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Response of Broiler Chickens fed Diets Containing Differently Processed Sesame (*Sesame indicum L.)* Seed Meal

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This study was carried out to determine the growth performance and carcass characteristics of broilers fed diets containing differently processed sesame seed meal (SSM). Five experimental diets were formulated with diet 1 (control) containing 0% SSM, while diets 2 to 5 contained sundried (Su), roasted (Ro), boiled (Bo) and soaked (So) sesame seed meal each at 15% inclusion level respectively. One hundred and eighty (180) one day-old broiler chicks average 42.15g sourced from a commercial hatchery were allocated into 5 treatments of 12 birds in 3 replicates in a completely randomised design and dietary treatment lasting 56 days. Roasting and soaking significantly (P<0.05) reduced the anti-nutritional factors in sesame seed meal better than sun drying and boiling. Final body weight, average weight gain and average daily weight gain were significantly different (P<0.05) among the treatments. Control, Ro, Bo and So showed better utilisation of feed than Su. Total feed consumption and average daily feed intake were significantly (P<0.05) higher among birds fed So. There were significant (P<0.05) differences among carcass parameters and organs weight measured between the control diet and other treatments. It can be concluded that roasting and soaking were adequate to remove toxic phytochemicals in sesame seed meal to tolerable levels for broiler diets and inclusion up to 15% of Ro and So is recommended. At these levels, growth and carcass characteristics were not significantly affected compared to the control diet.

Key words: anti-nutritional factors, oxalate, sesame seed meal, tannins, broilers, performance

INTRODUCTION

The increasing cost of feed resources in livestock production has been identified as a serious impediment to meeting the demand for animal protein particularly in developing countries (Adejinmi *et al*., 2000). Poultry production relies mainly on maize as the main energy source but it suffers intense competition as food for humans resulting in higher demand than supply, higher cost and thus lower profit margin for poultry producers. This scenario is worsened among smallholder producers who find it increasingly hard to break even under the present circumstances. However, the ever-increasing cost of poultry feeds with concomitant increase in cost of poultry products (meat and eggs) makes it necessary to explore the use of alternative feed ingredients that are cheaper, locally available and of low human preference (Agbede *et al.,* 2002; Tuleun *et al*., 2009). Non-conventional feedstuffs offer cheaper and less competitive alternatives to producers especially during periods of scarcity of specific ingredients. Sesame (*Sesamum indicum L)* is a drought-tolerant crop adapted to many soil types (Ram *et al.,* 1990). According to Ahmed (2005) there are about 335,000 hectares of land under sesame cultivation in Nigeria with yields of between 1.5-2.0 tonnes / hectare. Full-fat sesame seed contains 22% crude protein and the meal after oil extraction about 44% crude protein (Peace Corps, 1990; Mamputu and Buhr, 1991). The amino acid composition of the protein is similar to that of soyabean meal with the exception of lower lysine (Mamputu and Buhr, 1991) and higher methionine in sesame (Olomu, 1995; Dipasa, 2003).

The seed contains 50-60% oil compared to 20% in soyabean (Kato *et al.,* 1998; Ahmed, 2005). The fibre content of the seed ranges from 2.7 to 6.7% (Beckstrom-Sternberg and Duke*,* 1994). Mukhopadhyay and Ray (1999) reported that sesame whole seed, oil and meal are considered as animal feed for long time. Sesame meal was used to substitute Soyabean meal at 25% in broiler diet (Bell *et al*., 1990). The higher level caused higher fat deposit but lower water and protein content of the carcass (Heo *et al*., 1990). Also, Tangtawewipat and Cheva-Isarakul (1992) reported that SSM could be used at 5% in growing pullet diet (6-20 weeks of age) or 10% in Japanese quail diet without adverse effect on production performance. They reported that at 15-20% of the diet, no mortality was observed. However, there is a limitation to the use of sesame seed as a non-conventional feedstuff due to the presence of anti-nutritional factors which include tannins, phytic acid, oxalates, antitrypsin inhibitors etc. These anti-nutritional factors have serious implication on the performance and health status of animals when considerable amounts are ingested in feed. Nahm (2007) reported that phytic acid (PA) reduces the biological availability of zinc, calcium, magnesium and iron to the birds. Simple biotechnological methods such as soaking in water, sun-drying, toasting, boiling, cooking, ensiling etc. have been found suitable to destroy or reduce the anti-nutritional factors inherent in non-conventional feedstuffs and make them useful as livestock feed (Amaefule and Onwudike, 2000). Amaefule and Obioha (2001) noted that cooking improved the nutritive value by destroying most of the ANFs and utilization of protein and energy in the legumes (Kankuka *et al*., 2000; Abeke *et al*., 2008). Diarra *et al*. (2007) reported that soaking is one of the most effective methods of lowering the phytic acid (PA) content of the seed. Some researchers (Obun *et al*., 2008; Uhegbu *et al*., 2009) reported the impacts of several methods of processing especially roasting and boiling on the elimination of the anti-nutritional factors (ANFs) in *D. microcarpum* seeds. How efficient these processing methods might affect composition of nutrients, anti-nutritional factors and in turn, their effects on the performance of birds are still considered as vital issue to be searched. Such work will be of potential benefits, offers recommendations to manufacturers and helps to formulate accurate diets to animals. This paper will focus mainly on the effect of differently processed sesame seed meal on the growth performance and carcass characteristics of broiler chickens.

