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Effect of Processing Method of Sesame (*Sesamum indicum* Linn.) Seeds on the Growth Performance and Nutrient Utilization of Broiler Chicks

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Abstract **Objective:** This research was conducted to investigate the effect of feeding processed sesame seed (Sesamum indicum) on the performance and nutrient utilization of broiler chicks. **Method:** 400 day old (Anak, 2000) white strain unsexed broiler chicks were allocated to four treatments with each treatment having two replicates in a completely randomized design (CRD). Each treatment contained 100 chicks with 50 chicks per replicate. A control diet, which served as treatment 1 had full fat soya bean, whereas the cooked, pre-pressed and de-hulled seed based diets served as treatments 2, 3 and 4 respectively. Feed and water were supplied ad libitum. **Result:** The pre-pressed Sesame seeds had significantly ($P<0.05$) higher crude protein and NFE values but the ether extract was significantly ($P<0.05$) lower than those of other treatments. There were no significant ($P>0.05$) differences in the means of the other treatments. The mean values for mean weekly feed intake of the birds fed de-hulled and pre-pressed (291.21 g) and de-hulled (292.21 g) were significantly ($P<0.05$) higher than that of the control (335.96 g), which was significantly lower than cooked (260.92 g). The results for body weight gain and FCR follow the same trend. The digestibility of crude fibre in the pre-pressed seeds (40.80%) is significantly ($P<0.05$) higher, and least in the cooked (31.02%) and control treatment. A cooked Sesame seed give better feed conversion ratio than other processing methods but does not necessarily correspond to the best performance. **Conclusion:** Arising from this study, the three processing methods show promise as feed for broiler chicks. As a result, all three processing methods are commended for the different objectives for which they perform optimally but the pre-pressed proved to be the best method of processing sesame seeds for appreciable result on crude protein levels.

Keywords Processing, Sesame seed, Broiler chicks, Performance, Anti-nutritional Factors

1. Introduction

Broilers are fast growing birds with ready market weight of 1800 g to 2500 g at 8 - 10 weeks [1]. The weight and growth rate depend on feed type and feed regime. Proteins are very important for the growth and development of the cells and tissues of any living organism and these are made up of amino acids. Methionine is one of the most important limiting amino acids in poultry. Synthetic methionine is an essential amino acid, which is usually added in the formulation of poultry diets.

Feeds formulated with synthetic methionine, which is not always accessible to farmers especially the rural farmers' accounts for over 60-85% cost of raising commercial poultry [2, 3]. In recent years, the cost of synthetic methionine in Nigeria has been on the increase with a resultant increase in the price of the finished feed [4]. [5] Observed that when a diet is supplemented with synthetic methionine at 0.5% supplementation level, it represents up to 10.26% of the total cost of producing feed in Nigeria. The rising cost as well as the inaccessibility of synthetic methionine by rural farmers has resulted in several researchers advocating for the use of alternative sources of synthetic methionine that is readily available and cheaper [6-8]. One of such sources is the use of grain legume, and *Sesame indicum* seed (benniseed) is a good source of proteins with an appreciable amount of methionine [9]. Sesame seed meal has a higher content of methionine than most plant protein supplements. When used in the right proportions with soyabean meal, which has a higher content of lysine; a balanced diet with respect to lysine and methionine will result [1]. Sesame seed (benniseed) is produced locally in Nigeria around Nasarawa, Jigawa, Benue, Yobe, Niger, Kano, Katsina, Kogi, Gombe, Plateau and Taraba States [10]. The protein is rich in essential amino acids, which include leucine, arginine and methionine but is low in lysine [11] when compared with soybean. Sesame seeds are also good sources of minerals and

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vitamins such as manganese, copper, calcium, vitamin B1 and vitamin E [12]. In poultry nutrition, sesame seed has been used to supplement synthetic methionine in laying hens [4] and broilers [13]. It has been reported to partially replace soybean meal in the diet as a source of plant protein for chicks, broiler and laying hen [14]. Sesame seed meal has also been used to substitute soybean meal at 25% in broiler diet [15]. [8] Observed that raw or toasted seed can be included up to 10% without adverse effect on growth performance of broiler. However, as with most tropical legumes, sesame seed contain anti-nutritional factors, which may reduce its nutritive value in poultry feed [16]. Anti-nutritional factors have adverse effects on digestion and performance of chickens. Chief among these anti nutrients are oxalate and phytic acid, which has been reported to be appreciably eliminated when subjected to heat [17]. The aim of this study therefore was to investigate the effects of the different methods of processing on the performance of broilers and nutrient utilization as an indication of efficacy of reduction elimination of the anti-nutritional factors.

