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REPLACEMENT OF GROUNDNUT MEAL WITH ROASTED SOYBEAN MEAL ON PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKENS

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ABSTRACT

Soybean meal SBM is a globally popular protein source for poultry feeding. In Sudan, peanut meal PNM is considered the main source of protein in poultry feeding. An experiment was conducted to study the replacement of PNM with roasted SBM (RSBM15) on broiler performance, carcass characteristics, and economic appraisal. One hundred and eight, one-week-old male (Ross 308) broiler chicks were used. The chicks were allocated randomly into three dietary treatments using a completely randomized design with three replicates and twelve birds in each replicate. Treatment one T1 (100% RSBM^{15}), T2 (50% RSBM ^{15}+ 50% GNM) and T3 (100% GNM). PNM had significantly (P≤0.05) the best performance results concerning body weight (BW), body weight gain (BWG), feed intake (FI), and feed conversion ratio (FCR). PNM had significantly (P≤0.05) the best results in carcasses and some carcass parts weights (breasts, thighs, wings, and drumsticks) and dressing percentages. The gastrointestinal tract (GIT) weights were insignificantly (P≥0.05) different, except the heart and pancreas weights, where PNM reported the highest weights of livers and pancreases. There were no significant differences (P≥0.05) in mortality rates and sensory attributes (taste, flavor, color, and tenderness) among all treatments. However, there were significant (P≤0.05) differences in the economic appraisal among the three treatments, where PNM recorded the best revenue. It can be revealed that PNM had the best performance parameters. It was concluded that further studies are recommended for the different varieties of SBM.

***Keywords*:** Soybean Meal, Peanut Meal, Broiler, Carcass Characteristics, Economic Appraisal.

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1. INTRODUCTION

Broiler production, being one of the most important resources for animal protein, has a short production duration compared to other livestock. However, the production cost of broilers increases and remains high due to the continuous increment in the feeding cost. In Sudan, the poultry feeding accounts for up to 70 % of the total cost of broiler production (MOA 2014). The major challenge confronting poultry production in developing countries is the high cost of feed ingredients as it accounts for 70-80% of the total cost of production (Ghadge et al. 2009). Soybeans are a globally popular crop, usually processed for soybean oil extraction. The remaining byproduct obtained is soybean meal, having a pronounced amount of nitrogen (Chen et al. 2010).

Chicken meat is considered a healthy source of meat, as it does not contain trans fats, found in beef and lamb meats. Furthermore, poultry meat has low amounts of fat, mainly omega-3 fatty acids, that is beneficial for humans' vascular health (Betti et al. 2009). Poultry meat is inexpensive and an important source of protein in the world (Daniel et al. 2011; Al-Baidhani and Al-Qutaifi 2021; Abadula et al. 2022; Uazhanova et al. 2025). In 2019, statistically, the consumption rates of poultry meat per capita in the world and the USA were approximately 14.7kg (OECD-FAO 2021). However, the consumption rates of poultry meat were higher compared to other sources of meat, including sheep, goats, beef and pork, (Whitton et al. 2021). It is expected that the consumption rate of poultry meat will continue to increase periodically. This is due to the global increase in population and due to the poultry preference (Tripathi et al. 2019). Soybean residues can also be used to 100% replace groundnut meal broiler chickens' diets, providing the productive usage for this neglected agro-industrial byproduct (Haruna et al. 2020).

Soybean seeds are characterized with their high nutritional values (Gawęda et al. 2016). However, these seeds account for 58% of the oil-seed production in the world. However, the main problem with raw SBMs is the high concentration of anti-nutritional factors (ANF) (Chen et al. 2013; Erdaw et al. 2016). The nutritive value of raw full-fat soybeans is negatively affected by the ANF presence ANF (Erdaw et al. 2016), specifically the trypsin

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inhibitors and lectins (Newkirk, 2010). The digestibility of protein could be reduced by multi-faceted actions of ANF, including the binding of nutrients and increasing the gut viscosity (Ao 2011). Various authors (Newkirk 2010; Erdaw et al. 2015) outlined that feeding raw SBM negatively affected the pancreatic function, feed efficiency, and birds' growth rates. Nouri et al. (2024) concluded that the use of roasted SBM at 120°C for 15min improved performance of BW, FI and FCR. They added that the meat quantity and quality were enhanced, besides having high dressing percentage and better economic appraisal. However, some authors compared different processing methods of soybeans (Ekeocha et al. 2023a). They didn't find differences in the different performance parameters but concluded that soybean processing was good for broiler feeding. They added that although groundnut cake and soybean meal have similar crude protein content, soybean meals are of superior quality due to its greater amino acid profile (Ekeocha et al. 2023b). Anthony et al. (2023) reported that roasted soybean was an efficient diet for maximum performance for Japanese quails.

