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Carcass Characteristics of Broiler Chickens Fed Sunflower (*Helianthus annus*) Seed Meal (SFM) With Enzyme supplementation in Semi-Arid Zone of Maiduguri

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Abstract: *A feeding trial was conducted to determine the carcass characteristics of broiler chickens fed sunflower Seed Meal (SFSM). Experimental diets at the starter and finisher phases were formulated using locally procured feed ingredients which include maize, wheat offals, Sunflower seed meal, fish meal, bone meal, limestone, premix, methionine, common salt and lysine. Six starter and finisher diets were formulated with the inclusion levels of T1 (control) (0% SFSM and Enzyme), T2, T3, T4, T5 and T6 respectively. The experimental birds were allocated to the experimental diets in groups of 28 birds per treatments and each treatment group were replicated two times with 14 birds per replicate in a completely randomized design (CRD). Data collected was carcass characteristics, organs measurements, and cut off parts of broiler chickens fed sunflower seed meal. The result revealed no significant (P>0.05) difference in bled weight, plucked weight in all treatment groups but live weight dressed weight showed significant (P<0.05) difference among the treatment groups. The cut-up parts of broiler chickens fed SFM showed significant (P<0.05) differences except for the drumstick which is no significantly (P>0.05) differed from the other treatments diets. The result of the organs weight showed significant (P>0.05) difference among the treatment groups except liver which showed significant (P<0.05) differences among the treatment. The result of intestinal weight showed no significant (P>0.05) difference among the treatment groups. The outcome of this study indicated that inclusion of SFSM has no adverse effects on the growth performance of broiler chicken.*

Keywords: *Sunflower Seeds Meal, Helianthus annus, Broiler Chickens and Carcass Characteristics.*

Introduction

Background of the Study

Sub-optimal intake of animal protein in Nigeria has been attributed to uneven rate of increase in human population and animal production (Mbanasor and Nwosu (2003). Reduced purchasing power DFID (2011) and increased cost of feeding have led to Nigeria's low consumption of animal protein. Feed accounts for about 70% of the cost of poultry production and about 95% of this is used to meet the requirement for the main ingredients supplying energy and protein (Ravindran, (2013). As such, the search for non – conventional feedstuffs which are cheap and have noncompetitive demand has become a priority for nutritionist and feed manufacturers.

The growing feed crises in the Nigerian livestock industry can be addressed through the promotion and utilization of under-utilized wild legumes such as sunflower seed meal. Emenalom and Udedibie (2005) further pointed out that of the many legume species, only few have been used and many others are yet to be exploited. Arisa and Aworh (2007) observed that lesser-known legumes can be used together with other conventional legumes in order to combat protein malnutrition prevalent in the third world countries. Studies conducted by Ismaila *et al.* (2011) on the chemical properties of sunflower seed meal revealed that the seed has good nutritional properties which qualifies it to be an alternative protein source for livestock. Information on the adverse effect of some raw legume seeds have been documented (Kaya *et al*., 2011). At the moment, baseline information on the effects of raw sunflower seed meal the performance of broiler chickens seems to be scanty hence the need to bridge such information gap. The objective of the review is to evaluated carcass characteristics of broiler chickens fed sunflower seed meal.

Materials and Method

Experimental Site

The study was conducted at the Livestock Unit of the Teaching and Research Farm, Department of Animal Production Technology, Ramat Polytechnic, Maiduguri. Maiduguri is located between latitude 11°5' and 12^0 North, longitude 13°09' and 14^0 East and at an altitude of 354 m above sea level (DNMA, 2013). The area has a semi-arid tropical climate with a wide seasonal diurnal range of temperature. The hottest months are April and May with a temperature range between 39.4 and 40.1 ^{0}C under shade (Afolayan *et al.,* 2013). There is a long dry season of 7 – 8 months between the months of October to May.

Experimental Stock and their Management

A total of 168 day- old broiler chicks were purchased for the study. The chicks were brooded for two weeks during which they were fed commercial broiler starter diet and then fed the formulated/ experimental starter diet from three to four weeks and experimental finisher diet from 5^{th} to the 9^{th} weeks. The chicks were vaccinated against Gumboro disease at 2^{nd} and 5^{th} weeks of age and Newcastle disease at 3^{rd} week of age. Feeding and watering were given *ad libitum* throughout the experimental period.

