Growth Performance of Broilers Fed on Processed *Acacia Tortilis* Seed Meal as a Replacement of Soya Bean Meal

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Abstract

Chicken is a major source of protein to humans and a regular income earner to the farmer. *Acacia tortilis* seeds meal is a key diet in poultry farming. This study sought to determine the growth performance of broiler chicken fed on processed *Acacia tortilis* seed meal as a replacement of soya bean meal. The study employed a Completely Randomized Design (CRD), and aimed at achieving the following specific Objectives: to determine the growth performance of broilers fed on processed *Acacia Tortilis* seed meal as a substitute of Soya bean meal; to determine carcass characteristics of broilers fed on processed *Acacia Tortilis* seed meal as a substitute of Soya bean meal; and to determine the economic benefit when broilers are fed on diets containing processed *Acacia Tortilis* seed meal as a substitute of Soya bean meal. The study adopted an experimental methodology. The broiler chicks were randomly assigned to six treatments, with three (3) replication (five birds per cubicle). The replacement feed levels; T0-Control 0% acacia + 100% soybean, T1-20% acacia + 80% soybean, T2- 40% acacia + 60% soybean T3- 60% acacia+ 40% soybean, T4 - 80% acacia + 20% soybean and T5 - 100% acacia+0% soybean in a deep litter rearing system. Ninety-day old broiler chicks of mixed sex were experimented. The chicks were fed on broiler starter for 7 days and on experimental diet from day 8-35. The feed and water was provided *ad libitum*. Data collected was summarized and organized in excel. SPSS software was used to carry out Analysis of Variance (ANOVA), using the predictive analysis software version 20. The initial body weight was not significant ($p > 0.05$). The Final weight gain, Daily weight gain, Body weight Change was significant and biomass harvested was significant ($p < 0.05$), where T1 was the highest, followed by T2, T0, T3, T4 and T5 in that order. Voluntary feed intake was not significant ($p > 0.05$), showing that this ration was palatable and acceptable by the birds. Feed conversion ratio (FCR), T1 was the lowest and was significant ($p < 0.05$) and T5 was the highest. The higher the FCR the lesser desirable the feed is. It is recommended that *Acacia tortilis* seed meal of up to 40% can be included in chicken diet as a substitute of Soybean meal but optimally at 20%.

Key Words: *Acacia tortilis, Soybean, broilers, growth performance, Anti- nutritional factors*

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1.0Introduction

Feeding the planet is a major challenge today as human population grows and natural resources are constantly strained. By 2030, 80 % of people will be living in urban areas in the developing world (Population Fund, 2007). Livestock plays an important role in providing the human population with high-quality protein and regular income to farmers (McLeod, Ahuja & FAO, 2011). Globally, demand for chicken and their products have shown a rapid upward trend, with chicken accounting for 28% of all meat.

Chicken meat and eggs in many cultures are appropriate feeds. Chicken can even be raised at home by families with very little land and small amounts of feed which they can effectively convert into meat and eggs. They are sustained even by poor farmers. Indigenous chickens play a large role in rural Africa's household food supply. Nowadays they are raised with more efficient output per bird in semi-intensive systems (Radwan et al.,2010).

The shortage of chicken feed may be improved by blending full on-farm rations with imported and local feed ingredients; diluting foreign feed bought with local ingredients; and by matching a purchased concentrate combination with local ingredients. Chicken requires nutrients which can survive, grow, produce and reproduce. Important amounts of energy, carbohydrates, essential amino acids, essential fatty acids, minerals, vitamins, and particularly water are required.

Chicken obtains energy and essential nutrients through the ingestion and digestion of natural feed. They also receive as synthetic supplements minerals, vitamins, and some important amino acids (lysine, methionine, threonine, and tryptophan). Chicken producers continue to search for ways and means that allow for flexibility of feed formulations in both the types and quantities of feed ingredients to be used. These prospects are growing because of developments in nutrient analysis research and feed assessment technologies (UN-FAO, 2013).

Acacia tortilis trees grow abundantly in the vast rangeland in the Arid and semi-arid lands of Kenya and produce large quantities of seeds during the dry seasons. The leaves and pods of the tree are eaten by other species and thus provide an opportunity to feed chicken if it is possible to use them. During the dry season, *Acacia tortilis* pods and leaves were used as a substitute in low quality forage grazed by ruminant livestock to provide energy and protein feedstuffs.