MATERIALS AND METHODS

Experimental site

The study was conducted at the Large Animals' Experimental Station, National Veterinary Research Institute (NVRI) Vom in Plateau State, Northern Guinea Savannah zone of Nigeria in 2012.

Material collection and processing

Sesame Seeds were purchased from a local market in Zaria, Kaduna State. They were screened and winnowed to remove sand, chaff and other foreign particles. They were then subjected to the following processing methods in order to improve its nutritive value.

The method previously described by Diarra *et al.* (2007) was used to obtain Soaked (So) seed meal. The cleaned seed was soaked in tap water for 24 hours, sun-dried for 72 hours and milled. Sundried sesame seed (Su) were obtained by spread raw seed on an even surface to sundry. Sundrying was done for seven consecutive days until crisp textured before milling. Seeds were immersed in boiling water at 100^oC and allowed to boil continuously for thirty minutes, cooled, drained, dehydrated and milled to obtain boiled (Bo) seed meal. The seed was roasted at 80-90^oC in a heated aluminium pot while being constantly stirred for 30 minutes, cooled and milled to obtain roasted (Ro) seed meal.

Experimental birds, management and design

A total of 225, one day-old Anak Broiler chicks average 42.15g were purchased from a reputable Hatchery and kept together for 3days of acclimitization before they were randomly allotted to the five dietary treatments in a Completely Randomized Design (CRD). They were reared in a deep litter house partitioned into pens as experimental units. Each treatment had 45broiler birds in triplicate. Water and feed were offered *ad libitum* through out study period*.* All the necessary routine management practices and the recommended vaccinations were strictly observed throughout 56-days study period.

Experimental diets

Five experimental diets were formulated with the control diet containing 0% SSM while the sun-dried, roasted, boiled and soaked sesame seed meal were included at 15% each in diets 2, 3, 4 and 5 respectively. The gross composition of the experimental diets is presented in Table 1.

Data collection

Daily feed consumption was recorded as the difference between feed offered and the surplus left over. Weight gain was measured weekly. Feed samples were collected for proximate analysis.

Carcass and Organs Weight Determination

At the end of 8 weeks, four birds per replicate were selected at random and starved for about 18h to empty their GI tract. They were then slaughtered, scalded, plucked and eviscerated. The carcass and internal organs (liver, heart, gizzard and intestines) were removed, weighed and expressed as a percentage of live weight according to 'Modified Kosher' method as described by Abe *et al*. (1996).

Chemical analysis

Proximate compositions of the sesame seed meals from the four processing methods were analysed using the method of AOAC (2000), while the presence of anti-nutritional factors were analysed as described for tannins by the Folin-Denis method (AOAC, 1990), Oxalate (AOAC, 1990) and Phytate (AOAC, 1990). Determination done at the Biochemistry Department, National Veterinary Research Institute (NVRI), Vom, Jos.

Statistical analysis

Experimental data were subjected to analysis of variance (ANOVA) using SAS (2008) software. Means were separated with Duncan multiple range test at a 5% level of significance.

