Response of Turkey Growers Fed Fermented Shea Butter Cake Based Diets with Fullzyme® Supplementation

Aguihe P.C.[1], Fatokun B.O.[1], Ilaboya I.I.[2], Jeje C.A.[1], and Mohammed H.[1]*

[1]*Department of Animal Production and Health Technology, Federal College of Wildlife Management, New Bussa, Niger State, Nigeria.*
[2]*Department of Animal Science, Benson Idahosa University, Benin, Edo state, Nigeria.*

KEYWORDS

Multienzymes,
Performance,
Probiotic,
Shea butter cake,
Turkey.

*CORRESPONDING AUTHOR

aguihepc@gmail.com

ABSTRACT

A 6-week experiment was conducted to evaluate the growth performance and economic analysis of broad breasted bronze turkey growers fed diets containing fermented shea butter cake meal (FSBCM) as replacement for maize with Fullzyme® supplementation. Three treatment diets were formulated, where T1 contained maize-soybean based control diet, T2 had 25% FSBCM replacing maize in T1 diet and T3 contained 0.5% Fullzyme supplementation to T2 diet. A total of 72, six-week old unsexed broad breasted bronze turkey growers were weighed and allocated to three dietary treatments with four replications of six birds each in a completely randomized design (CRD). Data collected on feed intake, body weight gain and feed:gain as well as cost indices were subjected to analysis of variance with the aid of SAS software package. Feed and water were provided ad libitum. Results showed that significant (P<0.05) higher weight gain and lower feed intake were recorded in turkeys fed control and T3 diets compared to those offered T2 diet. Feed:gain deceased (P<0.05) in turkeys fed control and T3 diets than those fed T2 diet. Cost analysis revealed that cost/kg gain was significantly (P<0.05) lower in turkeys fed T3 diet compared to those on control and T2 diets. Cost of feed consumed, cost of production and % feed cost were higher (P<0.05) in control group than T2 and T3 groups. In conclusion, FSBCM can replace maize in turkey growers diet up to 25% level with mixture of enzymes cocktail and probiotics (Fullzyme) supplementation without compromising growth performance at a lower feed cost/kg weight gain.

INTRODUCTION

The increasing surge in population growth has caused an increase in global demand for animal protein especially consumption of poultry meat in developing countries. The need for increased animal protein consumption of the rural and urban Nigeria populace in the face of rising population and inflation has resulted in the increase in cost of conventional feed ingredients (Agbogidi and Okonta, 2011; Oguntoye *et al*., 2018). 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 (Onu *et al*., 2011). 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. It has therefore become imperative to explore other alternatives for poultry farmers and 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.

One of such alternative and potential feed resource is shea butter cake (SBC), a by-product obtained from processing shea nut into shea butter, and has always been discarded as waste and unusable by man and any conventional industry. Chemical composition analysis of SBC indicated its overall nutritional value to be high but its inclusion in poultry diet has been limited due to the occurrence of antinutritional factors (ANFs) such as tannin, bromine and saponin (Annongu *et al*., 1996; Atuahene *et al*., 1998; Orogun *et al*., 2015). Some researchers have reported the effectiveness of fermentation treatment of SBC in increasing its nutritive potential by reducing the level of these ANFs contained in the cake meal (Agbo and Prah, 2014; Matthew *et al*., 2018; Aguihe and Kehinde, 2019). Also, the incorporation of SBC in poultry diets has been challenged by its highly fibrous nature that can cause poor performance and health of birds (Dei *et al* 2008; Oddoye *et al*, 2012; Orogun *et al*., 2015). Consequently, appropriate application of supplemental feed

additives such as enzymes and probiotics are well documented as effective means to improving the nutritive value of fibrous plant based ingredients through increased nutrient digestibility and beneficial microbial population in the digestive tract of birds (Wealleans *et al*., 2017; Singh *et al*., 2019; Aguihe *et al*., 2020; Luo *et al*., 2022; Shekarabi *et al*., 2022). Although the application of multienzymes and probiotics in poultry ration has gained wide attention, until recently, there is dearth of information on the impact of their combined supplementation in growing turkey birds fed SBC based diet. Therefore, the present study was conducted to evaluate the combined effect of multienzymes and probiotic supplementation in diets of turkey birds containing fermented SBC meal on growth performance and cost benefit.

