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Assessing sweet potato chips as a cost-effective alternative for maize in broiler's diet

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Abstract. *The consistent increase in the price of feedstuff, especially maize, is one of the many challenges faced by the Nigerian populace, especially the livestock farmers. The post-COVID-19 influenced food insecurity had increased the cost of feed available for livestock production especially in poultry industries. This study aims to assess sweet potato chips as a cost-effective alternative for maize in broiler's diet. One hundred and fifty broiler chickens were raised on deep litter intensive management system for eight (8) weeks and fed with sweet potato-based diet at the finisher phase (4th – 8th week). At 4 weeks of feeding the one hundred and fifty birds were distributed based on weight equalization from the pool into five treatments of three replicates each with ten birds per replicate. Milled sweet potato were incorporated to replace maize in diet at 25, 50, 75 and 100% inclusion. The diets were compounded to supply 21.32% crude protein and 3360.20 kcal/g ME on average. Data on performance were collected weekly, data on digestibility were collected daily during the last seven (7) days of the 28 days' experimental trial. The carcass yield was weighed at the last day of the experiment. The economic analysis was conducted based on the prevailing price at the time of the study. Data collected were subjected to analysis of variance and significant differences were compared using DMRT while a t-test ($p<0.05$) was used for economic analysis. Birds on maize diet utilized the feed better than those on sweet potato. Birds on T1 (100% maize-based diet) digested crude protein (27.44%) significantly better than those on sweet potato which resulted in the highest final weight (3.431 kg), dressing percentage and higher weights of breast, thigh and drum stick. On the other hand, the birds on 100% sweet potato diet were able to digest more soluble carbohydrates, hence, more energy than those on another treatment. The economic analysis revealed that 100% maize diet is economically better than sweet potato diet, although the latter has a great potential to serve as feedstuff for broiler finisher. It was recommended that further study should be carried out using pelletized feed as birds may pick grains in their diets rather than non-grains.*

Keywords: broiler's diet, alternative feed, meat performance, sweet potato chips

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Introduction

The poultry industry is germane in the growth and development of the various sectors of the economy as crucial for food consumption, income generation, and industrial development. It is possibly the fastest growing and most flexible of all livestock sectors. FAO (2013) reported that poultry production and product is expected to contribute about 27% of global protein intake while fish consumption contributed about 32% by the year 2023. In Nigeria, poultry contributes about 15 percent of the total annual protein intake with approximately 1.3kg of poultry products consumed per head per annum (Ologbon and Ambali, 2012). Out of these statistics, Broiler production is one of the major agricultural business enterprises that has added greatly to the income of our farming community and has greatly helped in employment in the rural areas through self-employment opportunities in Nigeria (Olagunju and Babatunde, 2011).

Nutrition and feed are the critical cornerstones of livestock production around the world. However, the consistent increase in the price of feedstuff especially the major ones such as maize grains, and scarcity due to increase in demands for human consumption and industrial use; are the most discouraging problems encountered by farmers (Afolayan et al., 2012). According to Ahaotu et al. (2020), the imminent demand-supply gap emanates from competition between the teeming population of human beings and livestock for the small quantity of available foodstuff. The situation got worst after the COVID-19 pandemic as there was a sharp surge in food insecurity due to lockdown, sickness among other factors (Bamiwuye et al., 2021; Hojatollah et al., 2022). The implication of the costly price of grains has paved the way for the alternative feed formulates such as cassava tuber meal and potato meal, potato chips, among others, which are cheaper than maize (Sakib et al., 2014; Ahaotu et al., 2018; Mosebework et al., 2018).

Sweet potato is one of the tuber crops whose cultivation is fast gaining ground in Nigeria. Presently, it is being grown exclusively for human consumption, while its foliage has always been considered as forage (Ahmed et al., 2012). In research stations, the estimated yield of some improved varieties in Nigeria varies from 40-70 t/ha/crop of roots and average yield of 23.5 tha-1 had been recorded in different zones of the country (Afuape et al., 2011). Its main nutritional importance has been its starch content; however, nutrients such as vitamin A, ascorbic acid, thiamine, riboflavin and niacin are also adequate (Ukom et al., 2009; Uwah et al., 2013). Carbohydrates constitute about 80-90% of dry weight of the tuber and have energy value with high percentage of soluble carbohydrates which is highly available and digestible because of its small granules.

