



Performance and Economics of Production of Broiler Chickens Fed Dietary Levels of Toasted Full Fat Sunflower Seed Meal (*Helianthus annuus*)

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Abstract

An experiment was carried out to investigate the performance and economic of production of broiler chickens fed dietary levels of full fat sunflower seed meal. Toasted sunflower was included in the diets at 0, 5, 10, 15 and 20 % levels and coded as diets 1, 2, 3, 4 and 5 respectively. Three hundred (300) day old broiler chicks were randomly allotted to five dietary groups of sixty (60) birds per treatment in a completely randomized design (CRD) and the birds were fed experimental diets and water ad-libitum. The results revealed significant ($P<0.001$) difference in daily feed intake (DFI) and daily weight gain (DWG) at the starter phase. The finisher phase showed that DFI, DWG and feed conversion ratio (FCR) were found to be significantly ($P<0.001$) different. However, at both the finisher and the overall phase DFI, DWG and FCR were significantly ($P<0.001$) influenced by the dietary levels of toasted sunflower seed meal (TSFM) with better performance obtained in broiler chickens fed diet 2 (5 % TSFM). Feed cost per kg gain was highest on diet 4 (₦277.78/kg) and the least was obtained on diet 2 (₦234.20/kg). Broiler chickens can tolerate 5 % roasted full fat sunflower seed meal without compromising performance and carcass yield as well as reduction in feed cost.

Keywords: Broiler, Diets, Economics, Performance, Sunflower,

Introduction

Poultry are known to serve as source of meat, eggs and income to man. According to Faniyi (2009), about two million Nigerians depend directly or indirectly on poultry production. Okonkwo and Akubuo (2001) also pointed out that about 10 % of the Nigerian population is engaged in poultry production, mostly on subsistence and small or medium scale farms. The industry has assumed a greater importance in improving employment opportunity and animal food production in Nigeria (Adebayo and Adeola, 2005).

Most of the developing tropical countries depend on soya bean and other common leguminous grains as protein source for both humans and animals, but their production is

not yet sufficient to meet the protein requirement of the increasing and expanding livestock industries (Vijayakumari *et al.*, 2007). Replacement of expensive conventional feed ingredients with cheap and available substitutes represents a suitable strategy at reducing feed cost and encouraging production. Several researches have been carried out in the search for alternatives to soya bean in poultry diets.

Nutrition plays an important role in intensive chicken production (Emenalon, 2004). Feed represents between 70 – 80 % of the variable costs of production (Akinmutimi and Onen 2008) in a typical poultry enterprise. Efforts are being made by animal nutritionists to explore the possibilities of incorporating

unconventional feedstuffs either from protein or energy sources instead of the conventional feedstuffs such as fishmeal, soyabean meal and maize which constitute the largest part of balanced diet for livestock and poultry (Oluremi *et al.*, 2010).

Sunflower seeds (SFS) belong to the genus of *Helianthus annuus* (Soliman *et al.*, 1996; Canibe *et al.*, 1999; San Juan and Villamide, 2001). The cultivated SFS is one of 67 species of genus *Helianthus* in the world (Flagella *et al.*, 2002). The production of SFS reached 37.08 million tonnes and thereby produced 15.22 million tonnes of oil in the world (FAO, 2012). SFS is one of the major oil seeds produced in the world beside cotton seed, soya bean and rape seed (Salunkhe *et al.*, 1992). This plant has been developed to become second largest reserve of feed and protein source, the third most important source of consumed oil by human and animal, and fourth major oil seed oil in production (Lusas, 1985; Aboul *et al.*, 2000; Garces *et al.*, 2009).

Materials and Methods

Experimental Site

The study was conducted at a private poultry farm at Wuro Biriji village along Maiduguri bypass, Gombe. Gombe is located in the centre of North East of the country on latitude 9°30' and 8°51' N and longitude 12°30' and 11°45' E. It shares common boundary with state of Borno to East, Yobe to the North, Adamawa to the South, Taraba to the South and Bauchi state to the West (Encarta, 2007).

