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Utilization of Differently Processed Sesame Seed Meal as a Source of Methionine in Guinea Fowls Diets

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Abstract:- An experiment was conducted to evaluate the impact of different processing methods on sesame seeds meal as a source of methionine for guinea fowls. The research took place at the Teaching and Research Farm of the Department of Animal Health and Production in Jigawa State, Nigeria. Seventy-two guinea fowls of mixed sexes were raised under intensive management conditions for the experiment. Sesame seeds were divided into three groups: raw, soaked, and roasted, then ground into meal and incorporated into four experimental diets. Proximate analysis of the experimental diets was conducted at the Nutrition laboratory of the Department of Animal Science. Data generated were subjected to analysis of variance (ANOVA) using statistical analysis system (SAS) package. Results indicated that processing methods significantly reduced anti-nutritional factors without adverse effects on some of the performance parameters. Performance improved with all processed sesame seed meals compared to the control diet, suggesting their potential as methionine sources without additional supplementation. Raw, soaked, and roasted sesame seed meal can be incorporated at 15% level of inclusion in the diet of guinea fowls without negative impacts on their general performance. Overall, the study concludes that processing methods enhanced sesame seed's suitability as a methionine source for guinea fowls and recommends their inclusion in diets of guinea fowls at 15% level.

I. INTRODUCTION

Guinea fowl is known to be a wild bird found in many parts of the world. Many of them were reared in captivity by farmers for protein consumed by people. Guinea fowls (*Numidia meleagris*) are reared for meat and egg production, Smith[20]. Guinea fowl withstand well to environmental stresses and conditions, and they are less susceptible to diseases, unlike other poultry, Mathis and Mac-Donald[12]. Guinea fowl required no much use of medicated feed (no antibiotics) as is common in intensive other poultry production. Rearing of guinea fowl intensively has begun in Botswana and is likely to accelerate the potential of the species. Guinea fowl meat has higher protein content than that of chicken. There are no cultural barriers against consumption of guinea fowl products, Saina *et al*.[19].

Sesame (*Sesamum indicum* L.) is one of the first human production and consumption oil crops belongs to family of Pedaliaceae, rape, soybean, and peanuts, known as China's four major oil crops. First discovered in ancient areas in Pakistan, sesame is a long-established cultivated crop, Chattopadhyay et al.[6]. It is distribution extends to countries such as India, China, and Malaysia. Chinese people have been using sesame seeds for more than 5000 years. Globally, India, Sudan, Myanmar, China, and Tanzania are the major producers of sesame. In recent years, the production of sesame seeds in African countries has increased, and Tanzania has replaced India as the leading producer of sesame seeds. According to the Food and Agriculture Organization of the United Nations, the global production of sesame in 2017 was 5.899 million tons, of which 806,000 tons were produced in Tanzania and 733,000 tons in China, Aduku[2].

Deficiency of Methionine in poultry diets might lead to many deformities and improper functions of body system some of which include low feed intake, ruffled appearance of birds, lean tissue weight, fat accumulation and poor carcass quality. In severe and chronic cases, it could impair immune response and increase susceptibility to infectious diseases affecting broiler growth and performance. In a layer flock, methionine deficiency could lead to decrease in egg production, poor quality eggs and shell less or thin shelled eggs, Bishnol[5].

Amino acids are essential building blocks of life and therefore very crucial in any animal diet preparation. Protein known as the precursors of amino acids, are available in many biological sources. Feed proteins are complex amino acid polymers which are broken down in the gut into amino acids. These amino acids are absorbed and assembled into body proteins which are used in the building of body tissue like nerves, muscles, skin and feathers, Aduku[2]. All of the essential amino acids required by poultry, methionine and lysine are the first two limiting essential in broiler diets and therefore must be supplemented in order to meet the

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nutritional needs of the birds. Therefore, the study was designed to evaluate the effect of feeding differently processed sesame seed meal as a dietary source of methionine on overall performance of guinea fowls.

II. MATERIALS AND METHODS

The research was conducted at the Teaching and Research Farm of the Department of Animal Health and Production Technology (AHP) Binyaminu Usman Polytechnic Hadejia, Jigawa State. The farm lies between latitude $12.45^0$6N and longitude $10.04^0$4E.

