GROWTH PERFORMANCE AND CARCASS CHARACTERISTIC OF WEANER RABBITS (*Oryctolagus cunniculus*) FED DIETS CONTAINING VARYING LEVELS OF *Stylosanthes hamata* LEAF MEAL

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ABSTRACT

This experiment was conducted to investigate the growth performance and carcass characteristics of weaner rabbits fed varying levels of *Stylosanthes hamata* leaf meal in the diet. The rabbits were randomly allocated into five treatment groups with three replicates comprising of two rabbits in each replicate. The rabbits were initially weighed and there after, subsequent weights were taken at weekly intervals throughout the experimental period which lasted for twelve weeks. Five rations were formulated for the five treatment groups with varying levels of *Stylosanthes hamata* leaf meal. The inclusion levels of *Stylosanthes hamata* leaf meal in the diet were 0, 25, 50, 75 and 100 % for T_1, T_2, T_3, T_4 and T_5 respectively. The formulated diets were also taken for analysis to determine their proximate composition and energy values. Feeding regimes were twice daily, in the morning and in the evening Data were collected on growth parameters, digestibility, anti-nutritional factors, carcass components of rabbits, and organ proportions, organoleptic properties of meat and cost/benefit effect of feeding rabbits with *Stylosanthes hamata* leaf meal. The results showed that *Stylosanthes hamata* leaf meal contained low levels of phenol, tannin, saponin, phytate, and oxalate. Rabbits fed the control diet had significantly ($p<0.05$) reduced performance in terms of feed conversion efficiency, digestibility, final body weights, dressed carcass percentage and carcass cuts. Significant differences ($p<0.05$) were recorded between treatments for colour, juiciness and overall acceptability with T_5 having overall acceptability. The cost of feed per kg and the cost of daily feed intake per rabbit followed the same trend as the cost decreased as the level of *Stylosanthes hamata* leaf meal diets inclusion increased. However, higher and better performance were observed when rabbits fed 50 % inclusion levels of *Stylosanthes hamata* leaf meal with regard to the performance indices mentioned above. It was concluded that *Stylosanthes hamata* leaf meal inclusion at the 40% level improved rabbits performance, and carcass values.

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CHAPTER ONE

1.0 INTRODUCTION

In most developing countries of the world as well as in Nigeria, the consumption of animal protein is very low which is approximated to be about (4.5 g/head/day) as against (35g/head/day) minimum requirement recommended by Food and Agriculture Organization of the United Nation (FAO, 2001). One of the reasons why there is an acute shortage of animal protein in the diets of most Nigerians is as a result of exorbitant cost of conventional feed ingredients as well as inadequate supply of animal protein leading to high cost of meat and animal products such as mutton, beef, poultry eggs and milk. Rabbit (*Oryctolagus cunniculus*) has been recommended to be one of the animal having the best productive advantages to bridge the gap of protein deficiency "Taiwo, A.A., Adejuigbe, A.D., Adebowale, E.A., Oshotan, J.S & David O.O (2005)". Similarly, Iyeghe-Erakpotobor G.T, Abdulmalik M.E, Uguru J.O and Abeke F.O. (2002) "reported that one of the sure way of meeting the animal protein requirements of the populace is by increased rabbit production". Akinmutimi and Ezea (2006) on the other hand stated that 70 % of the total cost of rabbit production goes to conventional feeds thereby making them more expensive to most farmers. The major advantages of rabbits in alleviating inadequacy animal protein in developing economies is hinged on its attributes such as high prolificacy and hence more productive than large ruminants with shorter generation interval and small body size as compared to other farm animals as well as its ability to thrive well on forages. Besides there are no cultural or religious barriers against rabbits meat or keeping rabbits in contrast to pork and beef by Muslims, Jews and Hindus respectively. ((Biobaku and Dosumu, 2003; Odimba, 2006). Egbo (2001) reported that rabbits are excellent converters of feed to meat and utilize as much as 30 % fibre as against 10 % by most species of poultry.

Thus, rabbit daily weight gain is high in proportion to the body weight which gives them a fast growth rate before sexual maturity. As such they attain a high weight at sexual maturity 30 % faster than other animals Ajayi, F.O., Balogun, O.O., Ovuru, S.S and Mgbere (2005). Nutritionally, rabbit meat is low in cholesterol and fat, and high in protein and highly digestible with dressed weight of 82 to 85 % (Cheeke, 1987; Nyako, 2001; Yusuf 2011. The potential of forages as feed for rabbit is of great importance because of the ability of rabbits to effectively digest leaf protein its availability (Bello, 2003) . Rabbits are raised for commercial meat production, as laboratory research animals, show, home and as stock for breeding. The feeding habits of rabbits does not offer much appreciable competition with man because it can subsist on green-based diets, crop by-product and animal by-product (Mohammed, Igwebuike, and Kwari, 2005). In addition to these unique characteristics. Rabbit (*Oryctolagus cunniculus*) is a non-ruminant herbivores which utilizes much undigested, unabsorbed feed materials, primarily cellulose, as a source of nutrients for maintenance and production. They are known to have the ability to thrive on non-conventional feedstuffs and forages which cannot be consumed directly by man. Such forages are cheap, abundant and available all the year round in many parts of Nigeria (Odeyinka and Ijiyemi, 1997; Shiawoya and Musa, 2006).

Therefore, the relationship between animal production output and feed ingredients and is both direct and obvious. It has been reported that energy feed ingredients and conventional protein for non-ruminants including rabbits, are very expensive and scarce because of the competition between this group of livestock and humans.

. The primary aim of conventional feed substitution is to reduce feed cost and consequently cost of producing meat and improving reproduction in livestock. There is therefore the need for source for an alternative, locally available and cheap sources of feed ingredients to substitute these scarce and expensive ones particularly those that do not involve

competition in times of consumption between humans and livestock (Ayoade, Obiaka, Uza and Ibeawuchi., 2000; Esonu *et al.,* 2006). One possible source of cheap material is Forages such as *Stylosanthes hamata.*

Stylosanthes hamata is naturally distributed throughout the tropical and subtropical region in America, Africa, and South Asia (Mannetje, 1992). *Stylosanthes* species may also be used as cover crops, manure and fallow crops, and may be cut and fed fresh or used as hay (Mannetje and Jones, 1990). Crude protein levels range from 16-24 % in green leaf and 6-12 % in the stem, depending on age of regrowth and general growing conditions. *Stylosanthes* was introduced into a number of communities in the northern and coastal savanna of Ghana in 1994. It is estimated that about 5,000 hactares of natural pastures have been over sown with the legume in almost 300 communities in the Savannah zones since 1994 (Oppong- Anane, 1999). Empirical observation indicates that this forage is readily available and some farmers use it as a sole feed or in combination.

1.2 Statement of research problem

In Nigeria, The primary aim of conventional feed substitution was to reduce feed cost and consequently cost of producing meat and improving reproduction in livestock. There is therefore the need to source for an alternative, locally available and cheap sources of feed ingredients to substitute these scarce and expensive ones particularly those that do not involve much competition in consumption between humans and livestock (Ayoade, Obiaka, Ibeawuchi., 2000; Esonu *et al.*, 2006). One possible source of cheap material is *Stylosanthes* . The potential of this forage *Stylosanthes hamata* as feed for rabbit is of great importance because of its availability and ability of rabbits to digest leaf protein effectively (Bello, 2003).

1.3 The Justification for the study are :-

(i) The high cost and scarcity of conventional feed resources coupled with increasing demand for animal protein supply need investigation.

(ii) There is need to provide animal protein source at a cheaper rate

(iii) The need to provide an acceptable and healthy animal protein source to the public.

1.4 AIMS AND OBJECTIVES OF THE STUDY

This work is aimed at investigating the growth performance and carcass characteristics of rabbit (*Oryctolagus cunniculus*) fed diet containing varying levels of *Stylosanthes hamata* leaf meal

The Specific Objectives of the study are to :-

- determine the optimum inclusion levels of *Stylosanthes hamata* leaf meal in the diet of growing rabbits that will produce maximum growth performance in the animal.
- evaluate the carcass characteristics of rabbits fed different level of *Stylosanthes hamata* leaf meal (SHLM) in rabbit diet.
- examine the organoleptic properties of meat of rabbits fed varying levels of SHLM
- evaluate the cost/benefit effect of feeding rabbits with *Stylosanthes hamata* leaf meal.

CHAPTER TWO.

2.0 LITERATURE REVIEW

2.1 Origin of rabbit.

The rabbits was believed to have been originated from Spain. They were later introduced by the Normans into Britain. Originally, the rabbit enclosure or "Corneygarth" (as it was known) consisted of a small field surrounded by trees and hedges. In the 15th century, island were built to house rabbits. The rabbits kept in this way retained much of their wild characteristics. Domestic breeding of the rabbits began in the 17th century. One of the front liners of rabbit breeding was Emperor Napoleon 111 of France who established small holdings for workers on condition that they bred rabbits as it would have not been possible to allocate each small holder with enough land for pigs and goats. This produced million of rabbit pelts that were used to line soldiers clothes. (Galen`s Garden, 2006).

2.2 Growth and development of the rabbit

Growth, which is the stage of sexual maturity, constitutes part of the process of reproduction, since it involves differentiation of organs, changes of size and body proportions and ageing. Growth and development of bones generally take place earlier in life than muscular and fat growth. The muscle and a little of fat along with bone structures contribute in the formation of the chest and the pouch girth. The fundamental period of growth in an animal is of importance. The relative growth rate of different parts of the body entails the ultimate shape the animal will take within a breed (Ijaiya, 1995). Body conformation, on the other hand, is a function of the development of various body structures of an animal. It was well known also that growth of the foetal is dependent on an adequate supply of nutrients and oxygen crossing the placenta from the mother (Robinson

et al., 1994). Godfrey (2002), reported that diets as well as maternal body composition are thought to affect the foetal development as a result of both direct effects on substrate availability to the foetus and indirectly through changes in placental functions and structure. Szendro and Maertens (2001) stated that the supply of nutrients to foetuses and embryos is exclusively dependent upon the mother. Therefore, rabbits have been found to give high performance when fed concentrate feeds (Obinne, 2002).

2.3 Non-conventional feed ingredients for rabbits

The competition between man, animals and industries for conventional feed resources and the high cost of compounding concentrate and pelletised feed has been a major constraint militating against the increased production of valuable sources of animal protein (Animashaun *et al.,b 2006;* Ogunbajo *et al.,* 2009). With the constant threat of hunger/malnutrition in developing countries, there is an urgent need to source for non-conventional or alternative feedstuffs within our respective localities for incorporation into the diets of our farm animals at least cost. Such alternative feedstuffs should not be in great demand as human food or having any industrial use and should be readily available and not subjected to the dictates of season (Agwunobi *et al.,* 2000). one of such feedstuffs envisaged that appears to fit into this description is *Stylosanthes hamata.*

2.4. Nutritive values of *Stylosanthes hamata* as a non-conventional feed

. Ingredient

Stylosanthes is a leguminous forage that is grown as hay, fresh feeds and commercial leaf meal production, used to supply protein and other nutrients for ducks pigs and chickens in China as reported by (Yi, 2000).

