THE RESPONSE OF BROILER CHICKENS TO DIETARY INCLUSION OF *ALTERNANTHERA SESSILIS* LEAF MEAL (ASLM)

BY

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DECLARATION

I hereby certify that this research was carried out by me and that this thesis is entirely my own account of the research. The work has not been submitted to any other University for a degree. However, works of other researchers and authors which served as sources of information were duly acknowledged.

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DEDICATION

I dedicate this work to my children, Albert Nii Teiko Tagoe and Emmanuella Naa Ameley Tagoe.

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Blessed be the name of God almighty the creator of heaven and earth, the giver of life and the only one who knows the future. I thank God for how far he has brought me. It is not because I have planned well or put in my maximum effort but it is the grace and favour of God most high.

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ABSTRACT

Two phases of experiment were conducted with the aim of assessing the possibility of using dried *Alternanthera sessilis* leaf meal (ASLM) in broiler starter and finisher diets. Five diets were prepared with ASLM inclusion levels of 0% (T0), 5% (T1), 7.5% (T2), 10% (T3) and 12.5% (T4) and 225 Cobb commercial broiler birds were used in each experiment. The ASLM substituted varying levels of soya bean meal and wheat bran. Complete Randomised Design was used for the study. In Phase One, as the inclusion level of ASLM increased signs of ill–health and mortalities increased even though there were no significant ($P>0.05$) differences among treatment means. In Phase Two, however there were no signs of ill–health or mortalities. In Phase One, there was no significant ($P>0.05$) difference between T0 and T4 with respect to feed intake. Significant ($P<0.05$) differences were also observed between T1, T2 and T3, and T4. The control (T0) had the highest gain and T4 had the lowest gain. No significant ($P>0.05$) difference was seen between T0 and T1 but there were significant ($P<0.05$) difference between T0 and, T2, T3 and T4. In addition, there were significant ($P<0.05$) differences between T1, T2, T3, and T4. In Phase Two, dietary treatments did not exert any significant ($P>0.05$) effect on the daily feed intake of the birds. With respect to weight gain, no significant ($P>0.05$) differences were observed between treatment means of T0, T1 T2 and T3. There was also no significant ($P>0.05$) differences T3 and T4. But significant ($P<0.05$) differences were observed between treatment means of T0, T1 and T2, and T4. Dietary treatments did exert significant ($P<0.05$) differences on some of the carcass parameters measured. In Phase One, significant ($P<0.05$) differences were observed in the Hb levels of birds between T1 and T3. The WBC profile indicated that there were significant ($P<0.05$) differences in values obtained from T0 birds and those fed the ASLM containing diet. Treatment diet effected significant ($P<0.05$) differences in the low-density lipoprotein and albumen during initial and final blood biochemical analysis. In Phase Two, significant ($P<0.05$) differences were shown between the RBC, MCV, MCH, high density lipoprotein as well as their globulin before treatment birds were given ASLM. However after taking ASLM there were no significant ($P>0.05$) differences. A farmer will spend more without adding ASLM in broilers starter diet but it will not affect profit. The study revealed that at 5% inclusion level of the ASLM in broiler finisher diet, a profit of GH¢ 0.26 more can be made per kg of broiler carcass. It can be concluded that up to 5% *Alternanthera sessilis* leaf meal can be included in broiler starter or finisher diet without any deleterious effect on growth performance.

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LIST OF ABBREVIATION

NCFR	Non-conventional feed resource
AIBPs	Agro-industrial by products
NRC	National Research Council
CP	Crude protein
SPLM	Sweet Potato Leaf Meal
CLM	Cassava leaf meal
MPLM	*Microdesmis puberula* leaf meal
CRD	Completely randomized design
ACLM	*Amaranthus cruentus* leaf meal
AWG	Average weight gain
GLM	*Gliricidia* leaf meal

NR	Nitrogen Retention
AND	Apparent Nitrogen Digestibility
CALM	Chaya (*Cnidoscolus aconitifolius*) leaf meal
IALM	*Ipomoea asarifolia* leaf meal
NLM	Neem Leaf Meal
AFBW	Average Final Body Weight
ADG	Average Daily Gain
ADFI	Average Daily Feed Intake
FCR	Feed Conversion Ratio
MOLM	*Moringa oleifera* leaf meal
LDL	Low-density lipoproteins
HDL	High-density lipoproteins
g/dl	Gram per decilitre,
HCT	Haematocrit,
Hb	Haemoglobin
MCH	Mean cell haemoglobin
MCHC	Mean cell haemoglobin concentration
MCV	Mean cell volume
RBC	Red blood cells
WBC	White blood cells
l	Litre
fl	Femtoliter
pg	Picogram

CHAPTER ONE

1.0 INTRODUCTION

The science of nutrition involves providing a balance of nutrients that best meets the need of an animal for optimal growth, and ensuring effective metabolic activities. For economic reasons, the supply of nutrients should be at least cost therefore only enough must be supplied to meet requirement without any major excess (Ranjhan, 2001). Poultry are fed diets consisting of grains, both animal and plant protein sources (soybean meal, fish meal, groundnut cake, blood meal, etc.), mineral, vitamins and fats.

Non-conventional feed resources (NCFR) are those that have not been traditionally used in feeding and/or are not normally used in commercially produced rations for animals (Devendra, 1992). According to Ngou and Mafeni (1983), high feed cost and some animal's competition with humans for feed items suggest strongly that alternative energy and protein sources such as crop residues should be used partially or wholly to replace maize in livestock diet to reduce cost of meat production and to make available more of the primary products for human consumption. Most poultry nutrition experiments simply deal with the substitution of one ingredient by another; however, a well balanced diet is always the prime aim. There is the need therefore to look for locally available and cheap sources of feed ingredients particularly those that do not attract competition in consumption between humans and livestock. One possible cheap source of protein is the leaf meal of some tropical legumes and browse plants. According to D'Mello *et al*. (1987) and Opara (1996), leaf meals do not only serve as protein source but also provide some necessary vitamins. One plant that needs detailed study and possible exploitation is *Alternanthera sessilis*.

Alternanthera sessilis grows in the tropical regions of the world, especially tropical America, Africa and Asia (Chandrika *et al*., (2006); Grubben and Denton, (2004). It is known as a noxious weed, which grows in ditches, swamps, gardens, rice fields, tea plantations and by roadsides. Its leaves and young shoots are eaten as a vegetable particularly in tropical Africa or cooked in soup (Jansen, 2004). In Ghana, it is used mainly as a medicinal plant and feeding livestock (pigs and rabbits) by some farmers.

Despite the availability and abundance of *Alternanthera sessilis*, there is little or no information available on the use of this plant as a feed resource and response of animals to the plant.

1.1 OBJECTIVES

The main objective of the study was to use *Alternanthera sessilis* as dietary feed resource for broiler chickens and to assess the response of broiler chickens to ASLM.

The objectives of the study were to:

- Measure the performance of broiler chickens fed diets containing varying levels of ASLM (0, 5%, 7.5%, 10%, and 12.5%) during the starter period (2-4weeks).
- Assess the performance of finisher broiler chickens (5-8weeks) fed diets containing varying levels of ASLM (0, 5%, 7.5%, 10%, and 12.5%).
- Determine the carcass, blood haematological and biochemical indices of broiler chickens fed diet containing varying levels of ASLM.
- Assess the economics using *Alternanthera sessilis* leaf meal (ASLM) in broiler diets.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Poultry Meat Production

Poultry is the term that is used to refer to birds raised for profit. Examples are fowls (*Gallus gallus*), duck (*Anas platyrhynchos*), guinea fowl (*Numida meleagris*), goose (*Anser anser*), ostrich (*Struthio camelus*_spp), and Turkey (*Meleagris gallopavo*). The white-feathered chickens bred specifically for meat production are called broilers**,** fryers or roasters, depending on the size they will be raised to. The modern poultry industry emerged in the late nineteenth century in Europe and America as breeders focused on improving meat and egg production (FAO, 2010). According to FAO 2010, Production and consumption of poultry products increased significantly during World War II when beef and pork were in limited supply. Chicken meat is an excellent source of protein and can be produced on most small and backyard farms. FAO 2009, reported that poultry meat accounts for 30% of global meat consumption. Poultry meat and eggs are highly nutritious being rich source of proteins, phosphorus and other minerals, and of B-complex vitamins. Poultry meat contains less fat than most cuts of beef and pork. Poultry liver is especially rich in vitamin A. It has a higher proportion of unsaturated fatty acids than saturated fatty acids. This fatty acid ratio suggests that poultry may be a more healthful alternative to red meat (FAO, 2010).

2.1.1 Factors Affecting Poultry Meat Production

The poultry industry is faced with a number of challenges which tends affect the production of poultry meat. The challenges include capital, disease outbreak eg. Avian influenza, skilled labour, marketing, importation of poultry products, access to flexible loans and high feed cost due competition with human.

2.1.2 Addressing the Problem of High Feed Cost

Rising feed cost and competition in consumption between human and animals for food items strongly suggest that alternative energy sources should be used partially or wholly to replace maize in livestock diet to reduce cost of meat production and to make available the major cereals for human consumption (Ngou and Mafeni, 1983). In developing countries, labour is cheap and climatic conditions require simple and inexpensive housing for poultry but feed cost is the most important component accounting for 55 to 75% (Ensminger *et al*., 1990) and 70-85% (Opara, 1996) of total production cost of poultry. The bulk of the feed cost arises from protein concentrates such as groundnut cake, fishmeal and soybean meal. Prices of these conventional protein sources have soared so high in recent times that it is becoming uneconomical to use them in poultry feeds (Opara, 1996; Esonu *et al*., 2001).

According to Moghazy and Elwatak (1982), most experiments on poultry nutrition simply deal with the substitution of one ingredient by another but making sure of maintaining a well balanced diet. This situation warrants the evaluation of agricultural by-products (non-conventional feeds) and incorporation of suitable ones in poultry feeds (Moghazy and Elwatak, 1982). This is one of the solutions to increase the supply of animal protein. Broiler production should be supported with efficient techniques of incorporating locally available agricultural by-products. The use of agricultural by-products in poultry nutrition represents valuable means of the indirect production of food from waste (El Boushy and Vanderpoel, 2000).

There is the need therefore to look for locally available and cheap sources of feed ingredients particularly those that do not attract competition in consumption between humans and livestock. One possible source of cheap protein is the leaf meal of some tropical legumes and browse plants. According to D'Mello *et al*. (1987) and Opara (1996), leaf meals do not only serve as protein source but also provide some necessary vitamins.