Peanut meal (PNM) is one of the protein sources used in poultry feeding. It is deficient in some amino acids; lysine (Lys) and methionine (Met) (Bolanle et al. 2021; Seck et al. 2023; Yin et al. 2024). These amino acids deficiencies can be overcome by adding synthetic forms of Lys and Met. Sudhir and Rajesh (2021) revealed that macadamia nut cake (MNC) could be successfully included in the diet to replace conventional feedstuffs like corn and SBM partially. PNMs are abundant in protein with a diverse range of nutrients that make them an economical protein source (Zhao et al. 2023). Sule et al. (2024) found that SBM substitution with Moringa oleifera leaf meal in broiler finisher diets up to 50% didn't affect the performance in terms of growth and carcass characteristics. Pesti et al. (2003) concluded that PNM is an excellent ingredient for laying hen diets when comparing corn and PNM diets to corn and soybean meal (SBM) diets.

Esonu (2006) found that SBM had higher amounts of lysine (2.8%) compared to PNM (1.6%). Soya bean meals are good sources of protein (44%) in poultry diets (Abimiku et al. 2017). Aguiheet et al. (2012) showed that local groundnut cake meal (LGNCM) recorded promising results concerning carcasses and organs' parts when replacing SBM in broiler chickens' meals. In different parts of the world (Ghana, India, and Nigeria), PNM from normal-oleic peanuts and commonly used as a source of protein in poultry feeding (Naulia et al. 2002). Jazi et al. (2017) reported a positive effect of using diets containing fermented cottonseed meal (FCSM) on the growth performance and intestinal health of broiler chickens. They reported that the processed source of FCSM protein can serve as an alternative for SBM in broiler diets. In Sudan, PNM is the main source of protein in poultry feeding as well as other livestock. A few studies were undertaken in Sudan to compare SBM versus PNM in broiler feeding. However, this study was conducted to evaluate replacing PNM Meal with roasted SBM on the performance and carcass characteristics of broiler chickens.

2. MATERIALS AND METHODS

2.1. Experimental Layout and Management

This experiment was conducted in a commercial farm (Albashair farm), south Wed Mdani Town, Gezira State, Sudan). One-day-old chicks (Ross 308) were brought from a commercial hatchery and reared together for one week. During this period, the chicks were offered a pre-starter broiler diet. One hundred and eight (108) male broiler chicks with an average body weight were randomly distributed into nine experimental small cages allotted inside a deep litter floor poultry house with an available area of 1.5m^2 for 12 chicks. Each pen was provided with water and feed troughs and light. The pens were cleaned and disinfected firstly by using fire flame and then formalin for protect disinfection. The environment was controlled with a temperature ranging from 21-33°C and humidity 50-70% and light was offered all day. The chicks were reared under standard management conditions, with water and feed available at all times. The experimental diets (Table 1) were formulated according to the recommendations of the National Research Council (NRC 1994) for nutrient requirements for broiler chicks. All birds were subjected to Marek's disease vaccination after hatching (first DOA) at the hatchery.

After their arrival to the farm, vaccination according to local area was undertaken program was carried out. This includes (IB, NC and IBD) vaccination and it was performed using drinking water. Birds were kept for five weeks and were slaughtered at six weeks of age. Halal Islamic Tradition slaughtering was done. Three chickens from each replicate were chosen based on the average weight group. Feed troughs were removed eight hours before slaughter, but they had access to water. Birds were caught in dim light to avoid jumping; and slaughtering was carried out near the farm and no transportation was needed.

Though the Ethics committee, University of Gezira, Sudan, approved the synopsis of the study, the Halal slaughtering method was done by holding both feet and the wings were downward. The process began with reciting Allah's name and (Bismillah Allahu Akbar). Then with a very sharp knife, the neck of the chicken was cut till reaching the neck bone where the jugular veins and windpipe were cut to ensure proper bleeding. After slaughtering, the slaughtered birds were immersed in hot water at 60°C for 2min to help in feather scalding.

