Meat Research
Vol 6, Issue 2: 1-8, Article 141, April, 2026
ISSN: 2790-1971
https://doi.org/10.55002/mr.6.2.141 http://www.bmsa.info/meatresearch

[1]Department of Animal and Environmental Biology, Federal University of Agriculture and Development Studies, Iragbiji, Osun State, Nigeria.

[2]Department of Animal Production, Federal University of Technology, Minna, Niger State, Nigeria.

[3]Department of Animal Production, Olabisi Onabanjo University Ago-Iwoye Ayetoro Campus Ogun State Nigeria

[4]Department of Agricultural Economics, Federal University of Agriculture and Development Studies, Iragbiji, Osun State, Nigeria.

***Corresponding Author:**
MB Daniel
E-mail: modupeblessing001@gmail.com

Keywords:
Broiler Chicken
Meat Quality
Shea butter cake
Aspergillus niger
Proximate composition

Article Info:
Received: 14 March 2026
Accepted: 15 April 2026
Published online: 30 April 2026

Research Article

Effects of graded dietary inclusion of aspergillus niger-fermented shea butter cake on carcass yield and physicochemical and nutritional quality of broiler meat

MB Daniel[1]*, EZ Jiya[2], ES Apata[3], JO Olalere[4]

Abstract

The intense competition between man and his livestock for scarce conventional feed ingredients has resulted to high cost of producing poultry birds and its products. It has therefore become imperative to explore other alternatives for the feed industry in order to reduce the current stress on human food supply, enhance production of food sustainability at least cost, without compromising the environment, minimize hunger and malnutrition. This calls for urgent utilization of potential agroforestry by-products such as shea butter cake (SBC). Therefore, this study focuses exclusively on effects of graded dietary inclusion of *aspergillus niger* fermented shea butter cake on carcass yield and physicochemical and nutritional quality of broiler meat. The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Federal University of Technology, Gidan Kwano Campus, Minna, Niger State. Shea butter cake was obtained from a local shea butter processing factory in Bida, Niger State, was air dried for 7 days, pulverized, and fermented with *Aspergillus niger* at 0.25 g/kg using water in a 1:2 ratio for 7 days at ambient temperature (24°C). The fermented sample was dried 30°C - 40°C for 7 days and included in the experimental diets at 0%, 5%, 10%, 15% and 20%. Day-old Ross 180 broiler chicks were randomly allocated to five treatments in a completely randomized design, with three replicates of 12 birds per replicate. Meat yield, proximate composition, pH, cooking yield, cooking loss and water holding capacity were determined. Data were subjected to analysis of variance (ANOVA) of completely randomized design using SPSS version 16.0, and variations in means were separated using Duncan Multiple Range Test. The result obtained for carcass characteristics shows that all the parameters measured were not significantly ($p>0.05$) influenced across the treatments except for the dressing percentage that were significantly ($p<0.05$) difference. The best live weight (1750.00), slaughtered weight (1680.00), dressed weight (1350.00) and the dressing percentage (77.13) was observed in (T_1). Also, no significant ($p>0.05$) difference was obtained in the weight of internal or visceral organs across the treatments for the liver, lungs, gizzard, intestine and abdominal fat but the heart weight percentage were significantly ($p<0.05$) difference. There were significant ($p<0.05$) differences across the treatments for water holding capacity, cooking yield and cooking loss but no significant ($p>0.05$) difference for the pH. The (T_4) has the best water holding capacity (52.37), cooking yield (89.33) and the cooking loss (10.94). The proximate composition of the meat of broiler chickens shows that there were significant ($p<0.05$) differences across the treatments in moisture content, ether extract and fat but no significant ($p>0.05$) differences for crude protein. The findings suggested that up to 20% inclusion level of fermented shea butter cake did not impose any detrimental effect on the birds; also, at 15% inclusion level could produce high water holding capacity and the cooking yield.

Introduction

The poultry industry has grown tremendously with the rapid increase in the global population, and the development of broiler bird sustainability has also increased (Park & Kim, 2021). In 2024, total meat production worldwide was reported at 374 million tons. Poultry meat worldwide accounts for 150 million tons, the most produced meat, with a share of 40.1% (Selvi et al., 2026). Poultry meat is an excellent source of essential proteins, vitamins, and minerals with a relatively low saturated fat content, making it a highly nutritious and healthy food option (Ahmad et al., 2022; Sajib et al., 2023). Similarly, Chicken (*Gallus gallus domesticus*) is a globally essential domestic animal due to its nourishing meat that is consumed as food, income generation and food security for rural families (Biplob et al., 2024; Hossan et al., 2024; Adebayo et al., 2020). However, feed accounts for 75-80% of the total cost of poultry production in Nigeria and this is largely due to the high cost of conventional feed stuffs stemming directly from their high demands as staple food by humans (Adebayo et al., 2020). In Nigeria, the poultry feed industry is heavily dependent on grains such as maize, millet and sorghum; and oilseed resources such as groundnut cake, soybean cake, cotton seed cake and palm kernel meal (RMRDC, 2003). The intense competition between man and his livestock for scarce conventional feed ingredients has resulted to high cost of producing poultry birds and its products. Technical constraints and high production costs are major challenges faced in West African poultry sector, especially in Nigeria (Schneilder and Polnick, 2010).