2.2 Some Leaf Meals That Have Been Used in Poultry Feeding Trials

2.2.1 Sweet Potato Leaf Meal (SPLM)

With inclusion levels of 5, 10, 15 and 20%, Tsega and Tamir (2009) assessed the effect of increasing levels of dried leaves of sweet potato (*Ipomoea batatas*) on dry matter intake and body weight gain of broiler-finisher chickens. They concluded that the optimum inclusion level should be 10%. Teguia *et al*. (1993) have used up to 20% of SPLM to replace maize in broiler diets. They observed, however, that the leaves of sweet potato have some adverse effects on weight gain and feed consumption. This is due to the fact that SPLM is deficient in an essential amino acid, lysine, necessitating the inclusion of feed ingredients with adequate lysine contents in poultry diets (Fuller and Chambellain 1982; Teguia and Beynen 2005).

Mmereole (2009) conducted an experiment to test the effects of SPLM as a supplement in broiler diet with or without enzyme (Roxazyme 20%). The study was part of an ongoing effort to reduce feed costs in broiler production and make more animal products available and affordable to the growing world population, especially in those countries where there is serious deficiency gaps between the quantities of animal protein required and the quantity consumed. The results obtained from the study revealed that the birds fed with diets containing Roxazyme 20% treated SPLM proved superior in all parameters evaluated. Based on these observations the study recommended that farmers should be encouraged to include 20% SPLM with enzyme in their feed formulation for improved broiler production.

2.2.2 Cassava leaf meal (CLM)

Cassava leaf meal (CLM) is nutritionally rich in nutrients and could be fed to livestock to supply protein, energy, minerals and vitamins (Okai *et al*., 1984). It contains most of the essential amino acids such as valine (1.06%), threonine (0.7%), arginine (1.22%), histidine

(0.49%), lysine (1.13%), methionine (0.07%), etc. Ravindran *et al*. (1986) evaluated cassava leaf meal (CLM) as a replacement for coconut oil meal (COM) in tropical broiler diets and concluded that broilers can tolerate a level of 15% CLM without adversely affecting their growth. The use of high level of CLM in broiler diets is limited by its bulkiness, low energy content, methionine deficiency, and the presence of antinutritional factors (Ravindran *et al*., 1986). The inclusion of 100 g/kg of a cassava product (50:50 of cassava root and leaf meal) in the broiler diet had no effect on growth, feed conversion, and carcass characteristics (Eruvbetine *et al*., 2003).

Iheukwumere *et al*. (2007) carried out a 25-day feeding trial with 120 five-week old Anak broilers to evaluate growth, blood chemistry and carcass yield of broilers fed CLM at dietary levels of 0, 5, 10, or 15%. Results of the trial indicated that, feed intake, body weight gain, feed conversion ratio of the control (0% leaf meal) were superior ($p<0.05$) to the groups on 10 and 15% leaf meal diets. The total serum protein, albumen and haemoglobin at 0 and 5% leaf meal were levels superior to the values at higher levels, however, cholesterol, creatinine and urea showed no significant ($p>0.05$) differences between the treatment groups. The cut parts of the carcass showed superior values ($p<0.05$) in the control treatment and they differed significantly ($p<0.05$) from broilers fed on 5, 10 and 15% leaf meal in carcass yield. In conclusion, it was suggested that 5% of cassava leaf meal could be used in broiler finisher diet without any deleterious effect on growth, blood chemistry and carcass yield.

2.2.3 *Microdesmis puberula* leaf meal (MPLM)

Esonu *et al*. (2002), conducted a 35-day feeding trial involving 180, 5-week old Hubbard broilers to evaluate the performance, nutrient utilization and organ characteristics of broilers fed MPLM at dietary levels of 0, 10 and 15%. Feed intake, body weight gain, feed conversion ratio and organ weight of birds on the control (0%) and 10% leaf meals diets

were significantly (P<0.05) superior to those from the group on 15% leaf meal diet. The utilization of dry matter (DM), crude protein, ether extract and ash was significantly poorer at the 15% dietary level. It was suggested that 10% MPLM could be used in broiler finisher diets without any deleterious effects on the birds. It was also suggested that further treatment is necessary to improve the nutritive value of MPLM for monogastric animals in view of its relative cheapness and abundance (Esonu *et al*., 2002).

Esonu *et al*. (2004) conducted a fifty-day feeding trial to evaluate the MPLM as feed ingredient in laying hen diets. Seven experimental layer diets were formulated incorporating the MPLM at 0.0, 2.5, 5.0, 7.5, 10.0, 12.5 and 15.0% dietary levels. One hundred and five (105), Shikka brown layers already 10 months in lay were divided into 7 groups of 15 birds each and randomly assigned to the 7 treatment diets in a completely randomized design (CRD). There were no significant (p>0.05) differences in body weight, Haugh unit, shell thickness, yolk index and albumen among the treatments. The results of this study suggest that 15% MPLM could be used in layers diets without any deleterious effects on performance.

Esonu *et al*. (2004) conducted a thirty-five day feeding trial to evaluate the performance of broiler finishers fed MPLM supplemented with `Safzyme$^{R}$` (a cellulolytic enzyme). Three broiler finisher diets were formulated to contain 0.0, 12.5% MPLM without enzyme and 12.5% MPLM with 0.10% enzyme. One hundred and twenty (120) four-week-old Hubbard broiler chicks were divided into three groups of forty (40) birds each and randomly assigned to the three treatment diets in a completely randomized design (CRD). Data were collected on feed intake, body weight gain and feed conversion ratio. There was significant (p<0.05) difference in feed intake between birds on 0.0% leaf meal diet and birds on 12.5% leaf meal diet. Daily body weight gain of the birds on the leaf meal with enzyme diet did not significantly (p>0.05) differ from birds on leaf meal diets without

enzyme supplementation. Birds on 0.0% leaf meal diet recorded the highest daily body weight gain. Feed conversion ratios of all treatment groups were comparable. The result suggests that 0.10% enzyme supplementation in diets containing 12.5% MPLM did not improve the performance of broiler finishers.

2.2.4 *Amaranthus cruentus* leaf meal (ACLM)

According Fasuyi *et al.* (2007), the sun-dried leaves of ACLM has the following proximate profile: Crude protein: 23.0±0.55; crude fat: 5.4±0.01; crude fibre: 8.8%±0.02; ash: 19.3%±0.01; gross energy, 3.3±0.01 kcal g^{-1}; and metabolisable energy: 2.8±0.21 kcal g^{-1} all on dry matter basis. Methionine and to a lesser extent, lysine, arginine, leucine and aspartate were high. Fasuyi *et al.* (2007) evaluated protein supplementary quality of ACLM in broiler starter diets. The ACLM was incorporated into six formulated broiler starter diets at varying inclusion levels of 0, 5, 10, 15, 20 and 25% respectively. The control diet 1 had no ACLM inclusion. All the six diets including control (diet 1) were isocaloric and isonitrogenous and were fed to the experimental chicks (n = 540). Birds fed diet 2 (5% ACLM) had the best average weight gain (AWG) of 372.9±29.94 g $chick^{-1}$ but this was statistically similar to values obtained for birds on Diets 1, 3 and 4. The Nitrogen Retention (NR) and Apparent Nitrogen Digestibility (AND) values obtained for Diet 2 were the highest (1.48±0.24g N $chick^{-1}$ day^{-1} and 63.12%±10.28, respectively). Except for dressed weight, all the organs weights taken were similar ($p>0.05$). Haematological results were similar ($p>0.05$). The results generally indicated that ACLM could be a useful dietary protein source for broiler starter chicks at the 5% inclusion level.

2.2.5 *Gliricidia* leaf meal (GLM)

Odunsi *et al*. (2002) studied the effect of feeding *Gliricidia sepium* leaf meal on the performance and egg quality of layers. Seventy-two laying hens were allotted to four dietary treatments containing 0, 5, 10 or 15% GLM. The inclusion of the GLM in the layer

diets significantly ($p<0.05$) reduced feed consumption. Layers fed 0 and 5% GLM had similar ($p>0.05$) hen-day egg production, body weight changes and feed conversion ratio but this worsened significantly ($p<0.05$) at 10 and 15% GLM levels. Egg quality values showed no significant ($p>0.05$) differences in terms of egg weight, haugh units and shell thickness while yolk index increased ($p<0.05$) with GLM and was found to be best at 10 and 15% GLM. Yolk colour was positively enhanced at all levels of GLM inclusion. Proportionally, egg membrane values were lower ($p<0.05$) on GLM diets compared to the control while the egg yolk, albumen and shell were not affected. Results of the study indicated that at dietary levels greater than 5%, GLM depressed feed intake and egg production.

2.2.6 *Chromolaena odorata* Leaf meal (COLM)

The response of broiler chickens to dietary inclusion of *Chromolaena odorata* was studied by Donkoh *et al*. (2002). This study determined the nutrient composition of the leaf meal of the tropical plant *Chromolaena odorata*, and its value as a feed ingredient and colouring agent in broiler chickens diets. *Chromolaena odorata* leaf meal (COLM) contained (on dry matter basis) crude protein 218.0g , crude fibre 141.0g , and metabolisable energy 5.42 MJ, tannic acid equivalent 143g. Two hundred and forty, 2-week-old broiler chickens were used in a complete randomised design to evaluate the effect of diets containing varying amounts of COLM (0, 25, 50 and 75g/kg) on growth performance and some physiological parameters. The diets were fed *ad libitum* for 6 weeks. The COLM addition had an adverse effect on the performance of broiler chickens by reducing feed intake (r=-0.97), body weight gain (r=-0.99), feed conversion ratio (r=0.96), water consumption (r=-0.74) and carcass yield (r=-0.98). Mortality rates were, however, unaffected by dietary treatments. Body colour intensity increased with increasing levels of COLM. At dietary levels of 0, 25, 50 and 75 g , the skin, beak and

shank colour scores on the Roche colour fan were 0, 4.6, 6.8 and 7.9, respectively, Haematological and blood biochemical indices and spleen, liver, heart, gizzard and intestinal weights were unaffected by the level of inclusion of COLM.

Ekenyem *et al.* (2010) evaluated the effect of *Chromolaena odorata* leaf meal (COLM) on the growth performance of broiler finisher chickens. The chickens were grouped into four dietary treatments namely 0, 2.5, 5 and 7.5% COLM; the treatments were replicated thrice. Feed and water were supplied *ad libitum*. In addition, medication, vaccination, scrupulous sanitation, regular disinfection of the pens and other standard management practices were adopted. Initial weights of the birds, that is 633.00, 636.67, 630.00 and 585.67 g for treatments 0, 2.5, 5 and 7.5% COLM respectively did not vary significantly ($p>0.05$). However, significant differences ($p<0.05$) occurred between the final weights of 2120,00, 2096.67, 2003.33 and 1506.67 g for treatments 0, 2.5, 5.0 and 7.5% COLM respectively. Daily weight gain, daily feed intake and feed conversion ratio, showed similar trends for birds on the 0, 2.5 and 5.0% COLM diets but differed significantly ($p<0.05$) from the values for birds on 7.5% COLM diets. The results confirmed that COLM could substitute soya bean meal, as feed ingredient for broiler chicks up to 7.5% but 5.0% is optimal.

