of 329.05µg/mg which is greater than the cysteine content of eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) (173.99µg/mg) and eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) (238.32µg/mg)

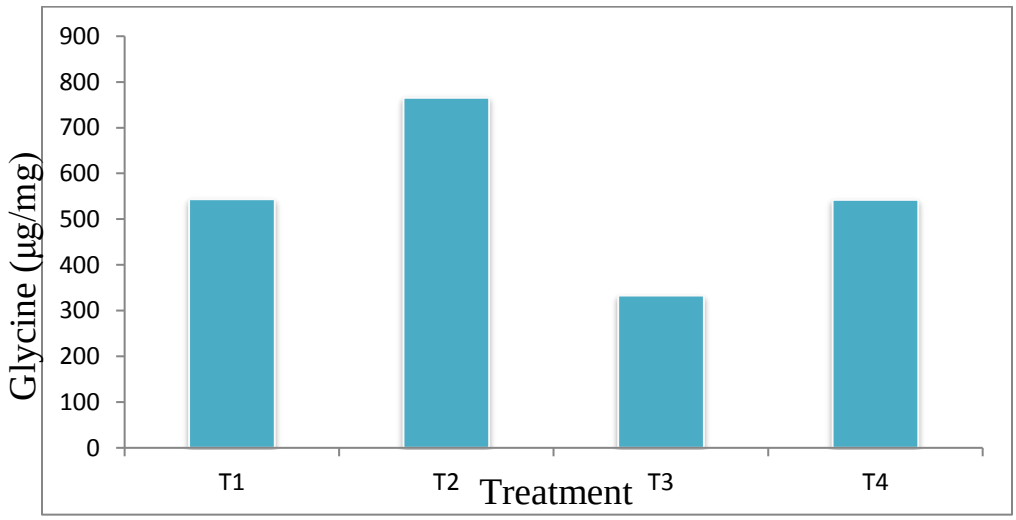

Figure 49: Bar Chart Analysis of the Glycine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Glycine content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, Figure 49 (Appendix 67, Page 283) shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the highest value of 765.37µg/mg followed by eggs produced by layers fed with control feed. The figure further reveals that the Glycine content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the least value

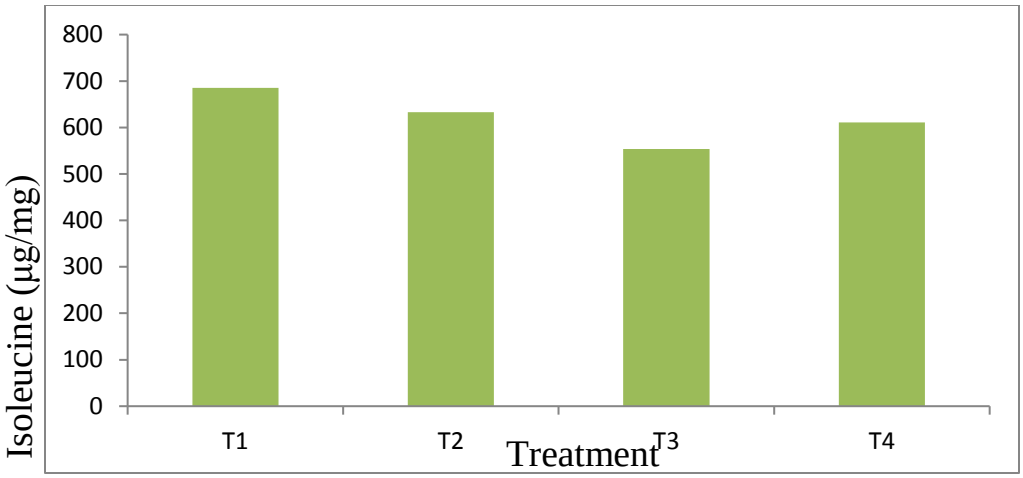

Figure 50: Bar Chart Analysis of the Isoleucine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 50 (Appendix 68, Page 283) shows that eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (T1) had the Isoleucine content of 685.34µg/mg which was the highest when compared to other eggs. Similarly, eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the least Isoleucine content value (533.43µg/mg) when compared to others.

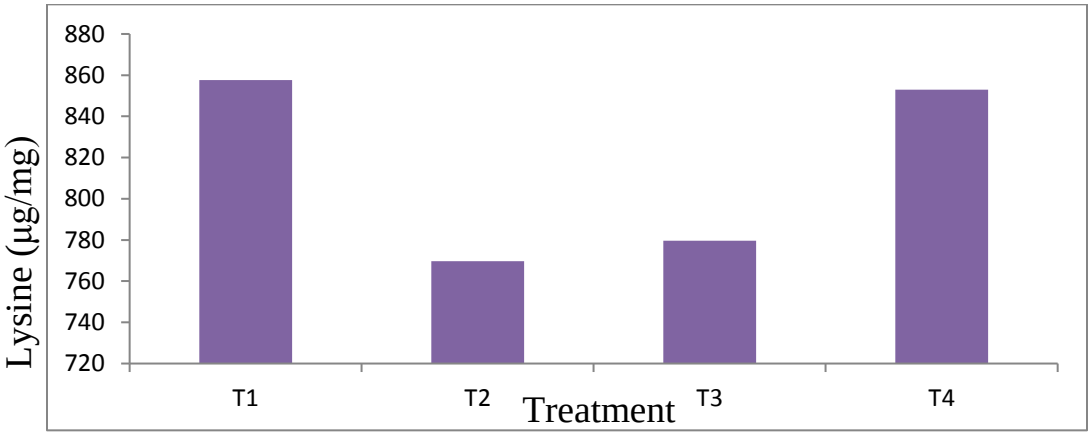

Figure 51: Bar Chart Analysis of the Lysine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 51 (Appendix 69, Page 283) reveals that the Lysine content of eggs produced by layers fed with control feed (T1) recorded the highest value of 857.67µg/mg and followed by the eggs fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) which had the Lysine content value of 852.89µg/mg. The figure further shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) recorded the least Lysine content value of 769.75µg/mg and followed by eggs fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) which recorded the Lysine content value of 779.66µg/mg.

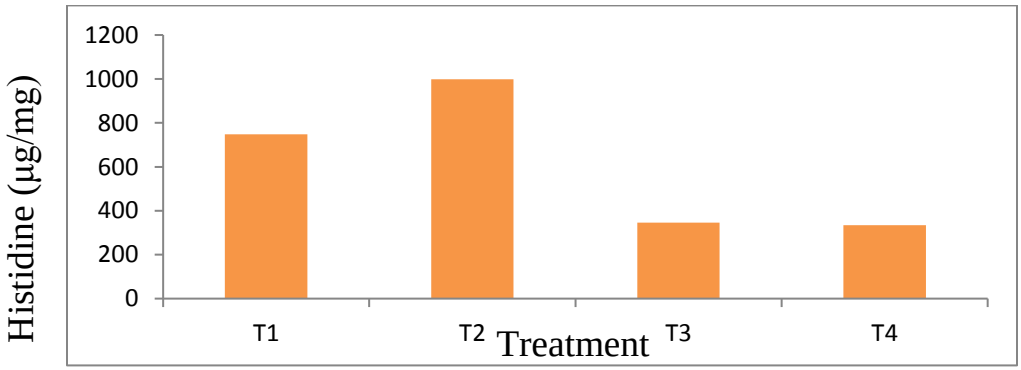

Figure 52: Bar Chart Analysis of the Histidine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Histidine content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, Figure 52 (Appendix 70, Page 283) shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the highest value of 998.41µg/mg. The figure also shows that the Histidine content of eggs produced by layers fed with control feed (T1) had the value of 748.38µg/mg which was greater than the Histidine content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) (345.50µg/mg) and eggs produced by layers fed with 7.5%

Moringa oleifera leaf powder fortified feed (T4) which had the Histidine content of 344.13µg/mg.

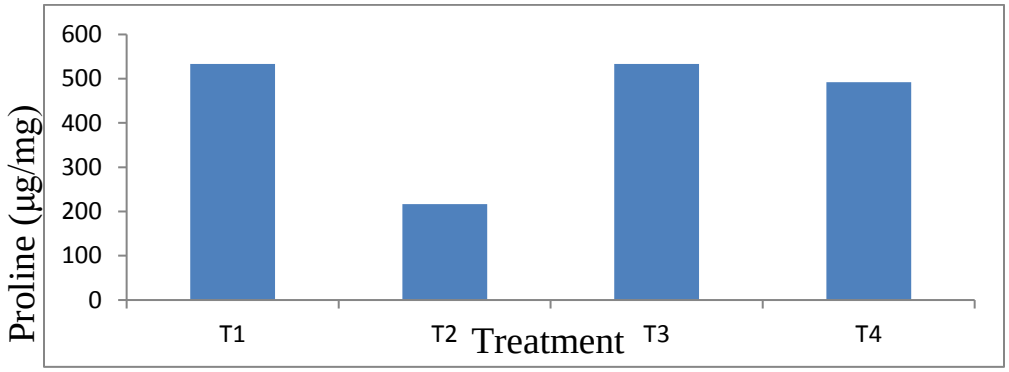

Figure 53: Bar Chart Analysis of the Proline Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Figure 53 (Appendix 71, Page 283) reveals that the Proline content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the highest value of 533.58µg/mg and slightly higher than the Proline content of eggs produced by layers fed with control feed (T1) which had the value of 533.39µg/mg. Similarly, eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the least Proline content value of 217.05µg/mg

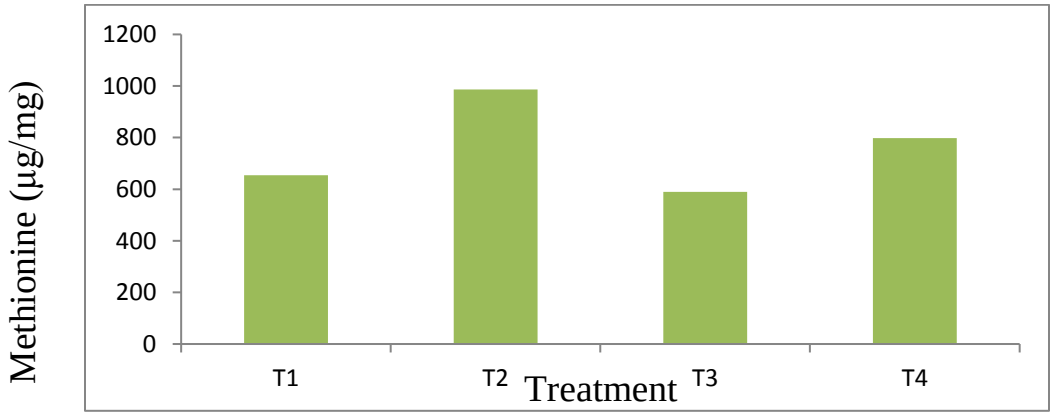

Figure 54: Bar Chart Analysis of the Methionine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Methionine content of eggs, Figure 54 (Appendix 72, Page 284) reveals that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) recorded the highest value (986.07µg/mg) when compared to other eggs. Similarly, the figure indicates that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the least Methionine content value of 589.33µg/mg. The Methionine content of eggs in control group (T1) was 654.20µg/mg which was lesser than the Methionine content of eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) (986.07µg/mg) and the Methionine content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) (798.32µg/mg).

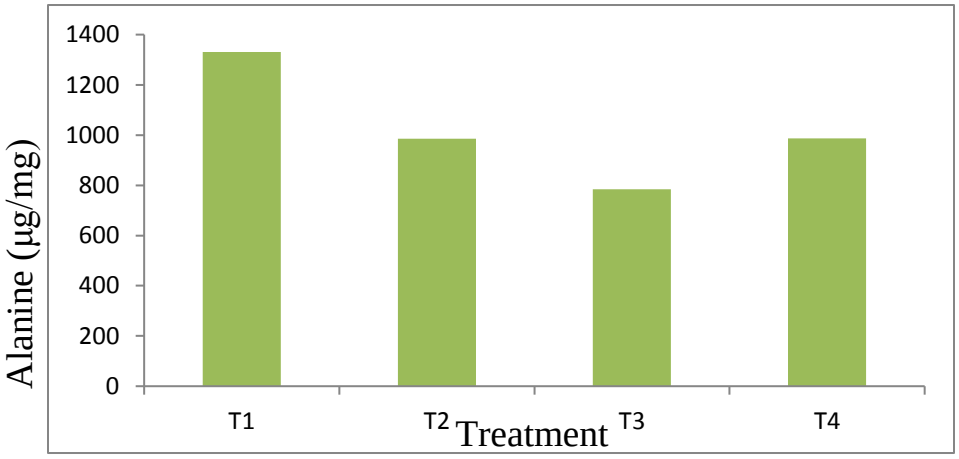

Figure 55: Bar Chart Analysis of the Alanine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Information presented in Figure 55 (Appendix 73, Page 284) shows that eggs produced by layers fed with control feed (T1) had the highest Alanine content value of 1330.33µg/mg followed by eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) with the Alanine content value of 987.21µg/mg. Moreover, eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the least Alanine content value of 784.01µg/mg.

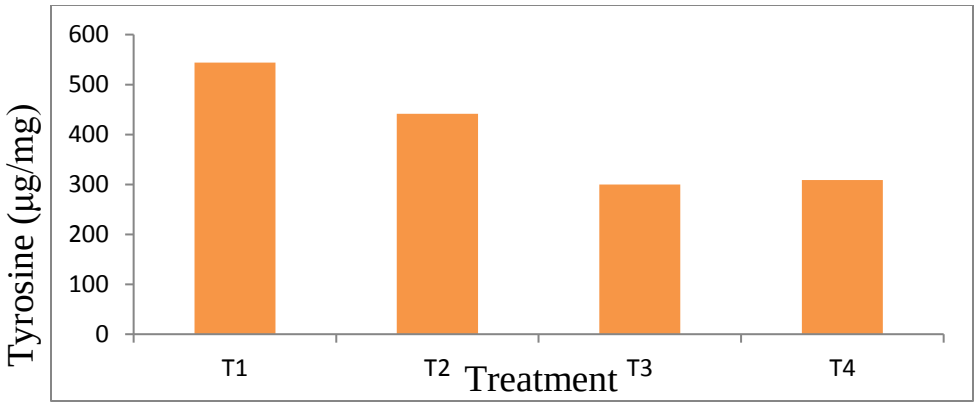

Figure 56: Bar Chart Analysis of the Tyrosine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the Tyrosine content of eggs, Figure 56 (Appendix 74, Page 284) reveals that eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed (T1) had the highest value of 543.91µg/mg followed by the eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) which recorded a value of 441.08µg/mg. According to the figure, eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) recorded the least Tyrosine content (299.87µg/mg) followed by eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) which had the Tyrosine content value of 308.04µg/mg.

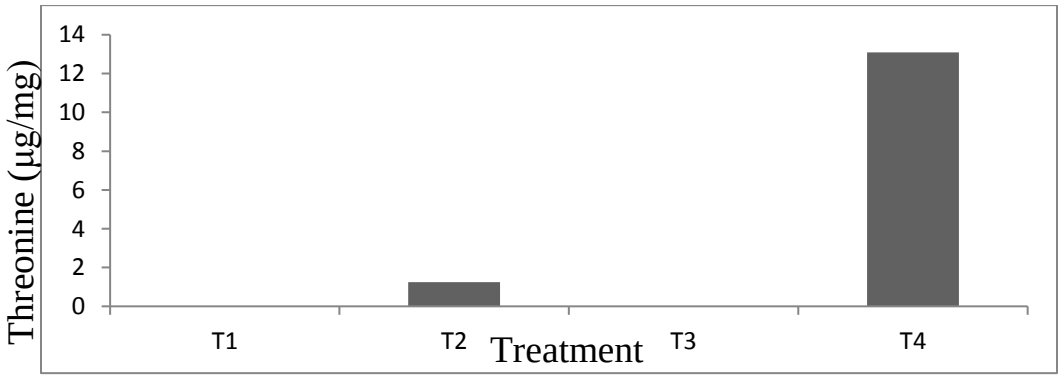

Figure 57: Bar Chart Analysis of the Threonine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Information in Figure 57 (Appendix 75, Page 284) indicates that eggs produced by layers fed with control feed (T1) and eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had no threonine which is one of the essential amino acids needed for protein formation. Similarly, the figure above showed that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) recorded threonine content value of 13.09µg/mg. A little amount of threonine (1.25µg/mg) was found in eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2).

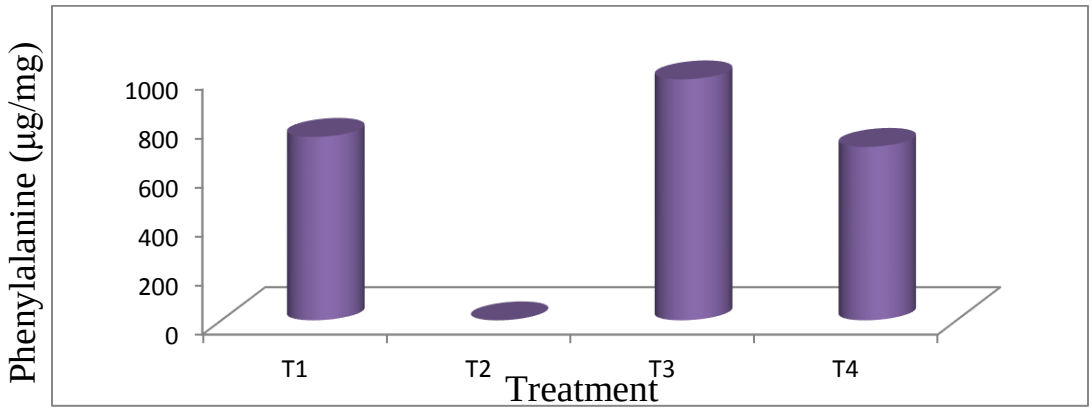

Figure 58: Bar Chart Analysis of the Phenylalanine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 58 (Appendix 76, Page 284) reveals that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the phenylalanine content value of 983.18µg/mg which was the highest value obtained among the treatment groups. Figure 57 also shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had approximately 0µg/mg phenylalanine content. Similarly, the phenylalanine content value of eggs produced by layers fed with control feed (T1) was 749.36µg/mg which was greater than the phenylalanine content of eggs produced by layers

fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) (708.63µg/mg) and those produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) (0µg/mg).

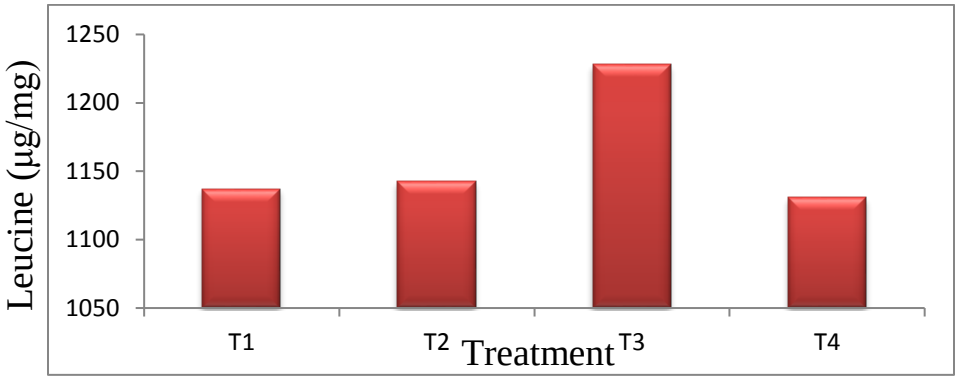

Figure 59: Bar Chart Analysis of the Leucine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

Figure 59 (Appendix 77, Page 284) shows that the leucine content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) was 1228.24µg/mg which was the highest value among the treatment groups. The figure further shows that T4 had the lowest leucine content of 1131.01µg/mg when compared to others. The leucine content of the control was 1137.05µg/mg which was lower than the leucine content of T2 and T3.

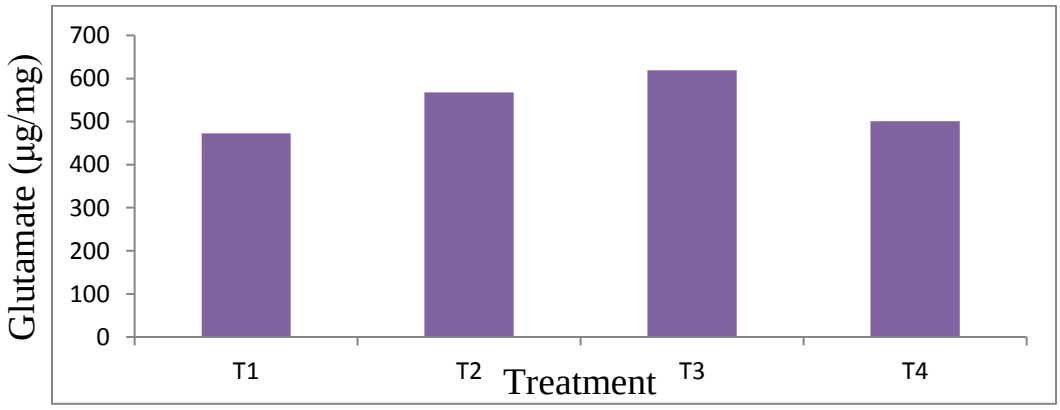

Figure 60: Bar Chart Analysis of the Glutamate Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the glutamate content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed, Figure 60 (Appendix 78, Page 284) shows that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the highest glutamate content of 619.05µg/mg followed by eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) which had the value of 567.98µg/mg. Similarly, eggs produced by layers fed with control feed (T1) had the least glutamate content of 473.01µg/mg and then followed by the glutamate content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) (501.04µg/mg).

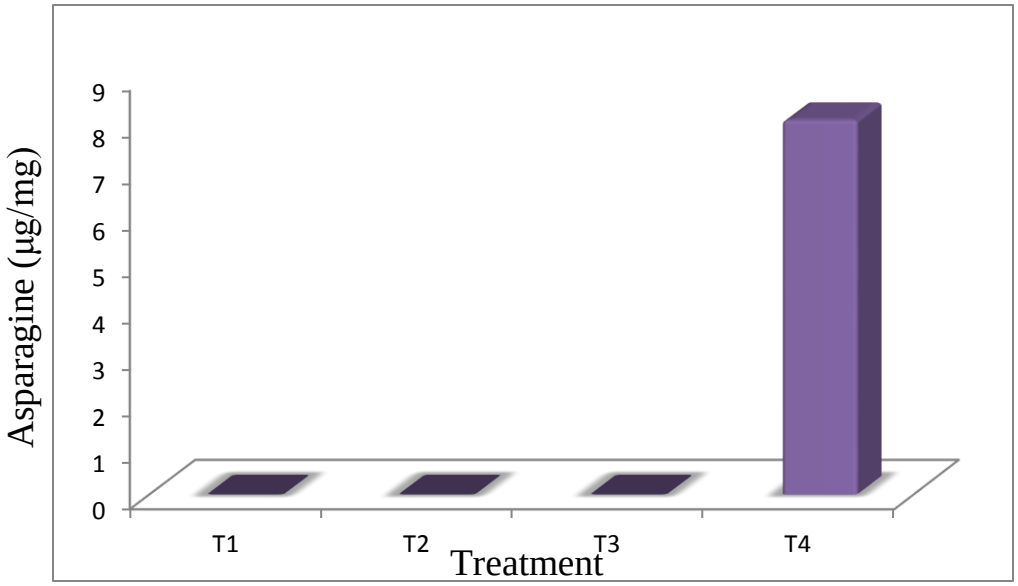

Figure 61: Bar Chart Analysis of the Asparagine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 61 (Appendix 79, Page 285) shows that in all the treatment groups, it was only the eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed that had Asparagine. According to the figure, the Asparagine content of

eggs produced by layers fed with 7.5% Moringa oleifera leaf powder fortified feed (T4) was 8.056µg/mg but the Asparagine content of T1, T2 and T3 was 0µg/mg.

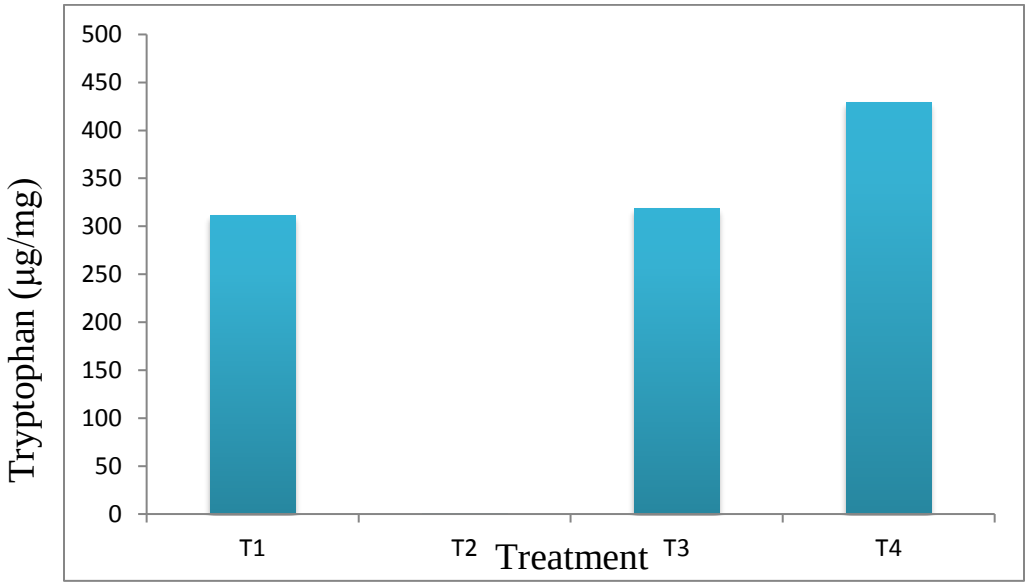

Figure 62: Bar Chart Analysis of the Tryptophan Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

On the tryptophan content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, Figure 62 (Appendix 80, Page 285) revealed that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) had the highest tryptophan content of 428.74µg/mg followed by the tryptophan content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) which had a value of 318.37µg/mg. Information presented in Figure 61 also showed that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the tryptophan content of 0.03µg/mg which is approximately 0µg/mg in relation to other eggs. The tryptophan content of the control group was 310.99µg/mg which was lesser than the tryptophan content of T3 and T4.

Figure 63: Pie Chart Analysis of the Valine Content of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 63 (Appendix 81, Page 285) showed that eggs produced by layers fed with control feed (T1) had the highest Valine content value of 840.24µg/mg and followed by the Valine content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) which had the value of 790.89µg/mg. The figure also showed that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the least Valine content of 260.05µg/mg when compared to others.

Lipid Parameters

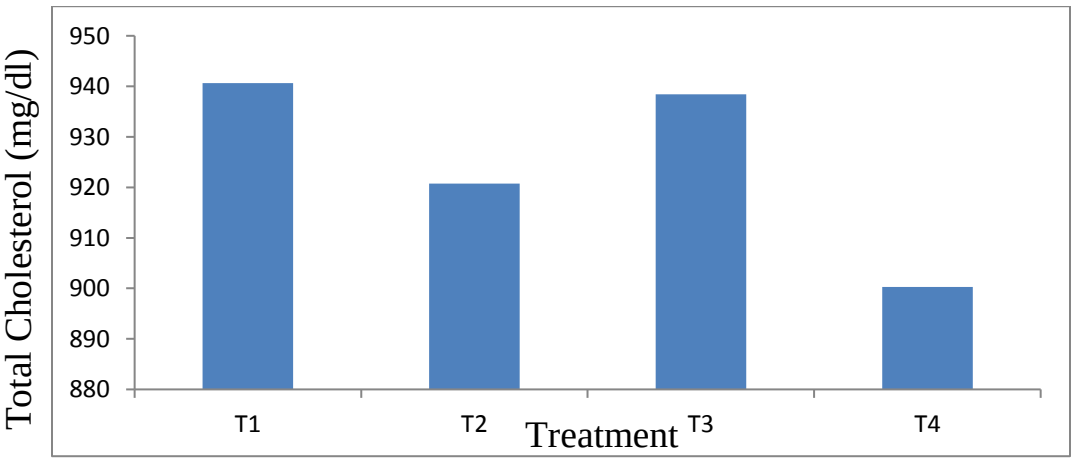

Figure 64: Bar Chart Analysis of Total Cholesterol Content of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 64 (Appendix 82, Page 285) on the total cholesterol content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed shows that eggs produced by layers fed with control feed (T1) contained the highest amount of total cholesterol (940.65 mg/dl) followed by eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) which had the total cholesterol content value of 938.41mg/dl. The study equally found the eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) contained the least amount of total cholesterol (900.28mg/dl)

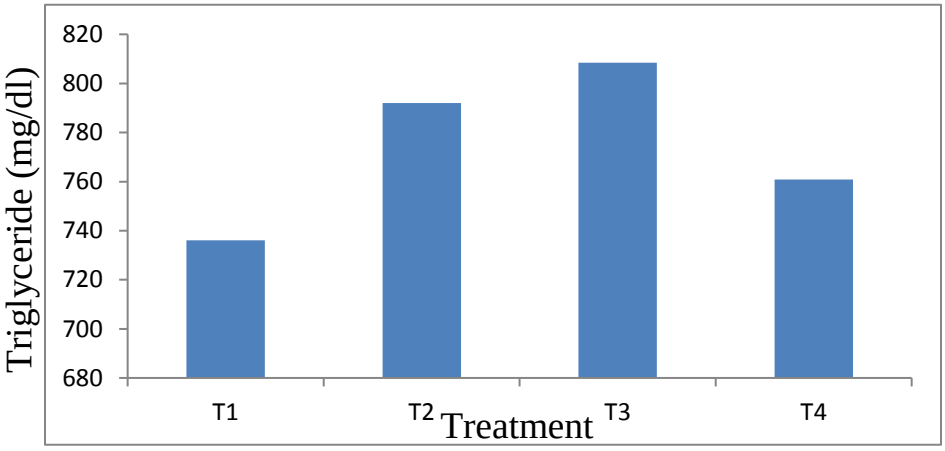

Figure 65: Bar Chart Analysis of Triglyceride Content of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf powder Fortified Feeds and those Fed with Control Feed.

Information presented in Figure 65 (Appendix 83, Page 285) indicates the eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed had the highest amount of triglyceride (808.38mg/dl) when compared to other treatment groups. This was followed by the triglyceride content of eggs (792.04mg/dl) produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed. Similarly, the study found that eggs produced by layers fed with control feed (T1) contained the least amount of triglyceride (760.83mg/dl)

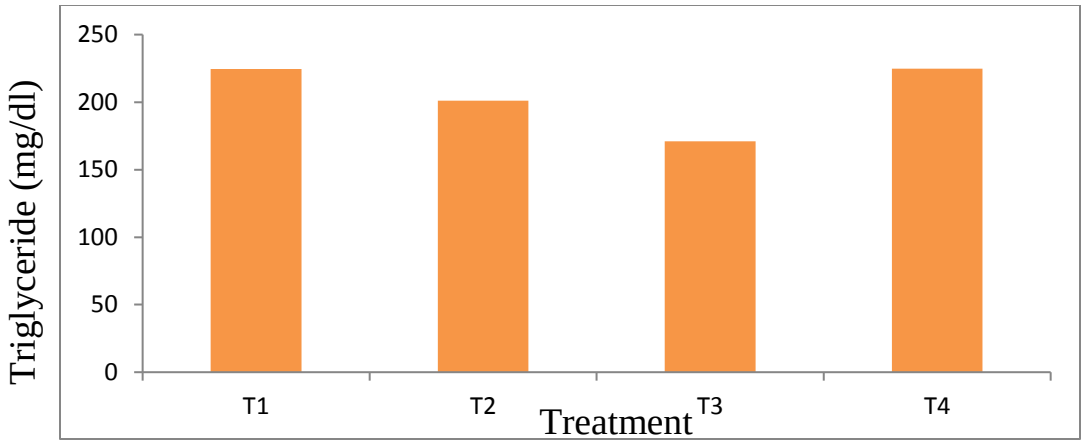

Figure 66: Bar Chart Analysis of the Free Cholesterol Content of Eggs produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

The data presented in Figure 66 (Appendix 84, Page 285) shows that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (T4) contained the highest amount of free cholesterol (224.69mg/dl) and closely followed by eggs produced by layers fed with control feed (T1) which had the free cholesterol content of 224.50mg/dl. The study equally found that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed contained the least amount of free cholesterol

Hypothesis 5: There is no significant difference in the mean nutritive value of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed

Data for testing hypothesis 5 are presented in the tables 20 - 24.

Table 20: ANOVA Analysis of the proximate content of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2445.738	3	815.246	.011	.998
Within Groups	1450873.939	20	72543.697		
Total	1453319.677	23			

The ANOVA analysis of the proximate content (crude protein, carbohydrate, crude lipids, moisture, crude fibre, ash, and metabolizeable energy) of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed presented in Table 20 reveals that the probability value was 0.998 which was greater than 0.05. This implies that there is no significance difference (P > 0.05) in the mean proximate content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. Therefore, the hypothesis of no significant difference is upheld.

Table 21: ANOVA Analysis of the Vitamin Profile of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	71.988	3	23.996	.009	.999
Within Groups	73740.585	28	2633.592		
Total	73812.573	31			

The data presented in Table 21 on the ANOVA analysis of the Vitamin profile (Vitamin A, Vitamin B1, Vitamin B2, Vitamin B3, Vitamin B5, Vitamin C, Vitamin D and Vitamin E) of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed shows that the probability value was 0.999 which was greater than 0.05. This signified that there was no significant difference (P > 0.05) in the mean vitamin profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed. Therefore, the null hypothesis is accepted.

Table 22: ANOVA Analysis of the Mineral Profile of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4076.548	3	1358.849	.180	.909
Within Groups	302336.059	40	7558.401		
Total	306412.607	43			

On the Mineral profile (Phosphorous, Sodium, Magnesium, Zinc, Manganese, Iron, Potassium, Calcium, Selenium, Copper and Chromium) of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the ANOVA Table 22 presented shows that the probability value was 0.909 which was greater than 0.05. This implies that there is no significant difference (P > 0.05) in the mean Mineral profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. Therefore, the null hypothesis is accepted.

Table 23: ANOVA Analysis of the Amino Acids Profile of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	228613295.605	3	76204431.868	1.048	.377
Within Groups	5237230458.789	72	72739311.928		
Total	5465843754.394	75			

The ANOVA analysis of the amino acids profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed presented in Table 23 shows that the probability value was 0.377 which was greater than 0.05. This

implied that there is no significant difference (P > 0.05) in the mean amino acids profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with no *Moringa oleifera* leaf powder fortified feed. Therefore, the hypothesis of no significant difference is accepted.