© Bangladesh Meat Science Association. This is an open access article which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

It has therefore become imperative to explore other alternatives for the feed industry in order to reduce the current stress on human food supply, enhance production of food sustainability at least cost, without compromising the environment, minimize hunger and malnutrition. Hence, this calls for urgent utilization of potential agroforestry by-products such as shea butter cake (SBC).

One such alternative is the Shea Butter Cake (SBC) (Agbetuyi and Oloruntola, 2020), which is an agroforestry by-product and residue after fat extraction from Shea nuts (*Vitellaria paradoxa*). The annual production of shea kernels exceeds 2.5 million tons and approximately 55% ended up as SNC (Abdul-Mumeen et al., 2013). The SBC, as a by-product obtained during the processing of shea nuts to produce shea butter, has been identified to spare these conventional feed ingredients in livestock diets because of their low price, availability and high nutritional potential (Orogun, 2010). Shea Butter Cake (SBC) is the spin-off and filtrate (Dei et al., 2008). Shea Butter Cake (SBC) is an agroforestry by-product and residue after fat extraction from Shea nuts (Agbetuyi and Oloruntola, 2020). Shea butter has been utilized for cooking purposes, cosmetic formulations (moisturizer), cocoa butter substitutes and other edible fat spreads. Thus, wider utilization of SNC has been limited due to its anti-nutritional constituents such as tannin, saponin and theobromine (Salihu et al., 2016). Abdul Mumeen et al. (2013) documented that the general nutritional value of Shea butter cake was appreciable with 13% crude protein, 23% crude fat, 4% ash, 4% crude fibre, 59% carbohydrates, and 4048KCal/kg metabolizable energy per kilogram. They also highlighted its richness in minerals such as magnesium, potassium, and calcium. Its composition, however, depends on the methods used in the extraction. The SBC is carefully considered as a potential feed ingredient and a backup for maize in poultry diets, based on its composition (Aguihe et al., 2020). Its composition depends on the methods used in the withdrawal of the oils which could either be by an industrial or a traditional procedure. (Adebayo et al., 2020). The presence of such anti-nutritional factors like tannin and saponin could prevent the availability of some nutrients like protein to the animal if not properly processed. Additionally, the cake has bitter taste due to the presence of such factors making the cake to be unpalatable to livestock. The palatability of the cake and the anti-nutritional factors of the cake could be improved through various processing methods. *Aspergillus niger* was reported to possess tannin–protein complex degrading activity (Bhat et al., 1998). *Aspergillus niger* is a member of a group of species named Aspergillus section Nigri, formerly known as *Aspergillus niger* group. This fungus causes the “black mold” disease and it is the most common contaminant of stored food, being responsible for postharvest decay of fresh fruits, grains, and crops worldwide (Lima et al., 2019).

Broiler production at mass level has already been achieved and now emphasis is being laid on increasing meat quality by altering various characteristics of broiler meat. Appearance, texture, juiciness, wateriness, firmness, tenderness, odor and flavor are the most important and perceptible meat features that influence the initial and final quality judgment by consumers before and after purchasing a meat product (Liza et al., 2024). The quantifiable properties of meat such as water holding capacity, shear force, drip loss, cook loss, pH, shelf life, collagen content, protein solubility, cohesiveness, and fat binding capacity are indispensable for processors involved in the manufacture of value-added meat products (Islam et al., 2025; Masum et al., 2025). There are many definitions of quality, but the most preferred one is; ‘‘Quality is the composite of those characteristics that differentiate individual units of a product and which have significance in determining the degree of acceptability of that unit to the user’’ (Groom 1990). However, for meat industry, meat quality is a term used to describe the overall meat characteristics including its physical, chemical, morphological, biochemical, microbial, sensory, technological, hygienic, nutritional and culinary properties (Hassan et al., 2026; Akter et al., 2022; Hasan et al., 2024; Ingr, 1989). It is a well-known fact that broiler production at mass level has already been achieved and now emphasis is laid on increasing meat quality by altering the said characteristics of broiler meat.

Therefore, the consumption of broiler chicken meat increased mainly as a result of its low price, easy processing, diversity, and high nutritive value. Chicken meat has a high content of high-value protein and readily available fats, a low cholesterol content, and is tender and fine-fibred (Hossan et al., 2024; Grabowski and Kijowski, 2004). In addition to high content of meat (especially breast muscles) and low content of skin with subcutaneous fat and abdominal fat in carcass, modern consumers are also paying more attention to the quality of meat as a result of the increased incidence of lifestyle-related diseases such as obesity, diabetes, heart attacks and atherosclerotic strokes. Apart from good meatiness and low fatness of broiler carcasses, more importance is now given to the chemical composition, fatty acid profile, cholesterol content, microstructure, and physicochemical and sensory properties of meat. According to Fletcher (2002), the major poultry meat quality attributes are appearance, texture, juiciness, flavour and functionality. Meat colour is a very important quality trait as it determines the appearance of meat and plays an important role in consumer acceptance of a product. Meat colour depends mainly on myoglobin content, chemical structure of heme, and pH of meat. Myoglobin content is mainly influenced by bird species and age and muscle type, whereas pH of animal muscles is associated with their biochemical state at slaughter and the advancing rigor mortis. Tenderness and juiciness of meat is largely determined by the content of intermusuclar fat (Tůmová and Teimouri, 2010). In addition, chicken meat is considered a healthier option than red meat due to its lower cholesterol and fat levels. Compared with other animal products, commercial broiler breeds have a shorter production cycle. (Adebayo et al., 2020).