2.2.7 Chaya (*Cnidoscolus aconitifolius*) leaf meal (CALM)

Donkoh *et al.* (1998) evaluated Chaya (*Cnidoscolus aconitifolius*) leaf meal (CALM) as poultry feed ingredient in a series of two pilot studies. In experiment I, diets containing 0, 25, 50 and 75 g CALM kg^{-1} were fed, *ad libitum,* to 480 day-old broiler chicks for a period of 8 weeks. Birds had free access to water. The concentration of CALM in the diet had no effect on feed consumption. Overall, significant correlations were found between the concentrations of CALM in the diet and weight gain ($r = -0.98$) and feed: gain ratio ($r = 0.99$). The level of CALM in the diet was shown to be strongly correlated with the

carcass dressing percentage ($r = -0.97$). Mortality rates of birds fed CALM -containing diets were markedly lower than for those fed the Chaya-free diet. Increased concentrations of red blood cells, haemoglobin, haematocrit and decreased total serum cholesterol as well as increased liver and heart weights were observed in birds fed the diets containing high amounts of CALM. It can be concluded that CALM could be included in chicks' diet at concentrations up to 25g kg^{-1} without any adverse effect on performance. In experiment II, 240 broiler chicks were fed diets containing either 0 or 25g CALM kg^{-1} and with or without 100 g oil palm slurry (OPS) kg^{-1} from day-old to 8 weeks of age. The diets were formulated to be isonitrogenous but not isocaloric. The OPS-containing diets were higher in energy content. Birds fed the OPS diet and the CALM and OPS diet gained the highest ($p<0.01$) weight. Carcass dressing percentage followed the same trend. Furthermore, mortality rates of birds fed the CALM -free diets were markedly higher than those fed the CALM -containing diets.

2.2.8 *Ipomoea asarifolia* leaf meal (IALM)

Ekenyem and Madubuike (2006) assessed *Ipomoea asarifolia* leaf meal (IALM) as feed ingredient in broiler chick production. Two hundred and forty one week old Anak broiler chicks were involved in a 49-day feeding trial in a completely randomized design to assess the effects of 0%, 5%, 10% and 15% inclusion levels of IALM on the performance, organ and carcass characteristics of broiler chicks. The birds were fed the experimental broiler diets for 28 days while they were fed the finisher diets for the remaining 21 days. The initial weight, final weight, weight gain, feed intake, feed conversion ratio and feed cost per broiler were evaluated. The results showed that the final live weight of birds on the control (0% IALM) diet i.e. 2.200kg and the 5% IALM i.e. 2.050kg diet were significantly ($P< 0.05$) superior to the values for birds on the 10% IALM (1.775kg) and 15% IALM (1.600kg). Feed conversion ratio for the control (0% IALM) was significantly superior

(P< 0.05) to those for the 10% and 15% IALM inclusions, while 0% and 5% levels were statistically similar (P>0.05). Daily feed intake at the 0%, 5% and 10% levels were significantly higher (P< 0.05) than at the 15% level of IALM inclusion. Dressed weights for 0% and 5% levels were similar (P>0.05) but superior (P< 0.05) to 10% and 15% levels. Ekenyem and Madubuike (2006) concluded that from the results of the experiment, the optimum inclusion level of IALM in broiler diets is between 5% and 10% and recommended that a further research was necessary to improve the nutritive value of *Ipomoea asarifolia* leaves for livestock because of its abundance and cheapness for improved meat production.

The haematology and serum biochemistry characteristics of broiler chicks fed varying dietary levels of IALM was studied by Ekenyem and Madubuike (2006b). A 49-day feeding trial involving 240 one-week old Anak broiler chicks was carried out by Ekenyem and Madubuike (2006b) to study the haematology and serum biochemistry of broilers fed varying dietary inclusion levels of *Ipomoea asarifolia* leaf meal. The birds were grouped into four dietary treatments namely: 0%, 5%, 10% and 15% levels of IALM, which were further replicated 4 times in a completely randomized design. At 8th week of age, 16 birds were randomly selected (4 per treatment), bled 9.00am – 10.00am from punctured vein to aspirate 7mls of blood from each bird for haematology and serum assay. Results of the haematology parameters showed significant (P<0.05) differences between treatments, indicating that IALM influenced the values of the parameters. However, packed cell volume (PCV) and Eosinophil did not significantly (P>0.05) differ between their treatments. Ekenyem and Madubuike (2006) concluded that the IALM influenced the serum chemistry of Anak broilers as their values reduced with increasing levels of IALM.

2.2.9 Neem Leaf Meal (NLM)

Opara *et al.* (2006) conducted a 12-week feeding trial to evaluate the effects of Neem *(Azadirachta indica)* leaf meal (NLM) on body weight gain, carcass and organ characteristics and haematological values of laying hens. The leaves were harvested, chopped to facilitate drying in the sun until they became crispy but still greenish in coloration. The sun-dried leaves were milled using a hammer mill to produce the leaf meal. Four layer diets were formulated to contain the NLM at 0%, 5%, 10% and 15% dietary levels respectively and were used to feed 120 Shikka Brown layers already 10 months in lay. The birds were divided into 4 groups of 30 each and randomly assigned to the four treatment diets in a completely randomized design (CRD). The NLM inclusion did not cause any appreciable difference in weight gain between the birds at 0% and those at 5%, 10% dietary levels. Carcass weight, dressed weight, liver, heart and gizzard weights were significantly ($P<0.05$) increased at the 5% dietary level of NLM. There were no significant difference in Hb and PCV between birds on 0% and 5% treatment diets. However, these differed significantly ($P<0.05$) from those of birds on the 10% and 15% treatment diets. There were variations in the differential WBC count; marked lymphocytopenia adversely affected the total leucocyte counts in the birds on 5%, 10% and 15% treatment diets. The results of the study suggest that old laying birds could tolerate 5% to 15% dietary levels of NLM without deleterious effects.

The performance and economic indices of broilers fed varying dietary levels of sun dried NLM were investigated by Onyimonyi *et al.* (2009) using ninety 'Ross' unsexed two weeks old broilers. The birds were randomly assigned to five treatment groups of eighteen birds each in which NLM was incorporated at 0, 0.5, 1.0, 1.5 and 2% for treatments 1, 2, 3, 4 and 5 respectively. Each treatment was further replicated twice with nine birds per replicate in a CRD. Results showed that treatment effects on Average Final Body Weight

(AFBW), Average Daily Gain (ADG), Average Daily Feed Intake [ADFI] and Feed Conversion Ratio (FCR) were significant (P<0.05). Birds on the 0.5% NLM had significantly (P<0.05) superior AFBW, ADG and FCR. The ADFI of birds on the 0.5% NLM was statistically the same with the control birds but differed from the NLM remaining treatments. Gross margin analysis revealed that a profit of N707.30 was made per bird on the 0.5% NLM as against N630.97, N620.73, N621.81 and N507.06 for birds on the control, 1.0, 1.5 and 2.0% NLM respectively. It was concluded that inclusion of 0.5% NLM in the diets of broilers would support optimum performance and economic benefit.

2.2.10 *Moringa oleifera* leaf meal (MOLM)

Olugbemi *et al.* (2010) investigated the potential of MOLM as a hypocholesterolemic agent using layers fed cassava-based diets over a 90-day period. Eighty layers were assigned to four dietary treatments containing MOLM at 0, 5, and 10% (treatments 2, 3 and 4) levels with cassava chip constituting 20% of each diet and a control diet (treatment 1) containing neither cassava nor Moringa. A completely randomized design was employed. The effect of the dietary treatments on serum and yolk cholesterol was determined. Serum cholesterol levels in treatments 2, 3 and 4 declined by 14.2%, 19.8% and 22.0 %, respectively, while yolk cholesterol levels declined by 6.55%, 7.45% and 12.1%, respectively. Results of the study indicated that *Moringa oleifera* possesses hypocholesterolemic properties and its inclusion in layers diets could facilitate reductions in egg cholesterol content.

Olugbemi *et al.* (2010) evaluated the suitability of including MOLM as a feed ingredient in cassava (CC)-based broiler diets. Seven isonitrogenous and isocaloric diets represented as treatments 1 (maize meal based-control), 2, 3, 4 (20% CC and 0, 5, 10% MOLM) and 5, 6, 7 (30% CC and 0, 5, 10% MOLM) were fed to 378 broiler chicks for 49 days in a

completely randomized design. Parameters measured were initial weight, weight gains, final weight and feed consumed. Feed conversion ratio and feed cost per kilogram weight gain were also calculated. Haematological parameters were obtained after the 49-days trial. A reduction in performance was observed with increasing inclusion level of MOLM beyond 5%. Birds on treatment 3 (20% CC, 5% MOLM) did not differ significantly ($p>0.05$) in terms of weight gain (2263.62 to 2428.26g), feed conversion ratio (2.57 to 2.81), final body weight at 8 weeks (2342.09 to 2501.24g) and feed cost per kg weight gain (979.38 to 1075.78g) from those on the control, 20 and 30% diets (treatments 1, 2, 5). The highest feed consumption (6390.7g) was recorded among birds on treatment 3 but did not significantly ($p>0.05$) differ from those on treatments 1, 2, 6 and 7 (6002.7 to 6346.9g). They concluded that broilers could be fed safely on cassava-based diets containing MOLM at a maximum level of 5% without deleterious effects.

2.3 *Alternanthera sessilis* (L.) DC (sessile joy weed)

2.3.1 Description

Alternanthera sessilis (Plate 1) grows in the tropical regions of the world, especially tropical America, Africa and Asia (Chandrika *et al*., (2006); Grubben and Denton, (2004). It is known as a noxious weed, which grows in ditches, swamps, gardens, rice fields, tea plantations and by roadsides. Its leaves and young shoots are eaten as a vegetable particularly in tropical Africa or cooked in soup (Jansen, 2004). A decoction is recommended as herbal remedy for treating wounds, flatulence, nausea, vomiting, cough, bronchitis, diarrhoea, dysentery and diabetes and its root can relieve inflamed wounds (Hosamani *et al.*, 2004). *Alternanthera sessilis* is a perennial herb, which grows annually up to 1 meter tall, erect, ascending or creeping, often widely branched, with robust taproot.