Table 24: ANOVA Analysis of the Lipids Parameter of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	328.498	3	109.499	.001	1.000
Within Groups	1164536.580	8	145567.072		
Total	1164865.078	11			

ANOVA analysis of the lipids parameter of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed presented in Table 24 shows that the probability value was 1.00 which was above 0.05. This signifies that there is no significant difference (P > 0.05) in the mean lipids parameters of eggs produced by layers fed with *Moringa oleifera* leaf powder and those fed with control feed. Hence, the hypothesis of no significant difference is accepted.

Research Question 6: What are the effects of different inclusion rates of *Moringa oleifera* leaf powder on the nutritive value of eggs produced by the layers

Figures presented below are used to answer research question 6.

Proximate Analysis of Egg

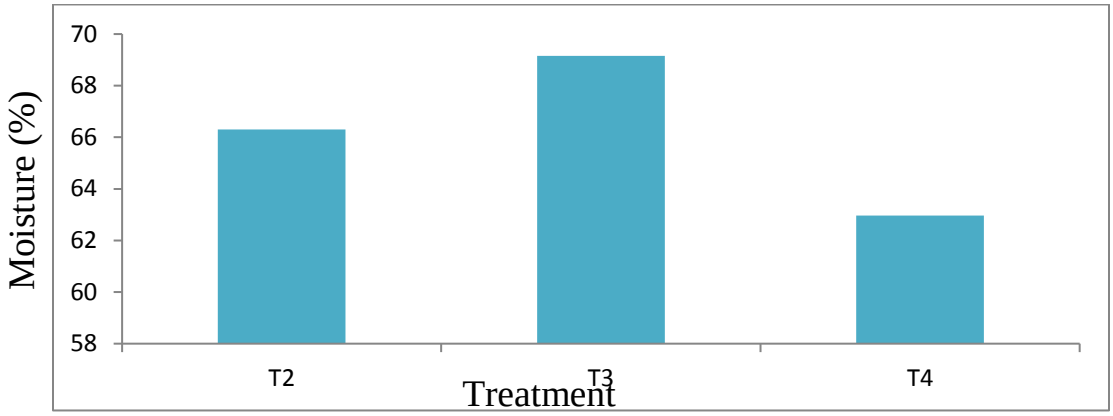

Figure 67: Bar Chart Analysis of the Moisture Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Data presented in Figure 67 (Appendix 85, Page 285) shows that the moisture content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed (T3) had the highest value (69.15%) compared to other eggs produced by different inclusion rates of *Moringa oleifera* leaf powder. Similarly, eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed (62.96) had the least moisture content when compared to others.

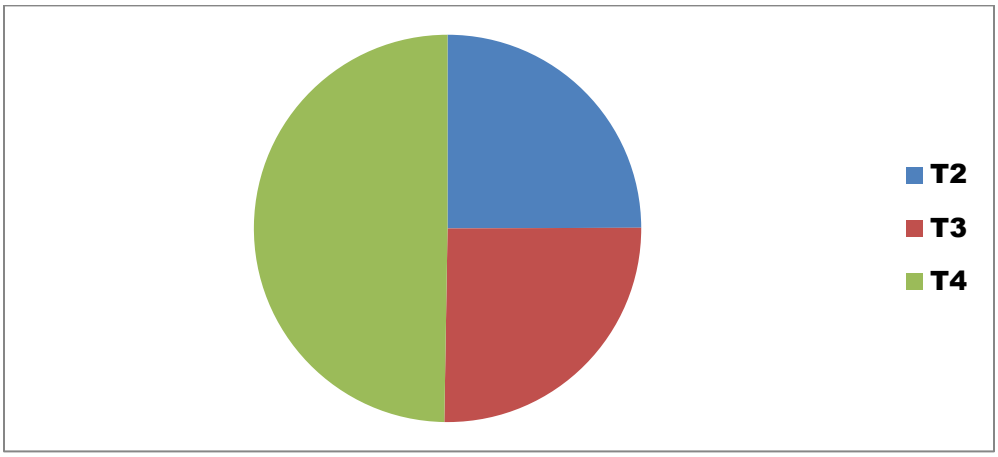

Figure 68: Pie Chart Analysis of the Carbohydrate Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Information presented in Figure 68 (Appendix 86, Page 286) indicates that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed had the highest amount of carbohydrate content of 6.54% and the least was the eggs produced by layers fed with 2.5% *Moringa* oleifera leaf powder fortified feed (T2) which had the value of 3.28%

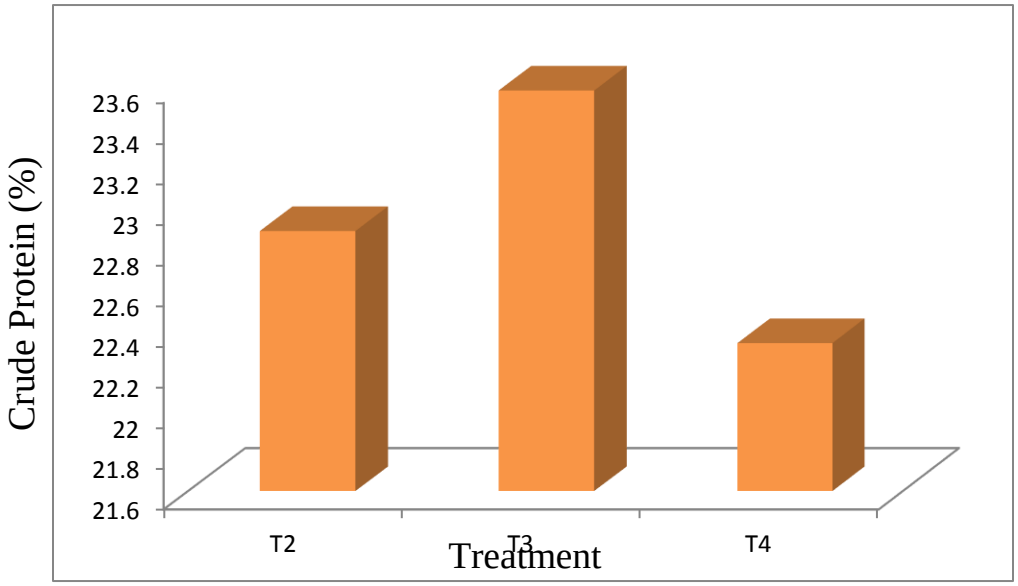

Figure 69: Bar Chart Analysis of the Crude Protein Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Crude protein content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 69 (Appendix 87, Page 286) indicates that eggs produced by inclusion of 5% *Moringa oleifera* leaf powder fortified feed (T3) had the highest value of 23.57% when compared to other eggs produced by different *Moringa oleifera* inclusion rates. Similarly, eggs produced by 7.5% *Moringa oleifera* inclusion rate (T4) had the least Crude protein content of 22.33% when compared to others.

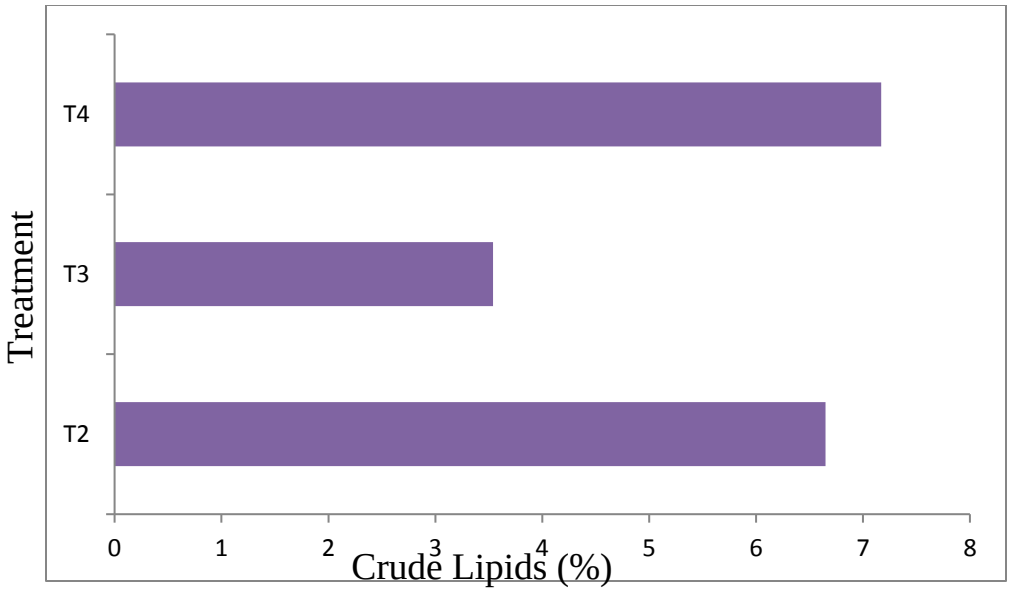

Figure 70: Bar Chart Analysis of the Crude Lipids Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 70 (Appendix 88, Page 286) indicates that eggs produced by inclusion of 7.5% *Moringa oleifera* leaf powder in the feed (T4) had the highest Crude lipids content (7.17%) while eggs produced by the inclusion of 5% *Moringa oleifera* leaf powder in feed (T3) had the least Crude lipids content of 3.54%

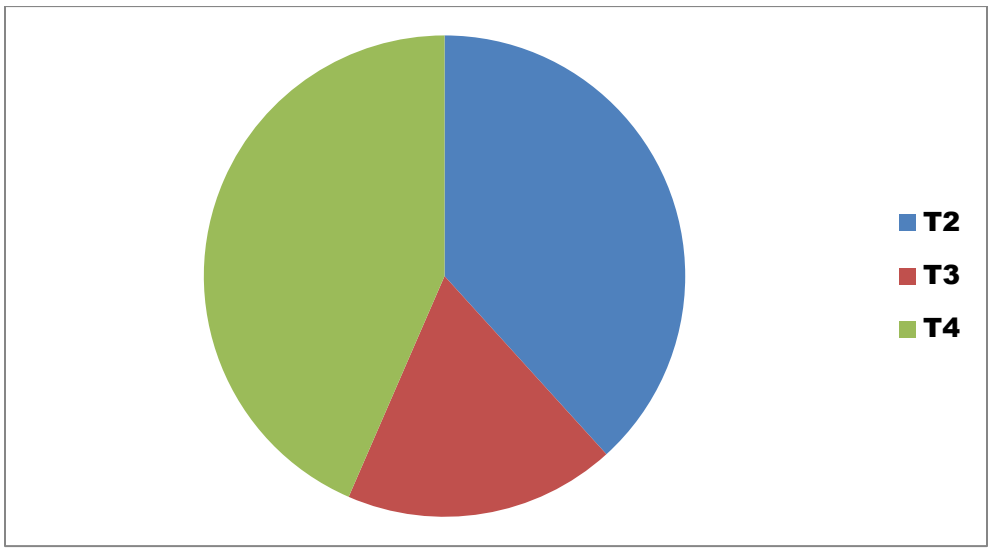

Figure 71: Pie Chart Analysis of the Ash Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 71 (Appendix 89, Page 286) revealed that the ash content of eggs produced by inclusion of 7.5% *Moringa oleifera* leaf powder in feed had the highest value of 1.00% followed by the ash content of eggs produced by layers fed with 2.5% *Moringa oleifera* inclusion rate which yielded a value of 0.88% while the eggs produced by 5% inclusion rate of *Moringa oleifera* leaf powder in feed had the least ash content value of 0.42%.

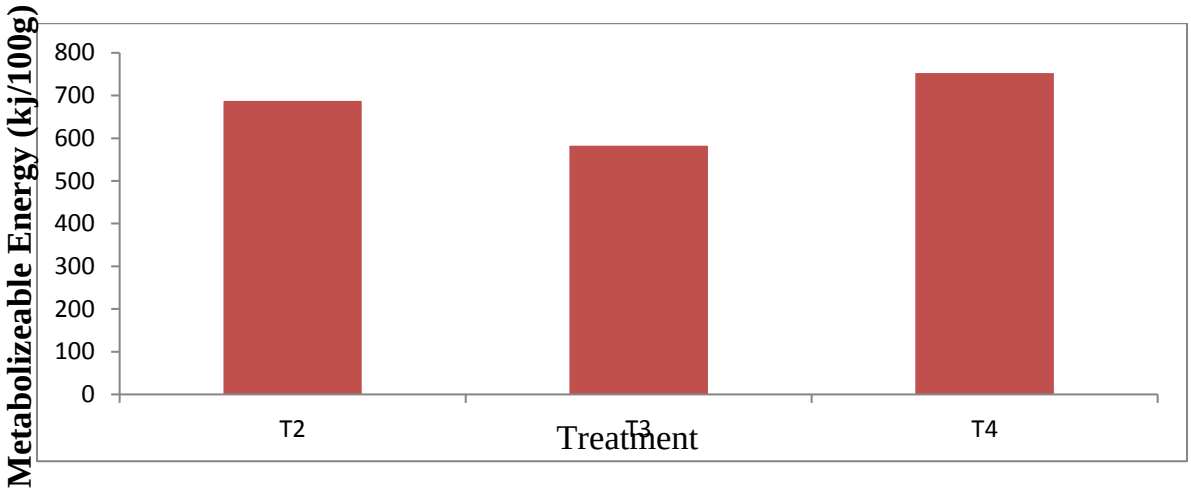

Figure 72: Bar Chart Analysis of the Metabolizeable Energy Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Metabolizeable energy content of eggs produced by different inclusion rates of *Moringa oleifera* leaf powder in feeds, Figure 72 (Appendix 90, Page 286) reveals that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder (T4) inclusion rate had the highest value of 752.46Kj/100g followed by eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder in feed which yielded a Metabolizeable energy content of 687.74Kj/100g. The figure further shows that eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3) recorded the least Metabolizeable energy content value of 582.72Kj/100g.

Vitamin Profile

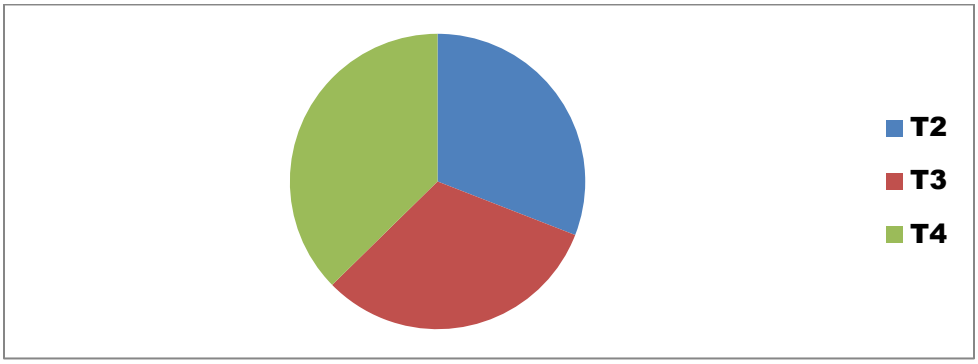

Figure 73: Pie Chart Analysis of the Vitamin A Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Vitamin profile of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder in feed, Figure 73 (Appendix 91, Page 286) shows that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder in feed (T4) recorded the highest Vitamin A content (168.66µg/100g) when compared to other eggs. The figure further shows that eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder in feed (T2) recorded the least value of Vitamin A content (139.57µg/100g) when compared to other eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder in feed.

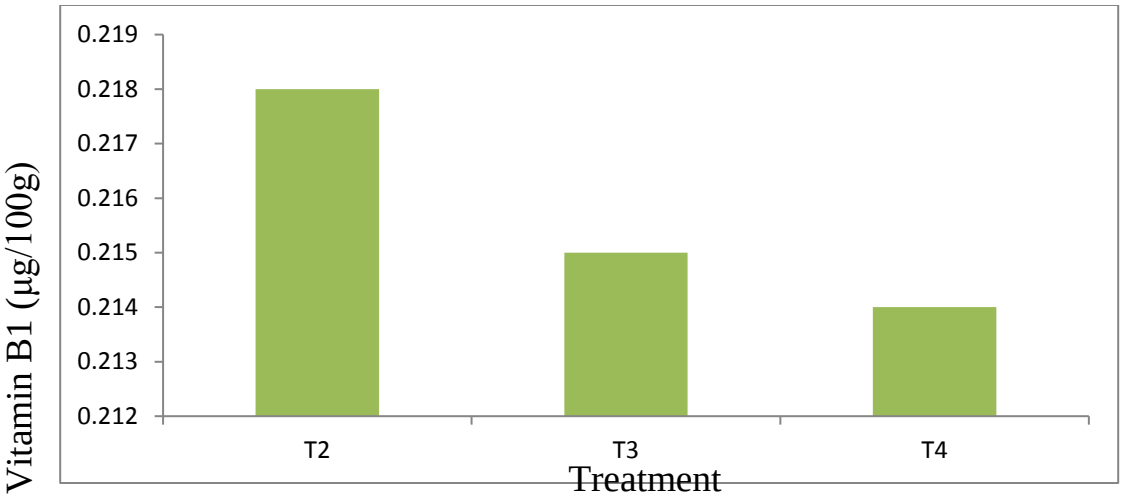

Figure 74: Bar Chart Analysis of the Vitamin B1 Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Information presented in Figure 74 (Appendix 92, Page 286) shows that eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder in feed (T2) had the highest value of Vitamin B1 content (0.218µg/100g) when compared to others. Similarly, eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder (T4) had the least value of Vitamin B1 content (0.214µg/100g).

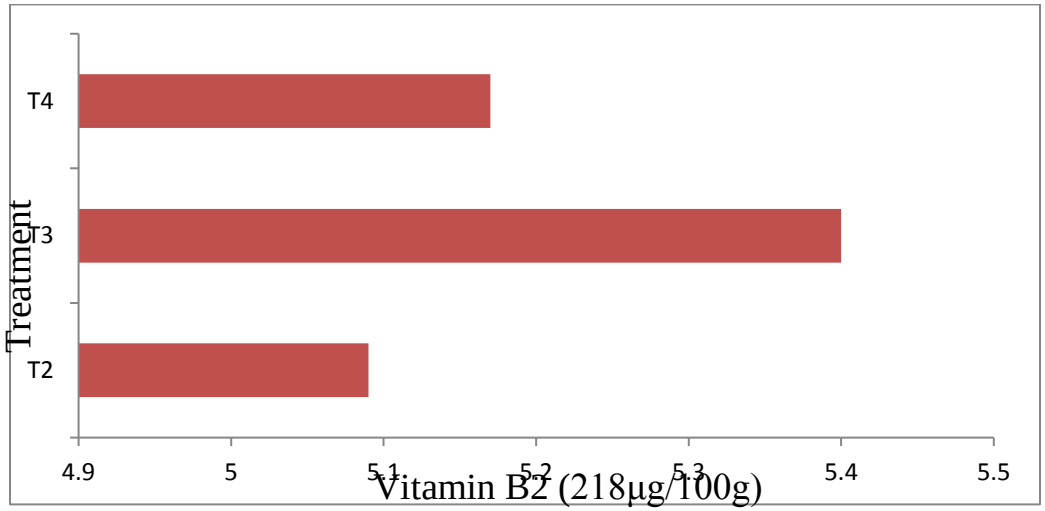

Figure 75: Bar Chart Analysis of the Vitamin B2 Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Figure 75 (Appendix 93, Page 287) shows that eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3) had the highest value of Vitamin B2

(5.40µg/100g) while the eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) had the least Vitamin B2 content (5.09µg/100g)

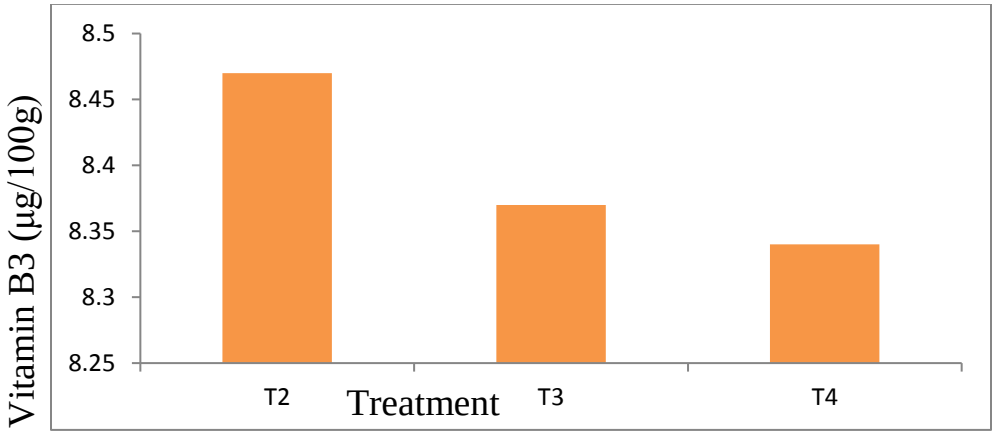

Figure 76: Bar Chart Analysis of the Vitamin B3 Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 76 (Appendix 94, Page 287) shows that eggs produced by 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) had the highest Vitamin B3 content value of 8.47µg/100g followed by eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T2) which had the value of 8.37µg/100g.

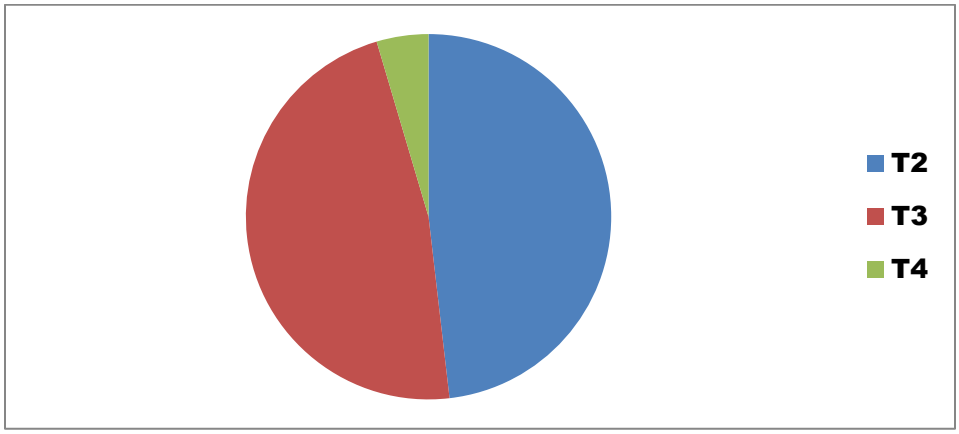

Figure 77: Pie Chart Analysis of the Vitamin B5 Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Vitamin B5 content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 77 (Appendix 95, Page 287) shows that eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) had the highest value of 1.05µg/100g followed by eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3) which recorded Vitamin B5 content of 1.03µg/100g. The figure further shows that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder (T4) had the least Vitamin B5 content (0.10µg/100g).

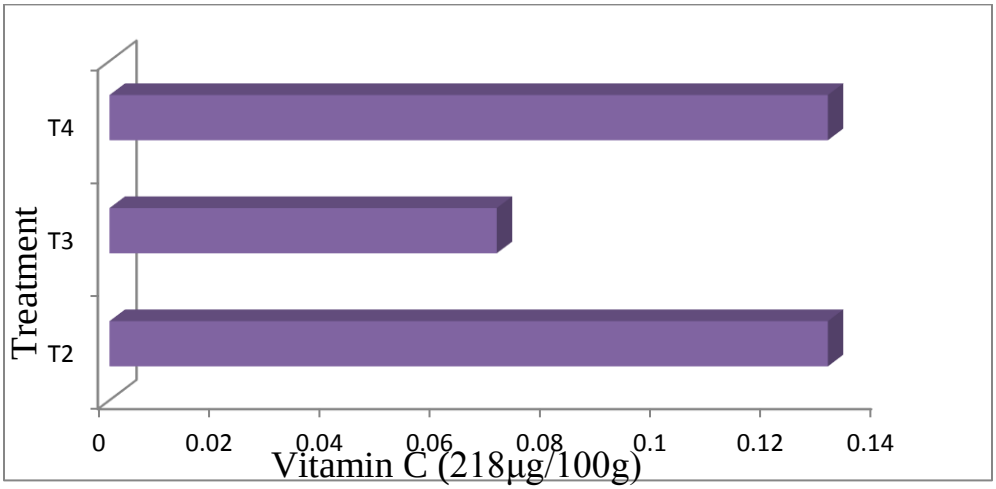

Figure 78: Bar Chart Analysis of the Vitamin C Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Data presented in Figure 78 (Appendix 96, Page 287) shows that eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) and eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder (T4) had the same value of Vitamin C content of 0.13µg/100g. The figure further shows that eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder had a very low amount of Vitamin C (0.07µg/100g) when compared to other eggs fed with different inclusion rates of *Moringa oleifera* leaf powder.

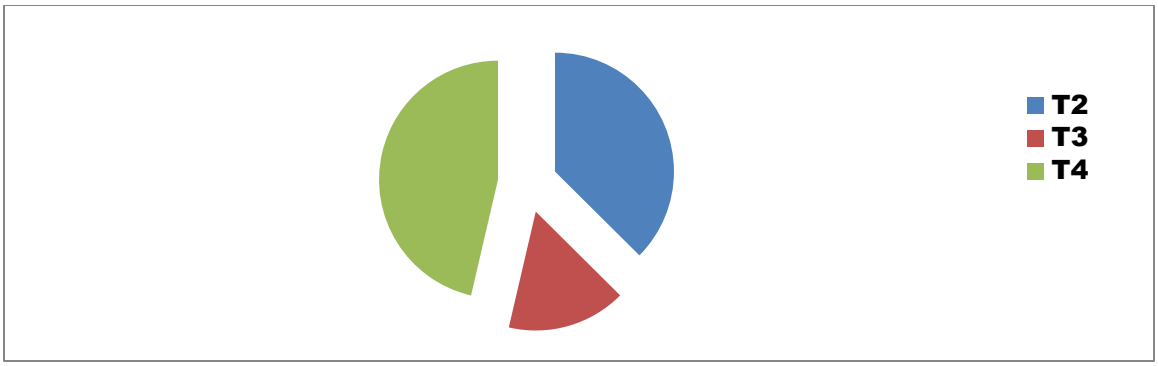

Figure 79: Pie Chart Analysis of the Vitamin D Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Figure 79 (Appendix 97, Page 287) shows that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder inclusion rate (T4) in feed recorded the highest amount of Vitamin D content (3.12µg/100g) when compared to other eggs produced by different inclusion rates of *Moringa oleifera* leaf powder followed by eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) which recorded Vitamin D content value of 2.52µg/100g. Similarly, figure 75 reveals that eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder had the least value of Vitamin D content (1.09µg/100g).

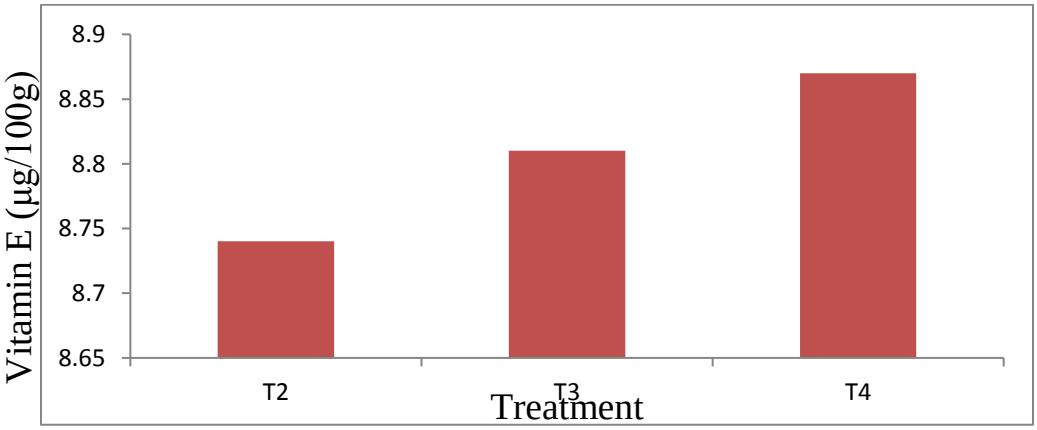

Figure 80: Bar Chart Analysis of the Vitamin E Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Vitamin E content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 80 (Appendix 98, Page 287) shows that eggs produced by inclusion of 7.5% *Moringa oleifera* leaf powder (T4) had the highest Vitamin E content (8.87µg/100g) when compared to others. The figure further shows that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder inclusion rate (T2) contain the least Vitamin E content (8.74µg/100g) followed by eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3) (8.81µg/100g).

Minerals

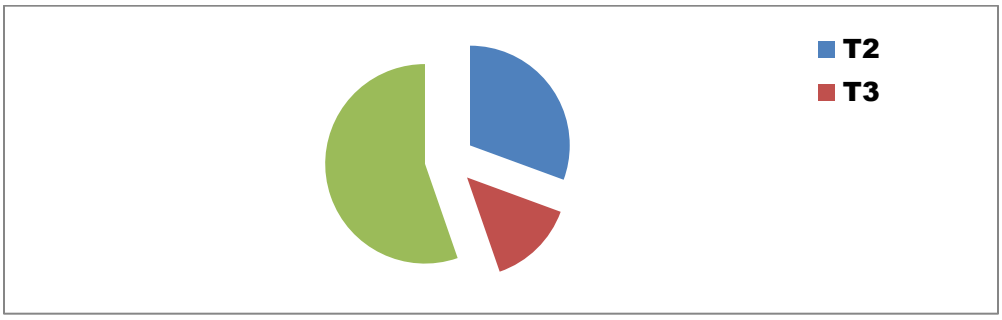

Figure 81: Pie Chart Analysis of the Phosphorous (P) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 81 (Appendix 99, Page 287) reveals that the phosphorous (P) content of eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder (T4) (301.95ppm) dominated the phosphorous content of other eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder followed by the phosphorous content of eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* (T2) which had the value of 167.03ppm. Similarly, the phosphorous content of eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3) was the

least of all the phosphorous content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder.

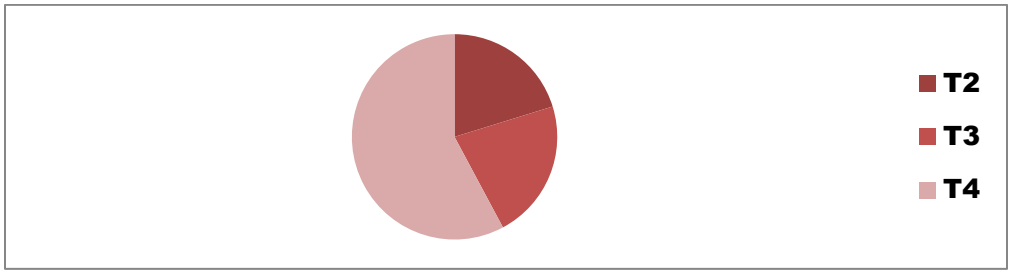

Figure 82: Pie Chart Analysis of the Sodium (Na) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 82 (Appendix 100, Page 288) shows that the Sodium (Na) content of eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder (T4) (283.43ppm) dominated the Sodium content of other eggs produced by different inclusion rates of *Moringa oleifera* leaf powder. Furthermore, the figure shows that eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) had the least Sodium content (99.17ppm) when compared to other eggs produced by inclusion of different amount of *Moringa oleifera* leaf powder in the feed of layers.

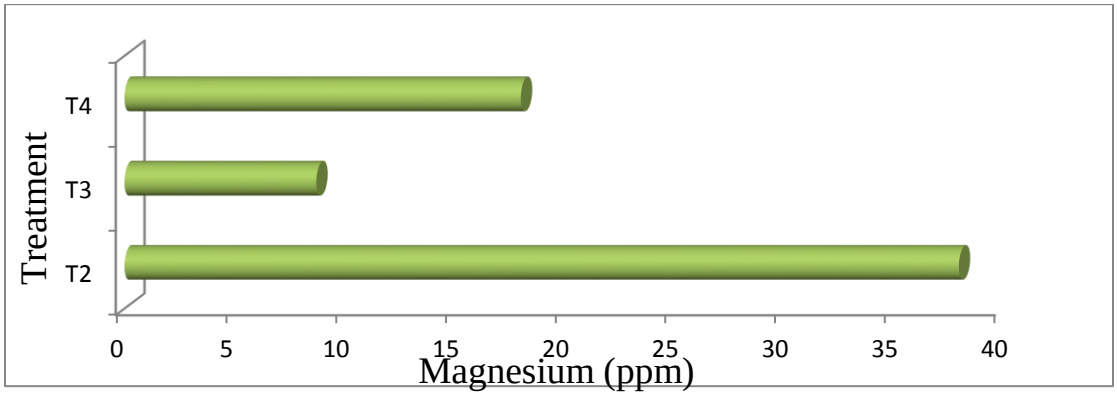

Figure 83: Bar Chart Analysis of the Magnesium (Mg) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Magnesium content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 83 (Appendix 101, Page 288) shows that the Magnesium content of eggs produced by inclusion of 2.5% *Moringa oleifera* leaf powder (T2) in layer feed had the highest value of 37.96ppm. Moreover, eggs produced by inclusion of 5% *Moringa oleifera* leaf powder in feed (T3) recorded the least Magnesium content value of 8.72ppm when compared to other eggs

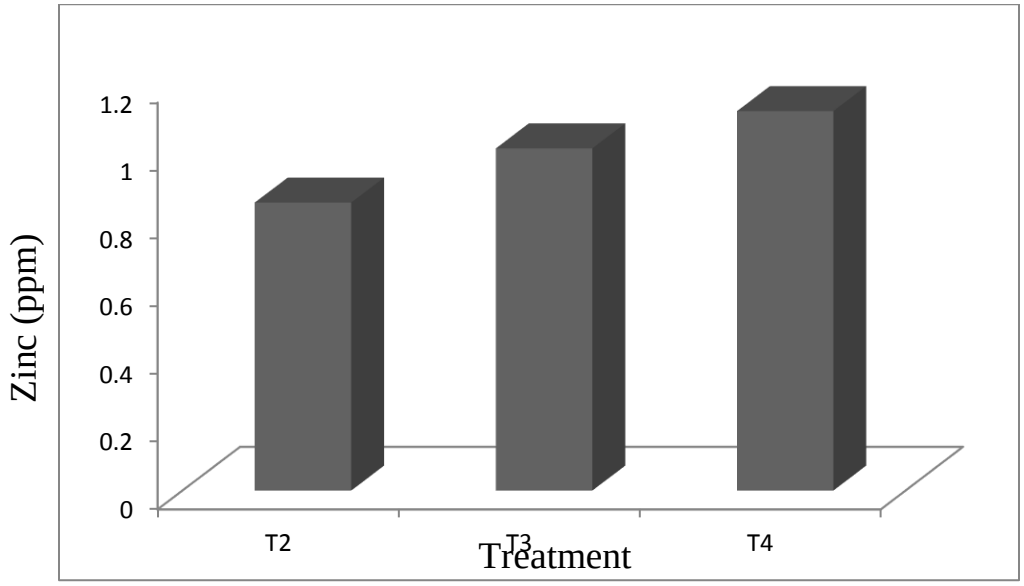

Figure 84: Bar Chart Analysis of the Zinc (Zn) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Information presented in Figure 84 (Appendix 102, Page 288) shows that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder inclusion rate (T4) had the highest Zinc (Zn) content value (1.12ppm) when compared with other eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Similarly, eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the least value of Zinc content (0.85ppm) followed by the Zinc content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder which had the value of 1.01ppm.