Grinding increases the digestibility of the seeds (Aganga et al.,1998).Through this research, it is envisaged that *Acacia tortilis* seed meal could be used as an ingredient in formulations of poultry feed. A solution to the rising ingredient costs is to explore the potential of alternative feed as part of replacing costly traditional feed ingredients such as soybean (Animal Science and Range Management Department 2017). In the study the bird were fed different replacement levels of soya bean with *Acacia tortilis* seed meal.

The experimental diet was introduced after the bird had acclimatized. The first week of life they were fed commercial starter mash and introduced to the experimental diet from day 8 to the end of the experiment at 35 days. The processed *Acacia tortilis* seed meal had not been utilized as an alternative feed ingredient in chicken feed in the region before. The study sought to provide an alternative feed ingredient for inclusion in chicken feed formulation and contribute to academic knowledge. The study was thus designed to evaluate the growth output of broilers when they're fed on processed *Acacia tortilis* seed meal as a substitute for soya bean meal.

2.0 Materials and Methods

The experiment was conducted at Mangaza estate which is located in Isiolo Municipality, Wabera ward Isiolo North Sub County, Isiolo County in Kenya. Mwangaza estate is located on western side of *Isiolo International Airport,* about 1km from Isiolo Town centre. At an altitude of 1085 meters above sea level with Northing 341547 and Easting 36561 coordinates Arc 1960 utm 37n (Isiolo Land Department).The feed diet was composed of the following ingredients; maize germ, maize grain, processed *Acacia tortilis* seed meal, soybean meal, fish meal (*Rastrionaebola argentea*), cotton seed cake, sunflower cake, wheat pollard, broiler premix, stock salt, limestone, methionine, lysine bone meal, Salinomycin and Mycotoxin binder.

The diet ingredients were sourced from the main markets in Meru County and the other ingredients were purchased from well-known feed manufacturer and from supermarkets. The *Acacia tortilis* pods were collected from the trees in the vicinity of Maili Saba town in Buuri sub county, Meru county- Kenya. The pods collected were dried and thrashed to release the seeds. Winnowing was done to remove the chaff. The seeds were boiled for 1 hour to reduce the anti-nutritional factors and increase digestibility. After boiling, water was decanted. Seeds were dried and ground into flour using a hammer mill.

The flour was sent to laboratory for proximate analysis and was used to formulate the diets at various substitution levels of soya bean. Proximate analysis was carried out at the College of Agriculture and Veterinary Science, Department of Animal Production, University of Nairobi, Kenya, for all eight key fed ingredients used in dietary formulations following the AOAC (1995) protocol. The crude protein and dietary energy levels were rendered as isonitrogenous and isocaloretic as much as possible.

3.0 Results and Discussion

The main purpose of formulating a chicken diet is to provide an affordable cost of a nutritionally healthy mixture of ingredients to support the maintenance, growth, reproduction and health of animals (NRC, 1993, Kirimi et al., 2016). Table 1 shows the composition of the feed ingredients by weight per treatment.

Table 1
Ingredient Composition, Calculated Crude Protein (%) and Metablizable Energy (Kcal/kg), of the Diets Supplemented to Broiler Chicks Containing Acacia tortilis meal as replacement for Soybean Meal

Ingredients	T0	T1	T2	T3	T4	T5
Maize germ	3.85	3.85	3.85	3.85	3.85	3.85
Wheat pollard	10	10	10	10	10	10
Fish meal	4	4	4	4	4	4
Cotton seed cake	8.05	8.05	8.05	8.05	8.05	8.05
Acacia seed meal	**0**	**3**	**6**	**9**	**12**	**15**
Maize grain	27	27	27	27	27	27
sunflower	2.1	2.1	2.1	2.1	2.1	2.1
Soybean meal	**15**	**12**	**9**	**6**	**3**	**0**
Stock salt	0.175	0.175	0.175	0.175	0.175	0.175
Limestone	0.98	0.98	0.98	0.98	0.98	0.98
Bone meal	0.91	0.91	0.91	0.91	0.91	0.91
Salinomycin	0.035	0.035	0.035	0.035	0.035	0.035
Mycotixin binder	0.105	0.105	0.105	0.105	0.105	0.105
Methionine	0.035	0.035	0.035	0.035	0.035	0.035
Lysine	0.28	0.28	0.28	0.28	0.28	0.28
Broiler premix	0.14	0.14	0.14	0.14	0.14	0.14
Total(kg)	72.66	72.66	72.66	72.66	72.66	72.66
ME	2930.8	2906.58	2888.31	2858.07	2833.83	2809.59
CP	22.0	21.8	21.7	21.5	21.6	21.7