Extant literatures have conducted several researches on broiler chicken with respect to apparent nutrient digestibility, growth performance and nutrients digestibility of broiler chickens (Hussein et al., 2020; Aguihe et al., 2020; Dei et al., 2008). However, there are limited study focusing exclusively on effects of graded dietary inclusion of *aspergillus niger* fermented shea butter cake on carcass yield and physicochemical and nutritional quality of broiler meat. This present study bridges this research gap by evaluating the effects of graded dietary inclusion of *Aspergillus niger* fermented shea butter cake on carcass yield and characteristics of broiler chickens. It also determines the effects of graded dirtary inclusion of *Aspergillus niger*-fermented shea butter cake on the physicochemical and nutritional quality of broiler meat.

Materials and Methods

Study location

The experiment was conducted at the Poultry unit of the Teaching and Research Farm of the Department of Animal Production, School of Agriculture and Agricultural Technology Federal University of Technology, Gidan Kwano Campus, Minna, Niger State, Minna is located between latitude 9°37° North and latitude 6°33' East. It is located in the Southern Guinea Savanna Zone of North Central Nigeria. The mean monthly minimum and maximum temperature are 38°C and 42°C respectively. The mean annual rainfall between 1200 mm-1300 mm while the mean monthly relative humidity is 65% (Niger Mate Agricultural Development Project, 2010).

Source of Shea Butter Cake and Preparation of Test Ingredients

Shea Butter Cake was obtained from a local shea butter processing factory in Bida, area Niger State, Nigeria. The shea butter cake was air dried for 7 days and then pulverized into powdery form. The fermentation was carried out by mixing the shea butter cake with water in the ratio 1:2 (1 kg of shea butter cake to 2 litter of water) after the spores of *Aspergillus niger* (0.25 g/kg) were premixed with the water. The mixture was packed in a plastic covered container, gently firmed, and sealed with adhesive film before being kept in container at ambient temperature (24°C). The sample was fermented for 7 days. Although *Aspergillus niger* is an aerobic organism, there would be a production phase under micro aerobic conditions that existed in the closed container (Dieye et al., 2004). The fermented sample was spread on a polythene sheet in a place at 30 to 40°C, dried for 7days. The dried grounded ingredients (Shea butter cake by-product) were stored in an air-tight sack bag to prevent the air entering and water to avoid spoilage by insects and rats. The powdered ingredients (Shea butter by-product) were given to the experimental birds based on their treatments (T_1 0%, T_2 5%, T_3 10%, T_4 15%, T_5 20%), shown in Table 1. The composition of fermented shea butter cake diets and the nutrients at the starter phase is shown in Table 2. Alongside, the composition of fermented shea butter cake diets and the nutrients at the finisher phase is shown in Table 3.

Table 1: The Inclusion levels of test ingredients

Treatments	Inclusion level per (%)
T_1:	0% of fermented shea butter cake (SBC)
T_2:	5% of fermented shea butter cake (SBC)
T_3:	10% of fermented shea butter cake (SBC)
T_4:	15% of fermented shea butter cake (SBC)
T_5:	20% of fermented shea butter cake (SBC)

Table 2: Composition of fermented shea butter cake diets and calculated nutrients at the starter phase

Ingredients (%)	T_1	T_2	T_3	T_4	T_5
Maize	54.69	51.95	49.22	46.48	43.75
Shea meal (SM)	0.00	2.73	5.47	8.20	10.94
Groundnut cake	32.31	31.31	31.31	28.31	26.31
Rice bran	8.00	8.00	9.00	10.00	13.00
Fishmeal	3.00	3.00	2.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Bone meal	1.00	2.00	2.00	3.00	2.00
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total Weight (kg)	100.00	100.00	100.00	100.00	100.00
Crude protein (%)	23.00	23.07	23.07	23.02	23.02
Crude fibre (%)	3.71	3.71	3.86	3.92	4.24
Metabolisable energy (Kcal/kg)	2932.19	2936.80	2956.92	2958.78	2994.97

Premix (Vitamin × minerals) Vitamins; A = 7,500 IU, D=500,000, E=100 IU, BI 325 mg, B2=125 MG, B3=500 mg, B12=2.5 mg, C=10 mg, K = 15mg and folic acid = 150 mg. Minerals: Ca = 12.5mg, Cu = 8.0mg, Fe = 32, 1 = 0.8mg, Se = 100 mg, Mg = 0.25, Chlorine = 250 mg, Pantothemic acid = 14.4 mg, Lysine, Methionine and Terramycine (Broad spectrum antibiotics and growth promoters).