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Table 1: Feed ingredients and chemical composition of broiler starter and finisher diets

Ingredients	Starter Diets (8-21 days)			Finisher Diets (22-42 days)		
	RSBM[15]	RSBM[15] + PNM	PNM	RSBM[15]	RSBM[15] + PNM	PNM
Feed ingredients of starter and finisher diets						
Sorghum	56.0	56.0	56.0	57.0	57.0	57.0
Soybean meal	39.0	19.5	0.0	35.0	17.5	0.0
Peanut meal	0.0	19.5	39.0	0.0	17.5	35.0
Broiler concentrate	2.0	2.0	2.0	2.0	2.0	2.0
Vegetable oil	0.5	0.5	0.5	3.5	3.5	3.5
L- Lysine	0.2	0.2	0.2	0.2	0.2	0.2
DL- Methionine	0.1	0.1	0.1	0.1	0.1	0.1
Premix	0.5	0.5	0.5	0.5	0.5	0.5
Oyster shell	0.9	0.9	0.9	0.9	0.9	0.9
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Choline chloride	0.2	0.2	0.2	0.2	0.2	0.2
Antioxidants and antifungal	0.2	0.2	0.2	0.2	0.2	0.2
Di-Calcium phosphate	0.1	0.1	0.1	0.1	0.1	0.1
Total	100	100	100	100	100	100
Determined Chemical Composition of Starter and Finisher Diets						
D.M%	94.5	94.8	96.4	95.0	94.9	95.2
C.P%	22.1	22.5	22.5	20.3	20.5	20.5
E.E%	3.4	3.7	4.1	4.4	4.2	4.3
Ash%	6.9	6.5	7.2	5.8	6.4	6.5
C.F%	3.2	3.2	3.5	3.1	3.7	3.8
N.F.E%	58.9	58.7	59.2	61.5	61.0	60.1
Ca %	1	1	1	0.9	0.9	0.9
P (available) %	0.5	0.5	0.5	0.4	0.4	0.4
Lysine %	1.1	1.1	1.02	1	1	1
Methionine %	0.5	0.5	0.5	0.4	0.4	0.4
Methionine+Cysteine %	0.9	0.9	0.9	0.7	0.7	0.7
ME (K Cal /kg)	3012.09	3026.25	2966.94	3094.46	3089.52	2945.36

Super concentrate contains the following: 35% CP, 2% EE, 4% CF, 10% calcium, 4.5% available phosphorus, 5.7% lysine, 4.5% methionine and 4.9% methionine + cystine. Metabolizable energy 2000 kcal/kg, 2.6% Sodium, with added vitamins and minerals: Metabolizable energy (ME K cal/kg) was calculated according to the formula derived by Lodhi et al. (1976). ME kcal/kg = 32·95 (% crude protein + % ether extract × 2·25 + %

Evisceration and removal of internal organs was done, and they were kept for further studies. The carcasses were cleaned thoroughly weighted and then immersed in ice water for cooling. The carcasses were then left to drip cold; then kept cooling in a deep freezer for one day. Some were cut to different parts (breast, legs, drumsticks and thighs) for further investigations.

A feeding trial was carried out in Sudan, Gezira State, Wad Medani city. The study was undertaken during March-May (2023). The main objective of this trial was to use RSBM[15] versus PNM in evaluating the performance of broiler chickens. RSBM[15] was found to be the best roasted SBM in a study aimed at determining the optimal heating temperature and time for roasting SBM in broiler performance (Nouri et al. 2024). Boilers performed well using SBM roasted at 120°C and 15min for temperature and time, respectively. One-week-old male broiler chicks (Ross 308) of 108 birds were used in this study. They were randomly allocated to three dietary treatments. Each treatment consisted of three cages with 12 birds per cage. The cage was considered as an experimental unit or replicate. Feed and water were offered *Ad libitum*. These cages were allocated inside a semi-closed poultry house. Three diets were formulated for each phase of the experiment (starter and finisher) according to the recommendations of the National Research Council (NRC, 1994) for nutrient requirements for broiler chicks. Treatment one control (RSBM[15]) where the diet was formulated using SBM roasted at 120°C for 15 minutes with 100% for the plant protein source (PPS). Treatment two (RSBM[15]+PNM), the diets were formulated using RSBM[15] and PNM at 50% for each of them PPS. Treatment three (PNM), where the diet was formulated using PNM with 100% PPS.