Key: T=treatment, kg=kilogram, ME= Metabolizable Energy (Kca/kg), Kcal= Kilocalories, CP=Crude protein

Diet composition, formulation and feeding

The formulated diet ingredient composition was the same except the *Acacia tortilis* seed meal which was substituted with soya bean meal as indicated in Table 2.

Table 2

Substitution levels of Acacia tortilis seed meal with Soybean Meal in the diet formulation which was used to feed Broiler Chick in the study.

TREATMENT	FEED SUB STITUTION LEVEL
T0 Control	0% *Acacia tortilis* seed meal + 100% of Soya bean in the diet.
T1	20% *Acacia tortilis* seed meal + 80% of Soya bean meal in the diet
T2	40% *Acacia tortilis* seed meal + 60% of Soya bean meal in the diet
T 3	60% *Acacia tortilis* seed meal + 40% of Soya bean meal in the diet
T4	80% *Acacia tortilis* seed meal + 20% of Soya bean meal in the diet
T5	100 *Acacia tortilis* seed meal + 0% of Soya bean meal in the diet

Feed and water were offered to the chicken at *ad libitum* in the morning, at 6:30 a.m. Before placing more feeds, the left overs was collected and put in appropriate receptacles, stored and weighed weekly. The difference between feed offered and feed balance (left over) was used to calculate the voluntary feed intake per group. The spillage was assumed to be uniform for all treatments since all the feeders were homogenous. As such, the spillage was insignificant. The birds were weighed on weekly basis to access the weight gain. The weighing was done using electric balance. The feeder and waterers were clean every morning. The birds were vaccinated on day 7 for Newcastle disease, and on day 10 for gumboro. Hygiene was observed all the time. Disinfectant solution with water was placed in a container at the entrance of the chicken house for dipping the feet before entering to avoid introduction of pathogens. People were not allowed into the chicken house.

Daily weight gain (DWG) was measure as the difference between the chicks' final body weight over a span of 28 days, and their initial body weight. DWG percentage = [(final body weight)/ (initial body weight = 28 test days)

The effectiveness of the conversion of feed was determined by dividing average daily intake of feed per bird by average weight gain per bird

$$\text{FCR} = \frac{\text{Average feed intake}}{\text{Average daily wt. gain}}$$

Table 3

Proximate Composition of Feed Ingredient (%) Used to Formulate Diets for Broiler Chicks

Feed	CP %	DM %	Ash %	EE %	Fibre %	NFE	ME KCAL/Kg
Fish meal	64.01±0.22^{a}	92.67±0.02^{fecd}	18.14±0.03^{a}	12.94±0.03^{c}	0.20± 0.02^{h}	4.22±0.49^{h}	3437.49±1.99^{a}
Wheat pollard	15.85±0.08^{f}	92.75±0.02^{efcd}	3.96±0.04^{f}	5.14±0.04^{f}	9.87±.08^{e}	65.44±0.24^{bc}	2825.71±4.22^{f}
Sunflower cake	26.29±0.14^{e}	94.62±0.00^{a}	4.76±0.16^{de}	15.18±0.25^{b}	33.84±0.08^{a}	19.91±0.29^{g}	2961.82±12.73^{d}
Maize meal	8.15±0.17^{h}	89.97±0.05^{g}	1.35±0.06^{h}	3.66±0.03^{h}	3.90±0.03^{g}	83.45±0.30^{a}	2670.79±10.44^{h}
Maize germ	31.66±0.08^{dc}	93.40±0.23^{b}	5.51±0.16^{c}	7.66±0.10^{e}	23.62±0.30^{b}	31.01±0.27^{e}	2891.83±9.54^{e}
Cotton seed cake	12.93±0.08^{g}	87.70±0.01^{h}	3.46±0.04^{g}	12.50±0.10^{d}	6.14±0.09^{f}	65.40±0.28^{cb}	3096.80±4.93^{c}
Acacia tortilis seed meal	31.74±0.15^{cd}	92.94±0.03^{cfed}	4.74±0.01^{ed}	4.12±0.08^{g}	20.42±0.06^{c}	38.88±0.06^{d}	2743.21±5.20^{g}
Soya bean meal	36.37±0.14^{b}	92.87±.07^{dfce}	6.01±.01^{b}	19.40±0.18^{a}	14.27±0.04^{d}	23.71±0.01^{f}	3310.67±8.68^{b}