Plate 1: Pictures of *Alternanthera sessilis*

2.3.2 Properties

Alternanthera sessilis contains β-carotene (Chandrika *et al*., 2006), ricinoleic acid, myristic, palmitic, stearic, oleic, and linoleic acids (Mehrotra and Ojha, 2006), α-spirasterol, uronic acid and β-sitosterol (Acharya and Pokhrel 2006). According to Jansen (2004), in a test in India, leaf pastes of *Alternanthera sessilis* exhibited inhibition of mutagenicity in *Salmonella typhimurium* strains. They inhibited the formation of the potent environmental carcinogen nitroso-diethanolamine from its precursors such as triethanolamine. The aqueous alcohol extracts of the entire plant exhibits hypothermic and histaminergic activities and relaxes smooth muscles. An ether extract of *Alternanthera sessilis* yielded an active principle having anti-ulcerative properties. The fresh leaves of *Alternanthera sessilis* contain per 100 g: water 80g, energy 251kJ (60 kcal), protein 4.7g, fat 0.8g, carbohydrate 11.8g, fibre 2.1g, Ca 146mg and P 45mg (Jansen, 2004).

2.3.3 Toxicities

Gayathri *et al.* (2006) reported that oral administration of the water extract of *Alternanthera sessilis* (aerial parts; leaves, stems, flowers) in Swiss mice in daily doses of 16.9 mg, 33.8 mg and 67.7 mg for 14 consecutive days did not result in severe symptoms

of toxicity except for diarrhoea in one animal that received the highest dose. In the high dose groups, the water extract of *Alternanthera sessilis* causes histopathological changes in the liver and kidney tissues. There was moderate to severe hepatocyte degeneration in the centrilobular area associated with sinusoidal congestion and focal hepatocellular necrosis, and moderate degeneration of renal tubular cells and necrosis. *Alternanthera sessilis* showed a significant level of cytotoxicity in brine shrimp lethality bioassay (Igoli *et al.*, 2005). Raghavender Roa *et al.* (2011) studies on the phytochemical constituents of *Alternanthera sessilis* revealed that it contains saponins.

2.4 Anti-nutritional factors

Anti-nutritional factors are natural or synthetic substances found in human or animal food that have the potential to adversely affect health and growth by preventing the absorption of nutrients from food. According to Barnes and Amega (1984), anti-nutritional factors may occur as natural constituents of plant and in animal feeds, as artificial factors added during processing or as contaminants of the ecosystem. Consumption of food containing such substances induces, in some cases, chronic intoxication and in others, interferes with the digestion and utilization of dietary protein and carbohydrate as well as interfering with the availability of some minerals. Thus, feed efficiency and growth rate are affected. Although anti-nutritional factors are present in many conventional feeds, they are more common in most of the non-conventional feeds.

Akinmutimi (2004) had observed that most processing methods employed in improving the food value of non-conventional or alternative feedstuffs do not eliminate anti-nutritional factor substances completely. It only reduces their concentrations to tolerable levels in feedstuffs. It is a common practice in feeding trials to use the weights of some internal organs like liver and kidney as indicators of toxicity (Akinmutimi, 2004).

Nityanand (1997) classified the various anti-nutritional factors (ANFs) in feedstuffs according to their chemical nature and their activity in animals as:

- Chemical nature: In this category are acids, enzymes, nitrogenous compounds, saponins, tannins, glucosinolates and phenolic compounds.
- Factors interfering with the digestion and utilization of dietary proteins and carbohydrates. Examples are tannins, trypsin or protease inhibitors, saponins, and haemagglutinins.
- Factors interfering with the availability of minerals. Examples are phytates or phytic acid, oxalates or oxalic acid, glucosinolates and gossypol.

2.4.1 Tannins

Tannins are an astringent, bitter plant polyphenolic compounds that bind to and precipitate proteins and various other organic compounds including amino acids and alkaloids. The tannin compounds are widely distributed in many species of plants, where they play a role in protection from predation, perhaps as pesticides, and in plant growth regulation. Tannins, which are complex polymeric phenols having molecular weight greater than 500dalton, are natural constituents of many plants, and are usually grouped into two forms; hydrolysable tannins and condensed tannins (Nityanand, 1997). Hydrolysable tannins are potentially toxic and cause poisoning if large amounts of tannin-containing plant material such as leaves of oak (*Quercus spp*.) and yellow wood (*Terminalia oblongata)* are consumed (Garg *et al*., 1982).

The tannins form complexes with protein, cellulose, hemicelluloses, lignin and starch and interfere with their optimum utilization in the digestive tract and systems. Protein sources of plant origin containing high amounts of tannins and in particular hydrolysable tannins should be used with caution (Becker and Makker, 1999). Ranjhan (1999) reported that soaking and washing removes substantial amounts of tannins and this is usually

accompanied by some loss of dry matter. Tannins have been found to affect digestibility and therefore rate of utilization of dietary nutrients in both ruminants (Kumar and Singh, 1984) and non-ruminants (Hale and McCormick, 1981; Okai *et al*., 1984).

2.4.2 Saponins

Saponins are a class of chemical compounds, one of many secondary metabolites found in natural sources. Saponins are particularly found abundantly in various plant species. According to Nityanand, (1997) saponins are bitter in taste and hence reduce palatability; they are also haemolytic, alter the permeability of cell membranes, and produce toxic effects on organized tissues when ingested. *Lucerne*, white and red clovers, mahua seed cake and soya bean are rich sources of saponins. Soaking and washing in water is quite effective in removing a greater proportion of saponins. Saponins have been reported to cause depressions in feed intake (Cheeke, 1976). According to Rajhan (2001), ruminants can breakdown saponins but monogastrics cannot.

2.4.3 Phytates

Phytates (and phytic acid) are antioxidant compounds found in whole grains, legumes, nuts and seeds. The chief concern about phytates is that they can bind to certain dietary minerals including iron, zinc, and manganese, and to a lesser extent calcium, and slow their absorption. All feeds of plant origin contain phytates (salts of phytic acid). The phytates are present in association with protein and generally, high in protein feeds e.g. groundnut cake, soya bean cake and sesame cake. Phytic acid possesses high chelating ability and in plants, it is found as phytates of many minerals that are mostly not available to monogastrics as they lack the enzyme phytase. The use of the enzyme phytase can make minerals such as phosphorus available to monogastrics (Nityanand, 1997).

2.4.4 Anti-vitamins

An anti-vitamin is simply "a substance (thiaminase, avidin, aminopterin, etc) that makes a vitamin ineffective." A vitamin antagonist is essentially the same thing as an anti-vitamin. It is a substance that lessens or negates the chemical action of a vitamin in the body. According to Nityanand (1997) anti-vitamin activities against vitamins A and D have been observed in soya bean, against vitamin E in kidney bean (*Phaseolus vulgaris),* against vitamin K in sweet clover and against pyridoxine in linseed cake.

2.5 Inferences from literature review

- Poultry are fed diets comprised primarily of grains, both animal and plant protein sources e.g. soybean meal, fish meal, groundnut cake, blood meal, etc., mineral, vitamins and fats and oils.
- Agricultural and industrial by products such as brewer's spent grains, wheat bran, bakery waste, etc are sometimes used because of their cost effectiveness.
- Feed cost and animal competition with humans for feed items suggest strongly that alternative energy sources such as residues of crop harvested should be used partially or wholly to replace maize in livestock diet to reduce cost of meat production and to make available the major crop for human consumption (Ngou and Mafuni, 1983).
- Most experiments on poultry nutrition simply deal with the substitution of one ingredient by another but making sure of maintaining a well balanced diet, which provide no answer to the question how chickens should be fed where cereals, high quality oil seed cakes, vitamin and mineral premixes are scarce.
- One possible source of cheap protein is the leaf meal of some tropical legumes and browse plants. According to D'Mello *et al.* (1987) and Opara (1996), leaf meals do not only serve as protein source but also provide some necessary vitamins.
- One plant that needs exploitation is *Alternanthera sessilis*.

CHAPTER THREE

3.0. MATERIALS AND METHODS

3.1 Location and Duration of Experiment

The study was conducted at the Poultry Section of the Department of Animal Science Kwame Nkrumah University of Science and Technology (KNUST), Kumasi. The study site is located within the semi-deciduous humid forest zone of Ghana characterized by bimodal rainfall pattern with annual rainfall of 1300mm. Daily temperatures range from 20^{o}C to 35^{o}C with an average of 26^{o}C. The relative humidity varies from 97 percent during the morning of the wet season to as low as 20 percent during the late afternoon in the dry season (Meteorological report, Unpublished). Two phased experiment was carried out and the first phase lasted for three weeks (27th May 2011 to 17th June 2011) while the second for four weeks (13th September 2011 to 11th October 2011).

3.2 Preparation of *Alternanthera Sessilis* Leaf Meal (ASLM)

Alternanthera sessilis was harvested along the banks of water bodies in areas like KNUST Campus, Oforikrom New Site, Ahinsan Estate and Atonsu all in Kumasi, Ghana. The water bodies are Wiwi, Aboabo and Susa. The whole *Alternanthera sessilis* was sun–dried between 3 and 4 days. The leaves and soft stems were separated from the stem by shaking and crumbling between the palms. The leaves were milled with a plate mill to a particle size less than 5mm and stored in polythene bags for later use.

Plate 2: Pictures showing cutting, drying and crumbing of *Alternanthera sessilis* plant

3.3 Experimental Diets

The experimental diets were made up of maize, fishmeal, soya bean meal, wheat bran, iodated salt, oyster shell, dicalcium phosphate, premix (vitamins and trace minerals), lysine and methionine, and different levels of dried *Alternanthera sessilis* leaf meal (ASLM). The different diets were T0 (0% ASLM), T1 (5% ASLM), T2 (7.5% ASLM), T3 (10% ASLM), and T4 (12.5% ASLM). The ASLM replaced varying proportions soya bean meal and wheat bran. The detailed physical composition of the diet is shown in Tables 1. The starter diets were used in Phase One and were fed between 2nd week and the 4th week while the finisher diets were used for Phase Two of the Experiment and were fed from the 5th to the end of the 8th week.

3.4 Source of Dietary Ingredients

With the exception of *Alternanthera sessilis,* all the other ingredients used were purchased from the open market in Kumasi.

3.5 Experimental Design and Experimental Birds

Complete Randomised Design (CRD) was used for the study. Two hundred and twenty-five Cobb commercial birds purchased from Akate farms, Kumasi were used in each phase the experiment. They were grouped into five treatments with 45 birds per treatment and three replicates of 15 birds each with average weight of 116g in the Phase One and 928g in the Phase Two. The 5 treatments were T0, T1, T2, T3 and T4 fed diets with varying levels of ASLM (0%, 5%, 7.5%, 10% and 12.5%) respectively. In Phase One, there was a week for acclimatisation and to cater any mortalities that might occur as a result of transportation before the birds were randomly assigned to the treatment diet. In Phase Two, all the birds were feed with control diet until they were 4weeks old. The birds were then weighed, replicated and randomly allotted to treatment diets.