2.2. Parameters Studied

Parameters taken were body weight (BW), body weight gain (BWG), feed intake (FI), and feed conversion ratio (FCR) of the birds, and recorded every week. FI was calculated in grams by taking the difference between feed offered through the week and feed withdrawal at the end of the week, divided by the average number of birds in the replicate. The average BW was taken weekly by weighing all the birds in each cage divided by the number of birds.

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Eventually, the BWG was calculated by subtracting the last BW from the previous BW. FCR was calculated as the amount of feed consumed to gain one kg of BW. The overall FI and BWG were recorded to calculate the overall FCR of each replicate.

At 35 days of age, three broilers with an average body weight were selected from each experimental replicate, for a total of nine birds per treatment. The birds were fasted for nine to ten hours with access to water only.They were slaughtered by Islamic Tradition as described previously (Ali et al. 2011). After slaughter they were immersed in a scalder with a temperature of 60°C for 3min and water flow of 1L/bird/min. Evisceration was carried out manually to determine the weights of the edible portions. Some carcasses were cut into different parts (breasts, wings, thighs, and drumsticks) and shanks for further investigations. Evaluation of carcass characteristics and sensory properties of meat were done in the Animal Science Department lab, Faculty of Agricultural Sciences, Gezira University. The weights of the gastrointestinal tract (GIT) organs (gizzard and intestines) were taken. The weights of the associated GIT organs (heart, liver and pancreas) were taken as well as the abdominal fat pad (AFP). Some physical attributes of meat were carried out. Sensory (taste, flavor, color and tenderness) properties of breast meat were done using the sensory description technique with trained panelist. The total production costs and returns were calculated in Sudanese pounds to get the total revenue by subtracting the total costs from the total returns.

2.3. Statistical Analysis

The SAS (2003) program was used to analyze the data collected. The data collected were subjected to a one-way analysis of variance (ANOVA) as described by Steel and Torrie (1983). Means were compared using Duncan (1955) multiple-range test with a significance level of 0.05.

3. RESULTS

3.1. Broiler Performance

Results of evaluating the effect of replacing soybean meals with peanut meals on broiler performance are presented in Table 2. The results showed significant (P≤0.05) differences in weekly feed intake and the overall FI during the whole experimental period. However, the PNM group consumed the highest feed. There were insignificant (P≥0.05) differences during the first and second weeks. However, the PNM group recorded the highest BW during 3rd-5th weeks of age. The PNM recorded the best FCR. However, the GNM group recorded the best results for the whole experimental period (Table 2). As shown in Fig. 1 there were significant (P≤0.05) differences in the body weight gain (BWG). However, $RSBM^{15}$ recorded the lowest FI, BW, BWG, and worst FCR throughout the experiment period.

Table 2: The effect of replacement of groundnut meal with roasted soybean meal on performance of broiler chicken.

Age (Weeks)	Treatments			C.V %	P value
	$RSBM^{15}$	$RSBM^{15}$ + PNM	PNM		
Feed Intake (g)					
Week 1	319.0±18.2b	372.3±15.9ab	388.0±3.1a	0.9	0.0002
Week 2	562.0±11.6b	603.3±12.0ab	624.0±6.1a	0.35	0.0001
Week 3	721.0±2.1c	784.0±5.9b	868.3±16.5a	0.38	0.0001
Week 4	1175.0±13.2ab	1216.7±3.3b	1211.7±15.9a	0.36	0.0001
Week 5	1073.3±14.5ab	1111.7±6.0a	1083.3±17.6ab	0.67	0.0001
Body Weight (g)					
Week 0	210.0±2.28	210.0±2.89	205.0±2.89	2.7	0.5289
Week1	451.7±39.2	428.7±5.24	445.0±5.51	6.42	0.8164
Week 2	741.7±16.4c	792.3±9.60b	861.0±10.7a	2.68	0.0001
Week 3	1128.3±11.79b	1215.7±15.56ab	1377.7±6.74a	1.62	0.0001
Week 4	1719.3±14.85c	1845.7±22.5b	2062.7±9.60b	1.47	0.0002
Week 5	2242.7±19.97c	2399.0±31.2b	2638.7±12.25a	1.63	0.0005
Feed Conversion Ratio					
Week 1	1.66±0.05ab	1.7±0.02a	1.62±0.03b	2.98	0.0504
Week 2	1.64±0.01b	1.66±0.02a	1.5±0.04c	2.8	0.0008
Week 3	1.87±0.02a	1.85±0.04b	1.68±0.02c	2.1	0.0004
Week 4	1.99±0.01a	1.93±0.03b	1.77±0.01c	1.38	0.0001
Week 5	2.05±0.01a	2.01±0.03b	1.88±0.02c	1.5	0.0001