Experimental Diets and Experimental Design

Experimental diets at the starter and finisher phases were formulated using locally procured feed ingredients which include maize, wheat offals, Sunflower seed meal, fish meal, bone meal, limestone, premix, methionine, common salt and lysine. Six starter and finisher diets were formulated with the inclusion levels of T1 (control) (0% SFSM and Enzyme), T2, T3, T4, T5 and T6 respectively as shown in Tables 1 and 2. The experimental birds were allocated to the experimental diets in groups of 28 birds per treatments and each treatment group were replicated two times with 14 birds per replicate in a completely randomized design (CRD). The study lasted for 7 weeks.

Table 1: Ingredient Composition and Calculated Analysis of the Experimental Broiler Starter Diet

Ingredient	T1	T2	T3	T4	T5	T6
Maize	45.67	45.17	45.28	45.28	45.12	45.12
Wheat offal	10.00	10.00	10.00	10.00	10.00	10.00
Sunflower seed	-	-	30.00	30.00	25.00	25.00
Groundnut cake	25.40	25.40	10.64	10.44	5.47	5.22
Fish meal	4.70	4.70	3.72	3.72	2.10	2.10
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	1.00	1.00	1.00	1.00	1.00	1.00
Limestone	0.30	0.30	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.20	0.20	0.20	0.20	0.20	0.20
Enzyme	-	1.00	0.75	1.00	0.75	1.00
	100	**100**	**100**	**100**	**100**	**100**
Calculated analysis						
Crude protein (%)	21.00	21.00	21.00	21.00	21.00	21.00
Crude fibre (%)	04.05	04.05	04.12	04.11	04.11	04.14
Ether extract (%)	03.90	03.88	03.67	03.76	03.76	03.78
Methionine (%)	00.45	00.44	00.43	00.42	00.42	00.41
Lysine (%)	01.39	01.38	01.36	01.34	01.34	01.31
Calcium (%)	01.00	01.00	01.00	01.00	01.00	01.00
Phosphorus (%)	00.65	00.65	00.65	00.65	00.65	00.65
ME (kcal/kg)	2854.16	2854.30	2940.93	2936.97	2936.97	2947.29

ME= Metabolizable energy; GNC= groundnut cake, SFM= Sunflower Meal,

* = 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, VitaminK3 = 800mg, VitaminB1 = 400mg, Vitamin B2 = 2200mg, Niacin=1,100mg, Pantothenic acid=3300mg, Vitamin B6 = 1200mg, Vitamin B12 =6mg Folic acid = 300mg, BiotinH2=24mg, Choline Chloride=1,200,000mg, Cobalt = 800mg, copper = 1200mg, Iodine=400mg, Iron=800mg, Manganese=16,000mg, Selenium=80mg, Zinc=12,000mg and Antioxidant=500mg

Table 2: Ingredient Composition and Calculated Analysis of the Experimental Broiler Finisher Diet

Ingredient	T1	T2	T3	T4	T5	T6
Maize	52.16	52.16	52.28	52.03	52.39	52.14
Wheat offal	10.00	10.00	10.00	10.00	10.00	10.00
Sunflower seed	-	-	30.00	30.00	25.00	25.00
Groundnut cake	19.40	19.40	5.64	5.64	3.20	3.20
Fish meal	3.70	3.70	2.72	2.72	1.10	1.10
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	1.00	1.00	1.00	1.00	1.00	1.00
Limestone	0.30	0.30	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.20	0.20	0.20	0.20	0.20	0.20
Enzyme	-	1.00	0.75	1.00	0.75	1.00
	100	**100**	**100**	**100**	**100**	**100**
Calculated analysis						
Crude protein (%)	21.00	21.00	21.00	21.00	21.00	21.00
Crude fibre (%)	04.05	04.05	04.12	04.11	04.11	04.14
Ether extract (%)	03.90	03.88	03.67	03.76	03.76	03.78
Methionine (%)	00.45	00.44	00.43	00.42	00.42	00.41
Lysine (%)	01.39	01.38	01.36	01.34	01.34	01.31
Calcium (%)	01.00	01.00	01.00	01.00	01.00	01.00
Phosphorus (%)	00.65	00.65	00.65	00.65	00.65	00.65
ME (kcal/kg)	2854.16	2854.30	2940.93	2936.97	2936.97	2947.29