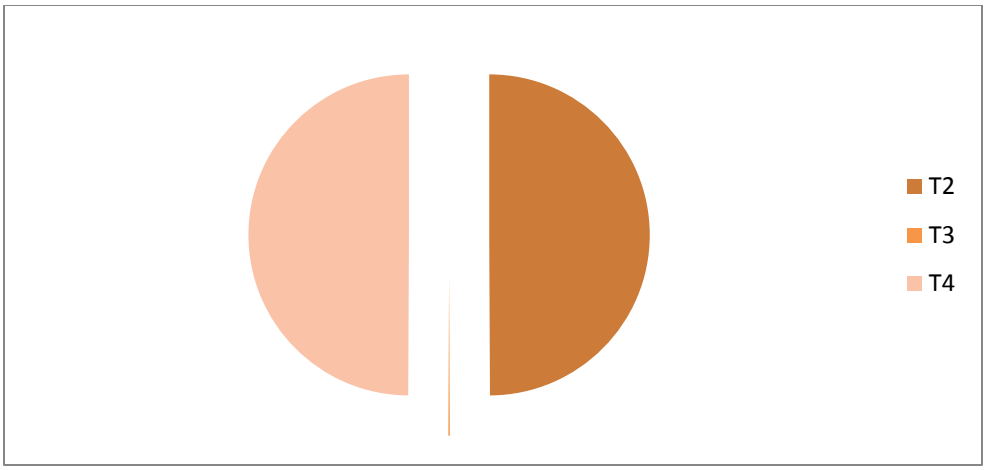

Figure 85: Pie Chart Analysis of the Manganese (Mn) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Data presented in Figure 85 (Appendix 103, Page 288) shows that the Manganese (Mn) content of eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* (T2) and those fed with 7.5% inclusion rate of *Moringa oleifera* (T4) are equal and they contain 0.34ppm of Manganese. The figure further shows that negligible amount of Manganese (0.001ppm) was found in eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3).

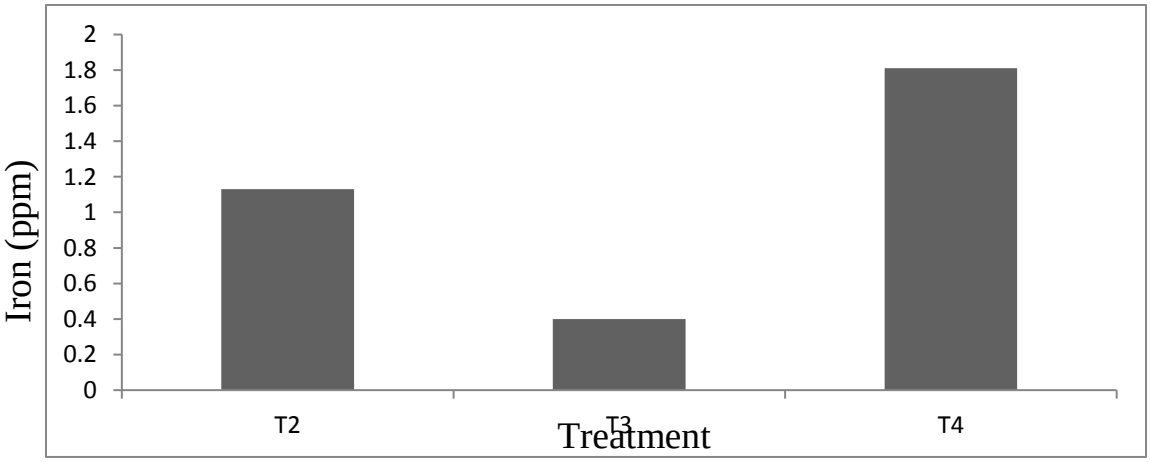

Figure 86: Bar Chart Analysis of the Iron (Fe) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Iron (Fe) content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 86 (Appendix 104, Page 288) reveals that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder (T4) contained the highest amount of Iron (1.81ppm) when compared with other eggs. Similarly, eggs produced by inclusion of 5% *Moringa oleifera* leaf powder in feed (T3) had the least Iron content (0.4ppm) followed by the eggs produced by inclusion of 2.5% *Moringa oleifera* leaf powder (T2) which contained 1.13ppm of Iron.

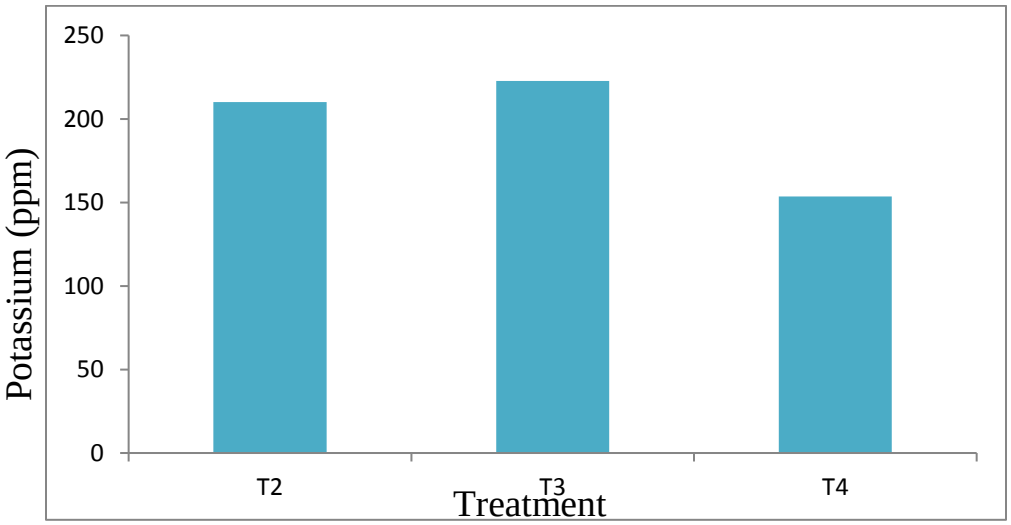

Figure 87: Bar Chart Analysis of the Potassium (K) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the potassium content of eggs produced by inclusion of different rates of *Moringa oleifera* leaf powder in feed presented in Figure 87 (Appendix 105, Page 288), the Potassium content of eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* (T3) (222.76ppm) dominated the other eggs. Next in the potassium profile of the experimental eggs was the Potassium content of T2 which was found to contain 210.19ppm. The figure further shows that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* in feed (T4) contained the least amount of potassium (153.63ppm).

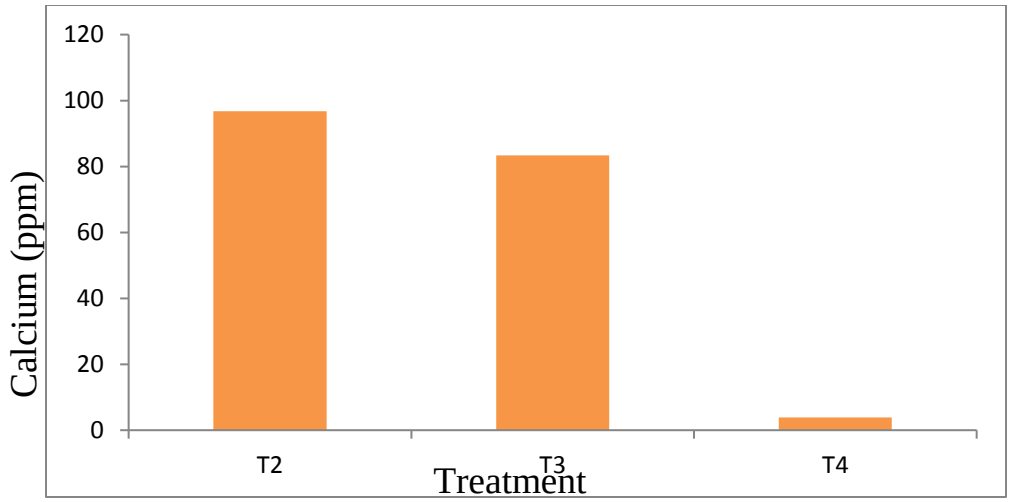

Figure 88: Bar Chart Analysis of the Calcium (Ca) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 88 (Appendix 106, Page 288) shows that the Calcium content of eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) was the highest (96.79ppm) when compared to other eggs. Small amount of Calcium (3.85) was found in eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder (T4) in feed.

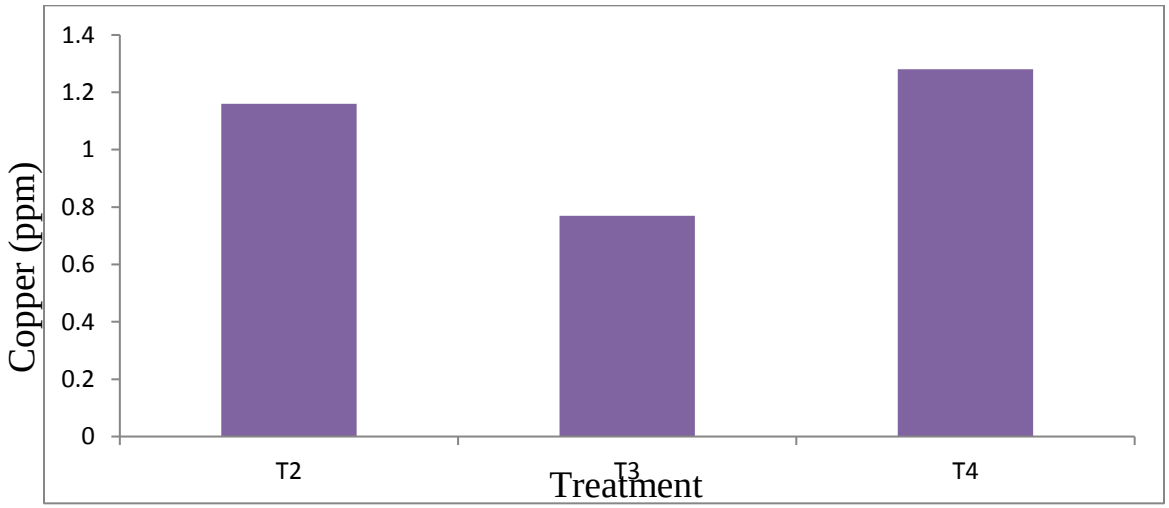

Figure 89: Bar Chart Analysis of the Copper (Cu) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 89 (Appendix 107, Page 288) shows that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder (T4) recorded the highest Copper (Cu) content value of 1.28ppm, then followed by eggs produced by 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) which recorded the Copper content value of 1.16ppm. Similarly, the figure reveals that the least Copper content (0.77ppm) was contained in eggs produced by layers fed with 5% inclusion of *Moringa oleifera* leaf powder fortified feed (T3).

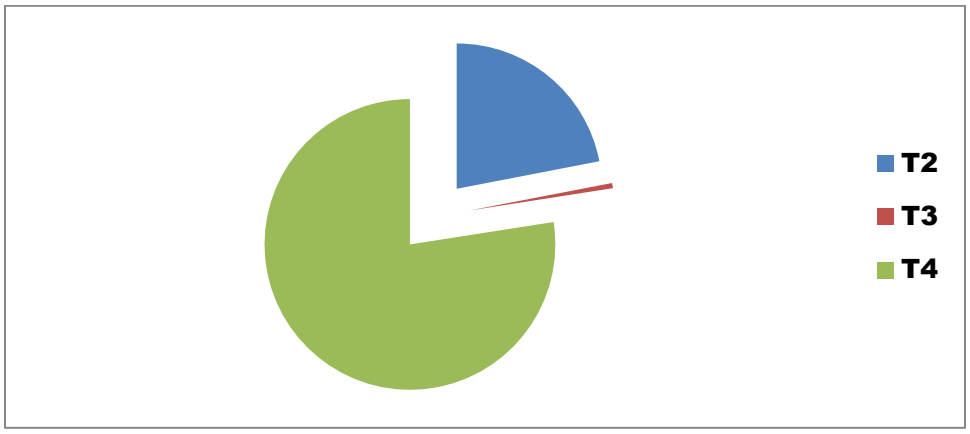

Figure 90: Pie Chart Analysis of the Selenium (Se) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Information presented in Figure 90 (Appendix 108, Page 289) shows that the Selenium content (31.11µg/100g) was dominant in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder (T4) when compared to other eggs produced by different inclusion rates of *Moringa oleifera* leaf powder. Data presented in the above figure also shows that very small amount of Selenium (0.23µg/100g) was contained in eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3).

Figure 91: Pie Chart Analysis of the Chromium (Cr) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Chromium content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 91 (Appendix 109, Page 289) shows that the dominant amount of Chromium (0.021µg/100g) was present in eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder in feed (T4), then followed by the Chromium content of eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder (T2) which recorded a value of 0.003µg/100g. According to the data in the above figure, eggs produced by the inclusion of 5% *Moringa oleifera* leaf powder in feed contained 0µg/100g.

Amino Acids Profile

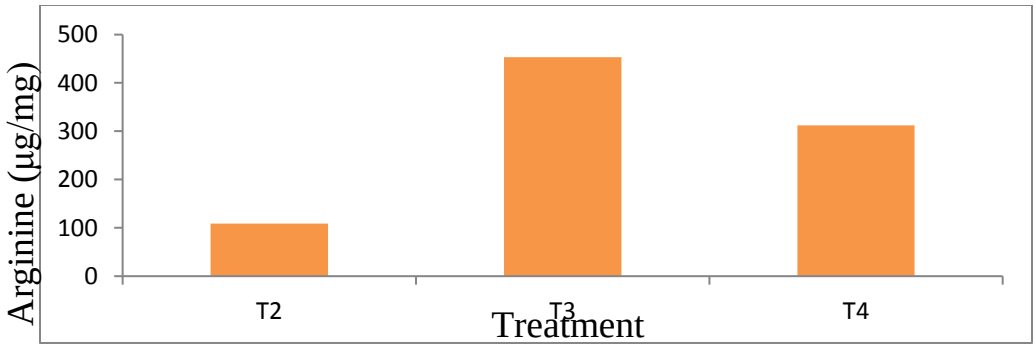

Figure 92: Bar Chart Analysis of the Arginine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The Arginine content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* in feeds presented in Figure 92 (Appendix 110, Page 289) shows that eggs produced by layers fed with 5% inclusion of *Moringa oleifera* leaf powder (T3) had the highest value of 453.02µg/mg followed by the Arginine content of eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder (T4) which had the value of 311.90µg/mg when compared to other eggs. The figure further shows that eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder in feed (T2) had the least amount of Arginine content of 108.67µg/mg.

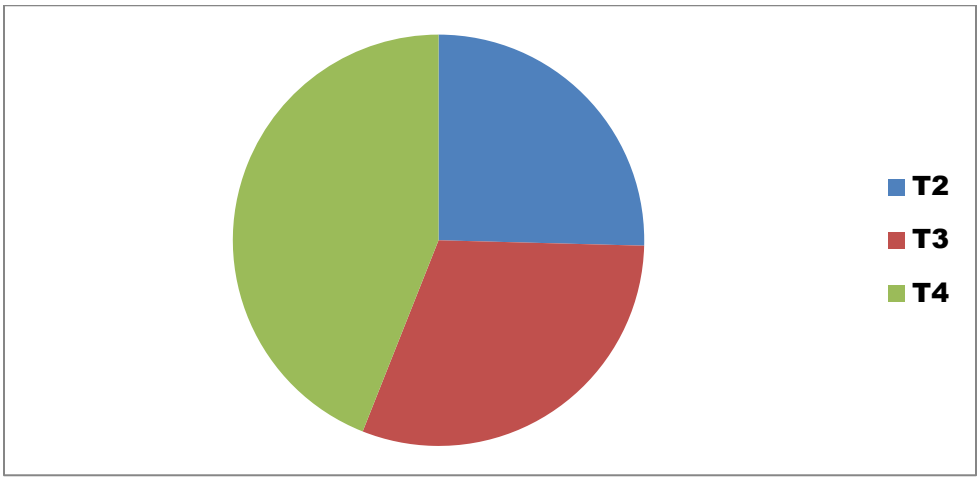

Figure 93: Pie Chart Analysis of the Aspartate Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Aspartate content of eggs produced by different inclusion rates of *Moringa oleifera* leaf powder in feeds, Figure 93 (Appendix 111, Page 289) shows that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder in feed (T4) contained the highest amount of Aspartate (1699.48µg/mg) when compared to other eggs, then followed by the Aspartate content of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder

inclusion rate (T3) which contained the amount of 1182µg/mg. Similarly, the figure above reveals that eggs produced by inclusion of 2.5% *Moringa oleifera* leaf powder in feed (T2) contained the least amount of Aspartate (982.13µg/mg) when compared to other eggs.

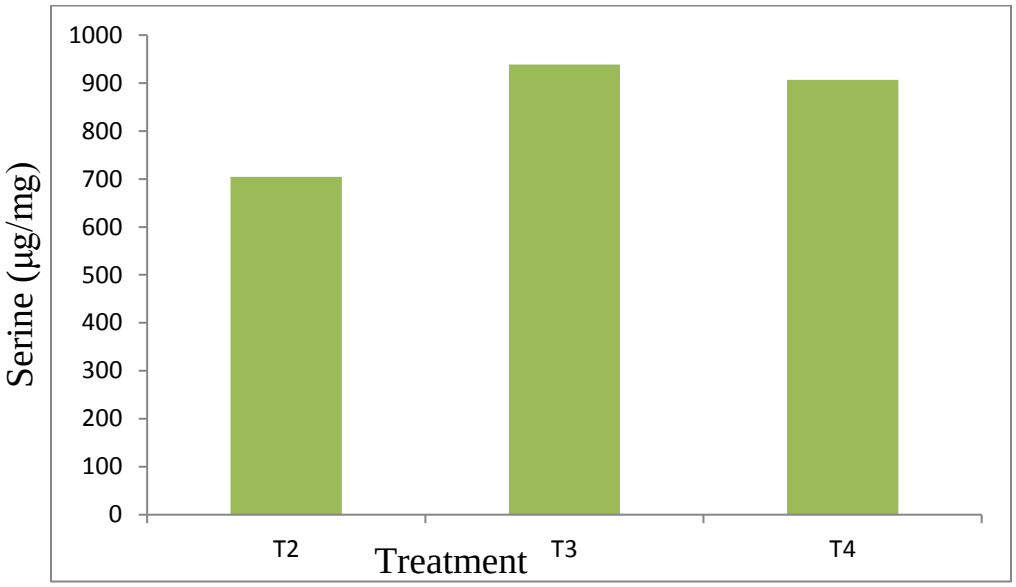

Figure 94: Bar Chart Analysis of the Serine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 94 (Appendix 112, Page 289) shows that the highest amount of Serine (938.73µg/mg) was present in eggs produced by layers fed with 5% inclusion of *Moringa oleifera* leaf powder in feed (T3) followed by the Serine content of eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder (T4) which recorded the amount of 906.65µg/mg. Further, the figure shows that eggs produced by inclusion of 2.5% *Moringa oleifera* leaf powder in feed (T2) had the least amount of Serine (704.66µg/mg) when compared to other eggs.

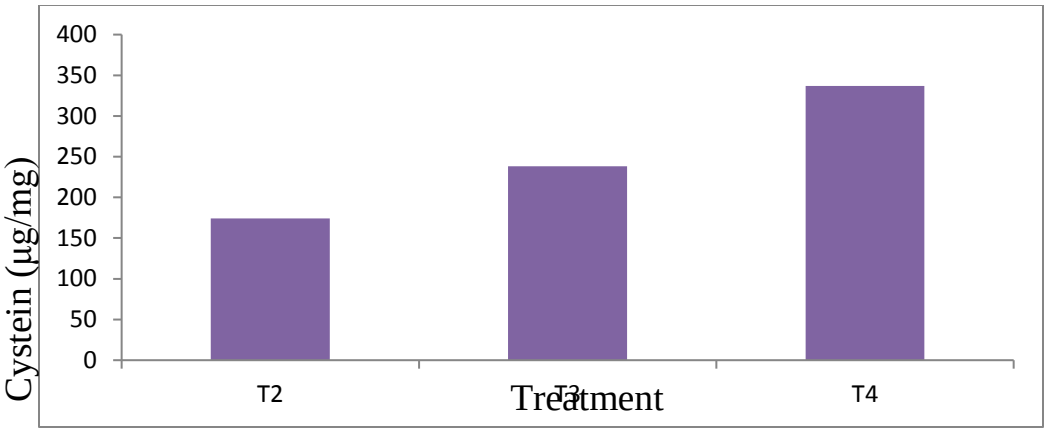

Figure 95: Bar Chart Analysis of the Cysteine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the Cysteine content of eggs produced by inclusion of different amount of *Moringa oleifera* leaf powder in feeds presented in Figure 95 (Appendix 113, Page 289), it was discovered that eggs produced by the inclusion of 7.5% *Moringa oleifera* leaf powder in feed had the highest amount of Cysteine (337.02µg/mg) when compared to eggs from other treatment groups. The figure further shows that eggs produced by inclusion of 5% *Moringa oleifera* leaf powder in feed (T3) had the Cysteine content of 238.32µg/mg which was greater than the Cysteine content of eggs (173.99µg/mg) produced by layers fed with 2.5% *Moringa oleifera* leaf powder inclusion in feed (T2).

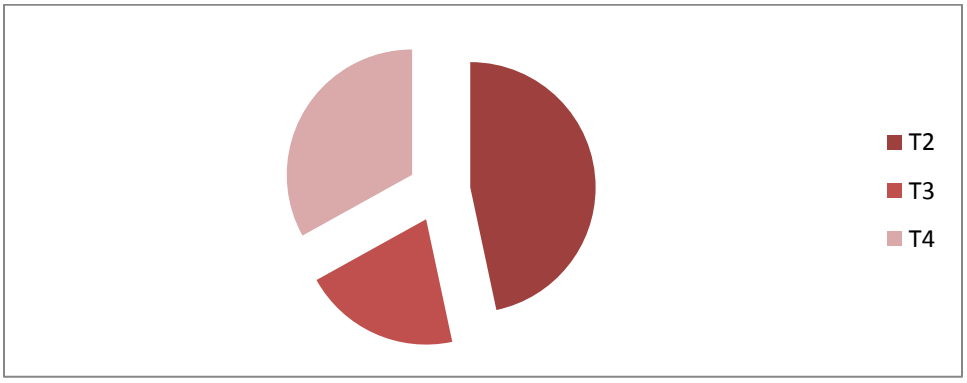

Figure 96: Pie Chart Analysis of the Glycine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 96 (Appendix 114, Page 289) on the glycine content of eggs produced by inclusion of different amount of *Moringa oleifera* in feeds shows that eggs produced by inclusion of 2.5% *Moringa oleifera* leaf powder in feed (T2) contained the dominant quantity of glycine (765.37µg/mg), then followed by the glycine content of eggs produced by inclusion of 7.5% *Moringa oleifera* leaf powder in feed (T4) which was 542.32µg/mg. Similarly, it was shown in the above figure that eggs produced by inclusion of 5% *Moringa oleifera* leaf powder in feed (T3) contained the least amount of glycine (332.91µg/mg) when compared to eggs from other treatment groups.

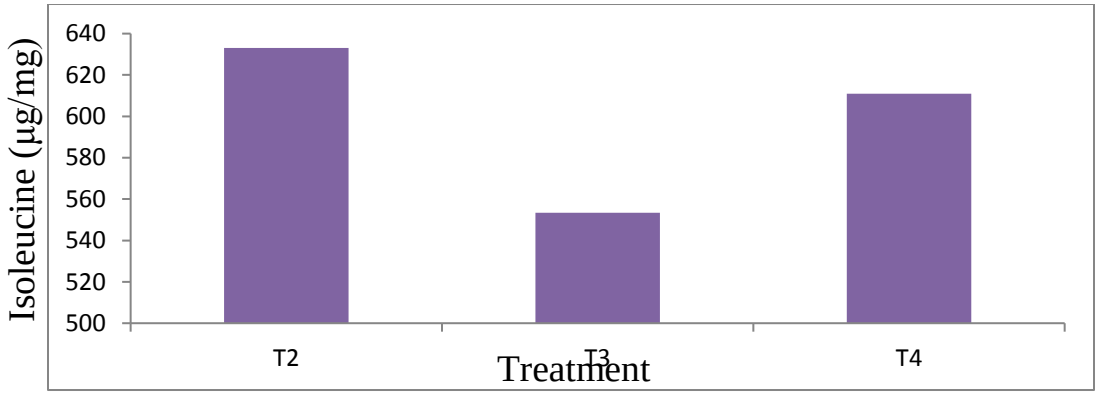

Figure 97: Bar Chart Analysis of the Isoleucine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 97 (Appendix 115, Page 289) indicates that eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder (T2) in feed contained the highest amount of Isoleucine (633.06µg/mg), then followed by the Isoleucine content of eggs produced by inclusion of 7.5% *Moringa oleifera* leaf powder in feed (T4) which recorded the value of 611µg/mg when compared to other eggs produced by other treatment groups. The figure further shows that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder inclusion rate contained the least amount of Isoleucine (553.43µg/mg).

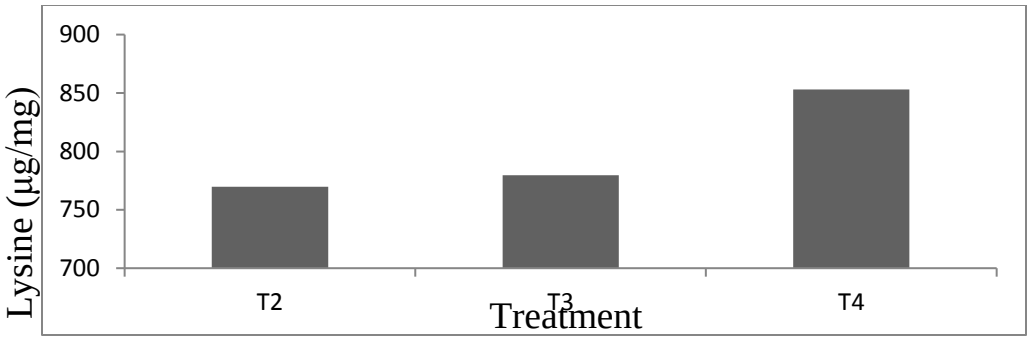

Figure 98: Bar Chart Analysis of the Lysine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

According to the data presented in Figure 98 (Appendix 116, Page 290) on the lysine content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, it was discovered that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder (T4) contained the highest amount of lysine (852.89µg/mg) when compared to other eggs. The figure further shows that eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) had the least amount of lysine (769.75µg/mg), then followed by the lysine content of eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3) which recorded the value of 779.66µg/mg.

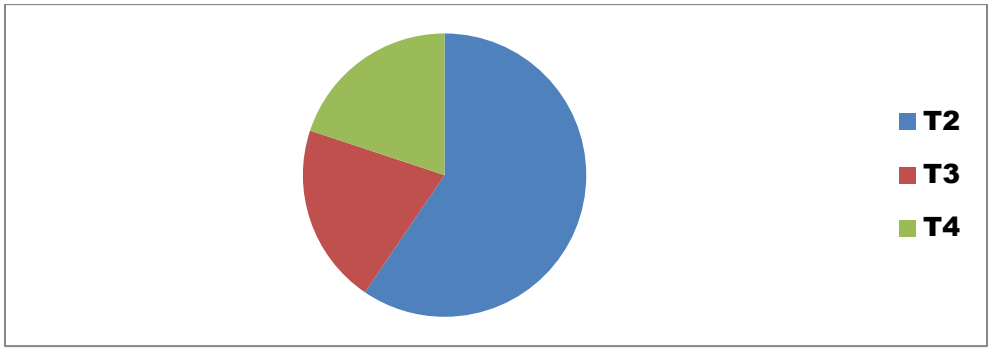

Figure 99: Pie Chart Analysis of the Histidine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Figure 99 (Appendix 117, Page 290) shows that the histidine content of eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder in feed (T2) was highest (998.41µg/mg) when compared to other eggs produced by inclusion of different rates of *Moringa oleifera* leaf powder in feed. The figure further shows that the histidine content of eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder had the least amount (334.13µg/mg) when compared to other eggs, followed by the histidine content of eggs produced by inclusion of 5% *Moringa oleifera* leaf powder in layer feed (T3) which recorded a value of 345.50µg/mg.

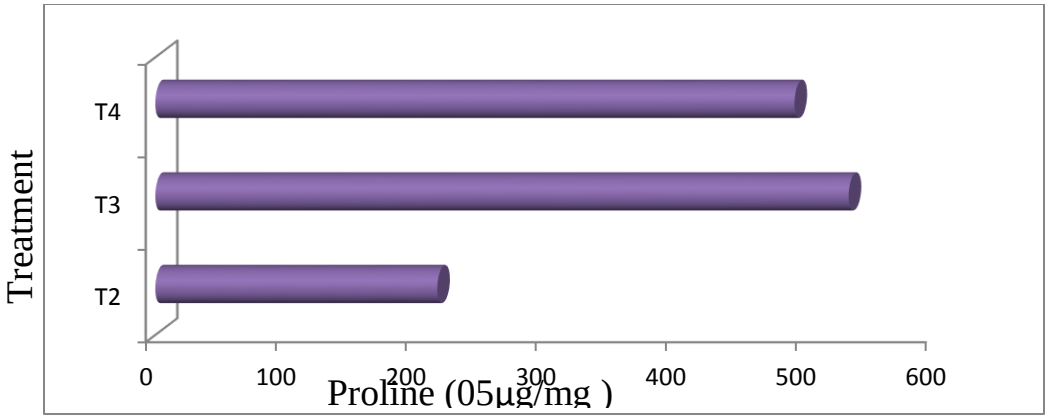

Figure 100: Bar Chart Analysis of the Proline Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the proline content of eggs produced by layers fed with inclusion of different amount of *Moringa oleifera* leaf powder, it was shown in Figure 100 (Appendix 118, Page 290) that eggs produced by inclusion of 5% *Moringa oleifera* leaf powder (T3) contained the highest amount of proline (533.58µg/mg) when compared to others. Secondly, the figure shows that eggs produced by inclusion of 2.5% *Moringa oleifera* leaf powder in feed (T2) contained the least amount of proline (217.05µg/mg) followed by eggs produced by inclusion of 7.5% *Moringa oleifera* leaf powder which recorded the proline content of 492.04µg/mg.

Figure 101: Pie Chart Analysis of the Methionine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the methionine content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 101 (Appendix 119, Page 290) reveals that eggs produced by inclusion of 2.5% *Moringa oleifera* leaf powder in feed (T2) contained the highest amount of methionine (986.07µg/mg) when compared with other eggs, then followed by eggs produced by layers fed with inclusion of 7.5% *Moringa oleifera* leaf powder (T4) which contained 798.32µg/mg of methionine. The figure further shows that eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder in feed (T3) contained the least amount of methionine (589.33µg/mg) when compared to other eggs.

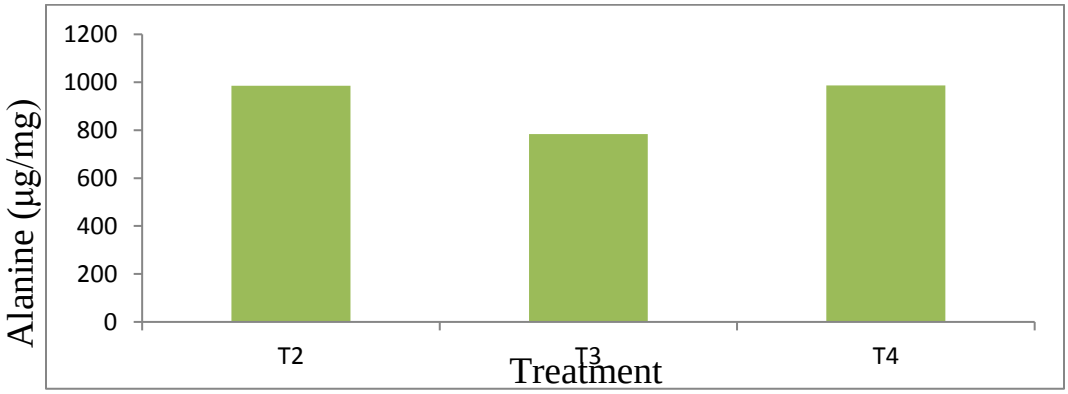

Figure 102: Bar Chart Analysis of the Alanine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Information presented in Figure 102 (Appendix 120, Page 290) shows that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder (T4) had the highest amount of alanine (987.21µg/mg) when compared to other eggs. Moreover, eggs produced by inclusion of 5% *Moringa oleifera* leaf powder in feed (T3) recorded the least alanine content of 748.01µg/mg, then, followed by eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder which contained 985.32µg/mg of alanine.

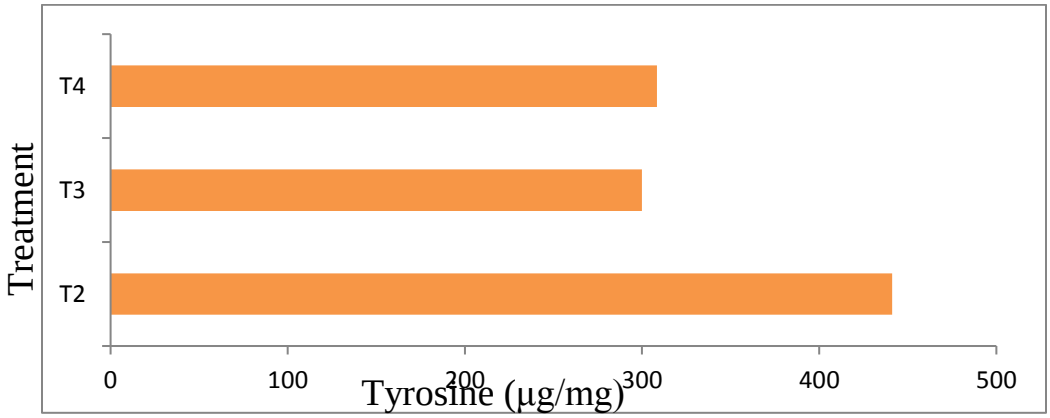

Figure 103: Bar Chart Analysis of the Tyrosine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 103 (Appendix 121, Page 290) shows that eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2) contained the highest amount of tyrosine (441.08µg/mg) when compared to other treatment groups. The figure further shows that eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder in feed (T3) had the lowest amount of tyrosine (299.87µg/mg), then followed by the tyrosine content of eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder in feed (T4) which contained the amount of 308.44µg/mg when compared to other eggs produced by inclusion of different amount of *Moringa oleifera* leaf powder in feeds.