2. Materials and Methods

The five-week study was conducted at the Poultry Unit of Teaching and Research Farm, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, a tropical humid climate.

Experimental birds and their management

400 day-old (*Anak, 2000*) white strain unsexed broiler chicks were purchased from Zartech Farms, Ibadan, Nigeria. The birds were managed on deep litter housing system throughout the study. Brooding was done for the first week of the study during which the chicks were fed commercial broiler starters mash. Thereafter, the birds were randomly allotted to the four dietary treatments of 100 birds per treatment and were replicated two times with 50 birds per replicate in a completely randomized design. The birds were vaccinated routinely as described by [7]. At day old intraocular Newcastle disease vaccine was administered. Gumboro vaccine was administered on Day 14, while coccidiostat was occasionally added in water. On Day 28 Lasota was given as a booster against Newcastle disease.

Housing

The experiment was carried out in the broiler's house located at the southern part of the Teaching and Research Farm, University of Ibadan. The house was properly cleared, washed with detergents and disinfected with izal before the arrival of the chicks. The floor was covered with wood shavings to a depth of about 5cm after drying.

The house was partitioned with wire netting into four treatment pens, with each treatment divided into two replicates. Each pen was fitted with a 200 W bulb to heat the pens especially for the brooding periods. The sides of the brooder pens were covered with polythene sheets to conserve heat for chicks in the early stages of their growth.

Sources of ingredients

Maize, fish meal, bone meal, blood meal, full fat soya bean, oyster shell, methionine, premix and salts were bought at Adom Feed Mill, Orogun along Ibadan-Oyo Road. The palm oil was purchased at Agbowo, while the sesame seed was purchased at Oshodi Market, Lagos, Nigeria. All feed ingredients were milled in a hammer mill fitted with a 2 mm mesh at Feed Depot, Agricultural Mechanization Departments University of Ibadan. The feed ingredients were weighed accurately and compounded by floor mixing before adding the trial material, sesame seed processed by different methods as applicable. The experimental diets were then transferred into jute bags according to the treatments and conveyed to the University of Ibadan Teaching and Research Farm. The starter diet was formulated to contain approximately 23% crude protein on air dry basis and between 2933.03 - 2961.5 kcal/kg of metabolizable energy as shown in Table 1.

Table 1. Gross composition of experimental diet (% air-dried)

Ingredients	T1	T2	T3	T4
Maize	43.95	42.45	42.45	42.45
Sesame seed	-	30.00	30.00	30.00
Full fat soya bean	30.00	-	-	-
Wheat bran	9.50	9.50	9.70	9.50
Fish meal	4.00	5.00	5.00	5'00
Blood meal	5.50	6.00	5.80	6.00
Palm oil	3.00	3.00	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50
Oyster shell	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30
Premix	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient composition				
ME (kcal/kg)	2961.50	2935.73	2933.03	2935.73
Crude protein (%)	23.0	22.80	22.64	22.80
Energy-protein ratio	129 (1.403)	129 (1.37)	130 (1.35)	129 (1.19)

T1 = Control diet with full fat soybean T2 = Cooked sesame seed based diet
T3 = Pre-pressed sesame seed based diet T4 = De-hulled sesame seed based diet

Experimental diets

Four dietary treatments were formulated, three of which contained 30% sesame seed meal, processed by different methods, to replace full fat soya as follows; 0.00%, in treatments 1 (control), and at 30.0% for treatments 2, 3 and 4 respectively (Table 1). The control treatment (T1) contained full fat soya while treatment 2 (T2) contained cooked sesame seed based diet; treatment 3 (T3) is pre-pressed sesame seed based diet; treatment 4 (T4) is de-hulled sesame seed based diet. The sesame seed was analyzed for proximate composition. The birds were fed the experimental diets and

clean drinking water *ad libitum* throughout the study period as shown in Table 1.