ME= Metabolizable energy; GNC= groundnut cake, SFM= Sunflower Meal,

* = 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, VitaminK3 = 800mg, VitaminB1 = 400mg, Vitamin B2 = 2200mg, Niacin=1,100mg, Pantothenic acid=3300mg, Vitamin B6 = 1200mg, Vitamin B12 =6mg Folic acid = 300mg, BiotinH2=24mg, Choline Chloride=1,200,000mg, Cobalt = 800mg, copper = 1200mg, Iodine=400mg, Iron=800mg, Manganese=16,000mg, Selenium=80mg, Zinc=12,000mg and Antioxidant=500mg

Chemical analysis

The chemical composition of the sunflower seed and experimental diets were determined according to AOAC (2000) methods. The Kjeldahl procedure was used to determine the crude protein content. The dry matter was determined first by obtaining the moisture content using the vacuum oven-dried method and the dry matter was determined by difference using formula:

Dry matter = 100 - % moisture.

The ashing procedure was used to determine the ash content. The defatting, boiling and reflux procedure was used to determine the crude fibre. Soxhlet fat extraction method was carried out to determine the ether extract. The nitrogen-free extract was obtained by difference using the formula shown below:

NFE = 100 – (%Moisture + CP +CF + EE + Ash)

Where:

CP – crude protein

CF - crude fibre

EE – ether extract

The energy values of the diets were calculated using the formula of Pauzenga (1985):
ME (kcal/kg) = 37 x %CP + 81 + %EE + 35.5 x %NFE
Statistical Analysis.

All data collected were subjected to the analysis of variance (ANOVA) using the completely randomized design (Steel *et al.,* 1997) Significant differences between the treatment means were separated and compared using Duncan's Multiple Range Test (Duncan, 1955). A computer package (Statistix 10.0) was used for the analysis.

Results and Discussion

Proximate Composition of the Starter and Finisher Diets

The results of the proximate composition of the experimental starter and finisher diets are presented in Tables 3 and 4. The metabolizable energy (ME) values of 2946.73 – 3395.99 kcal/kg and 3106.89 – 3381.34 kcal/kg for starter and finisher diets, respectively are in accordance with the reports of other workers (Aduku, 1992; Pfizer, 2001; NRC, 1994; Oluyemi and Roberts, 2000) whose recommendations ranged from 2800 – 3200 and 2800 -3300 kcal/kg for starter and finisher diets, respectively. Thus metabolizable energy values are adequate and can support the growth of the chicks at both phases.

The analysed Crude Protein (CP) values obtained from the study ranged from 22.22 – 23.89 and 19.33 – 20.88 % for starter and finisher diets, respectively. The values (22.22 – 23.89 %) for starter diet is slightly lower than the 24 % CP recommended by Olomu (2011), but comparable to the 23 % CP reported by NRC (1994), for broiler starter. The CP values (19.33 – 20.88 %) obtained zb here for finisher are similar to the 20 % CP reported by Olomu (2011) for broiler finisher, but slightly higher than 18% CP recommended by NRC (1994).

The analysed Crude Fibre (CF) values of 4.08 – 5.00 % and 4.09 – 5.56 % for starter and finisher diets obtained from this study are within the range (4 – 5 % CF) recommended by Olomu (2011) for broiler chicken. According to Gonzalez-Alvarado *et al*. (2008), fibre content must be kept below 7 % in poultry feed.

Table 3: Proximate Composition of the Experimental Broiler Starter Diets Containing Grade level of Sunflower Seed Meal

Nutrient (%)	T1	T2	T3	T4	T5	T6
Moisture	8.45	8.22	8.33	8.11	8.45	8.66
Crude protein	22.24	22.22	23.89	22.75	23.01	22.89
Crude fibre	4.08	4.08	5.00	4.91	5.00	5.00
Ether extract	7.55	9.43	7.65	7.55	6.98	7.72
Ash	5.56	5.76	6.56	5.56	8.34	7.69
NFE	42.68	45.61	47.37	47.18	50.64	54.19
ME (Kcal/kg)	2946.73	3205.13	3190.90	3128.19	3214.40	3395.99

ME (Kcal/kg) = 37 x %CP + 81 x %EE + 35.5 x % NFE (Pauzenga, 1985)
NFE = Nitrogen-Free Extract

