PHYSIOLOGICAL RESPONSE OF BROILER BIRDS TO ORAL SUPPLEMENTATION WITH ALOE VERA AND NEEM LEAVE EXTRACTS

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PG/MSC/11/58309

DEPARTMENT OF ANIMAL SCIENCE

UNIVERSITY OF NIGERIA, NSUKKA

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A THESIS SUBMITTED TO THE DEPARTMENT OF ANIMAL SCIENCE, FACULITY OF AGRICULTURE, UNIVERSITY OF NIGERIA, NSUKKA

IN FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF SCIENCE DEGREE

SUPERVISOR: DR.A.O. ANI

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CERTIFICATION

We certify that EDEH HENRY ONYEJI. (PG/MSC/11/58309) carried out the research in the Poultry Unit of the Department of Animal Science University of Nigeria Nsukka. The report embodied here is original and has not been submitted for any other Degree of this or any University.

…… ……

Dr. A.O.Ani Date

Project supervisor

……. ……

Dr. (Bar.) A. E. Onyimonyi Date

Head of Department

…… ……

External Examiner Date

DEDICATION

This work is dedicated to my late Father, Mr. Raphael. U. Edeh. He is remembered for his zeal to see that all his children were educated.

ACKNOWLEDGMENT

My most profound gratitude goes to Almighty God who has never let me down in all my endeavours. He is my Lord and personal Saviour.

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Moreover, I am most indebted to my eldest Brother, Mr Samuel .O.Nnamonu for his all round support during this work and all my other brothers and sisters too. The prayer of my beloved Mum contributed much to the success of this work.

Finally, I cannot express the contribution and care of my brother and friend Dr Emmanuel Njioga and his wife. They made their home a home for me. God bless and reward you all together with the staff of UAC Food Court, Nnewi.

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ABSTRACT

Two hundred and forty 14-day old broiler birds were used in a study conducted to investigate the physiological response of boiler birds to oral supplementation with aloe vera gel and neem leaf extracts. In experiment one, one hundred and twenty 14- day old broilers were used to assess the physiological response of the broiler birds to oral supplementation with alovera gel extract, while in experiment two, one hundred and twenty 14- day old broilers were used to assess the physiological response of the broiler birds to oral supplementation with neem leaf extract. The birds of both sexes were randomly allotted into five treatment groups of 24 birds each in a completely randomized design (CRD) in both experiments. Treatments 1, 2, 3, 4, and 5 received ordinary water, Vitaltye, 10, 20, and 30% of each of the two extracts, respectively. Results obtained in experiment one showed that there were significant ($p<0.05$) differences in final body weight, feed conversion ratio, average cost/kg gain and mortality rate. Birds on T4(20%AVGE) had the lowest feed conversion ratio(3.09) and lower average cost of feed per kg gain(₦308.67) than others with feed conversion ratio [T1(3.36), T2(3.46),T3(3.21) and T5(3.18), and average cost of feed per kg gain [T1((₦336.33), T2(₦345.67), T5(₦317.66), respectively. There were significant ($p<0.05$)differences among treatments in packed cell volume, red blood cells, hetrophil, lymphocyte, moncyte, eosnoohil, and basophil. There were also significant ($p<0.05$) differences among treatments in crude protein, ether extract and nitrogen free ether retained; significant differences existed among treatments in total protein, albumin globulin, glucose, creatine, cholesterol and calcium. Live body weight, dressed weight (%LW), head, gizzard, empty gizzard, shank, heart, liver, kidney, abdominal fat, lungs, and large intestine were significantly affected by treatments. However, there were no significant ($p<0.05$) differences among treatments in average daily weight gain, average daily feed intake, daily water intake, protein efficiency ratio, white blood cell, dry matter retained, dressed weight(kg), and small intestines. Birds that received neem leaf extract (T4 and T5) showed progressive increase in final body weight (3.42kg and 3.70kg, respectively) compared to the control (3.14kg) and T2 [(vitalyte) (3.39kg)]. Birds on T5(30%NLE) had the lowest feed conversion ratio(2.85) and lower average cost of feed per kg gain(₦284.67) than others which had feed conversion ratio of 3.48 (T1), 3.21 (T2), 3.29 (T3) and 3.15 (T4), and average cost of feed per kg gain as follows:T1(₦347.67), T2(321.00), and T4(₦315.33). There were significant ($p<0.05$) differences among treatments in packed cell volume, red blood cells, hetrophil, lymphocyte, moncyte, eosnoohil, and basophil. Significant differences ($p<0.05$) also existed between treatments in the apparent retentions of crude protein, ether extract and nitrogen free ether, and in total protein, albumin, globulin, glucose, cholesterol and calcium. There were also significant ($p<0.05$)differences among treatments in live weight, dressed weight(%LW), head, gizzard, empty gizzard, shank, heart, liver, kidney, abdominal fat, lungs, large intestine and small intestine. However, there were no significant ($p<0.05$) differences among treatments in average daily feed intake, total water intake, dry matter retained, and serum creatine. Results showed that the levels of aloe vera gel and neem leaf extracts used in the present study enhanced the growth performance of broiler birds, especially at 20% and 30% inclusions.

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Poultry is on the fastest means to achieving appreciable improvement in the nutritional standard of the populace because of its short generation interval, quick turnover rate and relatively low capital investment (Smith, 2001; Ani and Okeke, 2011)

Nutrition is the most important consideration in any livestock enterprise. Its survival is dependent on the availability of feedstuffs, which are mainly components of human food. The unavailability of grains and the high cost of imported ingredients have made the price of commercial animal feed to increase over 300%. These problems remain the most important constraints to the expansion of commercial poultry production in Nigeria.

The high cost of conventional feedstuff has already sent a lot of livestock farmers out of business, thus leading to reduction in overall animal protein production and availability for humans dietary's need. The provision of feed alone has been reported to account for 60-80% of total cost of livestock production in developing countries alone (Igboeli, 2000; Esonu, 2006). In view of this, there is increased interest by poultry farmers on the search for non conventional feed ingredients that could be cheaper such as leaf and seed meals of ethno medicinal plants (Okoli *et al*., 2001, 2002). The use of various plant extracts in broiler production has been documented (Essien et al; 2007; Nworgu et al 2007; Galib and Noor, 2010). One way is to look for alternative source of feed supplement that is not only cheap and could boost the growth of chickens but organic and readily available.

In an effort to develop new feedstuff for animal feeding, a number of researchers have investigated the proximate composition of neem seed cake (Bawa *et al*., 2006; Uko and Kamalu, 2001), leaf meal (Oforjindu, 2006; Esonu *et al*., 2005, 2006; Ogbuewu *et al*., 2010a, b) and its use as feedstuff in poultry (Esonu *et al*., 2005; Oforjindu, 2006; Uko and Kamalu, 2007) and rabbits (Sokunbi and Egbunike, 2000a; Ogbuewu, 2008). Result of proximate analysis of neem showed that of had 92.42% dry matter, 7.58% moisture, 20.68% crude protein, 16.60% crude fibre, 4.13% ether extract, 7.10% ash and 43.91% nitrogen free extract (Esonu *et al*., 2005; Oforjindu, 2006; Ogbuewu, 2008).

Neem cake has also been widely used as animal feed (Bawa *et al*., 2006; Uko and 2007). Despite the bitter components, poultry consume diets containing varied percentage of neem

cake. Alkali treatment of neem cake with caustic soda yields palatable product, by removing the toxicant triterpenoids (Devakumar and Dev, 1993). Nagalakshmi *et al.* (1996) and Verma *et al*. (1998) reported beneficial effect of alkali treated (10-20 g NaOH) neem kernel cake incorporated into poultry feeds. It resulted to an increased feeding value and protein utilization with spectacular growth. However, no significant difference was observed among the different dietary groups in feed intake, egg production, egg quality, fertility, hatchability and chick weight (Nagalakshmi *et al.,* 1996; Verma *et al*. 1998).

Neem oil and de-oiled neem seed cake are used as animal feed. Neem oil which is rich in long chain fatty acids is used in poultry feed. Deoiled neem seed cake is rich in essential amino acids, crude proteins, fiber contents, sulphur and nitrogen (Uko and Kamalu, 2007

Aloe vera (*Aloe barbadensis*) belongs to the family of lily; It is spiky, succulent, and perennial. It is native to the eastern and southern part of Africa but it has spread throughout the warmer regions of the world like the Philippines. Physically, it is a short-stemmed plant that could grow from 80 to 100 cm tall, spreading by offsets and root sprouts. The leaves are lanceolate, thick and fleshy with thorny edges and with color ranging from deep green to greygreen.

It is ubiquitous in almost every house garden and is either used as accents for landscaping or for its medicinal value. Since it is easy to grow and maintain, it is widely used as natural ground cover or container. Aloe vera is not only a natural healer; it's also a growth enhancer in poultry. Hearing that, one might think, it's too good to be true. Essentially, the leaves of aloe vera are often for external uses only, they are not meant to be taken in. But with the study of Bejar and Colapo, it's now clear that it's safe for animal intake. Thus, it is important to know what's in the aloe vera that makes it both a natural healer and a growth promoter in chickens.

Physically, the leaf of an aloe vera is composed of three layers. The first layer contains a clear gel, which is contained within the cells of the inner portion. Then there is the anthraquinones contained in the bitter yellow sap of the middle leaf layer and the fibrous outer part of the leaf that serves a protective function.

The content of the aloe vera leaf is just 0.5 – 1.5% solid, with an average pH value of 4.55. This solid material contains over 75 different nutrients including vitamins and minerals.

Aloe vera is rich in vitamins and minerals. Specific vitamins include: Vitamin A (Beta-Carotene), Vitamin B1 (Thiamine), Vitamin B2 (Riboflavin), Vitamin B3 (Niacin), Vitamin B5, Vitamin B6 (Pyridoxine), Vitamin B12, Vitamin C, Vitamin E, Choline, and Folic Acid. The vitamins A, C, and E are responsible for the aloe's antioxidant activity while vitamin B and choline are involved in amino acid metabolism and vitamin B12 is required for the production and development of blood cells.(source Rita dela cruz of www.bar.gov.ph)

Among the important minerals found in aloe vera are: calcium, chromium, copper, iron, magnesium, manganese, potassium, phosphorous, sodium, and zinc. These minerals are essential for good health and are known to work in synergistic combinations with each other, with vitamins and other trace elements. . (source Rita dela cruz of www.bar.gov.ph

Aside from vitamins and minerals, aloe vera is rich with enzymes (help the breakdown of food sugars and fats), hormones (aid in healing and antiinflammatory activities), sugars (i.e. glucose and fructose that provide antiinflammatory activity), anthraquinones or phenolic compounds (aid absorption from gastro-intestinal tract and have antimicrobial and pain killing effects), lignin (increases the blood circulation), saponins (provide cleansing and antiseptic activity), sterols (antiseptic and analgesic), amino acids (basic building blocks of proteins in the production of muscle tissue), and salicylic acid (works as a pain killer)(source: T. Rita dela cruz of www.bar.gov.ph).

Although the use of various plant extracts in broiler production has been documented, there is paucity of information on the growth and physiological response of broiler birds to oral supplementation with aloe vera and neem leaves extracts.

1.2 STATEMENT OF PROBLEM.

Achieving maximum health and performance of poultry requires nutritionally balanced diets. One of the common issues with regard to back yard flocks relates to poor or inadequate feeding programs that can lead to vitamin and mineral deficiencies in the birds. Since vitamins and minerals are very important to normal physiological functioning of birds, inadequate supply of these nutrients will pose a serious problem to birds. It is also costly to use commercial produced vitamins hence increasing the cost of poultry production.

1.3. OBJECTIVES OF THE STUDY.

The study aimed at determining the physiological response of broiler birds to oral supplementation with aloe vera and neem leaf extracts as supplementary sources of vitamins and minerals to broiler birds.

1.4 JUSTIFICATION OF THE STUDY.

As indicated above, vitamin and mineral deficiencies can produce numerous health problems for chickens including death in some cases. Thus, to prevent nutritional deficiencies, or to correct when deficiency symptoms are noted, feeding a balanced poultry ration with the required vitamins and minerals should be practiced. Besides, oral administration of vitamins and minerals to birds is inevitable especially in the time of stress and outbreak of diseases. The use of aloe vera and neem leaves extracts in broiler production is a step in the right direction since they are of potential sources of these essential nutrients that are necessary for normal well being, growth and development of birds.

SPECIFIC OBJECTIVES

The study was to:

i. Determine the effect of alovera gel and Neem leaf extracts on growth performance of broiler starter and finisher birds.
ii. Determine the effect of alovera gel and Neem leaf extracts on mortality, blood and biochemical parameters of broiler starter and finisher birds.
iii. Determine the effect of alovera gel and Neem leaf extracts on carcass yield and organ weights of broiler starter and finisher birds.
iv. Determine the cost implication of oral supplementation with aloe vera and neem leaf extracts as supplementary sources of vitamins and minerals.

CHAPTER TWO

LITERATUER REVIEW

2.1 Broiler breeders and their management

Broiler, also known as Cornish Cross, is a type of chicken raised specifically for meat production. Produced by fast-growing breeds with low mortality, broilers can be reared successfully in standard housing conditions on readily available, custom-formulated broiler feed rations.

Cross Breed For Parent Stock (Broiler Breeders)

Consumers expect the meat from broilers to be tender and of high quality. The whole broiler production process is designed for this requirement but the same inputs are at odds with those required for egg production by broiler breeders. The three main steps and stages in the whole broiler production process are:

- rearing and managing broiler breeders (i.e. the birds that produce eggs for hatching into broiler chicks),
- fattening of broiler chicks
- marketing and processing of finished broiler birds

The broiler producer clearly requires birds that will achieve a high body weight, with good carcass quality, over the shortest possible period of time using the minimum amount of regular feed. In addition the producer also wants birds that possess the correct body conformation, which will feather rapidly and have a minimal mortality rate.

Selection and breeding for fast growth rates in broilers form the most important processes in the world poultry industry. Male broilers achieve rapid gain from the start, and at 6 weeks of age can weigh in at 2kg (live-weight). Female birds will tend to grow at a slower rate but this has definite marketing advantages because overall consumer demand is for broiler carcasses of various weights. It is not the amount of food consumed but the efficiency of feed utilisation and food conversion into body tissue which underpins the growth rate.

Broiler producers tend to plump for white feathered strains because they result in a 'cleaner-looking' carcass after processing. But there are instances where production management considerations outweigh this and coloured-feathered strains are preferred. Examples include broiler production in countries with high rainfall and the indigenous soil is red. In these situations, red/brown Rhode Island Reds may be the most sensible choice. Feather cover must be good to maintain insulation and restrict heat loss from the body, as well as minimizing incidence of skin blistering which ruins marketability of processed birds.

Many modern strains of broiler will produce yellow fat because they have been custom-bred for the American market. In markets where yellow fat is undesirable, producers should remove carotene and carotenoid pigments (coloured chemicals) from the ration. Similarly, factors that determine carcass quality in one country may not suit another. For instance, consumers in some countries may consider the body conformation, texture and taste of carcasses high quality by 'Western' standards to offer an unattractive and insufficiently chewy eating experience. For supermarket sales in general, breast meat should be broad and deep. Many such problems are overcome by incorporating local strains into cross breeding programmes to produce appropriate broiler parents stock.

Biosecurity

Biosecurity involves the total management of a flock or herd of livestock in a manner that promotes their well-being and prevents the establishment and the spread of diseases. Starting with good-quality stock is an important first step. Whether stock is bought as day-old chicks, as grown birds, or as eggs, they should be purchased from companies or hatcheries that are part of the National Poultry Improvement Program (NPIP). The NPIP ensures that birds are free of certain diseases.

In order to maintain an effective health program, consulting with a local veterinarian or Extension office regularly is a good idea. If birds rather than eggs are bought for the flock, it is wise never to mix different species of birds. One specie may carry and be immune to a disease that is infectious for another. Never mix turkeys and chickens or raise turkeys in the same enclosure used to raise a flock of chickens. Pullets started elsewhere, mature pullets, or

force-molted hens introduced into a laying flock may carry diseases to the resident flock. For the same reason different age birds should never be mixed together. Older birds may carry diseases to which younger birds have not yet developed an immunity. The flock should be well housed and have access to good-quality feed and water. If the house has been used for other birds previously, make sure to have it cleaned out and disinfected. Remove the litter and add new litter, and make sure feeders and waterers are cleaned and disinfected. Providing feed and water is not always enough. The feeders and waterers should be positioned such that all birds have equal access to them. This prevents the aggressive ones from preventing the weak ones from eating and starving to death.

The flock should have access to enough light, enough space (not overcrowded), and have adequate ventilation, and it should not be subjected to stresses such as temperature extremes. Good-quality litter is essential in maintaining flock health. Litter should be laid out to about 4-6 inches and should not be too dry. Waterers should be checked frequently to make sure birds do not spill too much water. Wet litter encourages the growth of pathogens and leads to development of breast blisters and foot pad dermatitis. Crust out the litter periodically to remove wet spots and manure, and top dress it with fresh litter.

In any normal flock, there is a level of acceptable mortality. Dead birds should be removed promptly so that they do not become a source of infection for the rest. Dispose of them by burying, incinerating or composting. Visibly sick and moribund birds should also be culled regularly. If a disease is suspected, either consult with a veterinarian or send a few birds to a state or diagnostic laboratory for autopsy and diagnosis. If it is possible, separate the sick birds from the healthy ones in order to limit the spread of the disease. Poultry are usually very cannibalistic and therefore it may be advisable to trim their beaks slightly at a very young age.

What are the sources of infection that can be introduced into a backyard flock? Man is one of the primary and most important sources because human beings are very mobile and track in infectious agents on their clothes, footwear, supplies, and equipment. Clean and disinfect equipment regularly and do not borrow equipment from neighbors. Use coveralls, if possible.

Records

Record keeping and meeting production targets are good management practices that allow the identification and solution of problems. When a problem is identified, the next step is to attempt to fix it. Identifying the cause of and fixing a problem is an important part of the farmer's knowledge base, and is likely to assist in preventing a recurrence of the problem (Barnett *et al.,* 2001). Records kept over time can help identify some of the possible causes of problems. One of the most useful record-keeping documents is a diary, which can be used in combination with record-keeping sheets to record major activities, problems identified, equipment repairs, deviations from equipment settings, and any staff issues. Records of production, growth, feed, egg weights, mortalities, treatments given, and response to treatments should be maintained to assist investigations of sub-optimal performance. In all production systems, signs of ill health can be detected when poultry reduce their food and water intake; reduce production or growth; undergo a change in appearance, behaviour or activity level; or have abnormal feather condition or droppings.

2.2 Nutrient requirement of poultry

Poultry diets must be formulated to provide all of the bird's nutrient requirements if optimum growth and production is to be achieved. There are six classes of nutrients:

Carbohydrates – the major source of energy for poultry. Most of the carbohydrate in poultry diets is provided by cereal grains.

Fats – provide energy and essential fatty acids that are required for some body processes.

Proteins – required for the synthesis of body tissue (particularly muscle), physiological molecules (such as enzymes and hormones), feathers and for egg production. Proteins also provide a small amount of energy.

Vitamins – organic chemicals (chemicals containing carbon) which help control body processes and are required in small amounts for normal health and growth.

Minerals - inorganic chemicals (chemicals not containing carbon) which help control body processes and are required for normal health and growth.

Water - Water is the most important nutrient for the overall health and performance of commercial broilers. It plays an essential role in every aspect of metabolism and is critical to the regulation of the bird's body temperature, food digestion, and waste elimination. By weight, broilers consume almost twice as much water as feed

Factors affecting the nutrient requirements of poultry

The nutrient requirements of poultry are affected by a large number of factors, including:

Genetics (the species, breed or strain of bird) – Different species, breeds or strains of bird have different average body sizes, growth rates and production levels and will also absorb and utilise nutrients from feed with different levels of efficiency, leading to different nutrient requirements. As the genetics of commercial poultry is constantly changing, so are their nutrient requirements. Consequently, breeders of commercial poultry provide information on the specific nutrient requirements for the birds they sell.

Age - Nutrient requirements are related to both body weight and the stage of maturity.

Sex - Prior to sexual maturity the sexes have only small differences in their nutrient requirements and males and females can usually be fed the same compromise diet to achieve acceptable growth rates. Differences in nutrient requirements are larger following the onset of sexual maturity and significantly different diet formulations are then required for each sex.

Reproductive state - The level of egg production in hens and sexual activity in males will affect nutrient requirements.

Ambient temperature - Poultry have increased energy requirements to maintain normal body temperature in cold ambient temperatures and the opposite in hot ambient temperatures. The process of digestion of food produces body heat and the amount of heat produced will vary according to the nutrient composition of the diet. This is called the heat increment of the diet. In cold temperatures it may be desirable to formulate a diet with a higher heat increment and the opposite in hot temperatures.

Housing system - The type of housing system will influence the level of activity of the birds and therefore their energy requirements.

Health status - Birds experiencing a disease challenge may benefit from an increase in the intake of some nutrients, most commonly vitamins.

Production aims - Optimal nutrient composition of the diet will vary according to production aims, such as optimising weight gain or carcass composition, egg numbers or egg size. Poultry that are raised for breeding purposes may need to have their energy intake restricted to ensure that they do not become obese.

Nutrient levels for broiler diets

Feeding strategies for broiler chickens will vary depending on the target market for the final product. Strategies for feeding broilers destined for the whole bird market will differ from strategies for broilers destined to be sold as pieces. Furthermore, the nutrient intake of fast growing broilers must be carefully controlled to prevent metabolic diseases such as ascites and leg weakness. Table 1 provides data on typical levels of selected nutrients for broiler diets.

Table 1. Examples of broiler diets

Nutrients	**Starter**	**Grower**	**Finisher**
Age fed	0-10	11-24	25-slaughter
Crude protein (%)	22-25	21-23	19-21
ME (MJ/kg)	12.60	13.30	13.50
ME (kcal/kg)	3010	3175	3225
Total Arginine (%)	1.48	131	1.11
Digestible Arginine (%)	1.33	1.18	1.00
Total Lysine (%)	1.44	1.25	1.05
Digestible Lysine (%)	1.27	1.10	0.92
Total Methionine (%)	0.51	0.45	0.39
Digestible Methionine (%)	0.47	0.42	0.36
Total Methionine +Cystine (%)	1.09	0.97	0.83
Digestible Methionine +Cystine (%)	0.94	0.84	0.72
Total Threonine (%)	0.93	0.82	0.71
Digestible Threonine (%)	0.80	0.70	0.61
Total Trypophan (%)	0.25	0.22	0.19
Digestible Tryptophan (%)	0.22	0.19	0.17
Total Valine (%)	1.09	0.96	0.81
Digestible Valine (%)	0.94	0.83	0.70
Calcium (%)	1.0	0.90	0.85
Available phosphorous (%)	0.50	0.45	0.42
Sodium (%)	0.16	0.16	0.16

Source: Ross Broiler Management Manual

2.3 FEED INTAKE OF BROILER BIRDS.

Voluntary feed intake of chickens determines nutrient intake levels and thus has a great impact on efficiency of poultry production. Often, adequate feed intake is hard to maintain on many poultry operations in several farms and, thus, becomes an important factor limiting productivity. Stressors such as hot temperature, increased stocking density and reduced health status, together with genotype, influence feed intake and, thus, growth Mbajiorgu et al (2011). Furthermore, dietary factors, including energy density, deficiencies or excesses of nutrients such as carbohydrates, protein and minerals can also influence feed intake in poultry. Though the spectrum of factors that affect voluntary feed intake in poultry is very broad, the purpose of this review is to highlight the influence of dietary factors, particularly energy and protein densities, on voluntary feed intake in chickens.

2.4 ENERGY REQUIREMENT OF CHICKENS

Energy by itself is not a nutrient but a property of energy yielding nutrients, primarily carbohydrates, lipids and proteins when they are oxidized during metabolism. Dietary energy levels have been shown to affect broiler chickens' feed intake. Nahashon *et al*. (2005) reported that as dietary energy level increases, birds satisfy their energy needs by decreasing feed intake. Decreases in feed intake with high energy levels in the diets of broiler chickens have also been reported by Leeson (2000) and Veldkamp *et al*. (2005). Thus, in formulating poultry diets, the nutrient requirements of broiler chickens have frequently been expressed per unit of dietary metabolisable energy (Gonzalez and Pesti, 1993). This practice is based on the theory that birds will adjust their feed intake according to their metabolisable energy requirements and was summarized by the NRC (1984) as an absolute requirement for energy in terms of kilocalories per kilogram of diet cannot be stated because poultry adjust their feed intake to obtain their necessary daily requirement.

However, based on a re-evaluation of numerous research data, the NRC (1994) have revised their previous conclusions by stating that the practice of relating nutrient concentrations as a function of dietary metabolisable energy seems to apply more to leghorn type chickens fed diets with a low metabolisable energy concentration while, as a result of the over-consumption of energy on diets with a high metabolisable energy concentration, the application of specific nutrient-to-metabolisable energy ratios in broiler chickens and turkeys should be re-evaluated. Leeson *et al*. (1996) showed that broiler chickens fed up to 25 and 49

days of age were able to adjust their feed intake to a constant energy intake over a range of dietary metabolisable energy levels from 11.29 to 13.80 MJ ME/kg DM, which indicated that broiler chickens retain an innate ability to eat to a fixed energy requirement rather than to physical capacity as was suggested by Newcombe and Summers (1984). However, on closer observation of the data by Leeson *et al*. (1996), it can be seen that early feed intake to 25 days of age was not greatly affected by dietary metabolisable energy concentrations over the range of 12.13 to 13.80 MJ ME/kg DM and that it was only at the lowest metabolisable energy concentration of 11.29 MJ ME/kg DM that a significant increase in feed intake occurred. Also, the effects of metabolisable energy concentration on feed intake were very different between the early (0-25 days) and later (26-49 days) growth periods, with the metabolisable energy concentration having a far greater effect on increasing feed intake during the grower-finisher phase. This led to the overall conclusion by these authors that broiler chickens do indeed eat to a constant metabolisable energy intake when viewed over the entire 49-day growing period.

In contrast to the above observation, Richards (2003) observed that modern broiler chickens selected for rapid growth do not regulate voluntary feed intake to achieve energy balance. This altered ability of broiler chickens to adjust feed intake due to differences in metabolisable energy density of the diet was postulated to result from continued selection for rapid juvenile growth rates, which may have altered hypothalamic mechanisms that regulate feed intake in broiler chickens (Bokkers and Koene, 2003). Other reports have also shown no effect of dietary metabolisable energy concentration on feed intake between two groups of broiler chickens fed ad-libitum diets containing two energy levels of 13.38 and 15 MJ ME/kg DM.