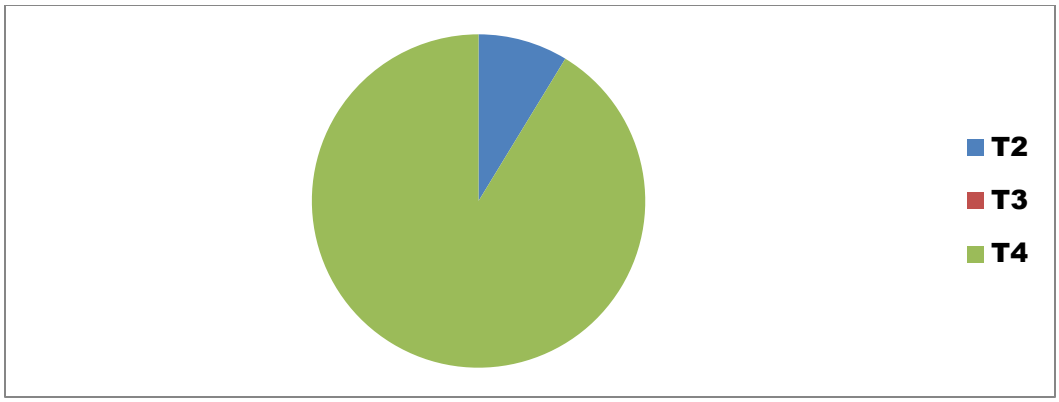

Figure 104: Pie Chart Analysis of the Threonine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the threonine content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 104 (Appendix 122, Page 290) shows that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* in feed contained the dominant amount of threonine (13.09µg/mg) with little amount (1.25µg/mg) found in eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder in feed (T2). The figure further shows that eggs produced by layers fed with 5% inclusion of *Moringa oleifera* leaf powder (T3) contained no threonine.

Figure 105: Pie Chart Analysis of the Phenylalanine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 105 (Appendix 123, Page 291) reveals that eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3) contained the highest amount of phenylalanine (983.18µg/mg) followed by the phenylalanine content of eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder (T4) which was 798.63µg/mg. According to Figure 105, it was discovered that eggs produced by layers fed with inclusion of 2.5% *Moringa oleifera* leaf powder (T2) in feed contained 0µg/mg of phenylalanine.

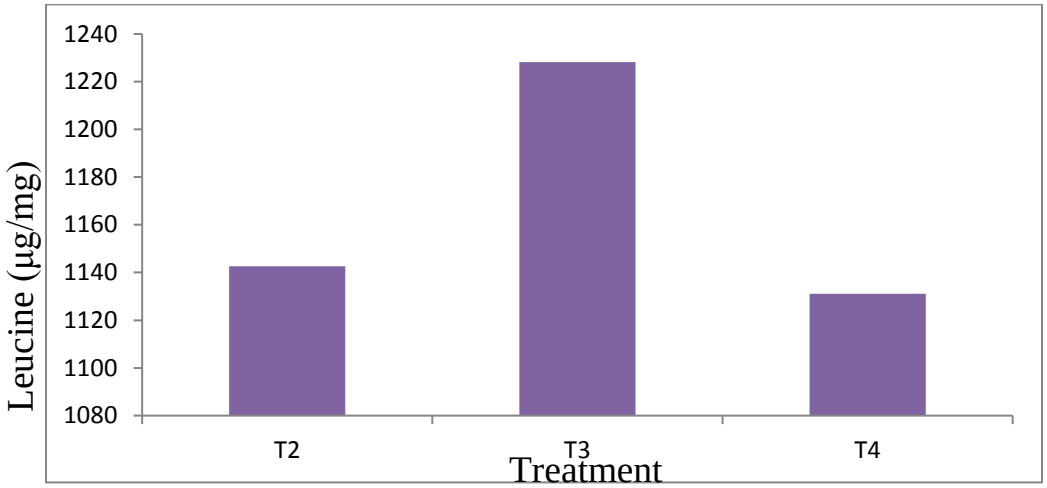

Figure 106: Bar Chart Analysis of the Leucine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 106 (Appendix 124, Page 291) indicates that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder (T3) contained the highest amount of leucine (1228.24µg/mg) when compared to other eggs produced by inclusion of different rates of *Moringa oleifera* leaf powder in feed. The figure further shows that eggs produced by inclusion of 7.5% *Moringa oleifera* leaf powder in feed (T4) contained the least amount of leucine, then followed by eggs produced by inclusion of 2.5% *Moringa oleifera* leaf powder (T2) which yielded the leucine content of 1142.62µg/mg.

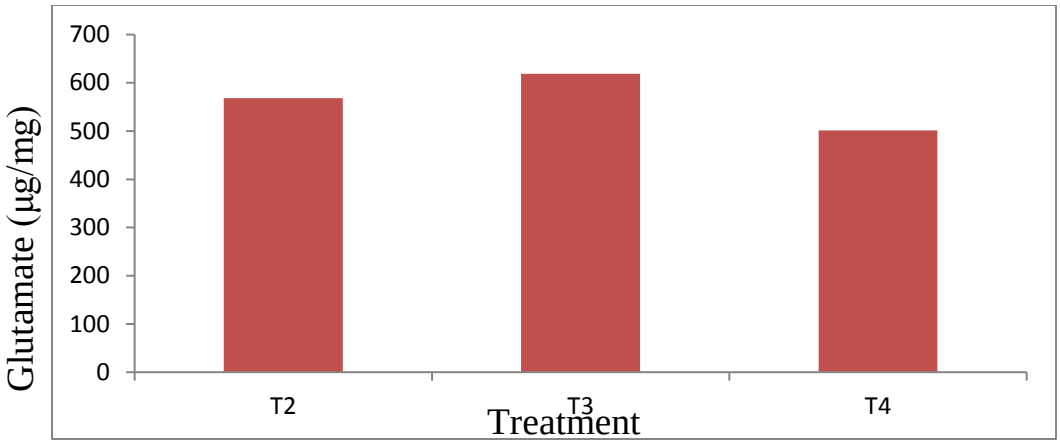

Figure 107: Bar Chart Analysis of the Glutamate Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

Information presented in Figure 107 (Appendix 125, Page 291) reveals that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder (T3) inclusion rate had the highest amount of glutamate (619.05µg/mg) when compared to others. Similarly, the figure above shows that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* (T4) leaf powder contained the least amount of glutamate (501.04µg/mg).

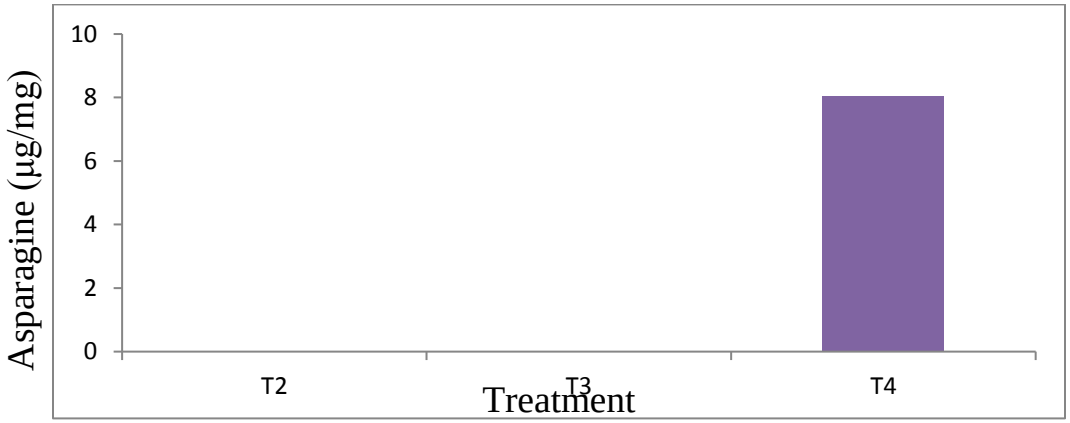

Figure 108: Bar Chart Analysis of the Asparagine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

On the asparagine content of eggs produced by inclusion of different rates of *Moringa oleifera* leaf powder in feed, Figure 108 (Appendix 126, Page 291) shows that it was only

eggs produced by inclusion of 7.5% *Moringa oleifera* leaf powder contained asparagine (8.056µg/mg). It was also discovered that both eggs produced by inclusion of 2.5% and 5% *Moringa oleifera* leaf powder contained 0µg/mg.

Figure 109: Pie Chart Analysis of the Tryptophan Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data presented in Figure 109 (Appendix 127, Page 291) shows that eggs produced by inclusion rate of 7.5% *Moringa oleifera* leaf powder (T4) contained the highest amount of tryptophan (428.74µg/mg) when compared to other eggs produced by inclusion of different rates of *Moringa oleifera* leaf powder in feed. This was followed by the tryptophan content of eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* which yielded the amount of 318.37µg/mg. The figure further shows that very little amount of tryptophan (0.03µg/mg) was contained in egg produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder (T2).

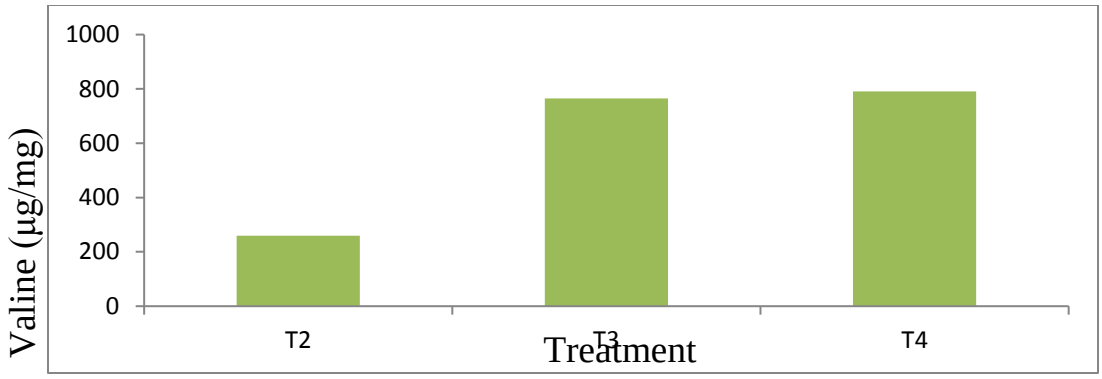

Figure 110: Bar Chart Analysis of the Valine Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

The data in Figure 110 (Appendix 128, Page 291) reveals that the valine content of eggs (790.89µg/mg) produced by inclusion of 7.5% *Moringa oleifera* leaf powder (T4) was the highest when compared to other eggs produced by inclusion of different rates of *Moringa oleifera* leaf powder in feeds. This was followed by the valine content of eggs (765.29µg/mg) produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder. The figure further shows that eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder contained the least amount of valine when compared to other eggs produced by inclusion of different rates of *Moringa oleifera* leaf powder in feeds.

Lipids Parameters

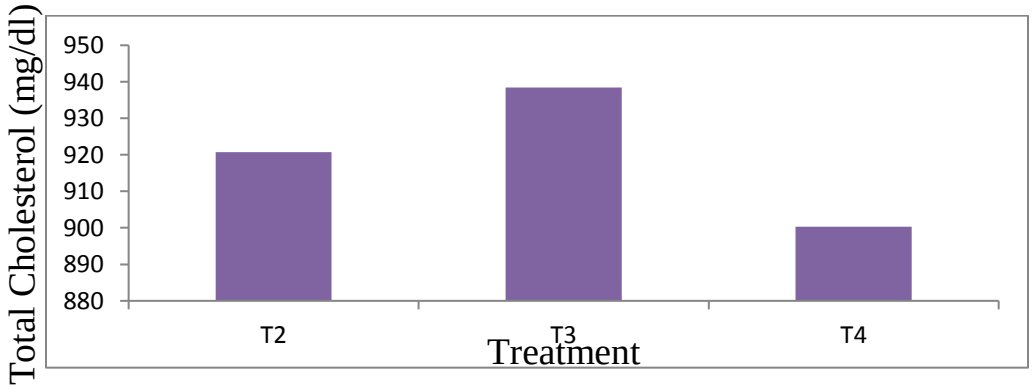

Figure 111: Bar Chart Analysis of the Total Cholesterol Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

On the lipids parameter of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, Figure 111 (Appendix 129, Page 291) shows that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the highest amount of total cholesterol. It was equally found that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder (T4) had the least amount of total cholesterol (900.28mg/dl)

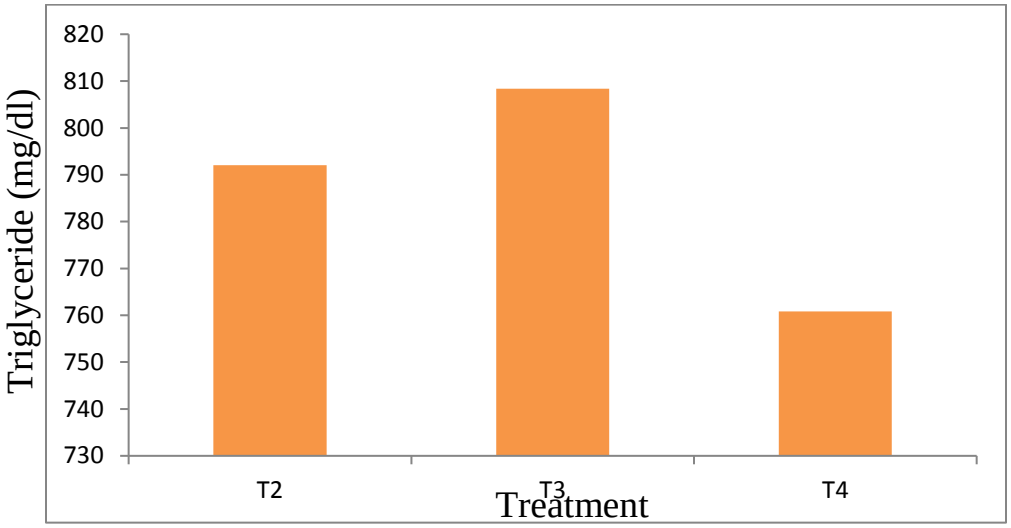

Figure 112: Bar Chart Analysis of the Triglyceride Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

Information presented in Figure 112 (Appendix 130, Page 292) shows that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder (T3) had the highest amount of triglyceride (808.38mg/dl) when compared to eggs produced by others. Similarly, the study found that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the least amount of triglyceride (760.83mg/dl)

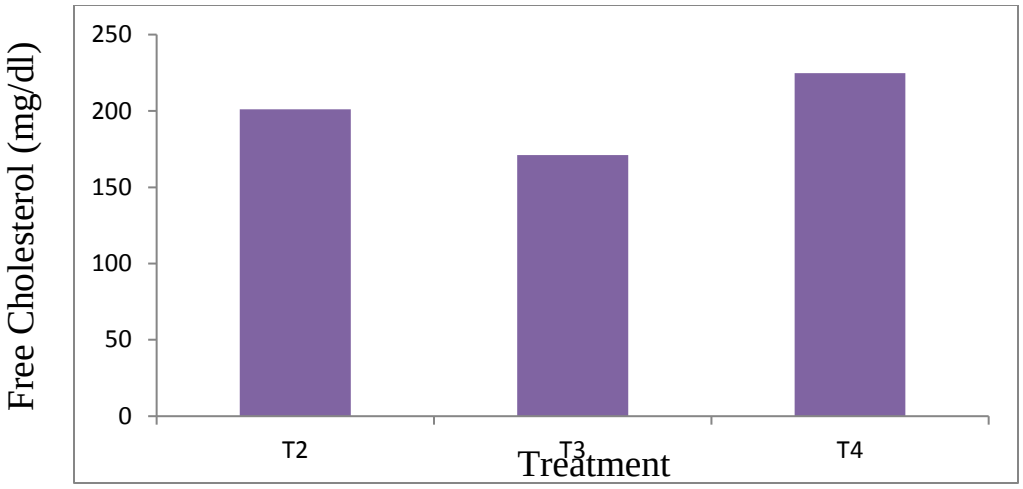

Figure 113: Bar Chart Analysis of the Free Cholesterol Content of Eggs Produced by Layers Fed with Inclusion of Different Rates of *Moringa oleifera* Leaf Powder.

Data presented in Figure 113 (Appendix 131, Page 292) shows that the highest free cholesterol content of egg was obtained in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder (T4) while the least amount of free cholesterol was obtained in eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder (T3).

Research Hypothesis 6: There is no significant difference in the mean nutritive value of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder

Data presented in Tables 25 - 29 are used to test null hypothesis 6.

Table 25: ANOVA Analysis of the Proximate Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2445.736	2	1222.868	.017	.983
Within Groups	1091417.590	15	72761.173		
Total	1093863.326	17			

The ANOVA analysis of the proximate content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder in feed presented in Table 25 shows that the probability value was 0.983 which was greater than 0.05. This implies that there was

no significant difference (p > 0.05) in the mean proximate content of eggs produced by layers fed with the inclusion of different rates of *Moringa oleifera* leaf powder in feed. Hence, the hypothesis of no significant difference was accepted.

Table 26: ANOVA Analysis of the Vitamin Profile of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	63.681	2	31.840	.012	.988
Within Groups	57301.690	21	2728.652		
Total	57365.370	23			

The data presented in ANOVA Table 26 on the Vitamin profile of eggs produce by layers fed with different inclusion rates of *Moringa oleifera* leaf powder shows that the probability value was 0.988 which was greater than 0.05. This signifies that there was no significant difference (p > 0.05) in the mean Vitamin profile of eggs produced by layers fed with inclusion of different rates of *Moringa oleifera* leaf powder in feed. Therefore, the null hypothesis was upheld.

Table 27: ANOVA Analysis of the Mineral Profile of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3989.680	2	1994.840	.242	.787
Within Groups	247469.409	30	8248.980		
Total	251459.089	32			

The ANOVA analysis of mineral profile of eggs produced by layers fed with different inclusion of *Moringa oleifera* leaf powder presented in Table 27 reveals that the probability value was 0.787 which was greater than 0.05. This implies that there was no significant

difference (p > 0.05) in the mean mineral profile of eggs produced by layers fed with inclusion of different rates of *Moringa oleifera* leaf powder in feed. Hence, the null hypothesis was accepted.

Table 28: ANOVA Analysis of the Amino Acids Profile of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	118539.493	2	59269.747	.391	.678
Within Groups	8191907.511	54	151701.991		
Total	8310447.004	56			

On the amino acids profile of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder in feed presented in ANOVA Table 28 above shows that the probability value was 0.678 which was greater than 0.05. This signifies that there was no significant difference in the mean amino acids profile of eggs produced by inclusion of different rates of *Moringa oleifera* leaf powder in feed. Therefore, the null hypothesis was accepted.

Table 29: ANOVA Analysis of the Lipids Parameters of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

ANOVA

Treatment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	203.096	2	101.548	.001	.999
Within Groups	886384.612	6	147730.769		
Total	886587.707	8			

ANOVA analysis of the lipids parameter of eggs produced by layers fed with different inclusion rates of M*oringa oleifera* leaf powder in Table 29 shows that the probability value was 0.999 which was greater than 0.05. This signifies that there was no significant difference

among the lipids parameters of eggs produced by layers fed with different inclusion rates of M*oringa oleifera* leaf power. Hence, the null hypothesis was accepted.

Research Question 7: What are the cost effectiveness of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed?

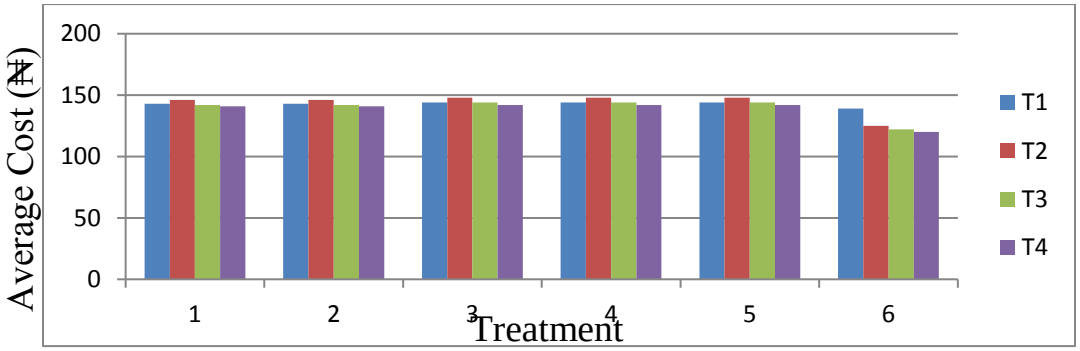

Figure 114: Average Cost of Feed/kilogramme Produced with *Moringa oleifera* Leaf Powder Fortified Feeds and the Control Feed

The data presented in Figure 114 (Appendix 132, Page 292) shows that feed produced by inclusion of 2.5% *Moringa oleifera* leaf powder had the highest cost in weeks 1, 2, 3, 4, and 5 while the control feed (T1) had the highest cost in week 6 of the production period under study. The figure further shows that feed produced by inclusion of 7.5% *Moringa oleifera* leaf powder (T4) had the least cost in the entire production week under study.

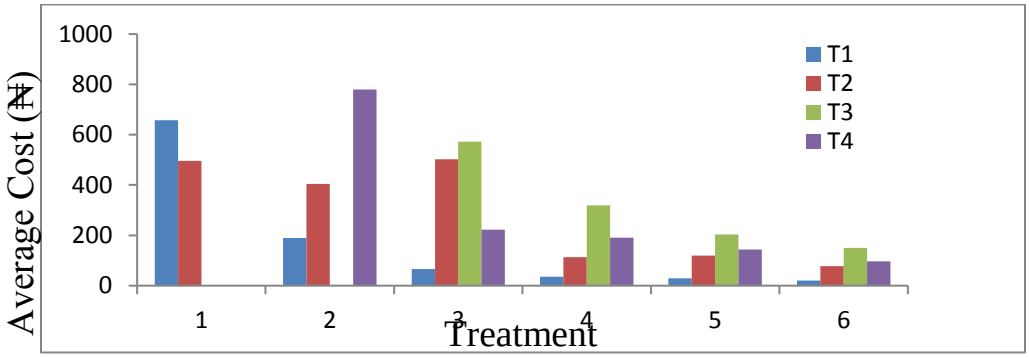

Figure 115: Average Feed Cost/Egg Produced with *Moringa oleifera* Leaf Powder Fortified Feeds and the Control Feed

Data presented in Figure 115 (Appendix 133, Page 292) indicated that the cost of feed spent to produce one egg was cheaper in eggs produced by layers in control group than others. In week 1 in control group, the cost of feed spent to produce one egg was very high but declined progressively as the hens laid more eggs over time. However, amount spent in producing one egg in T3 was higher than others in weeks 3, 4, 5 and 6.

Hypothesis 7: There is no significant difference in the mean cost of eggs produced with *Moringa oleifera* leaf powder and those with control feed

Table 30: ANOVA Analysis of the Cost of Feed/kilogramme Produced with *Moringa oleifera* leaf Powder and the Control Feed

ANOVA

Feed Cost	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	52.333	3	17.444	.427	.736
Within Groups	817.000	20	40.850		
Total	869.333	23			

The data presented in ANOVA Table 30 shows that the probability value was 0.736 which was greater than 0.05. This signifies that there was no significant difference between the cost of feed produced with *Moringa oleifera* leaf powder and the control feed. Therefore, the null hypothesis was accepted.

Table 31: ANOVA Analysis of the Feed Cost/Egg Produced with *Moringa oleifera* Leaf Powder Fortified Feeds and the Control Feed

ANOVA

Feed Cost	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	45632.833	3	15210.944	.269	.847
Within Groups	1132085.000	20	56604.250		
Total	1177717.833	23			

The information presented in Table 31 shows that the probability value was 0.847 which was greater than 0.05. This implies that there was no statistically significant difference between the mean feed cost per egg produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. Therefore, the hypothesis of no significant difference eas upheld.

Research Question 8: What is the cost effectiveness of eggs produced with different inclusion rates of *Moringa oleifera* leaf powder?

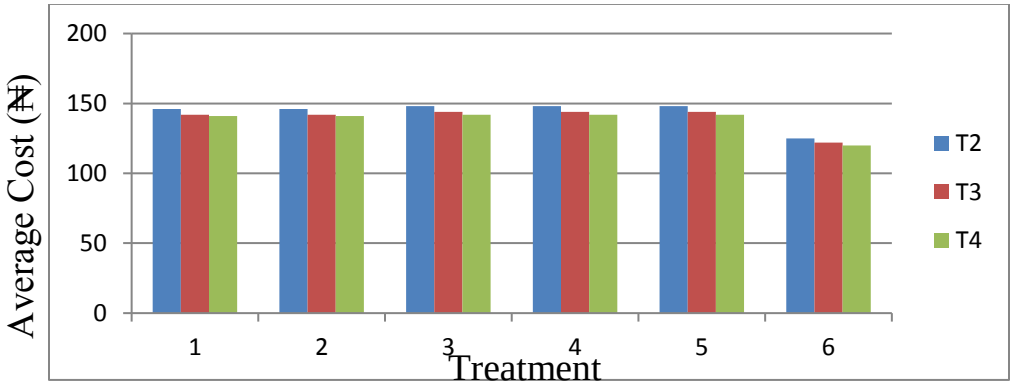

Figure 116: Average Cost of Feed/kilogramme Produced with Inclusion of Different Rates of *Moringa oleifera* Leaf Powder

The information presented in Figure 116 (Appendix 134, Page 292) indicates that feed produced by inclusion of 2.5% *Moringa oleifera* leaf powder had the highest cost in all the weeks of production under study. Similarly, feed produced by addition of 7.5% *Moringa oleifera* leaf powder in feed had the least cost in all the weeks under study.

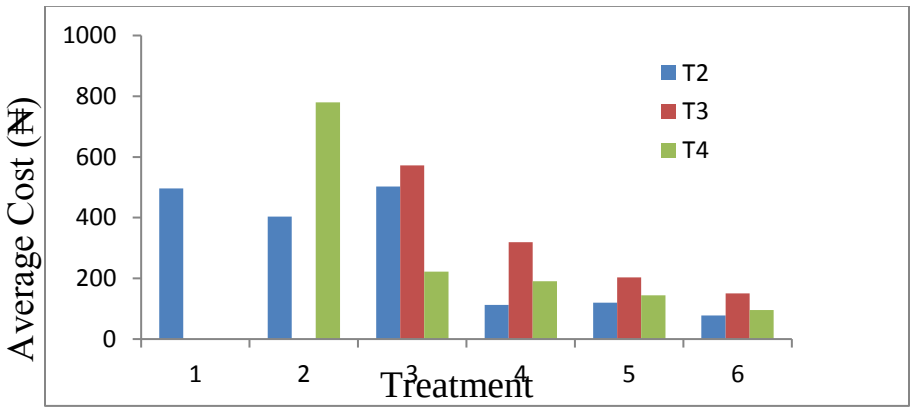

Figure 117: Average Feed Cost per Egg Produced with Inclusion of Different Rates of *Moringa oleifera* Leaf Powder

The data on feed cost/egg produced presented in Figure 117 (Appendix 135, Page 293) shows that the cost of producing on egg is very high in all the treatment groups. However, the cost of producing one egg using T2 feed was cheaper than other treatment groups.

Research Hypothesis 8: There is no significant difference among the cost of feeds produced with inclusion of different rates of *Moringa oleifera* leaf powder

Table 32: ANOVA Analysis of the Mean Cost of Feeds/Kilogramme Produced with Inclusion of Different Rates of *Moringa oleifera* Leaf Powder

ANOVA

Feed Cost	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	44.333	2	22.167	.417	.667
Within Groups	798.167	15	53.211		
Total	842.500	17			

The ANOVA analysis on the cost of feeds produced with inclusion of different rates of *Moringa oleifera* leaf powder presented in Table 32 indicates that the probability value was 0.667 which was greater than 0.05. This implies that there was no significant difference ($p > 0.05$) in the mean cost of feed/kilogramme produced with inclusion of different rates of *Moringa oleifera* leaf powder. Hence, the null hypothesis was upheld.

Table 33: ANOVA Analysis of the Mean Feed Cost per Egg Produced with Inclusion of Different Rates of *Moringa oleifera* Leaf Powder

ANOVA

Feed Cost	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18643.444	2	9321.722	.170	.845
Within Groups	822461.500	15	54830.767		
Total	841104.944	17			

Information in the ANOVATtable 33 shows that the probability value was 0.845 which was greater than 0.05. This implies that there was no significant difference in the mean

cost of feed per egg produced with inclusion of different rates of *Moringa oleifera* leaf powder. Ttherefore, the null hypothesis was accepted.

Research Question 9: What are the extent students participated in the research work acquired skills in feed formulation and layer production?

Table 34: Mean Analysis of the Extent Students Participated in the Research Work Acquired Skills in Feed Formulation and Layer Production

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Pre-test	12	38	5.19	1.49979
Post-test	12	72.	19.76	5.70353
Mean Gain		**34**	**14.57**	

The data presented in Table 34 shows that the mean pre-test score was 38 while the mean score of post-test was 72. The Table equally shows that the mean gain was 34. This implies that there was increase in skills acquisition in feed formulation and layer production among the students that participated in the research. Similarly, the standard deviation of the pre-test was 5.19 while the standard deviation of the post-test was 19.76. The difference in the standard deviation was 14.57 meaning that there was a wide disparity in skills acquisition before and after the research.

Hypothesis 9: There is no significant difference in the mean skills acquisition of participating students in feed formulation and layer production before and after the research work

Table 35: t-test Analysis of the Mean skills Acquired by the Students Participated in the Research Work in Feed Formulation and Layer Production

One-Sample Test

	Test Value = 0					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Pre-test	25.392	11	.000	38.08333	34.7823	41.3843
Post-test	12.624	11	.000	72.00000	59.4466	84.5534

The information presented in Table 35 shows that the probability value was 0.00 which was less than 0.05. This implies that there was a significant difference ($p > 0.05$) in the mean skills acquisition of students who participated in the research in feed formulation and layer production before and after the research work. Therefore, the null hypothesis was rejected.

Findings of the Study

The following were the findings of the study;

1. Average weights of layers from the four treatment groups vary from week to week. Layers fed with control feed had more average weight in weeks12, 13, 15, 16 and 19 while layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had more average weight in weeks 5, 6, 7, 8, 9, 10, 14, 19 and 20.

- On the average weight gain, it was found out that layers in T1 gained more weight than the others in weeks 6, 9, 11, 12, T2 gained more weight in weeks 5, 7 and 17 and 16 while layers in T3 as well gained more weight than others in weeks 15, 18, 19 and 20.
- On the average feed intake of layers, it was discovered that layers fed with control feed (T1) consume more feed in weeks 5, 6, 7, 8, 9, 11, 12, 15 and 19 while layers in T2 consumed more feed in some oher weeks 13, 14, 18 and 20.
- It was also found out that layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the least Feed Conversion Ratio (FCR) in weeks 5, 7, 8, 9, 10 and 20 and therefore better feed efficiency for those weeks while Layers in T3 had the least FCR in weeks 15, 16, 17 and 18 as well. T2 and T3 feeds had better efficiency than T1 as it had never assumed the least FCR in any of the weeks under study.

- The study found out that layers fed with control feed had the highest mortality percentage than other treatment groups while T3 had the least mortality percentage than others treatment groups as well.
- From the data collected and analysed, it was found out that there was no significant difference ($p > 0.05$) in the average weight of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed
- Similarly, it was found out that there was no statistically significant difference ($p > 0.05$) in the average weight gain of layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed.
- There was no significant difference ($p > 0.05$) in the average feed intake of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.
- It was equally found out that there was no significant difference ($p > 0.05$) in the average FCR of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.

2. On the average weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, the study found out that no particular treatment group had dominant average weight in all the research periods. Layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder had the highest average weight in some weeks while layers in T3 had the least average weight in some other weeks.

- From the data collected and analyzed on the average weight gain, it was found out that layers fed with T2 feed gained the highest weight in weeks 5, 7, 9, 11 and 17; layers in T3 gained the highest weight in weeks 6, 15, 18, 19 and 20 while layers in T4 gained the highest weight in weeks 8, 10, 12, 13 and 16 respectively.

- On the average feed intake/bird/day, it was found out that layers in T2 consumed the highest quantity of feed in weeks 6, 11, 12, 13, 14, 16, 18 and 20; T3 had the highest average feed intake/bird/day in weeks 5, 8, 15 while layers in T4 had the highest average feed intake/bird/day in weeks 16 and 19.
- Base on the data collected and analyzed on the FCR of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, it was found out that layers in T2 had the least FCR in weeks 5, 7, 9, 12 and 20; T3 had the least FCR in weeks 6, 15, 16, 17, and 18 while layers in T4 had the least FCR in weeks 8, 11, 13, and 14 respectively.
- On the percentage mortality of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, it was found out that T3 had the least mortality percentage while T4 had the highest percentage of mortality when compared to others.
- It was equally found out that there was no significant difference ($p > 0.05$) in the average weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder.
- On the average weight gain of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, the study found that there was no statistically significant difference ($p > 0.05$) among the treatment groups.
- It was equally found out that there was no significant difference ($p > 0.05$) in the average feed intake/bird/day of layers fed with different inclusion rates of *Moringa oleifera* leaf powder.
- Based on the data collected and analyzed, it was found out that there was no significant difference ($p > 0.05$) in the average FCR of layers fed with different inclusion rates of *Moringa oleifera* leaf powder.

3. On the average quantity of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, it was discovered that the average quantity of eggs produced by layers in control group was dominantly greater than the average quantity of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds. Layers in control group and layers in T2 started production earlier than those in T3 and T4.

- It was also found out that the average egg weight of layers fed with control feed was greater than the average egg weight of layers fed with *Moringa oleifera* leaf powder fortified feeds.
- The study further found out that the average egg mass of layers fed with control feed was greater than the average egg mass of layers fed with *Moringa oleifera* leaf powder fortified feeds.
- Similarly, the study discovered that the average laying percentage of layers in T1 was greater than the average laying percentage of layers in other treatment groups.
- It was further found out that there was statistically significant difference ($p < 0.05$) in the average quantity of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. The statistically significant difference was found to exist between the mean quantity of eggs produced by layers in control group and the mean quantity of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed.
- On the average weight of eggs produced by layers fed with *Moriga oleifera* leaf powder fortified feeds and those fed with control feed, it was found out that no significant difference ($p > 0.05$)existed.