Experimental Birds and Management

A total of three hundred (300) unsexed strains of broiler chicks were used for the experiments. The chicks were obtained at day-old from a reputable hatchery. Feed and water were provided to the birds ad-libitum

throughout the experimental period. Similarly, all the necessary brooding management practices were duly observed.

The experimental diets were compounded using the following ingredients; maize, Toasted sunflower seed, and full fat soya bean as variable feed ingredients. Fixed ingredients were wheat offal, fishmeal, bone meal, limestone, vitamin premix, methionine, NaCl (common salt) and lysine. Five starter and finisher experimental diets were formulated in which the TSFM was included at 0, 5, 10, 15 and 20 % levels and coded as diets 1, 2, 3, 4 and 5 respectively and the designed was completely randomized design (CRD). The ingredients and percentage compositions of the experimental diets are presented in Tables 1 and 2. Feeding was *ad libitum* from 2nd to the 8th week of age.

Data collection

Feed intake was determined as feed consumption from each treatment on daily basis by subtracting left over from feed served per group and adequate measures were taken to safeguard against spillage and related wastage. The mean daily feed intake was calculated on weekly basis by dividing the amount consumed by the number of birds in the group.

Body weight gain of the birds was determined by weighing on weekly basis using an electronic weighing balance to determine the weight gain. The mean live weight of each treatment group was determined by total weight divided by the total number in that group. The body weight change of each of the treatment group was obtained by calculating the difference between the mean live weights of the current week from the mean live weight of the preceding week.

Table 1. Ingredients Composition and Calculated Analysis of Toasted Sunflower Based Broiler Starter Diets at Graded Levels

Ingredients	Inclusion Levels of Toasted Sunflower Meal				
	1 (0%)	2 (5%)	3 (10%)	4 (15%)	5 (20%)
Maize	46.41	43.89	41.39	38.91	36.44
Full fat soya bean	34.39	31.91	29.41	26.89	24.36
Full fat sunflower seed	0.00	5.00	10.00	15.00	20.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
*Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	23.00	23.00	23.00	23.00	23.00
Metabolizable energy (kcal kg^{-1})	2909	2945	2981	3017	3035
Crude fibre (%)	4.04	4.33	4.62	4.90	5.20
Ether extract (%)	8.94	9.37	9.79	10.22	10.62
Calcium (%)	1.55	1.55	1.55	1.56	1.56
Phosphorous (%)	0.89	0.91	0.91	0.91	0.92
Methionine (%)	0.42	0.42	0.44	0.45	0.46
Lysine (%)	1.25	1.21	1.19	1.15	1.11

* Bio Mix Broiler Premix supplying the following per Kg of feed:

Vitamin A 4,000,000IU, Vitamin D₃ 1,000,000IU, Vitamin E 9,200mg, Vitamin K₃ 800mg, Vitamin B₁ 400mg, Vitamin B₂ 2200mg, Niacin 1,100mg, Pantothenic 3300mg, Vitamin B₆ 1200mg, Vitamin B₁₂ 6mg, Folic acid 300mg, Biotin 24mg, Choline 1,200,000mg, Cobalt 800mg, Copper 1200mg, Iodine 400mg, Iron 800mg, Manganese 16,000mg, selenium 80mg, Zinc 12,000mg and Antioxidant 500mg.