2.5 PROTEIN AND AMINO ACID REQUIREMENTS OF CHICKENS

Proteins have been described as complex organic compounds of high molecular weight composed of 22 different amino acids or derivatives that are linked by peptide bonds to form a primary chain structure. As a result of steric constraints this primary structure has been reported to form an α-helical structure stabilized by hydrogen bonds as well as by cross-linking of individual amino acid residues. The á-helix that describes the primary structure of the protein has been found to be subsequently folded and arranged into more complex secondary and tertiary structures which, with the specific number and sequences of different amino acids, ultimately determine the biological characteristics and functionality of the

protein (Leeson and Summers, 2001; Horton *et al*., 2002). Because body proteins are in a dynamic state, with synthesis and degradation occurring continuously, an adequate intake of dietary amino acid is required. If dietary protein or amino acid is inadequate, there is a reduction or cessation of growth or productivity and a withdrawal of protein from less vital body tissues to maintain the functions of more vital tissues (NRC, 1994).

As mentioned earlier, there are 22 amino acids in body proteins and all are physiologically essential (NRC, 1994). Nutritionally, ten of these are indispensable because chickens are unable to synthesize them or can not synthesize them at a rate sufficient to meet their needs. These are methionine, lysine, threonine, leucine, valine, isoleucine, arginine, phenylalanine, histidine and trytophan (Austic, 1995; NRC, 1994).

The amino acid requirements of poultry represent the requirements for the indispensable amino acids plus sufficient nitrogen in an appropriate chemical form for synthesis of the dispensible amino acids. Chickens are sensitive to the dietary balance of these amino acids (Austic, 1995). For the diet to be used with maximum efficiency, the chicken must receive the indispensable amino acids in the correct quantities and sufficient amino acids to meet the dispensable amino acids for metabolic demands must be available. The presence of adequate amounts of nonessential amino acids in the diet reduces the necessity of synthesizing them from essential amino acids. Amino acid requirements may be classified as those for maintenance, carcass growth, egg production and feather growth on the basis of their respective amino acid profiles (Hurwitz *et al*., 1978). In order for the bird to realize its genetic potential and achieve the best levels of performance through maximum rates of protein synthesis, amino acids must be provided in the necessary quantities, avoiding both excesses and deficiencies (Sainbury, 1984). Thus, stating dietary requirements for both protein and essential amino acids is an appropriate ways to ensure that all amino acids needed physiologically are provided. Protein and amino acid requirements vary considerably according to the physiological state of the bird, that is, the rate of growth or egg production. Other factors contributing to variations in amino acid requirements of the chickens include age, body size, sex and breed. Amino acid requirements decrease with age and at the same time, the ideal balance of amino acids changes gradually to reflect those of maintenance (Zubair and Leeson, 1996). For instance, the percentage of amino acid required in the diet is the highest for young growing animals and declines gradually to maturity, when only enough amino acid to maintain body tissue is required (Pond *et al*., 1995). The balance of amino

acids needed for maintenance is not proportional to the balance of amino acids in a bird's tissues, but rather reflects the relative rate of obligatory loss of each individual amino acid (Gous and Morris, 1985).

For this reason, the balance needed for maintenance is considerably different from that needed for growth or egg production (Nemavhola, 2001). Dietary amino acid levels slightly below maintenance can sustain life, but muscle mass and functions are impaired (Leeson, 1996). Matching the amino acid profile of the diet with animal requirements is crucial for maximizing animal performance. For instance, turkey poults and broiler chickens have high amino acid requirements to meet the needs for rapid growth while the indigenous chickens such as the Venda breed will require less amino acid to meet their needs because of their slow growth rate and small body size. Because the contributions of maintenance and growth to total amino acid requirement change with body size and the ideal amino acid profiles for maintenance and growth are different, the composition of the ideal amino acid pattern will change continuously during the growth period (Mack *et al*., 1999).

Table 2: Amino acid requirements (g kg^{-1} feed) at different ages of broiler chickens

Amino acid	Starter (1-3 weeks)	Grower (3-6 weeks)
Arginine	14.4	12.0
Glycine+Serine	15.0	10.0
Histidine	3.5	3.0
Isoleucine	8.0	7.0
Leucine	13.5	11.8
Lysine	12.0	10.0
Methionine+Cystine	9.3	7.2
Methionine	5.0	3.8
Phenylalanine+Tyrosine	13.4	17.7
Phenylalanine	7.2	6.3
Threonine	8.0	7.4
Trytophan	2.3	1.8
Valine	8.2	7.2
Linoleic acid	10.0	10.0

Source: NRC (1994)

Amino acid requirements at different ages of broiler chickens are shown in Table 1, it is now well documented that male broiler chickens have higher dietary amino acid requirements than females (Han and Baker, 1993; Thomas *et al*., 1986), because male chickens contain more protein and less fat in their weight gain (Edwards *et al*., 1973; Han and Baker, 1991).

Unlike the effect of diet energy concentration, the effect of protein density on feed intake responses in broiler chickens has not been consistent. Buyse *et al*. (1992) reported that broiler chickens reared on lower protein density of 15% crude protein in the diet increased their feed intake in an attempt to meet their protein requirement. Contrary to these findings, a decrease in feed intake with reduced protein density has been reported in broiler chickens by Kemp *et al*. (2005) and Berhe and Gous (2005). These authors observed that Ross 308 broiler chickens decreased their feed intake as dietary protein content was reduced, resulting in a lower growth rate.

2.6 RESPONSE TRENDS OF CHICKENS TO DIFFERING FEED ENERGY AND PROTEIN LEVELS

To be of any real value, attempts to optimize the feeding of chickens must be capable of predicting voluntary food intake. Gous (2007) suggested that where feed intake is seen as an input, as is most often the case, it is not possible to optimize feeding programs successfully since the composition of the food offered has a very important effect on voluntary food intake. As suggested by Emmans and Fisher (1986) appetite is dependent on the nutrient requirements of the animal and the contents of those nutrients in the feed and hence, responses in feed intake, therefore, are not independent of the composition of the feed and strain of the chicken as was previously believed (Hill and Dansky, 1954).

The theory of feed intake and growth in birds proposed by Emmans (1981, 1989) was based on the premise that birds attempt to grow at their genetic potential, which would imply that they would attempt to eat as much of a given feed as would be necessary to grow at that rate. Factors that would prevent them from achieving this goal would be the bulkiness of the feed or the inability to lose sufficient heat to the environment in order to enable them to remain in thermal balance. This theory has been shown to predict feed intake and hence growth and carcass composition with considerable accuracy in birds (Ferguson and Gous, 1997; Ferguson *et al*., 1997). Additionally, Cobb 500 broiler chickens (Burnham *et al*., 1992) and laying hens (Gous *et al*., 1987) have been shown to increase feed intake as dietary protein content in the feed is reduced, attempting thereby, to obtain more of the limiting protein irrespective of the feed energy level until a dietary concentration is reached where performance is so constrained that feed intake falls. Similarly, Mbajiorgu (2010) observed that indigenous Venda chickens

increased their feed intake with increase in feed energy level and with decrease in feed protein content. This is contrary to the observation that broiler chickens eat to satisfy their energy requirements (Leeson, 2000; Nahashon *et al*., 2005, 2006; Veldkamp *et al*., 2005), or that broiler chickens will eat less of a feed higher in energy content than the one having a lower energy value (Palvink *et al*., 1997; Nahashon *et al*., 2006; Veldkamp *et al*., 2005). These findings together suggest that feed intake of broiler chickens is, first and foremost, closely linked to the feed energy level and hence birds attempt, as a priority, to adjust their feed intakes according to the energy level of the diet.

As suggested by Mbajiorgu (2010), indigenous Venda chickens, however, tended to behave differently in this respect. Tadelle *et al*. (2000) suggested that genetic limitation influences indigenous chicken growth responses because it affects their nutritional requirements. Thus, one possible consequence of the intrinsic genetic limitations of indigenous Venda chickens might be the loss of sensitivity to regulate feed intake according to dietary energy level. The physiological explanation for the present observation in indigenous Venda chickens is not clear and merits further investigation. However, it has been shown that chickens will increase their feed intake in response to marginal levels of first limiting feed nutrient, independent of the diet energy level (Boorman, 1979) since appetite is assumed to be dependent on the nutrient requirements of the animal and the contents of those nutrients in the feed (Emmans and Fisher, 1986). As such, feed intake of indigenous Venda chickens may have increased regardless of the energy value of the feed. Thus, Venda chickens ate more feed in an attempt to meet their protein requirements, which were limiting with decreasing dietary crude protein levels. This observation is similar to the results obtained with broiler chickens by Burnham *et al*. (1992) and with laying hens by Gous *et al*. (1987). These authors observed that chickens increased their feed intake as the limiting nutrient in the feed decreased in an attempt to obtain more of the limiting nutrient to satisfy their requirements for that nutrient. In fact, the nutritional factors involved in broiler chicken feed intake control mechanisms are not completely understood. Parsons *et al*. (1993) pointed out that in many experiments, where only responses to dietary energy level are involved, such feed intake responses could be confounded with variable intake of other nutrients such as protein and hence differences in feed intake response patterns to limiting feed protein content observed for Ross 308 broiler chickens and Cobb 500 chickens as indicated in Fig. 1 below.

Importantly, it is interesting to note that these differing feed intake response patterns to limiting feed protein content were achieved regardless of the energy value of the feed. Contrary to the above observations, Kemp *et al*. (2005) and Berhe and Gous (2005) observed that the Ross 308 strain of broiler chickens does not apparently conform to the theory that birds attempt to consume sufficient of a feed to meet their requirement for the first limiting nutrient in the feed as proposed by Boorman (1979) and supported by the work of Emmans and Fisher (1986). These authors observed that instead of increasing food intake, the Ross 308 broiler chicken strains decreased their feed intake as dietary energy was increased and dietary protein content reduced, resulting in a lower growth rate than in the Cobb 500 strain whose feed intake increases as dietary protein content is reduced (Fig. 1).

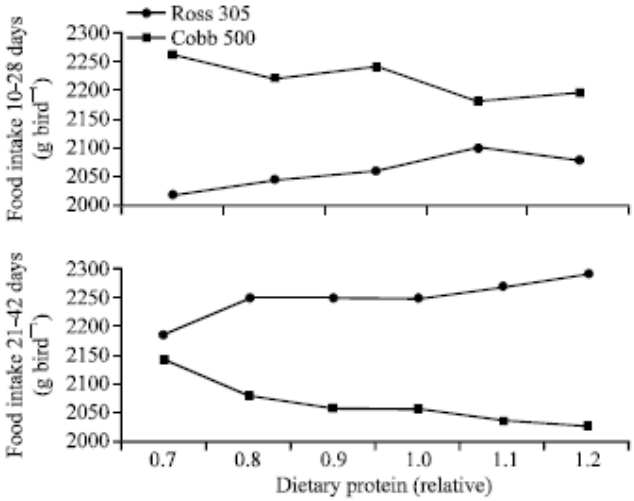

Fig.1: Response in **food intake** of two strains of broiler to increasing dietary balanced protein contents. Trial 1 from Kemp *et al*. (2005). Dietary protein contents relative to the Ross standard feeding levels (Aviagen, 2006)

They concluded that Ross 308 broiler chickens have been selected for improved growth and feed efficiency using high protein feeds. The authors went further to emphasize the point that such selection results in heavier carcasses (Pym and Solvens, 1979) and perhaps a reduced ability to fatten when faced with feeds marginally deficient in protein. Harper and Rogers (1965) suggested that when there is a dietary protein deficit, the free amino acid patterns of both muscle and plasma become imbalanced and consequently trigger the appetite regulating system to reduce feed intake. This may be the scenario when Ross 308 broiler chickens receive feeds marginally deficient in protein unlike the Cobb 500 and indigenous Venda chickens. Apparently, genetic potential may influence the Ross 308 broiler chickens' feeding

behaviour as it affects their nutritional requirements (Gous *et al*., 1999). Ross 308 broiler chickens have a pronounced genetic advantage for fast growth using high protein feed compared to Cobb 500 and Venda chickens and this might explain the differences in feed intake response patterns to marginally limiting feed protein content.

These observations on limitations in feed intake response patterns in Ross 308 broiler chickens, Cobb 500 and indigenous Venda chickens contradict the strongly held theory that all chickens eat to satisfy their energy requirements (Hill and Dansky, 1954; Scott *et al*., 1982; Leeson *et al*., 1996) or that chickens will eat less of a feed higher in energy content than the one having a lower energy value (Nahashon *et al*., 2006; Palvink *et al*., 1997; Veldkamp *et al*., 2005). However, because of the important implications of these differences, both the energy and protein levels of the diet should be taken into account when formulating diets aimed at achieving optimal feed intake in growing birds.

Apparently, the above observations by Boorman (1979), Gous *et al*. (1987), Burnham *et al.* (1992), Richards (2003) and Mbajiorgu (2010) on limitations in feed intake support the revised thinking of the NRC (1994) that some chicken strains do not adjust their feed intake to changes in the dietary metabolisable energy density and, as a result, may be prone to over-consume metabolisable energy in an attempt to obtain sufficiency of a limiting nutrient when offered diets high in energy, thereby, making the long held theory that all chickens do adjust feed intake to a constant metabolisable energy intake to necessitate further investigation.

2.7 Need of Vitamin supplements

Poultry require supplemental dietary Vitamins since common feed ingredients used in poultry production do not provide adequate quantities to meet minimum requirements. Vitamins are essential nutrients involved in over 30 metabolic reactions in cellular metabolism and critical to the efficiency of the Krebs/ Citric acid cycle. Vitamins represent only about 2 % of complete feed cost; however vitamins are involved in 100 % of metabolic functions (Marks, J., 1979). Vitamins are considered critical to both growth and health. Vitamins are organic compounds, present in most feedstuffs in minute amounts, essential for normal metabolism. The absence of adequate vitamins may cause a specific deficiency (McNaughton, J., 199O.).

2.7.1 ROLE OF VITAMINS

Table 3:Role of vitamins

Vitamins Fat soluble Vitamins	Role Of Vitamins	Deficiency Sympyoms
Vit. A.	Maintaining Integrity of the epithelial linings. Increases spermatogenesis in cocks and improve fertility and hatchability of eggs.	Night blindness, ataxia, Weakness and low hatchability.
Vit. D	Functions in Calcium Homeostasis.	• Rickets, thin shell eggs, reduced growth, weakness, and ataxia.
Vit. E	• Act as a biological antioxidant. • Important role in the metabolism of nucleic acid and sulphur amino acid.	• Encephalomalacia, Exudative diathesis, Muscular dystrophy. • Reduced fertility/ hatchability.
Vit. K	• Essential for clotting mechanism of blood.	• Excess bleeding, anemia, egg spot
Water Soluble Vitamins		
Vit. B1/ Thiamine	• Regulates Carbohydrate Metabolism. • Protects Gastro Intestinal tract. • Optimizes Energy Utilization.	• Anorexia, weakness, unthriftiness, retraction of head (Star gazing).
Vit. B2/ Riboflavin	• Affects Protein fat and Nucleic acid Metabolism. • Maintains nerve functions and production of ATP from ADP	• Curled toe paralysis slow growth, low fertility/ hatchability.
Vit. B3 / Nicotinamide/ Vit.PP	• It is a part of two coenzymes, which are involved in Carbohydrate, protein and fat metabolism.	• Enlargements of hoc joint, anorexia, poork growth and feathering, inflamed mucous Membranes
Pantothenic acid/Calcium D- Pantothenate	• It is an important coenzyme concerned with reversible acetylation reaction in the metabolism of carbohydrate fats and proteins.	• Poor growth, increased mortality, severe dermatitis, poor egg production and hatchability.
Vit. B6/ Pyridoxine	• Plays central Role in Protein metabolism, • Contributes in Mineral, Fat and Carbohydrate metabolism	• Anorexia, po tremors, convulsions.or growth,
Vit. B12/ Cynacobalamin	• Essential for Blood Formation • Promotes growth	• Anemia, reduced growth and performance, high mortality and reduced hatchability
Biotin /Vit.H	• As a component of various enzymes found in animal and in bacteria.	• Leg problems, dermatitis and poor Hatchability
Folic Acid	• Influence maturation of erythrocytes	• Macrocytic anemia, slipped tendons, poor growth and feathering and poor hatchability.
Choline	• Synthesis of acetylcholine for nerves and creatinine phosphates. • Fat metabolism	Perosis of hock joints
Vit. C/ Ascorbic acid	• Involved in tissue repairs • Influence on chicken immune functions. • Least toxic natural antioxidant • Reduce egg weight and increase shell thickness	• Decreased immunity

2.8 Vitamin requirements of Broilers

The vitamin requirement of poultry is usually affected by several factors such as age, body size, breed/strain, diet composition, diseases, endogenous or exogenous toxins, environment, feather coverage, feed form, feed intake, housing pattern, management conditions, minerals –vitamin bioavailability, other nutrient concentration, physiological condition, sex, stress, water intake etc .Information available on mineral and vitamin requirements of poultry gathered abroad is mostly concerned with those birds reared in temperate zones.

Contrary to the above, little work has been carried out in this area for chickens managed in the tropical climate. Considering the growth of tropical poultry industry, several workers have attempted to determine the requirements of minerals and vitamins for chickens in the tropics. The comparative recommended levels of Vitamins as per BIS (1992) and NRC (1994) are detailed in table 1. The vitamin levels recommended by NRC or BIS however are rarely followed in the Industry as these levels are the levels required to prevent deficiency symptoms whereas the industry is concerned with vitamin levels that are the most efficient in production. It is observed that the Industry uses Vitamin levels that are significantly higher than BIS or NRC recommendations.

Table 4: NRC (1994); BIS (1992) and Leeson & Summers Recommendations (Starter Rations)
(Values per Kg of Feed)

Vitamins	**NRC 1994**	**BIS 1992**	**Leeson and Summers Recommendations**	**Mean Values**
Vitamin A (I.U)	1500	6000	6500	4666
Vitamin D3 (I.U)	200	600	3000	1266
Vitamin E (mg)	10	20	30	20
Vitamin K3 (mg)	0.5	NR	2.0	1.3
Vitamin B1 (mg)	1.8	2.0	4.0	2.6
Vitamin B2 (mg)	3.6	5.0	5.5	4.7
Calcium DPantothenate (mg)	10	12	14	12
Vitamin B6 (mg)	3.5	NR	4.0	2.5
Vitamin B12 (mg)	0.010	0.008	0.013	0.010
Nicotinamide (mg)	35	40	40	38.33
Folic acid (mg)	0.55	NR	1.00	0.775
Biotin (mg)	0.15	0.10	0.20	0.15
Choline chloride (mg)	1300	1400	800	1166

NR-not recommended

Table 5: Recommendations by different Breeders for Broilers. (Starter Rations)
(Values Per Kg of feed)

Vitamins	**Cobb 100**	**Cobb 500**	**Hubbard -Isa**	**Arbor acres**	**Ross**	**Avian**	**Hybro**	**Mean values**
Vitamin A (I.U)	12000	14000	125000	8800	15000	8820	125000	11946
Vitamin D3 (I.U)	2500	5000	2500	3000	4000	3000	2500	3214
Vitamin E (mg)	20	80	30	30	50	22	25	36.71
Vitamin K3 (mg)	3.00	4.00	2.50	1.65	4.00	1.65	-*	2.8
Vitamin B1 (mg)	3.00	6.0	2.5	1.1	3.00	2.21	1.0	2.69
Vitamin B2 (mg)	8.00	8.00	8.00	6.60	9.00	7.72	5.00	7.47
Calcium D-Pantothenate(mg)	20.00	22.00	15.00	11.00	16.00	12.13	8.00	14.88
Vitamin B6 (mg)	3.00	5.00	3.50	4.40	5.00	2.21	2.00	3.59
Vitamin B12(mg)	0.015	0.020	0.020	0.022	0.016	0.014	0.015	0.017
Nicotinamide (mg)	50.00	85.00	40.00	66.00	45.00	48.51	30.00	52.07
Folic acid (mg)	2.00	2.00	1.00	1.00	2.00	1.00	1.50	1.50
Biotin (mg)	0.15	0.20	0.20	0.20	0.20	0.15	0.10	0.17
Choline chloride (mg)	400	450	600	550	400	660	500	508.57

***** Information not available. (Data From Techna, France).

Table 6: Recommendations by different Vitamin manufacturers for Broilers (Values Per kg of feed)

Vitamins	Roche	BASF	Rhonepoulenc	MeanValues
Vitamin A (I.U)	10000-12000	8000-12000	11000-13000	9666-12333
Vitamin D3 (I.U)	2000-4000	2500-4000	3000-4000	2500-4000
Vitamin E (mg)	30-50	30-50	30-150	30-83
Vitamin K3 (mg)	2-4	2-3	3-4	2.3-3.7
Vitamin B1 (mg)	2-3	2-3	2-3	2-3
Vitamin B2 (mg)	5-8	5-7	7-9	5.7-8.0
Calcium D-Pantothenate(mg)	10-15	10-12	12-14	10.7-13.7
Vitamin B6 (mg)	4-6	3-5	4-6	3.7-5.7
Vitamin B12(mg)	0.02-0.03	0.015-0.025	0.020-0.040	0.018-0.032
Nicotinamide (mg)	30-50	30-50	40-50	33.3-50.00
Folic acid (mg)	1.0-1.5	1.00	1.00-2.00	1.00-1.80
Biotin (mg)	0.05-0..10	0.10-0.15	0.1-0.2	0.083-0.15
Choline chloride (mg)	300-400	300-600	-*	300-500

* Information not available.

Table 7: Low 25%, Average, High 25% and High 5% Vitamin premixes for commercial Broiler Markets (Values per Kg of feed)

Vitamins	Low25%[3]	High25 %[2]	High 5%[4]	Avg[1]
Vitamin A (I.U)	6404	10141	12676	8113
Vitamin D3 (I.U)	2039	3036	3858	2568
Vitamin E (mg)	9.48	23.89	29.86	15.76
Vitamin K3 (mg)	0.90	2.82	3.53	1.63
thiamine (mg)	0.85	2.19	2.74	1.40
riboflavin (mg)	5.00	7.71	9.65	6.44
Pantothenic acid (mg)	8.40	12.47	15.59	10.91
pyridoxine (mg)	0.95	3.72	4.65	2.25
Vitamin B12(mg)	0.009	0.017	0.021	0.012
Nicotinamide (mg)	26.97	60.34	75.43	43.54
Folic acid (mg)	0.46	1.07	1.33	0.75
Biotin (mg)	0.024	0.126	0.157	0.07

(BASF, KC-9408)

1 Avg. represents the mean for 62 vitamin values used in the US poultry industry
2 High 25% represents the mean for the highest 15 vitamin values used in the US poultry industry
3 Low 25% represents the mean for the lowest 15 vitamin values used in the US poultry industry
4 High 5% represents the mean for the highest3 of 15 vitamin values used in the US poultry industry.

The challenge before any broiler producer is to determine Vitamin values that are efficient. This represents an inclusion level that is adequate for efficient performances whilst allowing a margin of safety. It is opined that excessive use of vitamins is an economic waste as beyond

a certain point additional vitamins do not lead to any improvement in performance, whilst adding to the cost.

There appears to be a significant variation in vitamin levels used by different broiler producers worldwide. It is observed that Breeders and Vitamin manufacturers generally recommend inclusion levels of vitamins far higher than what may be justified for economic performance. In this too there appears to be significant differences between the recommendations made by different breeders and Vitamin manufacturers.

The Vitamin recommendations by the Breeders are summarized in Table.2 and a recommendation by different Vitamin manufacturers is summarized in table 3.

It is of relevance to note that higher levels of any one particular Vitamin may interfere with the absorption or availability of other vitamins. For instance:

• Fat-soluble vitamins compete for the absorption sites. High dietary levels of Vitamin A can cause Vitamin D (Veltmann, J.R etal1983), Vitamin E (Combs, G.F.1976) or Vitamin K (Grimminger, P, 1965) deficiency

• Biotin becomes deficient in the presence of high levels of other B vitamins ((Veltmann, J.R et al 1983, Ferket, P., 1991)

The poultry industry is supplementing vitamins up to 10 times NRC requirements. (BASF, 1994). Increased vitamin fortification also increases feed cost; hence nutritionists must fortify rations with vitamins in accordance with the following criteria;

• Determine the factors in a grow out operation that impact vitamin supplementation

• Objectives to accomplish appropriate vitamin nutrition fortification with minimum feed cost and

• Determine “safety factor” Vitamin levels required due to unexpected and varied stress factors among locations and or within flocks.

The Vitamin levels used by the US Poultry industry were researched by BASF. These values are indicated in table.4

Comments

• There is a significant variation in levels of vitamins recommended in broiler rations by Breeders, Vitamin manufacturers and Researchers.

• There may be some differences in levels required due to breed variations however in view of the fact that all broilers grow more or less at a similar rate, these huge differences cannot be rationalized.
• In general all Breeders and Vitamin manufacturers recommend higher levels of vitamins than what is recommended by researchers like NRC and BIS. This is probably due to NRC defining vitamin requirements as the minimum vitamin level to prevent clinical symptoms of Vitamin deficiency; however commercial broilers are economic agricultural field production units, where the objective is not to prevent deficiencies but to maximize field performance. Whilst considering the above facts a Safety margin inclusion has to be rationalized homogenous premixes containing higher levels of vitamins.

2.9 Water-Related Factors in Broiler Production

Water is the most important nutrient for the overall health and performance of commercial broilers. It plays an essential role in every aspect of metabolism and is critical to the regulation of the bird's body temperature, food digestion, and waste elimination. By weight, broilers consume almost twice as much water as feed. During its lifetime, a five-pound broiler will consume about 18 pounds of water, compared to approximately 10 pounds of feed (Lacy, 2002).

An adequate water supply is important to ensure that enough water is actually available to your birds. Today, almost every broiler grower has houses with some form of nipple water system that should provide one nipple per 10 to 12 birds (Tabler, 2003). An adequate number of nipples is critical, but perhaps even more important is an adequate flow rate from those nipples.

Low **water flow rates** can decrease flock performance (Lott et al., 2003). Research shows that adequate flow rates (in ml per minute) could be estimated by multiplying 7ml by bird age in weeks and adding 20. Therefore, adequate nipple flow rates for eight-week-old broilers would be:
$7 \times 8 = 56 + 20 = 76$ml per minute A system that delivers more than this is not a problem when managed properly, but one that delivers less can restrict flow and reduce performance.

Broiler water intake is directly related to a variety of factors, including water quality (Barton,

1996) and diet composition (Belay and Teeter, 1993). However, perhaps the most important factor affecting broiler water intake patterns is environmental temperature.

Water evaporation through the respiratory system (panting) is one of the main ways birds regulate body temperature during heat stress conditions. Broilers increase water consumption approximately seven per cent for each degree increase in temperature (Fairchild and Ritz, 2012).