Detoxification processes of the sesame seed

The seeds were screened, winnowed and cleaned to remove dirt, sand, stones and other foreign particles. In view of the potentials of sesame seed and in order to make it safe for consumption by both man and livestock, the seeds were detoxified by different methods to reduce the levels of anti-nutritional factors to an acceptable level. The methods used to detoxify sesame seeds were cooking, de-hulling, and pre-pressing.

Pre-pressing involved soaking the seeds in enough water to cover the grains for a period of about 20 minutes. Then the seeds were removed from the water and pre-pressed under pressure using a pressing machine for about 2 days.

De-hulling: Since most of the anti-nutritional factors were concentrated on the hull, the hulls were then removed by soaking the raw seeds for 12 h in enough water to cover the grains. The seeds were pressed manually between the palms to de-hull them. The hulls float in water and were removed by decanting thus leaving the seeds, which were later dried in the sun till it became crisp enough to mill.

Boiling involved cooking the raw sesame seeds in a pot for about 1 hour at about 100°C. The softened seeds were then de-hulled manually and the hulls separated, again by decanting. The seeds were later dried in the sun till it became crisp enough to mill.

3. Data Collection

Growth performance indices

Data were collected on growth performance indices namely, feed intake, body weight gain, feed conversion ratio and protein efficiency ratio.

Metabolic study

On Day 35, two birds per replicate were taken from each treatment and placed in a metabolic cage. They were provided feed and water *ad libitum* as during the preceding rest of the study. An adaptation period of five days was allowed during which period data were not collected. From the Day 6 through Day 10, data were collected on feed intake as well as on the faeces voided by the animals from each replicate. The faecal samples were weighed and oven-dried at about 105°C for 2 days. The weights of the dried faeces were taken after cooling, and kept for chemical analysis.

Chemical analysis

Proximate analysis of feeds was carried out according to the standard methods of Association of Official Analytical Chemists [18].

4. Statistical Analysis

The result of the study was analyzed using one-tailed test of ANOVA and where significant differences existed they were separated using the Fischer's Least Significant Difference (F-LSD) [19]. Significance was accepted at a level of $P<0.05$.

5. Results

Proximate analysis of the sesame seeds

The results of the proximate analysis of the sesame seeds processed by different methods are presented in Table 2.

Table 2. Proximate analysis of sesame seed samples under different processing methods

Nutrients (%)	Raw	De-hulled	Pre-pressed	Cooked
Dry matter	96.16	94.87	95.03	95.80
Crude protein	24.02^{b}	27.37^{b}	38.60^{a}	20.17^{b}
Crude fibre	4.10	3.17	3.61	3.54
Ether extract	50.74^{a}	53.76^{a}	6.91^{b}	48.82^{a}
NFE	15.36^{b}	12.60^{b,c}	46.02^{a}	22.54^{b}
Ash	5.70	3.10	4.86	4.93

The proximate analysis of sesame seed samples (Table 2) showed that the dry matter content is highest in raw seed with 96.16% but there was no significant difference ($P<0.05$) between treatment means. There were also no significant differences ($P<0.05$) in the means of crude fibre, and ash. Pre-pressed sesame seeds had the highest crude protein level (38.60%), which differed significantly ($P<0.05$) from the other treatments among which there was no significant difference ($P<0.05$). The NFE value of pre-pressed sesame seeds was also significantly ($P<0.05$) higher (46.02%) than those of other treatments but the mean value of ether extract (6.91%) was significantly lower than other processing methods.

Proximate analysis of the experimental diets

The results of the proximate analysis of the experimental diets formulated with sesame seeds processed by different methods are presented in Table 3. There were no significant differences in the nutrient composition of the feed samples.