- Based on the data collected and analyzed, it was found out that there was a significant difference ($p < 0.05$) between the average egg mass of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. It was further found out that the significant difference existed between the mean eggs mass produced by layers fed with control feed (T1) and mean eggs mass produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed.(T3).
- From the study, it was found out that there was statistically significant difference ($p < 0.05$) in the average laying percentage of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. The difference according to the data analyzed was found to exist between the average laying percentage of layers in control group and average laying percentage of layers in T3 which had the highest positive mean difference.

4. On the average quantity of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, it was discovered that layers fed with 2.5% *Moringa oleifera* leaf powder laid more eggs than layers in other groups. Similarly, layers in T2 came into production earlier than layers in T3 and T4.

- The study further found out that the average egg weight of layers fed with different inclusion of *Moringa oleifera* leaf powder was variable. Eggs laid by layers in T2 and T3 had more weight than eggs laid by layers in T4.
- Eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder had more average egg mass than eggs produced by layers fed with 5% and 7.5% inclusion rates of *Moringa oleifera* leaf powder.

- On the average laying percentage of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, the study found out that layers fed with 2.5% *Moringa oleifera* leaf powder produce more eggs than the others.
- Based on the data collected and analyzed, it was found out that there was no statistically significant difference ($p > 0.05$) in the average quantity of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder.
- It was equally found out that statistically significant difference did not exist ($p > 0.05$) among the average egg weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder.
- Similarly, no significant difference ($P > 0.05$) existed in the average egg mass of layers fed with different inclusion rates of *Moringa oleifera* leaf powder.
- The study found out that there was no significant difference ($p > 0.05$) in the average laying percentage of layers fed with different inclusion rates of *Moringa oleifera* leaf powder.

5. The study found out that eggs produced by layers fed with control feed had the highest amount of carbohydrate and crude protein than eggs produced by layers in T2, T3 and T4.

- Eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed had the least amount of crude lipids content and highest amount of moisture content than other treatment groups.
- It was equally discovered that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed had the highest amount of ash and Metabolizable energy content than eggs laid by layers in other treatment groups.

- However, the study found out that there is no significance difference ($P > 0.05$) in the mean proximate content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.
- On the Vitamin profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, it was discovered that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the highest amount of Vitamin A.
- The study also found out that eggs produced by layers fed with control feed contained the highest amount of Vitamins B1, B2 and B3.
- From the data collected and analyzed, it was found out that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the highest amount of Vitamin B5.
- The study equally found out that eggs produced by layers fed with control feed contained the highest amount of Vitamin C.
- It was also found out that the highest amount of Vitamin D and Vitamin E was contained in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed.
- The study equally found out that there was no significant difference in the mean vitamin profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.
- The findings of the study showed that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest quantity of phosphorous and Sodium.

- Similarly, the study found out that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder had the highest amount of magnesium.
- It was also discovered that eggs produced by layers fed with control feed contained the highest quantity of Zinc.
- The findings also showed that the highest amount of manganese was contained in eggs produced by layers fed with 2.5% and 7.5% *Moringa oleifera* leaf powder fortified feeds as both eggs had equal amount of manganese.
- It was found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of Iron.
- The study equally found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder had the dominant amount of potassium.
- Base on the data collected and analyzed, it was found out that calcium content of eggs was dominantly contained in eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder and was insignificantly present in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed.
- On the copper content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the study found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of copper while very small amount of copper was present in eggs produced by layers fed with control feed.
- The study equally found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the dominant amount of Selenium and Chromium.

- The study however found out that there was no significant difference (P > 0.05) in the mean Mineral profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.
- On the amino acids profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the study found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed contained the dominant amount of arginine.
- Eggs produced by layers fed with control feed contained the highest amount of aspartate
- Based on the data collected and analyzed, it was discovered that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of serine.
- The study also found out that the dominant amount of cysteine was present in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed.
- The glycine content of eggs according to the findings was highest in eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed.
- It was found out that eggs produced by layers fed with control fed had the highest amount of Isoleucine and lysine
- On the hisidine and methionine content of eggs, the study found out that eggs produced by layers fed with 2.5% *Moringa o*leifera leaf powder fortified feed contained the highest amount.
- The study equally found out that eggs produced by layers fed with 5% Moringa oleifera leaf powder fortified feed contained the highest amount of proline.

- It was found out that eggs produced by layers fed with control fed had the highest amount of alanine and tyrosine.
- The findings of the study showed that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of threonine. Similarly, it was discovered that eggs produced by layers fed with control feed and eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed did not contain threonine.
- The study found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of phenylalanine, leucine and glutamate.
- It was found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the dominant amount of asparagine and tryptophan. It was equally discovered that asparagine was totally absent in eggs produced by layers fed with control feed, 2.5% and 5% *Moringa oleifera* leaf powder fortified feeds.
- The findings of the study showed that eggs produced by control feed contained the highest amount of valine
- The study further found out that none of the treatment groups contained glutamine at all.
- It was equally found out that there was no significant difference ($P > 0.05$) in the mean amino acids profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with no *Moringa oleifera* leaf powder fortified feed.
- On the lipids parameter of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the study found out that eggs

produced by layers fed with control feed contained the highest amount of total cholesterol than the other treatment groups while eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed had the least amount of total cholesterol.

- The study further found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed had the highest amount of triglyceride while eggs produced by layers fed with control feed contained the least amount of triglyceride when compared to the other eggs.
- On the free cholesterol level of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the study discovered that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount while eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the least amount.
- Moreover, the study found out that there was no significant difference ($p > 0.05$) in the mean lipids parameters of eggs produced by layers fed with M*oringa oleifera* leaf power fortified feeds and those fed with control feed.

6. On the proximate content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder in feeds, it was found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the highest amount of carbohydrate, ash and Metabolizeable energy.

- It was equally found that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the highest amount of moisture, crude protein and the least amount

of crude lipids. Eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the highest amount of crude lipids.

- It was further found out that there was no significant difference ($P > 0.05$) in the mean proximate content of eggs produced by layers fed with the inclusion of different rates of *Moringa oleifera* leaf powder in feed.
- On the Vitamin profile of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, it was found out that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* contained the highest amount of Vitamin A
- The study equally discovered that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder inclusion rate had the highest content of Vitamin B1
- It was found out that the highest amount of Vitamin B2 was contained in eggs produced by layers fed with 5% inclusion of *Moringa oleifera* leaf powder.
- Similarly, the study discovered that eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder contained the dominant quantity of Vitamins B3 and B5
- Based on the data collected and analyzed, it was found out that eggs produced by layers fed with 2.5% and eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder contained the highest and equal amount of Vitamin C.
- Furthermore, the study found out that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder contained the highest amount of Vitamin D and Vitamin E.

- It was further found out that there was no significant difference (P > 0.05) in the mean Vitamin profile of eggs produced by layers fed with inclusion of different rates of *Moringa oleifera* leaf powder in feed.
- On the mineral constituent of eggs produced by layers fed with different inclusion of *Moringa oleifera* leaf powder in feed, the study found out that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder contained the highest amount of phosphorous and Sodium.
- The study further found out that eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder in feed had the highest amount of Magnesium.
- It was also found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder inclusion rate contained the highest amount of Zinc.
- Based on the data collected and analyzed, it was found out that eggs produced by inclusion of 2.5% and 7.5% *Moringa oleifera* leaf powder contained the highest and equal amount of Manganese.
- Furthermore, the study discovered that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder in fed contained the highest amount of Iron.
- It was found out that the potassium constituent of eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder was the highest.
- The study equally found out that the calcium constituent of eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder in feed was the highest in quantity.

- According to the findings, the study discovered that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder contained the dominant quantity of copper, selenium and chromium. The study further found out that eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder in feed contained no chromium.
- On the amino acids profile of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder in feed, it was discovered that eggs produced by layers fed with 5% inclusion of *Moringa oleifera* leaf powder contained the highest amount of arginine.
- The study further found out that the aspartate constituent of eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder in feed dominated the others.
- It was found out that eggs produced by layers fed with 5% inclusion of *Moringa oleifera* in feed had the highest constituent of serine.
- It was also found out that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* in feed contained the highest amount of cysteine.
- Based on the data collected and analyzed, it was discovered that eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder in feed contained the highest amount of glycine and isoleucine.
- The findings showed that lysine was dominantly present in eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder in feed.
- The study also found out that eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder had the highest amount of histidine.

- The study further discovered that eggs produced by layers fed with 5% inclusion of *Moringa oleifera* in feed had that highest amount of proline.
- On the methionine content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, it was found out that the methionine constituent of eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder dominated.
- The study discovered that the alanine content of eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder was the highest.
- It was also found out that eggs produced by the inclusion of 2.5% *Moringa oleifera* leaf powder in layer feed had the highest amount of tyrosine.
- The findings showed that the threonine content of eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder was the highest. Similarly, the study found out that eggs produced by inclusion of 5% *Moringa oleifera* leaf powder did not contain threonine.
- According to the data collected and analyzed, eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder contain the highest quantity of phenylalanine, leucine and glutamate. The findings further show that eggs produced by the inclusion of 2.5% *Moringa oleifera* leaf powder did not contain phenylalanine.
- The study also discovered that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder contained the highest amount of asparagine, tryptophan and valine. The study also found out that eggs produced by layers fed with 2.5% and 5% inclusion of *Moringa oleifera* did not contain asparagine.

- The data collected and analyzed show that glutamine was not contained by any of the eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder.
- On the lipids parameters of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, the study found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the highest quantity of total cholesterol while eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder had the least amount of total cholesterol.
- Based on the data collected and analyzed, it was discovered that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder had the highest amount of triglyceride while eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the least amount of triglyceride.
- The study equally found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the highest amount of free cholesterol while eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the least amount of free cholesterol.
- It was further found out that there was no significant difference ($p > 0.05$) among the mean lipids parameters of eggs produced by layers fed with different inclusion rates of M*oringa oleifera* leaf power.

7. On the cost of feeds per kilogramme produced with varying amount of *Moringa oleifera* leaf powder and the control feed, it was found out that feed produced by addition of 2.5% *Moringa oleifera* leaf powder had the highest cost in almost all the

weeks in the production period while feed produced by addition of 7.5% *Moringa oleifera* leaf powder had the least cost when compared to other feeds.

- It was also discovered that the cost of feed spent to produce one egg was cheaper in egg produced by layers fed with control feed than eggs produced in T2, T3 and T4.
- However, it was found out that there was no significant difference ($p > 0.05$) in the mean cost of feeds produced with *Moringa oleifera* leaf powder and those produced without *Moringa oleifera* leaf powder.
- Similarly, no statistically significant difference ($p>0.05$) existed in the mean feed cost per egg producd by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.

8. On the cost of feeds per kilogramme produced with inclusion of varying quantities of *Moringa oleifera* leaf powder, the study found out that feed produced with inclusion of 2.5% *Moringa oleifera* leaf powder had the highest cost while feed produced with inclusion of 7.5% *Moringa oleifera* leaf powder leaf the least cost.

- Moreover, the study found out that the cost of producing one egg using T2, T3 and T4 feeds was very high with T3 recording highest in weeks 3, 4, 5 and 6 while T2 had the lowest cost in those weeks.
- There was however no statistically significant difference ($P > 0.05$) in the mean cost of feeds per kilogramme produced with addition of varying quantities of *Moringa oleifera* leaf powder.
- There was no significant difference ($p > 0.05$) in the mean feed cost per egg produced with different inclusion rates of *Moringa oleifera* leaf powder.

9. The study further found out that there was an increase in skills acquired in feeds formulation and layer production among the students participated in the research.

- It was also found out that there was statistically significant difference ($p > 0.05$) in skills acquisition in feed formulation and layer production among the students that participated in the study.

Discussion of the Findings

The findings of the study are discussed under the following sub-headings:

1. Effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the growth of layers
2. Effects of different inclusion rates of *Moringa oleifera* leaf powder on the growth of layers.
3. Effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the egg production of layers.
4. Effects of different inclusion rates of *Moringa oleifera* leaf powder on the egg production of layers.
5. Effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the nutritive value of eggs produced by the layers.
6. Effects of different inclusion rates of *Moringa oleifera* leaf powder on the nutritive value of eggs produced by the layers.
7. Cost effectiveness of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.

8. Cost effectiveness of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder.
9. Extent of acquisition of skills on feed formulation and layer production by the students that participated in the research.

Effects of Moringa oleifera Leaf Powder Fortified Feeds and Control Feed on the Growth of Layers

The findings of the study showed that the average weight of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed vary in some weeks. Layers fed with control feed had more average weight in some weeks within the production period while those fed with 2.5% *Moringa oleifera* leaf powder fortified feed had more average weight in some other weeks. The study equally found that layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the highest average weight gain in some weeks while layers fed with 5% *Moringa oleifera* leaf powder fortified feeds gained the highest average weight in some other weeks. It was also found that layers fed with control feed had the highest average feed intake in most of the weeks within the production period while layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed consumed the highest quantity of feed in some other weeks. It was also found that layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the least Feed Conversion Ratio (FCR) in some weeks and therefore better feed efficiency for those weeks while Layers in T3 had the least FCR in some other weeks as well. T2 and T3 feeds had better efficiency than T1 in some weeks.

The study found that layers fed with control feed had the highest mortality percentage than other treatment groups while T3 had the least mortality percentage than other treatment groups as well. The findings are supported by Richter, Siduhuraju and Becher (2003) who found that higher inclusion level of *Moringa oleifera* leaf powder depressed the growth performance of Tilapia fish compared to control group and group with little amount of *Moringa oleifera* leaf powder. According to the authors, the poor growth performance of the fish was attributed to the high relatively total phenolics, nonhaemolytic saponin, phytic acid as well as the neutral detergent fibre (NDF) and acid detergent fibre (ADF) contents of *Moringa oleifera* leaves. On the average weight gain of layers, the findings are in agreement with the findings of Ufele, Ebenebe, Igwe, Mogbo, Akunne and Aziagba (2013) who reported that average weight gain was highest in rabbit fed with 20% *Moringa oleifera* leaf meal when compared to the rabbit fed with control feed. The findings were equally in line with the findings of Ifedibia (2014) who reported that the mean weight gain of grasscutter fed with *Moringa oleifera* supplement was higher than the mean weight gain of grasscutter fed with control feed. The findings of the study were equally in agreement with the findings of Abou-Elezz, Sarmiento-Franco, Santos-Ricalde and Solorio-Sanchez (2012) who reported that layers fed with restricted feed and *Moringa oleifera* leaf had lower values of body weight and better feed conversion ratio than layers fed with control feed.

Effects of Different Inclusion Rates of Moringa oleifera Leaf Powder on the Growth of Layers.

Based on the data collected and analyzed on the average weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, the study found out that no particular treatment group had dominant average weight within the research periods. Layers

fed with 2.5% inclusion of *Moringa oleifera* leaf powder had the highest average weight in some weeks while layers in T3 had the least weight in some other weeks. On the average weight gain, it was found that layers fed with T2 feed gained the highest weight in weeks 5, 7, 9, 11 and 17; layers in T3 gained the highest weight in weeks 6, 15, 18, 19 and 20 while layers in T4 gained the highest weight in weeks 8, 10, 12, 13 and 16 respectively. On the average feed intake/bird/day, it was found that layers in T2 consumed the highest quantity of feed than other groups in weeks 6, 11, 12, 13, 14, 16, 18 and 20; T3 had the highest average feed intake/bird/day in weeks 5, 8 and 15 while layers in T4 had the highest average feed intake/bird/day in weeks 16 and 19.

Similarly, it was found that layers in T2 had the least FCR in weeks 5, 7, 9, 12 and 20; T3 had the least FCR in weeks 6, 15, 16, 17 and 18 while layers in T4 had the least FCR in weeks 8, 11, 13 and 14 respectively. On the percentage mortality of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, it was found that T3 had the least mortality percentage while T4 had the highest percentage of mortality than others. The findings were in alignment with the findings of Gadzirayi, Mupangwu and Washaya who worked on the performance of broiler chickens fed with mature *Moringa oleifera* leaf meal as a supplement to soybeans meal in 2012. The authors found that no significant difference was noted in the amount of feed taken by broilers under different treatments of *Moringa oleifera* leaf meal. Gadzirayi et al (2012) further found that inclusion of *Moringa oleifera* leaf meal at the rate of 25% produced broilers of similar weight and growth rate compared to those fed with conventional feed.

Effects of Moringa oleifera Leaf Powder Fortified Feeds and Control Feed on the Egg Production of Layers.

On the average quantity of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, it was discovered that the average quantity of eggs produced by layers in control group was dominantly greater than the average quantity of eggs produced by layers in T1, T2 and T3. Layers in control group and layers in T2 started production earlier than those in T3 and T4. It was also found out that the average egg weight of layers fed with control feed was greater than the average egg weight of layers fed with *Moringa oleifera* leaf powder fortified feeds. The study further found out that the average egg mass of layers fed with control feed was greater than the average egg mass of layers fed with *Moringa oleifera* leaf powder fortified feeds. Similarly, the study discovered that the average laying percentage of layers fed with control feed (T1) was greater than the average laying percentage of layers in T2, T3 and T4. It was further found out that there was statistically significant difference ($P > 0.05$) in the average quantity of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. The statistically significant difference was found to exist between the average quantity of eggs produced by layers in control group and the average quantity of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed.

On the average weight of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, it was found that no significant difference ($P > 0.05$) existed. Based on the data collected and analyzed, it was equally found that there was a significant difference ($P < 0.05$) in the average egg mass of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. It was further

confirmed that the significant difference existed between the mean eggs mass produced by layers fed with control feed (T1) and mean eggs mass produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed.(T3). The findings of the study were in consonance with the findings of Abou-Elezz et al (2012) who studied on the nutritional effect of *Moringa oleifera* fresh leaves as feed supplement on Rhode Island Red hen egg production and quality. According to the findings of the authors, layers fed with restricted feed and *Moringa oleifera* leaves had lower values of egg laying rate, egg weight and egg mass. The differences in egg production parameters between the layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed can be attributed to the presence of anti-nutrient factors in *Moringa oleifera* leaf powder. Ant-nutrient factors according to Soetan and Oyewole (2009) are compounds which reduce the nutrient utilization and metabolism of plant products used as food for humans and animals. Ndubuaku, Nwankwo, Baiyeri and Ukonze (2015) in their study found out that *Moringa oleifera* contains some anti-nutrients and include tannin, oxalate, phytate and saponin. According to the authors, phytates decrease the availability of minerals and reduce protein digestion. Foidl, Makkar and Becher (2001) equally found that the presence of oxalates and phytic acids in *Moringa oleifera* leaf powder reduces the bioavailability of minerals in the product.

Effects of Different Inclusion Rates of Moringa oleifera Leaf Powder on the Egg Production of Layers

On the average quantity of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, it was discovered that layers fed with 2.5% *Moringa oleifera* leaf powder laid more eggs than layers in other groups. Similarly, layers in T2 come into production one week earlier than layers in T4, and two weeks earlier than layers in T3. The

study further found that the average egg weight of layers fed with different inclusion of *Moringa oleifera* leaf powder was variable. Eggs laid by layers in T2 and T3 had more weight than eggs laid by layers in T4. Eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder had greater average egg mass than eggs produced by layers fed with 5% and 7.5% inclusion rates of *Moringa oleifera* leaf powder. On the average laying percentage of layers fed with different inclusion rates of *Moringa oleifera* leaf powder, the study found out that layers fed with 2.5% *Moringa oleifera* leaf powder produced more eggs than the others. Based on the data collected and analyzed, it was found that there was no statistically significant difference ($P > 0.05$) in the average quantity of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder.

It was equally found that statistically significant difference did not exist ($P > 0.05$) among the average egg weight of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. Similarly, no significant difference existed ($P > 0.05$) in the average egg mass of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. The study found that there was no significant difference in the average laying percentage of layers fed with different inclusion rates of *Moringa oleifera* leaf powder. The findings were in consonance with the findings of Ebelebe, Anigbogu, Anizoba and Ufele who studied the effects of various levels of *Moringa oleifera* leaf meal on the egg quality of Isa brown breed of layers in 2013. According to Ebelebe at al, layers fed with 2.5% *Moringa oleifera* leaf meal produced the highest numbers of eggs when compared with eggs produced by the other treatment groups. The authors equally found out that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf meal had the highest egg weight. The findings were also in line with the findings of Raphael, Christian, Juliano, Lisita, Soultan. Herve and Alexis (2015) who reported that the

rates of laying, egg weight and egg width decrease with increasing levels of *Moringa oleifera* leaf meal in the diets. The authors further found that layers fed with the lowest amount of *Moringa oleifera* leaf meal (5%) laid their first eggs one week earlier than those layers fed with the highest inclusion of *Moringa oleifera* leaf meal (10%) in diets.

Effects of Moringa oleifera Leaf Powder Fortified Feeds and Control Feed on the Nutritive Value of Eggs Produced by the Layers

Based on the data collected and analyzed, the study discovered that eggs produced by layers fed with control feed had the highest amount of carbohydrate and crude protein than those fed with *Moringa oleifera* leaf powder fortified feeds. Eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed had the least amount of crude lipids content and highest amount of moisture content than other treatment groups. It was equally discovered that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed had the highest amount of ash and Metabolizable energy content than eggs laid by layers in other treatment groups. However, there is no significance difference ($p > 0.05$) in the mean proximate content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.

The findings were in line with the findings of Ezeokeke and Onuoha (2016) who reported that maize contains 80% carbohydrate while soybean contains 43% crude protein. These were the main feed ingredients used as the carbohydrate and protein sources in feed formulation. Moyo, Masika, Hugo and Muchnje (2011) found that dried *Moringa oleifera* leaf contain 30% crude protein. This was in support of the proximate analysis of the *Moringa oleifera* leaf powder used in the study (Appendix 2, Page 243) which found out that the percentage

composition of crude protein and carbohydrate were 30% and 32% respectively. Ndubuaku et al (2015) found that the presence of phytate and oxalate in *Moringa oleifera* leaf powder limits the nutrients contained in them thus lowering the amount of carbohydrate and crude protein contained in eggs produced by layers fed with *Moringa oleifera* leaf powder. Similarly, the findings were in line with Amabye (2016) who found that *Moringa oleifera* leaf powder contained high quantity of ash (11%) which signifies that eggs produced with high inclusion of *Moringa oleifera* in the feed will contain many minerals. The findings were also supported by the proximate composition of the *Moringa oleifera* leaf powder used in the experiment which indicated the presence of high quantity of ash (12%), metabolizeable energy (299.33%) and low amount of crude lipids (5.77%) (Appendix 2, Page 243).

On the Vitamin profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, it was discovered that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the highest amount of Vitamin A. The study also found out that eggs produced by layers fed with control feed contained the highest amount of Vitamins B1, B2 and B3. From the data collected and analyzed, it was found out that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the highest amount of Vitamin B5. The study equally found that eggs produced by layers fed with control feed contained the highest amount of Vitamin C. It was also found out that the highest amount of Vitamin D and Vitamin E was contained in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed. However, there was no significant difference ($p > 0.05$) in the mean vitamin profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed.

The findings of the study were in agreement with the findings of Abioye and Aka (2015) who reported that there was a significant increase in vitamin A (beta carotene) as a result of increase in the inclusion level of *Moringa oleifera* leaf powder in feed. The findings were also in consonance with Anwar, el at (2007) who found that the presence of β-carotene, vitamin A, C and E in *Moringa oleifera* leaf powder explains the reason people recommend it for organic feed additive. Akhouri, et al (2013) found that *Moringa oleifera* is a good source of provitamin A, Vitamin B and C but the bioavailability of the nutrients are hindered by the presence of anti-nutrient factors.

The findings of the study showed that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest quantity of phosphorous and Sodium. Similarly, the study found that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder had the highest amount of magnesium. It was also discovered that eggs produced by layers fed with control feed contained the highest quantity of Zinc. The findings also showed that the highest amount of manganese was contained in eggs produced by layers fed with 2.5% and 7.5% *Moringa oleifera* leaf powder fortified feeds as both eggs had equal amount of manganese. It was found that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of Iron. The study equally found that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder had the dominant amount of potassium. Based on the data collected and analyzed, it was found out that calcium content of eggs was dominantly contained in eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder and was insignificantly present in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed. On the copper content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the

study found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of copper while very small amount of copper was present in the eggs produced by layers fed with control feed. The study equally found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the dominant amount of Selenium and Chromium.

However, there is no significant difference ($p > 0.05$) in the mean mineral profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. The findings were in line with the findings of Moyo, et al (2011) who reported that *Moringa oleifera* leaf powder is a good source of iron, zinc and copper to layers when included in feed. Similarly, the result presented by Amabye in 2016 showed that there was high presence of calcium, magnesium, potassium, iron and sodium in *Moringa oleifera* leaf powder. The result of the analysis presented by Abiyo and Aka in 2015 equally showed that there was an increase in some selected minerals with increase in *Moringa oleifera* leaf powder inclusion in feed. The authors found that the increase in calcium, magnesium, iron, potassium, zinc and copper contents of Moringa supplemented feed made it an excellent additive in layer feeds. The absence of chromium in eggs produced by layers fed with control feed but high in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed testified the importance of Moringa.

On the amino acids profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the study found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed contained the dominant amount of arginine. Eggs produced by layers fed with control feed contained the highest amount of aspartate. Based on the data collected and analyzed, it was discovered that eggs

produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of serine. The study also found out that the dominant amount of cysteine was present in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed. The glycine content of eggs according to the findings was highest in eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed. It was found out that eggs produced by layers fed with control fed had the highest amount of Isoleucine and lysine. On the hisidine and methionine content of eggs, the study found out that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount. The study equally found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of proline. The findings of the study showed that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount of threonine. Similarly, it was discovered that eggs produced by layers fed with control feed and eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed did not contain threonine. However, there was no significant difference ($P > 0.05$) in the mean amino acids profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with no *Moringa oleifera* leaf powder fortified feed.

The findings were supported by the study of Moyo et al (2011) on the nutritional characterization of Moringa (*Moringa oleifera* Lam.) leaves which found that amino acids profile of *Moringa oleifera* showed the presence of high quantity of arginine, serine, cysteine, glutamate, histidine, proline, methionine, threonine, tryptophan, phenylalanine and leucine. Amino acids play significant role in the formation of protein and therefore determine the quality, quality and functions of protein. Generally, amino acids are required in growth, repair

of worn-out tissues, formation of hormones and enzymes. The findings of the present study showed that eggs produced by layers fed with control feed did not contain threonine and asparagine but high in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed. If amino acids are the building units of protein, it therefore means that protein in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder is better than protein in eggs produced by layers in T1, T2 and T3.

On the lipids parameters of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the study found out that eggs produced by layers fed with control feed contained the highest amount of total cholesterol than the other treatment groups while eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed had the least amount of total cholesterol. The study further found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed had the highest amount of triglyceride while eggs produced by layers fed with control feed contained the least amount of triglyceride when compared to the other eggs. On the free cholesterol level of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the study discovered that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount while eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the least amount. Moreover, the study found out that there was no significant difference ($p > 0.05$) in the mean lipids parameters of eggs produced by layers fed with M*oringa oleifera* leaf power fortified feeds and those fed with control feed.

The findings were in line with the findings of Anthony and Ashawe (2014) who studied the effects of *Moringa oleifera* leaf meal on the hematological parameters and the cholesterol

level of rabbits. The authors found out that addition of 15% *Moringa oleifera* leaf meal in diets of weaner rabbits had significant effect on the reduction of cholesterol level. The findings were also supported by El-Sheikh, El-Shazly, Abbas and El-Gobary (2015) who found out that inclusion of *Moringa oleifera* leaf powder in feed resulted to a significant decrease in total cholesterol and as well increase significantly the amount of high density lipoprotein (HDL). The authors further found out that the decreased yolk weight in eggs was a result of lower cholesterol content of eggs. The findings of Halaby, Elmetwaly and Omar (2013) were in line with the findings of the present study. The authors found out that addition of *Moringa oleifera* leaf powder at the rate of 10% and 15% caused significant reduction in total cholesterol, triglyceride, low density lipoprotein (LDL) and very low density lipoprotein (VLDL). In their study, Priyadarshani, Pratap and Varma (2013) found that *Moringa oleifera* leaf powder improved serum lipid profile in normal and diabetic mice by decreasing the total cholesterol, triglyceride, LDL and increasing serum HDL when compared to the control.

Effects of Different Inclusion Rates of Moringa oleifera Leaf Powder on the Nutritive Value of Eggs Produced by the Layers.

On the proximate content of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder in feeds, it was found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the highest amount of carbohydrate, ash and Metabolizeable energy. It was equally found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the highest amount of moisture and crude protein, and the least amount of crude lipids. Eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder also contained the highest amount of crude lipids. However, there was no significant difference ($p > 0.05$) in the mean proximate content of eggs produced by layers fed

with the inclusion of different rates of *Moringa oleifera* leaf powder in feed. The findings of the study were supported by the findings of Amabye (2016) who reported that Moringa was found to contain crude protein (10.6%), crude fiber (8%), ash (about 11%), carbohydrates (56%), moisture (3.2%), and lipid (about 10.2%). The ash content of about 11% indicates that the leaves are rich in minerals. However, the findings of the study were in contrast with the findings of Abioye and Aka (2015) who found out that the crude protein content of feed supplemented with *Moringa oleifera* leaf powder increases with the increase in the quantity of Moringa inclusion. According to the authors, feed with 15% *Moringa oleifera* leaf powder contained the highest amount of protein.

On the Vitamin profile of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, it was found out that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* contained the highest amount of Vitamin A. The study equally discovered that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder inclusion rate had the highest content of Vitamin B1. It was found out that the highest amount of Vitamin B2 was contained in eggs produced by layers fed with 5% inclusion of *Moringa oleifera* leaf powder. Similarly, the study discovered that eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder contained the dominant quantity of Vitamins B3 and B5. Based on the data collected and analyzed, it was found out that eggs produced by layers fed with 2.5% and eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder contained the highest and equal amount of Vitamin C. Furthermore, the study found out that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder contained the highest amount of Vitamin D and Vitamin E. It was further found out

that there was no significant difference in the mean Vitamin profile of eggs produced by layers fed with inclusion of different rates of *Moringa oleifera* leaf powder in feed.

The findings of the study were in agreement with the findings of Moyo et al (2011) who found out that *Moringa oleifera* leaf powder contained high amount of Vitamins A and E. The findings were also supported by the findings of Anwar (2007) who reported that the reducing potentials of *Moringa oleifera* was as a result of the high level content of β-carotene, Vitamins A, C and E. The findings of Abioye and Aka (2015) showed that supplementation of feeds with *Moringa oleifera* leaf powder will help to alleviate the problem of Vitamin A deficiency

On the mineral constituent of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder in feed, the study found out that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder contained the highest amount of phosphorous and Sodium. The study further found out that eggs produced by layers fed with 2.5% inclusion rate of *Moringa oleifera* leaf powder in feed had the highest amount of Magnesium. It was also found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder inclusion rate contained the highest amount of Zinc. Based on the data collected and analyzed, it was found out that eggs produced by inclusion of 2.5% and 7.5% *Moringa oleifera* leaf powder contained the highest and equal amount of Manganese. Furthermore, the study discovered that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder in fed contained the highest amount of Iron. It was found out that the potassium constituent of eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder was the highest. The study equally found out that the calcium constituent of eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf

powder in feed was the highest in quantity. According to the findings, eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder contained dominant quantity of copper, selenium and chromium. The study equally found out that eggs produced by layers fed with 5% inclusion rate of *Moringa oleifera* leaf powder in feed contained no chromium. The study further found out that there was no significant difference ($P > 0.05$) in the mean mineral profile of eggs produced by layers fed with inclusion of different rates of *Moringa oleifera* leaf powder in feed.

The findings of the study were in consonance with the findings of Donkor, Glover, Addae and Kubi (2013) who reported that the serum calcium, sodium, potassium and chloride of broilers increased as a result of introduction of *Moringa oleifera* leaf meal in feed. Similarly, Amabye (2016) found out that calcium, magnesium, potassium, iron and sodium were present in M*oringa* in a very high quantity to the tune of g/100g dry matter, whereas zinc and copper were present to the tune of mg/100g level. Furthermore, the findings of Moyo et al (2011) supporting the present findings by reporting that *Moringa oleifera* leaf powder is a rich source of minerals and contains high amount of calcium (3.65%), phosphorous (0.30%), magnesium (0.50%), potassium (1.50%), sodium (0.164%), sulphur (0.631%), zinc (31.03mg/kg), copper (8.25mg/kg), manganese (86.8mg/kg), iron (490mg/kg) and selenium (363mg/kg).

On the amino acids profile of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder in feed, it was discovered that eggs produced by layers fed with 5% inclusion of *Moringa oleifera* leaf powder contained the highest amount of arginine. The study further found out that the aspartate constituent of eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder in feed dominated the others. It was found

that eggs produced by layers fed with 5% inclusion of *Moringa oleifera* in feed had the highest constituent of serine. It was also found out that eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* in feed contained the highest amount of cysteine. Based on the data collected and analyzed, it was discovered that eggs produced by layers fed with 2.5% inclusion of *Moringa oleifera* leaf powder in feed contained the highest amount of glycine and isoleucine. The findings show that lysine was dominantly present in eggs produced by layers fed with 7.5% inclusion of *Moringa oleifera* leaf powder in feed. The study also discovered that eggs produced by layers fed with 7.5% inclusion rate of *Moringa oleifera* leaf powder contained the highest amount of asparagine, tryptophan and valine. The study also found out that eggs produced by layers fed with 2.5% and 5% inclusion rates of *Moringa oleifera* did not contain asparagine. The data collected and analyzed show that glutamine was not contained in any of the eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder. The study further found out that there was no significant difference ($p > 0.05$) in the mean amino acids profile of eggs produced by inclusion of different rates of *Moringa oleifera* leaf powder in feed.

The findings were in agreement with the study of Moyo et al (2011) who found out that *Moringa oleifera* leaf powder contained nineteen amino acids which include arginine, serine, aspartic acid, glutamic acid, glycine, threonine, alanine, tyrosine, proline, HO-proline, methionine, valine, phenylalanine, isoleucine, leucine, histidine, lysine, cysteine and tryptophan. This was the major evidence eggs produced by layers fed with high inclusion of *Moringa oleifera* leaf powder contained threonine and asparagine. Furthermore, Gopalakrishnan, Doriya and Kurmar (2016) found out that *Moringa oleifera* leaf powder contain rich amount of various amino acids which include arginine, histidine, lysine,

tryptophan, phenylalanine, threonine, leucine, methionine and valine. According to the study of Takahashi, Toda, Singh, Meester, Wilczynska, Wilson & Juneja (2011), amino acids were found to be the main precursors needed for the formation of hormones and low-molecular nitrogenous substances. Wu (2009) also found out that amino acids are cell signalling molecules as well as being regulators of gene expression and protein phosphorylation.