TABLE 1

3.6 Vaccination and Medication

A vaccination programme was planned and followed carefully. The birds were vaccinated against Gumboro and Newcastle disease. The procedure for vaccination was as recommended by the Veterinary Services Department of the Ministry of Food and Agriculture and the dosage was according to the manufacturer's specifications. Prophylactic treatment was carried out to avert any outbreak of diseases. The detailed vaccination and medication programme followed is shown in Table 2.

Table 2: Vaccination and Medication Schedule

Week	Age in Days	Programme
1	1	Glucose C
	2,3,4	Antibiotics
	5,6,7	Plain water
2	8	1st Newcastle – HB1
	9	Plain water
	10,11,12	Coccidiostats
	13,14	Plain water
3	15	Gumboro 228E
	16	Multivitamins/amino acids
	17,18,19	Coccidiostats and vitamins
	20	Multivitamins/amino acids
	21,22,23	Plain water
4	24,25,26	Coccidiostats and Antibiotics
	27,28	Multivitamins/amino acids
5	29	2nd Newcastle – lasota
	30,31,32,33	Coccidiostats and vitamins
	34,35,36	Plain water
6	37,38,39	Coccidiostats and Antibiotics
	40,41,42,43	Plain water
7	44,45,46	Coccidiostats, Antibiotics and vitamins
	47,48,49	vitamins
8	50 , 51,52,53,54,55,56	Plain water

Source: Veterinary Service Department of the Ministry of Food and Agriculture, Kumasi

3.7 Housing and Management

The birds were housed in 15 deep litter pens. Wood shavings were spread on the floor to serve as litter for the birds. To ensure a clean bedding material at all times, the wood shavings were changed at fortnightly interval. Each bird had an average floor space of 1.3sq ft. Lighting was by electricity and the birds had light throughout the night after the brooding period.

3.8 Facilities and Equipment Used

Facilities and equipment used are those that are available at the Department of Animal Science. From the open market, a digital electronic weighing scale was bought for weighing purposes.

3.9 Feeding and Watering

The birds were given a weighed quantity of feed every morning but had *ad libitum* access to both feed and water.

3.10 Parameters Measured

The parameters measured were feed consumption (feed intake), live weight changes, feed conversion ratio, mortality, carcass characteristics, economics of production and haematology and serum or blood biochemical profile of the birds. Visual observation was made of the colour changes of the shank, beak and skin.

3.10.1 Feed Consumption

Average daily feed consumed per bird was calculated. This was done every morning by subtracting feed left in the feeding trough from what was given the previous day and then dividing it by the number of birds in the replicate.

3.10.2 Live Weight Changes

The birds were weighed at the start of the experiment and weekly thereafter. The birds in a pen were weighed together with a digital weighing scale and the previous weight was subtracted from the current weight and then divided by the number of birds in the replicate to determine the average weight gain per bird for the week. The initial weight was also subtracted from the final weight to determine the final weight gain.

3.10.3 Feed Conversion Ratio

Feed conversion ratio was computed as feed consumed/weight gain. That is feed conversion was calculated by dividing the feed consumed by the live weight gain.

3.10.4 Carcass Parameters

Carcass evaluation was done was done at the end of the Phase two of the experiment. Two birds (one female and one male) from each replicate of a treatment were randomly selected for carcass evaluation. The birds were starved overnight to empty the crop and were put in slaughtering trough and the head cut. The following measurements were taken for the carcass analysis: live, bled, defeathered, shank, head, neck, heart, liver, lungs, empty gizzard, and empty intestine weights. All these were calculated as a percentage of the live weight of the bird. Dressing percentage was also calculated as follows:

$$\text{Dressing (\%)} = \frac{\text{Eviscerated carcass weight} \times 100}{\text{Live weight}}$$

3.10.5 Mortality

Mortality was recorded as it occurred throughout the experimental periods. Dead birds were sent for post-mortem examination at the Veterinary Services Department of the Ministry of Food and Agriculture, Kumasi.

3.10.6 Economics of Production

Economics of production were determined based on the feed cost per kg diet and feed cost per kg live weight gain. Feed costs per kg for each of the experimental diets were calculated based on the prevailing prices of the ingredients at the time of the experiment. Even though ASLM was harvested free, the price quoted (Table 4) was meant to cover labour (2hours man day) and milling costs. Feed cost per kg live weight gain was calculated for individual dietary treatments as a product of the feed cost and the feed

conversion ratio. The profit margin was calculated by subtracting the cost of producing a kg carcass from the cost of carcass per kg. Table 5 below shows the feed ingredients used and their prices per kg.

Table 3: Prices of Feed Ingredients Used Per Kg

Item	Price per kg (GH¢)
Maize	0.85
ASLM	0.40
Fish meal	2.38
Soya bean – Experiment 1	1.30
Soya bean – Experiment 2	1.34
Wheat bran – Experiment 1	0.30
Wheat bran – Experiment 2	0.32
Dicalcium phosphate	2
Oyster shell	0.14
Premix	3.2
Lysine	6
Methionine	13
Salt	1

3.10.7 Collection of Blood sample and Analysis

The blood samples were collected in the 2nd and a day after the experiment was terminated for Phase One. In Phase Two it was on the day of the start of the experiment and 8th week. The blood samples were collected from each bird from the wing vein using a sterilized disposable syringe and needle. Three birds were randomly selected from each replicate for bleeding. Prior to bleeding, a cotton swab soaked in 70% ethanol was used to dilate the vein and to prevent infection. About 2.0 ml blood was collected into labelled sterile universal bottles containing Ethylene-Diamine-Tetra-Acetic acid (EDTA) as anticoagulant. All blood samples taken were analysed using Sysmex KX–21N haematology auto analyser and Flexor Junior serum biochemical auto analyser.

3.11 Chemical Analysis

Alternanthera sessilis was analysed using Proximate Analysis method by the standard procedures of the Association of Official Analytical Chemists (1990) and was carried out

at the Nutrition Laboratory of the Department of Animal Science, KNUST-Kumasi. The metabolisable energy value of *Alternanthera sessilis* was calculated from the chemical composition using the equation of Pauzenga (1985); i.e. ME= (37 x %Crude Protein) + (81.8 x %E.E) + (35 x %N.F.E.) Kcal/kg. The mineral status was determined at the analytical laboratory of the Department of Crop and Soil Science, Faculty of Agriculture, KNUST-Kumasi using Split Photometer and Atomic Absorption Pectrometer methods. The calculated nutrient composition of the diets was done using chemical composition values obtained from NRC (1998).

3.12 Statistical Analysis

The data collected were computed and subjected to analysis of variance (ANOVA) using GenStat statistical software release 7.22 DE for windows (GenStat, 2009) and differences between means were separated using the Least Significance Difference (LSD) procedure at significance level of 5%.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Chemical Composition of ASLM

The nutrient composition of the ASLM is presented in Table 4.

Table 4: Proximate Composition of the ASLM (Dry matter basis)

Item	Quantity
Dry matter	89.50%
Crude protein	29.94%
Ether extract	6.15%
Crude fibre	15.55%
Ash	17.32%
Nitrogen Free Extract	31.04%
***** Metabolisable energy (ME)	2697.25 Kcal/kg
Phosphorus	0.29%
Potassium	5.28%
Sodium	1.57%
Calcium	4.80%
Magnesium	1.73%
Zinc	0.10mg/kg
Copper	7.60mg/kg
Iron	1.90mg/kg
Manganese	0.20mg/kg

***** Equation of Pauzenga (1985)

When the ASLM was used to replace varying amount of soya bean meal and wheat bran, it did not cause disparity in the protein (Table 1) content because the diets were designed to be isonitrogenous. The ME differed from each other but the difference was not much and was within the requirement range (NRC, 1994). ASLM could partly replace both energy and protein based ingredients in poultry diet. The nutritional value of ASLM can be compared to Cassava leaf meal (Okai *et al*., 1984: Iheukwumere *et al*., 2007), *Microdesmis puberula* leaf meal (Esonu *et al*., 2002) and *Amaranthus cruentus* leaf meal (Fasuyi *et al.*, 2007).

4.2 Morbidity and Mortalities

The general health condition and mortalities that occurred during the experiment are shown in Table 5.

Table 5: Effect of ASLM on Mortality and Morbidity of birds–Phase One

Parameter	Treatments						
	T0	T1	T2	T3	T4	L. S. D.	SL
Sick	0^{a}	1.67^{a}	2.00^{a}	3.33^{ab}	7.67^{b}	4.381	*
Dead	0^{a}	0^{a}	0.33^{a}	0.67^{a}	1^{a}	1.0500	NS

- a,b: Means in the same row followed by different superscripts are significantly (P< 0.05) different
- L.S.D: Least Significant Difference

On sick situation during the Phase One, there was significant (P<0.05) differences between T0 and T4 as well as significant (P<0.05) differences among T1, T2 and T4. However, no significant (P>0.05) differences existed between the values for treatments T0, T1, T2 and T3. Also no significant (P>0.05) existed between T3 and T4. The number of birds showing signs of ill–health was more in T4 than the other treatments. As the inclusion level of ASLM increased signs of ill–health also increased, so as mortalities, even though there were no significant (P>0.05) differences among treatment means. A post mortem examination revealed acute toxicity and the ASLM was the suspect. The rate of intoxication was severe in birds taking higher inclusion level. This could be why birds showing ill health increased as inclusion level of ASLM increased. From the post mortem results, there were changes in the liver and kidney and this can be attributed to the intake of ASLM. The alkaloidal extract of *Alternanthera sessilis* injected intraperitoneally into Swiss mice led to alterations of liver and kidney functions and a high dose of the water extract of *Alternanthera sessilis* causes histopathological changes in the liver and kidney tissue (Igoli *et al.*, 2005).

4.3 Performance of Birds

4.3.1 The Performance of the Birds during the Experiment

The general performance of the birds during the Phases One and Two is shown in Table 6.

