Effect of differently processed shea butter (*Vitellaria paradoxa*) cake on growth and haematological parameters of broiler starter chicks

¹Matthew, U. D., ²Alu*, S. E. and ³Maimako, M. B.

¹Department of Agricultural Education, College of Education, P.M.B. 05, Akwanga, Nasarawa State, Nigeria

²Department of Animal Science, Faculty of Agriculture, Nasarawa State University, Keffi, P.M.B. 135 Shabu-Lafia Campus, Nasarawa State.

³Farm Unit, College of Agriculture, P.M.B. 033 Lafia, Nasarawa State, Nasarawa State.

*Corresponding Author: drsamalu@nsuk.edu.ng; drsamalunsuk@gmail.com
+2348033690937; +2347085510322

Abstract

Dietary effects of differently processed Shea Butter Cake (SBC) on growth and haematological parameters of broiler chicks were evaluated in this study lasting 28 days. Six iso-nitrogenous (23% crude protein) and isocaloric (2871.31kcal/kg metabolizable energy) diets tagged T1, T2, T3, T4, T5 and T6 were compounded such that T1 served as the control while the remaining treatments had 15% inclusion of the differently processed SBC. Two hundred and seventy day old chicks were randomly allocated to the six diets and each treatment was replicated 3 times in a completely randomized design. Dietary inclusion of SBC reduced final live weight significantly ($P<0.05$). Chicks fed T1, T2, T3, T4 and T5 had higher final live weights of 223.89 vs. 265.00 vs. 253.33 and 233.33 g/b, respectively than those fed the T6 (226.67 g/b) which however, were lower than the control (602.22 g/b). Similarly, birds fed T3, T4 and T6 had significantly higher ($P<0.05$) daily weight gain than those fed the T5 although highest in birds on control (19.90 g/b/d); similar trend was recorded in feed intake and feed cost per kg diet. Birds fed diets T1, T2 and T4 had lower ($P<0.05$) FCR of 2.01, 2.91 and 2.98, respectively. The RBC increased significantly ($P<0.05$) in birds fed T4 ($2.58 \times 10^6/\mu\text{l}$) and T5 ($2.41 \times 10^6/\mu\text{l}$) compared to other treatments. Broiler chicken producers can therefore, include up to 15% processed Shea butter cake in the diets of broiler chicks without affecting their growth performance as well as wellbeing.

Keywords: Processing, fermentation, boiling, toasting, soaking, Shea butter cake meal, growth rate, haematological parameters and broiler starter chickens

Introduction

Feed is the most important input in a profitable poultry production. It accounts for 70-80 % of the total cost of production (Bello, 1984; Ogundipe, 2003; Kehinde *et al.*, 2006). The use of non- conventional feed ingredient and the search for other feed resources that are not expensive is therefore necessary (Farinu *et al.*, 2006). Non-conventional feedstuff offers the best alternative in our environment for reduction in feed cost (Dafwang *et al.*, 2001). In terms of total cost, energy is the main factor

influencing diet cost (Afolayan *et al.*, 2009) high cost of maize has contributed immensely to increased cost of poultry feeds. Surprisingly, energy sources (grains) had turned out to be more expensive, thereby increasing the cost of production (Abeke *et al.*, 2003 and Bawa *et al.*, 2003). The incorporation of agro-industrial by-products into animal feeds holds tremendous potentials for alleviating the short supply and high cost of feed (Babatunde *et al.*, 2000). Many of these agro-industrial by-products are fibrous in

nature and their use in monogastric animals' diets is therefore limited due to the fibre handling abilities of the livestock, which is about 5-7 % (NRC, 1977; Olomu, 1995). Shea butter cake, a by-product of Shea butter oil extraction contains 92.57% dry matter, 12.70% crude protein, 5.96% crude fibre, 0.84% oil, 3.77% ash and 76.72% nitrogen free extract (Orogun *et al.*, 2015). Iddrisu *et al.* (2013) reported $13.03 \pm 1.70\%$ crude protein, $59.37 \pm 8.66\%$ carbohydrate, $23.38 \pm 10.15\%$ crude fibre, $4.25 \pm 0.79\%$ ash, $5.29 \pm 0.98\%$ moisture and $8.71 \pm 0.85\%$ fibre.