Table 2. Ingredients Composition and Calculated Analysis of Toasted Sunflower Based Broiler Finisher Diets at Graded Levels

Ingredients	Inclusion Levels of Toasted Sunflower Meal				
	1 (0%)	2 (5%)	3 (10%)	4 (15%)	5 (20%)
Maize	53.06	50.56	48.07	45.58	43.11
Full fat soya bean	27.74	25.24	22.73	20.22	17.69
Full fat sunflower seed	0.00	5.00	10.00	15.00	20.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
*Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	21.00	21.00	21.00	21.00	21.00
Metabolizable energy (kcal kg^{-1})	2929	2965	3001	3037	3073
Crude fibre (%)	3.89	4.18	4.47	4.75	5.04
Ether extract (%)	8.01	8.43	8.85	9.28	9.39
Calcium (%)	1.53	1.53	1.54	1.54	1.54
Phosphorous(%)	0.87	0.89	0.89	0.89	0.90

* Bio Mix Broiler Premix supplying the following per Kg of feed:

Vitamin A 4,000,000IU, Vitamin D₃ 1,000,000IU, Vitamin E 9,200mg, Vitamin K₃ 800mg, Vitamin B₁ 400mg, Vitamin B₂ 2200mg, Niacin 1,100mg, Pantothenic 3300mg, Vitamin B₆ 1200mg, Vitamin B₁₂ 6mg, Folic acid 300mg, Biotin 24mg, Choline

1,200,000mg, Cobalt 800mg, Copper 1200mg, Iodine 400mg, Iron 800mg, Manganese 16,000mg, selenium 80mg, Zinc 12,000mg and Antioxidant 500mg.

Feed conversion ratio (FCR) was measured by dividing the feed intake per birds in grams by the live weight gain per bird for each treatment group.

$$FCR = \frac{\text{Feed in take}}{\text{weight gain}}$$

The cost-benefit analysis of the experimental diets was determined at the end of the experiment. The economic analysis was based on the market prices of the feed ingredients used during the study period. The cost of each diet and the cost per kilogram of weight gain by each bird were assessed. The price of each bird was also determined.

All data collected were subjected to analysis of variance using Statistical Package for Social Science Version 21 (SPSS, 2012) and where significant differences among treatments exist, Duncan Multiple Range Test (DMRT) was used to separate the means.

Results

The growth performance of broiler chickens fed dietary levels of full fat sunflower seed meal was presented in Table 3. The initial weights of broiler chickens were similar and ranged from 156.83 to 166.97 g in birds on diets 1 and 2 respective. The highest final body weight gain value of 2386.39 g was obtained in diet 2 (5 % FFSSM) which did not differ from the value of 2367.04 g observed on diet1 (0 % FFSSM) but significantly ($P<0.001$) higher than the values observed in diets diet 4 (1447.20 g), diet 5 (1781.75 g) and diet 3 (1897.64 g). The highest total weight gain value of 2219.72 g was observed in broiler chickens fed diet 2 (5 % FFSSM) which is similar with 2210.37 g obtained on birds fed diet 1 (0 % FFSSM) but significantly ($P<0.001$) higher than the values obtained on

those fed diet 5 (1616.75 g) and diet 3 (1739.31 g) respectively. The highest total feed intake value of 4463.26 g was obtained in broiler birds fed diet 1 (0 % FFSSM) which did not differ from 4424.35 g observed on those fed diet 2 (5 % FFSSM) but significantly ($P<0.001$) higher than values observed in diet 5 (3612.11 g) and diet 3 (3924.25 g), respectively.

At the starter phase the highest daily feed intake (DFI) value of 70 g was obtained in broiler birds fed diet 1 (0 % FFSSM) which is similar to 66.60 g observed on broiler chickens fed diet 2 but significantly ($P<0.001$) different from the values obtained in broiler birds fed diet 3 (59.80 g) and diet 5 (62.59 g) respectively. The daily weight gain (DWG) values varied from 26.85 g to 37.35 g in broiler chickens fed diet 4 and 1 respectively. However, the values obtained differ statistically across the dietary treatments. The feed conversion ratio (FCR) were similar across the dietary treatments with the highest value recorded in broiler chickens fed diet 5 (1.97) and the lowest on those fed diet 1 (1.87).