TABLE 6

At the end of Phase One daily feed intake per bird ranged from 45.70g to 65.70g and there was no significant ($P>0.05$) difference among T0, T1, T2 and T3. Significant ($P<0.05$) differences existed between T0, and T4. Significant ($P<0.05$) differences were also observed between T1, T2 and T3, and T4. The significantly ($P<0.05$) lower feed intake recorded in T4 can be attributed to the bitterness of the diet. According to Nityanand (1997), saponins are bitter in taste and have been noted for introducing a bitter taste into diets hence reducing palatability. Studies on phytochemical constituents of *Alternanthera sessilis* by Raghavender Roa *et al.* (2011) revealed that it contains saponins and these (saponins) have been reported to cause depressions in feed intake (Cheeke, 1976). At the end of the study, weight gain ranged from 331g to 709g. The weight gain declined as the inclusion level of ASLM increased. The control (T0) had the highest gain and T4 had the lowest gain. No significant ($P>0.05$) difference was seen between T0 and T1 but there were significant ($P<0.05$) difference between T0 and, T2, T3 and T4. In addition, there were significant ($P<0.05$) differences between T1, T2, T3, and T4. The weight gain reflected feed conversion ratio. The better the feed conversion ratio the more weight gain as seen in Table 6. Teguia *et al*. (1993) fed a 20% sweet potato leaf meal diet to broilers and it had adverse effects on weight gain. The result of this study shows that 12.5% ASLM inclusion in broiler starter diet could influence negatively on weight gain.

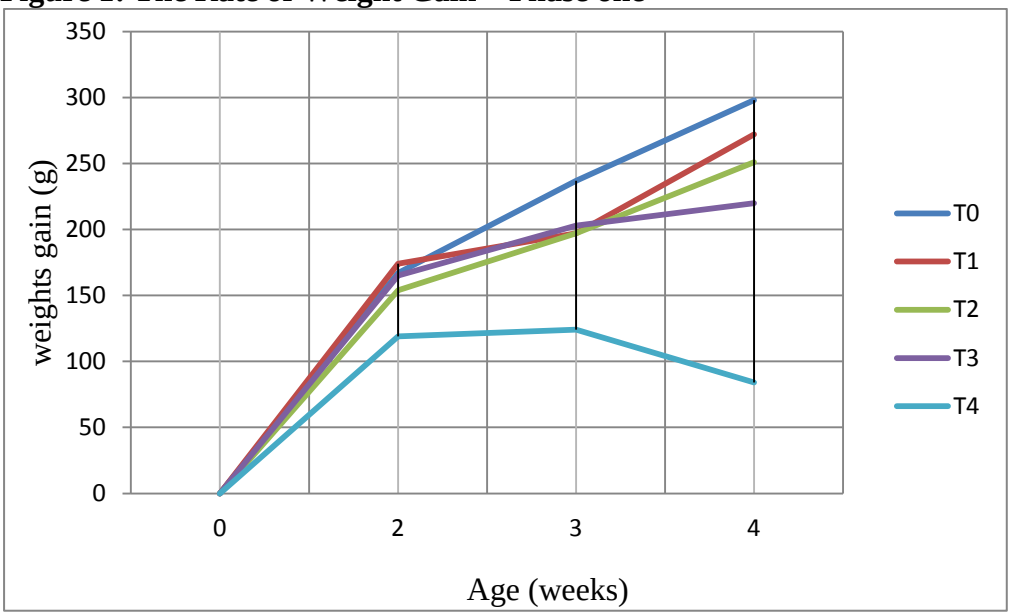
At the end of Phase Two different dietary treatments did not exert any significant ($P>0.05$) effect on the daily feed intake of the birds. The non-significant effect of the dietary treatments on feed intake of the birds during Phase Two may suggest that the birds accepted whatever was offered them. This could be an indication that finisher broilers tolerated the ASLM better than starter broiler. In Phase One, there were significant ($P<0.05$) differences in daily feed intake but in Phase Two there was no significant ($P>0.05$) difference. This could perhaps be attributed to differences in age of the birds. In

Phase One the birds were a week old and in Phase Two they were 4 weeks old. With respect to weight gain, no significant (P>0.05) differences were observed between treatment means of T0, T1 T2 and T3. There was also no significant (P>0.05) differences T3 and T4. But significant (P<0.05) differences were observed between treatment means of T0, T1 and T2, and T4. T1 had a weight gain of 1746g (the highest) with T4 gaining 1485g (the lowest). The weight gain of birds in T0, T1 and T2 did not reflect the feed conversion ratio even though there were no significant (P>0.05) differences. T0 had best feed conversion ratio but it was T1 that had more weight gain while T3 and T4, which had the poorest feed conversion ratio, had the lowest weight gain. Even though diets intakes were not significant (P>0.05), this did not reflect in the weight gain of some of the birds fed the ASLM. This may be due to the presence of anti–nutritional factors associated with ASLM. The more the inclusion levels of ASLM, the poorer the feed conversion ratio. Consumption of feeds containing anti-nutritional substances induces, in some cases, chronic intoxication and in others interferes with the digestion and utilization of dietary protein and carbohydrate. Thus, affecting feed efficiency and growth rate (Barnes and Amega, 1984). Studies on phytochemical constituents of *Alternanthera sessilis* by Raghavender Roa *et al.* (2011) revealed that it contains saponins and the saponins might have interfered with the digestion and utilization of dietary protein and carbohydrate(Barnes and Amega, 1984).

4.3.2 The rate of weight gain during the Experiment

The rate of weight gain during the Phase One is shown in Figure 1.

Figure 1: The Rate of Weight Gain – Phase one



As shown in figure 1, the birds in T4 were growing at a decreasing rate after week 3, giving an indication that the treatment diet had a negative impact on the birds (T4). Though the rates of weight gain of T1 and T2 were not declining, it was not as good as T0, which was seen to be showing, signs of good gains. Thus, higher inclusion levels of ASLM adversely affected the weight gain of birds (Teguia *et al.*, 1993) while lower inclusion did have any adverse effect. Fasuyi *et al.* (2007) indicated that *Amaranthus cruentus* leaf meal could be a useful dietary protein source for broiler starter chicks at 5% inclusion level.

Figure 2: The Rate of Weight Gain–Phase Two

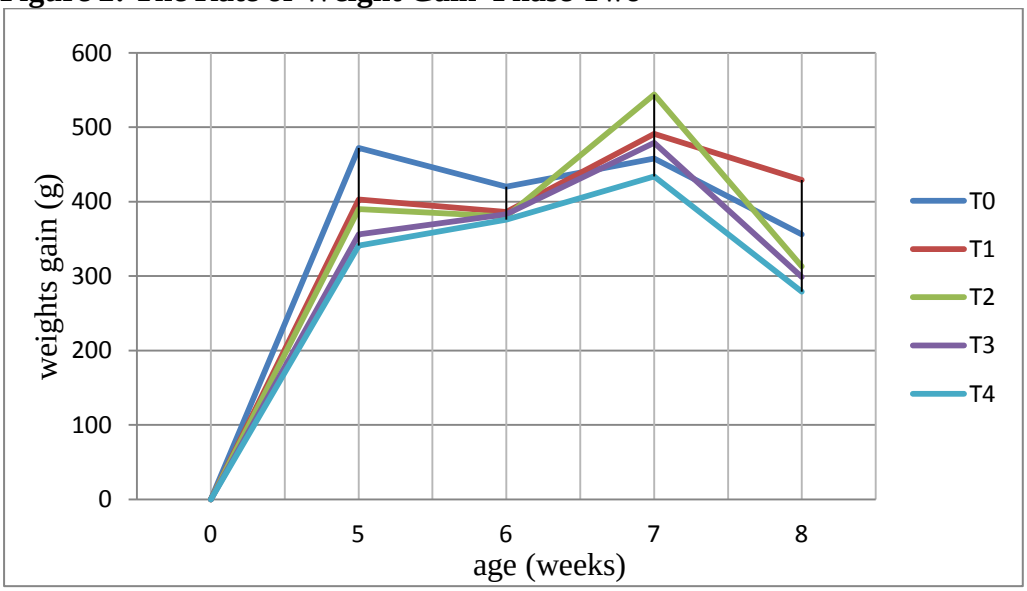


Figure 2 shows that after 7 weeks of feeding, all the birds were growing at a decreasing rate. If this study had been terminated at the 7th week, T2 birds would have been the highest weight gainers for the week. Nevertheless, on the 8th week, it can be seen that T2 birds were the 3rd highest weight gainer. At the end of the 8th week, it can be seen (Figure 2) that T1 were the highest weight gainers followed by T0 and T4 had the lowest gain.

4.4 Carcass characteristics

4.4.1 Carcass Characteristics of Birds during Phase Two

Table 7 shows the general effect of ASLM on Carcass characteristics of birds**.**

Table 7: Effect of varying levels of ASLM on Carcass characteristics of broiler chicken–Phase Two

Parameter	Treatments					L.S.D	
	T0	T1	T2	T3	T4		SL
Live weight (g)	2483^{ab}	2757^{a}	2695^{a}	2517^{ab}	2283^{b}	382.3000	*
Bled weight (g)	2393^{ab}	2663^{a}	2627^{a}	2370^{ab}	2180^{b}	422.5000	*
Defeathered weight (g)	2218^{ab}	2520^{a}	2427^{a}	2202^{ab}	2047^{b}	375.5000	*
Carcass weight (g)	1619^{a}	1880^{ab}	1789^{ab}	1634^{a}	1430^{ac}	348.1000	*
head weight (g)	51.30^{a}	61.30^{ab}	43.70^{ac}	51.00^{a}	52.00^{a}	16.6500	*
Neck weight (g)	128.30	129.70	123.00	120.30	122.70	26.0000	NS
Shank weight (g)	75.00^{a}	100.70^{b}	85.00^{ab}	85.70^{ab}	88.30^{ab}	25.3300	*
Gizzard weight (g)	45.70	51.70	49.30	46.70	46.00	13.5700	NS
Proventriculus weight (g)	9.67^{a}	9.33^{a}	11.33^{ab}	8.67^{ac}	9.67^{a}	2.2530	*
Heart weight (g)	11.33	10.33	12.00	10.33	11.67	2.0480	NS
Liver weight (g)	50.30	46.30	46.00	42.00	46.70	12.7900	NS
Lungs weight (g)	16.33	14.67	15.67	14.33	15.33	5.2520	NS
Intestine weight (g)	142.30	138.70	168.00	146.00	154.30	48.0600	NS
Dressed %	65.20a	68.10^{ab}	66.31^{a}	64.83^{a}	62.34^{ac}	4.8910^{a}	*

- a-c: Means in the same row followed by different superscripts are significantly (P< 0.05) different
- L.S.D: Least Significant Difference

From Table 7, it can be seen that the dietary treatments did exert significant (P<0.05) differences on some of the parameters measured. The significant (P<0.05) difference in the live weights was as a results of random selection. The ASLM fed birds (T1–T4) have heavier shanks than T0 and these birds may be able to support body weight than T0. However it can be seen some of the ASLM fed birds have higher dressed percentage than T0. Generally, it can be stated that the varying levels of the ASLM studied did not effect much changes in the carcass characteristics.

4.5 Haematological and serum biochemical components

4.5.1 Haematological Profile of Birds

The general effect of varying levels of ASLM on haematological profile of birds during the experiment is presented in Table 8.