On the lipids parameters of eggs produced by layers fed with different inclusion rates of *Moringa oleifera* leaf powder, the study found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the highest quantity of total cholesterol while eggs produced by layers fed with7.5% *Moringa oleifera* leaf powder had the least amount of total cholesterol. On the data collected and analyzed, it was discovered that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder had the highest amount of triglyceride while eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the least amount of triglyceride. The study equally found out that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the highest amount of free cholesterol while eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the least amount of free cholesterol. It was further found out that there was no significant difference ($p > 0.05$) in the lipids parameters of eggs produced by layers fed with different inclusion rates of M*oringa oleifera* leaf power.

The findings of the study were in agreement with the findings of Donkor et al (2013) who reported that reduction in serum triglyceride level of broilers was achieved by addition of *Moringa oleifera* leaf powder in feeds. The findings were also in line with the findings of Prasanna and Ravi (2013) who reported that supplementation of feeds with *Moringa oleifera* leaf powder decreased serum LDL. The authors further found out that the powder of *Moringa*

oleifera leaf has definite hypoglycemic and hypocholesterolemic activity in type II diabetic people. The findings of Ara, Rashid and Amran (2008) showed that there was a significant reduction in the mean serum cholesterol and triglyceride of animals offered *Moringa oleifera* leaf extract.

Cost Effectiveness of Eggs Produced by Layers Fed with Moringa oleifera Leaf Powder Fortified Feeds and those Fed with Control Feed.

On the cost of feeds per kilogramme produced with *Moringa oleifera* leaf powder and the control feed, it was found out that feed produced by addition of 2.5% *Moringa oleifera* leaf powder had the highest cost per kilogramme in almost all the weeks in the production period while feed produced by addition of 7.5% *Moringa oleifera* leaf powder had the least cost per kilogramme when compared to other feeds. It was equally found out that the feed cost per egg produced was lower in eggs produced by layers fede with control feed than egg produced by layers in T2, T3 and T4. However, it was found out that there was no significant difference ($p > 0.05$) in the mean cost of feeds per kilogramme produced with *Moringa oleifera* leaf powder and those produced without *Moringa oleifera* leaf powder. Similarly, no significant difference existed ($p > 0.05$) in the mean feed cost per egg produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and the control feed.

The findings were in consonance with the findings of Altahat, El-Sharafat and Altarawneh (2012) who reported that high feed cost increases the total cost of producing table eggs and consequently had the highest negative impact on the profitability of egg production enterprise. The authors also found out that higher feed ingredient prices are associated with lower profitability of laying hen enterprise. Njoroge, Bett and Njehia (2015) further found out

that the high increase in prices of poultry feeds had a significant effect on layer population. The authors also found out that poultry feed manufacturers should adjust the prices of layer feeds moderately if layer farmers must remain in production.

Cost Effectiveness of Eggs Produced by Layers Fed with Different Inclusion Rates of Moringa oleifera Leaf Powder.

On the cost of feeds per kilogramme produced with inclusion of varying quantities of *Moringa oleifera* leaf powder, the study found out that feed produced with inclusion of 2.5% *Moringa oleifera* leaf powder had the highest cost while feed produced with inclusion of 7.5% *Moringa oleifera* leaf powder had the least cost. The study also found out that the feed cost per egg produced in T2, T3 and T4 was very high with T3 dominantly higher than the others in weeks 3, 4, 5 and 6. There was however no statistically significant difference in the mean cost of feeds per kilogramme produced with addition of varying quantities of *Moringa oleifera* leaf powder. There was also no statistically significant difference in the mean feed cost per egg produced with inclusion of different *Moringa oleifera* leaf powder fortified feeds.

The findings were in consonance with the findings of Sujatha, Kundu, Jeyakumar and Kundu (2013) who reported that supplementation of fresh Azolla leaves in duck feed at 200g/kg of feed resulted in a decrease in feed cost and feed intake without any reduction in egg production and weight. The authors discovered that a significant amount of 30 percent feed saving mechanism which reduced feed cost was achieved.

Extent Students that Participated in the Research Work Acquired Skills in Feed Formulation and Layer Production.

The study found that there was an increase in skills acquired in feed formulation and layer production among the students participated in the research. It was also found out that there was statistically significant difference ($p < 0.05$) in skills acquisition in feed formulation and layer production among the students that participated in the study.

The findings were supported by the findings of Alaribe (2010) who reported that students learn more effectively when taught using school farm than classroom instructions. The author also found that teaching productive skills using school farm exposes students to the practical skills that need to be mastered. Furthermore, the findings were in line with the findings of Gökhan and Mustafa (2011) who reported that there was a significant achievement difference between the students taught with laboratory teaching method and those taught with the traditional approach which was in favour of those taught with laboratory method. The findings of this study equally affirm Prosser theory of vocational education which states that effective vocational education can only be given where the training jobs are carried on in the same way with the same operations, tools and machines as in the occupation itself. Students who participated in the study significantly acquired the productive skills in feed formulation and layer production because the job of rearing layers was done in school farm where the facilities (drinkers, feeders, layers, feed, water, vaccines, drugs, litter, hovers, heating equipment, etc) were present. Students equally learn feed formulation practices in Chidera feed mill where the facilities such as grinder, mixer, feed raw materials, weighing machines, among others were available.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents the restatement of the problem, summary of the procedure used, principal findings, conclusion, implications of the study, recommendations, limitations of the study and suggestion for further research.

Restatement of the Problem

School farm is one of the most essential facilities for teaching agricultural education to students. In most occasions, Agricultural Education students were trained without being exposed to rearing poultry using school farm. When students graduate without exposing them to practical training in agriculture using school farm, the graduates will only be loaded with theoretical knowledge devoid of practical agricultural skills. This was in line with Onu and Ugwuoke (2010) that school poultry farm available in some schools for skills acquisition in agriculture in Enugu State were not functional due to high cost of quality poultry feeds. Training students in poultry using school poultry farm can avail the students the opportunity of learning how to feed poultry, vaccinate birds, clean and disinfect poultry house, it will also acquaint them with brooding and different poultry feeds as well as skills needed in picking and classifying eggs, formulating feed using locally available materials like *Moringa oleifera*, among others. When students are practically trained in egg production using *Moringa oleifera*, they will contribute their quota in alleviating the problem of poor protein supply to the Nigerian population after graduation.

Moringa oleifera is a tropical plant that provides valuable products to different people. Moringa oleifera can be used as vegetable, water purifier, drug, feed supplement and animal feed. It is a prolific plant that grows tall and produces large volume of leaves within few

months. Inclusion of *Moringa oleifera* in broiler and pig feed has been known to increase growth and enhance feed conversion ratio due to the high amount of Vitamins A, B, C, protein and amino acids compositions of the product. Studies have also shown that inclusion of *Moringa oleifera* in feeds have increased the quality and quantity of protein in broilers.

However, protein supply to the teeming population is grossly inadequate due to high cost of poultry production. This was in line with Casartelli et al (2006) who stated that quality feed was the main cost of layer production, and often accounts for 60-65% total cost of commercial egg production. Feed cost according to Kasule, Katongole, Nambi-Kasozi, Lumu, Bareeba, Presto, Ivarsson and Lindberg (2014) had often been reported as the major element in the total cost of rearing layers compared to the rearing of other livestock species. Similarly, high cost of quality feed limits egg production by disengaging some people who would have gone into egg production to ameliorate protein inadequacies in the country, hence, the need to determine with the students, the effect of locally produced *Moringa oleifera* leaf powder additive as a high quality and cost saving feed material on the growth of layers, egg production and nutritive value of eggs. Specifically, the study sought to determine the:

1. effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the growth of layers.

2. effects of different inclusion rates of *Moringa oleifera* leaf powder on the growth of layers

3. effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the egg production of layers.

4. effects of different inclusion rates of *Moringa oleifera* leaf powder on the egg production of layers.

5. effects of *Moringa oleifera* leaf powder fortified feeds and control feed on the nutritive value of eggs produced by the layers.

6. effects of different inclusion rates of *Moringa oleifera* leaf powder on the nutritive value of eggs produced by the layers.

7. cost effectiveness of eggs produced with *Moringa oleifera* leaf powder fortified feeds and the control feed.

8. cost effectiveness of eggs produced with different inclusion rates of *Moringa oleifera* leaf powder.

9. extent students that participated in the research work acquired skills on feed formulation and layer management.

Summary of the Procedures Used

The study adopted a Completely Randomized Design (CRD). Completely randomized design in the view of Obi (2002) is an experimental design used when the experimental units are homogeneous such as same animal breed, where environmental effects are homogeneous such as animal house and treatments are assigned to experimental units at random without restriction. The study was carried out in Agricultural Education poultry farm, Faculty of Vocational and Technical Education, University of Nigeria, Nsukka. The population of the study was 252 day-old chicks and 25 Agricultural Education students, University of Nigeria, Nsukka. The chicks were bought from day-old chick distributors in Nsukka urban area. The

sample for the study consisted of 240 chicks and 12 students of Agricultural Education, University of Nigeria, Nsukka. Twelve groups of 20 chicks each were drawn from the population of 252 chicks using simple random sampling technique. Simple random sampling technique was also used to select 12 Agricultural Education students who participated in the study.

Weighing scale, laboratory test and psycho-productive multiple choice test (PMCT) were used to collect data to answer the research questions and test the null hypotheses. Data on the average weight of layers and feed intake were collected using weighing scale. Similarly, information on the average egg weight was collected using Mettler Toledo electronic weighing machine which measures specifically in grammes. Information on the nutritive value of eggs was obtained from laboratory analysis of eggs produced with and without *Moringa oleifera* leaf powder fortified feeds which was carried out in Central Research and Diagnostic Laboratory located in Ilorin, Nigeria. Moreover, psycho-productive multiple choice question items were developed by the researcher to collect data on students' level of skills acquisition before and after the research work. The psycho-productive multiple choice question items were content validated by using Simpson (1972) psychomotor domain of educational objectives taxonomy for the development of the table of specification. Similarly, the instrument was face validated by three experts, two from the Department of Agricultural Education and one from the Measurement and Evaluation unit of Science Education Department, all from the University of Nigeria, Nsukka. The test was pilot tested on 20 students who were randomly selected from the school which was not part of the study to determine the stability using test-retest method which yielded a coefficient of 0.71. The internal consistency of the instrument was established using Kuder-Richardson 20.

Data were collected by the researcher with the help of 12 Agricultural Education students, University of Nigeria, Nsukka. Data on the weight of hens, feed offered, feed consumed, weight gain, egg weight, among others were collected. Similarly, the PMCT test was administered by the researcher on the 12 Agricultural Education students who participated in the study. The same instrument served as the pre-test and posttest. Pre-test was administered a day before the arrival of the day-old chicks while the posttest was administered on the day of completion of the study.

On the procedure of experiment, 240 chicks were randomly selected from the population of 252 chicks and placed in 12 treatment groups. The 12 groups were also randomly allotted to four different treatment groups on the 5th week of rearing. Uniform feed was given to them on the 1st, 2nd, 3rd and 4th weeks to place them at the same condition to ensure uniformity. The four main groups were: T1 – Control group (No *Moringa oleifera* leaf powder supplement given), T2 – 1st experimental group (2.5% *Moringa oleifera* leaf powder supplement given), T3 – 2nd experimental group (5% *Moringa oleifera* leaf powder supplement given), and T4 – 3rd experimental group (7.5% *Moringa oleifera* leaf powder supplement given). The four treatment groups were in three replicates which gave rise to 12 groups. Hence, there were T1 A, T1 B, T1 C, T2 A, T2 B, T2 C, T3 A, T3 B, T3 C, T4 A, T4 B, and T4 C groups.

Before the arrival of the day-old chicks, the brooding pen was properly prepared by keeping litter material on the floor. The pen was heated up to 34^0c by the use of kerosene stove and well lighted with three big kerosene lamps. Minimum and maximum thermometer was placed on the floor to check temperature fluctuations. The hens were regularly vaccinated against coccidiosis, Newcastle disease, gumboro disease, fowl pox. Prior to the transfer of

pullets to the rearing pens, the pens were cleaned, washed and disinfected with Vinkokill disinfectant. Litter material of 5-10 cm was placed on the floor after drying. Feed, clean water and ant-stress were provided.

Moringa oleifera leaves used in the study were harvested and dried inside the room. The dried leaves were ground to powder using grinding machine. Four different feeds were formulated to feed T1, T2, T3 and T4 groups. The feeds were formulated using feed formulation software called Feedwin developed by PTC+, located in Barneveld, the Netherlands. Production of the feeds which involved dosing, grinding and mixing was done in Chidera Feed Mill located in Onuiyi, Nsukka. Data collected were analyzed using mean, bar charts and pie charts to answer the research questions. One-way Analysis of Variance (ANOVA) was used to test the null hypotheses 1-8 at 0.05 level of significance and at the appropriate degrees of freedom while hypothesis 9 was analyzed using one sample t-test at 0.05 level of significance. A null hypothesis was accepted when the probability value was greater or equal to 0.05 and rejected when the probability was less than 0.05. Test of significance between means was done using scheffe.

Principal Findings

Based on the data analyzed, the following major findings were made:

- Average weights of layers from the four treatment groups were variable. Layers fed with control feed had more average weight in some weeks while layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had more average weight in some other weeks.

- On the average weight gain, it was found out that layers in T1 had more weight than the others in some weeks while layers in T3 as well gained more weight than others in some other weeks.
- On the average feed intake of layers, it was discovered that layers fed with control feed (T1) consumed more feed in most of the weeks under study while layers in T2 consumed more feed in some other weeks.
- It was also found out that layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed (T2) had the least Feed Conversion Ratio (FCR) in some weeks and therefore better feed efficiency for those weeks while Layers in T3 had the least FCR in some other weeks as well. T2 and T3 feeds had better efficiency than T1 in some weeks.
- The study found out that layers fed with control feed had the highest mortality percentage than other treatment groups while T3 had the least mortality percentage than other treatment groups as well.
- From the data collected and analysed, it was found out that there was no significant difference ($P > 0.05$) in the average weight of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed
- Similarly, it was found that there was no statistically significant difference ($P > 0.05$) in the average weight gain of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.
- There was no significant difference ($P > 0.05$) in the average feed intake of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.

- It was equally found out that there was no significant difference (P > 0.05) in the average FCR of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.
- On the average quantity of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, it was discovered that the average quantity of eggs produced by layers in control group was dominantly greater than the average quantity of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds. Layers in control group and layers in T2 started production earlier than those in T3 and T4.
- It was also found out that the average egg weight of layers fed with control feed was greater than the average egg weight of layers fed with *Moringa oleifera* leaf powder fortified feeds.
- The study further found out that the average egg mass of layers fed with control feed was greater than the average egg mass of layers in other treatment groups
- Similarly, the study discovered that the average laying percentage of layers fed with control feed (T1) was greater than the average laying percentage of layers fed with *Moringa oleifera* leaf powder fortified feeds.
- It was further found out that there was statistically significant difference (P > 0.05) in the average quantity of eggs produced by layers fed with Moringa oleifera leaf powder fortified feeds and those fed with the control feed. The statistically significant difference was found to exist between the mean quantity of eggs produced by layers in the control group and the mean quantity of eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed.

- On the average weight of eggs produced by layers fed with *Moriga oleifera* leaf powder fortified feeds and those fed with control feed, it was found out that no significant difference existed.
- Based on the data collected and analyzed, it was found out that there was a significant difference between the average egg mass of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. It was further found out that significant difference existed between the mean eggs mass produced by layers fed with control feed (T1) and mean eggs mass produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed.(T3).
- From the study, it was found out that there was statistically significant difference in the average laying percentage of layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed. The difference according to the data analyzed was found out to exist between the average laying percentage of layers in control group and average laying percentage of layers fed with 5% *Moringa oleifera* leaf powder fortified feed which had the highest positive mean difference
- The study also found out that eggs produced by layers fed with control feed had the highest amount of carbohydrate and crude protein than eggs produced by layers in T2, T3 and T4.
- Eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed had the least amount of crude lipids content and highest amount of moisture content than other treatment groups.

- It was equally discovered that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed had the highest amount of ash and Metabolizable energy content than eggs laid by layers in other treatment groups.
- However, the study found out that there was no significance difference ($P > 0.05$) in the mean proximate content of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed.
- On the Vitamin profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, it was discovered that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder contained the highest amount of Vitamin A.
- The study also found out that eggs produced by layers fed with control feed contained the highest amount of Vitamins B1, B2 and B3.
- From the data collected and analyzed, it was found out that eggs produced by layers fed with 2.5% *Moringa oleifera* leaf powder fortified feed had the highest amount of Vitamin B5.
- The study equally found that eggs produced by layers fed with control feed contained the highest amount of Vitamin C.
- It was also found out that the highest amount of Vitamin D and Vitamin E was contained in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed.
- The study equally found out that there was no significant difference ($P > 0.05$) in the mean vitamin profile of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feed and those fed with control feed.

- On the lipids parameters of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the study found out that eggs produced by layers fed with control feed contained the highest amount of total cholesterol than the other treatment groups while eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed had the least amount of total cholesterol.
- The study further found out that eggs produced by layers fed with 5% *Moringa oleifera* leaf powder fortified feed had the highest amount of triglyceride while eggs produced by layers fed with control feed contained the least amount of triglyceride when compared to the other eggs.
- On the free cholesterol level of eggs produced by layers fed with *Moringa oleifera* leaf powder fortified feeds and those fed with control feed, the study discovered that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed contained the highest amount while eggs produced by layers fed with 5% *Moringa oleifera* leaf powder contained the least amount.
- Moreover, the study found out that there was no significant difference ($P > 0.05$) in the mean lipids parameters of eggs produced by layers fed with M*oringa oleifera* leaf power fortified feeds and those fed with control feed.
- On the cost of feeds per kilogramme produced with *Moringa oleifera* leaf powder and the control feed, it was found out that feed produced by the addition of 2.5% *Moringa oleifera* leaf powder had the highest cost in almost all the weeks in the production period while feed produced by addition of 7.5% *Moringa oleifera* leaf powder had the least cost when compared to other feeds.

- The study also discovered that feed cost per egg produced was cheapest in T1 when compared with other treatment groups. T3 had the highest feed cost per egg produced in weeks 3, 4, 5 and 6 respectively.
- Furthermore, it was found out that there was no significant difference ($P > 0.05$) in the cost of feeds produced with *Moringa oleifera* leaf powder and those produced without *Moringa oleifera* leaf powder.
- There was no significant difference in the mean feed cost per egg produced with *Moringa oleifera* leaf powder fortified feeds and the control feed.
- The study further found out that there was an increase in skills acquired in feed formulation and layer production among the students participated in the research.
- Moreover, it was found out that there was statistically significant difference ($P < 0.05$) in skills acquired in feed formulation and layer production among the students that participated in the study.

Conclusions

Inclusion of *Moringa oleifera* leaf powder in layer feed up to 7.5% did not have significant effect on the feed intake, weight of the hens, weight gain and feed conversion ratio. Also, *Moringa oleifera* leaf powder retards the egg production potentials of layers. This could be attributed to the presence of saponin, tannin, anti-trypsin factor and phytate in *Moringa oleifera* leaf powder. Similarly, mortality rate in layers fed with the control feed was highest while the mortality rate in layers fed with 5% *Moringa oleifera* leaf powder recorded the least. This could be attributed to the antibiotic property of *Moringa oleifera* leaf powder.

The presence of Chromium in eggs produced by inclusion of 7.5% *Moringa oleifera* leaf powder which was relatively absent in eggs produced by layers fed with no *Moringa oleifera* leaf powder fortified feed proves its richness in minerals. Similarly, the presence of threonine and asparagine in eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder but absent in eggs produced by layers fed with control feed signifies that eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder fortified feed is complete in amino acids profile which is the raw materials for protein formation. It is worthy to note that glutamine was absent in eggs produced with and without *Moringa oleifera* leaf powder. Glutamine is one of the non-essential amino acids and can therefore be produced in the body of the layers for protein formation. It is worthy to note that students trained using school farm acquired significant amount of skills in feed formulation and layer production. This was accounted to the active participation of students in all the layer rearing and feed formulation operations using the facilities available.

Educational Implications of the Study

The study has implications to farmers, high cholesterol patients, children, technical instructors in Agricultural Education and students. Farmers who engage in brood and sell or point of lay enterprise can add *Moringa oleifera* leaf powder in the feed of pullets as additive to reduce mortality. Inclusion of 2.5% *Moringa oleifera* leaf powder helped in growth of the pullets. Layer farmers can therefore include *Moringa oleifera* at the rater of 2.5% to layer feed to boost the weight. The farmer can as well stop the inclusion of *Moringa oleifera* leaf powder when the birds start laying to avoid retardation in egg production.

Eggs produced by layers fed with 7.5% *Moringa oleifera* leaf powder had the least quantity of total cholesterol and triglyceride but highest amount of free cholesterol. Hypercholesterolemic patients can include *Moringa oleifera* leaf powder in their daily diets to reduce the bad cholesterol level and subsequently increase the good cholesterol.

The chromium, threonine and asparagine content of eggs produced by inclusion of 7.5% *Moring oleifera* leaf powder are high but absent in eggs produced without the inclusion of *Moringa oleifera* leaf powder. The eggs produced by layers fed with inclusion of 7.5% *Moringa oleifera* leaf powder fortified feed when given to children can supply enough minerals and amino acids needed for protein formation which helps in growth and development.

The productive skills of the students who participated in the study appreciated significantly due to their active involvement in keeping the layer and feed formulation. Technical instructors in Agricultural education can improve the productive skills of Agricultural education students in layer production and feed formulation when they actively involve them in rearing layers using school poultry farm.

Agricultural education is a skill oriented progamme that equips students with various competencies that will help them survive in a challenging economy. Students of agricultural education who acquire slkills in poultry production and feed formulation can establish their own poultry farm after graduation. The skills acquired in layers production and feed formulation will help them move into family poultry production involving their parents to increase the income generating powder of the family.

Recommendations

Based on the findings of the study, the following recommendations were made:

1) Farmers should include *Moringa oleifera* leaf powder at the rate of 2.5% to improve the weight of layers.
2) Layer farmers should not include *Moringa oleifera* leaf powder in feeds during the production period of the layers.
3) Agricultural Education farm manager should add 5% *Moringa oleifera* leaf powder in feeds to reduce the mortality.
4) Students of Agriculture should be taught poultry production in school poultry farm where there is presence of layers, feeders, drinkers, drugs and other rearing facilities for active experimentation.

Limitations of the Study

The following identified problems limit the generalizability of the findings:

1. Students who participated in the research were not constantly present in the farm due to interruptions of their lectures and examinations.
2. On one of the occasion, the experimental feeds finished and the available *Moringa oleifera* leaf powder was insufficient to produce another feed. All the groups were placed on commercial feed for 2 days.
3. The layers suffered serious mortality due to the outbreakof Newcastle and fowl pox diseases that struck the farm at the 13th week of rearing.
4. Psycho-productive multiple choice question items were used to collect data on the skills acquisition of the students that participated in the study instead of rating scale. Rating scale was not used because the participants were many and it was not always

easy for a rater to rate process skills step by step for more than one student at a time without bias.

5. Chidera feed mill where the feeds were produced broke down from time to time and this delayed feed production when the available feeds were exhausted.

Suggestions for Further Research

1. Effects of *Moringa oleifera* leaf powder on the qualities of eggs.
2. Effects of *Moringa oleifera* leaf powder on the post-moult production of layers.
3. Effects of *Moringa oleifera* leaf powder on the production duration of layers.

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Appendix 1: Nutrient Content of one Large Egg

Nutrient		Whole Egg	Egg White	Egg Yolk
Energy	Calories	72	17	55
Protein	Grams	6.3	3.6	2.7
Carbohydrate	Grams	0.4	0.2	0.6
Total Fat	Grams	4.8	0	4.5
Monounsaturated Fat	Grams	1.8	0	2
Polyunsaturated Fat	Grams	1	0	0.7
Saturated Fat	Grams	1.6	0	1.6
Trans Fat	Grams	0	0	0
Cholesterol	Milligrams	186	0	184
Choline	Milligrams	126	0.4	116
Riboflavin	Milligrams	0.2	0.2	0.1
Vitamin B_{12}	Micrograms	0.5	0	0.3
Folate	Micrograms	24	1	25
Vitamin D	IU	41	0	37
Vitamin A	IU	270	0	245
Vitamin B_6	Milligrams	0.1	0	0.1
Thiamin	Milligrams	0	0	0
Vitamin E	Milligrams	0.5	0	0.4
Selenium	Micrograms	15.4	6.6	9.5
Phosphorous	Milligrams	99	5	66
Iron	Milligrams	0.9	0	0.5
Zinc	Milligrams	0.7	0	0.4
Calcium	Milligrams	28	2	22
Sodium	Milligrams	71	55	8
Potassium	Milligrams	69	54	8
Magnesium	Milligrams	6	4	1

Source: Egg Nutrition Centre.

Appendix 2: Nutrient Composition of Moringa Leaf Powder Used in Compounding the Experimental Feeds

Nutrient	Composition
Metabolizeable energy	299.33lcal
Crude protein	30.21%
Ether extract	5.77%
Crude fibre	10.67%
Ash	12.00%
Carbohydrate	31.64%
Phosphorous	40.53mg/100g
Calcium	240mg/100g

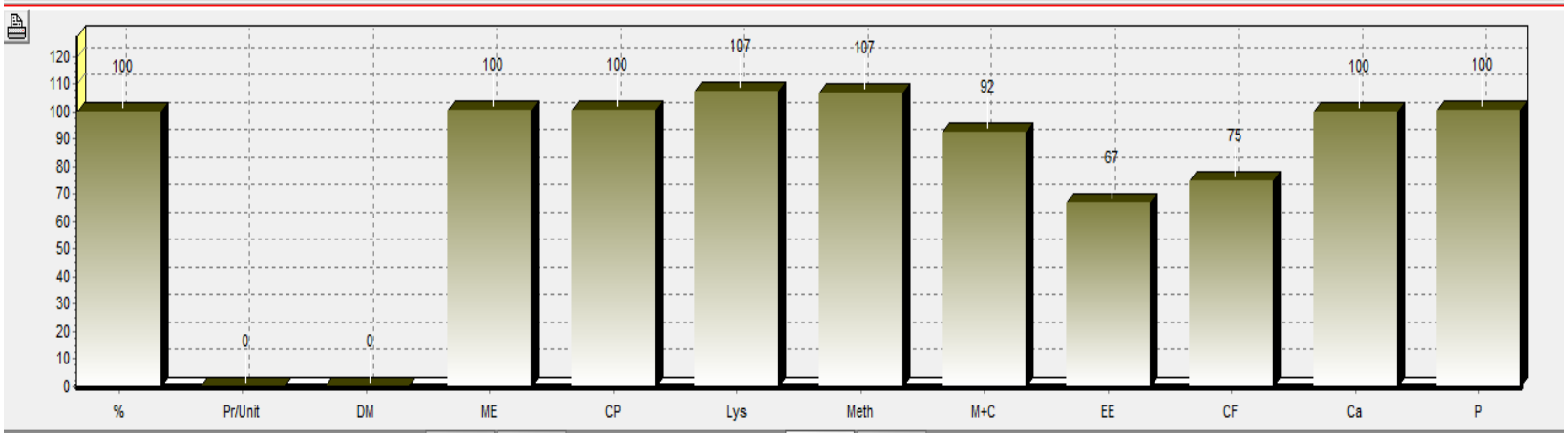
Appendix 3: Nutrient Composition of *Moringa oleifera* Leaf Powder

Nutrient	Amount in 100g
Moisture (%)	7.5
Calories	205.0
Protein (g)	27.1
Fat (g)	2.3
Carbohydrate (g)	38.2
Fibre (g)	19.2
Calcium (mg)	2.003
Magnesium (mg)	368.0
Phosphorous (mg)	204.0
Potassium (mg)	1.324
Copper (mg)	0.57
Iron (mg)	28.2
Sulphur (mg)	870.0
Oxalic acid (mg)	1.6%
Vitamin A (mg)	16.3
Vitamin B1 (mg)	2.64
Vitamin B2 (mg)	20.5
Vitamin B3 (mg)	8.2
Vitamin C (mg)	17.3
Vitamin E (mg)	113.0
Arginine (g/16N)	1.33%
Histidine (g/16N)	0.61%
Lysine (g/16N)	1.32%
Tryptophan (g/16N)	0.43%
Phenylanaline (g/16N)	1.39%
Methionine (g/16N)	0.35%
Threonine (g/16N)	1.19%
Leucine (g/16N)	1.95%
Isoleucine (g/16N)	0.83%
Methionine + cystine (g/16N)	0.60%
Valine	1.06%

Source : Endeshaw, 2003.

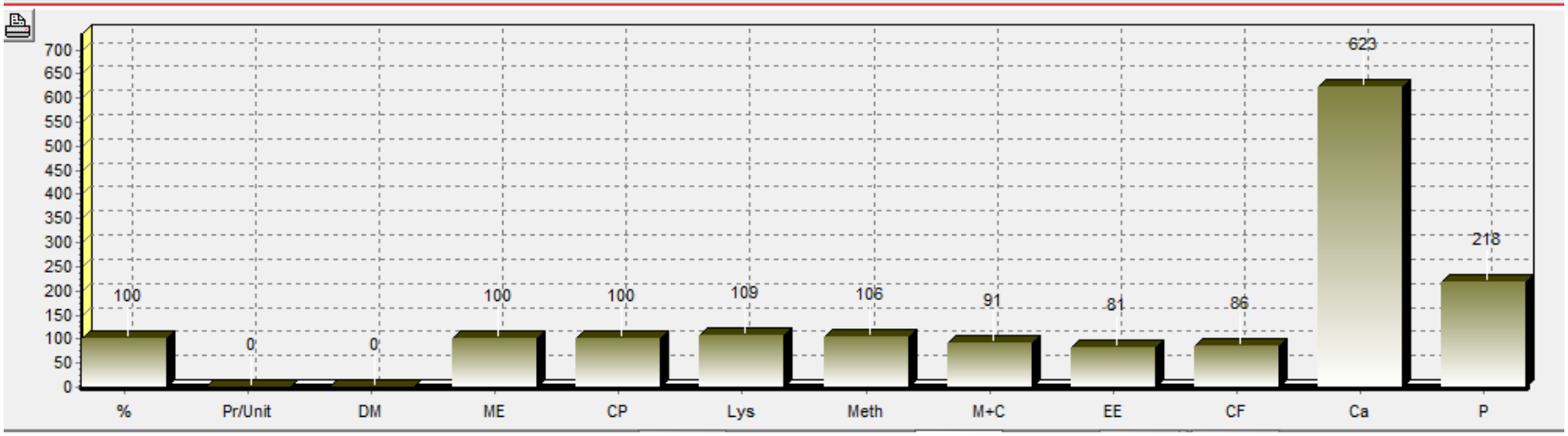
Appendix 4: Chicks' Starter Feed (Control) for feeding chicks (0-6 weeks)

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1		0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
Limestone	1.4		0.00	0.00	99.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.00	0.00		10
SBM 44/7	26		0.00	0.00	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Maize	60		0.00	0.00	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
Rice bran 9-15% fibre	4.72		0.00	0.00	89.20	2200.00	13.30	0.63	0.27	0.53	10.20	11.90	0.10	1.58		10
Groundnut meal (Expeller	2.18		0.00	0.00	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
DiCalc.Ph.	1.03		0.00	0.00	99.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	18.00		5
L-Lysine HCl			0.00	0.00	98.50	3730.00	94.50	78.00								2
DL-meth.	0.01		0.00	0.00	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		2
Soybean oil	0.5		0.00	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
Fish Meal 70%	3.1		0.00	0.00	92.00	3320.00	70.00	5.39	2.03	2.66	8.00	0.00	3.50	2.60		5
Enzyme	0.06		0.00	0.00												2
Ration (po)	100	0.00	0.00	0.00	87.54	2864.94	20.06	1.07	0.38	0.69	4.02	3.73	1.00	0.70		
Starter 0-6 Wks	100	0.00			0.00	2860.00	20.00	1.00	0.36	0.75	6.00	5.00	1.00	0.70		



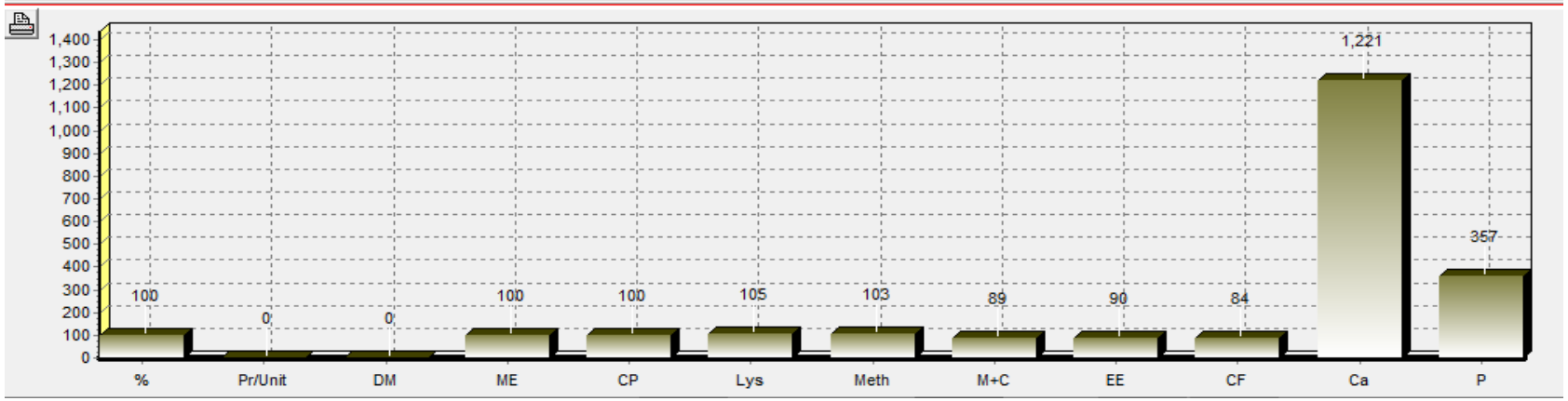
Appendix 5: Chicks' Starter Feed with 2.5% *Moringa Oleifera* Leaf Powder Inclusion Rate