Taste can have a big impact on water consumption in broilers. Chickens have a keen sense of taste and prefer water that is slightly acidic (Kare, 1970). This may explain why broiler growers who have run vinegar in the past may have noticed a slight increase in water consumption while doing so. However, unlike most animal species, a chicken's taste buds, for the most part, are not on the tongue. Taste buds in the chicken are distributed primarily on the back part of the roof of the mouth, with only two to four per cent located on the tongue (Ganchrow and Ganchrow, 1985).

In addition to taste, **water temperature** plays a major role on water intake in birds. Birds will drink cold water that is near freezing in temperature. However, they will suffer from extreme thirst rather than drink water that is a degree or two above their body temperature (Jones and Watkins, 2009). As long as water temperature is below body temperature, the bird receives some benefit from drinking because it helps with heat dissipation and body temperature regulation.

Lighting, either natural or artificial, affects water intake. With increased use of solid sidewall and dark-out housing, artificial lighting is replacing natural light. With natural lighting, two peaks in water consumption usually occur. The first is at dawn, as the sun comes up and the birds become active. The second is at dusk, as light levels begin to fade and the birds increase intake just before 'bedding down for the night'.

With artificial lighting, we see much the same pattern. Water intake increases when the lights first come on and increases again just before the lights go off. The birds 'learn' what time the lights go off, and increase consumption just before this 'bedding down' time. Therefore, whenever you make a change to your lighting schedule, always change the 'on' time, and not the 'off' time, so as not to disrupt the intake pattern the birds have established at 'bedtime'.

Feed availability will have a major influence on water intake. Feed and water consumption are very closely correlated. The birds will drink little water, even if it is available, if they do not have access to feed. And they will eat little or no feed if they do not have access to water.

Figure 1 shows daily feed and water consumption patterns for a flock of 56-day male broilers. Notice that, on most days, when water intake goes up, feed intake also goes up. The same is true if intake goes down. If you read your water meters daily, this can give you a fair assessment of flock performance. Even though you are not weighing the feed, you know that if water intake is up today from yesterday, then most likely the birds ate more feed today than yesterday.

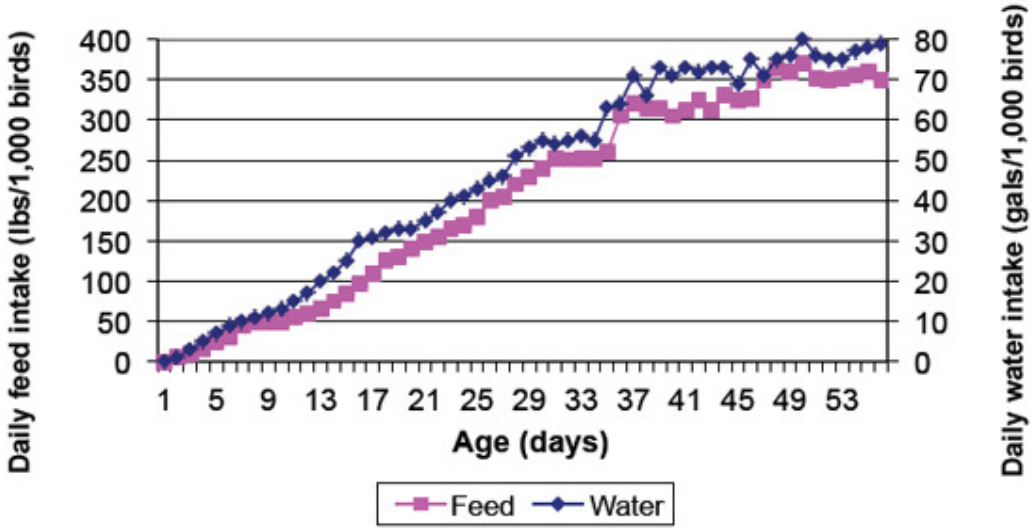

Figure 2. Correlation of broiler feed and water intake (Adapted from 1992 Annual Report)

Modern controllers can usually be programmed to read the water meters for you, so if you look back in the controller's history, you will have an idea of the water intake pattern for the flock.

If you record the daily water intake history before the controller's history is cleared out for a new flock, you can gradually build a database of water intake on your farm. You might then use this to recognise problems or unusual consumption patterns later on. You can also compare the current flock's intake pattern with that of previous flocks to estimate performance at any time throughout the flock

Knowing the **peak demand** for water will help you ensure an adequate water supply. This information is critical when sizing well pumps and supply lines from the water source to the chicken houses. Installing a pump that is too small and/or pipe that is too small in diameter will mean the system cannot maintain an adequate supply of water for drinking and cooling needs, especially in hot weather during times of peak demand.

A typical 500-foot broiler house requires about two gallons per minute (gpm) to meet the drinker demand, so an eight-house complex would need a 16gpm water supply, just to meet basic drinking water needs. However, evaporative cooling systems usually require an additional 8gpm per house, bringing the total water requirement per house up to 10gpm.

This means that an eight-house farm would need a flow rate of: 80 gpm (10gpm per house × 8 houses = 80gpm and require a three-inch PVC main supply line from the well.

You will not need this much capacity for the entire year. In fact, you may only need it for a few weeks during the summer when the birds are big. However, you must size the system to meet the peak demand when you have big chickens and hot weather.

If long runs or large differences in elevation exist from the well to the chicken houses, larger pipes may be needed. **Pump size** is also a factor. Use a pump capable of delivering more than peak demand as a safety precaution. Proper pump sizing depends on several factors, including depth of the well, length of the run and the associated pressure loss in piping between the well and chicken houses, and change in elevation between the well and the houses. Pressure loss in the piping system should be such that you still have at least 40 to 50 pounds per square inch at the chicken house; this typically means pressure at the wellhead is around 50 to 60 pounds per square inch.

Many growers have less than high-quality water supplies. Therefore, water filters are a common item on broiler farms. Unfortunately, filters can become clogged rapidly (especially during hot weather) and restrict water flow to drinking and cooling systems. So monitor filters closely and change them regularly, because an adequate supply and plenty of pressure will be of little value if water cannot get through the filter. Many water filters today have smaller micron sizes than filters from a few years ago, so they will clog more quickly and need changing more often. Therefore, keep plenty of spares for both the drinking and cooling systems.

2.10 Poultry Diseases: Causes, Symptoms and Treatment

Poultry diseases are ailments that affect birds that are usually raised for human consumption e.g. chickens, ducks, turkeys, geese, pheasants and quail. The diseases may be bacterial, viral, due to a deficiency, parasitic and neoplastic. Although, there are a number of common poultry diseases amongst these birds, let's take a look at particular diseases that affect different poultry.

Coccidiosis - This is one of the many universally-recognized poultry diseases in chickens and it comes about as a result of Eimirea. The infection takes place in the intestines after ingesting oocytes that are sporulated. This occurs due to poor living conditions such as spaces with excessive moisture, high temperature and unsanitary surroundings. When chickens are infected with poultry diseases such as coccidiosis, the result is bloody diarrhea, intestinal hemorrhaging and premature death of cells, tissue and organs. To detect this disease in chickens, take note of morbidity and the mortality rate of chickens as well as bloody/watery droppings in the coop. To treat this disease, vaccinations are required and this can be done by spraying the food with the vaccine, administering it as eye drops or distributing it in the water. If the infection returns due to moist litter, vitamins and minerals should be dispensed in the water.

Avian Influenza - This is one of the most well-known poultry diseases among birds, also commonly known as bird flu. It is caused by a virus, orthomyxovirus, and it's contracted by inhaling infected feces. It is one of the most contagious poultry diseases and is readily transmitted by waterfowl. Birds affected by this disease will show signs of sneezing, coughing, loss of appetite, diarrhea, depression, respiratory pain and emaciation. When it occurs in chickens, there is usually a drop in egg production and the quality of the shells is deficient. Antibiotics are available to treat the disease, although prevention is the best way to go because it is communicable to humans.

Newcastle Disease:

Description: The disease is very common during dry seasons, and is often seen in young chicks, but also in adults.

Effect: High flock mortality, often between 30% and 80% of the birds die when the disease hits.

Symptoms: The chickens lose appetite and have poor digestion. They might show heavy breathing, greenish droppings, and sometimes bloody diarrhea. They may show nervous symptoms, paralysis and die suddenly, and the symptoms may occur all at the same time.

Prevention/Treatment:

- The disease is a virus, so there is no treatment, but it may be prevented through vaccination of all birds including chicks from two weeks of age.

Fowl pox:

Description: It is often seen in young chicks, but also in adults. The disease is common during dry seasons, but may be found all year around

Effect: Flock may decrease by 30-50%, w/ high infection rates

Symptoms: Shows as pocks (small lumps) on wattles, comb and face. High body temperature, tiredness followed by sudden death.

Prevention/Treatment:

- *The disease is a virus, so there is no treatment, BUT a Vaccine is available and highly effective.*

Fowl cholera (pasteurellosis):

Description: It can occur any time in all ages.

Effect: Infection is through contaminated feed and drinking water. May occur as a chronic disease or hit as sudden death.

Symptoms: severe diarrhoea, respiratory symptoms, loss of appetite, blue combs and wattles.

Prevention/Treatment:

- *There is no treatment. Best prevention is strict hygiene and vaccination. Kill and burn affected birds. Vaccine is usually available.*

Pullorum disease (Bacillary white diarrhoea):

Description: It is common in young chicks

*Effec*t: Disease is transmitted to chicks from the eggs of infected hens, which may not show signs of being ill.

Symptoms: Chicks walk with difficulty, show big bellies and drag their wings. Their faeces are liquid and turn white.

Prevention/Treatment:

- There is no treatment. Prevention is strict hygiene. If illness occurs, isolate or kill and burn the birds.

Fowl typhoid:

Description: It is common in older birds.

Effect: Can be deadly, do not buy chicks from unknown sources, and do not use eggs for hatching from hens that have been ill.

Symptoms: high body temperature, tiredness, blue comb, sudden death.

Prevention/Treatment:

- *No treatment. Prevention is through strict hygiene and culling of ill hens.*

Ornithabacter (ORT) - This is a disease caused by bacteria and is prevalent in both turkeys and chickens. Though many poultry diseases occur in most pullets, some are more common in certain birds than others. This contagious disease affects the respiratory system with symptoms such as nasal congestion and coughing being signs of its onset. In some cases, poultry farmers may notice swelling on the head of the birds as well as noticing that the birds

experience respiratory discomfort. One way to treat this disease is through vaccination and this can be administered to fowl at a very early age to create resistance to the disease.

Colibacillosis - Also known as E-Coli or Cellulities, this is also a very common poultry disease. A bacterial infectious disease, it is transmitted via water, food, ovarian transmissions and through fecal matter. If younger birds or the embryos are infected, high mortality rates will be noted, whereas with older birds a decrease in general activity may be observed. To prevent this poultry disease, water can be chlorinated while improved sanitation can prevent transmission. Moreover, vaccinations are available that will help protect embryos. Diseases such as E-coli can be treated using antibiotics such as Oxytetracycline (OTC), Quinolones (Flumequine) and Chlortetracycline (CTC).

As already mentioned some diseases are common and display similar symptoms across bird species. But there are ways to prevent or curb these diseases before they can cause a pandemic. Not too long ago, bird flu posed a threat to humans. But through measures that in some cases included the quarantine of particular infected bird species, the disease was brought under control. As a poultry farmer, it is your obligation to know of the above diseases so that you may take the necessary steps when signs and symptoms occur.

2.11 Alternative ingredients in poultry feed

The use of alternative feed ingredients in poultry diets can be an interesting choice from an economically standpoint. But the nutritional value of the alternative ingredients should be kept in mind. Particularly the presence of anti-nutritive factors

The poultry industry relies on a few major ingredients for feed formulation. Cereal grains are the principal sources of energy in poultry diets, whereas grain legumes and oilseed cakes are the main sources of protein. Wheat, barley, triticale and sorghum are the key cereal grains and soybean meal, canola meal, peas, lupin and beans are important protein sources. The industry has always been inclined to use the cheapest ingredients to maximise profit. As such ingredients do not always support optimum productivity, they are included in small amounts or efforts are made to improve their nutritive value. Despite these limitations, the use of alternative feed ingredients is increasing due to a variety of factors. Conventional feed ingredients are more expensive and are not readily available to all producers at all locations. Adverse climatic conditions and the use of feed ingredients in the biofuel industry have

stimulated the search for alternative feed ingredients for poultry. The biofuel industry generates by-products such as distillers dried grains and solubles (DDGS) that not only need to be disposed of but are becoming core feed ingredients due to the shortage and cost of conventional ingredients. All over the world, especially in areas experiencing feed shortage, alternative ingredients are investigated with the aim of replacing all or some of the conventional feed ingredients. With alternative diets, poultry productivity is often poor due to deficiencies in nutrients such as amino acids and minerals, imbalances in energy to protein ratios or anti-nutritive factors like non-starch polysaccharides (NSPs), polyphenols or phytic acid. Researchers at the University of New England (UNE), Australia, have conducted research in recent years to find out how to improve the quality of those ingredients.

2.12 Use of herbs in poultry production.

Antibiotic growth promoters have been helpful in improvement of growth performance and feed conversion ratio in poultry (Miles *et al.*, 2006; Dibner and Buttin, 2002; Izat *et al.*, 1990). However, constant treatment of poultry by antibiotic may result in residues of these substances in poultry products and bacteria resistance against treatments in human body. Due to such threats to human health, use of antibiotics in poultry is banned (Owens *et al.*, 2008; Alcicek *et al.*, 2004; Botsoglou and Fletouris, 2001; Hinton, 1988). Many studies have been carried out on using additives, including herbs, as alternatives to antibiotics, with direct or indirect effects on intestinal microflora, in poultry products (Taylor, 2001). Several studies have shown antimicrobial properties of herb extracts (Cowan, 1999; Hammer *et al.*, 1999) which can improve intestinal microflora population and enhance health in birds' digestive systems through reduction in number of disease-making bacteria (Mitsch *et al.*, 2004). In addition, modified harmful microbial population in intestines will change intestinal morphology. Intestinal health is of great importance in poultry for improved performance and reduced feed conversion ratio (Montagne *et al.*, 2003). However, properties of other herbs, such as antioxidant, antiviral, or immunomodulatory properties and their effects on performance and digestive health cannot be ignored.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Location and Duration of the Study

The study was carried at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria Nsukka. The study lasted for a period of eight weeks. Nsukka lies in the derived savannah region, and is located on longitude 6^0 25´ N and latitude 7^0 24´E (Ofomata, 1975) at an altitude of 430m above sea level (Breinholt *et al*., 1981). The study area had the natural day-length of 13 to 14 hours; mean maximum weekly indoor and outdoor temperatures; of 27.9^{0}C to 29.2^{0}C and 26.8^{0}C to 30.5^{0}C respectively, mean minimum weekly indoor and outdoor temperatures; 20.5^{0}C to 22.3^{0}C and 20.0^{0}C and 23.60^{0}C respectively, relative humidity of 73.1% to 76.6% and mean total monthly rainfall of 781.33mm (Breinholt *et al*., 1981; Agbaha *et al*., 2000; Okonkwo and Akubuo, 2007; Energy Centre, UNN, 2008).

3.2 Preparation of Extracts

3.2.1 Preparation of Aloe Vera Gel Extract

Fresh Aloe leaves were collected from Mbu town in Isi-uzo Local Government area of Enugu State. The leaves were washed with clean water to remove dirt. Aloe Vera gel was extracted from 1kg leaves manually by making a cut on the leaves with a pocket knife. The gel was scooped out with a small spoon and drained into in a beaker. The extract was prepared by pouring 400ml (0.4litre) of fresh gel into a glass bottle containing 1.5 litre of clean tap water. The bottle was agitated for about 2 minutes to ensure thorough mixing, after which it was kept for 30mins to 40mins at room temperature prior to use. The homogenized gel extract was prepared at the interval of two (2) days and served to the animals fresh according to treatments.

3.2.2 Preparation of Neem Leaf Extract

Fresh matured Neem leaves were collected around the University of Nigeria Nsukka environment and washed with clean water to remove dirt. About 500g (0.5kg) of the leaves were placed in mortar and crushed with pestle for 5mins. The crushed leaves were scooped into a beaker containing 1.5litre of clean tap water and stirred with a glass rod for about 2 minutes to obtain a homogenous mixture. The neem leaf solution was sieved to obtain a homogenous leaf extract. The homogenous leaf extract was prepared at the interval of two (2) days and served to the animals fresh according to treatments.

3.3. Experimental Birds and Management

One hundred and twenty (120) 14-day old broiler birds were used for experiment 1 and this involved two phases, the starter phase and the finisher phase. During the starter phase of the experiment, a total of 120 fourteen days old broiler chicks of both sexes were randomly allotted into five treatment groups of 24 birds each in a completely randomized design (CRD). The treatments were as follows: T1 = water; T2 = vitalyte; T3 = (0.4litre of AVGE + 4litre of water); T4 = (0.8litre of AVGE+4 litre of water) and T5 = (1.2litre of AVGE + 4 litre of water). Treatment 1 served as the control while T2 which contains vitalyte represented the common commercial vitamins supplement that is usually made available to birds. Each treatment was replicated three times with 8 chicks per replicate placed in a deep litter pen of fresh wood shavings measuring 1.50m x 1.50m. All the groups were fed the same broiler starter diet containing 2.80/kg ME and 23.57% crude protein. The calculated composition of the vital feed diet is presented in Table 8.

Table 3.1 **Calculated Compoition of commercial feeds fed to birds**

	Starter	Finisher
Crude protein (%)	23.57	18.56
Energy (Mcal/KgME)	2.80	2.89
Crude fibre(%)	4.80	5.85

Routine management practices in terms of medication and vaccination were strictly observed. Birds were fed two times a day with the test material.The experimental feed, AVGE, water and vitalyte were given *ad libitum* to the birds for the 4 weeks of the starter phase. Birds in each replicate were weighed at the beginning of the experiment and subsequently on weekly basis to determine the weight gain of birds. Feed intake was recorded daily and was determined by the weigh-back technique, and this involved obtaining the difference between quantity of feed offered and the left over the following morning. Feed conversion ratio was calculated from the data on feed intake and weight gain as the number of grams of feed consumed per gram of weight gained over the same period. At the end of the starter period, the one hundred and twenty birds that were randomly assigned to the five treatments as described in the starter phase were fed broiler finisher diet containing 2.89/kg ME and 18.56% crude protein. The percentage composition of the diet is presented in Table 3.1. The management of birds and data collection were done out as described in the starter phase.

3.4 Parameters Measured and Parameters Determined

The parameters measured included as follows: live body weight, feed intake and water intake, while weight gain, feed conversion ratio and feed cost per kg weight gain were calculated. Apparent nutrient retention and haematological indices such as packed cell volume, haemoglobin concentration, red blood cells counts and white blood cell counts were determined. Carcass and organ weights were also evaluated.

3.4.1 Experimental Design

The experiments were carried out using completely randomized design (CRD). The experimental model of completely randomized design is as follows:

$$\mathbf{Xij = \mu + Ti + \sum ij}$$

Where **Xij** = any observation or measurement taken

μ = population mean

Ti = Treatment effect

∑ij = Experimental error

i = number of treatments

j = number of replicates

Proximate and Statistical Analyses

Feed and excreta samples were assayed for proximate composition by the method of AOAC (1990). Data collected were subjected to analysis of variance (ANOVA) for completely randomized design (CRD) using a Stat Graphic Computer Package (SPSS, 2007) Model. Significantly different means were separated using Duncan's New Multiple Range Test (Duncan, 1955) option in SPSS.

3.4.2 Haematology and serum analyses

At the 4^{th} week (for haematology) and 8^{th} week (for serum biochemistry) of the experiment, three birds per treatment were randomly selected and blood samples were collected from the wing veins of each bird using sterilized syringe and emptied into sterilized bottles containing EDTA (Ethylene diamine tetracetic acid) for haematological analysis. Haematological parameters that were determined included haemoglobin concentration (HbC), packed cell volume (PCV), white blood cell (WBC) count, and red blood cell (RBC)count .The PCV was determined by the microhaematocrit method described by Schalm *et al.*(1975, and Mitruka and Rawnsely (1977) using a microhaematocrit centrifuge and reader (Hawksley and Sons Ltd, England). The Hb was determined using a haemoglobinometer (Marienfeld, Germany), while the WBC counts were carried out by the haemocytometer method using an improved

Neubauer counting chamber (Hawksley, England) and avian RBC and WBC diluting fluids as described by Campbell and Coles (1986) and Lamb (1991). Serum metabolites (total protein (TP), glucose albumin, globulin, creatine, cholesterol and calcium) were determined according to the methods described by Campbell and Coles (1986) were measured included.

3.4.3 Apparent nutrient retention determination

At week 8 of the experiment, apparent nutrient retention was determined with the birda housed individually in metabolism cages and weighed quantity of feed (90% of the daily feed intake) were offered to each bird daily. The birds were allowed for two days to adjust to the cage environment before data collection, and before droppings were collected. Daily feed consumption was recorded as the difference between the quantity offered and the quantity left after 24 hours. Faecal droppings were collected from separate cages in detachable trays placed beneath the wire mesh floor of the cages, oven-dried at 60°C and weighed over a seven day period. At the end of the period, all faecal samples from each bird were bulked and preserved for analysis.

3.4.4 Carcass and organ evaluation

At the end of the eight weeks experimental period, three birds per treatment were randomly selected, starved overnight and weighed for carcass and organ evaluation. The birds were slaughtered by severing the jugular vein, scalded in warm water for a minute and de-feathered by manual plucking. The birds were eviscerated and weighed to obtain their dressed carcass weight. The kidneys, liver, gizzard, heart, intestine, lungs, head and legs were removed and weighed using a sensitive scale. The kidneys, liver, heart, intestine and lungs were grossly examined for any pathological lesion. The dressed carcass weight and the organ weights were expressed as percentages of live weight.

3.5 Experiment 2: Physiological response of broiler birds to oral supplementation with neem leaf extract

In experiment 2, the physiological response of broiler starter and finisher birds to oral supplementation with neem leaf extract (NLE) was investigated.

3.5.1 Experimental Birds and Management

One hundred and twenty 14-day old broiler birds were used for experiment 1 and this involved two phases, the starter phase and the finisher phase. During the starter phase the birds were randomly allotted into five treatment groups of 24 birds each in a completely randomized design (CRD). The treatments were as follows: T1 = water; T2 = vitalyte; T3 = (0.4litre of NLE + 4litre of water); T4 = (0.8litre of NLE +4 litre of water) and T5 = (1.2litre of NLE + 4 litre of water). Treatment 1 served as the control while T2 that contains vitalyte

represented the common commercial vitamins supplement that is usually made available to birds. Each treatment was replicated three times with 8 chicks per replicate placed in a deep litter pen of fresh wood shavings measuring 1.50m x 1.50m. All the groups were fed the same broiler starter diet containing 2.80/kg ME and 23.57% crude protein. The percentage composition of the diet is presented in Table 3.1.

Management of birds, data collection, haematological and serum evaluation, apparent nutrient retention determination and carcass evaluation were done as described in experiment 1.

3.6 Parameters Measured and Parameters Determined

The parameters measured included as follows: live body weight, feed intake and water intake, while weight gain, feed conversion ratio and feed cost per kg weight gain were calculated. Apparent nutrient retention and haematological indices such as packed cell volume, haemoglobin concentration, red blood cells counts and white blood cell counts were determined. Carcass and organ weights were also evaluated.

3.7 Experimental Design

The experiments were carried out using completely randomized design (CRD). The experimental model of completely randomized design is as follows:

$$\mathbf{Xij = \mu + Ti + \sum ij}$$

Where **Xij** = any observation or measurement taken

μ = population mean

Ti = Treatment effect

∑ij = Experimental error

i = number of treatments

j = number of replicates

Proximate and Statistical Analyses

Feed and excreta samples were assayed for proximate composition by the method of AOAC (1990). Data collected were subjected to analysis of variance (ANOVA) for completely randomized design (CRD) using a Stat Graphic Computer Package (SPSS, 2007) Model. Significantly different means were separated using Duncan's New Multiple Range Test (Duncan, 1955) option in SPSS.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Experiment 1: Physiological response of broiler birds to oral supplementation with aloe vera gel extract

4.1.1 Proximate composition of aloe vera gel extract

The proximate composition of the aloe vera gel extract used in the study is presented in Table 9.

Table 9: Proximate composition of aloe vera gel extract

Components	AVGE
Dry matter (%)	44.06
Crude fibre (%)	10.00
Ether extract (%)	4.40
Crude protein (%)	20.02
Ash (%)	8.99
Nitrogen-free extract (%)	0.65

4.1.2 Effect of alovera extract on performance of starter broiler birds

The effect aqueous alovera gel extract on growth performance of starter broiler birds is presented in Table 10.

Table 10: Effect of aqueous alovera gel extract on growth performance of starter broiler birds

	Treatments*					
Parameters/Treatments	T1	T2	T3	T4	T5	SEM
Initial body weight(g)	227.00	230.00	230.00	220.00	243.00	8.00
Final Body weight (g)	1260.00^{b}	1270.00^{b}	1240.00^{b}	1257.00^{b}	1283.00^{a}	0.01
Daily weight gain(g)/bird	30.00	30.00	30.00	30.00	33.00	1.00
Average daily feed intake(g)/bird	87.00^{b}	90.00^{a}	90.00^{a}	90.00^{a}	90.00^{a}	0.01
Feed conversion ratio	2.48	2.47	2.56	2.55	2.53	0.03
Daily water intake(cl)/bird	28.00	27.70	28.30	28.70	28.70	0.02
Protein efficiency ratio(PER)	1.55^{ab}	1.49^{b}	1.49^{b}	1.63^{a}	1.49^{b}	0.03
Cost of 1kg of feed(□)	100.00	100.00	100.00	100.00	100.00	0.00
Cost of feed per kg gain(□)	248.00	246.67	255.67	255.33	253.33	3.22
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

^{a,b} Means on the same row with different superscripts are significantly($p<0.05$) different.

SEM= Standard Error of the Mean.