Table 3. Proximate analysis of experimental diets formulated with sesame seeds processed by different methods

Nutrients (%)	Control	De-hulled	Pre-pressed	Cooked
Dry matter	89.96	90.91	88.57	90.11
Crude protein	23.92	23.11	23.48	22.16
Crude fibre	4.99	4.92	4.88	4.86
Ether extracts	5.90	6.41	5.06	6.75
NFE	52.99	53.65	55.24	54.68
Ash	12.20	11.91	11.34	11.55

Growth performance of experimental birds

The growth performance characteristics of broiler chicks fed diets containing sesame seeds processed in four different methods are presented in Table 4. The growth performance characteristics of interest here include feed intake, body weight gain, feed conversion ratio and protein efficiency ratio.

Table 4. Mean weekly feed intake (g), body weight gain (g) and feed conversion ratio of broilers fed diets containing sesame seeds processed by different methods

Parameters	Control	Cooked	Pre-pressed	De-hulled
Feed intake (g)	335.96[a]	260.92[c]	291.21[b]	292.21[b]
Body weight gain (g)	195.93[a]	181.55[b]	173.22b,[c]	173.80b,[c]
FCR	1.71[a]	1.43[b]	1.68[a]	1.68[a]
PER*	2.498[a]	2.534[a]	2.174[b]	2.171[b]

a,b = Means with different superscripts within the same row are statistically significant
*Protein efficiency ratio

The mean feed intake of birds fed the experimental diets were significantly (P<0.05) lower than those of those fed the control diet (335.96 g). The birds fed diets containing cooked sesame seeds were significantly lower than those containing pre-pressed or de-hulled between which there was no significant (P>0.05) difference. The same trend was maintained in all the parameters measured under growth performance characteristics.

Effect on processing method on the nutrient retention/digestibility of broilers

The effect on processing method on the nutrient retention/digestibility of broilers is presented in Table 5.

Table 5. Effect on processing method on the mean nutrient retention/digestibility of broilers

Nutrients (%)	Control	Cooked	Pre-pressed	De-hulled	SEM
Nitrogen	84.05	83.07	82.81	81.62	
Crude fibre	25.29[b,c]	31.02[b]	40.80[a]	19.93[c]	
Ether extract	91.72	93.32	92.78	90.67	
NFE	81.98	83.78	86.11	81.30	
Ash	42.83[b]	67.70[a]	71.28[a]	38.83[b]	

a,b = Means with different superscripts within the same row are statistically significant (P<0.05).

There was no significant (P>0.05) in the mean nitrogen digestibility of the birds in this study. The mean value crude fibre digestibility was highly significant for the birds fed diets formulated with pre-pressed sesame seeds (40.80%) while those fed diet containing de-hulled seeds had a significantly (P<0.05) lower mean value for crude fibre 19.93%. Ash digestibility was significantly (P<0.05) higher for the birds fed cooked and pre-pressed seeds while those on control diet and diet containing de-hulled had significantly (P<0.05) lower values.

6. Discussion

The objective of this experiment was to investigate the effect of processing method on the growth performance and nutrient utilization of broiler chicks. The effect observed in this study was apparently influenced by the level of reduction of anti-nutritional factors by individual processing methods investigated.

Proximate composition of seeds and feeds

The method of processing of sesame seeds did not influence the capacity of seeds to retain moisture; neither did it modify the fibre or ash content of the seeds. Thus there were no significant (P>0.05) differences in the dry matter, crude fibre and ash content of the processed seeds. Conversely, there were significant (P<0.05) differences observed in the mean values for crude protein, ether extract and NFE. It appears that pre-pressed seeds lose more of the phytic acids and oxalates than other processing methods, thus result in a crude protein level (38.60%) that is highly significant (P<0.05) compared to cooking (20.17%) and de-hulling (27.37%) [20], this is corroborated by the nutrient digestibility of crude protein (Table 5) where pre-pressed seeds have 40.80% digestibility and is significantly (P<0.05) compared to other processing methods.