Table 3: Composition of fermented shea butter cake diets and calculated nutrients at the finisher phase

Ingredients (%)	T_1	T_2	T_3	T_4	T_5
Maize	67.97	64.57	61.17	57.78	54.38
Shea meal (SM)	0.00	3.40	6.80	10.20	13.59
Groundnut cake	23.53	23.53	20.53	19.53	17.53
Rice bran	2.50	2.50	8.00	6.50	9.00
Fishmeal	2.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Bone meal	3.00	4.00	1.50	4.00	3.50
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total Weight (kg)	100.00	100.00	100.00	100.00	100.00
Crude protein (%)	19..01	19.01	19.02	19.02	19.09
Crude fibre (%)	3.06	3.10	3.69	3.53	3.80
Metabolisable energy (Kcal/kg)	3032.99	3041.52	3107.00	3097.52	3131.54

Premix (Vitamin × minerals) Vitamins; A = 7,500 IU, D=500,000, E=100 IU, B1 = 325 mg, B2=125mg, B3=500mg, B6 = 150mg, B12=2.5 mg, C=10 mg, K = 15mg and folic acid = 150 mg. Minerals: Ca = 12.5mg, Cu = 8.0mg, Fe = 32mg, I = 0.8mg, Se = 100mg, Mg = 0.25, Chlorine = 250mg, Pantothenic acid = 14.4mg, Lysine, Methionine and Terramycine (Broad spectrum antibiotics and growth promoters).

Proximate composition of the fermented shea butter cake is shown in Table 4. The results of phytochemical constituents for both fermented shea butter cake (Vitellaria paradoxa) and the unfermented shea butter cake (Vitellaria paradoxa) are presented in Table 5. Flavornoid, cyanogenic glucoside, tannins, oxalate, alkaloids, phylate and saponnis respectively.

Table 4: Proximate composition of the fermented shea butter cake

Parameters	%
Dry matter	86.55
Ash	13.1
Crude fibre	4.2
Ether extract	35.2
Crude protein	28.91
NFE	5.06

NFE – Nitrogen Free Extract

Table 5: Phytochemical constituents for both fermented shea butter cake (*Vitellaria paradoxa*) and the unfermented shea butter cake (*Vitellaria paradoxa*)

Samples (mg/100g)	Fermented (%)	Unfermented (%)
Flavornoid	723.06	777.38
Cyanogenic glucoside	47.49	10.28
Tannins	534.50	178.26
Oxalate	1.70	1.51
Alkaloids	491.96	520.12
Phylate	39.11	170.20
Saponins	603.45	480.11

Source of the Experimental Birds and Experimental Design

Day old Ross 180 broiler chicks were purchased from Agri-tech Farms, at Agri-tech Farms along Lagos-Ibadan expressway, Idi-ayunre Ibadan. Oyo State Nigeria. Feed ingredients such as maize, groundnut cake, rice bran, fishmeal, lysine, methionine, bone meal, vitamin premix, salt, and toxin binder were bought from Gidan-mantasa feed mill around Bosso area in Minna Niger State. The birds were randomly allocated into five treatments levels of the diets in a completely randomized design experimental model. Each of the treatments had three replicates with twelve (12) birds per replicate. The birds were acclimatized for one week and after this a week the birds were given the experimental treatments. Treatment 1 (T_1) was the control of which ordinary feed was given while the treatment 2 (T_2) were given 5% of shea butter cake, treatment 3 (T_3) were given 10% of shea butter cake, treatment 4 (T_4) were given 15% of shea butter cake, and the treatment 5 (T_5) were given 20% of shea butter cake respectively. The water given was natural/ordinary throughout the experiment.

Management of the Experimental Birds

Fifteen (15) pen units, with an area of a square shape meter each that accommodate 12-13 broilers were constructed at the broiler production unit. The walls and the floor of the pen were disinfected with germicide (Izal) after washing with detergent soap and water. Litter materials made of newspapers were used for the first 2 days of the chick's life. Clean and disinfected drinkers and feeders were set in a place accessible to the birds. Each unit was properly labeled for easier identification of each treatment group. Also, a local or traditional charcoal pot was placed at the strategic areas of each unit. The distance at which the charcoal pots were placed was normally adjusted based on the response of the chicks to cold, weather condition and feather development. The charcoal pot was removed at the closed to third week when their feathers were fully developed grown, in the feed aspect, a formulated/compounded feed containing a crude protein of 23.03% and the metabolized energy of 2994.97 Kcal/Kg were given during the first four weeks which was the starter phase. Also, a finisher diets which contained a crude protein of 19.09% and the metabolized energy of 3131.54 Kcal/Kg were fed to the birds at the second five weeks which was the finisher phase. Feeds were given *ad libitum* for the first week of acclimatization. Also, after the 6 days, the old newspaper used as litter material were removed and replaced with wood shavings. Medication and vaccination were given to the birds based on the recommendation of the Nigeria Medical Association (NMA) as recommended for this region.