Values in the same column having different superscript are significantly different (P<0.05), CP=Crude protein, DM=Dry Matter, EE= Ether Extract (fat), MEKCAL/Kg=Mega Calories Per Kilogram and NFE = Nitrogen free extracts

Proximate Composition

The composition proximate of the check components, i.e. fish meal, wheat pollard, sunflower cake, maize meal, corn germ, cotton cake, *Acacia tortilis* seed meal and also soy bean meal used in this analysis was once inside the sequence of values mentioned by way of other authors (Drew et al., 2007; Um-E-Kalsoom et al., 2009; Al Mahmud et al., 2012); preferred healthful protein was once 64.01% of the most advantageous in fish meal and also 8.15 percentile in fish dish; Lovell (1988) kept in idea that the nutritional make-up of the feed depends upon the production, scenario and processing techniques employed.

The removal of oil solvents leads, in accordance to the National Research Council (1993), to soybean dish (SBM) having forty four percent crude wholesome protein if it is saved in soybean hulls or forty eight percentage crude protein besides the hulls. The reduced CP content of soybean resulted from adulteration of soybean dish by advertising businesses on the use of low-budget products of lesser quality, such as sawdust. This was shared in SBM's excessive CF fabric (14.27 percent) mainly doubling that of Agbo (2008) and Noreen, and Salim (2008). It is interesting to observe that whilst the amount of crude protein in soybean has

been listed below the anticipated level of between 36 and 48. This has had the specific same impact on the six dietary regimens generated. This shows that farmers were able to buy adulterated ingredients from unscrupulous merchants resulting in substandard formulations of feed, which in turn is reflected in low animal results. Sunflower cake recorded a 33.84 percent higher unrefined fiber of all active ingredients that were regarded as a limiting factor in their use as feed in monogatric animals.

The crude healthful protein web content material of fish meals (64.01%) was once lower than that of Otubusin (2009) which stated 70% CP. This percentage along with the ash net content material (18.4%) was once inside the ordinary variety which, in accordance to Drew et al. (2007), may differ from 50 to 70% and 10 to 21% specifically, based upon the plant, source and dealing with system. High fiber material minimizes the diet's total digestibility of nutrients as well as dry issue, leading to inadequate efficiency (De Silva & Anderson 1995). *Acacia tortilis* seed meal had CP of 31.74 which is comparable to that of SBM of 36.37. The protein content of sunflower meal (26.29%) was lower than 28% CP recorded by Maina et al. (2007). This may be attributed to the high fiber content (33.84 per cent) that is inversely proportional to the fiber content of the sunflower cake concentration (Maina et al.,2007). Sunflower seeds' chemical structure is determined by the crop's temperature, climate, selection and growing approach (Karunajeewa et al., 1989; Senkoylu & Dale, 1999). The fat value was (15.18%). This distinction in unrefined fat values might be attributable to the type of processing system employed before ether removal (Akande, 2011). Reported that sunflower crude fiber ranged from 14% to 39% (Villamide & San, 1998) (33.84%).

Maize meal (8.15 percent) consisted of unrefined nutritious protein. The dietary significance of secure maize protein varies by way of cultivar, grain shape (damage, flint, dent / flint), increasing issues (Korniewicz et al., 2000), drying out grain temperature (Kaczmarek et al., 2007), starch shape (Svihus et al., 2005), and even anti-nutrient visibility, mostly phytate, enzyme inhibitors, and immune starch (Cowieson, 2005).