- *Source and Processing of Experimental Feed Ingredients*

Ingredients for feed formulation (limestone, bone meal, Methionine, vitamin premix, lysine and common salt) were purchased from Albarka Poultry Services, Sani Mainagge, Kano State, Nigeria. Soybeans, maize, millet, Sorghum wheat offal and groundnut cake were purchased in Hadejia town. Soybean was roasted and all ingredients were milled and mixed manually at departmental laboratory complex. The sesame seed was sourced from Malam-Madori market of Jigawa State, Nigeria. A total of seventy-two (72) guinea fowls of mixed sexes were used for the experiment sourced from reputable hatchery in Jos of Plateau State, Nigeria.

- *Experimental Diets and Design*

The experimental design was a completely randomized design (CRD) consisting of four (4) treatments with three (3) replications each, containing differently processed sesame seed meal allotted to each treatment. Four experimental diets were formulated manually and designated as T1, T2, T3 and T4. T1 served as a control (contained no sesame). The other treatments consisted three differently processed sesame seed meal and designated as T2 (containing raw sesame), T3 (containing roasted sesame) and T4 (containing soaked sesame). These processing methods of the sesame seed meal (incorporated at 15% each in the dietary treatments) determines its substitution to methionine. The samples of the diets were subjected to proximate analysis using standard method of AOAC[4]. The ingredient composition of the experimental diets is presented in Table 1.

Table: 1 Ingredient Composition of the Experiment Diets

		DIETS		
Ingredients	**T1 (CNTRL)**	**T2 (RSM)**	**T3 (ROSM)**	**T4 (SSM)**
Sesame Seed Meal	0.0	15	15	15
Maize	54	50	50	50
Soya bean meal	31	16	16	16
Wheat offal	5	4	4	4
GNC	1.5	12	12	12
Bone meal	1.5	0.45	0.45	0.45
Limestone	0.8	0.24	0.24	0.24
Premix*	0.25	0.075	0.075	0.075
Methionine	0.2	0.00	0.00	0.00
Lysine	0.23	0.06	0.06	0.06
Common salt	0.35	0.105	0.105	0.105
Total	100	100	100	100
Calculated Nutrient composition (%) unless otherwise stated.				
ME (kcal/kg)	3067	3043	3037	3037
Crude protein (%)	21.97	21.03	21.26	21.46
Crude fibre (%)	3.66	5.32	3.90	3.69
Calcium	0.76	0.89	0.94	0.78
Phosphorus (Av.)	0.46	0.49	0.54	0.44
Ether extract	9.60	16.40	17.50	17.70
Lysine	1.32	1.12	1.26	1.23
Methionine	0.57	0.50	0.404	0.41

ME= Metabolizable Energy.

*Composition of Premix (Vitamin-mineral mixture): vitamin A: 2 400 000 IU; vitamin D: 1 000 000 IU; vitamin E: 16 000 IU; vitamin K: 800 mg; vitamin B1: 600 mg; vitamin B2: 1 600 mg; vitamin B6: 1 000 mg; vitamin B12: 6 mg; niacin: 8 000 mg; folic acid: 400 mg; pantothenic acid: 3 000 mg; biotin: 40 mg; antioxidant: 3000 mg; cobalt: 80 mg; copper: 2000 mg; iodine: 400; iron: 1 200 mg; manganese: 18 000 mg; selenium: 60 mg; zinc: 14 000 mg.

- *Management of the Experimental Birds*

A total of 72-day-old helmeted guinea fowl was purchased and randomly allocated on weight equalization basis to four dietary groups (each with differently processed sesame). Keets were managed in a deep litter system and brood for 2 weeks; they were transferred into individual group pens and were randomly allocated to the four (4) experimental groups with 18 birds each replicated 12 times. The experimental birds were provided with additional light for the period of six (6) on daily basis. The treatment effect

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was estimated by comparing the means of the assessed parameters in the treated groups against the control, all medications and vaccination schedules were adhered to.