The search for cheaper sources of animal protein brings broilers chickens into focus. Earlier suggestions (Igwebuike *et al.*, 2001; Taiwo *et al.*, 2004; Ani and Okafor, 2004) revealed that solution to the problem of animal protein shortage in Nigeria lies in the production of highly prolific animals that are efficient converters of feed to flesh and with short generation intervals such as broilers chickens. Also the integration of the wide array of cheap and locally available non-conventional feedstuffs at our disposal into well-defined feeding systems to reduce cost becomes very necessary. Shea Butter cake is the targeted non-conventional feed resource for this study. Shea butter (*Vitellaria paradoxa*) cake; unlike other conventional energy sources have low human food preference; hence might be a very good substitute; but has some anti-nutritional factors like tannins and saponins that could limit its usage in poultry nutrition.

Most conventional feedstuffs for poultry are very expensive and in high demand by humans for industrial use or consumption. It can therefore be a very good substitute if properly processed. This study was aimed at evaluating the effect of differently processed Shea butter (*Vitellaria paradoxa*) cake on growth and haematological

parameters of broilers chicks.

Materials and Methods

Study Area

The experiment was undertaken at Animal Experimental Farm, College of Education, Akwanga, Nasarawa State. The Farm is located in Akwanga town, in the Guinea savanna zone of North Central Nigeria; on latitude 8.92° North, longitude 8.38° East and 359 meters elevation above the sea level. The mean monthly maximum and minimum temperatures are 35.06 and 20.16°C respectively, while the mean monthly relative humidity is 64 %. The mean rainfall is about 168.90mm (NIMET, 2008).

Source of SBC

The SBC sample for this study was obtained from villages around Gadabuiké, Nasarawa Local Government Area- Nasarawa State.

Methods of processing

One kg of unprocessed SBC sample labeled T1 (UP) was milled to a size of 0.5 mm. 1 kg of unprocessed SBC was soaked in 2.5 litres of water in an open container for 24 hours. The water was decanted and replaced every eight hours. Water was then drained and the sample labeled T2 (SK) was sun-dried for 3 days. The wet unprocessed SBC was bagged in an air-tight polythene bag and allowed to ferment for 3 days (72 hrs), then sun-dried for 3 days and labeled T3 (FER). The toasted sample labeled T4 was obtained by toasting the unprocessed SBC in a silver pot for few minutes until a uniform brownish colour was achieved. A sample labeled T5 (SB), of dry unprocessed SBC was suspended inside a Jute bag over a pot containing 2.5 litres of water at boiling point and covered on a kerosene stove with a steady flame for 30 minutes. The sample was then removed and sun-dried for 3 days. Each sample was analyzed for proximate

and results used to formulate the experimental diets.

Experimental diets, design and management of chicks

Six iso-nitrogenous (23% crude protein) and isocaloric (2871.31kcal/kg metabolizable energy) diets tagged T1, T2, T3, T4, T5 and T6 were compounded such that T1 served as the control while the remaining treatments had 15% inclusion of the differently processed test ingredient. Other nutrients were included at the recommended levels to meet the requirement of the animals as prescribed by Oluyemi and Roberts (2000). The chemical

composition of the experimental diets for starter broiler chicks is presented in Table 1. Two hundred and seventy 1 - day-old broiler chicks were randomly allocated to the 6 experimental diets and each treatment was replicated three times in a completely randomized design. The birds were fed twice daily (8.00 am and 4.00 pm) and clean drinking water was provided *ad libitum* for 28 days. Performance records such as feed intake, initial weight, and final weight were recorded and used to calculate feed conversion ratio, protein efficiency ratio, feed cost/kg and weight gain.

Table 1: Composition of broiler starter diets containing differently processed Shea butter cake (0-4 weeks)

Ingredient (%)	Treatment					
	T1	T2	T3	T4	T5	T6
Maize	49.60	42.60	42.60	42.60	42.60	42.60
Soybean cake	16.00	15.00	15.00	15.00	15.00	15.00
Shea butter cake	-	15.00	15.00	15.00	15.00	15.00
Groundnut cake	20.00	16.00	16.00	16.00	16.00	16.00
Wheat offal	10.00	7.00	7.00	7.00	7.00	7.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Lime stone	0.50	0.50	0.50	0.50	0.50	0.50
Common salt	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Vitamin Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculated Nutrient Analysis						
ME (Kcal/kg)	2,805.46	2,871.31	2,871.31	2,871.31	2,871.31	2,871.31
Crude protein (%)	23.05	23.13	23.13	23.13	23.13	23.13
Ether extract (%)	4.09	3.79	3.79	3.79	3.79	3.79
Calcium (%)	1.34	1.38	1.38	1.38	1.38	1.38
Phosphorus (%)	0.67	0.71	0.71	0.71	0.71	0.71
Crude fibre (%)	3.86	5.11	5.11	5.11	5.11	5.11
Lysine (%)	1.08	1.13	1.13	1.13	1.13	1.13
Methionine (%)	0.51	0.57	0.57	0.57	0.57	0.57
Cost/kg of Diet (N)	91.11	85.76	86.00	86.50	87.00	86.75