Values (mean±SE) showing different alphabets in a row differ significantly (P≤0.05). CV=Coefficient of Variation; $RSBM^{15}$=control, soybean meal roasted for120°C for 15 min; $RSBM^{15}$ + PNM = 50% $RSBM^{15}$ + 50% PNM; PNM = peanut meal (PNM)

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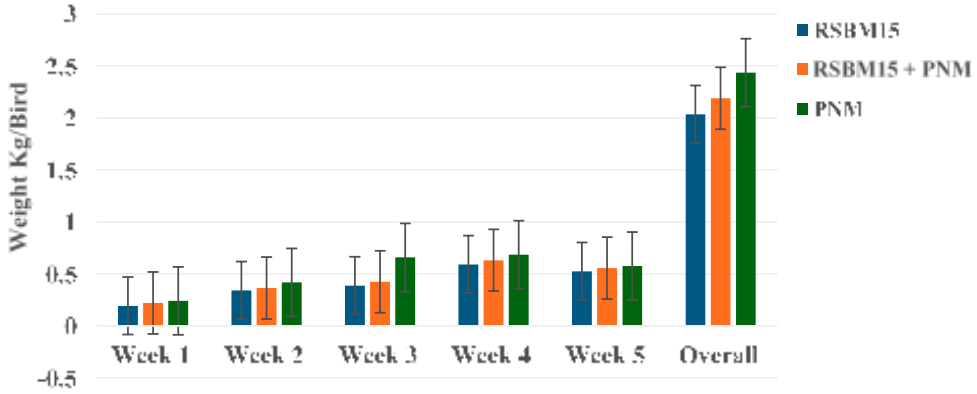

Fig. 1: The effect of replacement of groundnut meal with roasted soybean meal on body weight gain (g) of broiler chicken.

3.2. Gastrointestinal Tracts (GIT)

As shown in Table 3, there were significant (P≤0.05) differences in weights of gizzards, hearts, and pancreases. The highest gizzard weights were recorded by PNM+RSBM15, whereas the (GNM) recorded the lowest weights. PNM recorded the highest heart weights; however, the lowest heart weights were recorded by $RSBM^{15}$. The highest pancreas weights were recorded by PNM and $RSBM^{15}$ + PNM, whereas $RSBM^{15}$ recorded the lowest weights. The liver, intestines, and abdominal fat pad recorded insignificant (P≥0.05) differences (Table 3). Mathematically, the highest intestine weights were recorded by (RSBM15), whereas the PNM had the lowest weights. The highest liver weights were recorded by ($RSBM^{15}$ + PNM), whereas the lowest weights were recorded by $RSBM^{15}$. However, the highest abdominal fat pad weights were recorded by PNM, where the lowest weights were recorded by PNM and $RSBM^{15}$ + PNM.

Table 3: The Effect of the replacement of groundnut meal with roasted soybean meal on the gastrointestinal (GIT) weights (g)

Parameters	Treatments			CV%	P
	$RSBM^{15}$	$RSBM^{15}$ + PNM	PNM		
Gizzard	43.4±0.8	44.7±1.48	42.3±1.5	6.9	0.0539
Heart	11.3±0.72c	12.5±0.1b	15.0±0.0a	3.7	0.0077
Pancreas	7.8±0.16b	9.5±0.28ab	9.8±0.17a	4.0	0.0103
Liver	47.3±2.4	50.2±1.45	48.5±2.2	7.2	0.7150
Intestine	132.1±14.1	120.8±6.8	106.8±7.2	13.4	0.3364
Abdominal fat pad	18.2±2.96	18.2±2.96	19.0±0.8	21.2	0.9735

3.3. Some Carcasses Characteristics and Mortality Rate

As shown in Table 4, significant (P≤0.05) differences were found in live body weights, hot and cold carcasses, heads and necks weights, and dressing percentages. However, the highest weights were recorded by GNM treatment, whereas $RSBM^{15}$ treatment reported the lowest weights. There were insignificant (P≤0.05) differences in shanks weights. Mortality rate was found to be insignificant (P≤0.05) between different treatments (Table 4).