Ex-igbariam spp of sweet potato has advantages over other spp. Ex Igbariam is one of the locally adapted clones of Abia State, South Eastern Nigeria. It is among the top five clones selected based on higher selection coefficients (Akoroda and Egeonu, 2008).

It has higher dry matter content of about 42.85% (Afolabi et al., 2020). Low dry matter content has been a challenge in using sweet potatoes to replace maize in livestock feed. This species also has comparatively higher crude protein, zinc, iron and lower crude fibre than other identified species around in south western Nigeria (Afolabi et al., 2020). It has cream flesh and tuber colour. It has been established that it has the highest yield/ hectare when cultivated along with other species (Carpena, 2009).

It has been established in some past research findings that sweet potato tuber meal can be a perfect substitute for maize in broilers feeds (Afolayan et al., 2012; Mozafari et al., 2013; Sakib et al., 2014; Samira et al., 2016; Iwuanyanwu et al., 2019; Abubakar et al., 2021). There is need to improve efforts on scientific research for utilizing low-cost locally available feed ingredients in poultry feed in order to reduce the feed cost. This may improve the level of profit due to a significant reduction in the total cost of production (Thirumalaisamy et al., 2016). Profitability of an enterprise is driven by operating with the low-cost inputs and using resources efficiently, while maintaining the supply of the products at good market conditions (Dogan et al., 2018).

The rising price of feed ingredient has become one of the determining factors in the profit margins in poultry farming, especially in developing countries. They further asserted that it is pertinent that the most appropriate strategy for these countries is to develop diets which allow locally available new substitutes or complements to the feed ingredients This study is therefore aimed to determine the economic implications of feeding sweet potatoes chips as a replacement for maize in broiler ration by assessing the performance of broiler chickens and profit returns.

Material and methods

The experiment was carried out at the Animal Science Poultry Unit, Teaching and Research Farm, College of Agriculture, Osun State University, Osogbo, Ejigbo campus, Ejigbo, Osun State, Nigeria.

Sample Collection and Procedure

The sweet potatoes (Ex-igbariam spp) were obtained from Ijebu-Ijesha in Osun State, Nigeria. The fresh tubers were washed, sliced to about 2 cm thickness and blanched (without peeling) in water at 40^0C for 5 minutes. The blanched unpeeled sweet potato was then sun dried until constant weight was achieved. The dried sweet potato chips were milled (2 mm) and analyzed for proximate composition before incorporated into the experimental diets.

Experimental Birds Management

A total of 150-day-old arbor acres broiler chicks from a reputable hatchery were used for the feeding trial. These birds were raised under intensive management system on a deep litter in two (2) phases (the starter phase and the finisher phase). The starter phase lasted 4 weeks (0-4th week) while the finisher phase lasted another 4 weeks (4th-8th week). The chicks were brooded for the first two (2) weeks and were fed *ad libitum* with broiler starter diet without sweet potatoes from 0-4 weeks. The starter diet was compounded to supply 24.07% crude protein and 2870 kcal/kg metabolizable energy.

At the end of the 4th week, one hundred and fifty birds were distributed based on weight equalization. The value for initial weight was not significantly different from others in the same pool due to careful unbiased selection. Each pool was subjected to five treatments and replicated thrice. Each replicate had ten birds. Milled sweet potatoes were incorporated to replace maize grain in diet at 25, 50, 75 and 100% inclusion. The finisher diet included five treatments with varying level of inclusion of SPC to replace maize grain and these were compounded to supply an average of 21.32% crude protein and 3360 kcal/kg metabolizable energy. In the finisher diet, 55.15% was maize grain as the major source of energy in T1. In T2, T3 and T4, SPC were incorporated to replace maize grain at 25, 50 and 75 percent of 55.15, respectively. In T5, there was no maize in the diet, 55.15% of the diet was SPC as the major source of energy.