Data Collection

Determination of meat yield

At the end of week nine, two birds from each treatment were randomly picked and were kept separately given the feed and water, weighed to know their live-weight before slaughtering. The slaughtered and dressed weight was obtained used a weighing scale. Each of the birds was slaughtered and the blood was drained for like six minutes and they were scaled and de-feathered. The Gastro-intestinal tract (GIT) of each bird was eviscerated immediately and placed in a tray at room temperature and it was gently uncoiled to avoid tearing and stretching. A sensitive scale (Camry Premium Weighing scale) was used to measure the weight of the eviscerated parts which were the small intestines, gizzard, large intestines, heart, liver, spleen, crop liver, and the lungs. The cut-up-parts which were the head, neck, breast, thigh, and the drumsticks were also weighed. The qualities of the broiler meat were determined by subjecting the samples to proximate analysis which entailed the determination of moisture content, crude protein, ash, ether extract and the nitrogen free extract. The meat sample was ground using a mortar and pestle until a fine powdered of the sample was obtained.

pH Determination

pH of 10% solution was determined using a glass electrode fisher pH meter. The pH meter was calibrated with a buffer solution at pH 4.0. Buffers were prepared from potassium hydrogen phthalate according to the AOAC (2006) by dissolving 5-128g in 500ml distilled water.

Cooking yield

Cooking yield was determined according to the methodology proposed by Cason et al. (1997) breast meat samples were weighed (+ 90g) for 30 minutes, until internal endpoint temperature of 75 to 80°C. Samples were then left to cool until reaching room temperature and weighed. Cooking yield was calculated as:

CY (%) 100 × (1-cooked weight/fresh weight).

Cooking loss

Thawing loss was determined by calculating the difference in the pre-freezing and post-thawing weights. The meat samples were bagged in polythene nylon and thermally treated in and 80 water baths until the core temperature reached 75º C

Thawing loss (%) = $(W_1-W_2)/W_1 \times 100$

W_1 = weight of the sample after freezing (g)

W_2 = weight of the sample after thawing (g)

Water holding capacity

The water holding capacity was obtained according to the method described by Cason er al. (1997). Twenty-four (24) hours' post-mortems, samples were collected from the drumstick side of the chicken and cut into different sizes (+0.10) cubes. The samples were analyzed in duplicate. They were firstly carefully placed between two filter papers and then left under a 10kg weight for 4-5 minutes. The samples were then weighed and the water holding capacity was determined according to the following equation.

Water holding capacity (%) = $(100- [(W_1-W_2) \times 100])/W_1$

Proximate Composition

Proximate composition of the experimental diets fed to the birds at both starter and finisher phases and also the broiler meat samples were analyzed based on the standard procedures according to AOAC (2006). The parameters determined include Moisture, Crude protein, Ether extract and Ash. At the Department of Animal Production laboratory, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State.

Statistical Analysis

The data collected from this study on the meat yield and meat quality characteristics were subjected to Analysis of Variance (ANOVA) of completely randomized design, using Statistical Package for Social Science (SPSS) version 16.0. The variations in means were separated using the Duncan Multiple Range Test.

Results and Discussion

Proximate composition of formulated broiler starter and finisher diets

The results of proximate composition of formulated broiler starter diets are presented is Table 6. The dry matter, ether extract, Ash, crude fibre, crude protein, and nitrogen free extract (NFE) for the treatments respectively.

The results of proximate composition of formulated broiler finisher diets are presented in Table 7. The dry matter, ether extract, ash, crude fiber, crude protein, and nitrogen free extract (NFE) for the treatments respectively. Table 8 shows the result of Carcass characteristics of broiler chickens fed diet containing shes butter cake fermented with *Aspergillus niger*. The results showed that all the parameters measured were not significantly different (P>0.05) across the treatment except dressing percentage which was significantly (P<0.05) different among the treatment means.

Table 9 shows the result of visceral organs of broiler chickens fed diet containing shea butter cake fermented with *Aspergillus niger*. There shows that all the parameters measured were not significantly (P>0.05) different except percentage how that revealed significant (P<0.05) difference among the treatment means. The result showed that T_2 (0.29%) has the highest heart weight follow by T_5 (0.26%), T_3 (0.34), T_4 (0.19) and T_1 (0.16%) are statistically similar.

Table 6: Proximate composition of the experimental diets fed to the birds at starter phases

Parameters (%)	T_1	T_2	T_3	T_4	T_5
Dry matter	86.8	91.2	90.8	85.6	88.6
Ether extract	11.0	11.5	17.0	11.5	14.5
Ash	9.5	7.5	10.0	11.0	12.0
Crude fibre	12.5	9.0	10.0	8.5	9.0
Crude protein	22.75	22.75	22.40	23.45	23.63
NFE	30.05	40.45	31.4	23.15	29.47

NFE – Nitrogen Free Extract

Table 7: Proximate composition of the experimental diets fed to the birds at finisher phases

Parameters (%)	T_1	T_2	T_3	T_4	T_5
Dry matter	87.2	85.6	89.6	87.8	87.4
Ether extract	15.5	13.5	14.0	12.0	13.5
Crude fibre	6.5	9.0	8.0	9.0	8.0
Crude protein	19.6	18.9	19.25	17.78	20.13
NFE	37.6	34.7	41.83	36.52	35.27

NFE – Nitrogen Free Extract

Table 8: Carcass characteristics of broiler chickens fed shea butter cake fermented with *Aspergillus niger*