Table 8: Effect of varying levels of ASLM on haematological profile of birds

Age		Hb (g/dl)	HCT %	RBC ($X10^{12}$/l)	WBC ($X10^{9}$/l)	MCV (fl)	MCH (pg)	MCHC (%)
	T0	8.73^{a}	29.03	2.09^{a}	255.70^{a}	140.7	41.87	29.7
	T1	9.26^{ab}	30.56	2.20^{a}	272.60^{b}	135.5	40.91	30.03
2weeks	T2	9.20^{a}	30.29	2.23^{a}	270.6^{bc}	137.4	41.54	30.4
Initial	T3	8.42^{ac}	27.94	2.01^{b}	261.7^{ac}	140.2	42.09	29.78
	T4	8.60^{a}	28.51	2.17^{ab}	265.1^{abc}	140.1	41.42	30.33
	LSD	0.8170	2.9830	0.2023	10.7900	7.3600	3.4580	1.3460
	SL	*	NS	*	*	NS	NS	NS
	T0	11.34	37.59	2.6	257.1	140.33	41.89	29.70
	T1	11.21	37.18	2.68	257.9	139.90	41.69	30.09
4weeks	T2	10.86	36.26	2.62	256.4	140.32	41.97	29.92
Final	T3	11.08	36.49	2.62	257.8	140.42	43.02	30.67
	T4	10.68	35.56	2.52	254.6	140.34	42.23	30.04
	LSD	1.0400	2.7740	0.2534	9.8000	4.5270	1.5330	1.2730
	SL	NS	NS	NS	NS	NS	NS	NS
	T0	10.94	36.08	2.69^{a}	267.8	134.33^{a}	40.72^{a}	30.21a
	T1	10.63	35	2.49^{ab}	261.6	139.11^{b}	41.7^{ac}	30.00ab
5weeks	T2	10.94	36.39	2.5^{ab}	262.8	145.78^{c}	43.73^{bc}	29.95ab
Initial	T3	10.43	35.36	2.41^{b}	260.7	145.44^{c}	42.77^{c}	29.39bc
	T4	10.26	34.67	2.41^{b}	258.6	145.22^{c}	42.47^{c}	29.47bc
	LSD	0.9640	3.0970	0.2273	10.3700	4.0610	1.6200	0.6851
	SL	NS	NS	*	NS	*	*	*
	T0	11.11	34.52	2.61	279.33	131	42.1	31.96^{a}
	T1	10.90	33.91	2.61	275.67	132.22	42.62	32.12^{ab}
8weeks	T2	11.12	34.13	2.57	275.44	131.67	43.06	32.59^{bc}
Final	T3	11.28	34.21	2.58	278.78	132	43.66	32.97^{c}
	T4	11.19	34.41	2.6	278.78	131.11	42.66	32.5^{bc}
	LSD	0.5228	1.4960	0.0768	5.4580	5.7630	1.9860	0.5329
	SL	NS	NS	NS	NS	NS	NS	*

HCT-Haematocrit, Hb-Haemablobin, MCH-Mean cell haemoglobin, MCHC-Mean cell haemoglobin concentration, MCV-Mean cell volume, RBC-Red blood cells, WBC-White blood cells, %-percentage, g/dl-gram per decilitre, l-litre, fl-femtoliter, pg-picogram
a-c: Means in the same row followed by different superscripts are significantly (P< 0.05) different
L.S.D: Least Significant Difference; SL: Significant level; NS: Non significant

During the Phase One as shown in Table 8 2weeks, significant (P<0.05) differences existed in Hb of birds T1 and T3. Nevertheless, this cannot be attributed to ASLM

containing diets because T1 had higher Hb than T0 and T4 also had higher Hb than T3. In all, the Hb of the birds was within the normal range. The initial WBC profiles (Table 8) indicated that there were significant ($P<0.05$) differences between T0 and birds fed the ASLM containing diets. Even though the WBC profile of the birds were within the normal range, all the birds fed ASLM had higher WBC count (2weeks). When Opara *et al.* (2006) fed neem *(Azadirachta indica)* leaf meal to laying hens, there were variations in the WBC count of birds fed NLM containing diets. High WBC count is usually associated with microbial infection or the presence of a foreign body or antigen in the circulating system. Among birds fed the ASLM containing diet, there was significant ($P<0.05$) difference between T1 and T3. It can be deduced from 4weeks of Table 8 that when the birds were fed with the ASLM, the WBC counts reduced and were almost at the same level as T0 birds. There were no significant ($P>0.05$) differences in the haematological profile of birds after been fed ASLM.

During Phase Two of the experiment, significant ($P<0.05$) difference were observed between the treatment means of RBC, MCV and MCH before the birds were fed the ASLM (5weeks). Result from the study indicated that the significant ($P<0.05$) differences that existed between treatment birds were no more (8weeks) after the birds had fed the ASLM containing diet. Perhaps, ASLM could be able to correct any defect any in the blood of birds. As shown in 8weeks of Table 10, the ASLM containing diet exerted significant ($P<0.05$) differences on the MCHC treatment means of the birds. The treatment means of birds (T1–T4) on ASLM diet had higher values than T0. This could mean that ASLM will not influence the haematological profile of broilers with the exception of MCHC. However, when Ekenyem and Madubuike (2006) fed broilers with *Ipomoea asarifolia* leaf meal (IALM), results of the haematology parameters showed significant ($P<0.05$) differences between treatments, indicating that IALM influenced the values of the parameters.

4.5.2 Serum Biochemical Profile of Birds

The general serum biochemical profiles of birds during the experiment are presented in Tables 9.

Table 9: Effect of varying levels of ASLM on serum biochemical profile of birds

Age	Treatments	Total cholesterol (mmol/l)	Triglycerides (mmol/l)	High Density Lipoprotein (mmol/l)	Low Density Lipoprotein (mmol/l)	Total Protein(g/l)	Albumen (g/l)	Globulin (g/l)
	T0	1.81	0.42	0.73	0.76^{ab}	18.72	8.62^{ab}	10.08
	T1	1.78	0.38	0.72	0.73^{a}	18.72	8.43^{a}	10.27
2weeks	T2	1.71	0.31	0.77	0.69^{a}	18.67	8.42^{a}	10.24
Initial	T3	1.68	0.37	0.69	0.69^{a}	18.22	8.10^{ac}	10.12
	T4	1.67	0.30	0.72	0.61^{ac}	18.61	8.57^{a}	10.07
	LSD	0.1847	0.2287	0.1861	0.1223	0.5803	0.5194	0.6570
	SL	NS	NS	NS	*	NS	*	NS
	T0	3.28	0.91	1.27	1.07	31.56	16.11^{abc}	15.44
	T1	3.08	0.83	1.38	1.21	31.22	17.22^{ab}	14.11
4weeks	T2	3.32	0.98	1.49	1.27	32.22	17.33^{abd}	14.89
Final	T3	3.21	1.00	1.36	1.03	32.11	17.00^{ab}	15.11
	T4	3.32	0.91	1.49	1.26	32.44	17.44^{abd}	15.00
	LSD	0.2979	0.1934	0.2491	0.4182	1.9300	1.1820	2.3540
	SL	NS	NS	NS	NS	NS	*	NS
	T0	3.19	0.70	1.32^{a}	1.26	32.33	17.33	15.22^{ab}
	T1	3.11	0.70	1.27^{a}	5.41	31.22	17.11	14.11^{c}
5weeks	T2	3.14	1.80	1.27^{a}	1.39	31.78	17.67	14.11^{c}
Initial	T3	3.12	0.90	1.78^{b}	1.31	31.89	17.89	14.00^{a}
	T4	3.12	0.87	1.30^{a}	1.32	31.89	18.00	13.67^{ac}
	LSD	0.1001	1.278	0.1934	5.8200	1.566	1.426	1.4350
	SL	NS	NS	*	NS	NS	NS	*
	T0	2.38	1.21^{abc}	1.11	0.64^{ab}	80.90	19.33	61.60^{a}
	T1	2.49	1.00^{ab}	0.70	0.58^{a}	83.90	19.00	64.9^{ac}
8weeks	T2	2.48	0.96^{abd}	0.99	0.67^{a}	80.60	19.56	62.10^{a}
Final	T3	2.69	0.97^{ab}	0.97	0.82^{c}	91.30	20.67	71.10^{bc}
	T4	2.61	0.96^{abd}	0.94	0.77^{bc}	86.90	22.00	64.90^{ac}
	LSD	0.3447	0.2473	0.4914	0.1352	10.9500	3.6820	8.3500
	SL	NS	*	NS	*	NS	NS	*

mmol/l-millimoles per litre, g/l-grams per litre
- a-b: Means in the same row followed by different superscripts are significantly (P< 0.05) different
- L.S.D: Least Significant Difference; SL: Significant level; NS: Non significant

From 2weeks of Table 9 it can be observed that during the initial serum biochemical studies, significant (P<0.05) differences existed in the treatment means of T0 and T4 of

the low-density lipoprotein and with the albumen it was between T0 and T3. As shown during 4weeks, significant ($P<0.05$) differences existed between the treatment means T0 and T2, T4 of the albumen. There were no significant ($P>0.05$) differences between the values for rest of parameters studied. This could suggest that higher inclusion of the ASLM could influence LDL of broilers. *Alternanthera sessilis* is known to contain some saturated fatty acids. Ekenyem and Madubuike (2006) studied the haematology and serum biochemistry of broilers fed varying dietary inclusion levels of *Ipomoea asarifolia* leaf meal and concluded that *Ipomoea asarifolia* leaf meal can influenced the serum chemistry of Anak broilers.

Before the birds were given the ASLM containing diet, there was significant ($P<0.05$) difference in HDL treatment means as well as the globulin of the birds 5weeks of Table 9. When the birds took ASLM, there were no significant difference ($P>0.05$) in the HDL but there were significant ($P<0.05$) difference in the LDL. When the birds took ASLM, the significant ($P<0.05$) difference in the globulin that existed between T0 and T4 was now between T0, T2 and T3. Before the birds took ASLM, their globulin values were lower than T0. However, after been fed ASLM, their globulin values were more than that of T0. Thus, the ASLM has the potential of raising globulin levels of broilers. Ekenyem and Madubuike (2006) studied the haematology and serum biochemistry of broilers fed varying dietary inclusion levels of *Ipomoea asarifolia* leaf meal and concluded that *Ipomoea asarifolia* leaf meal can influenced the serum chemistry of Anak broilers.

4.6 Economics of production

The aim of every businessperson is to make profit. To every businessperson a pesewa counts. Before any business-minded farmer will accept a new product then he or she must be convinced that some profit will be made if such product is used. The data on general economics of gain or production are presented in Table 10.