MATERIALS AND METHODS

Experimental site and preparation of test ingredient: The experiment was carried out at the Poultry Unit of the Teaching and Research Farm of the Department of Animal Production Technology, Federal College of Wildlife Management, New-Bussa, Niger State. The SBC were obtained from some local shea butter processing factories in New-bussa, thoroughly mixed and subjected to fermentation under anaerobic conditions for five days. Thereafter, the fermented SBC were properly air dried for 3 days and then pulverized into finer particles to produce fermented shea butter cake meal (FSBCM), and thereafter subjected to proximate analysis using the procedure of AOAC (2016) as shown in Table 1.

Table 1: Proximate composition of fermented shea butter cake meal (FSBCM)

Nutrients (%)	Dry matter	Ash	Crude fiber	Crude protein	Crude fat	NFE
FSBCM	95.61	6.13	3.36	15.85	24.25	46.03

Experimental birds, design and management: A total of 72, six-week old unsexed broad breasted bronze turkey growers were weighed individually and allocated to three dietary treatments with four replications of six birds each in a completely randomized design (CRD). Feed and water were given *ad-libitum*. Data on feed intake and body weight were collected on weekly basis. The birds were raised for a period of 42 days in a deep litter system using wood shavings as litter material and kept in an open sided poultry pen facility.

Experimental Diets: Three isonitrogenous and isocaloric experimental turkey grower diets were formulated such that diet T1 which served as the control contained corn-soybean meal based while diets T2 contained 25% FSBCM replacing maize in T1 and diets T3 contained 0.5% Fullzyme® supplementation to diet T2. Table 2 shows the ingredient composition of the experimental diets.

Ingredient composition of Fullzyme®: Fullzyme® is a unique blend of mixture of concentrated exogenous enzymes cocktail (amylase, protease, cellulase, lipase, pectinase, xylanase, β-mannanase, β-glucanase, phytase, *Aspergillus oryzae*) and probiotics (yeast culture, and *Bacillus subtilis*), produced by Biofeed Technology Inc., Brossard QC, Canada. Fullzyme® was added at the rate 50g to 100kg of the diet according to the Biofeed guidelines.

Data collection: The turkey birds were weighed at the beginning of the experiment and weekly, subsequently. Body weight gain was determined as the difference between two consecutive weighing (1-week interval). Feed intake was obtained as the difference between the quantity offered and quantity not consumed. Feed conversion ratio (FCR) was calculated as feed intake divided by weight gain. Financial benefit was computed using the market cost of the ingredients as at the time of the study to estimate the cost per kg diets and other cost parameters were determined using the procedure as described by Oguntoye *et al*. (2018).

Statistical Analysis: Data generated was subjected to Analysis of variance (ANOVA) using the general linear model in a statistical analysis system (SAS, 2002). Existence of significant differences among the treatment means were separated using Tukey test and level of significance was adopted at probability level of 5%.

Table 2: Ingredient composition of experimental diets

Ingredients (kg)	T1 (0% FSBCM)	T2 (25% FSBCM)	T3 (25% FSBCM+FZ*)
Corn	44.00	33.00	33.00
Soybean	32.30	32.30	32.30
Fishmeal	5.00	5.00	5.00
Wheat offal	9.50	9.50	9.00
Groundnut oil	5.00	5.00	5.00
FSBCM	0.00	11.00	11.00
Di-calcium phosphate	1.50	1.50	1.50
Limestone	1.00	1.00	1.00
Salt	0.30	0.30	0.30
Methionine	0.40	0.40	0.40
Lysine	0.50	0.50	0.50
Premix	0.50	0.50	0.50
Fullzyme®	0.00	0.00	0.50
Total	100.00	100.00	100.00
Calculated Composition			
Crude protein %	22.55	22.39	22.62
ME Kcal/kg	3118.10	3182.55	3155.77

