



RESPONSE OF BROILER CHICKENS TO DIETARY LEVELS OF SUPER SOSAT MILLET IN SUNFLOWER MEAL BASED DIETS

*A. T. Bello, A.T., ¹M. Abubakar, ²U. M. Sani, *N. M. Alhassan, ³S. I. Garba, ³M. H. Bot and ³O. D. Olaiya

*National Veterinary Research Institute, NVRI, Vom, Plateau state

¹Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria

²Department of Animal Science, Federal University of Lafia, Nasarawa state, Nigeria

³Federal College of Animal Health and Production Technology, Vom, Plateau state

*Corresponding Author E-mail: mrnas11289@gmail.com, 08035739148

Abstract

The experiment was conducted to evaluate the response of broiler chickens fed Super SOSAT (SSM) pearl millet to replace maize in sunflower meal based diets. Three hundred broiler chicks were randomly allotted to five dietary treatments in replicates of three containing 20 birds each in a completely randomized design. In the trial, Super SOSAT millet replaced maize at 0, 25, 50, 75 and 100% levels. Feed and water were served ad lib and the experiment lasted for 42 days. The results indicated that in the overall phase, all parameters were significantly ($P < 0.05$) affected by the dietary treatments in favour of Super SOSAT millet based diets. Daily feed intake was similar for birds fed diets 4 (112.23 g) and 3 (113.76 g), but significantly lower on the other diets (99.01 – 103.76 g) which were similar. Birds on diet 5 (2.82) had better ($P < 0.05$) feed conversion ratio than those fed other diets (3.11 – 3.23). The cost benefit of broiler chickens fed the experimental diets showed that feed cost per kg gain (₦) increased from ₦311.78 for diet 1 to ₦336.57 for diet 2 and later dropped to ₦289.20 for diet 5. In all, diet 5 recorded the only cost saving of ₦22.58; however, no cost was saved by replacing maize with super SOSAT millet in the diets at the starter phase. At the finisher phase (4 -6weeks), a decreasing trend was also recorded for feed cost per kg gain (₦) where birds on the control diet had the highest value of ₦471.84 which decreased progressively to ₦305.61 on diet 5. Cost saving (₦) also increased from ₦47.87 on diet 2 to 166.23 on diet 5. At the Overall phase (0 - 6 weeks), the result indicated that feed cost (₦/kg) decreased from ₦125.50 for diet 1 to ₦105.72 for diet 5. Total feed cost for each bird was highest for diet 3 (₦553.86) and lowest for those on diet 5 (₦457.77). Broiler chickens fed diet 5 had the highest average total weight gain of 1.54 kg, while those on the control diet had 1.35 kg which was the lowest. Feed cost per kg gain was highest for birds on the control (₦386.73) and least for those on diet 5 (₦297.25). Birds raised on diet 5 showed the highest cost saving value of ₦89.48 compared to ₦3.80 for those on diet 2 which had the lowest. Feed cost per kg gain (₦) decreased with increasing level of super SOSAT millet. This could be attributed to the improved daily weight gain of birds fed these replacement levels. The results of the current study showed that Super SOSAT millet can completely replace maize in broiler chickens' diets without any deleterious effect on feed intake and growth performance with reduced feed cost per kg gain. Based on the higher daily weight gain of 36.67g, better feed conversion ratio of 2.82, the least feed cost/kg gain of ₦297.25 and the highest feed cost savings of ₦89.48 for broiler chickens in diet 5 compared to the others, this diet is recommended for broiler chickens.

Keywords; Broiler Chickens, Carcass Quality, Super Sosat Millet, Sunflower Meal,

1.0 Introduction

Maize constitutes the principal energy ingredient in poultry diets (Adam and El-Basheir, 2016). However, a threat posed by higher prices and availability of maize which constitutes the main energy source in poultry diets has been negatively affecting the poultry industry in Nigeria. This predicament may not be unconnected with the effect of climate change and higher prices of inorganic fertilizer (Adamu *et al.*, 2012). This scenario has indicated that to minimize feed cost with rapid growth at best feed conversion ratio and to maximize profit for the producer while making available cheaper poultry meat and products to the common man, cheapest alternative energy and protein sources need to be explored. Studies have indicated that millet grain could potentially be successfully incorporated into poultry diets (Adamu *et al.*, 2000; Baurhoo *et al.*, 2011; Yunusa *et al.*, 2015; Bala *et al.*, 2017; Qaisrani *et al.*, 2018; Kawu *et al.*, 2020).