Table 4: Proximate Composition of the Experimental Broiler Finisher Diets Containing Grade level of sunflower Seed Meal

	Experimental Diets					
Nutrient (%)	TI	T2	T3	T4	T5	T6
Moisture	6.28	6.78	6.24	6.30	6.29	6.28
Crude protein (CP)	19.75	19.53	20.65	20.25	20.85	21.00
Crude fibre (CF)	4.47	4.54	4.11	4.76	4.30	4.30
Ether extract (EE)	5.26	4.82	5.73	6.32	6.74	6.75
Ash	8.75	6.82	7.20	7.45	7.67	7.74
NFE	55.63	57.56	55.11	53.85	52.60	52.31
ME (Kcal/kg)	3106.89	3381.34	3384.72	3130.53	3254.31	3236.41

ME = Metabolizable energy
ME (Kcal/kg) = 37 x %CP + 81 x %EE + 35.5 x % NFE (Pauzenga, 1985)
NFE = Nitrogen-Free Extract

The values for ash were 5.68 – 8.34 % and 5.32 – 7.43 % for starter and finisher diets. These values can sufficiently provide the necessary minerals such as calcium and phosphorus for growth and development of bones and tissues and other physiological activities. The values are similar with the reports of NRC (1994), and Oluyemi and Roberts (2000). The levels of nitrogen-free extract fall within the recommended levels reported by NRC (1994).

Ether Extract (EE) values obtained from the study are 7.55, 9.43, 7.65, 7.55, 6.98 and 7. 72 and 7.46, 7.66, 6.46, 7.33, 7.51, and 7.45 % for both starter and finisher diet, respectively. The composition of the diets indicated that the nutrients profile of the diets is adequate for optimal performance of broiler chickens at all phases of growth.

Carcass Characteristics of Boiler Chickens Fed Graded Level Sunflower (*Helianthus annuus*) Seed Meal in Semi-Arid Zone

The result carcass characteristics and some organs measurement of broiler chicken fed with sunflower (*Helianthus annuus*) seed meal are presented in Table 5. The result revealed no significant (P>0.05) difference in bled weight, plucked weight in all treatment groups but live weight dressed weight showed significant (P<0.05) difference among the treatment groups.

The dressing percentage value obtained in this study which ranged from 4.58% - 5.42% are superior to the range values (72.33%-77.82%) reported by Omojola and Adesehinwa (2007). Halilu *et. al*. (2016), Asafa *et al.* (2012), and Sanusi *et. al* (2015) reported 68.90 – 73.70%; 59.525, 78.65% and 68.99 – 72.54%, respectively for dressing percentages which are higher than the value obtained from this study. Similarly, Nweza (2011) reported dressing percentage of 60 – 85 for well – finished broiler chicken. Omole *et. al.,* (2006) had reported above. This is the clear indication that the chickens fed with SFM which recorded the lowest value (4.58%) poorly utilized their diets which resulting to poor dressing percentage. The cut-up parts of broiler chickens fed SFM showed significant (P<0.05) differences except for the drumstick which is no significantly (P>0.05) differed from the other treatments diets.

The value of 4.16 – 8.50% for thighs and 7.99 – 10.30% for drumstick in the present study are not similar to the values of 10.10 – 12.04% and 9.43 – 10.62%, respectively reported by Kwari

et. al. (2019) for thighs and drumstick of broilers fed differently processed Senna Obtusifolia seed

Table 5: Carcass Characteristics of Boilers Chicken Fed Graded Level Sunflower (*Helianthus annulus*) Seed Meal in Semi-Arid Zone