*FSBCM: Fermented shea butter cake meal; FZ: Fullzyme®

RESULTS AND DISCUSSION

The effect of Fullzyme supplementation to FSBCM based diets fed to turkey growers on growth performance is presented on Table 3. The result showed that Fullzyme supplementation significantly affected (P<0.05) final body weight, feed intake, body weight gain and feed:gain of the birds. Birds fed T2 diet showed higher (P<0.05) feed intake compared to those on the control diet while birds fed T3 diet had the lowest (P<0.05) feed intake. Body weight gain of the birds was significantly (P<0.05) higher in the control diet than those fed T2 diet. The weight gain of birds fed T3 diet did not differ (p>0.05) from those offered control diet. Feed:gain ratio was significantly improved (P<0.05) in birds fed control and Fullzyme supplemented FSBCM diet (T3) than those fed FSBCM diet without Fullzyme addition (T2). The improvement in weight gain and feed:gain of broiler chickens fed diets supplemented with Fullzyme as observed in this study is in line with previous reports that demonstrated a positive interaction of broiler chickens fed enzymes and direct-fed microbials on increased body weight gain and decreased feed:gain (Oladipo *et al*., 2019; Aguihe *et al.*, 2020; Abdel-Ghany *et al*., 2020; Luo *et al*., 2022). The dual objectives of using exogenous digestive enzymes and probiotics are associated with enriching the microbial balance in the GIT by increasing the abundance of beneficial bacteria while decreasing pathogenic microorganisms (Dai *et al*., 2019; Luo *et al*., 2022; Sun *et al*., 2022). Thus, incorporating dietary probiotics and exogenous enzymes improves nutrient availability and intestinal health, and helps maintain a more balanced microbiome diversity (Wealleans *et al*., 2017; Oladipo *et al*., 2019; Shekarabi *et al*., 2022). The enhancement in the growth performance observed in turkey growers could be related to the improved digestion capacity in the intestines by synergetic action of dietary multi-enzymes and probiotics (Singh *et al*., 2019; Abdel-Ghany *et al*., 2020; Luo *et al*., 2022).

Table 3: Effect of enzymes cocktail and probiotic mixture on growth performance in turkey growers fed fermented shea butter cake based diets

Growth indices	T1	T2	T3	SEM	p-values
Initial body weight g/bird	1300.00	1330.00	1300.00	0.04	4.987
Final body weight g/bird	2430.00^{a}	2286.00^{b}	2395.50^{a}	18.12	0.024
Feed intake g/bird	2700.00^{b}	2833.33^{a}	2694.44^{b}	5.69	0.031
Body weight gain g/bird	1133.33^{a}	956.00^{b}	1095.50^{a}	21.78	0.016
Feed:gain	2.38^{b}	2.96^{a}	2.46^{ab}	0.28	0.001

$^{a-c}$Means in the same column with different superscripts differ significantly (P<0.05). T1: Control diets (corn-soybean based); T2: 25% FSBCM + 0% Fullzyme; T3: 25% FSBCM + 50g/kg Fullzyme.

The impact of multienzyme supplementation to turkey birds fed SBCM based diet is displayed in Table 4. The result indicates that all cost variables evaluated were significantly (P<0.05) affected by Fullzyme supplementation except operational cost and price/kg live weight. Birds fed control diets exhibited higher (P<0.05) mean values on cost/kg gain, followed by those fed T2 diet while those fed T3 diet recorded lower (P<0.05) cost/kg gain. Cost/kg feed, cost of feed consumed, cost of production and feed cost were significantly higher (P<0.05) in birds on control diet compared to those fed SBCM based diets with or without enzyme complex supplementation.

The observed reduction in these cost variables in turkey growers fed FSBCM based diets with or without Fullzyme supplementation may probably be attributed to lower cost per unit of SBCM compared to that of maize. Nevertheless, Fullzyme supplementation significantly reduced cost per kg weight gain of the birds due to improved efficiency of feed utilization. In accordance with the present findings, similar results have been previously reported by Onu *et al*. (2011) and Oguntoye *et al*. (2018). According to Wealleans *et al*., (2018) and Oladipo *et al*. (2019), the synergetic ability of supplemental enzymes cocktail and probiotic mixture to increase nutrient digestion and bioavailability could also be implicated in the reduction of feed cost per kg gain observed in the present study. The observation of lower cost of production in turkey growers offered FSBCM based diets with Fullzyme supplementation over the control group portray more profit margin. This could be attributed to reduced cost of diet per kg and improved feed efficiency in the birds fed Fullzyme supplemented FSBCM diets. The revenue generated per bird was significantly ($P<0.05$) higher in the groups that received control and Fullzyme supplemented SBCM diet compared to those fed SBCM diet. Thus, the increased revenue observed in turkeys fed SBCM diet with Fullzyme supplementation over those without Fullzyme might be attributed to improved feed conversion efficiency and utilization that resulted to the increased weight gains of the birds due to synergistic action of multienzymes and probiotics (Oladipo *et al*., 2019; Catootjle *et al*., 2020; Luo *et al*., 2022).