Nigeria, as one of the most important millet producing countries in the world, produces almost half (40%) of total African millet production according to FAO (2012). The northern parts of Nigeria provide an ideal agro – ecological condition for the production of pearl millet. For this reason, millet is predominantly produced and consumed within the region, making it a staple for over 40% of the populace (Jirgi *et al.*, 2010). Super SOSAT millet is a pearl millet variety developed by the Lake Chad Research Institute, Maiduguri, Nigeria. The variety has a potential yield of 3.0 -3.5 tonnes/hectare. It is drought resistant and

performs well on marginally poor soils (Umar, 2018). The current study was therefore designed to study the growth response and cost benefits of broiler chickens to dietary levels of Super SOSAT (SSM) pearl millet in sunflower meal based diets.

2.0 Materials and Methods

2.1 Experimental site

The experiments were conducted at the Poultry Unit, Teaching and Research Farm, Abubakar Tafawa Balewa University, Bauchi. The town, Bauchi, is located within the southern guinea savannah on latitude 10.31 N and longitude 9.84 E. Furthermore, it is 616 metres above sea level characterized by two well-defined seasons; Rainy season (May-October) and dry season (November-April). The average annual rainfall is 1009mm, highest relative humidity 94 % (August) and the lowest 35 % (February). Temperatures are between 13 – 17°C (December – February) and 36 – 37° C (March – April) (World Atlas, 2015). According to ICRISAT (1984), these agro - meteorological indices are also favourable for millet cultivation.

2.2 Management of Experimental Birds

Three hundred (300) unsexed, day-old, broiler chickens of the *Cobb* strain were purchased from Pieridox hatchery in Jos, Plateau State for the experiment. Two weeks prior to the birds' arrival, the experimental pens were cleaned, washed, disinfected and fumigated. Furthermore, feeders, drinkers and all other necessary equipment were also cleaned. A week after, litter material (wood shavings) were spread in the

experimental pens to a floor depth of approximately 3 inches. Adequate heating/lighting facilities were also provided. Brooding, which lasted for a period of 14 days, commenced with the arrival of chicks. Two (2) electric bulbs of 200 watts capacity each, were used to provide the necessary warmth needed in the brooding room. The birds were fed chick mash during this period. They were also given the first dose of IBDV (Gumboro vaccine) at 7 days, followed by an anti-stress drug for two consecutive days. Another vaccine, New Castle Disease Vaccine NCDV (LASOTA) was also administered on the 13th day. At the end of this brooding period, the birds were randomly assigned to five dietary treatments in a completely randomized design (CRD). Each treatment was replicated thrice containing 20 birds each giving a total of sixty birds (60) per treatment. Experimental diets and clean drinking water were served *ad libitum* throughout the six-weeks trial period. Birds were also given the second dose of Infectious Bursal Disease vaccine (Gumboro vaccine) (Booster) on the 21st day and another one for NCDV a week after. All vaccines and drugs were administered orally. The experiment was conducted in a completely randomized design (CRD).

2.3 Experimental Diets

Five experimental diets for both starter (23 % CP) and finisher (20 %) phases were formulated. Super Sosat Millet replaced maize at 0, 25, 50, 75 and 100 % levels, designated as diets 1 (control), 2, 3, 4, and 5 respectively. Sunflower meal was

the main plant protein source used in the diets. Broiler starter and finisher diets were fed for 3 weeks each. Ingredients and percentage composition of dietary Super Sosat Millet as replacement for maize are presented in Tables 1 and 2.

2.4 Experimental Design

The experiment was conducted in a completely randomized design (CRD).