- *Data Collection*

Growth performance of the guinea fowls were monitored and determined by measuring their weights, feed intake and feed conversion ratio (FCR). Body weight gain (g) was calculated from the differences between the body weight gain for the given week and previous week. A known quantity of feed was given to the keets while the leftover of the feed was weighed to determine daily feed intake for each treatment. Feed intake for each week was obtained from differences between the feed given per week and leftover. The feed conversion ratio of the birds was determined by calculating the ratio of their feed intake to weight gain:

$$FCR = \frac{Total\ Feed\ Intake}{Total\ Body\ Weight\ Gain}$$

The costs of the experimental feed ingredients were taken in accordance with the prevailing prices during the formulation of the experimental diets. The cost of each experimental diet, the average cost of feed consumed (₦/kg) and the cost per live weight gain were calculated by using the cost of each ingredient (₦) used in the diet formulation.

$$Total\ Feed\ Intake = \frac{Daily\ feed\ intake \times 28}{1000}$$

Cost of feed (₦/kg) *= price per kg of feed*

Total feed cost (₦) *=Total feed intake × Feed cost per kg*

$$Total\ weight\ Gain\ (kg) = \frac{Daily\ weight\ gain\ \times 28}{1000}$$

$$\text{Feed Cost/kg gain (₦)} = \frac{Total\ feed\ cost}{Total\ weight\ gain}$$

At weekly basis, the ruler and a thread were used to measure the morphologic indices of the birds which include: the beak length, tail length, wing length, shank length, thigh length. The data recorded for each treatments and replications were entered into excel spreadsheet for computation and analysis.

On weekly basis, the samples of the droppings from the guinea fowls were collected from each replicate and allowed to dry under the shade. At the end of the trial, the total dried droppings collected were grounded into powder for composition samples before taken to the laboratory for analysis.

- *Proximate Analysis of Experimental Diets*

The proximate analyses of the experimental diets were determined at the Laboratory of the Department of Animal Science, Bayero University, Kano according to the procedures described by AOAC (2006).

- *Determination of Haematologic Indices and Visceral Organs Characteristics*

At the end of the experiment, blood samples were collected from both the brachial and jugular vein using 5 mL sterilized disposable syringe and needle. In order to minimize the standard error in values, the animals were fasted for twelve hours (12 hrs) prior to blood sampling. The vein was seen after few removals of feathers from the site of collection and the needle at a slight angle was placed, bevel up against the vein on the underside of the wing. The needle was inserted into the vein and blood was slowly aspirated. Blood samples (3 mL) was collected in a labeled sterile serum separator tubes. Serum was separated by centrifugation at 3000 rpm at 4^oC for 10 minutes and stored immediately at -20^oC until use. Hematological parameters measured were packed cell volume (PCV), hemoglobin (Hb), red blood cell count (RBCs) and total white blood cell (WBCs) and differential leukocyte counts were assessed according to the routine hematological procedures for avian. All the parameters were assayed using spectrophotometer and commercial test kits of Randox following manufacturer's instruction. The birds were then killed by slaughter method and the bled weight of each bird was recorded before evisceration. The internal organs (liver, heart, spleen, full gizzard, small intestine) were removed and weighed.

- *Statistical Analysis*

Data obtained from the study were subjected into one-way analysis of variance (ANOVA) in a completely randomized design using the General linear modeling (GLM) procedure of statistical analysis software SAS® version 2000. Significant differences among treatment means were determined using Duncan Multiple Range Test (DMRT) as contained in the SAS software.

III. RESULTS

The results of proximate composition of the experimental diets are presented in Table 2. The dry matter content ranged from 94.69 to 95.75% and presented the highest value in T1 followed by T4 and T2, while T3 had the least value. The crude protein content ranged between 25.11 and 27.56 % and was higher in T4 followed by T3, and T2, while T1 had the least value.

The crude fibre content had the highest value in T1 followed by T4 and T3 while T2 presented the least value. Ash content ranged between 4.93 and 5.53% and presented the highest value in T1 followed by T2 and T3, while T4 had the least value. The dry matter, crude protein, and crude fibre contents did not follow any consistent trend. However, the contents of NFE decreased with the arrangement of treatments from 7.48 to 5.07%.