A number of research works have noted that the protein levels of *Stylosanthes hamata* and *Sida acuta* are around 16 % or more (Skerman *et al* 1988., Changjun *et al.,* 2004; Williams *et al.,* 2012). Changju, *et al.,*. (2004) have further observed that metabolisable energy (ME) contents of some *Stylosanthes* spp. were between 1730 and 1815 kcal/kg which are lower than growing rabbits requirement of about 2.5MJ/kg DE (Ibrahim et al., 2009).

Gupta et al. (1992) reported "that fish and meat meal fractions in the diets of broilers can be replaced with fresh green *Stylosanthes*. Steers given *Stylosanthes guyanensis* hay as sole feed maintained their bodyweight (Gupta and Singh 1983). *Stylosanthes spp* is also fairly palatable to rabbits (Aduku et al. 1989). Bamikole and Ezenwa (1999) reported that when 50 % of concentrate was replaced with the Verano variety of *stylo* hay, a similar performance was obtained as for an all-concentrate diet. These findings indicate the potential of *stylo* as a supplement for concentrate that could be used to reduce the cost of rabbit production in the tropics".

Omole, A.j, Adejuyigbe, A. ajayi, F.T and Fapohunda (2007) conduct an experiment to "evaluate the nutritive value of *Stylosanthes guianensis* and *Lablab purpureus* as sole feed for growing rabbit. Thirty-six cross-bred growing rabbits of mean weight 515 ± 2.3g were used for the study. The animals were randomly allotted to 3 different treatments. The animals in T_1 were fed *S. guanensis* only, while animals in T_2 and T_3 were fed solely on *L. purpureus* and sunflower leaf (control), respectively. Feed intake and weight gain were measured on daily and weekly basis respectively. The results showed that rabbits fed *S. guanensis* and *L. purpureus* compared favourably with those fed sunflower leaf in terms of feed intake, weight gain and feed conversion ratio. The results also revealed that the nutrients digestibility (dry matter, crude protein and crude fibre) were also better in rabbit fed *S. guanensis* and *L. purpureus*. The dressing per cent, lung weight, heart and kidney weight were not affected by the dietary treatment". Shiawoya and Musa (2006) reported

that feeding of forage like Tridax, banana and mango leaves can support growth successfully when fed with concentrate diets for weaned rabbits. Onyimonyi and Eze (2003) recommended that for better growth, rabbits fed *panicum maximum* should be supplemented with 50 % of concentrate diet. In other words, half of a growing rabbit *ad libitum* intake of forage should be made up of concentrate diet. Bamigbose *et al* (2002) reported that with mixed regime of forages and concentrates rabbits can performed well up to 50 % without any adverse effect on growth. Nwargu, F.O., Nwargu, B.I. and Iyeghe-Erakpotobor, G.T. (2010) and Iyeghe-Erakpotobor *et al*. (2002). reported that "an increase in the percentage of forage in diet reduced feed intake in rabbits. This reduction in intake was attributed to the high crude fibre content of all forages (Asuquo, 1997).

Iyeghe Erakpotobor *et al*. (2002) observed significant effect of diets on intake of rabbits offered a combination of concentrate, grass and other forages. Rabbits fed fibrous diets compensate for low nutrient density of such diets through higher voluntary feed intake (Santoma *et al*. 1989; Igwebuike *et al*., 1999)". Growth performance, carcass yield and organ weights of rabbits are influenced by dietary crude protein level in the diet of rabbits. In a study conducted to investigate the effect of varying protein and energy levels on growth performance of rabbits in terms of dry matter (DM) intake, dry matter weight gain, feed conversion ratio and apparent digestibility, Obinne, J.I., (2008) found that diet containing digestible energy level of 8.7 MJ/kg in combination with 16 % protein was adequate for the optimum growth of rabbits in the tropics

2.5 Effect of *Stylosanthes hamata* diet on rabbit performance

The type or nature of feed, among several other factors could affect livestock feed intake and general performance. The feed could determine the weight gains of the farm animals.

Iyeghe-Erakpotobor *et al.* (2006) carried out a 10 weeks trials involving "forty individually caged crossbred growing rabbits of an average initial weight of 1.12 kg fed combinations of concentrate and *Stylosanthes* in different ratios. The rabbits were randomly assigned to one of five treatments according to the daily weights of concentrate and *stylo* (g : g) supplied: (i) 25:100; (ii) 50:75; (iii) 75:50; (iv) 100:25; and (v) 125:10 in a completely randomized design with eight replicates to evaluate the performance of growing rabbits fed concentrate *and Stylosanthes (Veano)* combinations under tropical conditions. At the end of feeding trial, chemical analysis of *Stylosanthes* hay and concentrate fed to rabbits shows high levels of dry matter, crude protein, crude fibre and low nitrogen-free extracts in *Stylosanthes* hay. The authors reported *stylosanthes hamata* to contain 98.10 % DM, 4.04 % ash, 8.18 % EE, 50.50 % CF, 15.05 % CP, and 22.23 % NFE respectively. The final weight of rabbits were not significantly affected by the different dietary treatments. Daily and total weight gain were significantly ($p < 0.05$) lower for rabbits fed the 25:100 combination (treatment 1) compared with other treatments. The weight gain of rabbits increased quadratically with increases in concentrate level. The author reported that daily feed intake significantly ($p < 0.01$) decreased with increased in levels of *Stylosanyhes hamata* inclusion. At the end of the study, carcass characteristics were also assessed. The proportion of live weight represented by the head increased with an increase in concentrate level. The author concluded that "growing rabbits were able to utilize low-concentrate and high-*stylo* feed combinations efficiently for growth, even when *stylo* forms the bulk of the diet supplied, with only 25 g concentrate supplied daily. The 50:75 concentrate : *stylo* combination appeared to be the best combination compared to the 25:100 combination, it drastically reduces the time to attain market weight". Naandam et al. (2011) undertook a 42-day feeding trial to determine whether *Stylosanthes hamata* and *Sida acuta* could be used as sole feeds for local weaner rabbits. The experimental diets had three treatments

with three replicates each in a complete randomized design. The experimental diets were T_1 (100 % *Stylosanthes hamata*), T_2 (50 % *Stylosanthes hamata* 50 % *Sida acuta*) and T_3 (100 % *Sida acuta*). The growth parameters measured/calculated were mean weekly and total feed intake (g), mean weekly and total weight gain (g) and final weight (g). Additionally, meat colour, juiciness, tenderness and flavour were also evaluated after animals were sacrificed. They observed significant differences ($p < 0.05$) in mean weekly feed intake, total feed, mean weekly weight gain, total weight gain and final weight between treatments. T_3 animals consumed the highest feed yet T_2 animals had the best weight gain at the end of the experiment. The sole *Stylosanthes hamata* feed significantly ($P<0.05$) improved meat colour and juiciness, while tenderness and flavour did no record any significant differences ($p > 0.05$) between treatments. The results suggest that *Stylosanthes hamata* and *Sida acuta* may have a potential to enhance rabbit growth as a combined feed. Any negative effect on rabbit health either when fed individually or in combination was inconclusive and *Stylosanthes* in particular as sole feed could improve colour and juiciness of rabbit meat.

(Iyeghe-Erakpotobor *et al.*, (2006) studied forty eight rabbits allocated to three treatments consisting of *Stylosanthes hamata* (Verano stylo), *Arachis hypogea* (groundnut) haulms and 50:50 mixture of both forages in a completely randomized design for six weeks. 150 g forage and 50 g concentrate were supplied to the rabbits in separate feeders in the morning at 08.00hrs to evaluate the utilization of *Stylosanthes* and groundnut haulms supplemented with concentrate by growing rabbits. At the end of feeding trial initial and final weight of rabbits fed *Stylosanthes*, groundnut haulms and *stylosanthes* + groundnut haulms were similar. Concentrate, forage and total feed intake of rabbits were similar for the treatments, however, total weight gain was higher for *stylosanthes*

+ groundnut haulms and lowest on sole verano *stylo*. Performance of rabbits fed groundnut haulms, verano *stylosanthes* and *stylosanthes* + groundnut haulms indicate that rabbit performance on sole and combination forages were similar except for the feed conversion ratio which was significantly ($p<0.05$) higher for verano *Stylosanthes.* Though the feed cost were similar for the treatments. Cost/kg gain was higher ($p<0.05$) for verano *Stylosanthes* than *Stylosanthes* + groundnut haulms. They concluded that performance of rabbits were better on combination forages than sole forage.

2.6 Factors affecting nutrient utilization in rabbit

The main factors influencing nutritive value of a diet are the ingredients employed and their chemical composition. (Mc Donald, Edwards, Grenhalgh and Morgan, 2002). Other factors that can influence feed intake, nutrient utilization and general performance of livestock especially rabbits include size (weight) and age, reproductive status of the rabbit, fibre content of the feed as well as high environmental temperature. Farinu *et al*. (2006) reported that rabbits on test diet consumed significantly ($p<0.05$) lower feed (63.30) than those on control diet (72.12 g) in their experiment on organ characteristics and growth response of male weaner rabbits fed diet containing bovine rumen content – bovine blood meal mixture. However, their observation was contrary to the report of Whyte and Wadak (2002) who reported that there were no significant effect($p>0.05$) of rumen content on average daily feed intake in weaner rabbits. It was also contrary to the result of Dairo *et al*. (2005) who also reported that there was no significant effect ($p>0.05$) of rumen content and blood rumen-content mixture on growing rabbits. Fielding, (1991) reported that high ambient temperature also had adverse effect on intake of feed.

2.7 Carcass and organ characteristics of growing rabbits

Amata and Bratte (2008) conducted an experiment to determine the effect of feedind graded levels of *Glirisidia sepium* leaf meal (GLM) on organ weight of 25 weaner rabbits allotted to five dietary treatments containing 0 % (control), 5 %, 10 %, 15 % and 20 % (GLM) for treatments 1,2,3,4and 5 respectively. At the end of the experiment it was concluded that beyond 10 % GLM in rabbit diets, there would probably be increase in detoxification activities in the kidney as well as in the liver of the rabbits.

Okorie (2003) carried out an experiment to assess the effect of palmitic acid fortified maize wet-milling by-product on the performance of weaner rabbits and reported that breast weight and dressing percentage were lower ($p<0.05$) for the 50 % inclusion level of palmitic acid fortified maize wet-milling by-product, while the inclusion of the by-product increased *($p>0.05$)* the viscera weight. At the end of the experiment it was concluded that the tested ingredients could improve carcass yield of rabbits.

Biya *et al*. (2008) conducted an experiment on the effect of different feeding systems on the carcass characteristics of New Zealand white rabbits, reported carcass characteristic values based on the following feed allotments " 0 % T_1 represented rabbits which were fed with concentrate alone, T_2 rabbits had 25 % replacement of concentrate.T_3 had 50 % vegetable cuttings on DM basis.T_4 had 25 % concentrate and 75 % vegetable cuttings on DM basis and T_5 had 100 % vegetable cuttings on DM basis". At the end of the experiment it was concluded that T_2 which had 25 % vegetable cuttings and concentrate produced the highest dressing percentage compared to the other treatment groups.