2.5 Data Collection

Feed consumption, weight gain, feed conversion ratio and mortality were the performance parameters monitored during the experiments. Initial live weights of chickens were taken at the commencement of each experiment and thereafter, weights were determined on weekly basis. Values obtained were then used to calculate the daily weight gain. Daily feed intake was also determined by subtracting the weight of left-over feed from the quantity offered the previous day. However, feed conversion ratio, was calculated. The economic analysis of broiler production was calculated to assess the cost-benefit of replacing maize with super SOSAT millet in sunflower meal based diets of broiler chickens. Accordingly, the following parameters were determined. Feed cost per kilogram of each diet, total cost of feed consumed per bird on each diet, feed cost per kilogram weight gain and cost savings. The cost of diets (₦/kg) was calculated based on the on-season market prices of major ingredients and the prevailing prices of other ingredients at the time of the experiment.

Table 1: Ingredients Composition (%) and Calculated Analysis of Dietary Levels of Super Sosat Millet as Replacement for Maize in Sunflower Meal- Based Diets Fed to Starter Broiler Chickens (1-3 weeks)

Ingredients	DIETS				
	1	2	3	4	5
Maize	47.75	35.81	23.88	11.94	0.00
Super SOSAT millet	0.00	11.94	23.88	35.81	47.75
Sunflower meal	32.45	32.45	32.45	32.45	32.45
Palm oil	3.00	3.00	3.00	3.00	3.00
Wheat Offal	7.00	7.00	7.00	7.00	7.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.15	0.15	0.15	0.15	0.15
Lysine	0.15	0.15	0.15	0.15	0.15
TOTAL	100	100	100	100	100
Calculated Analysis (%)					
ME (Kcal/kg)	2897.00	2873.00	2865.00	2849.00	2831.00
Crude Protein	23.00	23.00	23.00	23.00	23.00
Crude Fibre	3.52	3.58	3.62	3.67	3.70
Ether Extract	3.65	3.59	3.53	3.47	3.41
Calcium	1.53	1.53	1.53	1.53	1.53
Phosphorus	1.02	1.02	1.02	1.03	1.03
Methionine	0.53	0.55	0.58	0.58	0.58
Lysine	0.87	0.87	0.87	0.86	0.86

ME; Metabolizable energy

*Vit/mineral premix supplied/Kg of Diet: Vit. A, 12,500 IU; Vit. D₃, 2,500 IU; Vit. E, 30 IU; Vit. K, 2.5 mg; Riboflavin, 6 mg; Pantothenic acid, 10 mg; Vit. B, 2 mg; Niacin, 30 mg; Vit. B₁₂, 2.2 mg; Biotin, 0.05 mg; Folic acid, 1 mg; Chlorine chloride, 0.3 mg; Antioxidant, 0.125 mg; Iron, 100 mg; Manganese, 100 mg; Zinc, 100 mg; Iodine, 1.5 mg; Cobalt, 0.5 mg; Selenium, 0.1 mg and Copper 10 mg.

Table 2: Ingredients Composition (%) and Calculated Analysis of Dietary Levels of Super Sosat Millet as Replacement for Maize in Sunflower Meal- Based Diets Fed to Finisher Broiler Chickens (4-6 weeks)

Ingredients	DIETS				
	1	2	3	4	5
Maize	52.41	39.31	26.21	13.10	0.00
SuperSOSAT millet	0.00	13.10	26.21	39.31	52.41
Sunflower meal	19.69	19.69	19.69	19.69	19.69
Palm oil	3.00	3.00	3.00	3.00	3.00
Wheat Offal	15.00	15.00	15.00	15.00	15.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
TOTAL	100	100	100	100	100
Calculated Analysis (%)					
ME (Kcal/kg)	2995.00	2982.00	2970.00	2962.00	2950.00
Crude Protein	20.00	20.00	20.00	20.00	20.00
Crude Fibre	3.62	3.67	3.72	3.77	3.81
Ether Extract	3.87	3.80	3.74	3.67	3.60
Calcium	1.52	1.53	1.53	1.54	1.54
Phosphorus	1.00	1.01	1.01	1.02	1.02
Methionine	0.55	0.55	0.57	0.57	0.57
Lysine	0.87	0.87	0.86	0.86	0.85