Table 3 presents the growth performance outcomes of guinea fowls fed diets containing variously processed sesame seed meal as methionine source. The result of growth performance shows significant variation ($P< 0.05$) in average feed intake (AFI) and feed conversion ratio (FCR) showing the best ratio compared to those on roasted, raw,

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and soaked sesame diets, indicating efficient feed-to-meat conversion. No significant (p>0.05) differences were observed in final body weight (FBW), body weight gain (BWG) indicating that all the processing methods gave a considerable result.

Table 4 displays the haematological indices of guinea fowls fed diets containing variously processed sesame seeds as methionine sources. Significant (P < 0.05) variations exist in hemoglobin and WBC, where the T2 and T3 appeared to be the in hemoglobin. These suggest enhanced nutrient availability in sesame diets, aiding oxygen utilization in feed breakdown; and T1 (control) happened to be the best in WBC. No significant (p>0.05) variation occurred in other blood components and it was found that all the blood parameters of the treatment groups were within the normal range of values.

The result of morphometric characteristics of guinea fowls fed diet containing differently processed sesame seed meal as source of methionine is presented in Table 5. No significant (p>0.05) variation exist in all morphometric characteristic of guinea fowl except in tail length. In tail length, T1 (control) was found to be the best despite all the morphometric characteristics were normal for normal growth of guinea fowls and numerical variation exist among the experimental groups.

Table 6 displays the digestibility outcomes of guinea fowls fed diets containing variously processed sesame seeds as methionine sources. No significant (p>0.05) differences exist in ash, crude fiber and crude protein among the treatment group digestion. However, the result reveals the significant (P< 0.05) variation in ether extract (EE) and nitrogen free extract (NFE) with statistical importance in raw and roasted sesame and soaked sesame respectively.

Table 7 presents the visceral organ weight of guinea fowls fed diets containing different processed sesame seed meals as methionine sources. The results showed no significant (p>0.05) differences in all the organs except liver; in liver weight raw sesame processing method had the best outcome of the weight.

IV. DISCUSSION

The proximate composition of diets containing differently processed sesame seeds as source of methionine indicated that the values obtained for this study were within the recommended/reported values in the literature. The mineral residue after organic matter oxidation varied among diets with CP content higher in sesame-containing diets (particularly the soaked sesame diet) showing a numerical CP increase possibly due to amino acid properties. It is well known that the CF which represents indigestible components in food, ranged from 5.89% to 7.84%, aligning with reported values. Ash and crude fiber content are crucial for food suitability and digestibility. *Sesame indicum* L. fiber content can contribute to daily fiber needs, important for preventing chronic diseases like cardiovascular disease and diabetes in humans. Carbohydrates play diverse roles in organisms, including energy transport and immune system function. Diets with roasted sesame had higher EE content, likely due to increased oil release during roasting. These findings are consistent with literature on dietary composition, NRC[14].

Growth performance outcomes of guinea fowls fed diets containing variously processed sesame seed meal as methionine sources signifies that, incorporating sesame seed meal at 10-15% adversely affected growth performance, with higher levels further depressing growth. Despite numerical variations, no significant differences were observed in final body weight (FBW), body weight gain (BWG), and initial body weight (IBW), Diarra *et al*.[7]; Yasothai *et al*.[21]; Agbulu *et al*.[3]. Feed intake varied significantly across treatments, consistent with prior research, Diarra *et al*.[7]; Agbulu *et al*.[3]. However, FCR increased significantly across treatments, with birds on sesame-free diets showing the best ratio compared to those on roasted, raw, and soaked sesame diets, Diarra *et al*.[7]; Agbulu *et al*.[3]; Ngele *et al*.[15], indicating efficient feed-to-meat conversion.

The haematological indices of guinea fowls fed diets containing variously processed sesame seeds as methionine sources signifies that, packed cell volume (PCV) and hemoglobin (Hb) count, crucial indicators of animal health and nutrient intake, Oladele[18]; showed no significant difference among treatments, although Hb differed significantly. Sesame seed diets generally resulted in higher PCV and Hb levels compared to the control, except in treatment 4, possibly due to water used for soaking. These values suggest enhanced nutrient availability in sesame diets, aiding oxygen utilization in feed breakdown. PCV values fell within normal ranges reported by Njidda and Isidahomen[15] and Njidda *et al*.[17] but exceeded those by Abeke *et al*.[1]. Hb levels aligned with ranges by Njidda and Isidahomen[16], surpassing Abeke *et al*.'s[1] range. Total protein (Tp) values didn't match ranges by Njidda and Isidahome[16] and Abeke *et al*.[1]. Although red blood cell (RBC) values varied numerically across treatments, they fell within normal poultry ranges, Fayeye and Adeshiyan[11]; Mitruka and Rawnsley[13], suggesting each diet stimulated RBC production, indicating normal bone marrow function.