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.5		0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
SBM 44/7	26.59	0.25	0.12	0.01	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Maize	60		0.00	0.00	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
Moringa Leaf Powder	2.5		0.00	0.00	92.50	299.00	30.21	1.32	0.35	0.60	5.77	10.67	240.00	40.53		2.5
DL-meth.	0.01		0.00	0.00	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		2
Soybean oil	1.4		0.00	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
Fishm. (S.Am.)	3.4		0.00	0.00	91.70	3320.00	65.90	5.07	1.85	2.44	10.30	0.00	3.50	2.60		5
Groundnut meal (Expeller)	0.22		0.00	0.00	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
Toxin binder	0.08		0.00	0.00												2
Rice bran 15-30% fibre	4.3		0.00	0.00	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Ration (po)	100	0.07	0.02	0.00	87.48	2867.17	20.04	1.09	0.38	0.68	4.84	4.31	6.23	1.52		
Starter 0-6 Wks	100	0.00			0.00	2860.00	20.00	1.00	0.36	0.75	6.00	5.00	1.00	0.70		



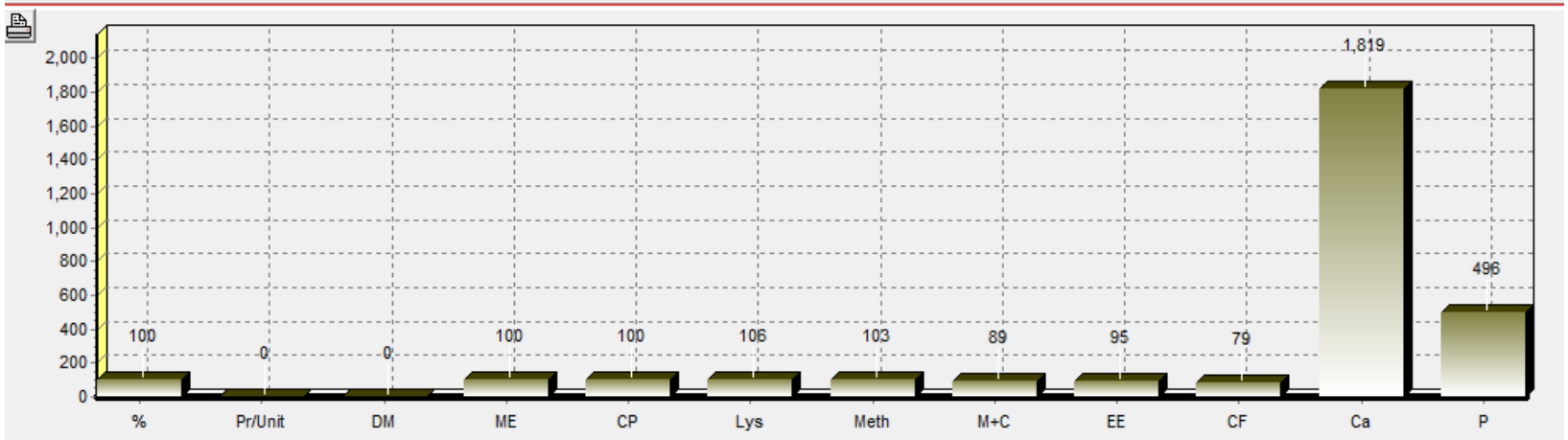
Appendix 6: Chicks' Starter Feed with 5% *Moringa Oleifera* Leaf Powder Inclusion Rate

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.5		0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		3
SBM 44/7	24.5	0.25	0.12	0.01	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Maize	59.7		0.00	0.00	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
Moringa Leaf Powder	5		0.00	0.00	92.50	299.00	30.21	1.32	0.35	0.60	5.77	10.67	240.00	40.53		10
DL-meth.	0.01		0.00	0.00	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		3
Soybean oil	1.9		0.00	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
Fishm. (S.Am.)	3		0.00	0.00	91.70	3320.00	65.90	5.07	1.85	2.44	10.30	0.00	3.50	2.60		5
Groundnut meal (Expeller)	1.54		0.00	0.00	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
Rice bran 15-30% fibre	2.76		0.00	0.00	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Toxin binder	0.09		0.00	0.00												3
Ration (po)	100	0.06	0.02	0.00	87.66	2872.20	20.02	1.05	0.37	0.67	5.39	4.20	12.21	2.50		
Starter 0-6 Wks	100	0.00			0.00	2860.00	20.00	1.00	0.36	0.75	6.00	5.00	1.00	0.70		



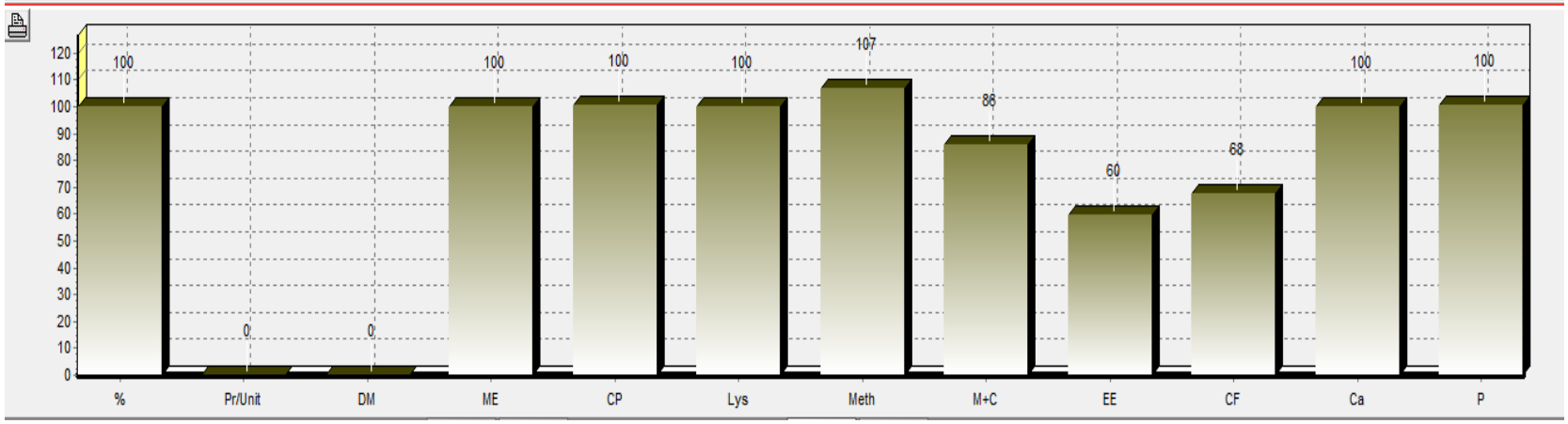
Appendix 7: Chicks' Starter Feed with 7.5% *Moringa Oleifera* Leaf Powder Inclusion Rate

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.4	100.00	0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
SBM 44/7	25	160.00	75.47	3.72	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Maize	60	85.00	25.45	9.77	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
Moringa Leaf Powder	7.5	1000.00	3344.48	33.10	92.50	299.00	30.21	1.32	0.35	0.60	5.77	10.67	240.00	40.53		7.5
DL-meth.	0.01	3000.00	1271.19	51.72	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		2
Soybean oil	2.3	480.00	51.61	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
Fishm. (S.Am.)	2.7	600.00	180.72	9.10	91.70	3320.00	65.90	5.07	1.85	2.44	10.30	0.00	3.50	2.60		5
Toxin binder	0.06	1000.00	0.00	0.00												2
Rice bran 15-30% fibre	1.03	12.00	12.00	1.71	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Ration (po)	100	195.66	68.16	9.74	87.76	2870.50	20.09	1.06	0.37	0.67	5.68	3.93	18.19	3.47		
Starter 0-6 Wks	100	0.00			0.00	2860.00	20.00	1.00	0.36	0.75	6.00	5.00	1.00	0.70		



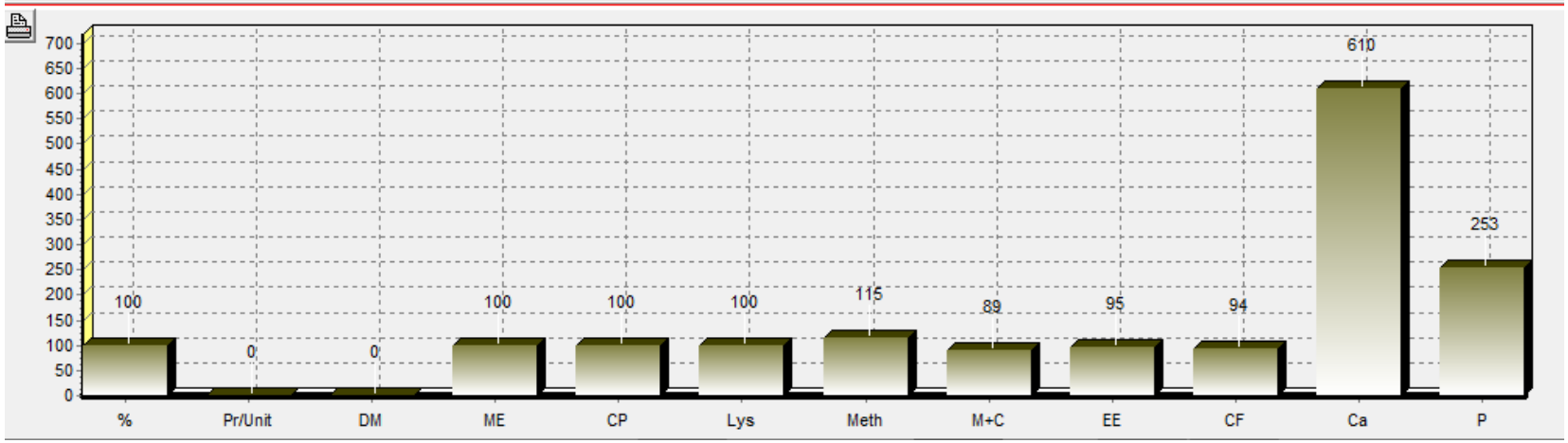
Appendix 8: Grower Mash (Control) for Feeding Growers (6-18 weeks)

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.2		0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
Limestone	1.83	0.05	0.00	0.00	99.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.00	0.00		100
Maize	54		0.00	0.00	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
SBM 44/7	10.8	0.25	0.12	0.01	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Groundnut meal (Expeller)	10		0.00	0.00	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
Wheat Bran	10		0.00	0.00	86.60	1710.00	15.20	0.61	0.25	0.59	3.60	9.20	0.11	1.15		10
DiCalc.Ph.	0.9		0.00	0.00	99.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	18.00		2
Sorghum	10		0.00	0.00	87.40	3260.00	10.00	0.23	0.16	0.35	3.10	2.10	0.03	0.30		20
L-Lysine HCl	0.22	1.00	0.27	0.01	98.50	3730.00	94.50	78.00								2
DL-meth.	0.08		0.00	0.00	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		2
Enzyme	0.6		0.00	0.00												2
Rice bran 15-30% fibre	0.37		0.00	0.00	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Ration (po)	100	0.03	0.01	0.00	87.15	2801.35	16.05	0.80	0.34	0.60	3.58	4.05	1.00	0.60		
Grower	100	0.00			0.00	2800.00	16.00	0.80	0.32	0.70	6.00	6.00	1.00	0.60		



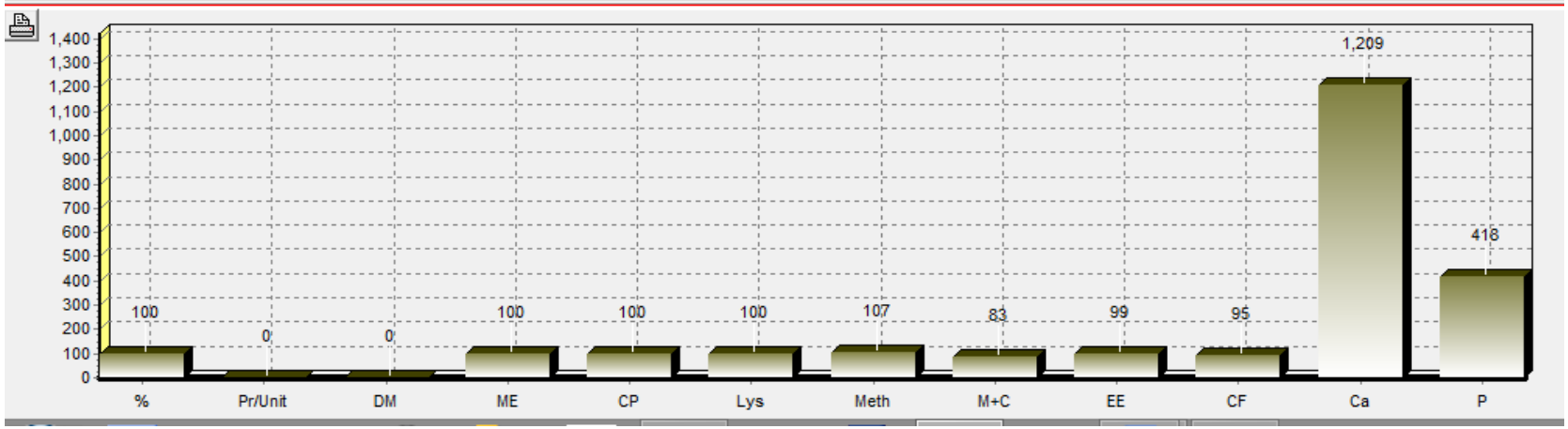
Appendix 9: Grower Mash with 2.5% *Moringa Oleifera* Leaf Powder Inclusion Rate

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.5	100.00	0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
Maize	60	85.00	25.45	9.77	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
SBM 44/7	18.8	160.00	75.47	3.72	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Groundnut meal (Expeller)	2	110.00	42.64	2.81	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
Wheat Bran	2.87	64.00	37.43	4.21	86.60	1710.00	15.20	0.61	0.25	0.59	3.60	9.20	0.11	1.15		10
L-Lysine HCl	0.05	100.00	26.81	1.06	98.50	3730.00	94.50	78.00								5
DL-meth.	0.09	3000.00	1271.19	51.72	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		5
Rice bran 15-30% fibre	10	12.00	12.00	1.71	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Moringa Leaf Powder	2.5	1000.00	3344.48	33.10	92.50	299.00	30.21	1.32	0.35	0.60	5.77	10.67	240.00	40.53		2.5
Soybean oil	2.1	480.00	51.61	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
Toxin binder	0.09	1000.00	0.00	0.00												2
Ration (po)	100	126.55	45.03	7.87	87.65	2810.00	16.08	0.80	0.37	0.63	5.69	5.61	6.10	1.52		
Grower	100	0.00			0.00	2800.00	16.00	0.80	0.32	0.70	6.00	6.00	1.00	0.60		



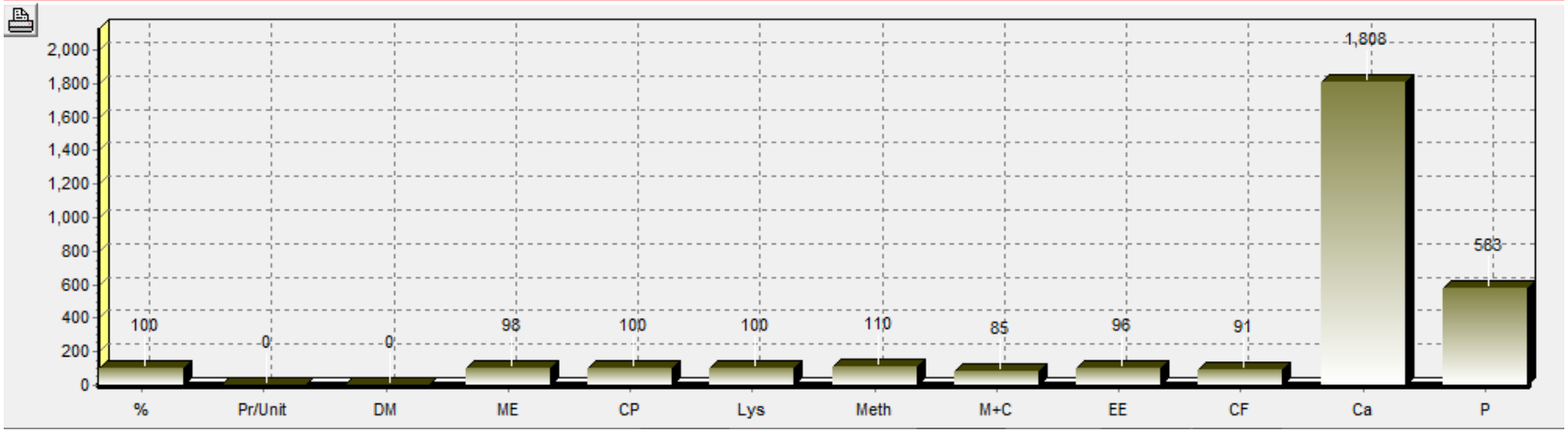
Appendix 10: Grower Mash with 5% *Moringa Oleifera* Leaf Powder Inclusion Rate

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.5	100.00	0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
Maize	60	85.00	25.45	9.77	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
SBM 45/46	14.2	160.00	73.39	3.68	88.00	2180.00	43.50	2.65	0.61	1.26	2.00	6.10	0.30	0.65		30
Groundnut meal (Expeller)	5	110.00	42.64	2.81	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
DL-meth.	0.08	3000.00	1271.19	51.72	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		3
Rice bran 15-30% fibre	9.8	12.00	12.00	1.71	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Moringa Leaf Powder	5	1000.00	3344.48	33.10	92.50	299.00	30.21	1.32	0.35	0.60	5.77	10.67	240.00	40.53		5
Soybean oil	2.1	480.00	51.61	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
L-Lysine HCl	0.15	1.00	0.27	0.01	98.50	3730.00	94.50	78.00								5
Wheat Bran	2.08	64.00	37.43	4.21	86.60	1710.00	15.20	0.61	0.25	0.59	3.60	9.20	0.11	1.15		10
Toxin binder	0.09	1000.00	0.00	0.00												2
Ration (po)	100	146.61	52.48	9.13	88.10	2793.86	16.05	0.80	0.34	0.58	5.96	5.70	12.09	2.51		
Grower	100	0.00			0.00	2800.00	16.00	0.80	0.32	0.70	6.00	6.00	1.00	0.60		



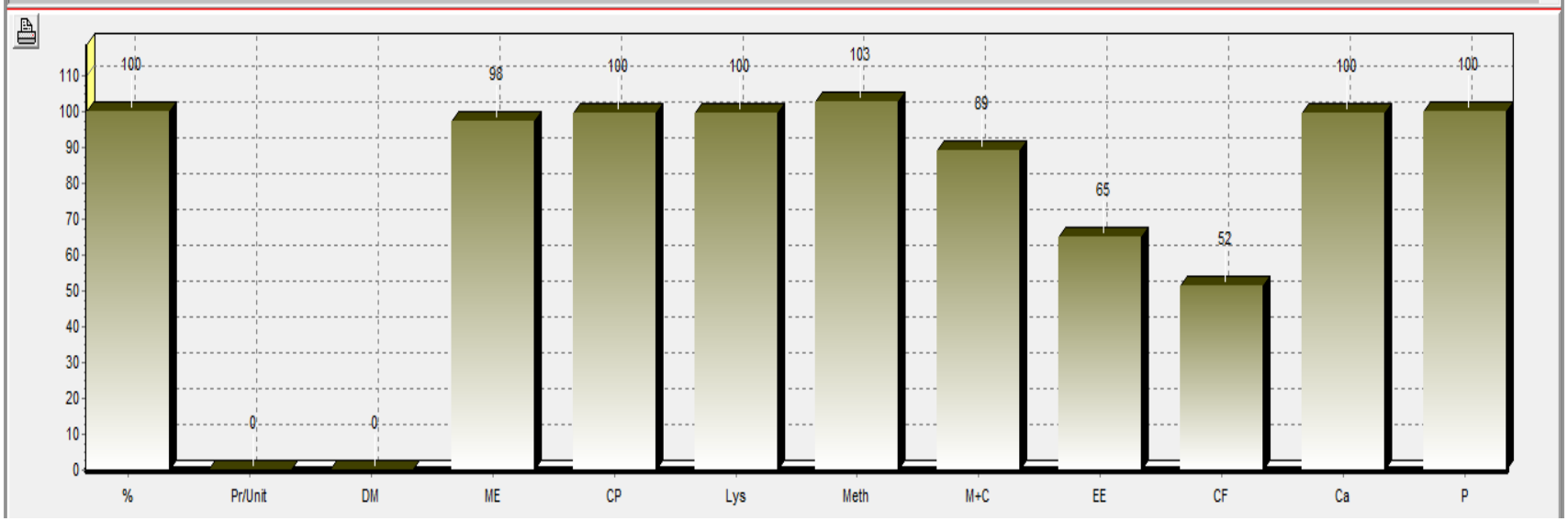
Appendix 11: Grower Mash with 7.5% *Moringa Oleifera* Leaf Powder Inclusion Rate

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.5	100.00	0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
Maize	60.2	85.00	25.45	9.77	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		62
SBM 44/7	15	160.00	75.47	3.72	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Groundnut meal (Expeller)	2	110.00	42.64	2.81	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
Wheat Bran	3.7	64.00	37.43	4.21	86.60	1710.00	15.20	0.61	0.25	0.59	3.60	9.20	0.11	1.15		10
L-Lysine HCl	0.1	0.00	0.00	0.00	98.50	3730.00	94.50	78.00								3
DL-meth.	0.08	3000.00	1271.19	51.72	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		3
Moringa Leaf Powder	7.5	1000.00	3344.48	33.10	92.50	299.00	30.21	1.32	0.35	0.60	5.77	10.67	240.00	40.53		7.5
Rice bran 15-30% fibre	7.73	12.00	12.00	1.71	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Soybean oil	2.1	480.00	51.61	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
Toxin binder	0.09	1000.00	0.00	0.00												2
Ration (po)	100	170.55	62.15	10.67	87.88	2744.19	15.98	0.80	0.35	0.60	5.78	5.44	18.08	3.50		
Grower	100	0.00			0.00	2800.00	16.00	0.80	0.32	0.70	6.00	6.00	1.00	0.60		



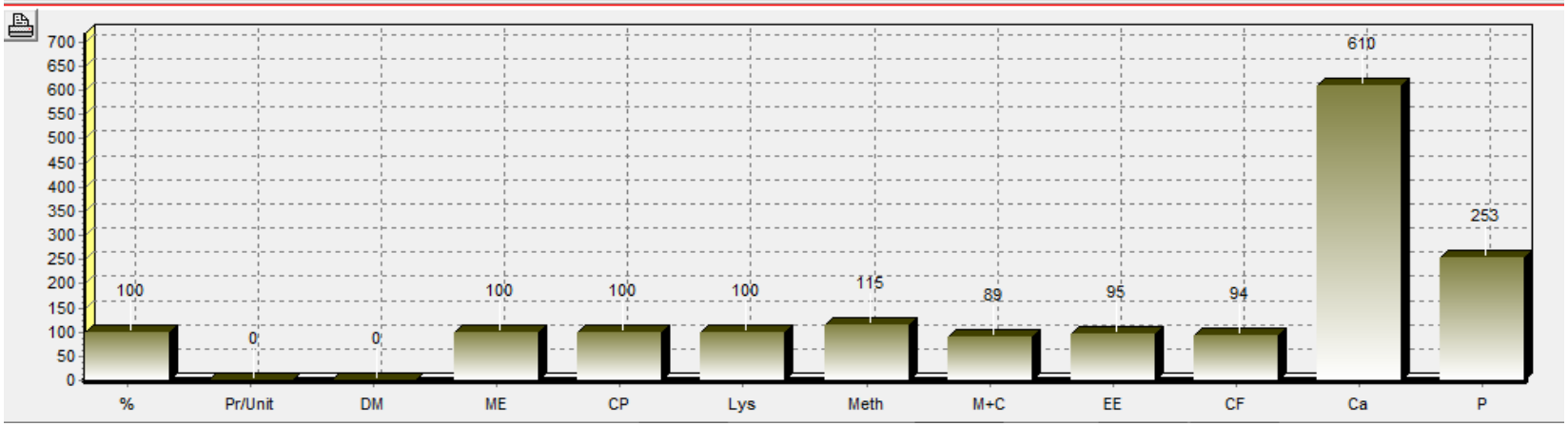
Appendix 12: Layer Mash (control) for Feeding Layers (20 weeks and above)

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1	100.00	0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
Limestone	7.54	20.00	0.00	0.00	99.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.00	0.00		100
Maize	53.7	125.00	37.43	14.37	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
SBM 44/7	10	160.00	75.47	3.72	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Groundnut meal (Expeller)	10	110.00	42.64	2.81	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
DL-meth.	0.02	3000.00	1271.19	51.72	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		2
Soybean oil	1.06	480.00	51.61	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
Wheat Bran	3	64.00	37.43	4.21	86.60	1710.00	15.20	0.61	0.25	0.59	3.60	9.20	0.11	1.15		10
Bone Meal	4.6	60.00	40.00	1.47	90.50	1500.00	40.70	1.83	0.45	0.77	5.40	0.00	16.04	7.42		10
Rice bran 9-15% fibre	9	12.00	5.45	0.90	89.20	2200.00	13.30	0.63	0.27	0.53	10.20	11.90	0.10	1.58		10
L-Lysine HCl	0.02	1200.00	321.72	12.70	98.50	3730.00	94.50	78.00								5
Toxin binder	0.06	1000.00	0.00	0.00												0.5
Ration (po)	100	108.92	40.62	6.63	88.62	2681.68	16.44	0.70	0.29	0.54	5.19	4.12	3.68	0.80		
Layer Complete	100	0.00			0.00	2750.00	16.50	0.70	0.28	0.60	8.00	8.00	3.70	0.80		



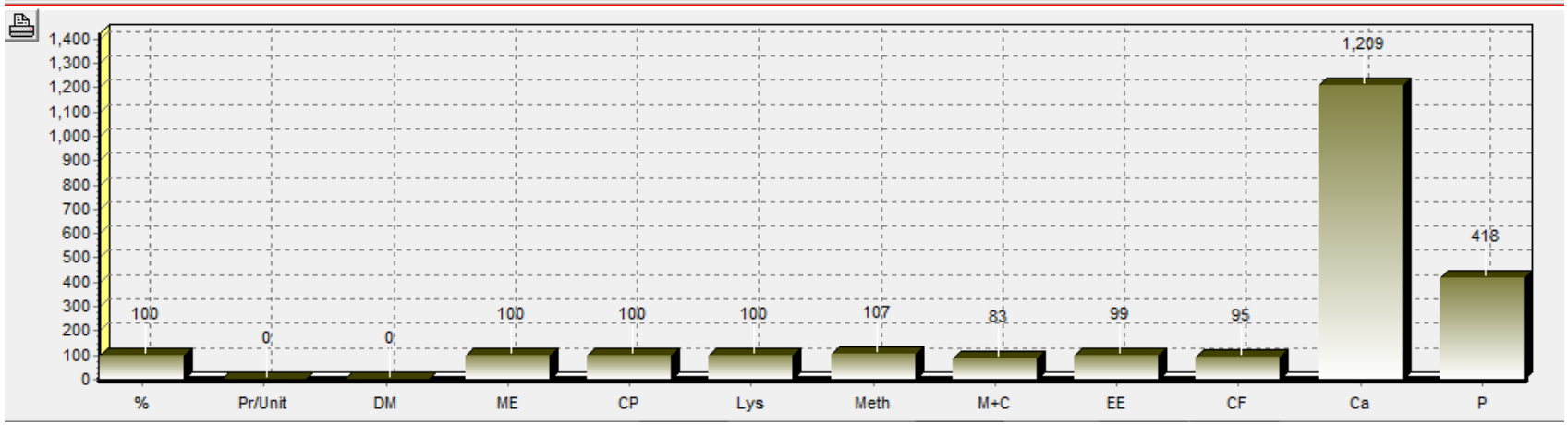
Appendix 13: Layer Mash with 2.5% *Moringa Oleifera* Leaf Powder Inclusion Rate

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.5	100.00	0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
Maize	60	85.00	25.45	9.77	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
SBM 44/7	18.8	160.00	75.47	3.72	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Groundnut meal (Expeller)	2	110.00	42.64	2.81	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
Wheat Bran	2.87	64.00	37.43	4.21	86.60	1710.00	15.20	0.61	0.25	0.59	3.60	9.20	0.11	1.15		10
L-Lysine HCl	0.05	100.00	26.81	1.06	98.50	3730.00	94.50	78.00								5
DL-meth.	0.09	3000.00	1271.19	51.72	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		5
Rice bran 15-30% fibre	10	12.00	12.00	1.71	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Moringa Leaf Powder	2.5	1000.00	3344.48	33.10	92.50	299.00	30.21	1.32	0.35	0.60	5.77	10.67	240.00	40.53		2.5
Soybean oil	2.1	480.00	51.61	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
Toxin binder	0.09	1000.00	0.00	0.00												2
Ration (po)	100	126.55	45.03	7.87	87.65	2810.00	16.08	0.80	0.37	0.63	5.69	5.61	6.10	1.52		
Grower	100	0.00			0.00	2800.00	16.00	0.80	0.32	0.70	6.00	6.00	1.00	0.60		



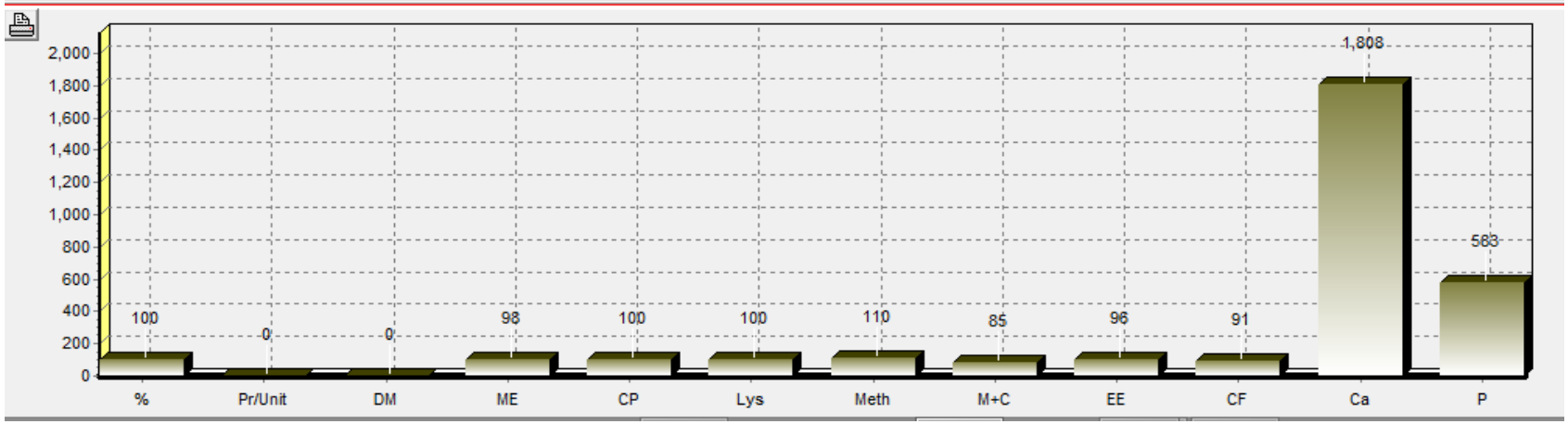
Appendix 14: Layer Mash with 5% *Moringa Oleifera* Leaf Powder Inclusion Rate

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.5	100.00	0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
Maize	60	85.00	25.45	9.77	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		60
SBM 45/46	14.2	160.00	73.39	3.68	88.00	2180.00	43.50	2.65	0.61	1.26	2.00	6.10	0.30	0.65		30
Groundnut meal (Expeller)	5	110.00	42.64	2.81	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
DL-meth.	0.08	3000.00	1271.19	51.72	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		3
Rice bran 15-30% fibre	9.8	12.00	12.00	1.71	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Moringa Leaf Powder	5	1000.00	3344.48	33.10	92.50	299.00	30.21	1.32	0.35	0.60	5.77	10.67	240.00	40.53		5
Soybean oil	2.1	480.00	51.61	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
L-Lysine HCl	0.15	1.00	0.27	0.01	98.50	3730.00	94.50	78.00								5
Wheat Bran	2.08	64.00	37.43	4.21	86.60	1710.00	15.20	0.61	0.25	0.59	3.60	9.20	0.11	1.15		10
Toxin binder	0.09	1000.00	0.00	0.00												2
Ration (po)	100	146.61	52.48	9.13	88.10	2793.86	16.05	0.80	0.34	0.58	5.96	5.70	12.09	2.51		
Grower	100	0.00			0.00	2800.00	16.00	0.80	0.32	0.70	6.00	6.00	1.00	0.60		



Appendix 15: Layer Mash with 7.5% *Moringa Oleifera* Leaf Powder Inclusion Rate

Ingredient as fed	%	Pr/Unit	Pr/ME	Pr/CP	DM	ME	CP	Lys	Meth	M+C	EE	CF	Ca	P	Min	Max
Salt	1.5	100.00	0.00	0.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		5
Maize	60.2	85.00	25.45	9.77	86.90	3340.00	8.70	0.22	0.20	0.35	3.60	2.10	0.04	0.30		62
SBM 44/7	15	160.00	75.47	3.72	86.60	2120.00	43.00	2.75	0.65	1.33	1.80	6.50	0.30	0.65		30
Groundnut meal (Expeller)	2	110.00	42.64	2.81	90.00	2580.00	39.10	1.29	0.43	0.94	7.50	10.00	0.18	0.57		10
Wheat Bran	3.7	64.00	37.43	4.21	86.60	1710.00	15.20	0.61	0.25	0.59	3.60	9.20	0.11	1.15		10
L-Lysine HCl	0.1	0.00	0.00	0.00	98.50	3730.00	94.50	78.00								3
DL-meth.	0.08	3000.00	1271.19	51.72	99.70	2360.00	58.00	0.00	99.00	99.00	0.00	0.00	0.00	0.00		3
Moringa Leaf Powder	7.5	1000.00	3344.48	33.10	92.50	299.00	30.21	1.32	0.35	0.60	5.77	10.67	240.00	40.53		7.5
Rice bran 15-30% fibre	7.73	12.00	12.00	1.71	89.80	1000.00	7.00	0.34	0.13	0.26	7.00	24.00	0.08	1.60		10
Soybean oil	2.1	480.00	51.61	0.00	99.50	9300.00	0.00	0.00	0.00	0.00	99.50	0.00	0.00	0.00		5
Toxin binder	0.09	1000.00	0.00	0.00												2
Ration (po)	100	170.55	62.15	10.67	87.88	2744.19	15.98	0.80	0.35	0.60	5.78	5.44	18.08	3.50		
Grower	100	0.00			0.00	2800.00	16.00	0.80	0.32	0.70	6.00	6.00	1.00	0.60		



Appendix 16: Table of Specification

Content	**Perception 20%**	**Set 20%**	**Guided Response 18%**	**Mechanism 15%**	**Complex Overt Response 12%**	**Adaptation 10%**	**Origination 5%**	**Total 100%**
Feed Formulation 40%	5	5	4	3	3	3	1	**24**
Layer Production 60%	7	7	6	5	4	3	2	**34**
Total 100%	**12**	**12**	**10**	**8**	**7**	**6**	**3**	**58**

17: Psycho-productive Multiple choice Question Items for Assessing the Level of Skills Acquired by the Students in Feed Formulation and Layer Production

Cluster A: Feed Formulation

1. Which of the following feed ingredients are mainly included to supply protein in layer feeds?
    a. Fish meal.
    b. Soybean meal.
    c. Groundnut cake.
    d. Cotton seed cake.
2. Which of the following purposes does *Moringa oleifera* leaf powder inclusion in layer feed mainly serve?
    a. Protein supply.
    b. Energy supply.
    c. Supplement.
    d. Crude fat supply.
3. In determining the type of feed ingredients to select during feed formulation, which of the following measures is considered least?
    a. Nutrient composition/Kilogramme.
    b. Cost/Kilogramme.
    c. Availability.
    d. Source.
4. In considering feed stuff to include in formulation, the following qualities can influence the choice of feed ingredient except:
    a. Anti-nutritional factor.
    b. Antioxidant property.
    c. Fibre content.
    d. Appearance.
5. Anti-nutritional factors in feedstuff can be removed by the following processing measures except:
    a. Grinding.
    b. Boiling.
    c. Dehulling.
    d. Roasting.