*Premix, the vitamins and mineral premix supplied the following per 100kg of diet. Vitamin A 15,000 I.U., vitamin D₃ 300,000 I.U., vitamin E 3,00 I.U., vitamin K 2.50mg, thiamin, (B₁) 200mg, riboflavin (B₂) 600mg, pyridoxine (B₆) 600mg, niacin 40.0mg, vitamin B₁₂ 2mg, panthothenic acid 10.0mg, folic acid 100mg, biotin 8mg, choline chloride 50g, antioxidant 12.5g, manganese 96g, zinc 6g, iron 24g, copper 0.6g, iodine 0.14g, selenium 24mg, cobalt 214mg.

T1= No Shea butter cake, T2= Unprocessed shea butter cake, T3= Soaked Shea butter cake, T4= Fermented Shea butter cake, T5= Toasted Shea butter cake, T6= Steam boiled shea butter cake

Data collection

Growth parameters

Performance data include feed intake which was obtained as the difference in the feed

offered and the leftover. Body weight gain was obtained by the difference between current and preceding weeks live weight of each bird. Feed conversion ratio was

calculated as the rate of feed intake to live weight gain $FCR = \text{feed intake (g)} / \text{weight gain (g)}$ while protein efficiency ratio (PER) was determined as gain in body weight (g) divided by protein consumed (g). The feed cost per kg diet was computed as the prevailing market price of individual ingredient multiplied by the level of ingredient used in the diet.

Haematological indices

At day 28 of trial, blood samples were collected from 6 birds per treatment using 5ml sterile disposable needles. The blood were collected from under the wings of the birds and emptied into sample bottles containing ethylene diamine tetra acetic acid (EDTA) as anti-coagulant; to prevent clotting of the blood and used to evaluate some haematological indices. The PCV was analyzed using microhaematocrit method as described (Schalm *et al.*, 1975). Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were determined with the formulae of Schalm *et al.* (1975).

$$MCV = \frac{PCV \times 10}{RBC} \text{ fentolitre (fl)}$$

$$MCH = \frac{Hb \times 10}{RBC} \text{ picogram (pg)}$$

$$MCHC = \frac{Hb \times 100}{PCV} \text{ gram per deciliter (gm/dl)}$$

Statistical analysis and model

Data were statistically analyzed using the general linear model of Statistical Analysis System (SAS, 2008) means were separated using the Duncan's multiple range test as described by Steel and Torrie (1980).

Results and Discussion

Effect of dietary inclusion of the differently processed Shear butter cake on growth performance of broiler chicks are in Table 2. The SBC inclusion in the diets of chicks reduced the final live weight of chicks

significantly ($P < 0.05$). Chicks fed diets T1, T2, T3, T4 and T5 had higher final live weights of 223.89 vs. 265.00 vs. 253.33 and 233.33 g/b, respectively than those fed the T6 (226.67 g/b). However, these values were lower than the control (602.22 g/b). Similarly, birds fed diets T3, T4 and T6 had significantly higher ($P < 0.05$) daily weight gain than those fed the T5 although a higher value was recorded in the control (19.90 g/b/d). A similar trend was recorded in feed intake and feed cost per kg diet. Birds fed diets T1, T2 and T4 had higher ($P < 0.05$) FCR of 2.01, 2.91 and 2.98, respectively compared to other treatments. These observations conformed to earlier reports (Fleury, 1981; Amaefule and Obioha, 2000) that incorporation of shea butter nut meal as protein ingredient in poultry ration up to 30% of the whole ration, resulted in improved feed conversion efficiency, higher body weight and live weight gain. Similarly, feeding trials using shea butter cake for pig rations in Thailand showed that inclusion of 30% ground pigeon pea increased live weight gain of pigs from 125g day⁻¹ to 159g day⁻¹ in the local basal feed of chopped banana stalk, rice bran and maize. By boiling the pigeon pea meal, the live weight gain was increased to 205g day⁻¹ (Fleury, 1981).