Parameters	T_1	T_2	T_3	T_4	T_5	T_6	SEM
Live Weight	1207.5^{ab}	1288.0^{ab}	1247.0^{ab}	1153.0^{b}	1382.0^{a}	1104.5^{b}	81.34*
Bled Weight	90.75	96.45	94.08	94.80	95.26	95.38	5.13^{NS}
Plucked Weight	82.35	91.54	89.37	87.73	92.00	85.42	5.86^{NS}
Dressed Weight	55.67^{b}	69.72^{a}	63.07^{ab}	62.51^{ab}	66.02^{ab}	57.99^{ab}	5.30*
Dressing Percentage	4.58^{b}	5.42^{a}	5.06^{ab}	5.42^{a}	4.77^{ab}	5.25^{ab}	0.30*
Component and Organs Expressed as Percentage (%) of Live Weight							
Heat	2.96^{a}	2.75^{a}	2.53^{a}	2.68^{a}	6.42^{a}	2.48^{a}	0.20*
Shark	4.74^{ab}	4.87^{a}	4.73^{ab}	4.84^{a}	3.90^{b}	4.61^{ab}	0.36*
Thigh	7.61	8.53	8.56	8.80	8.41	6.97	0.89^{NS}
Drumstick	8.03	10.30	9.08	9.09	9.80	9.37	1.10^{NS}
Wings	7.23^{b}	8.76^{a}	8.12^{ab}	8.06^{ab}	7.99^{ab}	7.87^{ab}	0.50**
Breast	15.38^{ab}	20.01^{a}	15.85^{ab}	16.74^{ab}	16.44^{ab}	13.21^{b}	2.40*
Back	13.3	16.30	16.71	14.62	19.13	13.71	2.55^{NS}
Neck	3.73^{ab}	4.25^{a}	4.54^{a}	4.21^{ab}	3.25^{b}	4.25^{a}	0.39*
Liver	2.11	2.41	2.67	2.68	2.38	2.21	0.23^{NS}
Heart	0.45^{b}	0.49^{ab}	0.60^{ab}	0.69^{a}	0.50^{ab}	0.45^{b}	0.08*
Gizzard	3.41	3.64	3.54	3.67	3.44	4.43	0.68^{NS}
Proventiculus	1.10	0.73	0.91	0.77	0.57	1.08	0.24^{NS}
Crop	0.46	0.60	0.48	0.52	0.54	0.54	0.16^{NS}
Intestinal Weight	7.40	5.59	6.92	6.41	6.75	6.65	1.47^{NS}
Intestinal Length	17.79	14.47	16.75	19.18	15.18	20.91	2.68^{NS}
Caeca	0.85^{ab}	1.05^{a}	0.83^{ab}	0.56^{b}	0.50^{b}	0.90^{ab}	0.19*
Abdominal Fat	2.02	1.78	1.80	1.23	3.19	1.53	0.81^{NS}

* = Significant (P<0.05): SEM = Standard Error of Means, a, b, c, d = means within the same row bearing different subscript differ significantly SFM = Sunflower Seed Meal NS = not significant (P>0.05)

meal, an alternative protein source. Agbabiaka *et. al.* (2012), Omajala and Adesehinwa (2007) and Aro (2013) recorded 23.04 – 28.57%; 18.87 – 22.04% and 10.30 – 12.10% relative breast weight respectively. However, the back weight (13.31 – 19.13%) obtained from this study is inferior to the values (24.01 – 25.05%) recorded by Agbabiaka *et. al*. (2012). The relative breast weight (13.21 – 20.01%) were significantly (P<0.05) differed among all treatments group. The values in this study are not comparable to the values of other workers (Agbabiaka *et. al.,* 2012).

The result of the organs weight showed significant (P>0.05) difference among the treatment groups except liver which showed significant (P<0.05) differences among the treatment. The gizzard values (3.41 – 4.43%) obtained from this study were reported supervisor to the finding of (Agbabiaka *et. al.,* 2012). Who reported 2.92 – 2.94%. The gizzard weight increased on significantly in the differently processed SFM. These findings are similar to the finding of panda

et. al. (2008) who related that the gizzard weight also increased significantly due to incorporation of sunflower seed meal (SFM). The result of intestinal weight showed no significant (P>0.05) difference among the treatment groups. Broilers chickens fed with SFM. The intestinal weight value (5.59 – 7.40%) obtained from the study where lower than the 6.00 – 7.70% reported by (Agbabiaka *et. al.,* 2012).

The impact of daily treatment on abdominal fat content (1.23 – 3.19%) of broiler chickens was similar in all treatment the values recorded here are lower than the 4.65 – 5.45% reported by Kwari *et. al*. (2019) for broiler chickens fed differently processed *Senna obtusfoolia* seed meal in the same environment. This is an advantage since high abdominal fat is undesirable in finished broiler chickens.

Conclusion

The outcome of this study indicated that sunflower seed meal has no adverse effects on the overall carcass performance, organs and cut-off parts of broiler chickens. Therefore, Poultry farmers are encouraged to use sunflower seed meal and incorporate them to poultry feed to reduce cost of feeding broiler chickens.

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