6. Grinding of feed ingredients begins after the following activity.
    a. Selection.
    b. Weighing.
    c. Dosing.
    d. Drying.
7. Storage of feed ingredients is preceded by the following activities except:
    a. Dosing.
    b. Drying.
    c. Transport.
    d. Weighing.
8. Mixing of ground feed stuff is done after the following activities except:
    a. Grinding.
    b. Weighing.
    c. Dosing.
    d. Filling.
9. The following activities precede bagging except:
    a. Filling.
    b. Weighing.
    c. Sewing.
    d. Pelleting.
10. Chicks' mash is ready for feeding after the following operation.
    a. Mixing.
    b. Grinding.
    c. Bagging.
    d. Dosing.
11. In weighing feed stuff, the first activity is to:
    a. Keep the feed stuff on the weighing platform.
    b. Take the reading.
    c. Adjust the weighing platform to 0.
    d. Open the feed stuff bag.
12. In grinding feed stuff to coarse mash, the first step to consider is:
    a. Increasing the number of hammer.
    b. Decreasing the number of hammer.
    c. Choosing a lower diameter screen.
    d. Choosing a higher diameter screen.
13. One of the following orders is not involved in emptying mixer.
    a. Place empty bags on the mixer outlet.
    b. Put on the mixer as the content is being removed.
    c. Adjust the outlet valve.

d. Put the grinder on.

14. One of the following activities demonstrates the first step in pelleting operation
    a. Routine check of the pelleting machine.
    b. Introduce the conditioning agent.
    c. Introduce the ground feed.
    d. Remove the feed from the mixer.
15. One of the following steps is not considered in the storage of feed stuff.
    a. First-in first-out procedure.
    b. The type of bag.
    c. Pallets on the floor.
    d. Cool and dry environment.
16. The following activities are involved in bagging except:
    a. Stand near the bagging machine with empty bag.
    b. Place the bag on the mixer outlet and adjust the valve.
    c. Sieve the feed to remove coarse particles.
    d. Weigh the feed to a known weight and sew.
17. The flow of feed ingredients in hammer mills can be regulated by the following steps except:
    a. Stand close the grinder.
    b. Hold the inlet valve with the right hand.
    c. Adjust the inlet valve up and down slowly.
    d. Pull the inlet valve and push slowly.
18. One of the following is the correct order for filling the grinder.
    a. Astride with the ingredients near the auger, bend and pour, switch on the auger.
    b. Stand near the auger with ingredients, pour and switch on the auger.
    c. Astride with the ingredients near the auger, pour and switch on the auger.
    d. Astride with the ingredients, bend and pour, switch on the auger.
19. Emptying the mixer follows one of the following orders below.
    a. Standing close the mixer astride with empty bag below the mixer outlet, pull the valve and push.
    b. Standing close the mixer astride with empty bag below the mixer outlet, raise up the valve and drop.
    c. Off the mixer, astride with empty bag below the mixer outlet, raise up the valve and drop.
    d. Off the mixer, astride with empty bag below the mixer outlet, pull the valve and push.
20. In dosing, one of the following orders below is correct.

a. Stand near the weighing platform with the feed stuff, bend and keep the feed stuff on the weighing platform, add or take away some ingredient, take the reading.
b. Stand near the weighing platform with the feed stuff, drop the feed stuff on the weighing platform and take the reading.
c. Stand near the weighing platform with the feed stuff, adjust the weighing platform and keep the feed stuff, take the reading.
d. Stand near the weighing platform with the feed stuff, keep the feed stuff on the weighing platform and adjust the weighing platform, take the reading.

21. One of these actions is not a biosecurity measure in feed mill.
    a. Cut two ends of a sac bag, fix and tie one end to the grinder outlet to reduce dust.
    b. Wear rain boot, overall cloth, and hair tie to cover the body.
    c. Close all holes and cracks, place rodenticide at strategic places in the feed mill to control rodents.
    d. Open small holes on the walls for humidity.
22. One of the following could be used to replace sewing machine in feed mill.
    a. Needle and thread.
    b. Nail and thread.
    c. Machine and rope.
    d. Needle and rope.
23. In small scale feed mill, one of the following can replace vertical mixer.
    a. Roller mixer.
    b. Hand mixer.
    c. Horizontal mixer.
    d. Venti mill.
24. In place of Molasses, one of the following can be a good alternative conditioner during pelleting.
    a. Water.
    b. Oil.
    c. Turpentine.
    d. Cake.

Cluster B: Layer Production

25. Which of the following is most appropriate for litter material?
    a. Rice straw
    b. Saw dust
    c. Wood shavings
    d. Rice husk
26. In litter management system, which of the following is the best practice?

a. Keeping the litter wet
b. Keeping the litter dry
c. Keeping the litter warm
d. Keeping the litter cold

27. Which of the following is a protozoan disease?
    a. Coccidiosis
    b. Gumboro
    c. Newcastle disease
    d. Fowl pox disease
28. In the control of cannibalism in layers, one of the following measures can be adopted except:
    a. Beak trimming.
    b. Increasing the calcium supply.
    c. Decongestion of the flock.
    d. Increasing protein supply.
29. For better management of layers, which of the following practices is mostly recommended?
    a. Battery cage system.
    b. Full litter system.
    c. Half litter half slate system.
    d. Full slate system.
30. Prevention of coccidiosis in layer farm requires one of the following measures except:
    a. Increasing the number of drinkers.
    b. Increasing the number of feeders.
    c. Avoidance of wet litter.
    d. Adopting adequate stocking density.
31. Which of the following layer disease is not zoonotic?
    a. Salmonella.
    b. Egg drop syndrome.
    c. Fowl pox disease.
    d. Newcastle disease.
32. The following activities come before stocking of chicks except:
    a. Cleaning of the brooding house
    b. Provision of clean drinking water
    c. Provision of feed
    d. Provision of vaccine
33. Disinfection of brooding house can be done immediately after the following operation:
    a. Cleaning
    b. Sweeping
    c. Washing

d. Dusting.

34. Layers are set for egg production at the age of?
    a. 22 weeks
    b. 21 weeks.
    c. 18 weeks.
    d. 19 weeks.
35. The most appropriate period to take pullets to the laying pen is at the age of?
    a. 17 weeks
    b. 19 weeks.
    c. 18 weeks.
    d. 20 weeks.
36. Coccidiosis vaccination through drinking water method is preceded by the following activity.
    a. Withdrawal of water for 2 hours.
    b. Administering Vitalite.
    c. Giving anti-stress 30 minutes earlier.
    d. Feeding adequately balance diet before the vaccination.
37. Chicks are moved from the brooding pen to the rearing pen after the following operations except:
    a. Vaccination of the chicks 2 days before the movement.
    b. Cleaning and disinfection of the rearing pen.
    c. Placing drinkers and feeders in the rearing pen.
    d. Supplying feed and water to the rearing pen.
38. Vaccination operation in layers is set after the following operation:
    a. Getting the appropriate vaccine.
    b. Diluting the vaccine with the appropriate amount of water.
    c. Washing and disinfecting the drinkers.
    d. Vaccinating the birds.

39. In administering vaccine through intra-ocular application, one of the following demonstrates the first step.
    a. Recombination of the vaccine.
    b. Holding the chick at the back and turn upside down.
    c. Apprehending the chick by the wings and turn side way while the eye is facing up.
    d. Pressing the dropper to release one drop at a time.
40. Which of the following facility must be ready before transporting vaccines from the veterinary hospital to the farm?
    a. Cold box.
    b. Crate.

c. Cage.
d. Bag.

41. In managing coccidiosis infected birds in a flock, the first thing to do is to:
    a. Treat the infected birds.
    b. Isolate the infected birds.
    c. Vaccinate the entire flock.
    d. De-worm the entire flock.
42. In feeding chicks, one of the following activities shows the first step.
    a. Put feed into the feeders.
    b. Wash the feeders.
    c. Replace the feeders.
    d. Clean the feeders.
43. In controlling fowl nice using piff paff insecticide, the first thing to do is to:
    a. Open the piff paff.
    b. Astride and bend.
    c. Drop the insecticide at the corners of the pen.
    d. Mix the piff paff with litter materials.
44. In transporting Lasota vaccine to the farm, one of the following activities demonstrates the first thing to do.
    a. Place the vaccine in-between blocks of ice.
    b. Transport the vaccine to the farm.
    c. Buy the vaccine.
    d. Obtain cold box.
45. One of the following steps is not involved in the removal of wet litter.
    a. Astride, bend with hands placed on the shovel handle.
    b. Scoop the wet litter with the shovel to gather them together.
    c. Scoop shovelful wet litter and put inside sac bag.
    d. Keep the sac full of wet litter at the corner of the house for drying.
46. The following activities are involved in feeding of layers except:
    a. Get the layer mash.
    b. Pour the feed in the clean feeders.
    c. Place the feeders in strategic positions in the layer house.
    d. Hold the layers and direct them to feed.
47. Disinfection in poultry house can be done at the following periods except:
    a. Before stocking of chicks
    b. After stocking of chicks
    c. After disposal of layers
    d. Before re-stocking of chicks.
48. One of the following activities is not appropriate step in checking chicks that consumed feed.

a. Astride, bend and catch a chick.
b. Keep the chick at the left hand and turn upside down.
c. With right fingers, feel the swollen stomach.
d. With the right fingers, feel the crop.

49. Filling the foot-dip involves the following steps except:
    a. Dilute a known disinfectant with appropriate quantity of water.
    b. Standing close the pit, astride and bend.
    c. Carrying the diluted disinfectant, pour into the pit.
    d. Cover the pit with a piece of wood.
50. Treatment of coccidiosis follows one of these orders:
    a. Obtain intracox, dilute in clean water, guide the birds to drink.
    b. Dilute in clean water, obtain intracox, guide the birds to drink.
    c. Obtain intracox, guide the birds to drink, dilute in clean water.
    d. Guide the birds to drink, obtain intracox, dilute in clean water.
51. One of the following is the correct order in debeaking operation.
    a. Catch the chick, hold the chick in left hand, hold the scissors in right hand, cut the upper lip.
    b. Hold the chick in left hand, hold the scissors in right hand, catch the chick, cut the upper lip.
    c. Catch the chick, hold the chick in right hand, hold the scissors in left hand, cut the upper lip.
    d. Hold the scissors in right hand, catch the chick, hold the chick in left hand, cut the upper lip.
52. One of the following is the best order for administering vaccine through eye drop method.
    a. With the chick at the left hand, turn eye up and place a drop of vaccine with the dropper using right hand.
    b. Astride, bend, pick the chick with left hand, turn the eye upside and give two drops of vaccine with the right hand.
    c. Astride, pick the chick with left hand, turn the eye upside and give two drops per time with the right hand.
    d. Pick the chick, turn upside down with the eye facing up, give a drop of vaccine.
53. The following order demonstrates the appropriate step in picking eggs.
    a. Standing close the laying nest with egg crate, bend down, collect the egg with the right hand, put the egg in the tray groove with the air space facing up.
    b. Collect the egg with the right hand, put the egg in the tray groove with the pointed end down.
    c. Astride, bend and collect the egg with the right hand, put the egg in the tray with the air space down.

d. Standing close the laying nest with egg crate, bend, collect the egg with the right hand, put the egg in the tray with air space end down.

54. The following can replace electricity for heating during brooding
    a. Kerosene lamp.
    b. Kerosene stove.
    c. Charcoal lamp.
    d. Rechargeable lamp.
55. The following materials can be used to substitute each other
    a. Wood shavings and rice straw.
    b. Wood shavings and saw dust.
    c. Saw dust and coconut husk.
    d. Rice bran and saw dust.
56. On manifestation of thin shelled egg in laying hens, one of the following control measures can be taken in the absence of high quality feed except:
    a. Throwing some quantities of bone meal on the litter daily.
    b. Spreading some quantities of oyster shell grits on the floor daily.
    c. Inclusion of some quantities of common salt in the feed.
    d. Inclusion of some quantities of limestone in the layer mash.
57. In construction of half slate half litter housing system, which of the following set of activities are the most appropriate procedure?
    a. Construct a platform of 60cm high on half of the pen, place slates on top and spread litter on the other half of the floor.
    b. Construct a platform on the half of the floor, place the slates on the other half of the pen.
    c. Spread litter on the half of the floor, place the slates on the other half of the pen.
    d. Spread litter on the half of the floor, obtain perforated plastic slates, construct a platform of 90cm high, place the slates on the platform.
58. One of the following set of activities describes the most efficient method of distinguishing fertile from sterile hen.
    a. Astrid, bend and catch the hen, hold it on the wings using the left hand, turn upside down, place 2 middle fingers in-between the cervical bones and 4 fingers in-between the lower abdominal bones.
    b. Holding the hen on the wings using the left hand, turn upside down, place 1 finger in-between the cervical bones and 3 fingers in-between the lower abdominal bones.
    c. Hold the hen on the right hand, insert 1 left finger in-between the cervical bones and 2 left fingers in-between the lower abdominal bones.

d. Astride, bend and catch the hen, apprehend her on the two wings and turn upside down, insert right middle finger in-between the cervical bones and 3 fingers in-between the lower abdominal bones.

Appendix 18: Reliability Coefficients

Correlations

		Scores1	Scores2
Scores1	Pearson Correlation	1	.712
	Sig. (2-tailed)		.795
	N	20	20
Scores2	Pearson Correlation	.712	1
	Sig. (2-tailed)	.795	
	N	20	20

Appendix 19: Students of Agricultural Education that Participated in the Research

S/N	Name	Reg No	Year of Study
1	Aneke Ann Onyinyechi	2014/191550	2/4
2	Areji Ukamake R.	2015/197609	1/4
3	Asogwa Agatha A.	2015/197874	1/4
4	Emmanuel Amarachi G.	2014/191211	2/4
5	Eze Francisca O.	2015/198902	1/4
6	Nnamani Stephen O.	2014/196153	2/4
7	Nwankwo Nkeiruka J.	2013/186852	2/4
8	Odoh Assumpta Chinenye	2014/192421	2/4
9	Okonkwo Chiamaka M.	2014/197075	1/4
10	Ugwuanyi Loveline I.	2015/198897	1/4
11	Ugwuoke Felicitas Ginika	2014/191551	2/4
12	Uramaugwuanyi Vivian E.	2015/197867	1/4

Appendix 20: Average Weight(g) of Layers fed with *Moringa ole*ifera Leaf Powder Fortified Feeds and those Fed with Control Feed

$\overline{X}$ **T1**	$\overline{X}$ **T2**	$\overline{X}$ **T3**	$\overline{X}$ **T4**
55	55	55	55
95	95	95	95
153	153	153	153
213	213	213	213
286	292	276	277
371	380	393	352
467	502	482	459
553	589	574	578
690	700	679	672
712	724	716	713
910	910	881	889
973	932	861	889
962	932	927	970
1060	1073	1007	1080
1242	1100	1218	1108
1350	1167	1183	1192
1325	1275	1183	1250
1358	1367	1375	1342
1267	1317	1192	1292
1348	1433	1358	1392

Key: $\overline{X}$ *- Mean; T1: Treatment 1 – Control; T2:Treatment 2 – group fed with 2.5% Moringa fortified feed; T3:Treatment 3 – group fed with 5% Moringa fortified feed; T4:Treatment 4 – group fed with 7.5% Moringa fortified feed*

Appendix 21: Average Weight Gain(g) of Layers Fed with *Moringa Oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed.

$\overline{X}$ **T1**	$\overline{X}$ **T2**	$\overline{X}$ **T3**	$\overline{X}$ **T4**
24	24	24	24
40	40	40	40
58	58	58	58
60	60	60	60
73	79	63	64
118	88	117	75
96	122	89	107
86	87	92	119
137	111	104	94
22	25	37	42
197	186	165	176
63	22	36	54
11	45	66	81

98	96	80	110
182	27	212	28
108	67	15	83
14	108	17	58
33	92	192	92
50	83	163	80
98	117	167	100

Key: $\overline{X}$ *- Mean; T1: Treatment 1 – Control; T2:Treatment 2 – group fed with 2.5% Moringa fortified feed; T3:Treatment 3 – group fed with 5% Moringa fortified feed; T4:Treatment 4 – group fed with 7.5% Moringa fortified feed*

Appendix 22: Average Feed intake/bird/day(g) of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

$\overline{X}$ **T1**	$\overline{X}$ **T2**	$\overline{X}$ **T3**	$\overline{X}$ **T4**
8	8	8	8
18	18	18	18
32	32	32	32
41	41	41	41
29	29	29	27
35	34	33	33
39	37	37	35
42	40	41	40
41	39	39	39
40	40	40	40
46	46	45	45
52	50	48	48
39	39	36	37
41	41	36	36
43	41	41	38
48	51	47	52
38	44	42	50
50	56	50	52
58	53	53	56
41	48	46	42

Appendix 23: Average Feed Conversion Ratio (FCR) of Layers fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

$\overline{X}$ **T1**	$\overline{X}$ **T2**	$\overline{X}$ **T3**	$\overline{X}$ **T4**
1.09	1.09	1.09	1.09
1.89	1.89	1.89	1.89
2.67	2.67	2.67	2.67
3.24	3.24	3.24	3.24
3.12	3.05	3.24	3.18
3.13	2.99	2.86	3.13
3.07	2.77	2.87	2.95
3.14	2.85	2.91	2.84
2.93	2.78	2.87	2.84
3.23	3.07	3.10	3.07
2.92	2.84	2.88	2.83
3.13	3.15	3.35	3.24
3.46	3.55	3.39	3.24
3.69	3.95	3.49	3.24
4.18	4.29	3.34	3.72
4.55	4.78	4.12	4.20
4.89	4.83	4.41	4.47
5.10	4.97	4.39	4.43
6.89	5.71	5.67	5.64
6.56	5.24	5.25	5.53

Appendix 24: Percentage Mortality of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

T1	**T2**	**T3**	**T4**
50%	40%	37%	43%

Appendix 25: Average Weight(g) of Layers Fed with Different Inclusion Rates of *Moringa* oleifera Leaf Powder

$\overline{X}$ **T2**	$\overline{X}$ **T3**	$\overline{X}$ **T4**
55	55	55
95	95	95
153	153	153
213	213	213
292	276	277
380	393	352
502	482	459
589	574	578
700	679	672

724	716	713
910	881	889
932	861	889
932	927	970
1073	1007	1080
1100	1218	1108
1167	1183	1192
1275	1183	1250
1367	1375	1342
1317	1192	1292
1433	1358	1392

Appendix 26: Average Weight Gain(g) of Layers Fed with Different Inclusion Rates of *Moringa Oleifera* Leaf Powder

$\overline{X}$ **T2**	$\overline{X}$ **T3**	$\overline{X}$ **T4**
24	24	24
40	40	40
58	58	58
60	60	60
79	63	64
88	117	75
122	89	107
87	92	119
111	104	94
25	37	42
186	165	176
22	36	54
45	66	81
96	80	110
27	212	28
67	15	83
108	17	58
92	192	92
83	163	80
117	167	100

Appendix 27: Feed Intake/bird/day(g) of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

$\overline{X}$ **T2**	$\overline{X}$ **T3**	$\overline{X}$ **T4**
8	8	8
18	18	18
32	32	32
41	41	41

29	29	27
34	33	33
37	37	35
40	41	40
39	39	39
40	40	40
46	45	45
50	48	48
39	36	37
41	36	36
41	41	38
51	47	52
44	42	50
56	50	52
53	53	56
48	46	42

Appendix 28: Average Feed Conversion (FCR) of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

$\overline{X}$ **T2**	$\overline{X}$ **T3**	$\overline{X}$ **T4**
1.09	1.09	1.09
1.89	1.89	1.89
2.67	2.67	2.67
3.24	3.24	3.24
3.05	3.24	3.18
2.99	2.86	3.13
2.77	2.87	2.95
2.85	2.91	2.84
2.78	2.87	2.84
3.07	3.10	3.07
2.84	2.88	2.83
3.15	3.35	3.24
3.55	3.39	3.24
3.95	3.49	3.24
4.29	3.34	3.72
4.78	4.12	4.20
4.83	4.41	4.47
4.97	4.39	4.43
5.71	5.67	5.64
5.24	5.25	5.53

Appendix 29: Percentage Mortality of Layers Fed with Different Inclusion Rates of *Moringa* oleifera Leaf Powder

T2	T3	T4
40	37	43

Appendix 30: Quantity of Eggs Produced by Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
2	4	0	0
11	6	0	3
37	5	4	10
68	23	8	13
80	22	12	16
107	26	15	19

Appendix 31: Average Egg Weight(g) of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

$\overline{X}$ T1	$\overline{X}$ T2	$\overline{X}$ T3	$\overline{X}$ T4
41.85	40.09	0	0
47.15	43.15	0	40
47.38	45.90	48.85	46.92
49.03	48.85	49.48	48.29
51.68	50.03	50	48.84
53.33	50.8	51.33	50.67
54.6	52.67	53.01	52.60

Appendix 32: Average Egg Mass(g) of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

$\overline{X}$ T1	$\overline{X}$ T2	$\overline{X}$ T3	$\overline{X}$ T4
0.38	0.40	0	0
2.36	0.86	0	0.40
8.05	0.92	0.49	1.88
15.69	4.40	1.59	2.41
19.64	4.50	2.47	3.42
27.85	5.08	3.00	4.21
28.80	14.22	7.19	6.59

Appendix 33: Laying Percentage of Layers Fed with *Moringa oleifera* Leaf Powder Fortified Feeds and those Fed with Control Feed

$\overline{X}$ T1	$\overline{X}$ T2	$\overline{X}$ T3	$\overline{X}$ T4
0.9	1	0	0
5	2	0	1

17	2	1	4
32	9	3	5
38	9	5	7
51	10	6	8

Appendix 34: Quantity of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

T2	T3	T4
4	0	0
6	0	3
5	4	10
23	8	13
22	12	16
26	15	19

Appendix 35: Average Egg Weight(g) of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

$\overline{X}$ T2	$\overline{X}$ T3	$\overline{X}$ T4
40.09	0	0
43.15	0	40
45.9	48.85	46.92
48.85	49.48	48.29
50.03	50	48.84
50.8	51.33	50.67
52.67	53.01	52.6

Appendix 36: Average Egg Mass(g) of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

$\overline{X}$ T2	$\overline{X}$ T3	$\overline{X}$ T4
0.40	0.00	0.00
0.86	0.00	0.40
0.92	0.49	1.88
4.40	1.59	2.41
4.50	2.47	3.42
5.08	3.00	4.21
14.22	7.19	6.59

Appendix 37: Average Laying Percentage of Layers Fed with Different Inclusion Rates of *Moringa oleifera* Leaf Powder

T2	T3	T4
1	0	0
2	0	1
2	1	4

9	3	5
9	5	7
10	6	8

Appendix 38: Mean Analysis of the Moisture Content(%) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
64.1	66.3	69.15	62.96

Appendix 39: Mean Analysis of the Carbohydrate Content(%) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
6.97	3.28	3.33	6.54

Appendix 40: Mean Analysis of the Crude Protein Content(%) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
23.71	22.88	23.57	22.33

Appendix 41: Mean Analysis of the Crude Lipids Content(%) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
4.23	6.65	3.54	7.17

Appendix 42: Mean Analysis of the Ash Content(%) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
0.93	0.88	0.42	1

Appendix 43: Mean Analysis of the Metabolizeable Energy Content(Kg/100g) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
674.25	687.74	582.72	752.46

Appendix 44: Mean Analysis of the Vitamin A Content(µg/100g) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
140.45	139.57	143.32	168.66

Appendix 45: Mean Analysis of the Vitamin B1 Content(µg/100g) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
0.219	0.218	0.215	0.214

Appendix 46: Mean Analysis of the Vitamin B2 Content(µg/100g) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
5.79	5.09	5.40	5.17

Appendix 47: Mean Analysis of the Vitamin B3 Content(µg/100g) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
8.57	8.47	8.37	8.34

Appendix 48: Mean Analysis of the Vitamin B5 Content(µg/100g) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
0.18	1.05	1.03	0.1

Appendix 49: Mean Analysis of the Vitamin C Content(µg/100g) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
0.27	0.13	0.07	0.13

Appendix 50: Mean Analysis of the Vitamin D Content(µg/100g) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
2.52	2.52	1.09	3.12

Appendix 51: Mean Analysis of the Vitamin E Content(µg/100g) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
8.82	8.74	8.81	8.87

Appendix 52: Mean Analysis of the Phosphorous (P) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
204.69	167.03	76.9	301.95

Appendix 53: Mean Analysis of the Sodium (Na) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
151.74	99.17	107.69	283.43

Appendix 54: Mean Analysis of the Magnesium (Mg) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
16.38	37.96	8.72	18.02

Appendix 55: Mean Analysis of the Zinc (Zn) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
1.12	0.85	1.01	1.12

Appendix 56: Mean Analysis of the Manganese (Mn) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
0.02	0.34	0.001	0.34

Appendix 57: Mean Analysis of the Iron (Fe) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
1.76	1.13	0.4	1.81

Appendix 58: Mean Analysis of the Potassium (K) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
132.01	210.19	222.76	153.63

Appendix 59: Mean Analysis of the Calcium (Ca) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
68.47	96.79	83.32	3.85

Appendix 60: Mean Analysis of the Copper (Cu) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
0.06	**1.16**	**0.77**	**1.28**

Appendix 61: Mean Analysis of the Selenium (se) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
28.66	8.82	0.23	31.11

Appendix 62: Mean Analysis of the Chromium (Cr) Content(ppm) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
0.001	0.003	0	0.021

Appendix 63: Mean Analysis of the Arginine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
312.04	108.67	453.02	311.90

Appendix 64: Mean Analysis of the Aspartate Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4

1764.38	982.13	1182	1699.48

Appendix 65: Mean Analysis of the Serine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
928	704.66	938.73	906.65

Appendix 66: Mean Analysis of the Cysteine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
329.05	173.99	238.32	337.02

Appendix 67: Mean Analysis of the Glycine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
543.38	765.37	332.91	542.32

Appendix 68: Mean Analysis of the Isoleucine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
685.34	633.06	553.43	611

Appendix 69: Mean Analysis of the Lysine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
857.67	769.75	779.66	852.89

Appendix 70: Mean Analysis of the Histidine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
748.38	998.41	345.5	334.13

Appendix 71: Mean Analysis of the Proline Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
533.39	**217.05**	**533.58**	**492.04**

Appendix 72: Mean Analysis of the Methionine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
654.2	986.07	589.33	798.32

Appendix 73: Mean Analysis of the Alanine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
1330.33	985.32	784.01	987.21

Appendix 74: Mean Analysis of the Tyrosine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
543.91	441.08	299.87	308.44

Appendix 75: Mean Analysis of the Threonine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
0	1.25	0	13.09

Appendix 76: Mean Analysis of the Phenylalanine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4

Appendix 77: Mean Analysis of the Leucine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
1137.05	1142.62	1228.24	1131.01

Appendix 78: Mean Analysis of the Glutamate Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
473.01	567.98	619.05	501.04

Appendix 79: Mean Analysis of the Asparagine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
0	0	0	8.056

Appendix 80: Mean Analysis of the Tryptophan Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
310.99	0.03	318.37	428.74

Appendix 81: Mean Analysis of the Valine Content(µg/mg) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
840.24	260.05	765.29	790.89

Appendix 82: Mean Analysis of the Total Cholesterol Content(mg/dl) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
940.65	920.75	938.41	900.28

Appendix 83: Mean Analysis of the Triglyceride Content(mg/dl) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
736.06	792.04	808.38	760.83

Appendix 84: Mean Analysis of the Free Cholesterol Content(mg/dl) of Eggs Produced by Layers Fed with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
224.5	200.97	171.09	224.69

Appendix 85: Mean Analysis of the Moisture Content(%) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
66.3	69.15	62.96

Appendix 86: Mean Analysis of the Carbohydrate Content(%) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
3.28	3.33	6.54

Appendix 87: Mean Analysis of the Crude Protein Content(%) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
22.88	23.57	22.33

Appendix 88: Mean Analysis of the Crude Lipids Content(%) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
6.65	3.54	7.17

Appendix 89: Mean Analysis of the Ash Content(%) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
0.88	0.42	1

Appendix 90: Mean Analysis of the Metabolizeable Energy(Kg/100g) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
687.74	582.72	752.46

Appendix 91: Mean Analysis of the Vitamin A Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
139.57	143.32	168.66

Appendix 92: Mean Analysis of the Vitamin B1 Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
0.218	0.215	0.214

Appendix 93: Mean Analysis of the Vitamin B2 Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
5.09	5.40	5.17

Appendix 94: Mean Analysis of the Vitamin B3 Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
8.47	8.37	8.34

Appendix 95: Mean Analysis of the Vitamin B5 Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
1.05	1.03	0.1

Appendix 96: Mean Analysis of the Vitamin C Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
0.13	0.07	0.13

Appendix 97: Mean Analysis of the Vitamin D Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
2.52	1.09	3.12

Appendix 98: Mean Analysis of the Vitamin E Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
8.74	8.81	8.87

Appendix 99: Mean Analysis of the Phosphorous (P) Content(ppm) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
167.03	76.9	301.95

Appendix 100: Mean Analysis of the Sodium (Na) Content(ppm) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
99.17	107.69	283.43

Appendix 101: Mean Analysis of the Magnesium (Mg) Content(ppm) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
37.96	8.72	18.02

Appendix 102: Mean Analysis of the Zinc (Zn) Content(ppm) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
0.85	1.01	1.12

Appendix 103: Mean Analysis of the Manganese (Mn) Content(ppm) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
0.34	0.001	0.34

Appendix 104: Mean Analysis of the Iron (Fe) Content(ppm) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
1.13	0.4	1.81

Appendix 105: Mean Analysis of the Potassium (K) Content(ppm) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
210.19	222.76	153.63

Appendix 106: Mean Analysis of the Calcium (Ca) (ppm) Content of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
96.79	83.32	3.85

Appendix 107: Mean Analysis of the Copper (Cu) Content(ppm) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
1.16	**0.77**	**1.28**

Appendix 108: Mean Analysis of the Selenium (Se) Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
8.82	0.23	31.11

Appendix 109: Mean Analysis of the Chromium (Cr) Content(µg/100g) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
0.003	0	0.021

Appendix 110: Mean Analysis of the Arginine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
108.67	453.02	311.9

Appendix 111: Mean Analysis of the Aspartate Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
982.13	1182	1699.48

Appendix 112: Mean Analysis of the Serine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
704.66	938.73	906.65

Appendix 113: Mean Analysis of the Cysteine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
173.99	238.32	337.02

Appendix 114: Mean Analysis of the Glycine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
765.37	332.91	542.32

Appendix 115: Mean Analysis of the Isoleucine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
633.06	553.43	611

Appendix 116: Mean Analysis of the Lysine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
769.75	779.66	852.89

Appendix 117: Mean Analysis of the Histidine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
998.41	345.5	334.13

Appendix 118: Mean Analysis of the Proline Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
217.05	**533.58**	**492.04**

Appendix 119: Mean Analysis of the Methionine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
986.07	589.33	798.32

Appendix 120: Mean Analysis of the Alanine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
985.32	784.01	987.21

Appendix 121: Mean Analysis of the Tyrosine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
441.08	299.87	308.44

Appendix 122: Mean Analysis of the Threonine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4

1.25	0	13.09

Appendix 123: Mean Analysis of the Phenylalanine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
0	983.18	708.63

Appendix 124: Mean Analysis of the Leucine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
1142.62	1228.24	1131.01

Appendix 125: Mean Analysis of the Glutamate Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
567.98	619.05	501.04

Appendix 126: Mean Analysis of the Asparagine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
0	0	8.056

Appendix 127: Mean Analysis of the Tryptophan Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
0.03	318.37	428.74

Appendix 128: Mean Analysis of the Valine Content(µg/mg) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
260.05	765.29	790.89

Appendix 129: Mean Analysis of the Total Cholesterol Content(mg/dl) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
920.75	938.41	900.28

Appendix 130: Mean Analysis of the Triglyceride Content(mg/dl) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
792.04	808.38	760.83

Appendix 131: Mean Analysis of the Free Cholesterol Content(mg/dl) of Eggs Produced by Layers Fed with Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
200.97	171.09	224.69

Appendix 132: Mean Analysis of the Cost of Feed/Kilogramme(₦) Produced with *Moringa oleifera* leaf Powder Fortified Feeds and those Fed with Control Feed

T1	T2	T3	T4
143	146	142	141
143	146	142	141
144	148	144	142
144	148	144	142
144	148	144	142
139	125	122	120

Appendix 133: Mean Analysis of Feed Cost per Egg(₦) Produced with *Moringa oleifera* Leaf PowderFortified Feeds and Control Feed

T1	T2	T3	T4
658	496	0	0
190	404	0	780
66	503	572	222
36	113	319	191
29	120	203	144
20	78	150	96

Appendix 134: Mean Analysis of the Cost of Feed/Kilogramme(₦) Produced by Different Inclusion Rates of *Moringa oleifera* leaf Powder

T2	T3	T4
146	142	141
146	142	141
148	144	142
148	144	142
148	144	142
125	122	120

Appendix 135: Mean Analysis of Feed Cost per Egg(₦) Produced with Inclusion of Different Rates of *Moringa oleifera* Leaf Powder

T2	T3	T4
496	0	0
404	0	780
503	572	222
113	319	191
120	203	144
78	150	96