*T1 = water; T2 = vitalyte; T3 = (0.4litre of AVGE + 4litre of water); T4 = (0.8litre of AVGE+4 litre of water) and T5 = (1.2litre of AVGE + 4 litre of water)

While no significant ($p>0.05$) differences existed among treatments in average daily weight gain, total fed intake, feed conversion ratio, daily and total water intakes, and cost of feed per kg weight gain, there were significant ($p<0.05$) differences among treatments in final body

weight (FBW), daily feed intake (ADFI) and protein efficiency ratio (PER). Broilers fed diet supplemented with (1.2litre of AVGE + 4 litre of water) had significantly ($p<0.05$) higher FBW than birds on other treatments which had similar FBW values ($p>0.05$). Broilers fed diet supplemented with (vitalyte, 0.4litre of AVGE+ 4litre of water, 0.8litre of AVGE+4 litre of water, and 1.2litre of AVGE + 4 litre of water, respectively) had similar ADFI values($p>0.05$) and these were significantly($p<0.05$) higher than the ADFI value of birds on treatment 1(water). (0.8litre of AVGE+ Broilers fed diet supplemented with (4 litre of water) had similar PER value with birds on treatment 1 and this was significantly ($p<0.05$) higher than the PER values of birds on treatments 2, 3 and 5. The PER values of birds on treatments 1, 2, 3 and 5 were similar ($p>0.05$).

4.1.3 Effect of aqueous aloe vera gel extract on haematological indices of starter broiler birds

The effect of aqueous alovera gel extract on haematological indices of starter broiler birds is presented in Table 11.

Table 11: Effect of aqueous alovera gel extract on haematological indices of starter broiler birds

	Treatments*					
Parameters/Treatments	T1	T2	T3	T4	T5	SEM
Packed cell volume (%)	23.67^{b}	24.00^{ab}	24.00^{ab}	24.17^{a}	24.83^{ab}	0.33
Red blood cells count($10^6/\mu$)	2.56^{a}	2.49^{ab}	2.52^{ab}	2.640^{a}	2.39^{b}	0.04
Haemoglobin concentration(g/dl)	8.28^{b}	8.79^{ab}	9.14^{a}	8.79^{ab}	8.62^{ab}	0.20
WBC($10^3/\mu$)	10.22	10.72	11.47	10.62	10.55	0.46
Mean Cell Hem. Con. (%)	34.82	36.60	38.18	35.42	35.68	0.60
Mean Cell hem. (pg)	32.36	35.27	36.38	33.36	36.20	0.81
Mean cell Volume (um^3)	90.30^{b}	96.32^{ab}	95.21^{ab}	94.13^{ab}	101.61^{a}	1.34
Heterophil	45.67^{a}	42.00^{ab}	37.33^{b}	38.33^{b}	40.67^{ab}	2.13
Lymphocyte	51.67^{b}	57.33^{ab}	60.33^{a}	58.33^{ab}	57.00^{ab}	2.24
Monocyte	1.00^{ab}	0.67^{ab}	0.33^{b}	1.33^{a}	0.67^{ab}	0.23
Eosnophil	1.00^{b}	0.00^{c}	1.67^{ab}	2.00^{a}	1.33^{ab}	0.31
Basophil	0.00^{b}	0.00^{b}	0.33^{a}	0.00^{b}	0.33^{a}	0.09

^{a,b} Means on the same row with different superscripts are significantly($p<0.05$) different.

SEM= Standard Error of the Mean.

*T1 = water; T2 = vitalyte; T3 = (0.4litre of AVGE + 4litre of water); T4 = (0.8litre of AVGE+4 litre of water) and T5 = (1.2litre of AVGE + 4 litre of water).

There were significant($p<0.05$) differences among the treatment groups in all the haematological parameters evaluated with the exception of white blood cells (WBC) count.

Broilers fed diet supplemented with (0.8litre of AVGE+4 litre of water) had similar PCV value with birds on treatments 2, 3 and 5 and this was significantly ($p<0.05$) higher than the PCV value of birds on treatment 1. The PCV values of birds on treatments 1, 2, 3 and 5 were similar ($p>0.05$).

Broilers fed diet supplemented with (water) and 4 (0.8litre of AVGE+4 litre of water) had similar RBC values and this was significantly ($p<0.05$) higher than the RBC value of birds on treatment 5. The RBC values of birds on treatments 1, 2, 3 and 4 were similar ($p>0.05$), while the RBC values of bird on treatments 2, 3 and 5 were also similar ($p>0.05$). Broilers fed diet supplemented with (0.4litre of AVGE+4 litre of water) had similar Hb value with birds on treatments 2, 4 and 5 and this was significantly ($p<0.05$) higher than the Hb value of birds on treatment 1. The Hb values of birds on treatments 1, 2, 4 and 5 were similar ($p>0.05$).

Broilers fed diet supplemented with (1.2litre of AVGE+4 litre of water) had similar MCV with birds on treatment 2, 3 and 4 and this was significantly ($p<0.05$) higher than the MCV value of birds on treatment 1. The MCV values of birds on treatment 1, 2, 3, and 4 were similar ($p>0.05$).

4.1.4 Effect of aqueous alovera gel extracts on growth performance of finisher broiler birds:

The Effect of aqueous alovera gel extracts on growth performance of finisher broiler birds is presented in Table 12

Table 12: Effect of aqueous alovera gel extracts on growth performance of finisher broiler birds:

	Treatments*					
Parameters	T1	T2	T3	T4	T5	SEM
Initial body weight(g)	1268.00	1270.00	1265.00	1267.00	1269.00	2.31
Final Body weight (g)	3.15^{b}	3.15^{b}	3.28^{ab}	3.38^{a}	3.41^{a}	0.04
Daily weight gain(g)/bird	50.00	50.00	51.02	51.30	52.05	0.07
Average daily feed intake(g)/bird	173.00	176.00	170.00	170.00	170.00	0.01
Feed conversion ratio	3.36^{ab}	3.46^{a}	3.21^{bc}	3.09^{c}	3.18^{bc}	0.05
Daily water intake(cl)/bird	70.00	69.70	70.70	70.00	77.00	0.30
Protein efficiency ratio(PER)	1.59	1.59	1.59	1.59	1.59	0.00
Cost of 1kg of feed(□)	100.00	100.00	100.00	100.00	100.00	0.00
Cost of feed per kg gain(□)	336.33^{ab}	345.67^{a}	321.00^{bc}	308.67^{c}	317.66^{bc}	4.50
Mortality (%)	0.00^{b}	$0.3\ 33^{a}$	0.67^{a}	0.00^{b}	0.00^{b}	0.15

[a,b,c] Means on the same row with different superscripts are significantly($P<0.05$) different.

SEM= Standard Error of the Mean.

*T1 = water; T2 = vitalyte; T3 = (0.4litre of AVGE + 4litre of water); T4 = (0.8litre of AVGE+4 litre of water) and T5 = (1.2litre of AVGE + 4 litre of water).

While there were no significant ($p<0.05$) differences existing among treatments groups in average daily weight gain (DWG), average daily and total feed intake, average daily and total water intake and protein efficiency, there were significant ($p<0.05$) differences among the treatment groups in final body weight (FBW), feed conversion ratio (FCR), Cost of feed per kilogram gain (CFG), and mortality rate (MOR).

Birds on treatments 5 (1.2litre of AVGE + 4 litre of water) and 4(0.8litre of AVGE+4 litre of water) had significantly ($p<0.05$) higher FBW value than birds on treatments 1 (water) and 2(vitalyte) but similar ($p<0.05$) in FBW value with birds on treatments 3 (0.4litre of AVGE+4 litre of water). Birds on treatments 1, 2, and 3(water, vitalyte, 0.4litre of AVGE+ 4litre of water) were also similar respectively in FBW value.

Birds on treatment 2 had similar FCR value with the birds on treatment 1 and this was significantly ($p<0.05$) higher than FCR value of birds on treatments 3-5. Birds on treatment 1

had similar FCR value with birds on treatments 3 and 5 and this was significantly ($p<0.05$) higher than FCR value of birds on treatment 4. The values of FCR of birds on treatments 3-5 were similar ($p<0.05$) respectively.

Broilers fed diet supplemented with 2 had similar CFG value with birds on treatment1 and this was significantly ($p<0.05$) higher than CFG value of birds on treatments 3-5. The values of CFG of birds on treatment 1was similar with birds on treatment 3 and 5 and this was significantly ($p<0.05$) higher than CFG value of birds on treatment 4. Birds on treatments 3-5 were similar ($p<0.05$) in CFG value.

Broilers fed diet supplemented with 2 and 3(vitalyte, 0.4litre of AVGE+ 4litre of water) respectively had significantly ($p<0.05$) higher mortality value than birds on treatments 1, 4 and 5(water, (0.8litre of AVGE+4 litre of water and 1.2litre of AVGE + 4 litre of water) which are similar ($p<0.05$). also in mortality value.

4.1.5 Effects of aqueous alovera gel extracts on apparent nutrient retention finisher broiler birds.

The effects of aqueous alovera gel extracts on apparent nutrient retention finisher broiler birds is presented in Table 13

Table 13 Effects of aqueous alovera gel extracts on apparent nutrient retention finisher broiler birds.

	Treatments*					
Parameter	T1	T2	T3	T4	T5	SEM
Grude protein retained (%)	80.91[b]	91.15[a]	91.20[a]	91.88[a]	83.93[b]	1.26
Crude fibre retained (%)	22.09[b]	34.65[b]	32.39[b]	38.09[a]	36.70[a]	2.45
Dry matter retained (%)	63.15	66.10	63.15	65.07	62.01	1.17
Ether extract retained (%)	84.64[c]	86.94[c]	92.813[b]	95.86[a]	90.29[b]	1.13
Nitrogen free ether retained (%)	78.35[a]	76.72[a]	63.52[b]	63.24[b]	64.25[b]	2.15

[a,b,c] Means on the same row with different superscripts are significantly($P<0.05$) different.SEM= Standard Error of the Mean.*T1 = water; T2 = vitalyte; T3 = (0.4litre of AVGE + 4litre of water); T4 = (0.8litre of AVGE+4 litre of water) and T5 = (1.2litre of AVGE + 4 litre of water).

There were significant ($p<0.05$) differences in all the apparent nutrient retentions parameters determined except in dry matter retained. Birds given 2,3 and 4 had similar crude protein retained (CPR) that were significantly ($p<0.05$) higher than the value for broilers fed or given control and treatments 5.

Broilers fed diet supplemented with (0.8litre of AVGE+4 litre of water) and 5 (1.2litre of AVGE + 4 litre of water) were similar ($p<0.05$) and these had significantly ($p<0.05$) higher crude fiber retained value than birds on treatments 1-3. Birds on treatments 1-3 (water, vitalyte, 0.4litre of AVGE+ 4litre of water) had similar ($p<0.05$) crude fibre retained value respectively.

Broilers fed diet supplemented with (0.8litre of AVGE+4 litre of water) had significantly ($p<0.05$) highest ether extract retained value than birds on treatments 3, 5 and 1, 2. Broilers fed diet supplemented with (0.4litre of AVGE+ 4litre of water) and 5(1.2litre of AVGE + 4 litre of water) were similar ($p<0.05$) and these had significantly ($p<0.05$) higher ether extract retained value than birds on treatments 1 and 2 which were also similar ($p<0.05$).

Equally birds on treatments 1 and 2 (water and vitalyte) had similar nitrogen free ether retained (NFER) value and these were significantly ($p<0.05$) higher tthan NFER value of birds on treatment 3 -5. Broilers fed diet supplemented with (0.4litre of AVGE+ 4litre of water, 0.8litre of AVGE+4 litre of water and 1.2litre of AVGE + 4 litre of water) were also similar($p<0.05$) in NFER value.

4.1.6 Effects of aqueous alovera gel extract on Serum biochemistry indices of finisher broiler birds.

The Effects of aqueous alovera gel extract on Serum biochemistry indices of finisher broiler birds is presented in Table 14

Table 14: Effects of aqueous alovera gel extract on Serum biochemistry indices of finisher broiler birds.

	Treatments*					
Parameter	T1	T2	T3	T4	T5	SEM
Total protein	3.67^{a}	3.03^{b}	3.03^{b}	3.20^{ab}	3.77^{a}	0.11
Albumin	1.97^{a}	2.23^{a}	2.23^{a}	1.53^{b}	2.17^{a}	0.14
Globulin	1.70^{a}	0.80^{b}	0.80^{b}	1.67^{a}	1.60^{a}	0.16
Glucose	147.33^{a}	127.30^{abc}	103.33^{bc}	120.67^{bc}	98.67^{c}	9.03
Creatine	0.06^{b}	0.06^{b}	0.06^{b}	0.08^{b}	0.29^{a}	0.04
Cholesterol	109.00^{a}	74.99^{b}	108.33^{a}	117.00^{a}	120.00^{a}	8.10
Calcium	6.73^{b}	6.90^{b}	6.83^{b}	6.97^{b}	7.53^{a}	0.13

^{a,b,c} Means on the same row with different superscripts are significantly($P<0.05$) different.

SEM= Standard Error of the Mean.

*T1 = water; T2 = vitalyte; T3 = (0.4litre of AVGE + 4litre of water); T4 = (0.8litre of AVGE+4 litre of water) and T5 = (1.2litre of AVGE + 4 litre of water).

There exist significant ($p<0.05$) differences in all the parameters of serum biochemistry indices determined.

Broilers fed diet supplemented with (1.2litre of AVGE + 4 litre of water) and 1(water) had similar total protein (TP) value and these were significantly ($p<0.05$) higher than TP value of birds birds on treatments 2 and 3. Broilers fed diet supplemented with 1, 4 and 5 were similar ($p<0.05$) in TP value while birds on treatments 2, 3 and 4 had also similar TP respectively.

Broilers fed diet supplemented with 1, 2, 3, and 5(water, vitalyte, 0.4litre of AVGE + 4 litre of water and 1.2litre of AVGE + 4 litre of water) had similar albumin (ALB) value and these had significantly ($p<0.05$) higher ALB value than birds on treatment 4(0.8litre of AVGE + 4 litre of water).

Moreover, broilers fed diet supplemented with 1, 4 and 5 were similar in globulin (GLB) value and these had significantly ($p<0.05$) higher GLB value than birds on treatments 2 and 3 that were similar ($p<0.05$).

Broilers fed diet supplemented with (water) was significantly ($p<0.05$) higher than glucose (GLU) value of birds on treatments 3-5. The GLU value of birds on treatments 1(water) and 2(vitalyte) were similar ($p<0.05$). Also the value of GLU value of birds on treatments 2-5 were similar ($p<0.05$).

Broilers fed diet supplemented with (1.2litre of AVGE + 4 litre of water) was significantly ($p<0.05$) higher than creatine value of birds on treatments 1-4(water, vitalyte, 0.4litre of AVGE + 4 litre of water and 0.8litre of AVGE + 4 litre of water) which were similar($p<0.05$) respectively.

Broilers fed diet supplemented with 1, 3, 4, and, 5 were similar and these had significantly ($p<0.05$) higher cholesterol (CHO) value than birds on treatment2 (vitalyte).

Also Broilers fed diet supplemented with (1.2litre of AVGE + 4 litre of water) was significantly ($p<0.05$) higher than calcium value of birds on treatments 1-4. Birds on treatments 1-4 were similar ($p<0.05$) respectively.

4.1.7 Effects of aqueous alovera gel extract on carcass and relative organ weights of broiler finishers

The Effects of aqueous alovera gel extract on carcass and relative organ weights of broiler finishers is presented in Table 15

Table 15: Effects of aqueous alovera gel extract on carcass and relative organ weights of broiler finishers.

	Treatments*					
Parameters	T1	T2	T3	T4	T5	SEM
Live weight(kg)	3.80[a]	3.73[a]	3.60[a]	3.53[a]	3.27[b]	0.09
Dressedweight (%)	77.82[a]	77.10[a]	68.71[b]	70.14[ab]	74.13[ab]	1.39
Head (%)	1.07[ab]	1.81[b]	2.36[a]	2.15[a]	2.18[a]	0.07
Gizzard (%)	2.30[b]	2.35[b]	2.69[ab]	2.88[a]	2.55[b]	0.10
Empty gizzard (%)	1.72[b]	1.68[b]	1.92[a]	2.06[a]	1.79[b]	0.07
Shank (%)	3.26[bc]	2.93[c]	3.33[b]	3.71[a]	3.08[bc]	0.12
Heart (%)	0.42[a]	0.42[a]	0.41[a]	0.76[a]	0.41[b]	0.06
Liver (%)	1.68[abc]	1.52[bc]	1.43[c]	1.61[bc]	1.90[a]	0.08
Kidney (%)	0.32[b]	0.35[b]	0.39[b]	0.39[b]	2.11[a]	0.36
Abdominal fat (%)	1.22[b]	2.08[a]	0.93[b]	0.78[b]	1.06[b]	0.19
Lungs (%)	0.49[b]	0.58[b]	0.57[b]	0.64[a]	0.64[a]	0.03
Large intestine (%)	1.12[ab]	0.73[b]	1.06[ab]	1.15[a]	1.40[a]	0.13
Small intestine (%)	42.68[b]	36.73[b]	47.72[a]	47.42[a]	47.96[a]	1.45

[a,b,c] Means on the same row with different superscripts are significantly($P<0.05$) different.SEM= Standard Error of the Mean.

*T1 = water; T2 = vitalyte; T3 = (0.4litre of AVGE + 4litre of water); T4 = (0.8litre of AVGE+4 litre of water) and T5 = (1.2litre of AVGE + 4 litre of water).

There is significant ($p<0.05$) differences in all the parameters except in the length of the small intestine.

Broilers fed diet supplemented with (water, vitalyte, 0.4litre of AVGE + 4 litre of water and 0.8litre of AVGE + 4 litre of water) had similar live weight(LW) value and these were significantly ($p<0.05$) higher than LW value of birds on treatment 5(1.2litre of AVGE + 4 litre of water).

Broilers fed diet supplemented with1 and 2 had similar relative dressing weight (RDW) value and these were significantly ($p<0.05$) higher than RDW value of birds on treatment 3.

Broilers fed diet supplemented with 1, 2, 4, and 5 were similar ($p<0.05$) in broilers fed diet supplemented with RDW value while 3-5 were also similar ($p<0.05$)

Broilers fed diet supplemented with 3-5 were similar in relative head weight (RHW) value and these were significantly ($p<0.05$) higher than relative head weight value of birds on treatment 2(vitalyte). The value of RHW of birds on treatments 1(water) and 3-5 were similar. Broilers fed diet supplemented with 1 and 2 were also similar ($p<0.05$) in RHW value.

Furthermore, broilers fed diet supplemented with (0.8litre of AVGE + 4 litre of water) was significantly ($p<0.05$) higher than the relative gizzard weight (RGW) value of birds on treatments 1, 2, and 5 and this was similar with birds on treatment 3. The value of RGW of birds on treatments 1-3 and 5 are equally similar ($p<0.05$).

Birds placed on treatments 3 and 4 had similar relative empty gizzard weight (REGW) value and these were significantly ($p<0.05$) higher than REGW value of birds on treatments 1, 2, and 5 which were similar to one another.

Also broilers fed diet supplemented with (0.8litre of AVGE + 4 litre of water) was significantly ($p<0.05$) higher than relative shank weight (RSHK) value of birds on other treatments while birds on treatment 3 had significantly ($p<0.05$) higher RSHK value than birds on treatment 2(vitalyte) and this was similar ($p<0.05$) in RSHK value with birds on treatments 1, and 5 respectively. Birds that were administered vitalyte, water and 1.2litre of AVGE + 4 litre of water were also similar ($p<0.05$).

Again, birds on treatments 1-4 (water, vitalyte, 0.4litre of AVGE + 4 litre of water and 0.8litre of AVGE + 4 litre of water) had similar relative heart weight(RHTW) value and these were significantly ($p<0.05$) higher than RHTW of birds on treatment 5(1.2litre of AVGE + 4 litre of water).

Moreover, birds treated with1.2litre of AVGE + 4 litre of water was significantly ($p<0.05$) higher than relative liver weight (RLVW) value of birds treated with vitalyte, 0.4litre of AVGE + 4 litre of water and 0.8litre of AVGE + 4 litre of water and this was similar ($p<0.05$) with birds treated with water. The value of RLVW value of birds on treatments 1-4 were similar ($p<0.05$).

Equally, birds on treatment 5 was significantly ($p<0.05$) higher than relative kidney weight (RKW) value of birds on treatments 1-4. Birds on treatments 1-4 were also similar in the value of relative kidney weight.

In addition, birds on treatment 2(vitalyte) was significantly ($p<0.05$) higher than relative abdominal fat weight (RABDW) value of birds on treatments 1(water), 3(0.4litre of AVGE + 4 litre of water), 4(0.8litre of AVGE + 4 litre of water), and 5(1.2litre of AVGE + 4 litre of water) respectively. Birds on treatments 1, 3, 4, and 5 were also similar ($p<0.05$) respectively.

In relative lung weight (RLGW) value of the birds, birds on treatments 4 and 5 had similar RLGW value and these were significantly ($p<0.05$) higher than RLGW value of birds on treatments 1-3 which were similar ($p<0.05$).

Broilers fed diet supplemented with (0.8litre of AVGE + 4 litre of water) was significantly ($p<0.05$) higher than relative longer large intestine (RLIG) value of birds on treatments 1-3 and 5 which were similar ($p<0.05$) respectively.

On relative weight of large intestine (RLIW) value, birds on treatments 4 and 5 had similar RLIW and these were significantly ($p<0.05$) higher than RLIW of birds on treatment 2 but were similar with birds on treatments 1 and 3 in RLIW respectively. The value of RLIW of birds on treatment 2 was similar with birds on treatments 1 and 3 respectively.

Finally, birds on treatments 3-5 had similar relative small intestine weight (RSIW) value and these were significantly ($p<0.05$) higher than the RSIW value of birds on treatments 1 and 2 which were similar ($p<0.05$) respectively.

4.2 Experiment 2: Physiological response of broiler birds to oral supplementation with neem leaf extracts.

4.2.1 Proximate composition of neem leaf extracts

The proximate composition of the neem leaf extracts used in the study is presented in Table 16.

Table 16: Proximate composition of neem leaf extracts

Components	NLE
Dry matter (%)	81.65
Crude fibre (%)	11.35
Ether extract (%)	7.07
Crude protein (%)	18.00
Ash (%)	6.60
Nitrogen-free extract (%)	36.63

4.2.2 Effect of neem leaf extracts on growth performance of starter broiler birds

The effect neem leaf extracts on growth performance of starter broiler birds is presented in Table 17

Table 17: Effect of neem leaf extracts on growth performance of starter broiler birds:

	Treatments*					
Parameters	T1	T2	T3	T4	T5	SEM
Initial body weight(g)	313.00	330.00	323.00	323.00	277.00	2.08
Final Body weight (g)	1273.00^{b}	1280.00^{b}	1283.00^{b}	1317.00^{a}	1317.00^{a}	0.01
Average Daily weight gain(g)	30.00	32.00	32.02	33.00	33.00	0.01
Average Daily feed intake(g)	90.00	90.00	87.00	83.00	90.00	0.01
Feed conversion ratio(FCR)	2.723^{a}	2.727^{a}	2.617^{b}	2.550^{b}	2.493^{b}	0.05
Average Daily water intake(cl)	29.30	28.00	28.30	28.70	29.00	0.02
Protein efficiency ratio(PER)	1.49^{b}	1.653^{ab}	1.737^{a}	1.610^{ab}	1.490^{b}	0.057
Cost of 1kg of feed(₦)	100.00	100.00	100.00	100.00	100.00	0.00
Average Cost of feed per kg gain(₦)	272.33^{a}	272.67^{a}	261.67^{b}	255.00^{b}	259.67^{b}	4.44
Mortarity (%)	0.00	0.00	0.00	0.00	0.00	0.00

^{a,b} Means on the same row with different superscripts are significantly($P<0.05$) different.
SEM= Standard Error of the Mean.
*T1 = water; T2 = vitalyte; T3 = (0.4litre of NLE + 4litre of water); T4 = (0.8litre of NLE+4 litre of water) and T5 = (1.2litre of NLE + 4 litre of water).

While no significant ($p>0.05$) differences existed among treatments in average daily weight gain, average daily feed intake, total fed intake, daily and total water intakes, and cost of feed per kg weight gain, there were significant ($p<0.05$) differences among treatments in final body weight (FBW), feed conversion ratio (FCR), protein efficiency ratio (PER) and cost of feed per kg gain. Birds on treatments 4 and 5(0.8litre of NLE + 4 litre of water and 1.2litre of NLE + 4 litre of water) had significantly ($p<0.05$) higher FBW than birds on other treatments which had similar FBW values ($p>0.05$). Birds on treatments 1and 2(water and vitalyte) had

similar FCR values (p>0.05) and these were significantly (p<0.05) higher than the FCR value of birds on treatments 3-5 which had similar FCR values (p>0.05).

3 (0.4litre of AVGE+4 litre of water) had similar PER value with birds on treatment 3 and 4 Broilers fed diet supplemented with and this was significantly (p<0.05) higher than the PER values of birds on treatments 1and 5. The PER values of birds on treatments 1, 2, 4 and 5 were similar (p>0.05).

Broilers fed diet supplemented with 1 and 2 had similar cost of feed per kg gain (CFG) values (p>0.05) and these were significantly (p<0.05) higher than the CFG value of birds on treatments 3-5 which had similar CFG values (p>0.05).

4.2.3 Effect of neem leaf extracts on haematological indices of starter broiler birds

The effect of neem leaf extracts on haematological indices of starter broiler birds is presented in Table 18.

Table 18: .Effects of neem leaf extracts on Heamatological indices of starter broiler birds.

	Treatments*					
Parameters	T1	T2	T3	T4	T5	SEM
PCV (%)	24.83^{ab}	26.17^{a}	22.67^{b}	24.50^{ab}	24.83^{ab}	0.39
RBC(10^6/µ)	2.52^{a}	2.51^{a}	2.40^{b}	2.30^{b}	2.43^{ab}	0.04
HB(g/dl)	8.97^{a}	9.31^{a}	7.76^{b}	7.76^{b}	7.93^{b}	0.26
WBC(10^3/µ)	11.62^{ab}	11.83^{a}	11.33^{ab}	8.90^{c}	10.73^{b}	0.55
Mean Cell Hem. Con. (%)	36.14	35.59	34.17	31.76	31.92	0.86
Mean Cell hem. (pg)	35.50	37.12	32.86	32.86	32.65	1.00
Mean cell Volume (um^3)	98.64	104.40	95.60	103.77	102.22	1.94
HETEROPHIL	46.67^{ab}	51.67^{a}	38.00^{ab}	41.33^{ab}	37.00^{b}	2.16
LYMPHOCYTE	51.67^{ab}	45.67^{b}	64.00^{a}	56.00^{ab}	62.33^{a}	2.58
MONOCYTE	0.67^{b}	0.67^{b}	0.33^{bc}	1.00^{a}	0.00^{c}	0.19
EOSNOPHIL	0.67^{b}	1.67^{a}	1.00^{b}	1.67^{a}	0.67^{b}	0.27
BASOPHIL	0.33^{a}	0.33^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.09

^{a,b,c} Means on the same row with different superscripts are significantly(P<0.05) different.

SEM= Standard Error of the Mean.