At the finisher phase the highest DFI value of 126.11 g was obtained in broiler birds fed diet 2 (5 % FFSSM) which did not differ from 123.17 and 111.08 g observed in broiler chickens fed diet 1 and 3 respectively, but significantly ($P<0.001$) higher than the values found on diet 4 (81.02 g) and diet 5 (92.76 g). The DWG values ranges from 26.55 to 57.13 g which the highest value recorded in broiler birds on diet 2 and the lowest in those fed diet 4. The result obtained showed significant ($P<0.001$) difference across the dietary treatments. The FCR varied between 2.21 and 3.04 in broiler chickens fed diet 2 and 4 respectively. However, they differ significantly ($P<0.001$).

The overall DFI value of 96.61 g was recorded in broiler chickens fed diet 1 (0 % FFSSM) which is similar to 96.39 g obtained on those fed diet 2 but significantly ($P<0.001$) higher than those values observed in diet 5 (77.68 g) and diet 3 (85.44 g) respectively and also higher than those obtained in broiler birds fed diet 4 (66.90 g). Broiler chickens on diet 2 (5 % FFSSM) recorded the highest DWG value of 46.30 g which did not differ statistically from 46.03 g obtained on those fed diet 1 (0 %

FFSSM) but differ significantly ($P<0.01$) from the values obtained on other dietary treatments. The FCR at the overall phase showed significant ($P<0.001$) difference across the dietary treatments. The FCR values ranged between 2.08 and 2.50 in which diet 2 (2.08), diet 1 (2.10) and diet 5 (2.19) were found to be statistically similar but significantly different from broiler birds fed diet 3 (2.30) and diet 4 (2.50).

Table3. Growth Performance of Broiler Chickens Fed Dietary Levels of Full Fat Sunflower Seed Meal

Parameters	Inclusion Levels of Toasted Sunflower Meal					SEM
	1(0 %)	2(5 %)	3(10 %)	4(15 %)	5(20 %)	
Initial weight (g)	156.83	166.67	158.33	157.50	165.00	1.60 ^{NS}
Final weight gain (g)	2367.04 ^a	2386.39 ^a	1897.64 ^b	1447.20 ^c	1781.75 ^b	98.98 ^{***}
Total weight gain (g)	2210.37 ^a	2219.72 ^a	1739.31 ^b	1289.70 ^c	1616.75 ^b	98.78 ^{***}
Total feed intake (g)	4463.26 ^a	4424.35 ^a	3924.25 ^b	3081.96 ^c	3612.11 ^b	146.92 ^{***}
Starter phase (1 – 4 weeks)						
DFI (g)	70.05 ^a	66.60 ^a	59.80 ^c	52.11 ^d	62.59 ^{bc}	1.75 ^{***}
DWG (g)	37.35 ^a	35.47 ^a	30.45 ^b	26.85 ^c	31.75 ^b	1.07 ^{***}
FCR	1.87	1.88	1.94	1.95	1.97	0.18 ^{NS}
Mortality (No.)	0	0	0	0	0	
Finisher phase (5 – 7 weeks)						
DFI (g)	123.17 ^a	126.11 ^a	111.08 ^a	81.02 ^b	92.76 ^b	5.03 ^{***}
DWG (g)	54.69 ^a	57.13 ^a	43.48 ^b	26.55 ^c	39.64 ^b	3.09 ^{***}
FCR	2.26 ^c	2.21 ^c	2.56 ^b	3.04 ^a	2.36 ^{bc}	0.09 ^{***}
Mortality (No.)	0	0	0	0	0	
Overall performance(1 – 7 weeks)						
DFI (g)	96.61 ^a	96.36 ^a	85.44 ^b	66.90 ^c	77.68 ^b	3.21 ^{***}
DWG(g)	46.03 ^a	46.30 ^a	37.10 ^b	26.71 ^c	35.69 ^b	2.03 ^{***}
FCR	2.10 ^c	2.08 ^c	2.30 ^b	2.50 ^a	2.19 ^{bc}	0.05 ^{**}
Mortality (No.)	0	0	0	0	0	

a, b, c. Means in the same row with different superscript are significantly different **($p<0.01$), ***($p<0.001$), NS = Not Significant, SEM = Standard Error Mean