RESULTS AND DISCUSSION

Proximate Composition of the Test Ingredients

The nutrient composition of the test ingredients is presented in Table 2. The nutrient composition shows that sundried sesame seed meal contained higher dry matter, ash and Nitrogen Free Extract (NFE) than those processed by other methods. The higher level of ether extract observed in all the treatments may be probably due to the higher oil content of sesame seed meal. However, percentage crude protein was not significantly (P>0.05) different among the methods studied although sundried and soaked sesame meal had the highest crude fibre content. These results were within the range of nutrient requirement for broiler chickens reported by Olomu (1995) and Aduku (1992). The variations in values of some chemical compositions may be attributed to differences in processing methods.

The effect of processing methods on the anti-nutritional factors of sesame seed meal is shown in Table 3. Levels of tannin, oxalates, phytates and trypsin inhibitor recorded were within the range reported by Diarra *et al.* (2007). These anti-nutritional factors were significantly (P<0.05) reduced in the roasted and soaked sesame meal as compared to the sundried and boiled sesame meal. Diarra *et al*. (2007) had earlier reported that soaking is one of the most effective methods of lowering the anti-nutritional factors of the seed. This means sundrying alone may not be an effective method of reducing the toxic chemicals present in the meal to safe levels for poultry ration.

Growth Performance

The performance characteristics of broiler chickens fed experimental diets for 56days are presented in Table 4. The daily feed intake of birds fed soaked sesame seed meal was significantly (P<0.05) higher than those fed other diets. Average daily weight gain of birds fed the control, roasted and soaked sesame seed meal diets were not significantly (P>0.05) different. Birds fed So consumed significantly (P<0.05) more feed than those on other diets. Feed conversion ratio was significantly (P>0.05) similar for all the treatments except T2.

The observed increase in feed intake and body weight gain among birds fed Roasted and Soaked SSM diets could be attributed to better detoxification of the anti-nutrients by these processing methods. Diarra *et al*. (2007) had earlier reported that soaking is one of the most effective methods of lowering the phytic acid (PA) content of the sesame seed. They observed that soaking in water reduced phytic acids more than any other processing methods. However, the decreased average feed intake and body weight gain of birds on Sundried

Table 1: Gross Composition of the Experimental Diets

Ingredients,%	Control	Sundried (Su)	Roasted(Ro)	Boiled(Bo)	Soaked (So)
Maize	56.30	47.90	47.90	47.90	47.90
Rice offal	0.00	6.00	6.00	6.00	6.00
Sesame Meal	0.00	15.00	15.00	15.00	15.00
GNC	36.39	27.59	27.59	27.59	27.59
Palm oil	4.00	0.00	0.00	0.00	0.00
Bone meal	3.10	3.10	3.10	3.10	3.10
Salt	0.30	0.30	0.30	0.30	0.30
Limestone	0.60	0.60	0.60	0.60	0.60
Lysine	0.16	0.16	0.16	0.16	0.16
Methionine	0.20	0.20	0.20	0.20	0.20
*Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Determined Analysis (%)					
ME kcal/kg	3069	3183	3125	3193	3164
Crude protein	21.90	21.51	21.66	21.75	21.54
Crude fibre	3.39	4.24	4.21	4.50	4.86
Ether extract	7.87	12.34	12.34	11.87	11.47
Calcium	1.10	1.17	1.22	1.22	1.17
Phosphorus	0.52	0.53	0.54	0.53	0.53
Lysine	1.02	2.02	1.80	1.91	2.04
Methionine	0.47	0.40	0.47	0.34	0.48
Methionine+cystine	0.79	0.77	0.69	0.71	0.80
Feed cost/kg, ₦	67.23	70.95	70.94	70.95	70.94

*Su=Sundried sesame seed: Ro=roasted sesame seed: Bo=boiled sesame seed: So=soaked sesame seed. *Optimix premix supplied /kg of diet: Vit A- 13340 I.U; Vit. D_3-2680 I.U; Vit. E- 10 I.U; Vit. K- 2.68mg; Calcium pantothenate- 10.68mg; Vit. B_{12}- 0.022mg; Folic acid- 0.668mg; Choline chloride-400mg; Chlorotetracycline- 26.68mg; Manganese- 13mg; Iron- 66.68mg; Zinc, 53.34mg; Copper- 3.2mg; Iodine- 1.86mg; Cobalt- 0.268mg; Selenium- 0.108mg. ME – Metabolisable Energy

Table 2: Chemical composition of Differently Processed Sesame Seed Meal

Nutrient, %	Sundried (Su)	Roasted(Ro)	Boiled(Bo)	Soaked (So)	SEM
Dry matter	92.74^{a}	91.34^{b}	90.12^{b}	91.10^{b}	0.62
Crude protein	26.51	27.52	27.10	26.72	0.31
Crude fibre	8.04^{a}	5.87^{c}	7.25^{b}	8.20^{a}	0.58
Ether extract	54.38	56.11	55.94	54.30	0.91
Ash	5.66	5.35	5.36	4.88	0.40
NFE	5.41^{a}	2.15^{b}	2.82^{b}	4.90^{a}	0.82

NFE=Nitrogen Free Extract. SEM = Standard error of mean. a, b, c = Means in the same row having different superscripts are significantly different (P<0.05).