Normal daily routine management for broiler production was carried out during the course of study and occasional management practices such as vaccination and medication programs were carried out at the appropriate time. Both routine and occasional management practices were thoroughly carried out with strict hygiene measures and the birds were fed *ad libitum*.

Experimental diets and design

The experiment comprises four treatments of varying level of inclusion of sweet potatoes chips (SPC) and the control diet as presented below:

T1=100% Maize (control diet);

T2=75% Maize, 25% SPC;

T3=50% Maize, 50% SPC;

T4= 25% Maize, 75% SPC;

T5=0% Maize, 100% SPC.

The experiment was arranged in a completely randomized design (CRD). The gross composition of the starter and finisher diets are presented in Tables 1 and 2, respectively.

Table 1. Gross composition of broiler starter diets

Ingredients	%
Maize	54.00
Groundnut Cake	12.00
Soybean Meal	13.00
Wheat Offal	9.95
Fishmeal	5.00
Bone meal	3.50
Oyster Shell	1.00
Salt	0.50
Vitamin-mineral Premix	0.05
Lysine	0.05
Methionine	0.05
Total	**100.00**
Calculated analysis	
Metabolisable Energy (kcal/kg)	2870
Crude protein %	24.07

Premix used is broilers premix and it contains the following (per kg): Vit A=4000000IU, Vit D3=2500000IU, Vit E=4000mg; Vit K=800mg, Vit B3=300mg; Vit B2=6000mg; Vit B6=5000mg; Vit B12=25mg; Niacin=6000mg, Pantothenic Acid=20222mg; Folic Acid=800mg; Biotin=8mg, Manganese=300000mg; Iron=80000mg; Zinc=20000mg; Copper=25mg; Cobalt=80mg; Iodine=400mg; Selenium=40mg; Chlorine=800000mg.

Data collection

During the feeding trials, performance parameters such as weekly weight and feed intake were collected while weekly weight gain was determined. At the beginning of the 8^{th} week, one bird from each replicate were transferred into metabolic cages. They were served with known weight of feed and feacal samples were collected daily for a period of seven days. Feeds and feacal samples were analysed for proximate composition to determine the percentage nutrient digestibility by the experimental birds using the formula below

$$\text{Percentage nutrient digestibility} = \frac{\text{Nutrient in the feed} - \text{Nutrient in the feaces}}{\text{Nutrient in the feed}} \times 100$$

At the last day of the experiment, carcass yield was weighed. Slaughter weights was determined by weighing the carcass after defeathering. Carcass weight was recorded as weight after evisceration of internal organs and removal of head, neck and shank. Dressing percentage was calculated using the following formula

Table 2. Component and nutritional composition of broiler finisher diet

Ingredients (%)	T 1	T 2	T3	T 4	T 5
Maize	55.15	41.36	27.57	13.79	0.00
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Soybean meal	12.00	12.00	12.00	12.00	12.00
Wheat offal	14.45	14.45	14.45	14.45	14.45
SPC	0.00	13.79	27.57	41.36	55.15
Fishmeal	4.00	4.00	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.05	0.05	0.05	0.05	0.05
Vitamin-Mineral Premix	0.05	0.05	0.05	0.05	0.05
Lysine	0.05	0.05	0.05	0.05	0.05
Methionine	0.05	0.05	0.05	0.05	0.05
Total	**100**	**100**	**100**	**100**	**100**
Determined analysis					
Crude protein	21.63	21.43	21.45	21.01	21.10
Crude fibre	9.14	9.58	9.62	9.62	9.58
Metabolizable Energy (Kcal/g)	3392	3387	3326	3329	3367

Note: SPC - Sweet Potato chips

Premix used is broilers premix and it contains the following (per kg): Vit A=4000000IU, Vit D3=2500000IU, Vit E=4000mg; Vit K=800mg, Vit B3=300mg; Vit B2=6000mg; Vit B6=5000mg; Vit B12=25mg; Niacin=6000mg, Pantothenic Acid=20222mg; Folic Acid=800mg; Biotin=8mg, Manganese=300000mg; Iron=80000mg; Zinc=20000mg; Copper=25mg; Cobalt=80mg; Iodine=400mg; Selenium=40mg; Chlorine=800000mg.

$$\frac{\text{Carcass weight}}{\text{Live weight}} \times 100$$

Feed conversion ratio was calculated using the following formula:

$$\frac{\text{Feed intake (g)}}{\text{Weight gained(g)}}$$

The prevailing market prices of the formulated feed were used to calculate the cost of formulated diets and the analysis of return on investment as cost-benefit per kg was estimated from the difference between estimated market value of weight gain and total cost of feed in the study area.