Table 4: Economy of production of turkey growers fed fermented shea butter cake meal (FSBCM) based diet with supplemental enzymes cocktail and probiotic mixture (Fullzyme)

Cost indices	T1	T2	T3	SEM	P-values
Cost/kg feed (₦/bird)	171.67^{a}	116.07^{b}	124.69^{b}	5.02	0.008
Cost/kg gain (₦/bird)	408.57^{a}	328.83^{b}	306.74^{c}	19.59	0.042
Cost of feed consumed (₦/bird)	463.51^{a}	325.00^{b}	335.92^{b}	26.12	0.027
Operational cost (₦/bird)	110.00	110.00	110.00	ND	ND
Cost of production (₦/bird)	573.51^{a}	435.00^{b}	445.92^{b}	6.12	0.006
Feed cost (%)	80.82^{a}	74.71^{b}	75.33^{b}	0.33	0.001
Price/kg live weight (₦/bird)	1500.00	1500.00	1500.00	ND	ND
Revenue (₦/bird)	3645.00^{a}	3429.00^{b}	3592.50^{a}	28.25	0.018

$^{a-c}$Means in the same column with different superscripts differ significantly ($P<0.05$). T1: Control diets (corn-soybean based); T2: 25% FSBCM + 0% Fullzyme; T3: 25% FSBCM + 50g/kg Fullzyme. *ND: Not determined

CONCLUSION

The current results demonstrated that the inclusion of 50g/kg Fullzyme® has the potential to enhance the growth performance and reduced cost per kilogram weight gain as well as cost of production of turkey growers fed diets containing FSBCM replacing maize at 25%.

REFERENCES

Abdel-Ghany, H.M., Salem, M. E., Abouelkhier, S.S., and Helal, A.M. (2020). Effect of a cocktail of enzymes and probiotics on the growth and the bacterial enumeration in gut and effluents of red tilapia (Oreochromis niloticus x O. mossambicus). *Egyptian Journal of Aquatic Research*, 46, 289–294.

Agbo. N.W., and Prah, C.D. (2014). Evaluation of fermentation period on the proximate composition and tannin concentration of shea nut (*Vitellaria paradoxa*) meal. *Journal of Microbiology and Biotechnology Research*, 4, 21-27.

Agbogidi, M.O., and Okonta, B.C. (2011). Reducing poverty through snail farming in Nigeria. *Agriculture and Biology Journal of North America*, 2(11), 169-175.

Aguihe, P.C., and Kehinde, A.S. (2019). Performance, haematology and serum biochemistry of broiler chickens fed differently processed shea butter cake meal. *Nigerian J. Anim. Sci.*, 21 (2), 231-239.

Aguihe, P.C., Kehinde, A.S., Halidu, S.K., Sulyman, A., Chikezie, J., Joshua, D.A., Ilaboya, I.I., and Samuel, K.U. (2020). Effect of multienzymes + probiotic supplementation in fermented shea butter cake based diets on the carcass traits and the biochemistry of broiler chickens. *Agricultural Science and Technology*, 12 (3), 227-233.

Annongu, A.A., Termeulen, U., Atteh, J.O. and Apata, D.F. (1996). Toxicological assessment of native and industrial fermented shea butter cake in nutrition of broilers. *Arch. Gefluegelkd*. 60:221–226.

AOAC. (2016). Official Methods of Analysis of the Association of Official Analytical Chemists, 20th ed.; AOAC Inc.: Washington, DC, USA.

Atuahene, C. C., Donkoh, A., and Asante, F. (1998).Value of shea nut cake as a dietary ingredient for broiler chickens. *Animal Feed Science and Technology*, 72, 133 -142.

Catootjle, L.N., Helda, D.K., Probas, A.A., Lay R. and Max, A.J.S. (2020). The supplementation effects of multienzymes and synbotics on production performance, nutrient utilization, economic value and Salmonella Spp. Content of broilers. *Pak. J. Nutr.*, 19: 51-60

Dai B., Hou Y., Hou Y., and Qian L. (2019). Effects of multienzyme complex and probiotic supplementation on the growth performance, digestive enzyme activity and gut microorganisms composition of snakehead (*Channa argus*). *Aquacult. Nutr*., 25, 15–25.