ME; Metabolizable Energy

*Vit/mineral premix supplied/Kg of Diet: Vit. A, 8,500IU; Vit. D₃, 2,000IU; Vit. E, 10mg; Vit. K₃, 1.5 mg; Vit. B₁, 1.6 mg; Vit. B₂, 4 mg; Niacin, 20 mg; Pantothenic acid, 5 mg; Vit. B₆, 1.5 mg; Vit. B₁₂, 0.01 mg; Folic acid, 0.5 mg; Biotin, 0.75 mg; Chlorine chloride, 175 mg; Cobalt, 0.2 mg; Copper, 3 mg; Iodine, 1 mg; Iron, 20 mg; Manganese, 40 mg; Selenium, 0.2 mg; Zinc, 30 mg and Antioxidant, 1.25 mg.

2.6 Data analysis

All data were analyzed by one-way analysis of variance (ANOVA) using the statistical package, SPSS version 23. Differences between treatment means were separated using Duncan's Post Hoc method (Duncan, 1955).

3.0 Results and Discussion

Productive performance of broiler chickens fed diets containing Super SOSAT millet in sunflower meal based diets is presented in Table 3. In the starter phase, there were no significant ($P>0.05$) differences in the daily feed intake, daily weight gain and feed conversion ratio of the birds. Values for daily feed intake varied between 80.74 g in diet 5 to 87.05 g in diet 4. Values obtained for daily feed intake at the starter phase were however, were comparable to the 74.15 – 80.56 g reported by Kawu *et al.*, (2016) in a similar study. Daily weight gain ranged from 28.41g in diet 4 to 32.70 g in diet 1. Feed conversion ratio was between 2.67 for birds on diet 1 to 3.07 for birds fed diet 4. Daily weight gain values were similar to 32.82 ± 0.73 g reported by Adeleye and Oladotun (2020) using whole grain millet on broiler starter chicks 0 - 21 days post-hatch, while feed conversion ratio was poorer than that reported by Bulus *et al.* ((2014) (2.18 vs 2.80) in birds fed pearl millet over the same period of starter phase. Mortality of only one (1) bird was recorded in diet 4. This finding is in line with the report of Adam and El-bashir (2016) that pearl millet is at least equivalent to

maize. However, in the finisher phase, all parameters were significantly ($P<0.05$) affected by dietary levels of Super SOSAT millet. Daily feed intake was significantly higher in diet 3 (142.99 g) and lowest in diet 1 (116.09 g). Daily weight gain was highest ($P<0.05$) in diet 5 (44.44 g) and lowest for birds fed the control diet (31.75 g). Feed conversion ratio was better ($P<0.05$) in birds fed diet 5 (2.82) which did not differ from that of those fed diets 4 (3.16), 3 (3.30) and 2 (3.38) but poorer for the control. No mortality was recorded during this phase. In the overall phase, all parameters; daily feed intake, daily weight gain and feed conversion ratio were significantly ($P<0.05$) affected by the dietary treatments in favour of Super SOSAT millet based diets. This corroborated an earlier report by Ibe *et al.* (2014) that pearl millet is superior to maize in terms of daily weight gain and feed conversion ratio of broiler chickens. Daily feed intake was similar for birds fed diets 4 (112.23 g) and 3 (113.76 g), but significantly lower on the other diets (99.01 – 103.76 g) which were similar. Birds on diet 5 (2.82) had better ($P<0.05$) feed conversion ratio than those fed other diets (3.11 – 3.23). The reports in the current study further corroborates the findings of Davis *et al.* (2003) that at day 1 – 42, birds fed 100 % pearl millet diet had greater daily weight gain and feed conversion ratio than those fed maize and guinea corn based diets. This also confirms the assumption of Rooney (1990) that millets contain high crude protein content and a well-

balanced amino acid than other common cereal grains which enhance growth. Medugu *et al.* (2010), however asserted that replacing maize with pearl millet in broiler chicken diets did not

significantly ($P>0.05$) influence daily feed intake (94.00 – 100.17 g), daily weight gain (34.44 – 43.17 g) and feed conversion ratio (2.24 – 2.94).