*T1 = water; T2 = vitalyte; T3 = (0.4litre of NLE + 4litre of water); T4 = (0.8litre of NLE+4 litre of water) and T5 = (1.2litre of NLE + 4 litre of water).

There were significant (p<0.05) differences among the treatment groups in all the haematological parameters evaluated.

Birds on treatment 2 (vitalyte+4 litre of water) had similar PCV value with birds on treatments 1, 4 and 5 and this was significantly (p<0.05) higher than the PCV value of birds on treatment 3. The PCV values of birds on treatments 1, 3, 4 and 5 were similar (p>0.05).

Broilers fed diet supplemented with 1 (water) and 2 (vitalyte+4 litre of water) had similar RBC values and these were significantly ($p<0.05$) higher than the RBC value of birds on treatments 3 and 4. The RBC values of birds on treatments 3, 4 and 5 were similar ($p>0.05$). The RBC values of bird on treatments 1, 2 and 5 were also similar ($p>0.05$).

Broilers fed diet supplemented with 1 and 2 had similar Hb values these were significantly ($p<0.05$) higher than Hb value of birds on treatment 3-5 which had Hb value that were also similar ($p>0.05$).

Broilers fed diet supplemented with 2(vitalyte +4 litre of water) had similar WBC value with birds on treatments 1 and 3 and this was significantly ($p<0.05$) higher than the WBC values of birds on treatments 4 and 5. Birds on treatment 5 (1.2litre of NLE+4 litre of water) had similar WBC values with birds on treatments 1 and 3(water and 0.4litre of NLE+4 litre of water) and these were significantly ($p<0.05$) higher than the WBC value of birds on treatment 4(0.8litre of NLE+4 litre of water).

Broilers fed diet supplemented with 2(vitalyte +4 litre of water) had similar Heterophil (HET) value with birds on treatments 1,3 and 4 and this was significantly ($p<0.05$) higher than the HET value of birds on treatment 5. The HET values of birds on treatments 1, 3, 4 and 5 were similar ($p>0.05$).

Broilers fed diet supplemented with 3 and 5 had similar Lymphocyte (LYPH) values with birds on treatments 1 and 4 and these were significantly ($p<0.05$) higher than LYPH value of birds on treatment 2. The LYPH values of birds on treatments 1, 2 and 4 were also similar ($p>0.05$).

Broilers fed diet supplemented with 4(0.8litre of NLE+4 litre of water) had higher monocyte (MONO) value and this was significantly ($p<0.05$) higher than MONO values of birds in other groups. Broilers fed diet supplemented with 1 and 2 had similar MONO value with birds on treatment 3 and these were significantly ($p<0.05$) higher than MONO values of birds on treatment 5. Broilers fed diet supplemented with 3 and 5 were similar ($p<0.05$) in monocytes value. Birds on treatments 2 and 4 had similar Eonophil (EON) and these were significantly ($p<0.05$) higher than EON values of birds on treatments 1, 3 and 5 which were also similar ($p<0.05$).

Finally birds on treatment1 and 2 had similar basophil (BAS) and these were significantly ($p<0.05$) higher than BAS values of birds on treatments 3-5 which were similar ($p<0.05$) respectively.

4.2.4 Effect of neem leaf extracts extracts on growth performance of finisher broiler birds:

The Effect of neem leaf extracts on growth performance of finisher broiler birds is presented in Table 19

Table 19: Effect of neem leaf extracts on growth performance of finisher broiler birds:

	Treatments*.					
Parameters	T1	T2	T3	T4	T5	SEM
Initial body weight(g)	1298.00	1299.00	1296.00	1300.00	1300.00	0.25
Final Body weight gain(kg)	3.143^{b}	3.393^{ab}	3.330^{b}	3.420^{ab}	3.700^{a}	0.060
Average Daily weight gain(g)	47.00^{b}	50.00^{ab}	50.00^{ab}	53.00^{ab}	57.00^{a}	0.01
Average Daily feed intake(g)	173.00	173.00	170.00	170.00	167.00	0.01
Feed conversion ratio(FCR)	3.477^{a}	3.210^{ab}	3.290^{a}	3.153^{ab}	2.847^{b}	0.069
Daily water intake(cl)/bird	73.00^{a}	70.70^{ab}	71.30^{ab}	69.30^{b}	70.00^{ab}	0.05
Protein efficiency ratio(PER)	1.45^{b}	1.56^{ab}	1.59^{ab}	1.70^{ab}	1.84^{a}	0.05
Mortarity (%)	0.00	0.00	0.00	0.00	0.00	0.00
Cost of 1kg of feed(□)	100.00	100.00	100.00	100.00	100.00	0.00
Average Cost of feed per kg gain(□)	347.67^{a}	321.00^{ab}	329.00^{a}	315.33^{ab}	284.67^{b}	6.93

^{a,b,c} Means on the same row with different superscripts are significantly($P<0.05$) different.SEM= Standard Error of the mean.

*T1 = water; T2 = vitalyte; T3 = (0.4litre of NLE + 4litre of water); T4 = (0.8litre of NLE+4 litre of water) and T5 = (1.2litre of NLE + 4 litre of water).

While no significant ($p>0.05$) differences existed among treatments in average daily feed intake, total fed intake, total water intakes, and cost of feed per kg weight gain, there were significant ($p<0.05$) differences among treatments in final body weight (FBW), average daily weight gain (DWG), feed conversion ratio (FCR), daily water intake (DWI), protein efficiency ratio (PER) and cost of feed per kg gain (CFG). Birds on treatments 5(1.2litre of NLE + 4 litre of water) had similar FBW value with birds on treatments 2 and 4(vitalyte + 4

litre of water and 0.8litre of NLE + 4 litre of water) and this was significantly ($p<0.05$) higher than the FBW values of birds on treatments 1 and 3. The FBW values of birds on treatments 1-4 were similar ($p>0.05$).

Birds on treatment 5 had similar DWG value with birds on treatments 2-4 and this was significantly ($p<0.05$) higher than the DWG value of birds on treatment1. Also birds on treatments 1-4 were similar ($p<0.05$) in DWG value.

Birds on treatments 1 had similar DWI value with birds on treatments 2, 3 and 5 and this was significantly ($p<0.05$) higher than the DWI value of birds on treatment 4. The values of DWI of birds on treatments 2-5 were also similar ($p<0.05$).

Birds on treatment 5 had similar value of PER value with birds on treatments 2-4 and this was significantly ($p<0.05$) higher than PER value of birds on treatment 1. The PER value of birds on treatments 1-4 were similar ($p<0.05$).

Finally, birds on treatments 1 and 3 had similar CFG value with birds on treatments 2 and 4 and these were significantly ($p<0.05$) higher than the CFG value of birds on treatment 5. The CFG value of birds on treatments 2,4 and 5 are also similar($p<0.05$).

4.2.5 Effects of neem leaf extract on apparent nutrient retention finisher broiler birds.

The effects of neem leaf extracts on apparent nutrient retention finisher broiler birds is presented in Table 20

Table 20: Effects of neem leaf extract on apparent nutrient retention of finisher broiler birds.

	Treatments*					
Parameter	T1	T2	T3	T4	T5	SEM
Grude protein retained (%)	82.50^{c}	86.05^{b}	90.52^{a}	87.51^{b}	85.21^{b}	0.76
Crude fibre retained (%)	22.98^{b}	26.67^{b}	30.97^{b}	33.88^{b}	51.40^{a}	2.92
Dry matter retained (%)	63.69	63.84	61.14	61.95	66.97	0.90
Ether extract retained (%)	82.29^{c}	90.27^{b}	97.11^{a}	90.42^{b}	89.92^{b}	1.03
Nitrogen free ether retained (%)	68.03^{a}	62.34^{ab}	59.04^{b}	61.75^{ab}	65.46^{ab}	1.15

^{a,b,c} Means on the same row with different superscripts are significantly($P<0.05$) different.SEM= Standard Error of the Mean.*T1 = water; T2 = vitalyte; T3 = (0.4litre of NLE + 4litre of water); T4 = (0.8litre of NLE+4 litre of water) and T5 = (1.2litre of NLE + 4 litre of water).

There were significant ($p<0.05$) differences in all the apparent nutrient retentions parameters determined except in dry matter retained. Birds on treatment 3(0.4litre of NLE+4 litre of water) had significantly ($p<0.05$) higher crude protein retained (CPR) value than birds on other treatments. Birds on treatments 2, 4 and 5 had similar CPR and these were significantly ($p<0.05$) higher than the CPR value of birds on treatment 1.

Birds on treatments 5(1.2litre of NLE+4 litre of water) had significantly ($p<0.05$) higher crude fibre retained (CFR) value than birds on treatments 1-4(water, vitalyte+4 litre of water, 0.4litre of NLE+4 litre of water ,and 0.8litre of NLE+4 litre of water) which were similar ($p<0.05$) in CFR value respectively.

Birds on treatment 3(0.4litre of NLE+4 litre of water) had significantly ($p<0.05$) highest value of ether extract retained (EER) than birds on other treatments. Birds on treatments 2, 4, and 5 had similar EER and these were significantly ($p<0.05$) higher than the EER value of birds on treatment 1.

Birds on treatment 1had similar value of nitrogen free ether retained (NFER) with birds on treatments 2, 4 and 5 and this was significantly ($p<0.05$) higher than NFER value of birds on treatment 3. The NFER values of birds on treatments 2-5 are also similar ($p<0.05$) respectively.

4.2.6 Effects of neem leaf extract on Serum biochemistry indices of finisher broiler birds.

The Effects of neem leaf extract on Serum biochemistry indices of finisher broiler birds is presented in Table 21

Table 21: .Effects of neem leaf extracts on Serum biochemical indices of broiler finishers.

	Treatments*					
Parameter	T1	T2	T3	T4	T5	SEM
Total protein	3.33^{b}	3.93^{a}	3.60^{ab}	3.30^{b}	3.37^{b}	0.12
Albumin	2.07^{c}	2.33^{ab}	2.23^{bc}	2.50^{a}	2.27^{bc}	0.07
Globulin	1.27^{abc}	1.60^{a}	1.37^{ab}	0.80^{c}	1.10^{c}	0.14
Glucose	141.33^{a}	125.33^{ab}	112.67^{b}	124.67^{ab}	132.00^{ab}	6.38
Creatine	0.07	0.05	0.14	0.07	0.06	0.04
Cholesterol	124.67^{b}	128.00^{b}	119.33^{b}	131.33^{a}	130.67^{b}	3.31
Calcium	7.60^{a}	6.50^{b}	6.93^{b}	7.53^{a}	7.33^{ab}	0.18

^{a,b,c} Means on the same row with different superscripts are significantly($P<0.05$) different. SEM=Standard Error of the Mean.

*T1 = water; T2 = vitalyte; T3 = (0.4litre of NLE + 4litre of water); T4 = (0.8litre of NLE+4 litre of water) and T5 = (1.2litre of NLE + 4 litre of water).

There were significant ($p<0.05$) differences in all the parameters of serum biochemical indices evaluated except in the creatine. Birds on treatment 2(vitalyte+4 litre of water) had similar total protein (TP) value with birds on treatment 3(0.4litre of NLE+4 litre of water) and this was significantly ($p<0.05$) higher than TP value of birds on treatments 1, 4 and 5(water, 0.8litre of NLE+4 litre of water and 1.2litre of NLE+4 litre of water) respectively. Birds on treatments 1, 3, 4 and 5 are similar ($p<0.05$) in TP value.

Birds on treatments 4 had similar Albumin (ALB) value with birds on treatment2 and this was significantly ($p<0.05$) higher than ALB value of birds on treatments 1,3 and 5 respectively. The ALB value of birds on treatment 2 was similar with birds on treatments 3 and 5 and this was significantly ($p<0.05$) higher than value of ALB on treatment 1. The value of ALB of 1, 3 and 5 were similar ($p<0.05$).

Birds on treatment 2 had similar Globulin (GLB) value with birds on treatments 1 and 3 and this was significantly ($p<0.05$) higher than GLB value of birds on treatment 4 and 5. Birds on treatment 3 also had similar GLB value with birds on treatment 1 and this was significantly ($p<0.05$) higher than GLB value of birds on treatments 4 and 5. The values of GLB of birds on treatments 1, 4, and 5 were similar ($p<0.05$) also.

Moreover, birds on treatment 1 had similar Glucose (GLU) value with birds on treatments 2, 4, and 5 and this was significantly ($p<0.05$) higher than the value of GLU of birds on treatment 3. Birds on treatments 2-5 were similar ($p<0.05$) in GLU values.

Birds on treatment 4 was significantly ($p<0.05$) higher in cholesterol (CHO) value than birds on other treatments that were similar ($p<0.05$) in CHO values.

Finally, birds on treatments 1 and 4 had similar calcium (CL) value with birds on treatment 5 and these were significantly ($p<0.05$) higher than CL value of birds on treatment 2 and 3. The CL value of birds on treatments 2, 3 and 5 were similar ($p<0.05$).

4.2.7 Effects of neem leaf extracts on carcass and relative organ weights of broiler finishers

The Effects of neem leaf extracts on carcass and relative organ weights of broiler finishers is presented in Table 22

Table 22: Effects of neem leaf extracts on carcass and relative organ weights of broiler finishers.

	Treatments*					
Parameter	T1	T2	T3	T4	T5	SEM
Average Live weight(kg)	3.05^{d}	3.60^{b}	3.49^{c}	3.70^{a}	3.71^{a}	0.09
Dressed weight (%)	76.71^{b}	77.71^{a}	74.31^{d}	75.97^{c}	72.99^{e}	0.57
Head (%)	1.91^{d}	2.79^{a}	2.26^{b}	2.17^{c}	2.24^{b}	0.10
Gizzard (%)	2.22^{c}	2.69^{b}	1.84^{d}	2.86^{a}	2.71^{b}	0.13
Empty gizzard (%)	1.64^{e}	1.89^{c}	1.70^{d}	1.98^{a}	1.96^{b}	0.05
Shank (%)	2.57^{e}	3.70^{a}	3.35^{d}	3.41^{c}	3.55^{b}	0.13
Heart (%)	0.41^{b}	0.43^{b}	0.42^{b}	0.51^{a}	0.40^{b}	0.01
Liver (%)	2.16^{a}	1.46^{d}	1.31^{e}	1.70^{b}	1.50^{c}	0.10
Kidney (%)	0.28^{c}	0.34^{b}	0.36^{b}	0.21^{d}	0.44^{a}	0.03
Abdominal fat (%)	3.41^{a}	1.06^{e}	1.98^{b}	1.36^{d}	1.75^{c}	0.27
Lungs (%)	0.46^{d}	0.36^{e}	0.55^{b}	0.60^{a}	0.51^{c}	0.03
Large intestine (%)	6.68^{e}	15.00^{a}	9.72^{d}	12.71^{c}	14.6^{b}	1.12
Small intestine (%)	40.68^{d}	34.73^{e}	45.72^{b}	45.42^{c}	45.96^{a}	1.45

^{a,b,c,d,e} Means on the same row with different superscripts are significantly($P<0.05$) different.
SEM= Standard Error of the Mean.
*T1 = water; T2 = vitalyte; T3 = (0.4litre of NLE + 4litre of water); T4 = (0.8litre of NLE+4 litre of water) and T5 = (1.2litre of NLE + 4 litre of water).

There were significant ($p<0.05$) differences in all the parameters on carcass and relative organ weight evaluated. Birds on treatments 4 and 5(0.8litre of NLE + 4 litre of water and 1.2litre of NLEE + 4 litre of water) are similar in live weight (LW) value and these were significantly ($p<0.05$) higher than LW values of birds on treatments 1-3(water, vitalyte and 0.4litre of NLE + 4 litre of water). Birds on treatment 2 was significantly ($p<0.05$) higher than LW values of birds on treatments 3 and 1respectively while birds on treatment 3 was significantly ($p<0.05$) higher than LW values of birds on treatment1.

Birds on treatment 2 was significantly ($p<0.05$) higher than relative dressed weight (RDW) values of birds on other treatments. The RDW value of birds on treatment 1 was significantly

($p<0.05$) higher than RDW values of birds on treatments 3-4 respectively. Birds on treatment 4 was significantly ($p<0.05$) higher than RDW values of birds on treatment 3 and 5while birds on treatment 3 was significantly ($p<0.05$) higher than RDW values of birds on treatment5.

Birds on treatments 2 had higher value of relative head weight (RHW) and this was significantly ($p<0.05$) higher than RHW values of birds on other treatments. Birds on treatments 3 and 5 had similar RHW and these were significantly ($p<0.05$) higher than RHW values of birds on treatments 1, and 4 while birds on treatment 4 was significantly ($p<0.05$) higher than RHW values of birds on treatment1.

Furthermore, the value of the relative gizzard weight (RGW) of birds on treatment 4 was significantly ($p<0.05$) higher than RGW values of birds on other treatments. Meanwhile birds on treatments 2 and 5 had similar RGW value and these significantly ($p<0.05$) higher than RGW values of birds on treatments 1 and 3 respectively while birds on treatment 1 was significantly ($p<0.05$) higher than RGW values of birds on treatment3.

The value of relative empty gizzard weight (REGW) of birds on treatment 4 was significantly ($p<0.05$) higher than REGW values of birds on other treatments. Birds on treatment 5 also was significantly ($p<0.05$) higher than REGW values of birds on treatments 1, 2, and 3. Again birds on treatment 2 was significantly ($p<0.05$) higher than REGW values of birds on treatments 1and3 while birds on treatment 3 was significantly ($p<0.05$) higher than REGW values of birds on treatment1.

Moreover birds on treatment 2 had higher value of relative shank weight (RSHW) and this was significantly ($p<0.05$) higher than RSHW values of birds on other treatments. Equally birds on treatment 5 was significantly ($p<0.05$) higher than RSHW values of birds on treatments 1, 3 and 4 respectively. Birds on treatment 4 was also significantly ($p<0.05$) higher than RSHW values of birds on treatments 1 and 3 while birds on treatment 3 was significantly ($p<0.05$) higher than RSHW values of birds on treatment 1.

Again birds on treatment 4 was also significantly ($p<0.05$) higher than relative heart weight (RHTW) values of birds on other treatments group. Birds on treatments 1, 2, 3 and 5 had similar RHTW respectively.

The value of relative liver weight (RLVW) of birds on treatment 1 was significantly ($p<0.05$) higher than RLVW values of birds on other treatments. Birds on treatment 4 also was

significantly ($p<0.05$) higher than RLVW values of birds on treatments 2, 3 and 5 respectively. Birds on treatment 5 was significantly ($p<0.05$) higher than RLVW values of birds on treatments 2 and 3 while birds on treatment 2 was significantly ($p<0.05$) higher than RLVW values of birds on treatment 3 also.

Birds on treatment 5 was significantly ($p<0.05$) higher than relative kidney weight (RKW) values of birds on other treatments groups. The value of RKW of birds on treatment 2 and 3 had similar RKW and these were significantly ($p<0.05$) higher than RKW values of birds on treatment 1 and 4, respectively while birds on treatment 1 was also significantly ($p<0.05$) higher than RKW values of birds on treatment 4.

Interestingly, the relative abdominal weight (RABDW) value of birds on treatment 1 was significantly ($p<0.05$) higher than RABDW values of birds on other treatments. Birds on treatment 3 was significantly ($p<0.05$) higher than RABDW values of birds on treatment 2, 4 and 5. Also birds on treatments 5 was significantly ($p<0.05$) higher than RABDW values of birds on treatments 2 and 4 while birds on treatment 4 was significantly ($p<0.05$) higher than RABDW value of birds on treatment 2.

The value of relative lung weight (RLGW) of birds on treatment 4 was significantly ($p<0.05$) higher than RLGW values of birds on other treatments groups respectively. Birds on treatments 3 was significantly ($p<0.05$) higher than RLGW values of birds on treatments 1, 2 and 5. Also birds on treatment 5 was significantly ($p<0.05$) higher than RLGW values of birds on treatments 1and 2 while birds on treatment 2 was significantly ($p<0.05$) higher than RLGW values of birds on treatment 1.

Birds on treatment 2 had relative large intestine weight (RLGW) and this was significantly ($p<0.05$) higher than RLGW values of birds on other treatments groups respectively. Birds on treatment 5 was significantly ($p<0.05$) higher than RLGW values of birds on treatments l, 3 and 4. Birds on treatment 4 was also significantly ($p<0.05$) higher than RLGW values of birds on treatments l and 3 while birds on treatment 3 was significantly ($p<0.05$) higher than RLGW values of birds on treatment l.

Equally, birds on treatment 4 was significantly ($p<0.05$) higher than relative longer large intestine (RLGI) values of birds on other treatments groups. Birds on treatment1 was significantly ($p<0.05$) higher than RLGI values of birds on treatments 2, 3 and 5.birds on treatment 5 also was significantly ($p<0.05$) higher than RLGI values of birds on treatments 2

and 3 while birds on treatment 3 was significantly ($p<0.05$) higher than RLGI values of birds on treatment2.

Birds on treatment 4 had relative longer small intestine (RSMI) value and this was significantly ($p<0.05$) higher than RSMI values of birds on other treatments groups respectively. Birds on treatment 3 was also significantly ($p<0.05$) higher than RSMI values of birds on treatments 1, 2 and 5. Also the RSMI value of birds on treatment 5 was significantly ($p<0.05$) higher than RSMI values of birds on treatments 1 and 2 while birds on treatment 2 was significantly ($p<0.05$) higher than RSMI values of birds on treatment 1.

Finally, birds on treatment 5 was significantly ($p<0.05$) higher than relative small intestine weight (RSMW) values of birds on other treatments groups. Again birds on treatment 3 was significantly ($p<0.05$) higher than RSMW values of birds on treatments 1, 2 and 4 respectively. The value of RSMW of birds on treatment 4 was significantly ($p<0.05$) higher than RSMW values of birds on treatments 1and 2 respectively while birds on treatments 1 was significantly ($p<0.05$) higher than RSMW values of birds on treatment 2.

Discussions

4.3 Experiment 1: Physiological response of broiler birds to oral supplementation with aloe vera gel extract

4.3.1 Proximate composition of aloe vera gel extract.

The crude protein value obtained in the present study is higher than the crude protein value of 6.86% reported by Muaz *et al*. (2013). The same authors have also reported crude fibre level of 73.35%, ash 16.88 for the alovera leaf. This crude fibre and ash is higher than the 10.00% and 8.99 observed in this present study. This proximate is also higher than that reported by Adesuyi et al (2012). The same author reported moisture 11.7%, ether extract 2.91%, ash 2.36, crude protein 4.73 and crude fibre 7.84% respectively. These differences in the crude protein and crude fibre in present findings may be related to the ages of the leaf. It is established facts that as leafs ages the crude protein reduces whereas the crude fibre content increases (Onyimonyi et al., (2009)

4.3.2 Effect of aqueous alovera gel extract on growth performance of starter broiler birds

The observed increase in final live weight gain (FLW) may be attributed to diversified antimicrobial activities of aloe gel in 1.2litre of AVGE + 4 litre of water which has aided digestion and thereby making absorption of the digested nutrients easy. Similar findings have been reported by Jiang *et al*. (2005), Jamrose and Kamel (2002),Wheeler *et al.* (1994), Guo *et al.* (2004), Mehmet *et al.* (2005), Chand *et al.* (2005) and Durrani *et al*. (2007). Ojhas *et al* (2012) is also in support of this report. However, this findings disagrees with the report of Sinuratet al. (2002) who reported that broiler chickens fed with fresh Aloe vera gel (0.25 g/kg) and dry Aloe vera gel (0.25 and 1.0 g/kg) had no significant effect on body weight.

The observed decrease in average daily feed (ADFI) of birds on treatment 1(water) signifies that several multivitamins in vitalyte and AVGE may have stimulated the birds appetites on treatments 2-5 to consume more feed. Similar suggestions had been made by (Durrani et al., 2006) who stated that supplementation of alovera and turmeric at the rate of 0.5% level resulted in better feed efficiency.

The observed increase in protein efficiency ratio(PER) in treatment 4showed that at this level, the vitamin B and choline present in alovera were involved in amino acid metabolism and vitamin B12 is required for the production and development of blood cells (source: Rita T. dela cruz of www.bar.gov.ph).

4.3.3 Effect of aqueous aloe vera gel extract on haematological indices of starter broiler birds

This experiment shows a significant ($p<0.05$) difference in all heamatological parameters except in white blood cells, This supports Ojhas et al(2011) who stated that oral administration of alovera significantly increased the RBC count and the Hb contents. The percentage increase in RBC count at 0.8litre of AVGE + 4 litre in this results, suggests that it may be an appropriate level of inclusion. The HBC contents were higher in other treatments groups compared to the control group. The increase in the blood indices could be related to the chemical composition of the extract or gel. From the biochemical analysis, it was found that the gel mainly contains vitamins A, C, and F, vitamin B (thiamine), niacin, vitamin B 2 (riboflavin), choline, folic acid, histidine, glycine, choline, other essential amino acids, anthraquinones, saponins, phenolics, and polysaccaride.

Wantanee and McDaniel (2002) have shown that dietary histidine is particularly important amino acid for Hb synthesis in rats. According to Young et al (1997), substances having a

significant effect on the value of RBC and the associated parameters would have an effect on the bone marrow, kidney, and Hb metabolism also. It may be possible that due to its antioxidant activity, the extract component competes with Hb in RBC for oxygen, resulting in hypoxia, which then stimulates the Hb synthesis and RBC production.

4.3.4 Effect of aqueous alovera gel extracts on growth performance of finisher broiler birds

The higher body weight gain and improved FCR values observed in this findings with the birds on treatments 3-5(0.4litre of AVGE + 4 litre of water, 0.8litre of AVGE + 4 litre of water and 1.2litre of AVGE + 4 litre of water) could be due to better performance of the broilers and the diversified antimicrobial activities of aloe gel that had also been demonstrated by Swaim *et al. (*1992), giving aloe vera extract to chicken. The increase in body weight may be attributed to the fact that AVG possesses a tonic effect on the intestinal tract, with a reduced transit time. The bacterial flora in the gastrointestinal tract could also survive and thrive better because of a reduction in the presence of yeasts and a reduction in the PH. Danhoff and McAnally (1988) reported that Aloe vera accelerates the growth of new cells, thereby resulting to increased body weight.

This also supports the previous findings done by Barbak et al (2011) using 10 ml of aqueous extract of aloe gel per liter of drinking water. Olupona et al. (2010) also reported that Aloe vera gel added to water resulted in significant final body weight gain as well as in weekly body weight gain compared to control group. In addition, in a study to compare Chinese herbal medicine to virginiamycin, Guo et al. (2004a) reported higher feed conversion ratio in broilers treated with Chinese herbs on the days 21 through 2 8. However, it was also consistent with the findings of Mehala et al (2008) that reported there were significant difference among the treatment groups, higher body weight was observed in the groups due to dietary inclusion of Aloe vera and Curcuma longa and its combinations as compared to control groups. Kumar et al. (2005) and Jagadeeswaran (2007) also reported the same. This result is in agreement with the reported findings of Odo et al., (2010), Changkang et al (2005), Lorenzetti (1984) and Sims *et al.* (1971) respectively.