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Live weight (g)	1750.00	1500.00	1700.00	1550.00	1550.00	45.83NS
Slaughter weight (g)	1680.00	1415.00	1550.00	1465.00	1465.00	51.02NS
Dressed weight (g)	1350.00	1100.00	1250.00.	1150.00	1150.00	39.44NS
Dressing (%)	77.13^{a}	73.33^{b}	73.50^{b}	74.16^{b}	74.14^{b}	0.51*
Head (%)	1.86	1.77	1.89	1.80	2.09	0.19NS
Neck (%)	3.95	3.64	3.26	3.11	3.94	0.25NS
Back (%)	8.40	7.36	8.12	6.96	7.20	0.53NS
Breast (%)	10.51	9.68	10.07	10.38	11.86	0.70NS
Thigh (%)	8.55	8.73	8.25	8.50	7.98	0.66NS
Drum Stick (%)	6.26	7.18	6.86	6.87	6.33	0.58NS
Shank (%)	2.50	3.50	3.04	3.34	2.55	0.26NS
Wings (%)	8.56	7.14	6.14	7.76	7.46	0.47NS

Means within the same row with different superscripts were significantly different ($p<0.05$)

SEM: Standard Error Mean

T_1: 0% of Shea butter cake fermented with *Aspergillus niger* (Control)

T_2: 5% of Shea butter cake fermented with *Aspergillus niger*

T_3: 10% of Shea butter cake fermented with *Aspergillus niger*

T_4: 15% of Shea butter cake fermented with *Aspergillus niger*

T_5: 20% of Shea butter cake fermented with *Aspergillus niger*

Table 9: Weight of visceral organs of broiler chickens fed diets containing shear butter cake fermented with Aspergillus niger

Parameters (%)	T_1	T_2	T_3	T_4	T_5	SEM
Heart	0.18^{c}	0.29^{a}	0.24^{c}	0.19^{c}	0.26^{b}	0.02*
Liver	1.00	0.67	0.73	0.61	0.65	0.06NS
Lungs	0.46	0.47	0.23	0.26	0.29	0.04NS
Gizzard	1.13	1.47	0.84	0.94	1.17	0.12NS
Intestine	3.13	3.00	3.18	3.19	2.83	0.20NS
Abdominal fats	0.75	0.84	0.56	0.78	0.82	0.09NS

^{abc} Mean within the same row with different superscripts are significantly different ($p<0.05$)

SEM: Standard Error Mean

T_1: 0% of Shea butter cake fermented with *Aspergillus niger* (Control)

T_2: 5% of Shea butter cake fermented with *Aspergillus niger*

T_3: 10% of Shea butter cake fermented with *Aspergillus niger*

T_4: 15% of Shea butter cake fermented with *Aspergillus niger*

T_5: 20% of Shea butter cake fermented with *Aspergillus niger*

The result of meat quality characteristics of broiler chicken fed diets containing shea butter cake fermented with *Aspergillus niger* shown (Table 10). The mean water holding capacity, cooking yield and cooking loss were significantly ($p<0.05$) different. pH was not significantly ($p>0.05$) different among the treatment means.

The water holding capacity of broiler chickens fed diets containing shea butter cake fermented with *Aspergillus niger* were significantly ($p< 0.05$) higher in T_4 (52.37%) followed by the T_1 control (51.59%), T_5, T_2 and T_3) are similar and being the lowest.

Cooking yield was also highest in T_4 (89.33%) while the lowest cooking loss was recorded in the same treatment T_4 (10.94%).

The result of proximate composition of the meat of broiler chickens fed diets containing shea butter Cake fermented with *Aspergillus niger* shown in (Table 11). The moisture content was higher in T_2 (75.47%), the least values recorded in T_1 (65.75%) and T3 (65.63%). Fat content showed that T_2 (2.00%) and T_4 (1.84%) are similar and were significantly ($p<0.05$) higher than the other treatments which are also similar. Ash content was higher in T_3 (4.76%), T_1 (4.55%) and T_5 (4.35%) are similar followed by T_4 (3.85%) and the least was recorded in T_2 (3.44%).

Table 10: Meat Quality of broiler chicken fed diets containing shea butter cake fermented with Aspergillus niger

Treatments	T_1	T_2	T_3	T_4	T_5	SEM
pH	6.45	4.43	6.44	6.53	6.50	0.04NS
WHC	51.59^{b}	34.93^{d}	34.17^{e}	52.37^{a}	39.92^{c}	5.65*
Cooking yield	83.35^{c}	84.34^{b}	78.37^{e}	89.33^{d}	81.36^{d}	1.21*
Cooking loss	16.85^{c}	15.91^{d}	21.86^{a}	10.94^{e}	18.88^{b}	1.20*

^{Abcde} Means within the same row with different superscripts are significantly different ($p<0.05$)

SEM: Standard Error Mean

WHC: Water Holding Capacity

T1: 0% of Shea butter cake fermented with *Aspergillus niger* (Control)

T2: 5% of Shea butter cake fermented with *Aspergillus niger*

T3: 10% of Shea butter cake fermented with *Aspergillus niger*

T4: 15% of Shea butter cake fermented with *Aspergillus niger*

T5: 20% of Shea butter cake fermented with *Aspergillus niger*

Table 11: Proximate composition of the meat of broiler chickens given shea butter cake fermented with Aspergillus niger