Eustace *et al., (2003)* conducted an experiment with 24 growing rabbits to assessed the response of carcass characteristics to varying dietary cyanide levels. The result revealed that an increase in dietary cyanide levels caused a significant ($p<0.05$) reduction in the the

live weight, slaughter weight and lungs weight. This observation was attributed to be due to the effect of the cyanide levels interfering in the digestion of the nutrients.

Abubakar, Doma, Ibrahim, Muhammad and yusuf (2001) carried out an experiment on the effect of *Moringa olefera* leaf meal (MOLM) in diets on growth performance, organ and carcass characteristics of growing rabbits, using 28 growing rabbits of average age of 975 g in weight allotted to 4 treatment groups with 7 rabbits each in a completely randomized design. four is nitrogenous diets (16 % CP) were formulated in which MOLM was included at 0, 15, 30 and 45 % for treatments 1, 2, 3 and 4 respectively.

The diets were fed to the rabbits for complete eight weeks. At the end of the experiment the result indicated that "daily weight gain (5.95-13.39 g/day) and carcass weight (497.70-727.65 g) increased ($p<0.05$) with increasing levels of MOLM in the diets, but dressing percentage (42.49-45.96 %) was not affected by dietary treatments. Similarly, the weight of liver (40.35-57.05 g), lungs (10.22-11.24 g), heart (2.95-4.10 g), kidney (8.30-10.70 g),

kidney fat (11.10-12.65 g), small intestine (81.25-99.80 g), large intestine (102.45-117.95 g), caecum (20.50-30.50 g), stomach (90.75-114.65 g), spleen (1.00-1.80 g) and abdominal fat (7.89-11.25 g) characteristics were not different across the treatments" based on the result obtained it was concluded that growing rabbits can utilized *Moringa oleifera* leaf meal up to 45 % level without any adverse effects on growth performance, carcass yield and organ characteristics.

Olabanji, Akinade, Farinu and Ojebiyi (2007) conducted an experiment to studied the growth performance, carcass quality and organ characteristics of weaner rabbits fed varying levels of wild sunflower *Tithonia diversifolia* leaf-blood meal mixture and observed that the weight of the spleen, kidney, lungs, heart, pancrease and large intestine of rabbits on wild sunflower leaf – blood meal mixture (WSFLBM) diets compared favourably with those

rabbit on the control diets ($p>0.05$) and it was concluded that wild sun-flower leaf blood meal mixture (WSFLBM) could be tolerated and properly utilized by weaner rabbits up to 20 % inclusion level without any adverse effect.

Therefore, rabbit carcass characteristics like any other livestock is a function of its breed, age, sex as well as to a great extent the level of nutrition given to the animal. The quality of carcass of rabbit is defined by the proportion of the parts cut as loin, fore and hind parts as reported by (Larzul and Gondret, 2005).

Another criterion that is also used to determined carcass quality is the meat/bone ratio of the carcass predicted by the meat/bone ratio of the hind leg (Blasco, Quhayoun and Masoero 1992, as cited by Quyed and Brun, 2008). Composition of carcass relates to the relative proportion of lean fat and bone. Therefore,a carcass with a large amount of muscle and small amount of fat and bone is regarded as high quality carcass. The carcass of the animal becomes an increasing portion of its live weight as the animal grows., the ratio of muscles to bone increases and adipose tissue is laid down. Carcass quality has to satisfy economic objectives, such as sellable meat yield and attractiveness to consumer (Dalle-Zotte, 2002). The dressing percentage is a very important economic variable in the rabbit market. Some combination of measurement such as retail cut weights or length measurements are necessary to predict lean percentage in the carcass. Moreover, commercial cutting techniques are easier to carry out than the determination of total lean content in the carcass Fernandez and Fraga, 1996. (Damron, 2003) reported that" Information on carcass characteristics is therefore helpful for the effective utilization of rabbit meat. New Zealand White rabbit is the best meat type breed due to both husbandry and processor preference. This breed has the best size, growth rates, feed conversion ratios, dressing-out weights and meat to bone ratios". It was also reported that characteristics of carcass quality of California and New Zealand white breeds were found to be significantly

($p<0.05$) affected by age but not affected by sex (Akinci *et al., 1988).* In a related development, meat and carcass quality changes markedly with animals age and slaughter weight of the animal (Dalle-Zotte, 2002). These quality characteristics may also be affected by different in the sex of the animal (Cavani *et al*., 2000)

Tailor *et al.,* (1989)in their studied on meat to bone ratios, cooking losses and waste of meat from fryer rabbits reported that "The loin and legs represented the most valuable portion of the rabbit carcass, and that the ratio of meat to bone in forelegs, rack loin and hind legs were 4 : 3, 1 : 18, 3 : 20 and 3 : 54, respectively". Aduku *et al.,* (1986) in their study on the effect of different methods of processing rabbits on carcass yield and quality after evaluating the carcass characteristics of rabbits in Nigeria, reported that "Head, skin and feet contribute about 18 %, 11 % and 3 % respectively to the skinned carcass. This raised the dressing percentage of rabbits from 60 – 62 % (Europe) or 50 % (USA) to about 74 % in Nigeria. This is because skin, feet and some offals are often consumed in Nigeria".

Onakpa, Onuh, and Gode (2011) in their studies on effect of graded levels of maize bran on the growth and carcass characteristics of weaned rabbits observed that there was no significant ($p>0.05$) difference across the dietary treatment with respect to pre-slaughter weight, dressing percentage, the weight of the kidney, liver, heart, head, rack, pelt, spleen, lungs and legs. as well as the length of small and large intestine. There was significant ($p<0.05$) in the thigh weight, loin weight, carcass weight and caecum length. At the end of their findings it was concluded that inclusion level of maize bran at 35 % in the ration gives a better performance without deleterious effect. Akinnusi, Bamgbose.

Sogunle and Afolabi (2007) observed significant ($p<0.05$) difference in the dressing percentage of meat only when comparing the effect of different animal protein concentrates with forage on carcass quality of rabbits. Carcass quality of rabbits is characterized by

tenderness, juiciness, flavour, colour and marbling quality, which are direct effect of the animal protein concentrate of the diet and overall quality of formulated feed in general.

2.8 Digestibility values of rabbits fed concentrates in the tropics

Iyeghe-Erakpotobor *et al*. (2006) conducted an experiment to evaluate concentrate, legumes and grass combinations on performance and nutrient digestibility of grower rabbits under tropical conditions. The result revealed a high digestibility of crude protein, crude fibre, dry matter ether extract indicating that rabbits were able to utilize nutrients in the high forage and low concentrate combination for growth.

They concluded from their study that any of the combinations of concentrate, forage and would be adequate for grower rabbits.

Eustace *et al*. (2003) assessed the response of rabbits fed varying levels of dietary cyanide and reported the apparent digestibility of rabbits showed a low nutrient digestibility with a consequent reduction in feed conversion and growth rate as cyanide concentration increased beyond 250 mg. Based on the results of this study, diets formulated for rabbits should contain not more than 250 mg cyanide per kg in diet. A research was conducted to evaluate the digestibility of weaner rabbits fed graded levels of soyabean cheese waste/maize offal diet and Brachiaria grass hay by Iyeghe-erakpotobor *et al.,* (2006) reported digestibility coefficients that "Dry matter and ether extract digestibility values were similar for the control, and significantly higher than 100 and 50 % SBW treatments. Crude protein digestibility was similar for the control and all the experimental groups. This could indicate a high efficiency in crude protein utilization". It was concluded from their study that soybean cheese waste/maize offal diet compared favourably with the standard rabbit meal in nutrient digestibility.

2.9 Nutritional evaluation of leaf meals on the performance of animals

Some plant leaves have been used as feedstuffs for rabbits and other livestock as a partial substitute for conventional grain and forages. Example of such is *Leucaena* leucocephala which has been successfully utilized in rabbit diets at low inclusion levels. At a higher level of inclusion the presence of mimosine, a toxic amino acid can cause depression of animal growth (Parigi-Bini and Xiccato, 1994).

A 20-week feeding trial was conducted by Odeyinka *et al*. (2008) to evaluate the reproductive performance of rabbits fed *Moringa oleifera* as a replacement for *Centrosema pubescens*. Freshly harvested *C. pubescens* and *M. oleifera* leaves were offered to the animals at 20 % of their liveweight at the ratio of 100:0 (MO), 75:25 (M25), 50:50 (M50), 25:75 (M75), and 0:100 (M100), in addition to the concentrate feed offered to the animals. There were significant differences in the total DM intake, litter size at weaning, average daily weight gain per kid and milk yield of does, on the different treatments ($p<0.05$). However, ther was no significant difference in initial average body weight, crude protein intake, gestation length as well as litter weight at birth.. It was concluded that *Moringa oleifera* can be used to replace *Centrosema pubescens* without adverse effects on the reproductive performance of rabbits.

Iheukwumere *et al.,* (2007) conducted a 25- day feeding trial in Nigeria using 120 five week old broiler to evaluate the growth, carcass yield and blood chemistry of anak broilers fed cassava leaf meal at varying inclusion levels of 0, 5, 10 and 15 % respectively. Result of feeding trial revealed that feed intake, body weight gain, and feed conversion ratio of the control diet (0 %leaf meal) were superior ($p<0.05$) to those on group 10 and 15 % leaf meal. The haemoglobin, albumen and the total serum protein at 0 and 5 % leaf meal were superior to the values at 10 and 15 % leaf meal. However creatine, cholesterol and urea

show no significant differences *(p>0.05)* between the treatment groups. The parts of the carcass cut showed superior values (*p<0.05*) in the control treatment and they differed significantly (*p<0.05*) from broilers on 5, 10 and 15 % leaf meal in carcass yield. In conclusion it was suggested that inclusion level of cassava leaf meal at 5 % could be used for broiler finisher diet without any deleterious effect on growth, carcass yield and blood chemistry of broilers.

Odunsi *et al.,* (2002) conducted an experiment with 72 laying hens allotted to four dietary treatments containing 0, 5, 10 and 15 % *Gliricidia* leaf meal (GLM). It was reported from the result that "The inclusion of the GLM in the layer diets significantly (*p<0.05*) reduced feed consumption in a linear function. Layers fed 0 and 5 % GLM had similar (*p>0.05*) hen-day egg production, body weight changes and feed conversion efficiency which worsened significantly at 10 and 15 % GLM levels. Egg quality values showed no significant differences (*p>0.05*) in terms of egg weight, 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, 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". Result from this findings revealed that depressed feed intake and egg production occurred at dietary levels greater than 5 % GLM.