However, this findings disagrees consistently with Sinuratet al. (2002) who reported that broiler chickens fed with fresh Aloe vera gel (0.25 g/kg) and dry Aloe vera gel (0.25 and 1.0 g/kg) had no significant effect on body weight and Namagirilakshmi (2005) also stated that broiler chickens fed with turmeric at 0.25, 0.50, 0.75 and 1.00 percent levels did not significantly affect the body weight. .

There were no significant (P < 0.05) differences in total water intake both in the starter and finisher phases. This is in support with Durrani et al (2008) who reported no significant difference in mean water intake among groups. Ismail et al. (2004) and Chand et al. (2005) reported similar findings whereas, Mehmet et al. (2005),Barbak et al (2011) reported higher water intake in alovera groups than antibiotic group. The reasons while there was no differences in water intake may be ascribed to the fact that avians have no developed taste bud. Another reason may be that the birds get adapted to bitter taste of alovera gel extracts.

Finally, the significant decrease in feed gain /kg gain in alovera groups of □ 321.00, □ 308.67 and □317 shows that farmers stand better chance of making profit than using the commercial vitalyte that cost □345.67 to produce 1kg of a bird. This is in support of Odo et al (2010) that reported higher profit in using alovera to feed cockerel than the control group. However it did not agree with Durrani et al (2006) who reported that there were no significant differences in giving alovera in drinking water.

4.3.5 Effects of aqueous alovera gel extracts on apparent nutrient retention finisher broiler birds.

It was evident that broiler birds that received 0.8litre of AVGE + 4 litre of water had the capacity to retain nutrient more than the ones that drank ordinary water and others in terms of CPR, CFR and EER. This may be assumed as the best inclusion of AVGE to broiler birds in water. This can be ascribed to the fact that there is evidence to suggest that herbs, spices, and various plant extracts have appetite- and digestion-stimulating properties and antimicrobial effects (Kamel, 2001). Wenk (2002) argued that herbs can stimulate appetite and endogenous secretions which, in turn, improve performance. The beneficial effects of medicine herbal extracts on farm animals may arise from the increase of feed intake and activation of digestive enzymes secretion, immune stimulation and anti-bacterial, anti-viral and anti-oxidant properties. The lower nitrogen free ether retained in birds on treatments 3-5 groups showed that alovera might have acted upon the soluble carbohydrates in the feed.

4.3.6 Effects of aqueous alovera gel extract on Serum biochemistry indices of finisher broiler birds.

Statistical analysis of data on serum biochemical parameters revealed significant ($p<0.05$) differences among treatment groups. This finding did not support Mehala and Moorthy

(2008) who reported that no significant difference among the treatment groups by dietary inclusion of alovera and curcuma longa and its combinations in broiler birds.

The findings of a significant increase in serum creatinine in treatment 5(1.2litre of AVGE + 4 litre of water) is in agreement with, Biu et al (2009) and Rabo *et al*., (2003) who reported significant increase in serum creatinine and urea levels.

Reduced protein level in T3 (0.4litre of AVGE + 4 litre of water) and albumin levels in T4 (0.8litre of AVGE + 4 litre of water) tallies with Mehala et al.,(2008). Again, this study is in support with the report by Woodman, (1988) who attributed it to hepatocellular and renal damage, the liver being the primary organ of albumin synthesis.

It was also observed in this finding that AVGE groups had lower glucose value compared to the control group T1 (water) and T2 (vitalyte). This in agreement with Rajasekaran et al. (2006) who stated that the oral administration of aloe vera gel extract (300mg/kg body weight per day) to streptozotocin induced diabetic rats hat a significant reduction in fasting glucose . The decreasing effect of alovera to glucose level may be the reason why some preliminary studies have also suggested that it may be a powerful antiviral agent, and potent immune system enhancer. It is being tested as a possible treatment for certain types of cancer and conditions as serious as diabetes. Source :(Rita T. dela Cruz of www.bar.gov.ph)

Furthermore, the no significant difference observed in T1 and T3, T4 and T5 respectively in level of cholesterol level supports Mehala et al (2008).

The significant increase observed in the calcium level in this report may be attributed to the content of alovera as reported that among the important minerals found in aloe vera are: calcium, chromium, copper, iron, magnesium, manganese, potassium, phosphorous, sodium, and zinc. These minerals are essential for good health and are known to work in synergistic combinations with each other, with vitamins and other trace. Source: Rita T. dela Cruz of www.bar.gov.ph)

4.3.7 Effects of aqueous alovera gel extract on carcass and (relative) organ weights of broiler finishers.

The significance($p<0.05$) difference observed in this findings on dressed weight was in support with Barbak D et al (2011) who observed heavier dressing percentage in the antibiotic group than other groups treated with alovera `gel except for the 2% Aloe vera gel

group. There is decrease in eviscerated weight by oral supplementation of alovera gel. The heavier dressing weight value was experienced more in the control and vitalyte groups.

This findings did not favour the earlier reports of Sinurat *et al.* (2002) who stated that supplementation of fresh *Aloe vera* gel (0.25 g/kg) and dry *Aloe vera* gel (0.25 and 1.0 g/kg) in broiler diet from 1-day old to 5 weeks of age showed no significant effect on carcass yield and internal organs. On the contrary, Durrani *et al.* (2006) reported higher (55 percent) dressing percentage, breast, and thigh and giblet weight in broilers fed diet containing 0.5 percent turmeric.

Abdominal fat deposition shows a reduction in weight as percentage of alovera gel increases. This was in support of Barbak D et al (2011) who found the same result on administration of alovera to broiler chicken and use of antibiotics. Other organs like head, gizzard, and empty gizzards, were found to be heavier in AVGE groups. The significant ($p<0.05$) difference observed in 20%AVGE group with other groups in shank weight suggest that the absorption of calcium in alovera may be best in this inclusion.

The heavier heart observed in T4 (0.8litre of AVGE + 4 litre of water) and heavier liver and kidney weight also observed in T5 (1.2litre of AVGE + 4 litre of water) respectively in this recent research disagree with (Sadre *et al*., 1984), **re**ported that, medicinal plant usage have been associated with tissue damage and serum enzyme alterations. The heavier lung, lengthy and heavier large intestine in birds on treatments 4 and 5 showed that all organs performed well due to anti microbial nature of alovera which may have prevented any harmful effect to these organs. Findings of this present study were in agreement with Ismail et al., (2004) and Failey et al., (1985) who reported similar findings. An increase in the relative weight of Gizzard and other internal organs of birds on treatments 3-5 may be associated with that there is always nutrient in balance when plant extracts are fed to animals. Again the internal organs like kidneys and liver are known as the primary recipient of any medicinal herbs or products before it is being absorbed in the body. This finding however did not agree with Guo et al. (2004) and Hernandez et al. (2004) who reported no effect of feeding herbal extracts on intestinal weight.

4.4 Experiment 2: Physiological response of broiler birds to oral supplementation with neem leaf extract

4.4.1 Proximate composition of neem leaf extracts

The result of the proximate composition of the NLE is presented in Table 16. Result obtained is similar from that reported by Esonu *et al*. (2006) and Onyimonyi et al., (2009) .The crude protein value obtained in the present study is lower than the crude protein value of 20.68% and 24.06% reported by Esonu *et al*. (2006) and Onyimonyi et al., (2009) respectively. The same authors have also reported crude fibre level of 16.6%, ash 7.10%, moisture 7.58%, ether extract 4.13% and nitrogen free extract 43.90 for the neem leaf while Onyimonyi et al., (2009) reported crude fibre level of 12.00%, ash 6.00%, moisture 3.5%, ether extract 6.00% and nitrogen free extract 51.94 for the neem leaf. These differences in the crude protein and crude fibre in present findings may be related to the ages of the leaf. It is established facts that as leafs ages the crude protein reduces whereas the crude fibre content increases.

4.4.2 Effect of neem leaf extracts on growth performance of starter broiler birds

The effect of increase in final body weight (FBW) observed in this finding in birds on treatments 4 and 5(0.8litre of NLE + 4 litre of water and 1.2litre of NLE + 4 litre of water) can be attributed to the antimicrobial properties of neem which may have aided in reducing the harmful micro organisms in the intestine of the birds there by increasing absorption of digested feeds. Similar suggestions have been made (Esonu B O et al., 2006 and Onyimonyi A. E.et al., 2009). Many studies have been carried out on using additives, including herbs, as alternatives to antibiotics, with direct or indirect effects on intestinal microflora, in poultry products (Taylor, 2001). Several studies have shown antimicrobial properties of herb extracts (Cowan, 1999; Hammer *et al*., 1999)which can improve intestinal microflora population and enhance health in birds' digestive systems through reduction in number of disease making bacteria (Mitsch *et al*., 2004). In addition, modified harmful microbial population in intestines will change intestinal morphology. Intestinal health is of great importance in poultry for improved performance and reduced feed conversion ratio (Montagne *etal*. 2003). The antibiotic growth promoters which contains in neem leaves have been helpful in improvement of growth performance and feed conversion ratio in birds treated with neem extracts. Miles *et al.*, (2006). Dibner and Buttin, (2002); Izat *et al.*, (1990) reported similar results.

The decrease in average cost /kg gain in birds on treatments 3-5(0.4litre of NLE + 4 litre of water, 0.8litre of NLE + 4 litre of water and1.2litre of NLE + 4 litre of water is this result supports Onyimonyi et al (2009) who reported that incorporation of 0.5% NLM in the diets of broilers yields better performance and economic benefit.

4.4.3 Effect of neem leaf extracts on haematological indices of starter broiler birds.

Hematological parameters are good indicators of the physiological status of animal and its changes are of value in assessing the response of animals to various physiological situations (Esonu *et al*., 2006). Esonu et al. *(*2001) stated that haematological constituents reflect the physiological responsiveness of the animals and the influence of diet on haematological traits is very strong (Church et al., 1984; Babatunde et al., 1987). Haemoglobin and packed cell volume are very sensitive to the levels of protein intake as the values increase with increase in dietary protein concentration (Edoziem and Switzer, 1977) .The findings of this research shows that there is decline in haemoglobin concentration with inclusion of neem leaves compared to the control group. There is also decline in packed volume cell which is in support with Ogbuewu et al (2001) that showed that neem leaf meal had mild depressive effect on the hemoglobin concentration and packed cell volume of female rabbits at 15% inclusion level. This mild depressive effect indicates that these animals were slightly stressed by the test diet (neem leaf meal).

It has also been observed that serum urea, total protein and creatinine contents depend on both the quality and quantity of protein supplied in the diet (Iyayi and Tewe, 1998). Obikaonu et al (2011) reported no traces of monocytes, eosinophils and basophils in heamological analysis of broiler starter birds in all the treatment groups as earlier reported by Akpan (2007) but this current findings indicated traces of monocytes and eosinophils in all the treatment groups except T5 that no trace of monocytes was seen. It does not confirm with the earlier work of Obikaonu et al (2011) that showed that no trace of basophils can be seen in all the treatments as the absence of basophils are seen in treatment containing neem leaves extract. It therefore shows that Neem leaf meal did not produce any form of infection since these parameters only observed when there is infection (Frandson, 1974).

4.4.4 Effect of neem leaf extracts extracts on growth performance of finisher broiler birds:

The effect of increase in final body weight (FBW) observed in this finding in birds on treatments 4 and 5(0.8litre of NLE + 4 litre of water and 1.2litre of NLE + 4 litre of water)

can be attributed to the antimicrobial properties of neem which may have aided in reducing the harmful micro organisms in the intestine of the birds there by increasing absorption of digested feeds. Similar suggestions have been made (Esonu B O et al., 2006 and Onyimonyi A. E.et al., 2009).

Many studies have been carried out on using additives, including herbs, as alternatives to antibiotics, with direct or indirect effects on intestinal microflora, in poultry products (Taylor, 2001). Several studies have shown antimicrobial properties of herb extracts (Cowan, 1999; Hammer *et al*., 1999)which can improve intestinal microflora population and enhance health in birds' digestive systems through reduction in number of disease making bacteria (Mitsch *et al*., 2004). In addition, modified harmful microbial population in intestines will change intestinal morphology. Intestinal health is of great importance in poultry for improved performance and reduced feed conversion ratio (Montagne *etal*. 2003).

The significant difference in daily water intake during the finisher stage with the birds in T1 (ordinary water) taking 73cl of water compared with other neem leafs extract groups may be attributed to bitter taste of NLE. In other hand, the statistical smiliarity observed among the treatment groups shows that even though avians have taste buds, it is developed to detect the bitter taste.

The decrease in value of average cost /kg gain in birds on treatments 3-5(0.4litre of NLE + 4 litre of water, 0.8litre of NLE + 4 litre of water and1.2litre of NLE + 4 litre of water is this result supports Onyimonyi et al (2009) who reported that incorporation of 0.5% NLM in the diets of broilers yields better performance and economic benefit. This result recommends 1.2litre of NLE + 4 litre of water in broiler production for better economic profit to farmers.

4.4.5 Effects of neem leaf extract on apparent nutrient retention finisher broiler birds.

The significant increase in the crude protein retained and ether extract retained in the other groups compared to the control groups shows that the crude protein in the neem was well absorbed and utilized. This agrees with the hypothesis that plant extract effects may be due to the greater efficiency in the utilization of feed, resulting in enhanced growth. There is evidence to suggest that herbs, spices, and various plant extracts have appetite- and digestion-stimulating properties and antimicrobial effects (Kamel, 2001). Plant extracts contain different molecules that have intrinsic bio-activities on animal physiology and metabolism. The mechanisms by which these products influence the gut microflora and growth performance of poultry are not known. Neem as antibiotics, plant extracts could control and limit the growth and colonization of numerous pathogenic and nonpathogenic species of

bacteria in the gut. The plant extracts clearly demonstrate antibacterial properties, although the mechanistic processes are poorly understood (Dorman and Deans, 2000).

However, this report disagrees with Obun et al (2013) who reported depressed performance and nutrient retentions of birds fed diets NLM15 and NLM20.

Mello et al., (1989) and Ash et al., (1992) also reported that inclusion of high levels of leaf meal in poultry diet reduce feed intake, growth performance and nutrient digestibility. The reason for the differences may be the mode of administration.

4.4.6 Effects of neem leaf extract on Serum biochemistry indices of finisher broiler birds.

Serum biochemical investigations have been explored extensively to distinguish normal state from stress and disease conditions in animals. Dietary components have also been shown to have measurable effects on blood components (Awosanya *et al*., 2000) hence the serum biochemical metabolites are used to detect the existence of heart attack, liver damage and to evaluate protein quality and amino acid requirements in animals (Harper *et al*., 1999).

The disagreement of this research with Obikaonu et al (2011) who suggested that the slight increment in serum urea and **creatinine** values of rabbit does on neem leaf meal diet was an indication that neem leaf meal diet was of poor quality relative to the control diet suggest that neem leaf meal is not of poor quality. The reason being that there is evidence from the literature that neem leaves contain antimicrobial and anti fungal nutrient that can fight infections. The administration of the neem leaf extract in this study led to no significant difference in creatine content. It disagrees with the earlier work of Biu *et al*., (2009) who reported a significant increase in **serum creatinine** and urea levels on administration of neem leaves aqueous extract on broiler birds. He ascribed it to the fact that neem leaf aqueous extract has proven to be toxic to both the liver and kidney of chicken in his study as reported by (Ogbuewu *et al*., 2008) who attributed it to the presence of some of neem leaf bioactive compounds (Azadirachtin, nimbin, salanin) which have been reported to block the energy metabolic pathway in animals, thus making it difficult for the animals to meet their energy requirement (Rabo *et al*., 2003). The finding s of this research did not record any kidney or liver damage. The dosage of neem leaves administration may have caused the defect of organ damages in their study. This finding agrees with the report by Woodman, (1988) on reduction of protein as a result of hepatocellular and renal damage.

The reduction in the **serum glucose** level in the present study could be attributed to the presence of bioactive compounds contained in Neem leaves which has the ability to block the

energy metabolic pathway, thus making it difficult for the animals to meet their energy requirement. This was in line with Kenneth and Saladin (1998) who reported that in a state of negative nitrogen balance, the body protein (mainly muscles and liver proteins) are being broken down and used as energy. Even though the glucose levels in this finding did not follow a progressive flow with the inclusion of neem leaves extract, it negates the idea of Obikaonu et al (2011) who observed that Neem leaf meal tended to elevate the blood glucose level of the birds while reducing the cholesterol level. According to them, the increase in blood sugar level as the dietary Neem leaf meal increased was quite interesting because birds generally maintain a high and relatively constant blood sugar level even in low feed intake (Liukkonen-Anttila, 2001). The reason why this finding did not agree to their finds may be obvious that the oral inclusion of neem leaves do not reduce feed intake as purported by these researchers .This findings also supports Oyagbemi and Adejinmi (2012) who reported the same decline in glucose level using neem leaves extract in broiler production. The peripheral utilization of glucose and gycogenolytic effect due to epinephrine action has been reported to block by NLM completely in diabetic rats (Chattopadhyay, 1996; Bopanna et al., 1997). The result of this study was in support of Khallare and Shrivastav (2003) who reported that the administration of aqueous neem leaf extract in human, led to the blockage of the biochemical energy pathway.

The **serum cholesterol** of T5 (130.667) and T4 (131.333) are more than the control group while the serum glucose value were observed to decrease more than the control group in this work. However, T3(119.333) agrees with Ogbuewu et al (2001) who also noticed reduction in serum cholesterol concentration from (130.00 – 64.30 mg/dl) and serum glucose which is in agreement with the hypocholesmic effects of neem earlier reported by Ogbuewu *et al.* (2008) in rabbit bucks and Oforjindu (2006) in broiler birds. It appeared that at 10% oral administration of neem leaves extract will reduce the cholesterol level in broiler birds. Upadhyay (1990) also reported a decline in blood cholesterol levels of broilers and rats fed Neem leaf meal. The reason for this difference may not be known but there is tendency that different way of administering neem leaves may have prayed a major role in its determinant.

The non-significant increase in **serum calcium** of 1.2litre of NLE + 4 litre of water and 0.8litre of NLE + 4 litre of water with the control is an indication that the integrity of the kidney was maintained as reported by Ogbuewu (2008), Obikaonu et al (2011).

Obikaonu et al (2011) indicated that **Serum total protein** steadily decreased with increase in dietary Neem leaf meal although there was not a progressive decrease of total protein in this

findings, it is likely that at 0.8litre of NLE + 4 litre of water inclusion will be an ideal administration for reduction of protein. The reduction of 1.2litre of NLE + 4 litre of water treated birds in globulin may be a justified answer to this as reported by by Obikaonu et al (2011)that Serum albumin and **globulin** depend on availability of dietary protein depending on the dosage . The reduction in globulin in this study is also in support of Ogbuewu et al (2010) who recorded the same reduction in administering neem leaves meal in rabbit diets.

4.4.7 Effects of neem leaf extracst on carcass and (relative) organ weights of broiler finishers.

There were significant differences in the whole carcass parameters which also agree with Esonu B O et al (2006) who included dietary levels of Neem leaf meal on carcass and organ weights of laying hens. They reported that the carcass weight of birds fed 10% inclusion level of Neem leaf meal was significantly different from those on 15% level but similar to the carcass weights of birds on 0% and 5% inclusion levels. However, the dressed percentages of birds on ordinary water and vitalyte groups differed significantly from birds on Neem leaf extracts. The less dressing weight in neem leaves extract may be attributed to nutritional imbalances. Another reason behind the less dressing weight observed in broilers when treated with herbs like neem can be the fact that body organs are known to absorb drugs first before releasing them to entire cell for use. This may be the reason why the neem leaf extract groups have more organ weights than the control and vitalyte groups.

However this finding does not agree with Oyagbemi and Adejinmi (2012) who observed high dressing weight value on birds treated with neem leaf extracts. The decreased, relative dressed weight value obtained as the dietary levels of NLE diets increases indicate depletion of peripheral glucose level (Chattopadhyay et al., 2000). This finding, were in slight disagreement with earlier results of Esonu et al. (2006) and Amaefule and Obioha (2001) on birds fed NLM and pigeon (Cabanas cajan)seeds respectively. The relative increase in the values of liver, as the NLE inclusion increases was as a result of hepatoprotective nature of the test ingredient (Chattopadhyay et al., 2000)Liver weight of birds placed on ordinary water levels increased significantly and differed from the other groups. The weight of the gizzards with neem leaves extract that differ significantly is in support with Esonu B O et al (2006) who reported that weight of the gizzards with neem leaf meal of layers fed 5% inclusion level of Neem leaf meal is significantly different from the gizzards of the birds fed 0% and 15% inclusion level of Neem leaf meal.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

Two hundred and forty 14-day old broiler birds were used for the experiment to investigate the physiological response of boiler birds to oral supplementation with aloe vera gel and neem leaf extracts for eight weeks. Experinment one examined the physiological response of one hundred and twenty 14- day old broiler to oral supplementation to alovera gel extract while the experiment two examined the physiological response one hundred and twenty 14-day old broiler to oral supplementation to neem leaf extract. The birds of both sexes were randomly allotted into five treatment groups of 24 birds each in a completely randomized design (CRD) in both of the two experiments. Treatments 1, 2, 3, 4, and 5 received ordinary water, Vitaltye, 10, 20, and 30% of the two extracts respectively.

Results obtained in experiment one showed that there were significant ($p<0.05$) differences in final body weight, feed conversion ratio, average cost/kg gain and mortality rate. Treatments that received alovera gel extracts showed progressive increase in final body weight (3.28, 3.38 and 3.41kg) compared with the control (3.15) and T2 (vitalyte)(3.15kg) respectively. Birds on T4(20%AVGE) had the lowest feed conversion ratio(3.09) and lower average cost of feed per kg gain(₦308.67) than others with feed conversion ratio of T1(3.36) T2(3.46)T3(3.21) and T5(3.18) and in average cost of feed per kg gain as followsT1((₦ 336.33), T2(₦345.67), T5(₦317.66) respectively. There were significant ($p<0.05$)differences in Packed cell volume, Red blood cells, Mean cell volume, Hetrophil, Lymphocyte, Moncyte, Eosnoohil, Basophil, Crude protein retained, Crude fibre retained, Ether extract retained, Nitrogen free ether retained, Total protein, Albumin, Globulin, Glucose, Creative, Cholesterol and Calcium. There were also significant ($p<0.05$) differences in Life weight, Dressed weight (%LW), Head, Gizzard, Empty gizzard, Shank, Heart, Liver, Kidney, Abdominal fat, Lungs, and Large intestine.

However, there were no significant ($p<0.05$) differences in average daily weight gain, average daily feed intake, daily water intake, protein efficiency ratio, white blood cell, Mean Cell Heamoblobin concentration, Mean Cell Heamoblobin (pg), dry matter retained, dressed weight(kg), and small intestines.

Results obtained in experiment two showed that there were significant($p<0.05$) differences in final body weight, average daily weight gain, feed conversion ratio, daily water intake, protein efficiency ratio and average cost/kg gain . Treatments that received neem leaf extract of T4 and T5 showed progressive increase in final body weight (3.42, and 3.70kg) compared with the control (3.14) and T2 (vitalyte) (3.39kg) respectively. Birds on T5(30%NLE) had the lowest feed conversion ratio(2.85) and lower average cost of feed per kg gain(₦284.67) than others with feed conversion ratio of T1(3.48) T2(3.21)T3(3.29) and T4(3.15) and in average cost of feed per kg gain as followsT1((₦347.67), T2(₦321.00), T4(₦315.33) respectively. There were significant ($p<0.05$)differences in packed cell volume, red blood cells, hetrophil,lymphocyte, moncyte, eosnoohil, basophil, grude protein retained, crude fibre retained, ether extract retained, nitrogen free ether retained, total protein, albumin, globulin, glucose, cholesterol and calcium. There were also significant ($p<0.05$)differences in life weight, dressed weight(%LW), head, gizzard, empty gizzard, shank, heart, liver, kidney, abdominal fat, lungs, large intestine small intestine.

However, there were no significant ($p<0.05$) differences in average daily feed intake, total water intake, , Mean Cell Heamoblobin concentration, Mean Cell Heamoblobin (pg), Mean Cell Volume, dry matter retained, and creatine.

5.2 CONCLUSION AND RECOMMENDATION

Finally, it can be concluded from the experiment one that the groups treated with Aloe vera gel showed better performance and heavier organ weights compared to the control groups but the control groups showed heavier dressing percentage compared to the AVGE groups in experiment one. The same trend followed in the experiment two. It is recommended that farmers adopt the use of 20 and 30% alovera gel extract in oral supplementation in alternative to commercial vitalyte. It is evident from the this findings that it costs ₦308.67 and ₦317.66 to produce 1kg of broiler finisher in T4 and T5 respectively against 345.67 and 336.33 in T2 and T1. The use of AVGE will also aid in reduction of abdominal fat than the use of vitalyte. The same trend was also observed in the use of neem leaf extract. Notwithstanding, it showed that the better organ performance was at 20% inclusion of NLE.

REFERENCES

Agbagha,F.M, Ezema, F.U and Omeke, B.C.O(2000). Studies of management Effects on fertility of purebred and crossbred Exotic Gilts in Two Breeding farms at Nsukka, Nig.Jour. of Animal: prod. 28(1)pg20.

Alabi, O.M., Adejuma, D.O., Aderemi, F.A., Lawal, T.E., Oguntunji, A.O., Ayoola, M.O., Essien, A. and Alabi, O.B., 2008: Physiological response of broiler chickens to oral supplementation with *Telifaria occidentalis* leaf extract at finisher phase. *Proc. Ann. Conf. Anim. Sci. Assoc. of Nig. (ASAN).* Sept. 15-19 ABU Zaria.,Bawa, G.S., Akpa, G.N., Jokthan, G.E., Kabir, M. and Abdu, S.B.(Eds), **13**: 114-117.

Alçiçek A, Bozkurt M and Çabuk M (2004). The effects of a mixture of herbal essential oil, an organic acid or a probiotic on broiler performance. South African Journal of Animal Science, 34: 217–222.

Amaefule, K.U. and Obioha, F.C.2001. Performance and nutrient utilization of broiler starter diets containing raw, boiled or dehulled pigeon seeds (Cajanus cajan). Nig. J.Anim. Prod

Ani, A.O and Okeke, G.C. (2011). The performance of broiler birds fed varying dietary levels of roasted pigeon pea(cajanius cajann) seed meal. Pakistan Journal of Nutrition. 10(11): 1036-1040.