Table 3 shows the effect of differently processed Shear butter cake on haematological parameters of broiler chicks. The result showed that most evaluated parameters were not significantly ($P > 0.05$) affected the inclusion of the test ingredients. However, there was a significant ($P < 0.05$) increase in the red blood cells as birds fed diets T4 ($2.58 \times 10^6/\mu\text{l}$) and T5 ($2.41 \times 10^6/\mu\text{l}$) had higher values compared to the rest of the treatments. The health or wellbeing of an animal is determined by the status of the blood. Haematology ($2.30 - 2.58 \times 10^6/\mu\text{l}$)

Table 2: Effect of differently processed Shea butter (*Vitellaria paradoxa*) cake on growth parameters of broiler chicks

Starter	T1	T2	T3	T4	T5	T6	SEM	LOS
Initial weight (g/b)	45.00	45.00	45.00	44.44	44.44	43.89	2.39	NS
Final weight (g/b)	602.22 ^a	223.89 ^c	265.00 ^b	253.33 ^{bc}	233.33 ^{bc}	226.67 ^c	9.89	*
DWG(g/b/d)	19.90 ^a	6.39 ^c	7.86 ^b	7.48 ^b	6.75 ^c	7.28 ^b	0.53	*
Feed intake (g/b/d)	40.06 ^a	19.64 ^c	22.86 ^b	22.31 ^{bc}	20.97 ^c	21.81 ^{bc}	0.94	*
Feed conversion ratio	2.01 ^b	3.08 ^a	2.91 ^b	2.98 ^b	3.12 ^a	3.35 ^a	0.09	*
Feed cost/kg (N/kg)	95.36 ^a	88.01 ^a	88.60 ^b	89.01 ^c	90.01 ^d	90.60 ^e	4.40	*

NS=No significant difference ($p>0.05$), a,b,c, d, e - means on the same row bearing different superscript differ significantly ($P<0.05$), * - significantly different ($P<0.05$), SEM - standard error of means, LOS — Level of significance, T1= No Shea butter cake, T2= Unprocessed shea butter cake, T3= Soaked Shea butter cake, T4=Fermented Shea butter cake, T5= Toasted Shea butter cake, T6=Steam boiled shea butter cake, DWG=Daily weight gain

Table 3: Effect of differently processed Shea butter cake on haematological indices of broiler chicks (0-4wks)

Parameters	T1	T2	T3	T4	T5	T6	SEM	LOS
Packed cell volume (%)	23.33	23.11	22.33	24.89	23.57	22.89	2.00	NS
Haemoglobin (g/dl)	7.70	7.74	7.34	8.31	7.78	7.68	1.00	NS
Red blood cells ($\times 10^6/\mu\text{l}$)	2.37 ^b	2.35 ^b	2.31 ^b	2.58 ^a	2.41 ^a	2.30 ^b	0.00	*
White blood cells ($\times 10^3/\mu\text{l}$)	56.00	60.08	60.62	68.56	46.80	64.59	16.00	NS
MCV (fl)	98.50	97.60	98.27	97.67	99.10	92.27	2.00	NS
MCH (g/dl)	32.51	32.94	31.78	32.01	32.23	32.37	1.00	NS
MCHC (g/dl)	32.89	33.56	32.83	33.32	32.94	33.39	1.00	NS

SEM= standard error of mean, LOS= level of significant, NS= not significant ($P>0.05$), MCV - Mean corpuscular volume, MCH - Mean corpuscular haemoglobin, MCHC - Mean corpuscular haemoglobin concentration, T1= No Shea butter cake, T2= Unprocessed shea butter cake, T3= Soaked Shea butter cake, T4=Fermented Shea butter cake, T5= Toasted Shea butter cake, T6=Steam boiled shea butter cake

shows that the birds were not anaemic, consequently indicating that the differently processed SBC supported the growth and development of the birds. The values recorded in this study are close to those earlier reported (Alu *et al.*, 2015).

Conclusion and recommendations

Poultry farmers can include up to 15% processed Shea butter cake in the diets of broiler chicks without affecting their growth performance as well as wellbeing. This is so because; all the parameters of the haematology were not affected by Shea butter cake inclusion for broiler chickens.

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