Ross and Enriques (1969) in their study used up to 20 % of cassava leaf meal in poultry diets and reported that there is a decreased in the feed efficiency and weight when the diet had more than 5 % inclusion level of cassava leaf meal. But at 10 % inclusion levels of cassava leaf meal there was no any significant difference observed in feed efficiency, egg production and egg weight. Cassava leaf meal has some yellow pigment that gives good egg yolk pigmentation, and it can be a substitute for all the alfalfa in the diet of laying hens. In an experiment to determine the nutritional potential of two leafy vegetables (*Moringa*

oleifera and *Ipomoea batatas),* Oduro *et al*. (2008) reported that "*Moringa oleifera* leaves contained 27.51 % of crude protein, 19.25 % of crude fibre, 2.23 % of fat, 7.13 % of ash, 76.53 % of moisture, 43.88 % of carbohydrates and caloric value of 1296.00 kJ/g (305.62 cal/g).Calcium and Iron content in mg/100 g (DM) were 20.09and 28.29, respectively". They concluded that *Moringa oleifera* leaves could contribute to the nutrient requirements of humans and should be strongly recommended in Ghana. An experiment on the nutritional potentials of *Chromolaena odorata* (siam weed)leaf meal (SWLM) on laying hens: by Fasuyi =Fasuyi *et al., (2005)* conducted an experiment on the nutritional potentials of *Chromolaena odorata* (sun weed) leaf meal (SWLM) on laying hens biochemical and haematological implications was carried out using 24 laying hens in their eighth month of lay in an 8-week trial. In the experiment diet 1 served as the control with no SWLM inclusion. SWLM was introduced at 2.5 %, 5.0 % and 7.5 % in diets 2, 3 and 4 respectively. The biochemical and haematological investigations showed no statistical differences ($p>0.05$) among the mean values of treatments 1, 2 and 3. However, the mean value of treatment 4 (7.5 % SWLM inclusion level) was statistically different ($p<0.05$) from the others. The numerical values of most haematological indices showed an initial increase up to treatment 3 followed by a decrease in treatment 4. Almost all haematological indices studied (PCV, RBC counts, Hb content) progressively increased up to diet 3 (5 % SWLM inclusion) after which there was a decline indicating a probable acceptance limit of 5% SWLM dietary inclusion in layer diets without any serious health implication.

Bamikole *et al.,* (2005) "Investigated the potential of mulberry leaves in rabbit production in a 12-week long experiment where feed intake, weight gain, and nutrient digestibility of the rabbits were monitored". Thirty weaner rabbits were used for this experiment allocated to five treatment diets. The percentage of concentrate in the rations was incrementally replaced with mulberry leaves. The ratios 100:0, 75:25, 50:50, 25:75, 0:100 were fed in a

completely randomized design. Total dry matter (DM) intake of the concentrate: mulberry diet remained at the level of that of the all- concentrate ration until mulberry leaves comprised greater than 50 % of the ration before it declined significantly. The intakes of crude protein (CP) and crude fibre (CF) increased significantly whilst those of ether extract (EE), ash, and nitrogen free extract (NFE) decreased significantly with increasing level of mulberry leaves in the diets, following the trends of the concentrations of the nutrients in the materials. The nutrient digestibility of the diets were high and there were no significant differences among the means for dry matter, organic matter, crude protein, crude fibre, and ash. Digestibility of ether extract and nitrogen free extract significantly declined with increasing levels of mulberry leaves in the rations. Weight gain of rabbits on diets containing 20 % and 50 % mulberry leaves (5.14 and 4.72 g /d respectively) was not significantly different ($p>0.05$) from that of all-concentrate ration (5.72 g/d),but these were significantly higher than those of 25:75 and 0:100 concentrates: mulberry leaves (3.43 and 2.27 g/d respectively). It was concluded that mulberry leaves could support feed intake, digestibility and satisfactory weight gain in rabbits, and could reduce reliance on and cost of expensive concentrate diets.

Famounyan and Meffega (1986) feeding rabbits sun-dried cassava leaves diets containing 13, 14 and 16 % crude fibre contents observed that the rabbits consumed 65.8, 73.5 and 71.8 g/d and gained 17.4, 19.4 and 18.2 g/d, respectively. The low weight gains observed in this trial was attributed to the fact that the feed was not pelleted and was scattered.

Onyimonyi and Ene (2003) conducted an experiment on performance of growing rabbit fed *Panicum maxima* with graded levels of concentrate diets., recommended that rabbits should be fed *Panicum maxima* with 50 % of concentrate diet for better growth. Iyeghe-Erakpotobor (2003), studied the performance of growing rabbits fed different levels of concentrate and *Stylosanthes hamata*, concluded that rabbits were able to efficiently utilize

leaf protein concentrate in *stylosanthes hamata* for growth . He further observed improvement performance even when this forage formed the bulk of diet, supplied with only 25 g of concentrate to growing rabbits. Shiawoya and Musa (2006), in their study on evaluation of feeding potentials of mango leaves *Mangifera indica,* banana leaves *Musa spp* and *Tridax procumbens* as supplements to conventional feeds for growing rabbits found that *Tridax,* mango and banana leaves could successfully support growth when fed with concentrate diets to weaner rabbits. Bamgbose *et al.,* (2002), in their study on growth response of weaner rabbits fed concentrate/forage supplemented based diet concluded that "Rabbits could perform well with mixed regime of forages and concentrate (up to 50 % reduction) without any adverse effect on growth".

2.10 Organoleptic properties of rabbit meats

Malik *et al.,* (2011) studied the nutritional and organoleptic assessment of the meat of giant African land snail (*Archachatina magnata*) compare to the meat of other livestock. The nutritional quality and organoleptic characteristics of giant African land snail meat was compared to the meat of conventrional species of livestock (chicken, rabbit and beef). Each sample of meat was processed using three different methods (frying, boiling and barbecuing) and their sensory characteristics and organoleptic were evaluated (colour and appearance, taste, juiciness and general acceptability). The meat of chicken, rabbit and beef were highly accepted for their colour and acceptance, juiciness and taste when friend boiled and barbecued, whereas the meat of giant African land snail had a significantly lower acceptance ($P<0.05$) among the respondents.

Apata *et al.,* (2005) studied the taste panel, organoleptic properties and socio-economic characteristics of rabbits cooked by five different methods using forty New Zealand white rabbits weighing 1.8-2.0 kg (live weight) used for the study. They were starved overnight,

slaughter and dressed conventionally. The meats were allotted to five different cooking methods namely frying, boiling, roasting, frying+boiling and roasting+boiling. Assessment of sensory characteristics (tendeness, juiciness, flavour and overall acceptability was carried out using nine point scale by a 50 member taste panel. The statistical analysis was used to assessed nutritional qualities. The method of cooking employed did not have any significant effect ($p>0.05$) on the eating quality of rabbit meat. The highest score were recorded for juiciness and tenderness of rabbit meat cooked by roasting while the highest score for flavour and overall acceptability were recorded for rabbit meat cooked by frying.

Wasanthakumar *et al*. (1999) conducted a study on the effect of graded dietary levels of neem seed kernel cake on carcass characteristics of weaned rabbits and reported that sensory attributes of pressure cooked meat without salt and with salt were found to be similar as judged by a seven member of semi-trained taste panel on a seven point hedonic scale, including appearance, taste, texture, odour, tenderness, juiciness, tenderness as well as overall acceptability. The percentage of cooking loss of rabbit meat ranged from 28.2-29.8 (with salt) and 26.3-28.0 (without salt). At the end it appears that the bitterness of the neem present in (NSKC) did not impart any bitter taste or odour on the meat Comparable scores and no-untoward taste were reported by earlier workers in pork and meat of rabbits fed processed NSKC (Sushilkumar *et al*.,1989; Khan, 1994; Gowda, 1994; Boshale, 1994).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1. Location of the experimental site

The research work was carried out at the rabbitary unit of the Ministry of Livestock and Fisheries Development, Livestock services Department, State Veterinary centre, in Minna, Niger State. Minna is situated on latitude 9° 31´ North and longitude 6° 33´ East of the equator. It is located in the southern guinea savannah zone . Minna experiences a distinct dry and wet seasons with mean rainfall of 1,200mm (with highest mean monthly rainfall in September). Temperature range between 22-37°C . The peak temperature are 40^0c in February to the period of March and 35^0c in November and December. (F U T, Minna, 2009).

3.2. Sources of ingredients.

Stylosanthes hamata was cultivated at the horticultural farm of the Crop Production Department of the School of Agriculture and Agricultural Technology, Minna, Niger State. It was harvested and air dried for about three days to conserve its nutrient content and to reduce its moisture content to as low as possible for proper preservation. Maize was purchased in one of the market (kasuwan gwari) at Minna, while all other ingredients such as Groundnut cake (GNC) rice offal, fish meal, bone meal, oystershell, salt, lysine, methonine and vitamin mineral premix were purchased at the Sammy agro venture milling centre opposite U.K Bello Art Theatre in Minna, it was then mailed into a leaf meal and pelleted.

3.3 Experimental diets

Five dietary treatments were formulated. Diets T_1 was the control diet (0 % *stylosanthes*), while T_2, T_3, T_4, and T_5 diets contained 25 , 50 , 75 and 100 % *Stylosanthes hamata* respectively. The composition of experimental diets are presented in Table 3.1

3.4 Experimental rabbits and management.

The study was conducted using thirty (30) healthy weaned local breed rabbits, purchased from the Rabbitary unit of the Ministry of Livestock and Fisheries Development, Livestock services Department, Stats Veterinary Centre, Bosso in Minna, Niger State. The used rabbits were between 5 and 6 weeks old. with average initial weight of 536 g. Before the arrival of the rabbits, the hutches, feeders, drinkers and all other equipments were washed thoroughly, cleaned and disinfected with dettol. The hutches were maintained on a high hygienic standard basis by cleaning them daily. The drinkers and feeders were equally washed and dried everyday before fresh water and feeds were supplied into them respectively as described by Aduku and Olukosi (1990). Adaptation period of eight days was observed for animals to become accustomed to the feed and new environment. The rabbits were then allotted to five treatments randomly in a complete randomized design. There were six rabbits in each treatments with three replicates per treatment and two rabbits per replicate in the ratio 1:1 (male and female) respectively. The experiment lasted for 12 weeks.

Table 3.1: Composition of the experimental diets (%)

Ingredients	T_1	T_2	T_3	T_4	T_5
Maize	60.41	55.72	47.88	32.04	11.68
GNC	18.59	17.45	15.56	11.72	0.00
*Stylo. hamata l*eaf meal	0.00	5.82	15.56	35.22	67.32
Rice offal	15.00	15.00	15.00	15.00	15.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Oysters shell	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Vit/Min premix*	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis:					
Crude protein (%)	16.00	16.00	16.00	16.00	16.00
M.energy (kcal/kg) ME	2800.52	2757.29	2685.62	2540.40	2352.37

*Premix supplied per 2.5kg Retinol acetate(10000000 iu), Vit. D3 (2000000 iu), Vit E (15000 iu), Vit B (3000mg), Niacin(15000mg), Calcium pantothenate (800mg), Vit. B6 (3000mg), Vit. B12 (10mg), Vit. K3 (2000mg), Biotin (20gm), Folic acid (500mg), Choline chloride 250,000mg),Manganese (75000mg), Iron (25000mg), Copper (5000mg), Zinc (70000mg), Selenium (150mg), Iodine (1300mg), Magnesium (100mg), 500g ethoxyquin and BHT (700g)

T1 = (0 % *Stylosanthes hamata* and 100 % Groundnut cake)

T2 = (25 % *Stylosanthes hamata* and 75 % Groundnut cake)

T3 = (50 % *Stylosanthes hamata* and 50 % Groundnut cake)

T4 = (75 % *Stylosanthes hamata* and 25% Groundnut cake)

T5 = (100 % *Stylosanthes hamata* and 0 % Groudnut cake)

3.5 Data collection

Data were collected over a period of twelve (12) weeks on feed intake and live weight changes. Determination of feed intake by rabbits was on daily basis by weighing the quantity of feed given to the rabbits and the quantity of feed left over and differences between the two for each day gave the feed intake per day. This was calculated using the following expression;

Feed intake (g) = Quantity of feed offered(g) — Quantity of left over (g).