Dei, H. K., Rose, S. P., and Mackenzie, A. M. (2008). Variability of nutritive value of shea nut (*Vitellaria paradoxa*) meal for poultry. *International Journal of Poultry Science*, 9 (7), 403-406.

Luo, C., Wang, L., Chen, Y., and Yuan, J. (2022). Supplemental enzyme and probiotics on the growth performance and nutrient digestibility of broilers fed with a newly harvested corn diet. *Animals*, 12, 2381-2392.

Matthew, U. D., Alu, S. E. and Maimako, M.B. (2017). Effect of differently processed shea butter (*Vitellaria paradoxa*) cake on growth and haematological parameters of broiler starter chicks. *Nig. J. Anim. Prod.*, 44(1), 267 – 274.

Oddoye, E.O.K., Alemawor, F., Agyente-Badu, K., and Dzogbefia, V.P. (2012). Proximate analysis of shea nut kernel cake/meal samples from industry and cottage industry and some methods of removal of anti-nutritional factors. *International Journal of Biochemistry and Biotechnology*, 1(9), 239-242.

Oguntoye, M.A., Hapson, U., Adamu, F., Daniel, D.K., and Daniel, B. (2018). Performance and economic of production of broiler chickens fed maize and yam peels based diets supplemented with xylanase, amylase and protease multi-enzymes at starter phase. *Nigerian J. Anim. Sci*., 20 (3): 73-82.

Oladipo, M.F., Onimisi, P. A., Duru, S., and Abeke, F. O. (2019). Synergetic effect of enzymes and probiotic in improving sorghum (*Sorghum bicolor*) based diets for broiler chickens. *Nigerian J. Anim. Sci.* 21 (3), 71-81.

Onu P. N., Madubuike F. N., Onu D.O., and Ekenyem B. U. (2011). Performance and economic analysis of broiler starter chicks fed enzyme supplemented sheep manure-based diets. *Journal of Agricultural and Biological Science*, 6(1), 14 – 19.

Orogun, A. J., Oniye, S. J., and Olugbemi, T. S. (2015). Growth and haematological response of broiler starter chickens fed diets containing shea butter cake. *International Journal of Scientific Research in Science, Engineering and Technology*, 2 (1), 304-310.

SAS Institute (2002). SAS-STAT User`s Guide Statistic. 4th edition, SAS Inst. Inc. Cary, NC, USA.

Shekarabi, S.P.H., Ghodrati, M., Masouleh, A.S., and Roudbaraki, A.F. (2022). The multi-enzymes and probiotics mixture improves the growth performance, digestibility, intestinal health, and immune response of Siberian sturgeon (*Acipenser baerii*). *Ann. Anim. Sci*., 22 (3): 1063–1072.

Singh, A. K., Tiwari, U. P., Berrocoso, J. D., Dersjant-Li, Y., Awati, A., and Jha, R. (2019). Effects of a combination of xylanase, amylase and protease, and probiotics on major nutrients including amino acids and non-starch polysaccharides utilization in broilers fed different level of fibers. *Poultry Science*. 0, 1–11 http://dx.doi.org/10.3382/ps/pez310.

Sun, Y., Zhang, Y., Liu, M., Li, J., Lai, W., Geng, S., Yuan, T., Liu, Y., Di, Y., and Zhang, W. (2022). Effects of dietary Bacillus amyloliquefaciens CECT 5940 supplementation on growth performance, antioxidant status, immunity, and digestive enzyme activity of broilers fed corn-wheat-soybean meal diets. *Poult. Sci*., 101: 101585.

Wealleans, A.L., Walsh, M.C., Romero, L.F. and Ravindran, V. (2017). Comparative effects of two multi-enzyme combinations and a Bacillus probiotic on growth performance, digestibility of energy and nutrients, disappearance of non-starch polysaccharides and gut microflora in broiler chickens. *Poultry Science*, 96, 4287 - 4297.

Wealleans, A.L., Li, W., Romero, L.F., Mathis, G. and Lumpkins, B. (2018). Performance and cost-benefit improvements following supplementation with a combination of direct-fed microbilas and enzymes to broiler chickens raised with or without ionophores. *The Journal of Applied Poultry Research*, 27(1), 23-32.