Economics of Production

The economics of production of broiler chickens presented in Table 4 showed the highest total feed intake value of 4.46 kg was obtained in the control group while the value of 3.08 kg was observed on those fed diet 4 (15 % FFSSM). The feed cost value varied between 116.79 and 118.47 kg/₦) which the highest value recorded on broiler chickens fed

diet 1 and the lowest on diet 5. The total feed cost ranged from ₦359.74 to ₦528.78 with the highest value recorded on broiler chickens fed diets 1 and the lowest on those fed diet 4. The total weight gain values of broiler chickens observed in this study ranged between 1.29 and 2.22 kg with the highest value recorded on broiler birds fed diet 2 (5 % FFSSM) and the lowest recorded on those fed diets 4 (15 %

FFSSM). The feed cost/kg gain ₦ varied between ₦234.20 to ₦277.78 with the highest value observed on broiler chickens fed diet 4 and the lowest on those fed diet 2. All the

above parameters determined were significantly ($p < 0.05$) influenced by the dietary levels of full fat sunflower seed meal.

Table 4. Economics of Production of Broiler Chickens Fed Dietary Levels of Full Fat Sunflower Seed Meal

Parameters	Inclusion Levels of Toasted Sunflower Meal					SEM
	1(0 %)	2(5 %)	3(10%)	4(15 %)	5(20 %)	
Total feed intake (kg)	4.46	4.43	3.92	3.08	3.61	0.15
Feed cost (kg/₦)	118.47	118.06	117.64	117.22	116.79	0.16
Total feed cost (₦)	528.78	522.62	461.54	359.74	423.54	17.86
Total weight gain (kg)	2.21	2.22	1.74	1.29	1.62	0.10
Feed cost/kg gain (₦)	239.44	234.20	265.15	277.78	262.31	4.92

SEM = Standard Error Mean

Discussions

The daily feed intake (DFI) values obtained in this study ranged from 52.11 to 70.05 g. These values were in comparable to the values 49.10 to 59.35 g reported by Salari *et al.* (2009) who fed broiler chicks diets containing 0 to 21 % sunflower seed meal but higher than the findings of Ghadeer *et al.* (2016) who reported DFI of 49.75 to 51.55 g in broiler chicks fed diets containing 0 to 7.5 % sunflower seed meal. This difference could be attributed to the differences in the variety of sunflower. The daily weight gain (DWG) ranged between 26.85 and 37.35 g. These values were lower than 40.95 to 42.92 g obtained by Ghadeer *et al.* (2016) in broiler chickens fed varying levels of sunflower cake. The probable reason for this difference could be the method of processing and the strain of broilers used. The feed conversion ratio (FCR) values obtained in this study ranged from 1.87 to 1.97. These values were similar to those by Kamal and Khalid (2013) who reported the values of 1.89 to 1.97 at the starter phase in broiler chickens fed varying levels of locally produced sunflower seed meal.

The DFI values obtained in this study ranged from 81.02 to 126.11 g. The values obtained were comparable to the values of 95.61 to

101.89 g reported by Babawuro and Muhammad (2018) who fed broiler chickens with diets containing groundnut cake and full fat soya bean but lower than the findings of Saulawa *et al.* (2018) who reported DFI values between 126.44 and 135.38 g in the broiler chickens fed diets containing differently processed baobab seed meal. The DWG values observed in this work ranged between 26.55 and 57.13 g. The DWG values obtained in this study are in agreement with the findings of Dikko *et al.* (2018) who reported values of 36.34 to 44.85 g for broiler chickens fed varying levels of soya bean residue meal (Awara) and were also comparable to the values of 27.1 to 51.83 g reported by Babawuro and Muhammed (2018) in broiler chickens fed diets containing groundnut cake and full fat soya bean meal but lower than the values of 66.40 to 71.67 g reported by Ghadeer *et al.* (2016) who included sunflower meal in the diets of broiler chickens at 0 to 10 % levels. The differences may be attributed to high protein in the sunflower cake than full fat sunflower seed which contains higher proportion of fibre. The values of FCR obtained in this study ranged between 2.21 and 3.04. These values agreed with 2.13 to 3.09 reported by Salari *et al.* (2009) for broiler chickens fed diets containing full fat sunflower