Cost benefit per kg was estimated in naira (₦) of Nigeria currency denomination at exchange rate of 1 USD = ₦620 as at the time of the study.

The economic analysis of return on feed intake = Market value of weight gain - total cost of feed

Statistical Analysis

All data obtained were subjected to one-way analysis of variance (ANOVA) using the statistical analysis system (SAS version 9.1.2008) and significant differences was compared using Duncan multiple range test (DMRT).

Results and discussion

Table 3. Performance characteristics of birds fed varying level of sweet potato-based diet

Parameter Kg	T1	T2	T3	T4	T5	±SEM
Initial weight (4^{th} weeks)	1.234	1.235	1.234	1.235	1.235	0.018
Final weight (8^{th} weeks)	3.431^a	3.026^b	2.742^c	2.763^c	3.031^b	0.032
Weight gained	2.197^a	1.791^b	1.508^c	1.528^c	1.796^b	0.023
Av. Weekly Weight gain	0.314^a	0.256^b	0.215^c	$0.218b^c$	0.257^b	0.003
Av. weekly feed intake	0.841	0.910	0.945	0.951	0.948	0.001
Total feed intake (4 weeks)	3.364^d	3.64^c	3.78^b	3.804^a	3.792^a	0.118
Feed conversion ratio	2.678^c	3.555^b	4.395^a	4.362^a	3.668^b	0.028

^{abc} Means on the same row with different superscript are significantly different (P<0.05)

T1: Control (100% maize); T2: 25% SPC and 75% maize; T3: 50% SPC and 50% maize; T4: 75% SPC and 25% maize; T5: 100% SPC

SEM=Standard error of means

Table 3 shows the main effect of sweet potato chips (SPC) at different inclusion levels on performance characteristics of broiler chicken. Significant difference (P>0.05) was observed through all parameters of performance characteristics except in average weekly feed intake. Birds on 100% maize-based diet had the highest final weight. This indicates that these birds were able to utilize maize grains to gain weights better than those on SPC. This result agrees with the findings of Afolayan (2010) that observed that experimental birds gained higher weights when fed with maize-based diets than when fed with sweet potato-based diets. The result could be attributed to higher solubility of starch in sweet potatoes than maize. High starch solubility enhances rapid starch digestibility while lesser solubility of starch slows down the rate of digestibility in the gut. It has been shown that a slowly digested starch source helps improve growth performance and feed efficiency in broiler chickens (Herwig et al., 2019). Also, feed of grain particle and/or structural fibre, such as maize, improve digestibility and efficiency of nutrient utilization (Rubio et al., 2020).

The values recorded for average weekly feed intake (AWFI) revealed that experimental birds on T4 consumed more feed than all the birds on other treatments. This value was not significantly (P>0.05) higher than all other treatments, but the feed intake by the broilers on T1 was lower than those on SPC diets. The trend in the feed intake may be attributed to lower energy content of SPC based diets when compared to 100% maize-based diet, as broilers consumed feed to meet up with their energy requirement. These findings agree with the similar studies conducted by Sakib et al. (2014) that asserted that energy requirement of broilers is rightly supplied in maize feed diets than sweet potato ones. Feed intake is known to be affected by nutrient density of the diet, ingredient inclusion level, feed processing methods (particle size and feed form) among others (Abdollahi et al., 2018). These factors may also contribute to the higher feed intake in T5. The particles of the SPC were not finely ground (2 mm), and were coarser than the maize grain, this was as a result of blanching and drying. The feed was also presented in mash form which makes it easier for the birds to select from the diet, especially the 100% SPC where there was no option of maize. The fact that the feed intake was increasing as the level of maize was decreasing could be solely on eating to meet up with energy requirement.