Treatments (%)	T_1	T_2	T_3	T_4	T_5	SEM
Moisture content	65.75^{d}	75.47^{a}	65.63^{d}	70.10^{b}	68.97^{c}	1.20*
Crude protein	18.75	18.75	18.75	18.75	18. 52	0.04NS
Fat content	1.24^{b}	2.00^{a}	1.36^{b}	1.84^{a}	1.00^{b}	0.13*

Ash	4.55[b]	3.44[d]	4.76[a]	3.85[c]	4.35[b]	0.16*

SEM: Standard Error Mean
T_1: 0% of Shea butter cake fermented with *Aspergillus niger* (Control)
T_2: 5% of Shea butter cake fermented with *Aspergillus niger*
T_3: 10% of Shea butter cake fermented with *Aspergillus niger*
T_4: 15% of Shea butter cake fermented with *Aspergillus niger*
T_5: 20% of Shea butter cake fermented with *Aspergillus niger*

In this study, the result of the carcass characteristics of the broilers chicken fed fermented shea butter cake diets shows that the final dressing percentage were higher ($p<0.05$) in the birds fed 0% fermented shea butter cake diets (control T_1) than others. The highest dressing percentage of (T_1) is attributed to highest final body weight in the birds of these groups. These findings are compatible with the reports of previous workers (Ojebiyi et al., 2026) who observed higher dressing percentage values for birds whose diets had 0% shea butter inclusion. Birds on fermented shea butter cake diet recorded poor dressing percentage, live weight, slaughter weight, dressed weight compared with the control. This could be attributed to impairment in utilization of nutrients due to the presence of residual tannin in fermented shea butter cake (Annongu et al., 1996). This shows a pronounced negative effect of anti-nutritional factors on protein digestibility thus leading to poor carcass yield (Smulikowska et al., 2001).

The highest water holding capacity observed in T_4 could implied that 15% fermented shea butter cake inclusion level increased the ability of meat muscle to retained water more than other treatments. The best cooking yield and cooking loss observed in T_4 could be also attributed to the best water holding capacity in T_4 at 15% inclusion level.

The highest moisture content (75.47), ether extract (2.00) and Ash also agreed with Sese et al (2014). At T_5 which is the 20% inclusion level the ranges of (1.00 to 2.00%) fat was optimum which is acceptable by the consumers.

Conclusion

The result obtained from this study revealed that Carcass yield was best in the control diets. Also 15% inclusion of shea butter cake fermented with Aspergillus niger gave the best water holding capacity and cooking yield. Hence, low fat composition was recorded at 20% inclusion level. This study therefore recommends that the fermented shea butter cake be included in the diets of broiler chickens up to 15% is good for meat quality. Also, other processing methods could be used to processed shea butter cake which may reduce the anti-nutritional factors and improve the availability of nutrients for animal consumption. In addition, further research work in the use of Shea butter cake in feeding of other monogastric animals can be used.

References

Abdul-Mumeen I, Zakpaa HD, Mills Robertson FC. 2013. Biochemical and microbiological analysis of Shea nut cake: A waste product from Shea butter processing. Journal of Agricultural Biotechnology and Sustainable Development, 5 (4): 61-68.

Adebayo AO, Chikezie J, Halidu KS. 2020. Apparent nutrient digestibility and carcass yield of broiler chickens fed cooked Shea nut cake diets of different fermentation periods. Journal of Bioresource Management, 7 (3): 120-130. https://doi.org/10.35691/JBM.0202.0145.

Agbetuyi OA, Oloruntola OD. 2020. Effects on performance of broiler chickens of feeding Shea butter as replacement for vegetable oil in their diet. Livestock Research for Rural Development, 32 (6): 36-40.

Aguihe PC, Ilaboya II, Ukom SK. 2020. Performance and nutrient digestibility of broiler chickens fed fermented Shea butter cake-based diets with supplemental Nutrizyme (cocktail of enzymes + probiotics). Nigerian Society for Animal Production (NSAP) 45th Annual Conference, Bauchi, 2020, Book of Proceedings: 1202-1204.

Ahmad R, Yu YH, Hsiao FSH, Su CH, Liu HC, Tobin I. 2022. Influence of heat stress on poultry growth performance, intestinal inflammation, and immune function and potential mitigation by probiotics. Animals, 12: 229.

Akter R, Hossain MA, Khan M, Rahman MM, Azad MAK, Hashem MA. 2022. Formulation of value-added chicken meatballs by addition of Centella leaf (Centella asiatica) extracts. Meat Research, 2 (2): Article 18. https://doi.org/10.55002/mr.2.2.18.

Bhat TK, Singh B, Sharma OP. 1998. Microbial degradation of tannins: A current perspective. Biodegradation, 9: 343-357.

Biplob MAKA, Hossan MI, Khatun H, Rahman MM. 2024. Quality assessment of chicken meatball with different types of antioxidants in short-term preservation. Meat Research, 4 (6): Article 106. https://doi.org/10.55002/mr.4.6.106.

Dei HK, Rose SP, Mackenzie AM, Amarowicz R. 2008. Growth performance of broiler chickens fed diets containing Shea nut (Vitellaria paradoxa, Gaertn.) meal fermented with Aspergillus niger. Poultry Science, 87 (9): 1773-1778. https://doi.org/10.3382/ps.2008-00055.