seed meal but contrary with the findings of Lakurbe *et al.* (2018) who reported values of 3.13 to 4.18 and Babawuro and Muhammad (2018) who reported values of 3.17 to 3.53.

The overall DFI values obtained in this research ranges from 66.9 to 90.61 g. The values obtained were similar to the values 79.70 to 83.30 g reported by Lakurbe *et al.* (2018) who fed broiler chickens diets different protein sources in a sorghum based diets and also in agreement with Babawuro and Muhammad (2018) who reported values between 69.94 and 74.59 g in their work with broiler chickens fed diets containing groundnut cake and soya bean meal but in contrast with the findings of Dikko *et al.* (2018) who reported values between 94.93 and 127.51 g in their study with broiler chickens fed diets containing different dietary levels of soya bean residue meal. The overall DWG values obtained in this study ranges from 26.71 to 46.30 g. The values obtained were similar to those reported by Saulawa *et al.* (2018) who reported values of DWG between 28.40 and 45.89 g in broiler chickens fed diets containing differently processed baobab seed meal but in contrast with the findings of Lakurbe *et al.* (2018) who reported lower values between 27.43 and 29.75 g in broiler birds fed diet containing sorghum with different protein sources, the differences could be attributed to the used of sorghum in the diet which contain tannins which affect weight gain and also in disagreement with the findings of Babawuro and Muhammad (2018) who also reported lower values between 22.42 and 27.75 g in broiler chickens fed diets containing groundnut cake and full fat soya bean. The FCR values obtained in this study ranges from 2.08 to 2.50. The values obtained were in contrast with the values 2.62 to 3.13 reported by Babawuro and Muhammad (2018) who fed broiler chickens with diets containing groundnut cake and full fat soya bean and lower lower than the values reported by

Lakurbe *et al.* (2018) who reported values between 2.70 and 3.03. This indicates that the experimental diet used in this study was more efficiently utilized. Similarly, Abdurraham and Muktar (2015) reported FCR values between 1.79 and 2.03 in broiler chickens fed diets containing sunflower cake with xylanase enzyme which lower than those obtained in this study so also Ghadeer *et al.* (2016) reported lower values between 1.67 and 1.72 in their research with broiler birds fed dietary levels of sunflower meal. The better feed utilization observed in this two researches may be attributed to good quality protein in sunflower cake than sunflower seed meal which contain more fibre than the cake.

The feed cost in ₦ per kg (₦ 116.79 – ₦118.47) decreased with an increase in the inclusion level of FFSSM in the diets. The cost in ₦ per kg body weight gain also decreased with increasing level of FFSSM. The feed cost in naira per kilogram body weight gain was lowest in diet 2 (5% FFSSM) and the cheapest at the overall performance. Yisa *et al.* (2012) who reported poor feed conversion ratio and increasing feed cost per kilogram body weight gain of broiler chickens fed raw and boiled pigeon pea seed meal. On economic grounds, feeding FFSSM beyond 5 % is not cost effective.

Conclusions

Incorporation of 5 % level of TSFM can be tolerated by broiler chickens without compromising performance as well as reduction in feed cost. Further studies should be conducted using other processing methods to evaluate the nutritive value of this valuable ingredient in poultry.

Recommendations

Based on the result of this experiment the following recommendations were made:

- i. Toasted full fat sunflower seed meal can be included at 5 % level in broiler

- diets with concomitant reduction in feed cost.
- ii. Further studies should be conducted using other processing methods such as boiling and soaking.

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