The feed conversion ratio recorded by birds on T1 (100% maize) was the lowest in value when compared with those on SPC based diets, implying that birds fed T1 diet used the feed more efficiently than in other diets, resulting in increased weight gain and a considerably higher final weight. This was followed by the values of T2 (75% maize, 25% SPC) and then T5 (100% SPC). The trend observed may be attributed to high energy content of the maize diet. Diet energy level, among others, is one of the factors that affects feed efficiency (Wen et al., 2018). Potentially, attention must be paid to the values recorded by T2 and T5. However, birds fed 50% and 75% sweet potato did not perform up to other treatments. The trend exhibited by T2 and T5 in the results of feed efficiency ratio may not be easily explained but it can be that SPC can be better without maize, as the birds will not have option of picking maize, but have to do with SPC that was available. Also, it may be that the quantity of maize in T2 masked the effect of SPC as these two treatments showed considerably high-performance characteristics indices.

These results in Table 3 clearly showed that birds on 100% maize-based diet performed better than those on sweet potato-based diets, especially with feed conversion ratio which is lower in the maize diet than the potato diets with consequent results in final live weights.

Table 4. Percentage Digestibility of Sweet Potato Chips Based Diet by Experimental birds

Parameter						
Digestibility (%)	**T1**	**T2**	**T3**	**T4**	**T5**	**±SEM**
Crude Protein	27.44^{a}	22.09^{ab}	15.93^{c}	20.91^{bc}	21.89^{ab}	1.02
Ash	36.48^{c}	38.38^{c}	45.72^{b}	53.09^{a}	46.85^{b}	2.03
Crude Fibre	51.71^{a}	47.60^{bc}	51.20^{a}	48.29^{b}	43.62^{c}	2.50
Ether Extract	44.45^{c}	48.70^{b}	51.30^{a}	49.50^{b}	50.68^{a}	1.83
NFE	64.55^{cd}	65.43^{c}	65.98^{c}	66.60^{b}	68.75^{a}	3.12

^{abc} Means on the same row with different superscript are significantly different (P<0.05)

T1: Control (100% maize); T2: 25% SPC and 75% maize; T3: 50% SPC and 50% maize; T4: 75% SPC and 25% maize; T5: 100% SPC

SEM=Standard error of means

The results of the nutrient digestibility of broilers fed diet containing varying level of inclusion of sweet potato chips is presented in Table 4. The result observed was that birds on diet T1 (100% maize) digested the highest percentage of crude protein, which is not significantly higher than those of diets T2 and T5 of SPC diets. There was no significant difference (P>0.05) between T2 and T5 but these two are significantly higher than diet T3 (50% maize and 50% sweet potato). This may be a result of higher crude protein in maize. Also, it is believed that blanching (heat treatment) of sweet potato tubers might have unlocked the embedded nutrients for utilization. Traoré et al. (2017) and Edache (2018) reported that cooking did not significantly affect the utilization of energy, but it increased the digestibility of the nutrient. They found that cooking improved digestibility of all nutrients, but specially nitrogen. These results showed a remarkable similarity in the crude protein digestibility of maize and SPC at 25% and 100%, which may be a result of higher content of protein in T2 when compared with other SPC diets; and that of 100% SPC were more available due to blanching. It is expected that birds on T3 will digest protein better based on the above explanation, the observed results may be a result of the birds picking maize alone when there was option of doing so, thereby fed below daily requirement.

The utilization of crude fibre in experimental diet varied significantly. The control group T1 had the highest percentage digestibility of crude fibre. Nevertheless, crude fibre digestibility of T3 and T4 were significantly the same with T1 ($P<0.05$). The observed result may not be easily explained as both maize and sweet potato contain soluble fibre which is easily digestible by broiler chickens. Fibre is important in the diet of broiler chickens. Broiler chickens can tolerate up to 10% (Zhang et al., 2023). Swennen et al. (2010) recommended a low inclusion level of crude fibre between 3.0 to 4.0% in the diet which may be too low, while Adedokun and Adeola (2013) recommended 6% crude fibre for broiler finisher. The percentage of fibre digested by the broiler chickens was adequate for optimal growth.