In the sample, the crude protein content material of the six diets was once close to isoprotein (Table 1). This was once due to preliminary ingredient evaluate prior to food plan formula with a view of balancing for CP. Dietary protein plays a major role in providing amino acids that are important for growth and the biosynthesis of body proteins (Alam et al., 2016). Although the protein content was isoproteinous in the six diets, the concentration of protein ingredients per ingredient was meaningful ($P<0.05$).In this study, the crude fibre content differed significantly across diets ($P<0.05$). This difference in crude fibre was due to different ingredients for the crude protein to balance. Low fiber content of fish meal (0.02 percent) was high in protein. Crude fiber in the feed offers physical bulkiness, enhances binding and reduces feed passage through the feed channel (Ayuba & Iorkohol, 2012, Obeng et al., 2015). Monogastric animals, like chicken, however, are generally unable to digest fibre, as they do not secrete cellulose enzymes that allow ruminant animals to digest fibre (Bureau et al., 1999).

Carbohydrates of the cell wall can be quantified by determining the major components of neutral detergent fibers (NDF) which include cellulose, hemicellulose and lignin (Van Soest et al., 1991). NDF contains structural fibre, which is only partly digestible, and lignin is a completely indigestible component of NDF.

The highest NDF sample was maize meal at 83.45 per cent and the lowest was fish meal at 4.22 per cent.

A substantial underestimation of NSP (Non-starch polysaccharide) as well as a result overall dietary fiber web content happens where the identical neutral cleaning agent fiber tool is utilized in monogastric animal diet plan regimens for the research study of grains or protein supplements. The ash content in this study was significance ($p < 0.05$), the samples with highest figure was fish meal (18.14%) while maize meal was the lowest (1.35%).

Table 4

Growth Performance of Broiler Chicks Fed on Acacia tortilis Seed Meal as a replacement of Soybean Meal

	Treatment					
Parameter	0	1	2	3	4	5
IBW (g)	162.8±5.40^{a}	170.87±4.71^{a}	168.47±0.33^{a}	163.4±6.20^{a}	164.67±10.91^{a}	168.33±7.30^{a}
FBW(g)	1468.80±87.29^{cabd}	1681.13±53.18^{acb}	1496.27±7.12^{bcad}	1306.33±110.82^{dcbe}	1183.60±53.12^{ed}	966.27±63.7103^{f}
VFI(g)	2616.60±143.72^{a}	2975.067±64.14^{a}	2915.067±14.56^{a}	2875.467±164.35^{a}	2690.867±86.30^{a}	2541.600±79.96^{a}
BWC(g)	1306.00±82.10^{cabd}	1510.27±48.50^{abcd}	1327.80±7.18b^{acd}	1142.93±105.90^{dabce}	1018.93±42.25^{ed}	797.93±70.11^{f}
FCR	2.01±0.06^{efd}	1.96±0.04^{fed}	2.19±0.02^{defc}	2.53±0.09^{cdb}	2.64±0.08^{bc}	3.23±0.26^{a}
DWG(g)	46.98±3.26^{cabd}	53.94±1.73^{acb}	47.42±0.26^{bacd}	40.82±3.78^{dbcbe}	36.39±1.51^{ed}	28.50±2.50^{f}

Rows not connected by the same superscript letter are significantly different at P<0.05, IBW=Initial body weight, FBW = Final Body Weight, BWC = Body Weight Change, FCR=Feed Conversion Ration, DWG=Daily Weight Gain, and T=Treatment

The following bar charts for shows the results of different parameters analyzed

Figure 1

Mean final weight (g)