Table 3: Anti-nutritional factors Present in Differently Processed Sesame Seed Meal

Parameters, mg/100g	Sundried (Su)	Roasted(Ro)	Boiled(Bo)	Soaked (So)	SEM
Oxalate	1.80^{a}	0.82^{b}	1.35^{a}	0.80^{b}	0.25
Tannins	2.11^{a}	1.10^{b}	1.99^{a}	1.11^{b}	0.22
Trypsin inhibitor	1.62^{a}	0.14^{c}	1.10^{b}	0.16^{c}	0.19
Phytic acid	2.22^{a}	1.06^{b}	1.98^{a}	1.16^{b}	0.15

Determination done at the Biochemistry Department, National Veterinary Research Institute (NVRI), Vom, Jos. SEM = Standard error of mean. a, b, c = Means in the same row having different superscript are significantly different (P<0.05).

Table 4: Growth performance of Broiler Finishers Fed Diets Containing Differently Processed Sesame Seed Meal (56days)

Parameters	T1 (Control)	T2(Su)	T3(Ro)	T4(Bo)	T5(So)	SEM
Initial weight, g/b	57.15	57.14	57.15	57.16	57.14	1.59
Final weight, g/b	2225.93^{a}	1777.27^{c}	2190.74^{ab}	2126.64^{b}	2156.67^{ab}	48.07
Total weight gain, g/b	2168.78^{a}	1720.13^{c}	2133.60^{ab}	2069.50^{b}	2099.53^{ab}	46.07
Av. daily weight gain, g/b/d	38.73^{a}	30.72^{c}	38.10^{ab}	36.96^{b}	37.49^{ab}	0.85
Total Feed Intake, g/b	5425.00^{b}	5188.17^{c}	5473.61^{b}	5423.61^{b}	5548.61^{a}	27.70
Av. daily feed intake, g/b/d	96.88^{b}	92.65^{c}	97.74^{b}	96.85^{b}	99.08^{a}	0.50
FCR	2.50^{a}	3.02^{b}	2.57^{a}	2.62^{a}	2.64^{a}	0.24

a, b, c = Means in the same row having different superscript are significantly different (P<0.05). SEM = Standard error of mean; Su=Sundried sesame seed; Ro=roasted sesame seed: Bo=boiled sesame seed: So=soaked sesame seed; FCR=feed conversion ratio

Table 5: Carcass Characteristics of Broilers Fed Diets Containing Differently Processed Sesame Seed Meal

Parameters	T1(Control)	T2(Su)	T3(Ro)	T4(Bo)	T5(So)	SEM
Live weight, g	1941.70^{a}	1766.70^{b}	1950.30^{a}	1950.00^{a}	2000.00^{a}	59.58
Carcass weight, g	1429.17^{b}	1345.00^{c}	1545.00^{ab}	1587.50^{a}	1569.17^{ab}	46.87
Dressing, %	66.59^{b}	60.11^{c}	68.85^{a}	69.81^{a}	68.45^{a}	1.82
Breast, %	15.78^{b}	15.92^{b}	18.23^{a}	16.97^{ab}	16.40^{ab}	0.83
Thigh, %	11.28^{b}	12.33^{a}	12.50^{a}	12.68^{a}	11.05^{b}	0.45
Back, %	13.85	13.69	14.24	14.06	14.42	0.37
Wing, %	8.48	8.44	8.59	8.20	8.17	0.22
Drumstick, %	9.83^{bc}	9.70^{c}	10.64^{ab}	10.47^{abc}	10.74^{a}	0.19

a, b, c = Means in the same row having different superscript are significantly different (P<0.05). SEM = Standard error of means; Su=Sundried sesame seed; Ro=roasted sesame seed: Bo=boiled sesame seed: So=soaked sesame seed