The ash digestibility increased linearly as SPC increased from 25 to 100% of maize replacement. This could be attributed to higher content of phosphorus in SPC as phosphorus enhanced digestibility of mineral and vitamin content (Adedokun and Adeola, 2013). It has been reported that sweet potato tuber contains 32 g/kg DM (Kareem et al., 2020) while maize grain contains 3.41 g/kg DM of phosphorus (Nenova et al., 2019). Also, research has shown that 70% of phosphorus in maize are phytate (Mahmut et al., 2019) and this is not always available for broilers unless treated before feeding as they have low level of phytase in their gut. The heat treatment applied to sweet potato tubers in this study might have enhanced availability of locked up nutrients especially the ash content.

The birds on 100% sweet potato diet were able to digest more soluble carbohydrates, hence, more energy than those on other treatments. This observation may be attributed to the fact that SPC contains more soluble carbohydrates than maize.

The results of nutrients digestibility showed that birds on maize diet were able to digest all the nutrients, except ash and NFE, better than those on SPC diets. This may be as a result of the unpeeled sweet potato tubers used in preparing SPC fed to the experimental broilers. It has been reported that peeling of sweet potato significantly increased digestibility of crude protein, crude fibre and ether extract but had no effect on digestible and metabolizable energy nor on total digestible nutrient (Isikwenu et al., 2008).

Table 5. Slaughter characteristics of broilers fed maize and sweet potato-based diet

Parameter	T1	T2	T3	T4	T5	±SEM
Live weight (kg)	3.431[a]	3.026[b]	2.742[c]	2.763[c]	3.031[b]	0.13
Slaughter weight (kg)	2.82	2.44	2.14	2.15	2.43	0.02
Carcass weight (kg)	2.26[a]	2.00[b]	1.88[b]	1.88[b]	1.99[b]	0.01
Dressing percentage (%)	65.87[a]	62.13[b]	60.62[c]	60.18[c]	61.70[bc]	2.10
Wings with drummer (%CW)	11.43	11.30	11.26	11.37	11.28	1.23
Neck (%CW)	6.16	6.17	6.13	6.26	6.13	0.65
Breast (%CW)	30.60	28.69	28.07	28.15	28.89	1.87
Thighs (%CW)	16.14	16.78	17.21	17.32	17.00	1.78
Shank (%CW)	2.62	2.92	2.98	3.11	3.11	0.04
Back (%CW)	17.48	18.42	19.19	19.22	17.41	1.65
Drumstick (%CW)	13.37	12.40	11.30	11.22	13.37	1.32
Abdominal Fat (%CW)	2.20[d]	3.32[c]	3.86[a]	3.35[b]	3.81[a]	0.03

[abc] Means on the same row with different superscript are significantly different ($P<0.05$)

*T1: Control (100% maize); T2: 25% sweet potato and 75% maize; T3: 50% sweet potato and 50% maize; T4: 75% sweet potato and 25% maize; T5: 100% sweet potato %CW – Percentage Carcass weight. *SEM: standard error of mean

Table 5 shows the results of slaughter characteristics of broilers fed sweet potato-based diets. Observably, the live and carcass weights of T1 were significantly higher than other treatments, while the slaughter weights were not significantly affected. T3 assumed the lowest value for both live and slaughter weights. However, Beckford and Bartlett (2015) reported that pre-slaughter weight (live weight), carcass weight, and dressing percentages of broilers fed different levels of sweet potato-based diets did not differ among treatments in their study. This contradiction may be attributed to variations in the species of sweet potato and strain of broilers used.

Conformably, Beckford and Bartlett (2015) reported that there was a decrease in live weight and slaughter weight of broilers fed sweet potato diet compared to those fed maize. However, they attributed this to impaired utilization of nutrients occasioned by reduced feed intake and decreased body weight. Notably, the decrease in the slaughter weights might be attributed to increase in weight of internal organs instead of muscle and bone formation as highlighted by Ndubuisi and Okorie (2010). Proper note must be taken as of the high carcass weights of T2 and T5 birds. Highlighting that T2 only had 25% of sweet potato and T5 had 100%, this result may be attributed to similarity in the metabolizable energy content of maize (3798 to 4092 kcal/kg) and sweet potato (3940 kcal/kg).