Table 3: Performance of Broiler Chickens fed Super SOSAT Millet as Replacement for Maize in Sunflower Meal Based Diets

Parameters	DIETS					SEM
	1	2	3	4	5	
Initial Weight (g)	220.00	213.33	203.33	223.33	223.33	6.99 ^{NS}
Final Weight (g)	1573.33 ^b	1593.33 ^b	1726.67 ^a	1733.33 ^a	1763.33 ^a	32.32*
Body weight at week 3	906.67	820	813.33	820	830	61.79 ^{NS}
Total Weight Gain (g)	1353.33 ^b	1380.00 ^b	1523.33 ^a	1510.00 ^a	1540.00 ^a	34.51*
Starter Phase (1-3weeks)						
Daily Feed Intake (g)	81.92	83.1	84.53	87.05	80.74	1.97 ^{NS}
Daily Weight Gain (g)	32.7	28.89	29.04	28.41	28.89	2.92 ^{NS}
Feed Conversion Ratio	2.67	2.88	2.92	3.07	2.8	0.22 ^{NS}
Mortality (Number)	0	0	0	1	0	
Finisher Phase (4-6 Weeks)						
Daily Feed Intake (g)	116.09 ^c	124.42 ^{bc}	142.99 ^a	137.42 ^{ab}	125.61 ^{bc}	4.39*
Daily Weight Gain (g)	31.75 ^c	36.83 ^{bc}	43.49 ^{ab}	43.49 ^{ab}	44.44 ^a	2.14*
Feed Conversion Ratio	3.80 ^b	3.38 ^{ab}	3.30 ^{ab}	3.16 ^{ab}	2.82 ^a	0.28*
Mortality (Number)	0	0	0	0	0	-
Overall Phase (1-6 Weeks)						
Daily Feed Intake (g)	99.01 ^b	103.76 ^b	113.76 ^a	112.23 ^a	103.18 ^b	2.37*
Daily Weight Gain (g)	32.22 ^b	32.86 ^b	36.27 ^a	35.95 ^a	36.67 ^a	0.82*
Feed Conversion Ratio	3.23 ^b	3.12 ^b	3.11 ^b	3.12 ^b	2.82 ^a	0.08*
Mortality (Number)	0	0	0	1	0	-

^{abc}Means bearing different superscripts within the same row differ; * = ($P<0.05$); ns= Not significant; SEM = Standard Error of Means

3.1 Cost Benefit Analysis

The cost benefit of broiler chickens fed the experimental diets is presented in Table 4. At the Starter phase (1 -3 weeks), total feed intake of birds varied from 1.70 kg for those on diet 5 to 1.83 kg for those on diet 4. Cost of feed (₦/kg) decreased with increasing levels of the test material in the diet from ₦121.45 for diet 1 to ₦103.77 for diet 5. Total feed cost (₦) ranged between ₦176.41 for birds on diet 5 and ₦208.89 for those on diet 1. Total weight gain of birds (kg) was between 0.60 kg for birds on diet 4 and 0.67 kg for those on diet 1. Feed cost per kg gain (₦) increased from ₦311.78 for diet 1 to ₦336.57 for diet 2 and later dropped to ₦289.20 for diet 5. In all diet 5 recorded the only cost saving of ₦22.58; however, no cost was saved by replacing maize with super SOSAT millet in the diets at the starter phase. At the finisher phase (4 -6weeks), total feed intake ranged from 2.44 kg for birds on diet 1 to 3.00 kg for those fed diet 3. Feed cost (₦/kg) decreased with increased level of super SOSAT millet from ₦129.56 for diet 1 to ₦107.66 for diet 5. Total feed cost (₦) increased from ₦316.13 for the control diet to ₦355.95 for diet 3 and later declined to ₦284.22 for diet 5. Total weight gain of birds fed experimental diets appreciated from 0.67 kg for birds on diet 1 to 0.93 kg for those on diets 3, 4 and 5. A decreasing trend was also recorded for feed cost per kg gain (₦) where birds on the control diet had the highest value of

₦471.84 which decreased progressively to ₦305.61 on diet 5. Cost saving (₦) also increased from ₦47.87 on diet 2 to 166.23 on diet 5.