Rabbits were weighed individually on weekly basis using the weighing scale to determine weight changes. Weighing was carried out in the morning before feed and water were served. Weight gain was determined using the expression as followed:

$$\text{Daily weight gain/rabbit/day (g)} = \frac{\text{Final weight gain (g)} - \text{initial weight (g)}}{\text{Number of rabbits x number of days}}$$

3.5.1 Determining of body weight and body weight gain (g/rabbit)

Body weight was determined by weighing the rabbit in each replicate on a weighing scale on arrival and at the end of each week. The difference between initial live weight of rabbits and the final weight at the end of experimental period (12weeks), constitute the final body weight gain.

3.5.2 Feed/gain ratio (F/G)

This is the proportion of average feed intake per week per treatment to the average body weight gain per week per treatment group. From the quantity of feed intake and the weight gain, feed conversion ratio was determined using the following expression.

$$FCR = \frac{\text{Total feed intake (g)}}{\text{Total weight gain (g)}}$$

3.6 Digestibility trial

A digestibility trial was conducted at the 13th weeks of the experiment. The Rabbits were housed individually in the same set of cages. They were allowed three (3) days adjustment period and the data were collected for another four (4) days. Records of daily feed consumed and feed refusals as well as the weight of daily feaces voided out were collected with the help of bagco sac attached to the bottom of each cage. The faecal samples collected were weighed, bulked together and preserved with boric acid separately in black nylon bag and then stored inside refrigerator in the laboratory with label on each nylon bag. They were then analysed in accordance with the methods of (A.O.A.C 1990), to determine the crude fibre, crude protein, ether extract, ash and nitrogen free extract percentages. The results obtained were used to calculate nutrient digestibility. Thus nutrient digestibility was calculated using the expression;

$$ND = \frac{\text{Nutrient in the feed consumed} - \text{Nutrient in the feaces}}{\text{Nutrient in feed consumed}} \times 100$$

3.7 Carcass and organ characteristics

On the last day of the experiment, carcass analysis was carried out. Three rabbits were selected randomly from each treatment. The selected rabbits were starved overnight to clear the gut, weighed and slaughtered by cutting the jugular vein around the neck and were all skinned with a sharp knife, after which evisceration is done. the internal organs and other gut contents were removed and weighed. The dressed carcass, organs and parts were also weighed and expressed as percentage of the live weight.

3.8 Organoleptic characteristics

Consumption quality was assessed by a taste panel consisting of ten members. They evaluated the intensity of the following characteristics; tenderness, juiciness, colour, flavour and overall acceptability. The carcasses were sliced according to the individual treatment into fifteen pieces of the size of about 2 mm and cooked at the same temperature using a regulated electrical stove. During cooking, the slices were turned over every 10 minutes and the cooking was done for a period of 45 minutes. After cooking, the slices were each wrapped in tissue paper based on the individual treatment and placed in a tray and presented to the assessors for the taste evaluation.

Water was used as a neutralizer which the assessors took after tasting each slice from each treatment. Assessors scored the attributes of the meat according to the nine points hedonic scale below to record the result of the evaluation.

1. Dislike extremely,

2. Dislike very much,

3. Dislike moderately,

4.Dislike slightly,

5. Neither like nor dislike

6. Like slightly,

7. Like moderately,

8. Like very much and

9. Like extremely.

CHAPTER FOUR

4.0 RESULTS

4.1. Proximate composition of *Stylosanthes hamata* leaf meal (SHLM)

The proximate composition of the *Stylosanthes hamata* leaf meal (SHLM) is presented in Table 4.1. The result of the proximate composition of SHLM gave a value of 16.00 % for CP, while the values for CF, EE, Ash and NFE, were 26.00 %, 5.00 %, 10.00 % and 35.80 %, respectively.

Table 4.1: Proximate composition of *Stylosanthes hamata*

Component	Composition (%)
Dry matter	92.80
Moisture	7.20
Crude protein	16.00
Crude fibre	26.00
Ether extract	5.00
Nitrogen free extract	35.80
Ash	10.00

4.2 Anti-nutrients factor of *Stylosanthes hamata* leaf meal

The results showed that *Stylosanthes hamata* leaf meal contain below the lethal dose range of all the anti-nutritional factors analyzed that is the phenol, tannin, saponin, phytate and oxalate

Table 4.2: Anti-nutritioal factors present in *Stylosanthes hamata*

Anti-nutritional factor	Composition (mg/100g)
Phenol	1.47
Tannin	1.05
Saponin	1.38
Phytate	2,17
Oxalate	1.54

4.3. The proximate composition of the experimental diets.

Table 4.3 shows the proximate composition of experimental diets. The CP content ranged from from 18.30 % for diet (T_5) to 18.35 % for diet (T_1), 18.40 % for (T_2 and T_4) and 18.45 % for T_3 The values were similar and also similar to the values recommended by other workers (Dairo *et al.*, 2005 and Iyeghe-Erakpotobor *et al.*, 2008) who fed similar diet to growing rabbits. The CF level ranged from 12.00 % to 16.33 % for diets T_1, T_2, T_3 T_4 and T_5, respectively. The crude fibre increased as the level of *Stylosanthes hamata* increases in the diets and the values were adequate for growing rabbit as recommended by Johnson-Delaney, (2006) and as reported by (Bamikole *et al.*,1999) who fed similar diets to rabbits. The values of EE, ranged from 4.00 % (T_5) to 6.35 % **(**T_1). The value of fat was higher than (2.00 to 4.50) reported by Mohammed *et al.*, (2010). The differences observed could

be attributed to level of diet inclusion. The values for Ash ranged from 10.10 % (T_1) to 13.15 % (T_5). Ash increased as the levels of *Stylosanthes hamata* leaf meal increases in the diets. The values for NFE, were 43.10 % for T_1, 41.68 % for T_2, 39.90 % for T_3, 39.58 % for T_4 and 38.34 for T_5 were recorded. while the values obtained for DM content were very close ,ranging from 89.37 % for diet (T_5) to 89.90 % for diet (T_1).

Table 4.3 Proximate composition of experimental diets

	Dietary Treatments				
Nutrients (%)	T_1	T_2	T_3	T_4	T_5
Dry matter	89.90	89.78	89.65	89.45	89.37
Moisture	10.10	10.22	10.35	10.55	10.63
Crude protein	18.35	18.40	18.45	18.40	10.30
Crude fibre	12.00	13.05	14.50	15.17	16.33
Ether extract	6.35	6.15	5.40	5.25	4.00
Ash	10.10	10.50	11.50	11.25	13.15
Nitrogen free extract	43.10	41.68	39.90	39.58	38.34

KEY

T_1 = (0 % *Stylosanthes hamata* and 100 % Groundnut cake)

T_2 = (25 % *Stylosanthes hamata* and 75 % Groundnut cake)

T_3 = (50 % *Stylosanthes hamata* and 50 % Groundnut cake

T_4 = (75% *Stylosanthes hamata* and 25 % Groundnut cake)

T_5 = (100 % *Stylosanthes hamata* and 0 % Groundnut cake)

4.4 Growth performance of rabbits fed diets containing varying levels of *Stylosanthes hamata* leaf meal

The growth performance of experimental rabbits is summarized in Table 4.4

The rabbits in the control group consumed higher quantities of feed ($p>0.05$) than those on other treatment diets. The performance table also revealed that rabbits fed control diets had lower ($p<0.05$) mean weight gain when compared to other treatment groups. The feed conversion ratio (FCR) of rabbits in T_3 based diets was better than those on other treatment diets.

At the end of feeding trial, the final body weight of rabbits in the control group were ($p<0.05$) lower than that of other treatment groups

The results of growth performance and feed intake (Table 4.4) showed that there were significant ($p<0.05$) differences between the treatment diets with the control diet (T_1) having the highest value of feed intake, while T_5 (100 % SHLM inclusion) recorded the lowest value. There was no significant difference ($p>0.05$) in the values obtained for initial body weight of the rabbit, while the mean final body weight showed that there were significant ($p<0.05$) differences between the dietary treatments. The results of total body weight gain indicated that there were significant ($p<0.05$) differences between the weight gain of the rabbits which increased as the level of SHLM in the diet increased up to T_3, before declining slightly in T_4 and T_5. The differences observed could be as a result of varying levels of *stylosanthes hamata* leaf meal inclusion.

Table 4.4 : Growth performance of rabbits fed diets containing varying levels of *Stylosanthes hamata* leaf meal for 12 weeks.

	Treatment						
Parameter	T_1	T_2	T_3	T_4	T_5	SEM	LS
Initial body weight (g)	526.66	520.00	518.33	513.33	513.33	3.95	NS
Final body weight (g)	1526.70^{c}	1577.00^{b}	1645.00^{a}	1526.70^{c}	1535.00^{bc}	13.20	*
Total body weight gain(g)	1000.00^{c}	1057.00^{b}	1126.70^{a}	1013.37^{b}	1021.70^{b}	13.36	*
Total feed intake (g)	6970.00^{a}	6865.00^{ab}	6753.30^{bc}	6655.00^{c}	6515.30^{d}	44.52	*
Daily body weight gain (g)	11.90^{c}	12.58^{bc}	13.41^{a}	12.06^{b}	12.16^{d}	0.16	*
Daily feed intake (g)	82.98^{a}	81.73^{ab}	80.39^{bc}	79.23^{c}	77.56^{d}	0.53	*
Feed conversion ratio	6.97^{c}	6.49^{b}	5.99^{a}	6.56^{b}	6.38^{b}	0.08	*

Key:abcc =means with different superscripts on the same row are significantly($p<0.05$) different.