Table 10: Effect of ASLM on Economics of Production

Period	Treatments	Feed intake /day/bird (g)	Total intake/ bird (g)	Total weight gain/bird (g)	Feed cost/kg (GH¢)	Feed Cost/weight gain (GH¢)	Cost of carcass/kg (GH¢)	Profit (GH¢)
Phase One	T0	65.70	1379.70	709.00	1.05	1.45	5.67	4.22
	T1	62.30	1308.30	657.00	1.03	1.35	5.26	3.91
	T2	59.70	1253.70	600.00	1.02	1.28	4.80	3.52
	T3	65.00	1365.00	580.00	1.01	1.38	4.64	3.26
	T4	45.70	959.70	331.00	1.01	0.97	2.65	1.68
Phase Two	T0	156.30	4376.40	1701.00	0.95	4.16	13.61	9.45
	T1	162.00	4536.00	1746.00	0.94	4.26	13.97	9.71
	T2	159.00	4452.00	1665.00	0.93	4.14	13.32	9.18
	T3	159.30	4460.40	1612.00	0.92	4.11	12.90	8.79
	T4	158.00	4424.00	1485.00	0.91	4.03	11.88	7.85

Results in Phase One indicate that a farmer will spend more without adding ASLM in broilers starter diet to produce a kg of broiler carcass. However, such a farmer will gain more profit for not using ASLM. Comparing the profit margin of T0, T1, T2, T3 and T4, a farmer will loose between GH¢ 0.31 to GH¢ 2.54 more for using ASLM in broiler starter diet. The rate of loss increased as the inclusion levels of ASLM increased.

It can be ascertained that in Phase Two a farmer will spend more without adding ASLM in broilers finisher diet. However comparing the profit margin of T0 and T1, it can be seen that at 5% (T1) inclusion level of ASLM in finisher diet, a profit of GH¢ 0.26 is made more than not including ASLM in the finisher diet (T0). On the other hand, if the ASLM increase beyond 5%, a farmer will lose some profit (comparing T0 against T2, T3, and T4).

Observation

The colour of the shank, beak and skin changed to yellowish green and the rate of change increased in birds as the inclusion levels of ASLM in their diet increased. The colour change made the birds attractive and appealing to consumers who bought live birds.

CHAPTER FIVE

5.0 Conclusion and Recommendations

5.1 Conclusions

- *Alternanthera sessilis* leaf meal has good nutritional composition making it suitable for animal consumption.
- *Alternanthera sessilis* leaf meal can be included in broiler diet up to 5% without deleterious effect on growth performance.
- *Alternanthera sessilis* leaf meal can influence the haematological and serum biochemical profile of broiler keeping them within normal ranges.
- *Alternanthera sessilis* leaf meal can reduce the cost of production if added to finisher diets of broilers at 5%.

5.2 Recommendations

- *Alternanthera sessilis* leaf meal should be used by farmers at 5% inclusion level.
- *Alternanthera sessilis* leaf meal should be used along some enzymes as was done in the study of *microdesmis puberula* (Esonu *et al*., 2004) and Sweet potato leaf meal (Mmereole, 2009)

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APPENDIX I

ANOVA OF PHASE ONE

ANOVA FOR FEED CONVERSION RATIO

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	1.79580	0.44895	40.89	<.001
Residual	8	0.08784	0.01098		
Total	14	1.90193			

ANOVA FOR INITIAL WEIGHT

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.40	0.10	0.01	1.000
Residual	8	104.40	13.05		
Total	14	112.40			

ANOVA FOR MORTALITIES

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	2.2667	0.5667	1.70	0.226
Residual	8	3.3333	0.3333		
Total	14	5.6000			

ANOVA FOR SICK

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	100.933	25.233	4.35	0.027
Residual	8	58.000	5.800		
Total	14	158.933			

ANOVA FOR WEIGHT GAIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.248612	0.062153	37.62	<.001
Residual	8	0.016520	0.001652		
Total	14	0.265132			

ANOVA FOR INITIAL HAEMATOCRIT

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	15.242	3.811	1.42	0.297
Residual	8	26.889	2.689		
Total	14	42.131			

ANOVA FOR FINAL HAEMATOCRIT

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	7.597	1.899	0.82	0.543
Residual	8	23.255	2.326		
Total	14	30.853			

ANOVA FOR INITIAL MEAN CELL HAEMOGLOBIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	2.441	0.610	0.17	0.949
Residual	8	36.133	3.613		
Total	14	38.574			

ANOVA FOR FINAL MEAN CELL HAEMOGLOBIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	3.2455	0.8114	1.14	0.391
Residual	8	7.1028	0.7103		
Total	14	10.3483			

ANOVA FOR INITIAL MEAN CELL VOLUME

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	59.58	14.90	0.91	0.494
Residual	8	163.56	16.36		
Total	14	223.14			

ANOVA FOR FINAL MEAN CELL VOLUME

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.517	0.129	0.02	0.999
Residual	8	61.909	6.191		
Total	14	62.426			

ANOVA FOR INITIAL WHITE BLOOD CELLS

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	558.36	139.59	3.97	0.035
Residual	8	351.78	35.18		
Total	14	910.14			

ANOVA FOR FINAL WHITE BLOOD CELL

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	22.17	5.54	0.19	0.938
Residual	8	290.39	29.04		
Total	14	312.56			

ANOVA FOR INITIAL ALBUMEN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.49434	0.12359	1.52	0.270
Residual	8	0.81521	0.08152		
Total	14	1.30956			

ANOVA FOR FINAL ALBUMEN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	3.4352	0.8588	2.03	0.165
Residual	8	4.2216	0.4222		
Total	14	7.6568			

ANOVA FOR INITIAL HIGH DENSITY LIPOPROTEIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.00922	0.00231	0.22	0.921
Residual	8	0.10460	0.01046		
Total	14	0.11382			

ANOVA FOR FINAL HIGH DENSITY LIPOPROTEIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.10801	0.02700	1.44	0.291
Residual	8	0.18742	0.01874		
Total	14	0.29542			

ANOVA FOR INITIAL TRIGLYCERIDES

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.03046	0.00762	0.48	0.749
Residual	8	0.15802	0.01580		
Total	14	0.18848			

ANOVA FOR FINAL TRIGLYCERIDES

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.05170	0.01292	1.14	0.391
Residual	8	0.11307	0.01131		
Total	14	0.16477			

ANOVA FOR INITIAL TOTAL PROTEIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.5324	0.1331	1.31	0.331
Residual	8	1.0176	0.1018		
Total	14	1.5500			

ANOVA FOR FINAL TOTAL PROTEIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	3.070	0.768	0.68	0.620
Residual	8	11.256	1.126		
Total	14	14.326			

ANOVA OF EXPERIMENT 2

ANOVA FOR WEIGHT GAIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.178786	0.044696	5.59	0.013
Residual	8	0.079935	0.007993		
Total	14	0.258720			

ANOVA FOR BLED WEIGHT

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.47753	0.11938	2.21	0.140
Residual	8	0.53925	0.05393		
Total	14	1.01678			

ANOVA FOR DEFEATHERED WEIGHT

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.43038	0.10759	2.53	0.107
Residual	8	0.42607	0.04261		
Total	14	0.85644			

ANOVA FOR INTESTINE WEIGHT

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.0016377	0.0004094	0.59	0.680
Residual	8	0.0069780	0.0006978		
Total	14	0.0086157			

ANOVA FOR SHANK WEIGHT

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.0010149	0.0002537	1.31	0.331
Residual	8	0.0019380	0.0001938		
Total	14	0.0029529			

ANOVA LIVER WEIGHT

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.00010493	0.00002623	0.53	0.716
Residual	8	0.00049400	0.00004940		
Total	14	0.00059893			

ANOVA FOR LUNG WEIGHT

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	7.600E-06	1.900E-06	0.23	0.916
Residual	8	8.333E-05	8.333E-06		
Total	14	9.093E-05			

ANOVA FOR INITIAL HAEMABLOBIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	1.1276	0.2819	1.00	0.450
Residual	8	2.8084	0.2808		
Total	14	3.9361			

ANOVA FOR FINAL HAEMAGLOBIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.23463	0.05866	0.71	0.603
Residual	8	0.82570	0.08257		
Total	14	1.06034			

ANOVA FOR INITIAL RED BLOOD CELL

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.15467	0.03867	2.48	0.112
Residual	8	0.15615	0.01561		
Total	14	0.31082			

ANOVA FOR FINAL RED BLOOD CELL

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.004947	0.001237	0.69	0.612
Residual	8	0.017801	0.001780		
Total	14	0.022748			

ANOVA FOR INITIAL GLOBULIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	4.1463	1.0366	1.67	0.233
Residual	8	6.2216	0.6222		
Total	14	10.3679			

ANOVA FOR FINAL GLOBULIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	172.61	43.15	2.05	0.163
Residual	8	210.60	21.06		
Total	14	383.21			

ANOVA FOR INITIAL LOW DENSITY LIPOPROTEIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	40.21	10.05	0.98	0.460
Residual	8	102.35	10.23		
Total	14	142.55			

ANOVA FOR FINAL LOW DENSITY LIPOPROTEIN

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.115456	0.028864	5.23	0.016
Residual	8	0.055201	0.005520		
Total	14	0.170658			

ANOVA FOR INITIAL TOTAL CHOLESTEROL

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.011458	0.002865	0.95	0.476
Residual	8	0.030253	0.003025		
Total	14	0.041711			

ANOVA FOR FINAL TOTAL CHOLESTEROL

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatment	4	0.17846	0.04462	1.24	0.354
Residual	8	0.35896	0.03590		
Total	14	0.53743			

APPENDIX II

Pictures of various activities carried out during the experiment

1. *Alternanthera sessilis*

2. Tagoe ready to cut *Alternanthera sessilis*

3. cutting of *Alternanthera sessilis*

4. Bagging of *Alternanthera sessilis*

5. Crossing Wiwi river at Ahinsan Estate

6. Drying *Alternanthera sessilis*

7. Crumbling of *Alternanthera sessilis* before milling

8. Feed stuffs

9. Milling of maize

10. Milling of maize

11. Measuring ingredients for feed compounding

12. Mixing feed

13. Bagging prepared feed

14. Measured feed for bird.

15. Brooding birds


16. Birds after 1week.


17. Birds after 2weeks


18. Birds after 3weeks


19. Birds at 4weeks


20. Birds at 4weeks


21. Preparing birds for carcass characteristics during experiment 1


22.Dressed birds


23. Mr. Akowuah eviscerating.


24. Birds with internal organs removed


25. Tagoe defeathering


26. Ruth defeathering


27. Tagoe defeathering and Ruth washing


28. Weighing defeathered bird


29. Defeathered birds ready for evisceration


30. Ruth taking records