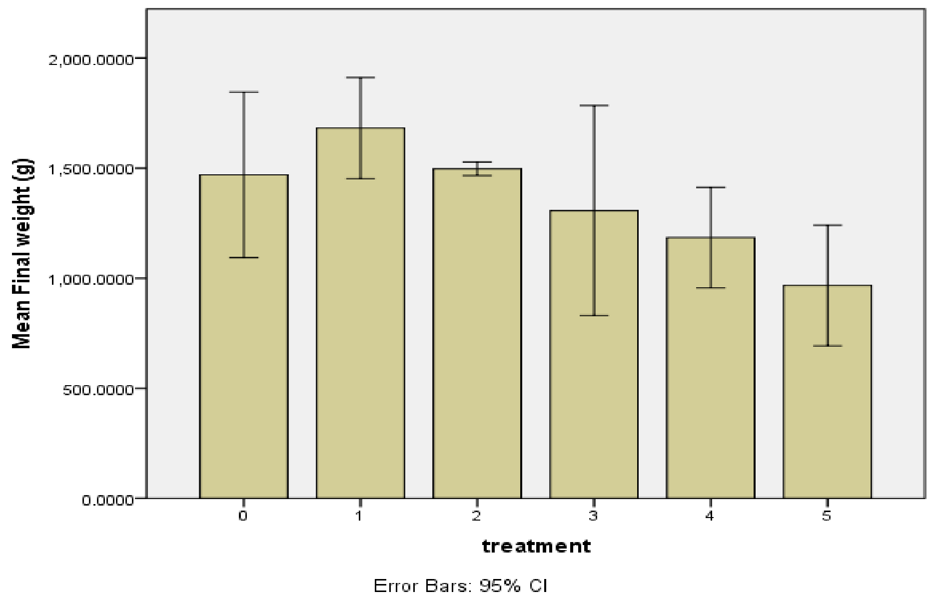


Figure 2

Mean weight gain

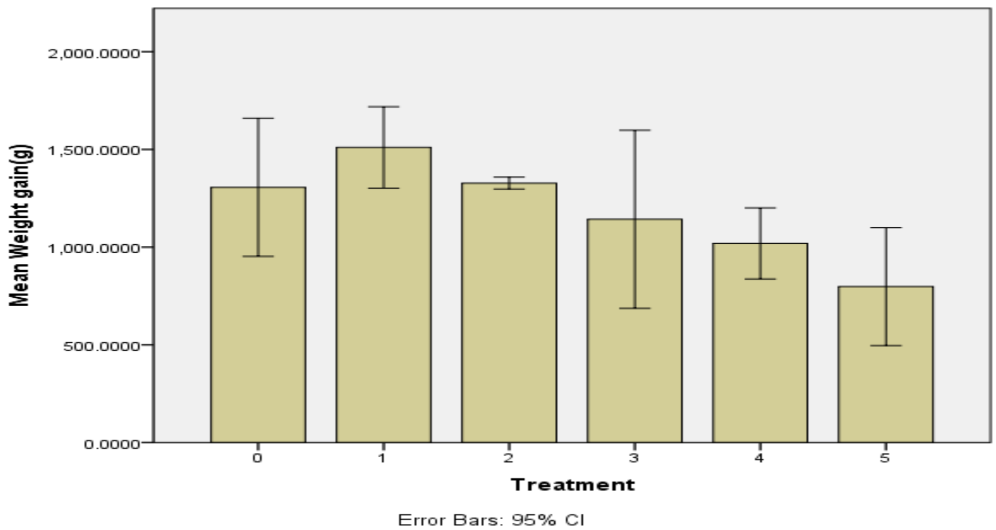


Figure 3

Mean Daily Weight Gaining

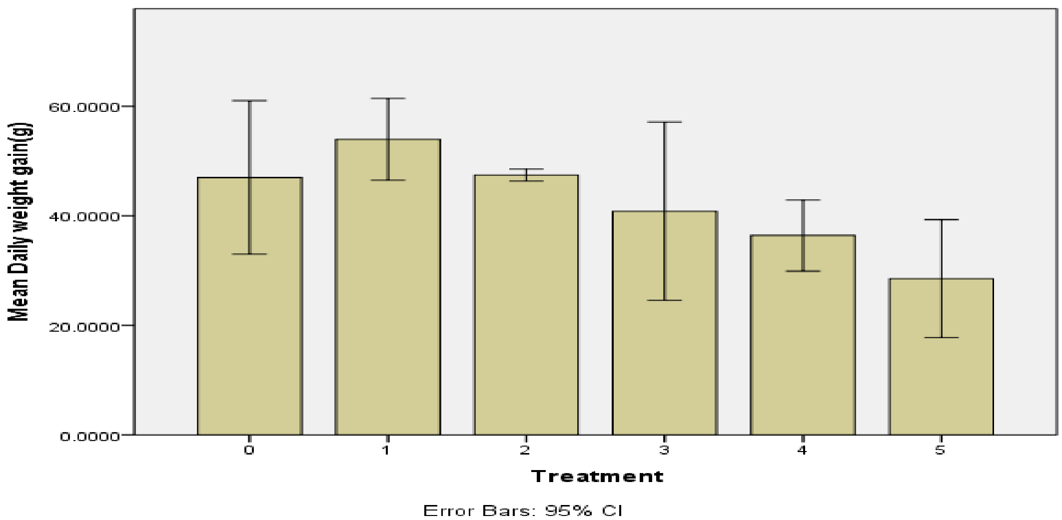


Figure 4

Mean biomass harvested in kg

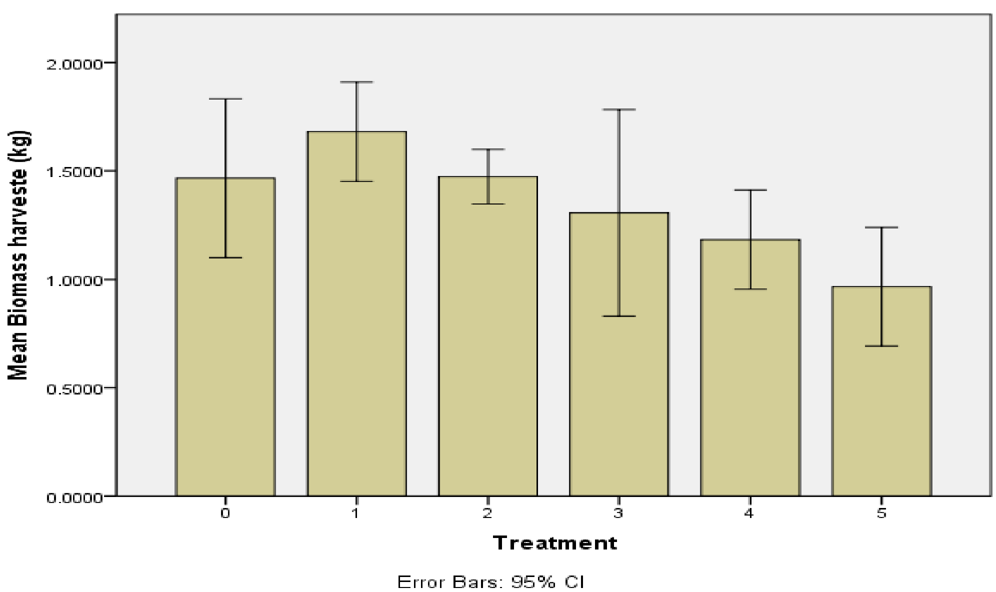
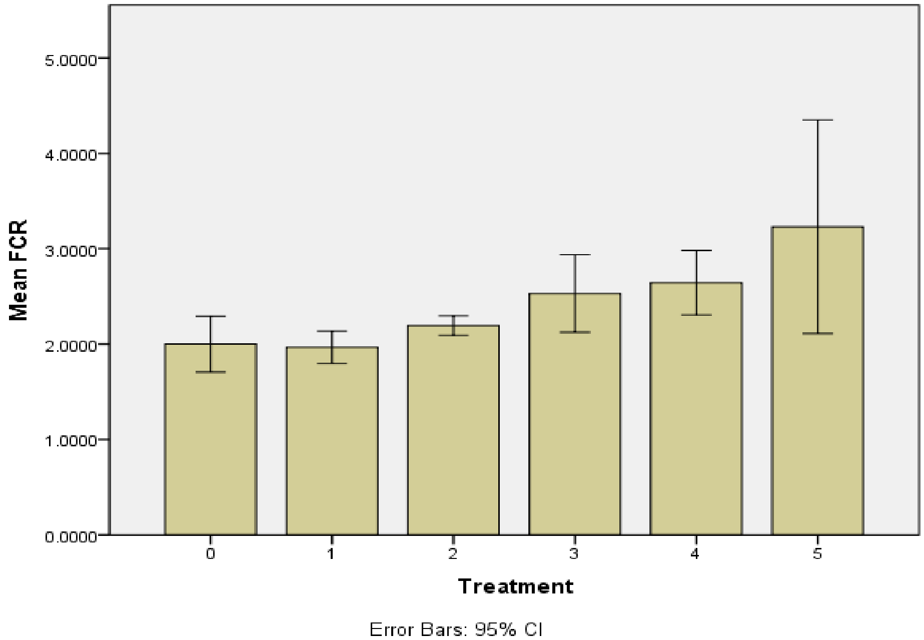


Figure 5

Mean Feed conversion ratio



The parameters used to determine Broiler 's growth efficiency were: initial body weight (IBW), final body weight (FBW), voluntary feed intake (VFI), body weight change (BWC), feed conversion ratio (FCR), daily weight gain (DWG), and biomass harvesting. The study results indicated that T1 was the best feed in all the parameters evaluated, revealing that *Acacia tortilis* seed meal (ATSM) could be used as a non-convectional feed in poultry feed formulations (Aganga, et al., 1998).