SEM = standard error of means

SHLM = Stylosanthes hamata leaf meal

LS = levels of significance

NS= No significant difference ($p>0.05$)

*= Significant difference ($p<0.05$)

T_1 = 0 % Inclusion of *Stylosanthes hamata* leaf meal and 100 % groundnut cake

T_2 = 25 % Inclusion of *stylosanthes hamata* leaf meal and 75 % groundnut cake

T_3 = 50 % Inclusion of *stylosanthes hamata* leaf meal and 50 % groundnut cake

T_4 = 75 % Inclusion of *stylosanthes hamata* leaf meal and 25 % groundnut cake

T5=100% inclusion of *stylosanthes hamata* leaf meal and 0 % groundnut cake

4.5 Nutrients digestibility of rabbits fed diets containing varying levels of . *Stylosanthes hamata* leaf meal

Results of apparent nutrients digestibility of the test diets are presented in Table 4.5

The results revealed that there were significant differences ($p<0.05$) between rabbits on all the treatment diets. The values obtained for apperant crude protein (CP) digestibility showed a similar trend to that of dry matter. The highest value was obtained from rabbits on diet T_3, while the lowest values was obtained in rabbits fed diet T_1. The results also revealed that the value of digestible crude fibre increased with increased levels of *Stylosanthes hamata* in the diet. The values for ash digestibility were similar to that of digestible ether extract as the value increased up to 50 % inclusion levels after which is starts to decline.

Table 4.5 Nutrients digestibility of rabbits fed diets containing varying Levels of *Stylosanthes hamata* leaf meal

	Dietary Stylosanthes hamata inclusion levels (%)						
Parameter	T_1	T_2	T_3	T_4	T_5	SEM	LS
Dry matter	70.93^{bc}	72.60^{a}	71.96^{ab}	70.48^{c}	70.38^{c}	0.4	*
Crude protein	66.81^{c}	$69,40^{b}$	73.20^{a}	69.94^{b}	67.14^{c}	0.64	*
Crude fibre	58.26^{c}	63.08^{b}	63.67^{b}	64.76^{b}	69.50^{a}	0. 99	*
Ether extract	66.26^{b}	67.59^{ab}	69.86^{a}	68.39^{ab}	68.77^{ab}	0.42	*
Ash	40.45^{c}	41.13^{ab}	43.14^{a}	42.00^{abc}	40.93^{bc}	0.31	*
Nitrogen free extract	91.13^{b}	91.55^{ab}	91.69^{a}	91.81^{a}	91.42^{ab}	0.08	*

Key:- a,b,c : Mean values with different superscripts on the same row are significantly different ($p<0.05$)

LS : Levels of significance

NS : Not significant.

SEM- Standard error of mean

T_1 = (0 % Stylosanthes hamata and 100 % Groundnut cake)

T_2 = (25 % Stylosanthes hamata and 75 % Groundnut cake)

T_3 = (50 % Stylosanthes hamata and 50 % Groundnut cake)

T_4 = (75% Stylosanthes hamata and 25 % Groundnut cake)

T_5 = (100 % Stylosanthes hamata and 0 % Groundnut cake

4.6 carcass and organ evaluation

The effect of *Stylosanthes hamata* leaf meal on the carcass characteristics of the experimental rabbits are shown in Table 4.6 and 4.7

Table 4.6 shows that rabbits fed control diets had lower body weights than the rabbits in the other experimental groups. The result also indicated that the rabbits fed control diets had significantly ($p<0.05$) lower hind limb, thoracic and lumber sacra proportion compared to other rabbits. However, there was no significant difference ($p>0.05$) in dressing percentage and tail weight of all the treatment groups.

Table 4.7 shows that the liver, lungs, heart and kidney percentage values did not show any significant difference ($p>0.05$) in all the treatments groups. However, there were significant difference ($p<0.05$) in abdominal fat, spleen and intestinal weights of all the treatment diets.

Table 4.6 Mean carcass cuts expressed as percentage of live body weight

Parameter	T_1	T_2	T_3	T_4	T_5	SEM	LS
Live weight(g)	1590^{c}	1641.70^{b}	1751.70^{a}	1646.70^{b}	1633.33^{bc}	59.42	*
Slaughter weight(g)	1538.30^{c}	1586.70^{bc}	1688.30^{a}	1595.00^{b}	1583.30^{bc}	55.31	*
Dressing percentage(%)	60.27	59.18	58.03	59.40	60.29	0.72	NS
Neck weight (%)	4.08^{b}	4.09^{b}	4.85^{a}	4.24^{b}	4.08^{b}	0.39	*
Fore limb (%)	6.08^{b}	6.09^{b}	6.75^{a}	5.87^{b}	6.01^{b}	0.40	*
Hind limb (%)	10.30^{c}	11.06^{ab}	11.60^{a}	11.13^{ab}	10.79^{bc}	0.50	*
Head weight (%)	12.57^{a}	12.28^{ab}	11.60^{b}	11.74^{b}	12.24^{ab}	0.50	*
Thoracic weight (%)	9.43^{b}	9.94^{b}	11.03^{a}	10.72^{a}	9.59^{b}	0.71	*
Lumber sacra (%)	16.78^{c}	17.40^{bc}	18.43^{a}	17.81^{ab}	16.94^{bc}	0.74	*
Skin weight (%)	10.69^{a}	10.05^{b}	10.08^{b}	10.12^{b}	10.81^{a}	0.38	*
Tail weight (%)	3.45	3.55	3.23	3.34	3.26	0.20	NS

KEY: a,b,c, Meanns with different superscripts on the same row are significantly ($p<0.05$) different

SEM= Standard error of means.

LS= Levels of significant

* = Significant ($P<0.05$)

NS = Non-significant ($p>0.05$)

T_1 = (0 % *Stylosanthes hamata* and 100 % Groundnut cake)

T_2 = (25 % *Stylosanthes hamata* and 75 % Groundnut cake)

T_3 = (50 % *Stylosanthes hamata* and 50 % Groundnut cake)

T_4 = (75% *Stylosanthes hamata* and 25 % Groundnut cake)

T_5 = (100 % *Stylosanthes hamata* and 0 % Groundnut cake)

Table 4.7 : Mean internal organs expressed as percentage of live body weight

Parameter (%)	T_1	T_2	T_3	T_4	T_5	SEM	LS
Abdominal fat	0.25^{a}	0.12^{d}	0.21^{c}	0.22^{b}	0.24^{ab}	0.03	*
Liver	3.14	3.12	3.14	3.14	3.14	0.07	NS
Lungs	0.80	0.79	0.80	0.79	0.80	0.01	NS
Heart	0.31	0.31	0.31	0.31	0.31	0.01	NS
Spleen	0.13^{a}	0.12^{b}	0.11^{c}	0.12^{b}	0.13^{a}	0.04	*
Kidney	0.84	0.81	0.84	0.81	0.81	0.20	NS
Intestinal weight	15.46^{a}	15.73^{a}	14.20^{b}	16.59^{a}	16.12^{a}	0.01	*

KEY:a, b, c, d : Mean values with different superscript in the same row significantly different ($p<0.05$).

N: number of replicates

LS: Levels of significance

NS: Not significant ($p>0.05$).

- : Significant difference

T_1 = (0 % *Stylosanthes hamata* and 100 % Groundnut cake)

T_2 = (25 % *Stylosanthes hamata* and 75 % Groundnut cake)

T_3 = (50 % *Stylosanthes hamata* and 50 % Groundnut cake)

T_4 = (75% *Stylosanthes hamata* and 25 % Groundnut cake)

T_5 = (100 % *Stylosanthes hamata* and 0 % Groundnut cake)

4.7 Organoleptic characteristics of weaned rabbits fed diets containing graded levels of *Stylosanthes* hamata leaf meal (SHLM).

The results of organoleptic characteristics of weaned rabbits fed graded levels of stylosanthes hamata leaf meal is shown in Table 4.8 Tenderness, and flavour did not show any significances ($P>0.05$) between treatments. The values for tenderness and flavour are similar and ranged from 6.00 -- 6.06, and 6.05 – 6.15 for T_1, T_2, T_3, T_4 and T_5 respectively. On juiciness, significant difference ($p<0.05$) were recorded between the treatments. *Stylosanthes hamata* significantly improved colour of the meat of the rabbits ($p<0.05$), the value for colour increases with the levels of *Stylosanthes hamata* inclusion in the diets. And rabbits in T_5 (100 % SHLM) were more acceptable compared to rabbits in the other treatments.

Table 4.8 Organoleptic characteristics of weaned rabbit fed diets containing graded levels of *Stylosanthes hamata* leaf meal (SHLM)

	TREATMENTS						
	T_1	T_2	T_3	T_4	T_5		
Paremeter	(0.00%)	(25.00%)	(50.00%)	(75.00%)	(100.00%)	SEM	SL
Colour	5.00^{c}	5.05^{c}	5.60^{b}	7.10^{a}	7.17^{a}	0.39	*
Tenderness	6.00	6.00	6.05	6.05	6.00	0.30	NS
Juiciness	5.66^{b}	5.75^{b}	$5..80^{b}$	8.15^{a}	8.30^{a}	0.26	*
Flavour	6.05	6.05	6.15	6.10	6.15	0.18	NS
Overall acceptability	5.00^{d}	6.33^{c}	6.35^{c}	7.00^{b}	8.05^{a}	0.13	*

KEY: abc = Means with different superscript on the same row are significantly different.($p<0.05$).

SEM= Standard error of means

SHLM= *Stylosanthes hamata* leaf meal.

LS = Levels of significant

* = Significant ($p<0.05$)

NS = Non-significant($p>0.05$)

4.8 Cost of feeding graded level of *styosanthes hamata* leaf meal to Weaned rabbitts

The result of cost of feeding graded levels of *styosanthes hamata* leaf meal to weaned rabbits is shown in Table 4.9. The cost of the feed per kg and the cost of daily feed intake per rabbits followed the same trend as the cost decreased with increase in the levels of *Stylosanthes hamata* in the diets.Whereas the cost of total feed consumed per rabbit and the cost of feed per kg weight gain also followed the same pattern as the costs value were higher in T_2 and T_4 compare to other treatments (T_1, T_3, and T_5) were the values were lower. There was a ($p<0.05$) significant reduction in feed cost per kg. The result tends to suggest that inclusion of *Stylosanthes hamata* at high levels in the diet of weaned rabbits may result in reduced cost of production in terms of feeding. This agreed with the view of Ani and Adiegwu (2005).

Table: 4.9 Cost of feeding graded levels of *styosanthes hamata* leaf meal to weaned rabbits

	TREATMENTS						
	Inclusion levels of *Stylosanthes hamata* leaf meal						
	T_1	T_2	T_3	T_4	T_5		
Parameters	(0.00)	(25.00)	(50.00)	(75.00)	(100.00)	SEM	LS
Total feed intake (g)	6970.00^{a}	6865.00^{ab}	6753.30^{bc}	6655.00^{c}	6515.30^{c}	44.52	*
Cost of feed/kg (#)	100.00	97.08	92.22	82.37	66.34	-	-
Cost of daily feed intake/rabbits (#)	9.55^{a}	8.17^{b}	7.41^{c}	7.35^{c}	6.38^{d}	0.30	*
Cost of total feed consumed/rabbits(#)	462.39^{e}	686.50^{a}	622.79^{c}	646.07^{b}	536.60^{d}	21.63	*
Average total body weight gain (g)	1000.00^{c}	1057.00^{b}	1126.70^{a}	1013.37^{b}	1021.70^{b}	13.36	*
Cost of feed/kg weight gain (#)	76.34^{a}	64.70^{b}	61.90^{c}	61.65^{c}	61.50^{c}	2.91	*

KEYS:-

a,b,c,d,e Mean in the same row with different superscripts differ significantly (P<0.05)

SEM= Standard error of means

= Naira

LS = Levels of significance.