At the Overall phase (0 - 6 weeks), the result of the cost benefit analysis indicated that total feed intake of birds was between 4.16 kg for diet 1 and 4.78 kg for diet 3. Feed cost (₦/kg) decreased from ₦125.50 for diet 1 to ₦105.72 for diet 5. Total feed cost for each bird was highest for diet 3 (₦553.86) and lowest for those on diet 5 (₦457.77). Broiler chickens fed diet 5 had the highest average total weight gain of 1.54 kg, while those on the control diet had 1.35 kg which was the lowest. Feed cost per kg gain was highest for birds on the control (₦386.73) and least for those on diet 5 (₦297.25). Birds raised on diet 5 showed the highest cost saving value of ₦89.48 compared to ₦3.80 for those on diet 2 which has the lowest. The reduction in feed cost with increased levels of millet in the diet is in line with those of Elangovan *et al.* (2003), Medugu *et al.* (2010) and Ibitoye *et al.* (2012). This could further be explained by the lower cost of super SOSAT millet in the study area. Feed cost per kg gain (₦) decreased with increasing level of super SOSAT millet. This could be attributed to the improved daily weight gain of birds fed these replacement levels. This is in line with previous findings of Ibe *et al.* (2014) and Yunusa *et al.* (2015).

Table 4: Cost Benefits of Broiler Chickens Fed Super SOSAT Millet as Replacement for Maize in Sunflower Meal Based Diets

Parameter	DIETS				
	1	2	3	4	5
Starter phase (1 – 3wks)					
Total feed intake (kg)	1.72	1.75	1.78	1.83	1.70
Feed cost (₦/kg)	121.45	117.32	113.08	108.64	103.77
Total feed cost (₦)	208.89	205.31	201.28	198.81	176.41
Total weight gain (kg)	0.67	0.61	0.61	0.60	0.61
Feed cost per kg gain (₦)	311.78	336.57	329.97	331.35	289.20
Cost saving (₦)	-	-24.79	-18.19	-19.57	22.58
Finisher phase (4 – 6 wks)					
Total feed intake (kg)	2.44	2.61	3.00	2.89	2.64
Feed cost (₦/kg)	129.56	125.08	118.65	113.03	107.66
Total feed cost (₦)	316.13	326.46	355.95	326.66	284.22
Total weight gain (kg)	0.67	0.77	0.93	0.93	0.93
Feed cost per kg gain (₦)	471.84	423.97	382.74	351.25	305.61
Cost saving (₦)	-	47.87	89.10	120.59	166.23
Overall phase (1 – 6 wks)					
Total feed intake (kg)	4.16	4.36	4.78	4.71	4.33
Feed cost (₦/kg)	125.50	121.20	115.87	110.84	105.72
Total feed cost (₦)	522.08	528.43	553.86	522.06	457.77
Total weight gain (kg)	1.35	1.38	1.52	1.51	1.54
Feed cost per kg gain (₦)	386.73	382.92	364.38	345.74	297.25
Cost saving (₦)	-	3.80	22.35	40.99	89.48

4.0 Conclusion and Recommendations

The results of the current study showed that Super SOSAT millet can completely replace maize in broiler chickens' diets without any deleterious effect on feed intake and growth performance with reduced feed cost per kg gain.

Based on the higher daily weight gain of 36.67g, better feed conversion ratio of 2.82, the least feed cost/kg gain of ₦297.25 and the highest feed cost savings of ₦89.48 for broiler chickens in diet 5 compared to the others, this diet is recommended for broiler chickens.

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