Ani, A.O., Ogbu, C.C., Abakasanga, I.U. and Ugwuowo, L.C.(2012).Response of meat-type chickens to dietary inclusion of *Gongronema latifolium* leaf meal as feed additive in the tropics. Journal of Animal Physiology and Animal Nutrition.(In Press)

Antai, A.B., Ofem, O.E., Ikpi, D.E., Ukafia, V and Agiang, E.A., 2009: Physiochemistry and some haematological changes following oral administration of ethanolic root extract of Gonglonema latifolium in rats. *Nig. J. Phyiol. Sci.* **24 (1):** 79-83.

Akpan MJ, Enyenihi GE, Obasi OL, Solomon IP, Udedibie ABI. Effects of dietary neem leaf extract on the performance of laying hens. Proceedings of 33rd Annual Conference Nigerian Society Animal Production March 20-25, 2008; 396-398.

Austic, R.E., 1995. Poultry. In: Basic Animal Nutrition and Feeding, Pond, W.G., D.C. Church and K.R. Pond (Eds.). John Wiley and Sons Canada, Ltd., New York, pp: 495-515.

A.O. Adesuyi, O.A. Awosanya, F.B. Adaramola and A.I. Omeonu. Nutritional and Phytochemical Screening of Aloe barbadensis. Research of Journal Biological Science 4(1): 4-9, 2012ISSN: 2041-0778

AOAC (1990). Association of Official Analytical Chemists. Official Methods of Analysis (21st edition)Washington D.C. USA

Awosanya B, Joseph JK, Apata DF, Ayoola MA. Performance, blood chemistry and carcass quality attributes of rabbits fed raw and processed *Puereria* seed meal. Tropical Journal of Animal Science 2000; 2: 89 - 96.

Aviagen, 2006. Ross Broiler Management Manual. Aviagen Ltd., Newbridge, UK.

Babatunde GM, Pond WO, Krook L, Dvan L, Walker ER and Chapman D (1987). Effect of dietary safflower oil or hydrogenerated coconut oil on growth rate and on swine blood and tissue components of pigs fed fat-free diets. Journal of Nutrition, 92: 1903.

Babak Darabighane,1 Abolfazl Zarei,1 Ahmad Zare Shahneh,2 Ali Mahdavi(2011) Effects of different levels of Aloe vera gel as an alternative to antibiotic on performance and ileum morphology in broilers Italian Journal of Animal Science 2011; volume 10:e36

Barton, T.L. 1996. Relevance of water quality to broiler and turkey performance. Poult. Sci. 75:854-856.

Bawa, G.S., M. Orumuyin, A.S. Agbaji, Z. Ladan and U.O. Okekeifi, 2006. Effects of different methods of processing Neem seeds on performance of young growing rabbits. Pak. J. Nutr., 6: 212-216.

Belay, T. and R.G. Teeter. 1993. Broiler water balance and thermobalance during thermoneutral and high ambient temperature exposure. Poult. Sci. 72:106-115.

Berhe, E.T. and R.M. Gous, 2005. Effect of dietary protein content on allometric relationships between carcass portions and body protein in Cobb and Ross broilers. Proceedings of the 24th Conference of South African Branch of WPSA, Pretoria, Jaboticabal, UNESP.

Biu, A.A., Yusuf, S.D and Rabo, J.S.;2010. Biochemical studies on the administration of aqueous leaf extract on neem(*Azadiracthta indica A. Juss*) in chicken. African scientist vol 10.

Bopanna, KN, Kannan, J, Sushman, G, Balaraman, R, Rathod, SP. (1997) Anti-diabetic and anti-hyperlipaemic effects of Neem seed kernel powder on alloxan diabetic rabbits. Indian. J. Pharmacol., 29:162-169.

Bokkers, E.A.M. and P. Koene, 2003. Eating behavior and preprandial and postprandial correlations in male broiler and layer chickens. Br. Poult. Sci., 44: 538-544

Boorman, K.N., 1979. Regulation of Protein and Amino Acid Intake. In: Food Intake Regulation in Poultry, Boorman, K.N. and B.M. Freeman (Eds.). British Poultry Science Ltd., Edunburgh,UK.,pp:87-125.

Botsoglu NA, Fletouris DJ (2001). Drug resistant in foods pharmacology, food safty and analysis. Marcel Dekker Inc. New York. pp.541-548.

Breinold K. A Gowen, F.A. and Nwosu, C.C ((1981). Influences of enviroemnt on animals. Factors on day and night grazing activities of imported holstain freesia cows in the humid low land tropics of Nigeria. *Journal of animal. Prod.* **6:** 4pp 3000-307

Burnham, D., G.C. Emmans and R. Gous, 1992. Isoleucine requirements of the chicken: The effect of excess leucine and valine on the response to isoleucine. Br. Poult. Sci., 33:71-87.

Buyse, J., E. Decuypere, L. Berghman, E.R. Kuhn and F. Vandesande, 1992. The effect of dietary protein content on episodic growth hormone secretion and on heat production of male broilers chickens. Br. Poult. Sci., 33: 1101-1109.

C.A. Mbajiorgu, J.W. Ng`ambi and D.D. Norris, 2011. Voluntary Feed Intake and Nutrient Composition in Chickens. *Asian Journal of Animal and Veterinary Advances, 6: 20-28.*

Campbell, T.W. and Coles, E.H., 1986: Avian clinical pathology. In: Coles E.H (ed) Veterinary Clinical Pathology. 4th edn. Saunders, Philadelphia, pp 279-291

Changkang, W., J. Hongqiang, T. Jianming, G. Weiwei, S. Renna and Z. Qi, 2007. Effect of *Aloe* powder and extract on production performance and immune function of broiler chickens. J. Fujian Agric. And Forestry Univ., 36: 614-617.

Chattopadhyay, RR. (1996) Possible mechanism of anti-hyperglycemic effects of Neem leaf extracts. Part IV. Gen. Pharmacol.27:431-434

Chattopadhyay, RR, Chattopadhyay, RN, Maitra, SK.(2000) Effects of Neem on hepatic glycogen in rats. Indians J. Pharmacol. 25:174-175

Church JP, Young JT, Kebau CW, Kebay JC and Ken WW (1984). Relationships among dietary constituents and specific serum clinical components of subjects eating self selected diets. The American Journal of Clinical Nutrition, 40: 1338 – 1344

Cowan, M.M., 1999. Plant products as antimicrobial agents. Clin. Microbiol. Rev. 12: 564-582.

Dibner JJ, Buttin P (2002). Use of organic acids as a model to study the impact of gutn microflora on nutrition and metaboli sm. J. Appl. Poult. Res. 11: 453-463

Dorman, H. J., and S. G. Deans. 2000. Antimicrobial agents from plants: Antibacterial activity of plant volatile oils. J. Appl. Microbiol. 88:308–316

Duncan D B 1955 Multiple Range and Multiple F-test.Biometrics, 11:1-42.

Durrani, F. R., A. Sultan., M. L. Marri., N. Chand and Z. Durrani. 2007. Effect of Wild Mint (*Mentha longifolia*) Infusion on the Overall Performance of Broiler Chicks. Pak. J. Biol. Sci. 10(7): 1130-1133.

Durrani, F.R., Sanaullah, N. Chand, Z. Durrani and S. Akhtar. 2008. Using aqueous extract of aloe gel as anticoccidial and immunostimulant agent in broiler production. Sarhad J. Agric. 24(4): 665-669

Durrani, F.R., Mohammad Ismail, Asad Sultan, S.M. Suhail, Naila Chand and Z. Durrani, 2006. Effect of different levels of feed added turmeric (*Curcuma longa*) on the performance of broiler chicks. J. Agri.Bio. Sci., 1: 9-11.

Edoziem JC and Switzer B.R (1977). Effects of dietary protein, fat and energy on blood haemoglobin and haematocrit in rat. Journal of Nutrition, 107: 1016 – 1021.

Edwards, Jr., H.M., F. Denman, A. Abou-ashour and D. Nugara, 1973. Carcass and fatty acid composition. Poult. Sci., 52: 934-948.

Emmans, G.C. and C. Fisher, 1986. Problems in Nutritional Theory. In: Nutrient Requirements of Poultry and Nutritional Research, Fisher, C. and K.N. Boorman (Eds.). Butterworths, London,pp:9-39.

Emmans, G.C., 1981. A Model of the Growth and Feed Intake of Ad Libitum Fed Animals, Particularly Poultry. In: Computers in Animal Production, Hillyer, G.M., C.T. Whittemore and R.G. Gunn (Eds.). British Society of Animal Production, Thames Ditton, pp: 103-110.

Emmans, G.C., 1989. The Growth of Turkeys. In: Recent Advances in Turkey Science, Nixey, C. and T.C. Grey (Eds.). Butterworths, London, pp: 135-166.

Essien, J.P.; Ebong, G.A. and Akpan, E.J., 2007: Antioxidant and Antitussive Properties of *Gongronema latifolium*. *J. Appl. Sci. Environ. Managt*. **11(4)**: 47-50.

Esonu, B.O., M.N. Opara, I.C. Okoli, H.O. Obikaonu, C. Udedibie and O.O.M. Iheshiulor, 2006. Physiological responses of laying birds to Neem (*Azadirachta indica*) leaf meal based diets, body weight, organ characteristics and hematology. Online J. Health Allied Sci., 2: 4-4.

Fairchild, B.D. and C.W. Ritz. 2012. Poultry drinking water primer. Bull. 1301. Cooperative Extension, University of Georgia, Athens

Ferguson, N.S. and R.M. Gous, 1997. The influence of heat production on voluntary food intake in growing pigs given protein deficient diets. Anim. Sci., 64: 365-378.

Ferguson, N.S., R.M. Gous and G.C. Emmans, 1997. Predicting the effects of animal variation on growth and food intake in growing pigs using stimulation modeling. Anim. Sci., 64: 513-522

Ferket,p.,1991. Effect of Vitamin stress packs on broiler performance and immunity. BASF Tech. Symposium,GA Nutrition Conf.,Atlanta, GA.

Frandson RD (1974). Anatomy and Physiology of Farm Animals. Lea & febiger, Philadelphia. 494p.

Galib A M A and Noor M W 2010. Comparative study on diet supplementation with a mixture of herbal plants dandelion as a source of prebiotics on the performance of broilers. Pakistian journal of Nutrition 9(1):67-71.

Ganchrow, D. and J.R. Ganchrow.1985. Number and distribution of taste buds in the oral cavity of hatchling chicks. Physiol. Behav. 34(6):889-894.

Combs, G.F.1976. Differential effects of high dietary levels of Vitamin A on the vitamin E – Selenium nutrition of young and adult chickens. J. Nutr. 106:967-975.

Gonzalez, M.J. and G.M. Pesti, 1993. Evaluation of the protein to energy ratio concept in broiler and turkey nutrition. Poult. Sci. J., 72: 2115-2123

Gous, R.M. and T.R. Morris, 1985. Evaluation of a diet dilution technique for measuring the response of broiler chickens to increasing concentrations of lysine. Br. Poult. Sci., 26: 147-161.

Gous, R.M., 2007. Predicting nutrient responses in poultry: Future challenges. Animal, 1: 57-65.

Gous, R.M., E.T. Moran, H.R. Stilborn, G.D. Bradford and G.C. Emmans, 1999. Evaluation of the parameters needed to describe the overall growth, the chemical growth and the growth of feathers and breast muscles of broilers. Poult. Sci., 78: 812-821.

Gous, R.M., M. Griessel and T.R. Morris, 1987. Effect of dietary energy concentration on the response of laying hens to amino acids. Br. Poult. Sci., 28: 427-436.

Cowan, M.M., 1999. Plant products as antimicrobial agents. Clin. Microbiol. Rev. 12: 564-582.

Grimminger, P.1965. Vitamin K in Chicks: phylloquinone and menadione in the presence of stress agents. J. Nutr. 87:337-343.

Guo, F.C., R.P. Kwakkel, J.Soede, B.A. Williams and M.W. Verstegen. 2004. Effect of a Chinese herb medicine formulation, as an alternative for antibiotics, on performance of broilers. Brit. Poult. Sci. 45(6):793-797.

Hammer, K.A., Carson, C.F., Riley, T.V., 1999. Antimicrobial activity of essential oils and other plants extracts. J. Appl. Microbiol. 86:985-990

Han, Y. and D.H. Baker, 1993. Effects of sex, heat stress, body weight and genetic strain on the lysine requirement of broiler chicks. Poult. Sci., 72: 701-708.

Han, Y.M. and D.H. Baker, 1991. Lysine requirement of fast and slow growing broiler chicks. Poult. Sci., 70: 2108-2114.

Harper, A.E. and Q.R. Rogers, 1965. Amino acid imbalance. Proc. Nutr. Soc., 24: 173-190.

Harper AE, Rodwell B, Mayes PA. Review of physiological chemistry. 17th ed. Lang Medical,
Los Altos, California 9442, 1999:60-81

Hernandez, F., J. Madrid, V. Garcia, J. Orengo and M.D. Megias. 2004. Influence of two plant extract on broiler performance,

Hill, F.W. and L.M. Dansky, 1954. Studies on the energy requirements of chickens. 1. The effect of dietary energy level on growth and feed consumption. Poult. Sci., 33: 112-116 digestibility, and digestive organ size. Poult. Sci. 83: 169-174.

Hinton, M.H., 1988. Antibiotics, poultry production and public health. World Poultry Sci. J. 44:67-69.

Horton, H.R., L.A. Moran, R.S. Ochs, J.D. Rawn and A. Schrimgeour, 2002. Principles of Biochemistry. 3rd Edn., Prentice Hall, Upper Saddle River, New Jersey.

Hurwitz, S., D. Sklan and I. Bartov, 1978. New formal approaches to the determination of energy and amino acid requirements of chicks. Poult. Sci., 57: 197-205.

Igboeli, G., 2000. Animal production and agriculture in the new millennium. Proceedings of the 25th Annual Conference, (AC`00), Nigeria Society Animal Production, pp :1-3.

Ikpeme, E.V., Nta, A.I., Ekaluo, U.B. and Udensi, O., 2012: Phytochemical screening and haematological evaluation of *Parkia biglobosa* and *Gonglonema latifolium*. *J. Basic App*

Ismail, M., F.R. Durrani, M. Amjad, S.M. Suhail and N. Chand. 2004. Effect of different levels of feed added *Curcuma longa* on overall performance of broiler chicks. J. Agric. and Bio. Sci. 1(2):*l. Res.,* **2 (3):** 2599-2606.

Iyayi EA and Tewe OO (1998). Serum total protein, urea and creatinine levels as indices of quality cassava diets for pigs. Tropical Veterinary, 16: 57 – 67.

Izat AL, Tidwell NM, Thomas RA, Reiber MA,Adams MH,Colberg M, Waldroup PW (1990). Effects of a buffered propionic acid in diets on the performance of broiler chickens and on microflora of the intestine and carcass. Poult Sci.69:818-826

Jamroz, D. and C. Kamel. 2002. Plant extracts enhance broiler performance. J. Anim. Sci. 80 (Suppl. 1)): 4:325-330

Jagadeeswaran, A., 2007. Exploration of growth promoting and immunomodulating potentials of indigenous drugs in broiler chicken immunized against Newcastle viral disease. Ph.D., thesis submitted to Tamil Nadu Veterinary and Animal Sciences University, Chennai.

Jamroz, D. and C. Kamel. 2002. Plant extracts enhance broiler performance. J. Anim. Sci. 80 (Suppl. 1)): 4:325-330.

Jiang Lin, Feng Yuan Zhang, Yang Xu, Zhou Xin Ting and Yang De Po, 2005. Effects of gel, polysaccharide and acemannan from *Aloe vera* on broiler gut flora, microvilli density, immune function and growth performance. Chinese J. Vet. Sci., 25: 668-67

Kamel, C. 2001. Tracing modes of action and the roles of plant extracts in non-ruminants. Pages 135–150 in Recent Advances in Animal Nutrition. P. C. Garnsworthy and J. Wiseman, ed. Nottingham University Press, Nottingham, UK

Kumar, M., R.S. Choudhary and J.K. Vaishnav, 2005. Effect of supplemental prebiotic, probiotic and turmeric in diet on the performance of broiler chicks during summer. Ind. J. Poult. Sci., 40: 137-141.

Kare, M.R. 1970. The chemical senses of birds. Bird Control Seminars Proceedings. Available online Accessed 10/4/12

Kemp, C., C. Fisher and M. Kenny, 2005. Genotype-nutrition interactions in broilers response to balanced protein in two commercial strains. Proceedings of the 15th European Symposium on Poultry Nutrition, Sept. 25-29, Balatonfured, Hungary, pp: 54-56.

Kenneth, SS, Carol, MP. (1998) Anatomy and physiology; The unity of form and function. 1st edition Mc Graw- Hill

Khallare, MA, Shrivastav, K.. (2003) Spermatocidal activity of Neem leaf extract. Contraception, 68(3):225-229

Lacy, M. 2002. Broiler management. Pages 829-868 in: Commercial Chicken Meat and Egg Production (D. B. Bell and W.D. Weaver, Eds.). Kluwer Academic Pub. Norwell, MA.

Lamb, G. N. (1991). *Manual of Veterinary Laboratory Technique*. CIBA – GEIGY, Kenya. Pp. 92 – 109

Leeson, S. and J.D. Summers, 2001. Protein and Amino Acids. In: Scott`s Nutrition of the Chicken, Leeson, S. and J.D. Summers (Eds.). University Books, Ontario, Canada, pp: 102-175.

Leeson, S., 2000. Is feed efficiency still a useful measure of broiler performance?. Department of Animal and Poultry Science, University of Guelp, Ministry of Agriculture, Food and Rural Affairs, Canada.

Leeson, S., L. Caston and J.D. Summers, 1996. Broiler response to diet energy. Poult. Sci., 75: 529-535.

Liukkonen-Anttila J (2001). Nutritional and genetic adaptation of gallitorns birds: Implications for hand rearings and resticking. Acanic Dissertation, Faculty of Science, University of Oulu, Oulu Yilopisto, Finland. Retrieved September 17, 2007 from http://herkulesoulu.fi/isbn951425990index.html

Lott, B.D., W.A. Dozier, J.D. Simmons and W.B. Rouch. 2003. Water flow rates in commercial broiler houses. Poult. Sci. 82(Suppl. 1):102(S56).

Mack, S., D. Bercovici, G. de Groote, B. Leclercq and M. Lippens *et al*., 1999. Ideal amino acid profile and dietary lysine specification for broiler chickens of 20-40 days of age. Br. Poult. Sci., 40: 257-265

Marks, J., 1979. A guide to the Vitamins: their role in health and disease. Published by MTP, Medical and Technical Publishing Co., Ltd.England.

Mbajiorgu, C.A., 2010. Effect of dietary energy and protein ratio level on growth and productivity of indigenous Venda chickens raised in closed confinement from day-old up to 13 weeks of age. Ph.D. Thesis, Department of Animal production, Faculty of Science and Agriculture, University of Limpopo, South Africa.

McNaughton, J., 1990. Vitamin fortification essential to poultry rations. Feedstuffs, Aug.27, p.13.

Miles, R.D., Butcher, G.D., Henry, P.R., Littell, R.C., 2006. Effect of antibiotic growth promoters on broiler performance, intestinal growth parameters, and quantitative morphology. Poultry Sci. 85:476-485.

Mitsch, P., Zitterl-Eglseer, K., Kohler, B., Gabler, C., Losa, R., Zimpernik, I., 2004. The effect of two different blends of essential oil components on the proliferation of Clostridium perfringens in the intestines of broiler chickens. Poultry Sci. 83:669-675.

Montagne, L., Pluske, J.R., Hampson, D.J.,2003. A review of interactions between dietary fibre and the intestinalmucosa, and their consequences on digestive health in young non ruminant animals. Anim. Feed Sci. Tech. 108:95-117.

Muaz Ahmed and, Fatma Hussain.Chemical Composition and Biochemical Activity of Aloe vera(Aloe barbadensis Miller) Leaves. IJCBS, 3(2013):29-33

National Research council, 1994. Nutrient requirements of Domestic animals, Nutrient requirements of poultry, 8th ed.,National Academic sciences., Wasington , DC.

Nahashon, S.N., N. Adefope, A. Amenyenu and D. Wright, 2005. Effect of dietary metabolisable energy and crude protein concentrations on growth performance and carcass characteristics of French guinea fowl broilers. Poult. Sci. J., 84: 337-344.

Nahashon, S.N., N. Adefope, A. Amenyenu and D. Wright, 2006. Effect of varying metabolisable energy and crude protein concentrations in diets of pearl gray guinea fowl pullets 1. Growth performance. Poult. Sci. J., 85: 1847-1854.

NRC, 1984. Nutrient Requirements of Poultry. 8th Rev. Edn., National Academy Press, Washington, DC.

NRC, 1994. Nutrient Requirements of Poultry. 9th Edn., National Academy Press, Washington, DC., USA., ISBN-13: 9780309048927, Pages: 155.

Nemavhola, Z., 2001. The effect of different diets on production performance and meat quality of the indigenous chickens. Masters of Agricultural Management (Animal Production) Dissertation, University of Limpopo, South Africa.

Newcombe, M. and J.D. Summers, 1984. Effect of previous diet on feed intake and body weight gain of broiler and Leghorn chicks. Poult. Sci. J., 63: 1237-1242

Mehala, C., and Moorthy, M.;2008: Production Performance of Broilers Fed with Aloe vera and Curcuma longa(turmeric). International Journal of Poultry sciences,7(91:852-856).

Mehala, C., and Moorthy, M.;2008: Effects of Aloe vera and Curcuma longa(turmeric)on carcass characteristics and Biochemical parameters of Broilers. International Journal of Poultry sciences,7(9) 857-861.

Mehmet C., G. Talat, B. Dalkilic and O. N. Ertas 2005. The Effect of Anise Oil (*Pimpinella anisum* L.) on broiler performance. Int. J. Poult. Sci. 4 (11): 851-855

Mitruka, B.M., and Rawnsley, H. M., 1977: *Clinical Biochemical and Haematological Reference Values in Normal Experimental Animals*, Masson, New York. Pp. 42 – 45.

Nahashon, S.N., N. Adefope, A. Amenyenu and D. Wright, 2006. Effect of varying metabolisable energy and crude protein concentrations in diets of pearl gray guinea fowl pullets 1. Growth performance. Poult. Sci. J., 85: 1847-1854.

Namagirilakshmi, S., 2005. Turmeric (*Curcuma longa*) as nutraceutical to improve broiler performance. M.V.Sc., thesis submitted to Tamil Nadu Veterinary and Animal Sciences University, Chennai, India.

Nworgu F C, Ogungbenro S A and Solesi K S 2007. Performance and some blood chemistry indices of broiler chicken served fluted pumpkin(Telefaria occidentalis)leaves extract supplement. American-Eurasian Journal of Agriculture & Environmental sciencies, 2(1):90-9

Obikaonu, H.O., Okoli, I.C., Opara, M.N., Okoro, V.M.O., Ogbuew, I.P., Etuk E.B. and Udedibie, A.B.I. 2011. Heamatological and serum biochemical indices of starter broilers fed neem (*Azadirachta indica*) leaf meal. *Online J. Anim. Feed Res.*, 1(4): 150-154. Journal homepage: http://www.ojafr.

Obun,C.C.,Olatunji E. A and Ukim C.I., 2013. Utilization of sun-cured neem leaf meal (*Azadirachta indica.A. juss),*Based diets by finisher Broiler chickens.

Odo, B.I., Ekenyem B.U., and Nwamo, A.C.;2010. Effects of Alovera as leaf protein concentrates on Growth Performance of Cockerals. International Journal of Poultry science 9(5) 426-428.

Oforjindu, O., 2006. The Toxicity of Graded Levels of Graded Levels of Neem (*Azadirachta indica*) Leaf Meal. B. Agric. Tech. Project Report, Federal University of Technology, Owerri, pp: 1-34.

OFormata, G.E.K. (1975). Nigeria in Maps. Eastern States, Ethiope Pu. Company Lt. Benin Nigerian

.

Ogbuewu IP, Okoli IC, Iloeje MU. Serum biochemical evaluation and organ weight characteristics of buck rabbits fed graded levels Neem (*Azadirachta indica*) leaf meal diets Veton- line - The International Journal of Veterinary Medicine 2008.

Ogbuewu, I.P., I.C. Okoli and M.U. Iloeje, 2010. Evaluation of toxicological effects of leaf meal of an ethno medicinal plant-neem on blood chemistry of puberal Chinchilla Rabbit does. Rep. Opin., 2: 29-34.

Okoli, I.C., C.S. Ebere, O.O. Emenalom, M.C. Uchegbu and B.O. Esonu, 2001. Indigenous livestock production paradigms revisited. III: An assessment of the proximate values of most preferred indigenous browses of South Eastern Nigeria. Trop. Anim. Prod. Invest, 4: 99-107.

Okonkwo, W. I. and Akubuo, C. O.(2007) Trombe wall system for Poultry building . int.J.Poult.Sc.6(2):125-130.

Ojha S, Sonker K, Pandey M, Saraf SA. *Aloe vera* gel: A potent nutraceutical. J Nat Pharm [serial online] 2011 [cited 2012 Dec 11];2:36-9. Available from: http://www.jnatpharm.org/text.asp?2011/2/1/36/78496

Olupona, J.A., Omotoso, O.R., Adeyeye, A.A., Kolawole, O.D., Airemionkhale, A.P., Adejinmi, O.O., 2010. Effect of aloe vera juice application through drinking water on performance, carcass characteristics, hematology and organoleptics properties in broilers. pp 42-43 in Proc. 98th Annual Meet. Poultry Science Association, Raleigh, NC, USA

Onyimonyi,A. E., Adeyemi Olabode and Okeke, G. C.;2009:
Performance and Economic Characteristics of Broilers Fed Varying Dietary Levels of Neem Leaf Meal (*Azadirachta indica*). International journal of poultry science 8(3) 256-259.

Okafor, J.C., 2005: Conservation and use of traditional vegetables from woody forest species in South Eastern Nigeria. Fame Agricultural Centre, Enugu, Nigeria. www.Agri.Cigiar.org

Owens, B., Tucker, L., Collins, M.A., McCracken, K.J., 2008. Effects of different feed additives alone or in combination on broiler performance, gut microflora and ileal histology. Brit. Poultry Sci. 49:202-212.

Oyagbemi, T. O., and Adejinmi, J. O: Supplementation of broiler feed with leaves of *Vernonia amygdalina* and *Azadirachta indica* protected birds naturally infected with *Eimeria* sp. African Journal of Biotechnology Vol. 11(33), pp. 8407-8413, 24 April, 2012

Parsons, C.M., K.W. Koelkebeck, Y. Zhang, X. Wang and R.W. Leeper, 1993. Effect of dietary protein and added fat levels on performance of young laying hens. J. Applied Poult. Res., 2:214-220.