The T1 (20% replacement level of Soya bean meal (SBM with ATSM) had the best results in all the attributes. The poor performance of T5 could be attributed to anti Nutritional Factors in the *Acacia tortilis* seed Meal. Some of the anti-nutritional factors(ANF) found in *Acacia tortilis* trees are tannin and Phytates, which could have effect in minimizing protein utilization by the host animal and especially the chicken (Ward & Young, 2002).Dietary anti-nutritional factors for rising hen have been reported as having a detrimental effect on the digestibility of proteins and amino acid bioavailability. Owing to the presence of fewer digestible protein components, elevated amounts of insoluble fibers as well as large concentrations of all-natural or confirmed anti-nutritional factors during fermentation, reduced protein digestibility is correlated with less processed grain and grain vegetables as the key balanced protein options in dietary regimens.

In plant proteins, the naturally occurring anti-nutritional aspects such as glucosinolates, trypsin inhibitors, haemagglutinins and also tannins in vegetables as well as grains. High levels of tannin present in Acacia as well as various other plants can cause substantial reductions in the digestibility of healthy proteins as well as amino acids in chicken (as much as 23 per cent). Typical levels of phytate in grains as well as legumes can decrease healthy protein and amino acid digestibility by up to 10 per cent (Sarwar , Wu , &

Cockell, 2012).On volunteer feed consumption, ANOVA reported no important difference (p > 0.05) in all six treatments. Feed use is an example of the palatability and acceptability of formulated rations. This means the birds were palatable and appropriate with the formulated fed. This shows that refined ATSM can be used as a supplement for SBM as broiler feed without any adverse impact on the birds (Mehari & Alemayehu, 2016).

On daily weight gain there was significance difference ($p<0.05$), when Post Hoc tests were carried, T1 had the highest daily weight. T0, T1 and T2 were not significant; T2, T0 and T3 were not significant. T3 and T4 were not significant. T5 had the lowest Daily weight gain. The final weight gain has also the same trend whereby the highest weight gain was T1, followed by T2, T0, T3,T4 and T5 in that order. The same was observed in the harvested Biomass. There was no statistical significance between T0, T1 andT2, this shows that *Acacia tortilis* meal can be used in poultry feed formulation as source of protein up to 40% inclusion level, although the optimum level is 20%.

The feed conversion efficiency reflects the amount of feed consumed to produce a kilo of gain in weight of the bird. Birds on 20% (T1) *Acacia tortilis* had the lowest FCR ,while 100% acacia had the highest FCR. The birds with the lowest FCR had the highest weight gain and Daily weight gain (P<0.05). The lower the FCR, the more desirable the feed is.

4.0 Conclusion

Processed *Acacia tortilis* Seed Meal (ATSM) can be used in poultry fed ingredient as a substitute of soy bean meal to provide protein. Substitution level of (T1) 20% and (T2) 40% of soybean seed meal (SBM) with *Acacia tortilis* seed meal performed better than the (T0) control. There was no significance difference in T0, T1 and T2.This shows that although the optimum replacement level of SBM is 20% with ATSM, the substitution could be increased to 40% since the three treatments are the same.

5.0 Recommendation

Processed *Acacia tortilis* Seed Meal (ATSM) can be included in chicken diet up to 40% as a substitute of Soya bean meal (SBM) but optimally at 20%.

The study further recommends that future research could be carried out to investigate the factors which lead to T5 (100% ATSM as substitute for SBM) to be poor in all the attributes which were evaluated despite the fact that attempt was made to reduce the anti-nutritional factors by processing.

The community and manufacturer of poultry feed should be sensitized on the potential of *Acacia tortilis* seeds as poultry feed and produce it commercially.*Acacia tortilis* trees should be promoted for production of poultry feed and environmental conservation.

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