* = Significant Difference

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

The proximate composition of the *Stylosanthes hamata* leaf mael (SHLM) as presented in Table 4.1. The result of the proximate composition of SHLM gave a value of 16.00 % for CP, this value was in agreement with the findings of Changjun *et al.,* (2004) and Williams *et al.,* 2012).

Table 4.2 showed the anti-nutritional factors present in *Stylosanthes hamata*. These low levels had to a large extent, rendered the anti-nutrients in SHLM inactive and safe for animal consumption.. The tannin content of *Stylosanthes hamata* was lower than those of cowpea and pigeon pea. Asante *et al.,* (2004) and Fasoyiro *et al.,* (2005) found the tannin content of cowpea and pigeon pea to range between 0.12-2.38 % and 0.43-4.60 % respectively.

Table 4.3 showed the proximate composition of the experimental diets. The values of CP content were similar to the values recorded by Iyeghe-Erakpotobor *et al.,* (2002\,2006) and Naandam *et al*., (2011) who fed *Stylosanthes hamata* and concentrate diets to weaner rabbits. The crude fibre increased as the level of *Stylosanthes hamata* leaf meal (SHLM) increases in the diets. The values were adequate for growing rabbit as reported by Johnson-Delaney (2006) and Mohammed *et al*., (2010; 2011). The values of EE, ranged from 4.00 % (T_5) to 6.35 % in (T_1) The values of fat were higher than the 0.67 to 0.80 reported by Iyeghe-Erakpotobor *et al., (2006).* The difference observed could be attributed to levels of inclusion of *Stylosanthes hamata* leaf meal.

The results of daily feed intake reveal that there were significant ($p<0.05$) differences in the daily feed intake. There were higher feed intake for rabbits on the control diet (T_1) than

those on the other treatment diets. The values recorded here were lower than those reported by Iyeghe *et al.* ,(2006) in a similar study. The difference observed could be attributed to variations in the duration of the experiment as well as to the level of inclusion of *Stylosanthes hamata* leaf meal in the diet. The daily weight gain results revealed that there were significant ($p<0.05$) differences in the daily weight gain. The highest gain of 13.41 g, / day obtained by the rabbits on diet T_3, agreed with the one obtained by (Bamikole *et al.*, 1999) who further stated that caribbean *stylo* (*Stylosanthes hamata)* Verano hay will support rabbit growth up to 50 % inclusion level of the dietary concentrate and sustain similar average rabbits growth rate as control diet. while the lowest value of 11.90 g was obtained in diet T_1. The result obtained for feed conversion ratio (FCR) is also shown in table 4.4. with the highest values of 6.97 g (T_1) and lowest value of 5.99 (T_3) is an indication that rabbits efficiently utilized all the four test dietary treatments. The values obtained for feed conversion ratio was lower than the values reported by Iyeghe *et al.*, (2006) but falls within the range of 5.89 and 10.30 reported by Naandam *et al*. (2011).

The results of nutrient digestibility was presented in Table 4.5, there were significant difference ($p<0.05$) between rabbits on all the treatment diets. These values were similar to the values reported by Iyeghe *et al.*, (2002) for dry matter digestibility when they fed *Stylosanthes hamata* with concentrate at different ratio to rabbits. The values gotten for apparent crude protein (CP) digestibility showed similar trend to that of dry matter, The highest value was gotten from rabbits on diet T_3 (73.20 %) while the lowest values was obtained in rabbits fed diet T_1 (66.81%). There was a significant ($p<0.05$) difference in CP digestibility by the experimental rabbits. The result agrees with the reports of Eustace *et al*. (2003) who reported similar crude proteinc digestibility values on similar study. However, the high CP values obtained were indication that protein was efficiently digested in the body of the rabbits. There was significant difference ($p<0.05$) in the values obtained for

digestible crude fibre (DCF) and there values increased with increased level of *Stylosanthes hamata* in the diets. The highest value (69.50 %) was obtained from the rabbits on diet T_5 and the lowest (58.26 %) from diet T_1. The result of the CF was in agreement with Esonu *et al*. (2004) who had earlier reported that crude fibre activates the intestine and initiate more occurrence of peristaltic movement and more enzyme production resulting in efficient digestion of nutrient. The values for ash digestibility were similar to that of DEE, as the values increased up to 50 % inclusion level after which it started to decline. This might be due to the range of inclusion levels of SHLM in the diet. The result of the values obtained for digestible nitrogen free extract (DNFE) were high and similar to each other within the treatments. The differences observed might also be as a result of those reason afore mentioned. Igwebuike *et al*. (1999) had reported reduced digestibility due to high levels of dietary fibre in rabbit diets.

The body weight of rabbits fed the control diet were significantly ($p<0.05$) lower than those of other experimental diets except those on diet T_5 (Table 4.6). This result is similar to that obtained by Omole, Adejuyigbe, ajayi and Fapohunda (2007) where they observed heavier final live body weight and carcass cuts in rabbits fed *Stylosanthes guianensis and lablab purpureum* as a sole feed for growing rabbits. The result also indicated that the rabbits fed control diets had significantly ($p<0.05$) lower hind limb, thoracic and lumber sacra proportion compared to other rabbits. However, there was no significant difference ($p>0.05$) in dressing percentage and tail weight of all the treatment groups This agreed with the work of Fasanya and Ijaiya (2002) who reported that different levels of protein supplements had no effect on the growth of fore and hind limbs, weight of breast and dressing percentage of rabbits. The dressing percentages values were similar to the values reported by Ayoade et al., (2000) and Dairo et al., (2005) but lower than the 72.92 to 77.39 % reported by Okorie *et al.,* (2003), and Esonu et al., (2006) . The reason for the

similarities observed in dressing percentage could be attributed to level of diet inclusion, age of the animals and methods used in carcass cuts.

The values obtained for parts and organ weight were expressed as percentage of live weight. (Table 4.7). The weight of liver (3.12-3.14 %), lungs (0.79-0.80 %), heart (0.31 %), and kidneys (0.81-0.84 %) were no significant ($p>0.05$) different across the treatments, this agreed with the work of Abubakar, *et al.,* (2011) reported that the weight of the liver, lungs, heart and kidney percentage were not t different across the treatment. However, there was a significant difference ($p<0.05$) in abdominal fat, spleen and intestinal weights of all the treatment diets.

The result of organoleptic characteristics of weaned rabbits fed graded levels of *Stylosanthes hamata* leaf meal was shown in Table 4.8. Tenderness, and flavour did not show any significant difference ($p>0.05$) between treatments. The values for tenderness and flavour were similar and ranged from 6.00 – 6.06 and 6.05 – 6.15 for T_1, T_2, T_3, T_4 and T_5 respectively. On juiciness, significant differences ($P<0.05$) were recorded between the treatments. Factors that influenced juiciness include: the animals age at slaughter, the amount of fat and collagen (connective tissue) contained in the particular cut and finer details in the cooking procedure. This values are similar to the one obtained by Hughes *et al.,* (1997) and Pietrasik and Duda, (2000), on a similar study. *Stylosanthes hamata* significantly improved colour of the meat of the rabbits ($p<0.05$), the value for colour increases with the levels of *Stylosanthes hamata* inclusion in the diets. However, rabbits on T_4 and T_5 (75% and 100%SHLM) ranked the same in colour (reddish). However there were no significant differences in the colour of T_1 and T_2 rabbits. The values for juiciness ranged from 5.66 (T_1) to 8.30 (T_5), flavour ranged from 6.05 – 6.15 for treatments one to five respectively. And rabbits in T4 and T5 (75 and100 % SHLM) ranked the same in terms of acceptability compared to rabbits in the other treatments.

The cost of feed per kg and the cost of daily feed intake per rabbits followed the same trend as the cost decreased as the levels of *Stylosanthes hamata* diets inclusion increased. Whereas the cost of total feed consumed per rabbit and the cost of feed per kg weight gain also followed the same pattern as the costs were higher in T_2 and T_4 compared to other treatments (T_1, T_3, and T_5) with lower values. There was significant reduction in the feed cost per kg. the result tend to suggest that inclusion of *Stylosanthes hamata* leaf meal in the diet of weaned rabbits may result in reduced cost of production in terms of feeding. This agreed with the view of Ani and Adiegwu (2005) , Iyeghe (2006) and Ani (2007) that the use of alternative livestock ingredients tend to reduce the overall cost of production.

5.1 Conclusion

A close consideration of the results from this study revealed that rabbits fed diets supplemented with *Stylosanthes hamata* leaf meal had improvement in their growth, feed intake, final body weight,body weight gain and feed conversion ratio within the twelve weeks of the feeding trials.

The carcass of rabbits fed *Stylosanthes hamata* leaf meal were significantly different from those of the control group ($p<0.05$) significant differences were also recorded in the live weight and slaughter weight percentages of rabbit carcass of those of 25, 50, 75 and 100% *Stylosanthes hamata* leaf meal levels when compared to 0% ($p<0.05$). However, the mean internal organs such as the lungs, liver, heart and kidney for all treatments had no significant difference ($p>0.05$). significant difference ($p<0.05$) were also recorded in the abdominal fat, spleen and intestinal weight for all the treatments. Nutrient digestibility of CP, CF, EE and NFE also improved due to *Stylosanthes hamata* leaf meal inclusion in the experimental diets of the rabbits. All rabbits fed *Stylosanthes hamata* leaf meal at varying inclusion levels performed better than the control group. Generally, the highest level of

performance was recorded in 50 % *Stylosanthes hamata* leaf meal diets, while the least performance in terms of growth and carcass characteristics occurred in the 0 % *Stylosanthes hamata* leaf meal diet. It is therefore concluded that 50 % inclusion level of SHLM had the best result. The usage of this material will help to reduce scarcity of rabbit feeds and also reduce dependency on conventional feed ingredients such as grains that bring competition between man and animals.

5.2. Recommendation.

It is recommended, therefore that the use of SHLM as feed ingredient in rabbit diets should be encourage among rabbit keepers to reduce scarcity of rabbit feeds and competition between man and animals for some conventional feed ingredients such as grains.

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APPENDIX I

PROCEDURE FOR PROXIMATE ANALYSIS

Proximate analysis is a scheme for obtaining values of a feed. This was developed by Hennerberg and Stodman at the Weendy Agricultural experimental station in Germany in 1860.