SSM could be due to high residue of anti-nutritional factors (ANFs). It could be recalled that of all the processing methods studied, the level of ANFs was highest in the sundried sample. Oxalates have been reported to form complexes with mineral particularly calcium thereby making them unavailable to the body, cause irritation of the gut and resulting in low feed intake, inhibit protein and energy utilisation in broilers (Agwunobi *et al.,* 2002; Ndimantang *et al*., 2006; Okereke, 2012). Phytates impair the utilisation of protein and some minerals resulting in poor performance while tannins inhibits digestive enzymes and causes irritation of the gut. Not only does oxalate interfere with calcium absorption in the digestive tract, it also limits nitrogen retention (Hang and Preston, 2009; Hang and Binh, 2013). The improved feed conversion ratio observed in this study agrees with the findings of Bell *et al.* (1990); Diarra *et al.* (2007), Yasothai *et al.* (2008) and Agbulu *et al.* (2010). They attributed the increase in performance of birds to the roles of methionine present in sesame seed meal.

Carcass Characteristics

The result of carcass characteristics of broiler chickens fed experimental diets for 56days are presented in Table 5. Birds fed Ro, Bo and So diets were significantly (P>0.05) comparable in all the carcass parameters considered. The live weight, carcass weight and dressing percentage of birds fed Su diet was significantly (P<0.05) lower than those fed other diets.

Back and wings weight were not significantly (P<0.05) different across the treatment groups.

The significant differences observed in the live weight, carcass weight and dressing percentage in this study was contrary to the report of Diarra *et al.* (2007). They observed no significant difference in slaughter, dressed

Table 6: Organs weight of Broilers Fed Diets Containing Differently Processed Sesame Seed Meal

Parameters	T1(Control)	T2(Su)	T3(Ro)	T4(Bo)	T5(So)	SEM
Liver, %	3.82	3.65	3.86	3.80	3.93	0.23
Heart, %	0.87	0.76	0.79	0.77	0.97	0.18
Gizzard, %	2.83[bc]	2.87[bc]	3.06[ab]	2.57[c]	3.39[a]	0.11
Spleen, %	0.31	0.20	0.21	0.33	0.24	0.09
Abdominal fat, %	2.44	2.35	2.57	2.17	2.56	0.27
Intestine weight, %	8.05[b]	10.96[a]	9.60[a]	8.06[b]	10.38[a]	0.88

a, b, c = Means in the same row having different superscript are significantly different (P<0.05). SEM = Standard error of means; Su=Sundried sesame seed: Ro=roasted sesame seed: Bo=boiled sesame seed: So=soaked sesame seed

and carcass weight when broilers were fed differently processed sesame meal diets. Also, Yakubu and Alfred (2014) evaluated the nutritional value of toasted white sesame seed meal as a source of methionine on carcass characteristics of finisher broiler chickens and reported no significant differences in all the parameters measured except abdominal fat. Although, Njidda and Isidahomen (2011) reported significant differences in dressing percentage of rabbits fed sesame seed meal, their findings were based on raw sesame seed meal alone. The weights of thigh, wings, drumstick and breast compared favourably with the report of Oluyemi and Robert (1988) but were higher than the values reported by Diarra *et al*. (2007). These differences may be due to the breed of birds used for the study, variety of sesame seed used and the climatic factors of the experimental site.

Organs weight

The results of Organs weight of broiler chickens fed experimental diets for 56days are presented in Table 6. There were no significant (P>0.05) differences in the parameters measured except the weights of gizzard and intestine. Birds fed Su, Ro, and So diets had significantly (P>0.05) higher weights for gizzard and intestine than those fed other diets. The fact that most of the internal organs measured showed no significant difference in size means that the test diets did not contain any appreciable ANFs that could be detrimental to the organs. Diarra *et al*. (2007) also observed non significant differences in the weights of organs measured when broilers were fed differently processed sesame seed meal diets. The differences observed in the weight of the intestine across the treatments may be due to their involvement in the digestion process.

CONCLUSION

On the basis of the results of this study, it was observed that roasting and soaking were adequate to remove toxic phytochemicals in sesame seed to tolerable levels for broiler chickens. Therefore, up to 15% of roasting and soaking sesame seed meal can be included in the diet of broiler chickens without adverse effect on growth performance, carcass characteristics and organs weight. Further research is therefore recommended on higher inclusion levels.

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