Table 4: The Effect of the replacement of groundnut meal with roasted soybean meal on carcass characteristics and some body parts weights (gm) and mortality rate

Parameters	Treatments			CV%	P
	$RSBM^{15}$	$RSBM^{15}$ + PNM	PNM		
Live weight	2071.2±12.3c	2418.3±4.4b	2671.8±37.7a	1.46	0.0001
Carcass weight	1313.5±7.9c	1435.8±7.1b	1784.2±33.4a	2.5	0.0001
Hot weight	1313.5±7.9c	1435.8±7.1b	1784.2±33.4a	2.5	0.0001
Neck-Head	118.5±0.76c	151.7±7.3a	125.8±6.5b	5.1	0.0035
Shank	82.8±3.9	95.8±2.2	86.5±5.5	7.8	0.2796
Dressing%	63.5±0.8b	59.4±0.4c	66.8±1.3a	2.4	0.0039
Mortality rate%	0.0±0.0	0.0±0.0	0.9±0.9	86.6	0.450

Values (mean±SE) showing different alphabets in a row differ significantly (P≤0.05). CV=Coefficient of Variation; $RSBM^{15}$=control, soybean meal roasted for120°C for 15 min; $RSBM^{15}$ + PNM = 50% $RSBM^{15}$ + 50% PNM; PNM = peanut meal (PNM)

3.4. Sensory Evaluation

As presented in Fig. 2 there were insignificant (P≥0.05) differences in the various sensory attributes (taste, flavor, color and tenderness) among all treatments.

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3.5. Economic Appraisal

Fig. 3 shows the economic appraisal of the experiment based on input costs, returns and revenues per bird. There were significant (P≤0.05) differences among the three treatments where 120-15 recorded the best revenue.

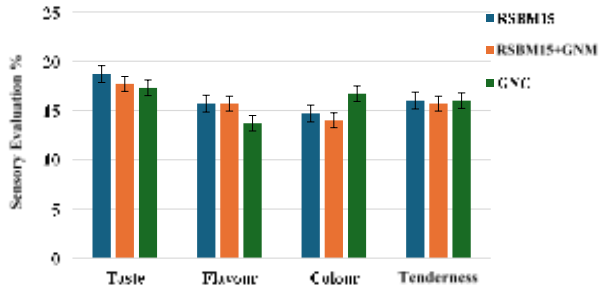

Fig. 2: Effect of GNM and RSM on Sensory Evaluation of Broiler Chicken Meat.

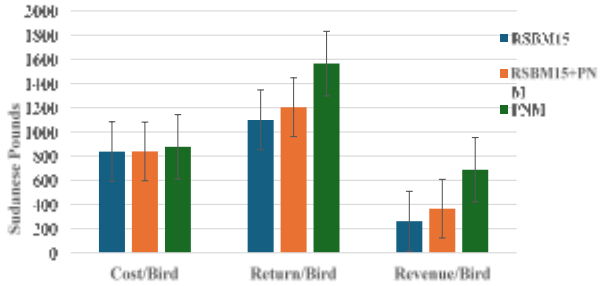

Fig. 3: Effect of RSM and PNM on Economical Appraisal of Broiler Chicken.

4. DISCUSSION

4.1. Broiler Performance

Results of the broiler performance findings disagree with those of some authors (El Boushy and Raterink 1989), who observed a reduction in performance with an increase in PNM% % in young birds' diets. However, these findings are in line with other authors' findings (Suswanto and Jones 1996; Costa et al. 2001). They reported that older birds performed better when fed PNM. Costa et al. (2001) reported that feeding PNM as a protein source for broilers in early ages increased feed intake. They explained this might be because older chicks are able to digest PNM or can tolerate some toxic factors present in PNM. Moreover, these findings are in contrast with those of Dieumou et al. (2013), who found birds fed SBM-based diets consumed significantly more feed compared to those fed PNM-based diets. Also, these study findings disagree with those of Mustafa et al. (2012), who found that the growth performance of birds fed SBM was significantly better than that of birds fed PNM. Also, it might be due to differences in the types of soybean and peanuts used in this study. Moreover, Ghadge et al (2009) reported that the superior performance of birds fed 75% and 100% of SBM was due to the high content of lysine and methionine in the diets. However, these study findings disagree with those of Ghadge et al. (2009), who found birds fed diets containing 100% of PNM as a protein source had the lowest body weight gain. The better growth rate and feed intake of birds on PNM diets observed in this study might be due to better palatability and nutrient digestibility.