The approximation separated the ingredient into the folloeing:-

1. Dry matter
2. Crude protein
3. Crude fat or Ether extract
4. Crude fibre
5. Nitrogen free extract
6. Ash.

Dry Matter

Feed 2g faecal samples were taken and dried in the oven at 600^0C for 48 hours. The dry matter determination was obtained as

$$\%DM = \left\{ \frac{final\ weight\ of\ sample}{initial\ weight\ of\ sample}\ X\ 100 \right\}$$

Crude protein

Feed sample 2g were weighed into Kjeldahl digestion flask into which 40ml of concentrated sulphuric acid was added. Selenium tablet (catalyst) was added. This

determination is based on the possibility that most of the nitrogen in the sample comes from amino acids and that the average nitrogen content of the protein in the feed is 16%

The digest was allowed to cool and diluted with distilled water. The excess acid was neutralized with sodium hydroxide. The solution was later distilled into boric acid indicator solution until a reddish-pink colour was obtained. The protein in the sample was obtained by multiplying the nitrogen by 6.25.

% Crude protein ={Total N X 6.25}

Ether extract

These include all portions of feed soluble in ether and contains true fat, fat soluble vitamins and pigments, phospholipids, waxes etc

Ground sample 1g was weighed into a known weight of filter peper and well folded. The sample was inserted into the soxhlet extraction jacket which was then attached to a round bottom flask into which petroleum ether had been poured. The flask was heated up and the jacket refluxed for about 24 hours. The fat in the sample was extracted into the flask. The sample was removed and dried in an oven for 1 hour and the residue was weighed.

% Ether extract was calculated as :-

$$\% \text{ Ether extract} = \left\{ \frac{weight\ of\ extraction}{weight\ of\ sample} X\ 100 \right\}$$

Crude fiber

These include cellulose, hemicelluloses and lignin. Dried fat free sample 2g was weighed into a beaker, H_2SO_4 200ml was added and it was placed under condenser until it boiled.

Further gentle boiling for 30 minutes using distilled water to maintain volume was done. It was then filtered and the residue transferred to the beaker. NaOH solution 200ml was added. All the procedures for removing the protein, sugar, starch, minerals and more soluble hemicelluloses were carried out. The sample was then ashed at 500^0C for 6 hours, cooled, and weighed.

% Crude fibre was calculated as :-

$$\% \text{ Crude fibre} = \left\{ \frac{weight\ of\ crude\ fibre}{weight\ of\ original\ sample} \ X\ 100 \right\}$$

Ash

This includes the organic and mineral portion of the feed ingredient. 2g of the dry sample was weighed in a crucible and placed in a furnace at 500^0C for 6 hours to obtain complete ash. The sample was allowed to cool before weighing and difference in weight was obtained.

% Ash was calculate as :

$$\% \text{ Ash = extract} = \left\{ \frac{weight\ of\ ash}{weight\ of\ original\ sample} \ X\ 100 \right\}$$

Nitrogen free extract

This include starch, sugar and some of the more soluble hemicelluloses and lignin. The fractions obtained by adding all the percentages in the above and subtracted from 100. Thus,

100 — (%Moisture — CP + EE + CF + Ash) = % NFE

APPENDIX II

PROCEDURE FOR ANTI-NUTRITIONAL FACTORS

Determination of Oxalate

Exactly 1.5g aliquot sample was weighed into 250ml volumetric flask and digested with a mixture of 190ml distilled water 10ml 0f 6N hydrochloric acid. It was incubated in a water bath at 90^0C for 5hours. Therefore the mixture was centrifuged and filtered into a 250ml volumetric

flask and the filtered made up to mar with distilled water. 50ml aliquot of the extract was mixed with 25ml 6NHCL and the mixture evaporated to about 26ml in hot plate. The brown precipitate formed was filtered off and washed with hot distilled water, the combined washings were titrated with concentrated ammonia until the pink yellow was obtained, and the solution was then heated on a hot plate to about 90^0C, the oxalate was precipitated with 10% (W/V0 calcium chloride solution. After keeping the mixture overnight, it was filtered and the precipitate washed with distilled water until calcium free is tested with bench sodium hydroxide.

The precipitate was then washed with 25% (V/V) sulphuric acid solution and diluted to125ml with distilled water. It was warmed to 90^0C and titrated with 0.05 potassium permanganate solution.

$$CaC_2O_4 \longrightarrow CaSO_4 + H_2C_2O_4$$

$$2MnO_4 + 5C_2O_4^{2-} + 16H \longrightarrow 2Mn^{2-} + 10Co_2 + 8H_20$$

Calculation: 1M of 0.05 N$KMnO_4$ = 2.2 mg oxalate

Determination of Phytate (Reddy et al., 1982)

Exactly 4.0g of neem seed cake was weighed out and soaked in 100ml of 2% hydrochloric acid and filtered 25ml of the filtrate was taken into a conical flask and 5cm^3 of 0.3% ammonium thiocyanide solution was added, the mixture was filtered with a standard solution of Iron (iii) chloride until brownish colour persists for 5minutes. Three replicate determinations were performed.

Calculation: 1cm^3 of 0.02M$FeCl_3$ = 0.601mg Phytate

Determination of Tannins (Allen et al., 1974)

0.5g grounded sample of neem seed was weighed into 100cm^3 conical flask, 50cm^3 of distilled water was added and allow to boil gently for 1hour on a hot plate. The solution was filtered, paper was washed and added into the solution and made to volume. When cooled 0.3cm^3 of tannic acid was taken into a range of 0.5cm^3, 1.0cm^3, 1.5cm^3, 2.0cm^3, 2.5cm^3 and 3.0cm^3 corresponding to 0.05mg, 0.1mg, 0.15mg, 0.20mg, 0.25mg, 0.30mg of the sample was pipette into 50cm^3 volumetric flask. To both standard and sample, water was added until half full. 2.5cm^3 of folin dernic reagent was added to each flask of carbonate solution and diluted to 50cm^3 marks and mixed. These were allowed to stand in water bath at 25^{0}C for five minutes. The optical density (absorbance) readings were taken at 760nm wavelength using distilled water as blank; the calibration curved was used for the result

Calculation

$$\text{Soluble tannins (\%)} = \frac{\text{conc graph x extract volume}}{\text{10 aliquate x sample wei}}$$

Determination of Saponins (Hudson and EL.Difrawi, 1979)

10g of neem seed sample was taken into a 100cm^3 of 20% aqueous ethanol in water and agitated with a magnetic stirrer for 12 hours at 55^0C, the solution was filtered using Whatman no 1 filter paper and the residue was re-extracted with 300cm^3 of 20% aqueous ethanol, the extract was combined and reduced to about 40cm^3 under vacuum using rotary evaporator, the extract and 20cm^3 diethylether were transferred into 250cm^3 separating funnel and shaken vigorously, the aqueous layer was discarded and the process of pacification was continue until a colorless aqueous content was obtained, the pH of the remaining aqueous solution was adjusted to about 4.5 by adding 4g of sodium dichloride and the solution was shaken. The butanolic extract was washed twice with butanol 10cm^3 of 5% (W/V) sodium chloride and evaporated to dryness in a fulum cupboard to give the saponins which is weighed and expressed as percentage.

Determination of Cyanide Content

Alkaline filtered method (AOAC, 1980) was employed. 10g of neem seed sample was soaked in a mixture of 200cm^3 distilled water and 10ml of orthophosphoric acid, the mixture was left for 12 hours to release all bounded hydrogen cyanide (HCN). A drop of anti-foaming agent (tannic acid) and anti bumping agent were added and the solution distilled until 150ml of the distillate was collected in a conical flask and dilute with 40cm^3 of distilled water. 8ml of 6mol/dm^3 ammonia hydroxide and 2cm^3 of 5% potassium iodide solution were added, the mixture was titrated with 0.02mol/dm^3 silver solution using a micro burette until a faint but permanent turbidity was obtained.

Calculation: 1ml/dm^3 of $AgNO_4$ =1.08mg

Determination of trypsin inhibitor levels.

The trypsin inhibitor levels were determined by the method of Kakade *et al* (1974) as modified by smith *et al* (1980).The following solutions were prepared:

Tris – Buffer (0.05M. pH 8.2) containing 0.02M $CaC1_2$: This was prepared by dissolving 6.05g Tris (8-Hydroxymethylaminomethane) and 2.94gm $Cacl_2$-$2H_20$ in 500ml distilled water. The OH of the resulting solution was adjusted to 8.2 with the volume brought to 1 litre with distilled water.

Substrate solution: This was prepared by dissolving 40mg of N- benzoyl - DL - anginine-P-nitro-anilide (BAPNA) hydrochloride in 1ml dimethylsulphoxine in a 100ml volumetric flask. The volume was made up to mark with the tris-bufer previously warmed to 37^0C. The BAPNA solution was prepared daily and kept on a hot plate at 37^0C while in use.

Trypsin solution: This was prepared by dissolving 4mg of trypsin in 200ml of 0.001M HCL. The solution was preserved in the refrigerator for 3 weeks without loss of activity.

Procedure for Determination of trypsin inhibitor: 1g of the finely ground sample was extracted with 50ml of 0.01M NaOH for 1hr. The pH of the suspension was adjusted to between 9.5 and 9.8 with 0.01M HCL. 2ml portion of each extract was pipetted into a 50ml volumetric flask and made up to mark with distilled water (giving it a dilution factor of 25)

In determining the trypsin inhibitor level, the following additions were pipetted into a series of 10ml test-tubes.

(a) Reagent blank: This was prepared by pipetting 2ml distilled water in a test – tube marked A

(b) Working standard trypsin (40ug): prepared by adding 2ml standard trypsin solution to 2ml of distilled water in a test-tube marked B.

(c) Sample blanks were prepared by adding 1ml of diluted sample extract to 1ml distilled water in test tube marked C.

(d) Samples were also prepared by adding 1ml diluted sample extract to 1ml diluted water and 2ml standard trypsin solution in a test-tube market D.

All the tubes were thoroughly mixed and heated to 37^0C in a water bath for 10 minutes, 5ml of BAPNA solution previously warmed to 37^0C was added to each tube and mixed. The reaction was stopped after 10 minutes by the addition of 1ml 30% (v/v) acetic acid solution to tube A, the reagent blank and to sample blanks. The tubes were thoroughly mixed and filtered through Whatman N0. 41 filter paper. The absorbance of the sample blanks, standard trypsin and samples respectively were taken at 410nm in a spectronic 20 spectrophotometer using the reagent blank as a reference.

Calculation

Change in absorbance (A_1) due to trypsin inhibition per ml of diluted sample extract is (A_b - A_a) where (a – d) is as shown below.

$$\% \text{ TIA} = \frac{100A_1}{(A_b - A_a)}$$

1 g pure trypsin gives A_{410} = 0.0190. Weight of pure trypsin inhibited per ml is

$$\frac{A_1}{0.0019} \text{ g} \quad \text{that is} \quad \frac{50A_1}{(19 \text{ mg } 50 \text{ml}^{-1}}$$

From the above value, the Trypsin inhibitor activity (TIA) is therefore calculated in terms of mg pure trypsin per g sample as weighed (mg/g).

$$TIA = \frac{2.632 \cdot D \cdot A_1}{S} \text{ g} \quad \text{Pure trypsin inhibitor per g sample}$$

Where D is Dilution factor

A_1 is change in Absorbance due to trypsin inhibition per ml of diluted sample extract

S is sample weight.

2.632 constant factor obtain from 50 as weight of pure trypsin inhibited per ml.