Plavnik, I., E. Wax, D. Sklan, I. Bartov and S. Hurwitz, 1997. The response of broiler chickens and turkey poults to dietary energy supplied either by fat or carbohydrates. Poult. Sci., 76: 1000-1005.

Pond, W.G., D.C. Church and K.R. Pond, 1995. Basic Animal Nutrition and Feeding. 4th Edn., John Wiley and Sons, New York, USA., pp: 615.

Proudfoot, F. G., H. W. Hulan, E. D. Jackson and C. D. Salisbury. 1990. Effect of lincomycin as a growth promoter for broilerchicks. Br. Poult.Sci. Agric. Canada, Res Station, Kentville, Nova Scotia, Canada.31(1): 181-187

Pym, R.A.E. and A.J. Solvens, 1979. Selection for food conversion in broilers: Body composition of birds selected for increased body weight gain, food consumption and feed conversion ratio. Br. Poult. Sci., 20: 87-97.

Richards, M.P., 2003. Genetic regulation of feed intake and energy balance in poultry. Poult. Sci., 82: 907-916

Rabo, J.S., Onyeyili, P.A. and Khalil, M.I. (2003).Chronic toxicity of aqueous extract of *Butyrospermum paradoxum* stem bark in rabbits. Haematology and enzymology. *Studies and Researches in Veterinary Medicine*, Bucharest. 1:37-46

Rajasekaran, S., K. Ravi, K. Sivagnanam and S.. Subramanian, 2006. Beneficial effects of *Aloe vera* leaf gel extract on lipid profile status in rats with streptozotocin diabetes. Cli. Exp. Pharm. Phy., 33: 232-237.

Rita T. dela Cruz of www.bar.gov.ph

Sadre, N.L., Deshpande, V.Y., Mendulkar, K.N. and, Nandal, D.H. (1984).Male anti-fertility activity of *Azadirachta indica* A. Juss (Neem) in different species. Pp. 473 – 482. In: Schmutterer, H. and Ascher, K. R. S. eds. *Natural pesticides from the neem tree (Azadirachta indica. A. Juss) and other tropical plants*.1st ed. pp. 103- 114 CRC Press, Boca Raton, Florida, U.S.A. 1984.

Sainbury, D., 1984. Poultry Health and Management. Granada Publishing, Great Britian.

Schalm, O.W; Jain, N.C; Caroll, E.J., 1975: *Veterinary Haematology*, 3rd edn. Lea and Febiger, Philadelphia. Pp. 471-538

Sinurat, A.P., T. Purwadaria, M.H. Togatorop, T. Pasaribu, I.A.K. Bintang, S. Sitompul and J. Rosida, 2002. Responses of broilers to *Aloe vera* bioactives as feed additive: the effect of different forms and levels of bioactives on performances of broilers. J. ILmu. Ternak. dan. Veteriner., 7: 69-75.

Smith,A.J.(2001). Poultry. The Tropical Agriculture.2nd(revised) ed. Macmillan education ltd.U.K.Pp1-73.

Smriti Ojha, Kanchan Sonker, Manisha Pandey, Shubhini A. Saraf. (2011), J. of Natural Pharmaceuticals, Vol 2(1) pp: 36-39.

Sokunbi, O.A. and G.N. Egbunike, 2000. Physiological response of growing rabbits to Neem leaf based diets. Haematol. Serum Biochem. Trop. Anim. Prod. Invest., 3: 81-87

SPSS.Com.(2007).IBM(R)SPSS(R) Advantage for Microsoft (R)IBM.Corporation 2010,IBM Corporation Route,100,Somers,N4. 10589.

Swaim, S. F., K. P. Riddell and J. A. McGuire. 1992. Effects of tropical medications on the healing of open pad wounds in dogs. J. Amer. Anim. Hospital Assoc. 28(6): 499-502.

Tabler, G.T. 2003. Water intake: A good measure of broiler performance. Avian Advice 5(3):7-9

Taylor, D.J., 2001. Effects of antimicrobials and their alternatives. Brit. Poultry Sci. 42:67-68.

Tadelle, D., Y. Alemu and K.J. Peters, 2000. Indigenous chickens in Ethiopia: Genetic potential and attempts at improvement. Poult. Sci., 56: 45-54.

Thomas, O.P., A.I. Zuckerman, M. Farran and C.B. Tampling, 1986. Updated amino acid requirements of broilers. Proceedings of the Maryland Nutrition Conference, (MNC'86), College Park, MD, pp: 79-85.

Thrall, M.A. and Weiser, M.G., 2002: *Haematology*. In: Hendrix CM (ed) Laboratory procedures for veterinary technicians. 4th edn. Mosby, St. Louis, M.O, pp 29-74.

Uko, O.J. and T.N. Kamalu, 2007. Performance and carcass characteristics of broilers fed raw and heat-treated Neem (Azadirachta indica A. Juss) seed kernels. Anim. Prod. Res. Adv., 3: 91-98.

Upadhyay, S. N., S. Dhawan, M. G. Sharma and G. P. Talwar, 1994. Long term contraceptive effects of intrauterine neem treatment (IUNT) in bonnet monkeys: an alternative to intra-uterine contraceptive devices(IUCD). Contraception, 49: 161-169.

Upadhyay C (1990). The medicinal properties of neem (*Azadirachta indica*) tree. In: Animal pharmacology 2nd edition. Longman England.

Veldkamp, T., R.P. Kwakkel, P.R. Ferket and M.W.A. Verstegen, 2005. Growth response to dietary energy and lysine at high and low ambient temperature in male Turkeys. Poult. Sci. J., 84: 273-282..

Veltmann,j.R., L.S. Jensen and J.N. Rowland .1983. Vitamin A toxicosis in turkey poults: detrimental effects induced by excess vitamin A ameliorated by extra dietary vitamin D. Poult. Sci. 62:1518.

Wantanee K. Long term effect of histidine depletion on whole body protein metabolism in healthy adult. J Nutr 2002;132:3340-8.

Wenk, C., 2002. Herbs, botanicals and other related substances. pp 1-10 in Proc. 11th Eur. Poultry Conf., Bremen, Germany

Wheeler, G.E. 1994. Use of an herbal supplement to reduce the effects of stress in intensively reared chicks. Ind. J. Indig. Med. 11 (1): 51-60.

Young NS. The path physiology of acquired aplastic anemia. Neu J Med 1997;336:1365-6

Zubair, A.K. and S. Leeson, 1996. Compensatory growth in the broiler chicken: A review. World's Poult. Sci. J., 52: 192-201

Appendix 1:ANOVA Table on effects of aloveragel extracts on growth performance of broiler starters

		Sum of Squares	df	Mean Square	F	Sig.
IBW	Between Groups	.001	4	.000	1.413	.299
	Within Groups	.002	10	.000		
	Total	.002	14			
FBW	Between Groups	.003	4	.001	.233	.913
	Within Groups	.033	10	.003		
	Total	.036	14			
BWG	Between Groups	.001	4	.000	.101	.980
	Within Groups	.037	10	.004		
	Total	.038	14			
DWG	Between Groups	.000	4	.000	1.000	.452
	Within Groups	.000	10	.000		
	Total	.000	14			
TFI	Between Groups	.015	4	.004	1.150	.388
	Within Groups	.033	10	.003		
	Total	.048	14			
DFI	Between Groups	.000	4	.000	1.000	.452
	Within Groups	.000	10	.000		
	Total	.000	14			
FCR	Between Groups	.021	4	.005	.270	.891
	Within Groups	.196	10	.020		
	Total	.217	14			
FER	Between Groups	.000	4	.000	.195	.935

	Within Groups	.005	10	.001		
	Total	.006	14			
TWI	Between Groups	.160	4	.040	.712	.602
	Within Groups	.562	10	.056		
	Total	.722	14			
DWI	Between Groups	.000	4	.000	.654	.637
	Within Groups	.001	10	.000		
	Total	.001	14			
PER	Between Groups	.044	4	.011	.809	.547
	Within Groups	.136	10	.014		
	Total	.180	14			
CDF	Between Groups	.267	4	.067	1.000	.452
	Within Groups	.667	10	.067		
	Total	.933	14			
CTF	Between Groups	150.267	4	37.567	1.150	.388
	Within Groups	326.667	10	32.667		
	Total	476.933	14			
CFG	Between Groups	211.733	4	52.933	.270	.891
	Within Groups	1960.667	10	196.067		
	Total	2172.400	14			

Appendix 2:ANOVA Ttable on effects of alovera gel extracts on heamatological indices of broiler starters

		Sum of Squares	df	Mean Square	F	Sig.
PCV	Between Groups	2.233	4	.558	.272	.889
	Within Groups	20.500	10	2.050		

	Total	22.733	14			
RBC	Between Groups	.103	4	.026	1.179	.377
	Within Groups	.219	10	.022		
	Total	.322	14			
HBC	Between Groups	1.170	4	.293	.432	.783
	Within Groups	6.774	10	.677		
	Total	7.945	14			
WBC	Between Groups	2.551	4	.638	.154	.957
	Within Groups	41.302	10	4.130		
	Total	43.852	14			
HET	Between Groups	129.733	4	32.433	.395	.808
	Within Groups	820.667	10	82.067		
	Total	950.400	14			
LYM	Between Groups	124.267	4	31.067	.343	.843
	Within Groups	904.667	10	90.467		
	Total	1028.933	14			
MON	Between Groups	1.733	4	.433	.406	.800
	Within Groups	10.667	10	1.067		
	Total	12.400	14			
EOS	Between Groups	7.067	4	1.767	1.325	.326
	Within Groups	13.333	10	1.333		
	Total	20.400	14			
BAS	Between Groups	.400	4	.100	.750	.580
	Within Groups	1.333	10	.133		
	Total	1.733	14			

MCHC	Between Groups	49.454	4	12.363	1.184	.375
	Within Groups	104.393	10	10.439		
	Total	153.847	14			
MCV	Between Groups	166.064	4	41.516	.664	.631
	Within Groups	625.126	10	62.513		
	Total	791.190	14			
MCHPG	Between Groups	48.688	4	12.172	.745	.583
	Within Groups	163.274	10	16.327		
	Total	211.962	14			

Appendix 3:ANOVA Table on effects of alovera gel extracts on growth performance of broiler finishers

		Sum of Squares	df	Mean Square	F	Sig.
IBW	Between Groups	.001	4	.000	1.413	.299
	Within Groups	.002	10	.000		
	Total	.002	14			
FBW	Between Groups	.177	4	.044	3.710	.042
	Within Groups	.119	10	.012		
	Total	.297	14			
BWG	Between Groups	.178	4	.045	3.867	.038
	Within Groups	.115	10	.012		
	Total	.294	14			
DWG	Between Groups	.000	4	.000	.	.
	Within Groups	.000	10	.000		
	Total	.000	14			
TFI	Between Groups	.174	4	.043	2.255	.135
	Within Groups	.192	10	.019		
	Total	.366	14			
DFI	Between Groups	.000	4	.000	2.000	.171
	Within Groups	.000	10	.000		
	Total	.000	14			
FCR	Between Groups	.267	4	.067	4.210	.030
	Within Groups	.158	10	.016		
	Total	.425	14			
FER	Between Groups	.002	4	.001	4.452	.025
	Within Groups	.001	10	.000		
	Total	.004	14			
TWI	Between Groups	3.838	4	.959	.699	.610

	Within Groups	13.732	10	1.373		
	Total	17.570	14			
DWI	Between Groups	.000	4	.000	.675	.624
	Within Groups	.001	10	.000		
	Total	.002	14			
PER	Between Groups	.000	4	.000	.	.
	Within Groups	.000	10	.000		
	Total	.000	14			
CDF	Between Groups	1.067	4	.267	2.000	.171
	Within Groups	1.333	10	.133		
	Total	2.400	14			
CTF	Between Groups	1756.267	4	439.067	2.274	.133
	Within Groups	1930.667	10	193.067		
	Total	3686.933	14			
CFG	Between Groups	2665.067	4	666.267	4.210	.030
	Within Groups	1582.667	10	158.267		
	Total	4247.733	14			
MOR	Between Groups	1.067	4	.267	.800	.552
	Within Groups	3.333	10	.333		
	Total	4.400	14			

Appendix 4:ANOVA Table on effects of alovera gel extracts on apparent nutrient retention of broiler finishers

		Sum of Squares	df	Mean Square	F	Sig.
DM	Between Groups	3.984	4	.996	.	.
	Within Groups	.000	10	.000		
	Total	3.984	14			
CF	Between Groups	618.585	4	154.646	.	.
	Within Groups	.000	10	.000		
	Total	618.585	14			
EE	Between Groups	1.920	4	.480	.	.
	Within Groups	.000	10	.000		
	Total	1.920	14			
CP	Between Groups	54.645	4	13.661	.	.
	Within Groups	.000	10	.000		
	Total	54.645	14			
NFE	Between Groups	2225.711	4	556.428	.	.
	Within Groups	.000	10	.000		
	Total	2225.711	14			
CPI	Between Groups	3.651	4	.913	2.000	.171
	Within Groups	4.563	10	.456		
	Total	8.214	14			
FO	Between Groups	28.706	4	7.177	25.275	.000
	Within Groups	2.839	10	.284		
	Total	31.546	14			

CPR	Between Groups	998.702	4	249.676	21.297	.000
	Within Groups	117.237	10	11.724		
	Total	1115.939	14			
EEO	Between Groups	.856	4	.214	21.342	.000
	Within Groups	.100	10	.010		
	Total	.956	14			
EER	Between Groups	28.834	4	7.209	20.623	.000
	Within Groups	3.495	10	.350		
	Total	32.330	14			

Appendix 5:ANOVA Table on effects of aloveragel extracts on serum biochemistry indices of broiler finishers

		Sum of Squares	df	Mean Square	F	Sig.
PRO	Between Groups	1.489	4	.372	3.557	.047
	Within Groups	1.047	10	.105		
	Total	2.536	14			
ALB	Between Groups	1.056	4	.264	.906	.496
	Within Groups	2.913	10	.291		
	Total	3.969	14			
GLO	Between Groups	2.651	4	.663	2.504	.109
	Within Groups	2.647	10	.265		
	Total	5.297	14			
GLU	Between Groups	4598.400	4	1149.600	.918	.491
	Within Groups	12525.333	10	1252.533		
	Total	17123.733	14			
CRE	Between Groups	.119	4	.030	1.097	.410
	Within Groups	.271	10	.027		
	Total	.390	14			
CHO	Between Groups	3878.919	4	969.730	.978	.461
	Within Groups	9911.107	10	991.111		
	Total	13790.026	14			
CAL	Between Groups	1.183	4	.296	1.403	.301
	Within Groups	2.107	10	.211		
	Total	3.289	14			

Appendix 6: ANOVA Table on effects of alovera gel extracts on carcass and relative organ weight of broiler finishers.

		Sum of Squares	df	Mean Square	F	Sig.
LWT	Between Groups	.331	4	.083	.894	.530
	Within Groups	.464	5	.093		
	Total	.795	9			
EWT	Between Groups	132.372	4	33.093	4.014	.080
	Within Groups	41.223	5	8.245		
	Total	173.594	9			
HED	Between Groups	.320	4	.080	6.100	.037
	Within Groups	.066	5	.013		
	Total	.386	9			
GZD	Between Groups	.455	4	.114	1.464	.338
	Within Groups	.389	5	.078		
	Total	.844	9			
EGZD	Between Groups	.195	4	.049	.890	.532
	Within Groups	.274	5	.055		
	Total	.469	9			
SHK	Between Groups	.695	4	.174	1.455	.340
	Within Groups	.597	5	.119		
	Total	1.292	9			
HRT	Between Groups	.192	4	.048	1.518	.325
	Within Groups	.158	5	.032		
	Total	.350	9			
LVR	Between Groups	.257	4	.064	1.127	.438
	Within Groups	.285	5	.057		
	Total	.542	9			
KDN	Between Groups	4.907	4	1.227	.909	.523

	Within Groups	6.746	5	1.349		
	Total	11.653	9			
ABF	Between Groups	2.085	4	.521	2.131	.214
	Within Groups	1.223	5	.245		
	Total	3.309	9			
LNG	Between Groups	.033	4	.008	.703	.623
	Within Groups	.058	5	.012		
	Total	.091	9			
LINT	Between Groups	257.400	4	64.350	2.564	.165
	Within Groups	125.500	5	25.100		
	Total	382.900	9			
LINT2	Between Groups	.456	4	.114	.542	.714
	Within Groups	1.051	5	.210		
	Total	1.507	9			
SINT	Between Groups	221.400	4	55.350	.051	.994
	Within Groups	5473.000	5	1094.600		
	Total	5694.400	9			
SINT2	Between Groups	4.690	4	1.173	.720	.621
	Within Groups	6.517	4	1.629		
	Total	11.208	8			

Appendix 7:ANOVA Table on effects of neem leaf extracts on growth performance of broiler starters

		Sum of Squares	df	Mean Square	F	Sig.
IBW	Between Groups	.005	4	.001	1.783	.209

	Within Groups	.008	10	.001		
	Total	.013	14			
FBW	Between Groups	.005	4	.001	.749	.581
	Within Groups	.018	10	.002		
	Total	.023	14			
BWG	Between Groups	.016	4	.004	1.484	.278
	Within Groups	.028	10	.003		
	Total	.044	14			
DWG	Between Groups	.000	4	.000	.500	.737
	Within Groups	.000	10	.000		
	Total	.000	14			
TFI	Between Groups	.023	4	.006	.921	.489
	Within Groups	.062	10	.006		
	Total	.085	14			
DFI	Between Groups	.000	4	.000	2.000	.171
	Within Groups	.000	10	.000		
	Total	.000	14			
FCR	Between Groups	.129	4	.032	.803	.550
	Within Groups	.402	10	.040		
	Total	.531	14			
FER	Between Groups	.003	4	.001	.991	.455
	Within Groups	.008	10	.001		
	Total	.011	14			
TWI	Between Groups	.099	4	.025	.547	.706
	Within Groups	.454	10	.045		

	Total	.553	14			
DWI	Between Groups	.000	4	.000	1.042	.433
	Within Groups	.001	10	.000		
	Total	.001	14			
PER	Between Groups	.137	4	.034	.627	.654
	Within Groups	.547	10	.055		
	Total	.684	14			
CDF	Between Groups	1.067	4	.267	2.000	.171
	Within Groups	1.333	10	.133		
	Total	2.400	14			
CTF	Between Groups	228.667	4	57.167	.921	.489
	Within Groups	620.667	10	62.067		
	Total	849.333	14			
CFG	Between Groups	748.267	4	187.067	.551	.703
	Within Groups	3396.667	10	339.667		
	Total	4144.933	14			

Appendix 8:ANOVA Table on effects of alovera gel extracts on heamatological indices of broiler starters

		Sum of Squares	df	Mean Square	F	Sig.
PCV	Between Groups	2.233	4	.558	.272	.889
	Within Groups	20.500	10	2.050		
	Total	22.733	14			
RBC	Between Groups	.103	4	.026	1.179	.377
	Within Groups	.219	10	.022		
	Total	.322	14			

HBC	Between Groups	1.170	4	.293	.432	.783
	Within Groups	6.774	10	.677		
	Total	7.945	14			
WBC	Between Groups	2.551	4	.638	.154	.957
	Within Groups	41.302	10	4.130		
	Total	43.852	14			
HET	Between Groups	129.733	4	32.433	.395	.808
	Within Groups	820.667	10	82.067		
	Total	950.400	14			
LYM	Between Groups	124.267	4	31.067	.343	.843
	Within Groups	904.667	10	90.467		
	Total	1028.933	14			
MON	Between Groups	1.733	4	.433	.406	.800
	Within Groups	10.667	10	1.067		
	Total	12.400	14			
EOS	Between Groups	7.067	4	1.767	1.325	.326
	Within Groups	13.333	10	1.333		
	Total	20.400	14			
BAS	Between Groups	.400	4	.100	.750	.580
	Within Groups	1.333	10	.133		
	Total	1.733	14			
MCHC	Between Groups	49.454	4	12.363	1.184	.375
	Within Groups	104.393	10	10.439		
	Total	153.847	14			
MCV	Between Groups	166.064	4	41.516	.664	.631

	Within Groups	625.126	10	62.513		
	Total	791.190	14			
MCHPG	Between Groups	48.688	4	12.172	.745	.583
	Within Groups	163.274	10	16.327		
	Total	211.962	14			

Appendix 9:ANOVA Table on effects of neem leaf extracts on growth performance of broiler finishers

		Sum of Squares	df	Mean Square	F	Sig.
IBW	Between Groups	.005	4	.001	1.783	.209
	Within Groups	.008	10	.001		
	Total	.013	14			
FBW	Between Groups	.484	4	.121	4.356	.027
	Within Groups	.278	10	.028		
	Total	.761	14			
BWG	Between Groups	.559	4	.140	4.883	.019
	Within Groups	.286	10	.029		
	Total	.845	14			
DWG	Between Groups	.000	4	.000	2.167	.147
	Within Groups	.000	10	.000		

	Total	.000	14			
TFI	Between Groups	.054	4	.014	.352	.837
	Within Groups	.385	10	.039		
	Total	.440	14			
DFI	Between Groups	.000	4	.000	1.167	.382
	Within Groups	.000	10	.000		
	Total	.000	14			
FCR	Between Groups	.635	4	.159	4.256	.029
	Within Groups	.373	10	.037		
	Total	1.008	14			
FER	Between Groups	.007	4	.002	4.981	.018
	Within Groups	.004	10	.000		
	Total	.011	14			
TWI	Between Groups	6.686	4	1.671	1.597	.249
	Within Groups	10.463	10	1.046		
	Total	17.149	14			
DWI	Between Groups	.002	4	.001	1.978	.174
	Within Groups	.003	10	.000		
	Total	.005	14			
PER	Between Groups	.263	4	.066	2.839	.082
	Within Groups	.232	10	.023		
	Total	.495	14			
CDF	Between Groups	.933	4	.233	1.167	.382
	Within Groups	2.000	10	.200		
	Total	2.933	14			
CTF	Between Groups	542.267	4	135.567	.352	.837
	Within Groups	3854.667	10	385.467		
	Total	4396.933	14			

CFG	Between Groups	6349.733	4	1587.433	4.256	.029
	Within Groups	3730.000	10	373.000		
	Total	10079.733	14			

Appendix 10:ANOVA Table on effects of neem leaf extracts on apparent nutrient retention of broiler finishers

		Sum of Squares	df	Mean Square	F	Sig.
DM	Between Groups	5.424	4	1.356	.	.
	Within Groups	.000	10	.000		
	Total	5.424	14			
CF	Between Groups	86.481	4	21.620	.	.
	Within Groups	.000	10	.000		
	Total	86.481	14			
EE	Between Groups	1.911	4	.478	.	.
	Within Groups	.000	10	.000		
	Total	1.911	14			
CP	Between Groups	29.128	4	7.282	.	.
	Within Groups	.000	10	.000		
	Total	29.128	14			
NFE	Between Groups	129.715	4	32.429	.	.
	Within Groups	.000	10	.000		
	Total	129.715	14			
CPI	Between Groups	.913	4	.228	1.000	.452
	Within Groups	2.282	10	.228		

	Total	3.194	14			
FO	Between Groups	10.308	4	2.577	14.504	.000
	Within Groups	1.777	10	.178		
	Total	12.085	14			
CPR	Between Groups	442.067	4	110.517	11.609	.001
	Within Groups	95.199	10	9.520		
	Total	537.267	14			
EEO	Between Groups	.833	4	.208	52.554	.000
	Within Groups	.040	10	.004		
	Total	.872	14			
EER	Between Groups	37.341	4	9.335	31.591	.000
	Within Groups	2.955	10	.296		
	Total	40.296	14			

Appendix 11:ANOVA Table on effects of neem leaf extracts on serum biochemistry indices of broiler finishers

		Sum of Squares	df	Mean Square	F	Sig.
PRO	Between Groups	.849	4	.212	.915	.492
	Within Groups	2.320	10	.232		
	Total	3.169	14			
ALB	Between Groups	.297	4	.074	.878	.511
	Within Groups	.847	10	.085		
	Total	1.144	14			
GLO	Between Groups	1.076	4	.269	.923	.488
	Within Groups	2.913	10	.291		
	Total	3.989	14			
GLU	Between Groups	1331.733	4	332.933	.460	.764
	Within Groups	7234.667	10	723.467		
	Total	8566.400	14			
CRE	Between Groups	2935.538	4	733.885	1.000	.452
	Within Groups	7338.829	10	733.883		
	Total	10274.367	14			
CHO	Between Groups	291.733	4	72.933	.364	.829
	Within Groups	2002.667	10	200.267		
	Total	2294.400	14			
CAL	Between Groups	2.544	4	.636	1.426	.295
	Within Groups	4.460	10	.446		
	Total	7.004	14			

Appendix 12:ANOVA Table on effects of neem leaf extracts on carcass and relative organ weight of broiler finishers

		Sum of Squares	df	Mean Square	F	Sig.
LWT	Between Groups	.672	4	.168	3361.200	.000
	Within Groups	.000	5	.000		
	Total	.672	9			
EWT	Between Groups	28.920	4	7.230	144601.200	.000

	Within Groups	.000	5	.000		
	Total	28.920	9			
HED	Between Groups	.823	4	.206	1469.393	.000
	Within Groups	.001	5	.000		
	Total	.824	9			
GZD	Between Groups	1.430	4	.358	2383.567	.000
	Within Groups	.001	5	.000		
	Total	1.431	9			
EGZD	Between Groups	.192	4	.048	959.200	.000
	Within Groups	.000	5	.000		
	Total	.192	9			
SHK	Between Groups	1.537	4	.384	7687.200	.000
	Within Groups	.000	5	.000		
	Total	1.538	9			
HRT	Between Groups	.015	4	.004	19.132	.003
	Within Groups	.001	5	.000		
	Total	.015	9			
LVR	Between Groups	.875	4	.219	1989.227	.000
	Within Groups	.001	5	.000		
	Total	.876	9			
KDY	Between Groups	.061	4	.015	89.412	.000
	Within Groups	.001	5	.000		
	Total	.062	9			
ABFT	Between Groups	6.638	4	1.659	1550.874	.000
	Within Groups	.005	5	.001		

	Total	6.643	9			
LNG	Between Groups	.067	4	.017	208.625	.000
	Within Groups	.000	5	.000		
	Total	.067	9			
INT	Between Groups	1.614	4	.403	1301.403	.000
	Within Groups	.002	5	.000		
	Total	1.615	9			