The result as presented in Table 5 shows that there was significant difference ($P<0.05$) in the dressing percentages of the broiler birds across the treatments. T1 had a significantly higher value than all the SPC-based diets. This could be as a result of cumulative effects of higher live, slaughter and carcass weights. It could also be the higher percentage of protein content of maize since protein is responsible for muscle formation. This result buttresses the results of protein digestibility by the experimental birds.

This is an indication that broilers fed maize-based diet were able to utilize the feed to deposit more flesh than those fed SPC-based diets.

Chickens mostly deposit fat in their abdomen. It can be observed that the abdominal fat was significantly higher at T5 than other treatments and was the lowest at T1. Beckford and Bartleet (2015) cited that the energy to protein ratio of feed, and the type and amount of dietary fat are the most important factors affecting body fat deposition. This observation can also be attributed to the higher amount of soluble carbohydrates in SPC, which can be deposited as fat when in excess through metabolic activities. This was ascertained from the result recorded for T5 birds.

Table 6. Cost-benefit analysis of production of broiler chickens fed with diets containing different percentage inclusion of sweet potato-based diet

Parameters	T1	T2	T3	T4	T5
Initial weight at week 4th	1.234	1.235	1.234	1.235	1.235
Final weight at week 8th (live weight)	3.431^a	3.026^b	2.742^c	2.763^c	3.031^b
Weight gained for 4 weeks	2.197^a	1.791^b	1.508^c	1.528^c	1.796^b
Market value of weight gain at ₦1,200 per kg*	₦2,636.40	₦2,149.20	₦1,809.60	₦1,833.6	₦2,155.2
Total feed intake (4 weeks)	3.364^d	3.64^c	3.78^b	3.804^a	3.792^a
Cost of feed per kg*	N200.00	N180.00	N165.00	N158.00	N150.00
Total cost of feed	N672.80	N 655.20	N623.70	N601.03	N568.80
Cost-benefit per kg	N1,963.60	N1,494.00	N1,185.90	N1,232.57	N1,586.40
Ranking	1st	3rd	5th	4th	2nd

Key: Mkt= market; Avg= average; T1: Control (100% maize); T2: 25% sweet potato and 75% maize; T3: 50% sweet potato and 50% maize; T4: 75% sweet potato and 25% maize; T5: 100% sweet potato

*Calculated based on the prevailing market price at the time of study. ₦ denotes Nigerian currency and 1USD = ₦620 at the time of study

Cost-benefit analysis of production of broiler chickens fed with diets containing maize and sweet potato-based diet is presented in Table 6. The values of initial weight at week 4th, final weight at week 8th (live weight), and the total feed intake for 4 weeks were obtained from Table 3 and Table 5. The return on feed intake is derived from the difference between the market value of weight gain at ₦1,200 (2.86 USD) per kg and total cost of feed. However, the market value of weight gain at ₦1,200 per kg is obtained at the prevailing market price as at the time of study. The economic analysis of return on feed intake in Table 6 reveals the highest return in T1 (₦1,963.60 = 3.17 USD), while T5 (₦1,586.40 = 2.56 USD) ranked second and T2 ranked third (₦1,494.00 = 2.41 USD).

This result on return on feed intake implies that feeding the birds with T1 (100% maize) brings higher return on investment than any other feed intake diets. This finding of the study is in consonance with the findings of Sakib et al. (2014) that suggested that rearing broilers on a potato-based diet reduced profit.

Conclusion

It can be concluded based on this study that maize, when used as a carbohydrates compound feed source, enhances better performance of broilers than when sweet potato was used. Also, the findings of this study showed that maize diet is economically better and recorded higher returns on investment than the SPC-based diets. However, the results from broilers fed SPC-based diet were not below what is expected for a normal growing broiler at 8 weeks of age in terms of performance and carcass yield. The authors recommend a further study using pelletized feed as birds may pick grains in their diets rather than non-grains.

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