The result of morphologic characteristics of guinea fowls fed diet containing differently processed sesame seed meal as source of methionine reveals significant (p < 0.05) difference in tail length where T1 (diet without sesame seed) turns out to be highest among the treatment groups both statistically and numerically (13.00cm) followed by T4 (diet with soaked sesame seed) numerically not statistically despite that all the diets with sesame seed meal (T2, T3 and T4) appeared to be statistically the same. The results of morphologic characteristics for beak length, wing length, thigh length and shank length appeared to be statistically not significantly affected by the processing method of the sesame seed although, numerical variation exist between the treatment groups.

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The digestibility outcomes of guinea fowls fed diets containing differently processed sesame seeds as methionine sources reveals that at a 15% sesame meal level, diets exhibited improved digestibility for crude protein, crude fibre, and nitrogen-free extract (NFE) compared to the control, indicating enhanced nutrient availability. While variations existed among sesame-containing diets, significant differences were observed in NFE, with soaked sesame (T4) demonstrating the highest digestibility. Roasted and soaked sesame diets (T3 and T4) showed superior crude protein digestibility over the control and raw sesame diet (T2), likely due to processing methods. Although ash digestibility showed numerical differences, no significant variation was observed. Notably, T3 exhibited the highest ether extract (EE) digestibility, potentially influenced by sesame seed processing. Diets lacking sesame meal displayed poorer EE and ash digestibility compared to sesame-inclusive diets. These findings align with previous research, Diarra *et al*.[7].

Visceral organ weight of guinea fowls fed diets containing different processed sesame seed meals as methionine sources indicated an increase in giblet (liver) weight, aligning with Fairly *et al*.[10]. While significant differences exist among treatment groups in some parameters, no significant disparity was observed in heart weight, consistent with Dorman and Deans[8]. Spleen weight showed no significant difference, suggesting sesame seed's negligible impact on spleen function. Filled intestine and abdominal fat were unaffected across treatments. This aligns with previous studies by Diarra *et al*.[7] and Agbulu *et al*.[3], reporting non-significant differences in heart, gizzard, spleen, abdominal fat, and intestinal weights. El-Husseiny *et al*.[9] also support these findings. Overall, liver weight was significantly impacted by dietary treatments, while other organ weights remained unaffected.

V. CONCLUSION

It was concluded that raw sesame seed meal supported increased liver weight, while soaking method enhanced the digestibility of NFE. Overall, processing of sesame seed especially soaking resulted in improved performance of guinea fowls. Therefore, its inclusion in the diet of guinea fowls at 15% level has no detrimental effect on their overall performance.

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Table 2: Means for the Proximate Composition of the Experimental Diets Containing Differently Processed Sesame Seed Meal

		Treatments		
Parameters (%)	**T1 (CNTRL)**	**T2 (RSM)**	**T3 (ROSM)**	**T4 (SSM)**
Dry Matter	95.75	95.56	94.69	95.59
Crude Protein	25.11	26.73	26.97	27.56
Crude Fiber	7.84	5.89	6.73	7.44
Ether Extract	4.38	4.17	4.52	4.18
Ash	5.53	5.18	5.08	4.93
Nitrogen Free Extract	7.48	3.66	5.48	5.07

Table 3: Means for the Growth Performance Indices of Guinea Fowls Fed Diets Containing Differently Processed Sesame Seed Meal