4.2. Gastrointestinal Tract

Current study findings coincide with Yusuf et al. (2022) who concluded that PNM can effectively be used to replace full fat soybean meals for better gut characteristics of broiler chickens. These findings were in line with that of Ata (2016). They concluded that feeding broiler diets containing PNM at 100% as a protein source, improved BW and FI without affecting FCR. They added that replacing SBM with PNM had a positive effect on growth performance of broiler chicken.

4.3. Some Carcasses Characteristics and Mortality Rate

These results coincide with Yusuf et al. (2022) who concluded that PNM can effectively be used to replace full fat soybean meal for better growth, carcass and gut characteristics of broiler chickens. Due to the high nutritional value and low cost of peanut protein, it has been proven to offer multiple potential health benefits (Bonku and Yu, 2020; Zhang et al. 2023; Sorita et al. 2020). Compared to soybean protein, the protein found in peanut meal has a lower level of anti-nutritional products. Carcass weights and breast yields were reduced in broilers fed PNM, while leg carcass yields were greater in broilers fed PNM in comparison to the other groups.

4.4. Economic Appraisal

The economical appraisal of the experiment soybean meal recorded the best revenue. These results were in accord with the findings of Ghadge et al. (2009) who reported the high cost of conventional feed ingredients used in poultry feed formulation has necessitated the search for alternative feedstuff in most developing countries. Adeniji (2008) reported that profitability increased GNM replacement for SBM. Some factors such as population growth and urbanization are contributors to the constant increase in cost of feed formulation as well as market prices of animal protein in Nigeria (Oboh, 2006). Costa et al. (2001) concluded that PNM could be used as a protein source for broilers under appropriate economic conditions. These results disagree with other authors (Aletor and

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Olonimoyo 1992) who reported that the cost-benefit analysis showed processed soya bean gave higher profit than groundnut cake diet. Also these findings disagree with that of Dieumou et al. (2013) who concluded that soybean meal-based diets resulted in higher yield of carcass at eight wks of age. However, these findings are online of that of (Shehu 2021) who reported that GNC at 20% can partly substitute SBM in finisher diet for improved performance and reduced production cost resulting in increased profit.

4.4. Sensory Evaluation

These findings agree with Ondulla et al. (2019), where a group of 100 consumer panelists scored all treatment groups (different levels of PNM and SBM), similar points in terms of sensory attributes for cooked chicken. No more work was done in studying evaluation between SBM and PNM in terms of sensory attributes concerning PNM versus SBM.

5. CONCLUSION

It can be concluded that PNM is better than SBM as a plant protein supplement, being better on all performance parameters and economic appraisal. More research work can be conducted to compare other local soybean meals with peanut meal and local plant meals.

Ethical Approval: Though the Ethics Committee, University of Gezira, Sudan, approved the synopsis of the study, the Halal slaughtering method.

DECLARATIONS

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Conflict of Interest: Authors declare no conflict of interest.

Data Availability: All the data generated during the study is inside the article.

Ethics Statement: The Ethics committee, University of Gezira, Sudan, approved the synopsis of the study, however, Halal slaughtering method was done by holding both feet and the wings were downward. The process began with reciting Allah's name and (Bismillah Allahu Akbar).

Author's Contribution: Syada Awad Mohamed Ali and Hiba Saeed Ali Nouri tailored the idea and planned the research. Syada Awad Mohamed Ali supervised the study. Hiba Saeed Ali Nouri was responsible for the management of birds, data collection, chemical and physical analysis, and drafted the manuscript. Hyder Osman Abdalla and Hatim Badwi Ahmed participated in birds' management and data collection. Hiba Saeed Ali Nouri and Syada Awad Mohamed Ali performed statistical analysis and interpreted the data, edited the manuscript, and all authors approved the final version of the manuscript.

Generative AI Statements: The authors declare that no Gen AI/Deep Seek was used in the writing/creation of this manuscript.

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