The mean values of ether extract for Sesame seeds processed by pre-pressing and boiling were not significantly (P<0.05) difference from that of raw seeds but all differed significantly from that of pre-pressed seeds. This was apparently due to the pre-pressing being similar to industrial process of extraction of oil from oil seeds. The pressure used on the pre-pressed seeds extracted more oil from the seeds than the other processing methods, thus the highly significant (P<0.05) low level (6.91%) of ether extract in the seeds. It is not clear why the crude protein and NFE levels of pre-pressed seeds was significantly (P<0.05) higher than those of the seeds processed by other methods. However, it is not indicated in this study whether the processing methods affected the availability of proteins to digestive enzymes. However, in a recent review, [21] observed that continuous screw-press processing at high pressure and temperature had a 13% reduction in nitrogen solubility (in 0.02 N sodium hydroxide) and 5% lower protein digestibility which they attributed to the dry heat effect on the seed during processing. Apparently, the significantly higher values of crude protein obtained in the study results from the fact that dry heat was not applied during the pre-pressing method.

It is possible that in the raw and de-hulled seeds, the anti-nutritional factors present also interfere with the availability of carbohydrates and protein, hence the significantly (P<0.05) lower levels in the seeds raw, de-hulled and boiled seeds. The nutrient compositions of the feeds formulated with the seeds processed by different methods were not significantly different. This was because the differences in crude protein, ether extract and NFE were not sufficient to cause significant (P<0.05) differences in the nutritional composition of the feeds.

Growth performance

The whole aim of processing legume oil seeds is to reduce or eliminate, as the case may be, the anti-nutritional factors present in the seeds, phytic acid and oxalates in the case of Sesame seeds [20]. Several different methods are usually applied depending on the plant secondary metabolite involved, the cost or feasibility of using the method, and the effectiveness of the method to achieve results that conform

to FAO approved concentrations. In this study, the sesame seeds were de-hulled, pre-pressed or boiled. Processing often tends to improve the palatability of feedstuffs thereby increasing feed intake but in this study it appears that none of the processing methods improved the feed intake of the birds. This is evident in the feed intake of the birds raised on diets containing Sesame seeds processed in any of the three methods considered. The mean weekly feed intake of the birds raised on the control diet (335.96 g) was significantly (P<0.05) higher than those of the birds raised on feeds supplemented with sesame seeds, while that of the cooked seeds (260.92 g) was significantly (P<0.05) lower than control and the other two treatments.

Body Weight Gain

The result shows no significant difference amongst the means of the treatment diets for average feed intake, average body weight gain and efficiency of feed utilization. This result agrees with the work of [8]; and [22] who also reported no significant difference.

The result of the efficiency of food utilization also agrees with the work of [8, 23]; as well as [22] who reported no significant difference in Feed conversion efficiency and Protein efficiency ratio among the means of the treated birds.

The highest body weight gain of the birds of the cooked diets may be due to the fact that most of the anti-nutritional factors in the cooked would have been completely destroyed by heat [24, 25], thereby making available the necessary nutrients to the chicks. The bird fed the pre-pressed sesame diet had the lowest body weight gain. This may be due to the fact that pre-pressing (extraction) alone was not enough to reduce the anti-nutritional factors in the sesame.

7. Conclusions and Recommendations

Three processing methods (cooking. dehulling and prepressing) could be use to eliminate the anti-nutritional factors in sesame seeds to make it better utilize by broiler chicks.

The study revealed there were no significant differences among the means of the performance parameters of the chicks fed differently processed sesame seeds with reference to FCE and PER. Numerically, the cooked is closest to the control.

Recommendations

From the result of this research work the following recommendations were made:

(1) Cooking and dehulling methods of processing sesame seeds for the feeding of broiler chicks is recommended.
(2) Two or more of these methods can be combined to give a better performance.
(3) Processed sesame seed serve as a very good source of plant protein for livestock feed.

Suggestion for Further Studies

Further studies could be carried out in order to reinforce or buttress the result obtained in this experiment.

Also the processing methods used can be improved upon by first dehulling before prepressing the seeds. Researchers in further studies should try as much as possible to make more standard the conditions of processing such as temperature regulation and proper timing of operations.

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