			Treatments			
Parameters (g)	**T1**	**T2**	**T3**	**T4**	**F val**	**SEM**
IBW	69.91	68.33	68.33	69.44	2.25	0.96
FBW	438.88	472.22	488.89	461.11	1.24	32.63
BWG	368.83	403.63	420.50	391.63	1.31	32.89
AFI	19.41^{a}	16.25^{bc}	18.06^{ab}	14.17^{c}	6.04	1.60
DBWG	8.19	8.96	9.34	8.70	1.31	58.72
FCR	2.21^{c}	1.69^{ab}	1.81^{b}	1.53^{a}	4.53	0.24

a,b,c, means with the same superscript along the row are not significant they different (P>0.05) IBW: Initial body weight, FBW: Final body weight, BWG: Body weight gain, TFI: Total feed intake, DBWG: Daily Body weight gain, AFI: Average feed intake and FCR: Feed Conversion ratio

Table 4: Means for the Haematological Parameters of Guinea Fowls Fed Diets Containing Differently Processed Sesame Seed Meal

Parameters		**Treatments**				
	T1	**T2**	**T3**	**T4**	**F val.**	**SEM**
RBC (10^6/µl)	2.56	2.57	2.41	2.30	0.87	0.24
WBC (10^3/µl)	6.26^a	4.71^b	4.59^b	4.33^b	7.28	0.56
HB (g/dl)	11.09^{ab}	11.42^a	11.25^a	10.53^b	2.39	0.43
MCV	85.33	92.67	91.00	91.00	0.68	6.73
MCH (g/dl)	68.17	68.80	70.37	67.73	0.66	2.45
MCHC (g/dl)	62.80	63.23	63.87	61.47	1.79	1.31
PCV (%)	32.49	33.17	32.84	30.69	1.93	1.36

a,b, means bearing different superscripts within rows are significantly different (P<0.05). WBC: White Blood Cells. RBC: Red Blood Cells, HB; hemoglobin, MCV; means corpuscular volume; PCV; Park cells volume MCH; Means cells hemoglobin MCHC; Corpuscular hemoglobin concentration. SEM= Standard Error of Means.

Table 5: Means for the Morphologic Indices of Guinea Fowls Fed Diets Containing Differently Processed Sesame Seed Meal

		Treatments				
Components (cm)	**T1**	**T2**	**T3**	**T4**	**F. val**	**SEM**
Wing Lgh	14.83	15.17	14.10	13.83	0.63	1.36
Thigh Lgh	10.17	9.83	9.97	10.27	0.23	0.71
Shank Lgh	11.53	11.37	10.73	11.37	0.81	0.67
Beak Lgh	2.93	3.00	3.00	3.07	0.18	0.22
Tail Lgh	13.00^a	11.23^b	11.47^b	11.53^b	4.98	0.62

a,b, means bearing different superscripts within row are significantly different (P<0.05). Lgh: Length, SEM = Standard Error of Means

Table 6: Means for the Nutrient Digestibility Components of Diets Fed to Guinea Fowls Containing Differently Processed Sesame Seed Meal

		Treatments			
Parameters (%)	**T1 (CNTRL)**	**T2 (RSM)**	**T3 (ROSM)**	**T4 (SSM)**	**SEM**
Dry Matter	48.39	52.11	55.58	54.02	5.17
Crude Protein	41.33	47.60	53.09	53.67	6.60
Crude Fiber	10.16	11.59	13.14	12.84	2.50
Ether Extract	2.65^b	6.61^a	7.49^a	4.62^{ab}	1.91
Ash	17.15	19.73	18.15	21.91	2.77
Nitrogen Free Extract	47.41^{ab}	42.02^b	51.69^{ab}	51.85^a	5.20

a,b, means bearing different superscripts within rows are significantly different (P<0.05).

Table 7: Means for the Internal Organs Weight of Guinea Fowls Fed Diets Containing Differently Processed Sesame Seed Meal

Parameters (g)			**Treatments**		**F. val**	**SEM**
	T1	**T2**	**T3**	**T4**		
Liver	20.57^b	23.41^a	20.37^b	20.83^b	3.56	1.31
Heart	7.23	6.83	7.23	7.13	0.15	0.85
Full Gizzard	31.57	30.40	27.50	26.90	0.46	5.74
Spleen	1.07	1.10	1.33	1.07	0.31	0.10
Abd. Fat	9.90	8.67	9.83	8.07	1.74	1.18
Intestine	61.97	63.23	57.30	62.30	0.44	6.89

a,b, means bearing different superscripts within row are significantly different (P<0.05);ABD: Abdominal.