Fletcher DL. 2002. Poultry meat quality. World's Poultry Science Journal, 58: 131-145.

Grabowski T, Kijowski J. 2004. Meat and poultry products – technologies, hygiene, quality. WNT, Warszawa (in Polish).

Groom GM. 1990. Factors affecting poultry meat quality. In: Options Méditerranéennes. Agricultural Development and Advisory Service (ADAS), Fisheries and Food, Cambridge, UK.

Hassan MM, Hossen K, Rahman MA, Hashem MA, Rahman MM. 2026. Effect of yoghurt, lemon juice and garlic-ginger paste marination on the quality of chicken meat during refrigerated storage. Meat Research, 6 (1): Article 137. https://doi.org/10.55002/mr.6.1.137.

Hasan MM, Shohiduzjaman M, Hashem MA, Khan M, Rahman MM. 2024. Effects of edible oil on the quality of chicken meat in short-term preservation. Meat Research, 4 (4): Article 99. https://doi.org/10.55002/mr.4.4.99.

Hossan MI, Biplob MAKA, Khan MRI, Rahman MM. 2024. Effect of oats on sensory and physico-chemical properties of chicken meatball. Meat Research, 4 (6): Article 104. https://doi.org/10.55002/mr.4.6.104.

Hussein EO, Suliman GM, Alowaimar AN, Ahmed SH, Abd El-Hack ME, Taha AE, Swelum AA. 2020. Growth, carcass characteristics, and meat quality of broilers fed a low-energy diet supplemented with a multienzyme preparation. Poultry Science, 99: 1988-1994. https://doi.org/10.1016/j.psj.2019.09.007.

Ingr I. 1989. Meat quality: Defining the term by modern standards. Fleisch, 69: 1268-1277.

Islam MR, Hasan MM, Masum MMR, Khan M, Rahman MM. 2025. Effect of organic acid and natural antioxidant on the quality and shelf life of raw chicken meat at refrigerated storage. Meat Research, 5 (1): Article 111. https://doi.org/10.55002/mr.5.1.111.

Lima MA, Oliveira MC, Pimenta AT, Uchôa PK. 2019. Aspergillus niger: A hundred years of contribution to the natural products chemistry. Journal of the Brazilian Chemical Society, 30 (10): 2029-2059. http://dx.doi.org/10.21577/0103-5053.20190080.

Liza FA, Hossan MI, Hashem MA, Rahman MM. 2024. Effect of cattle age on the physio-chemical properties of beef. Meat Research, 4 (4): Article 98. https://doi.org/10.55002/mr.4.4.98.

Masum MMR, Mahmud S, Liza FA, Islam MR, Azad MAK, Rahman MM. 2025. Effect of natural and synthetic antioxidant on the quality of broiler meat during refrigeration. Meat Research, 5 (1): Article 110. https://doi.org/10.55002/mr.5.1.110.

Ojebiyi OO, Shittu MD, Fatoki HO, Ayansina BA, Babayanju IG. 2026. Carcass, organ and organoleptic characteristics of broiler chickens fed diets containing Shea butter (Vitellaria paradoxa C. F. Gaertn) cake with or without enzyme supplementation. Nigerian Journal of Animal Production, 52 (2): 122-142. https://doi.org/10.51791/njap.v52i2.9202.

Orogun AJ. 2010. Growth response and haematological characteristics of broiler chickens fed diets containing Shea butter (Vitellaria paradoxa) seed cake as starter diet. Unpublished Master of Science thesis, Department of Biological Sciences, Faculty of Science, Ahmadu Bello University, Zaria, Nigeria: 126 pp.

Park SY, Kim HY. 2021. Effects of marketing ages on the physicochemical properties and sensory aspects of cured broiler chicken breast meat. Foods, 10: 1-14.

Raw Materials Research and Development Council (RMRDC). 2003. multi-disciplinary committee report of a techno-economic survey on food, beverage and tobacco sector. Abuja, Nigeria: 31 pp.

Sajib MMR, Obidullah M, Dutta A, Ghosh E, Nahar S, Hassin BM, Rahman MM, Ferdaus AJM. 2023. Body conformation, morphometry and meat yield characteristics of different genotypes of chicken. Meat Research, 3 (5): Article 68.

Salihu A, Bala M, Alam Z. 2016. Lipase production by Aspergillus niger using sheanut cake: An optimization study. Journal of Taibah University for Science, 10 (6): 850-859. https://doi.org/10.1016/j.jtusci.2015.02.011.

Schneilder K, Polnick R. 2010. Poultry market in West Africa: Overview and comparative analysis. EPAR Brief, 82: 1-8.

Selvi TN, Ustuner H, Ates Cakiroglu K, Petek M, Cavusoglu E, Demir M, Kupeli EC. 2026. Evaluation of growth performance, meat quality and carcass characteristics of slow and fast-growing broiler chickens under commercial conditions. Journal of Applied Poultry Research, 35 (2): 100698. https://doi.org/10.1016/j.japr.2026.100698.

Tůmová E, Teimouri A. 2010. Fat deposition in the broiler chicken: A review. Scientia Agriculturae Bohemica, 41: 121-128.