Effects of animal protein sources and sugarcane scraping-rumen content mixture on the performance of broiler chicken

Effiong Erikanobong[1]

[1] Department of Animal Science, University of Abuja, Nigeria

Correspondence: Effiong Erikanobong, Department of Animal Science, University of Abuja, Nigeria. E-mail: rykaneeffiong@gmail.com

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Abstract

The experiment was carried out to access the effect of animal protein sources (fishmeal and grasshopper meal) and sugarcane scrapping-rumen content mixture (SSRCM) on the performance of broiler chickens. The experiment lasted for 56 days. Two hundred and forty-one- day-old (Abor acre) was randomly allotted to eight dietary treatments with 30 birds per treatment. Each treatment was replicated three times in a 4 by 2 factorial arrangement having 10 birds per replicate, vaccinations was administered, feed and clean drinking water were provided ad libitum. The diets were compounded to be isonitrogenous and isocaloric with two animal protein sources. Treatments (FM + 0% SSRCM) and (GM + 0% SSRCM) were formulated without sugarcane scrapping-rumen content mixture (SSRCM) while (FM + 5% SSRCM), (GM + 5% SSRCM), (FM + 10% SSRCM), (GM + 10% SSRCM), (FM + 15% SSRCM) and (GM + 15% SSRCM) were formulated with SSRCM at 5, 10 and 15% inclusion level respectively with two animal protein sources (fishmeal and grasshopper meal) with (FM + 0% SSRCM) serving as the control diet. The results obtained showed that there was no significant ($p > 0.05$) differences between fishmeal and grasshopper meal in growth performance of broiler chickens. The result also showed that there was no significant ($p > 0.05$) difference between 0% SSRCM and 5% SSRCM on weight gain of broilers but there was significant ($p < 0.05$) difference in growth performance of broiler chickens as the inclusion levels of SSRCM increased (10% and 15%). Based on these results, broiler chickens can strive well either grasshopper meal or fishmeal and sugarcane scrapping-rumen content mixture at 5% inclusion level relative to the other treatment.

Keywords: sugarcane scrapping, rumen content, broilers, grasshopper, fishmeal.

Efeitos de fontes de proteína animal e mistura de raspa de cana e conteúdo ruminal sobre o desempenho de frangos de corte

Resumo

O experimento foi realizado para avaliar o efeito de fontes de proteína animal (farinha de peixe e farinha de gafanhoto) e mistura de sucateamento de cana-conteúdo ruminal (SSRCM) sobre o desempenho de frangos de corte. O experimento durou 56 dias. Duzentos e quarenta e um dias de idade (Abor acre) foram distribuídos aleatoriamente em oito tratamentos dietéticos com 30 aves por tratamento. Cada tratamento foi repetido três vezes em um arranjo fatorial 4 por 2, com 10 aves por repetição, as vacinas foram administradas, a ração e a água potável foram fornecidas ad libitum. As dietas foram compostas de forma isonitrogenada e isocalórica com duas fontes de proteína animal. Os tratamentos (FM + 0% SSRCM) e (GM + 0% SSRCM) foram formulados sem mistura de sucateamento de cana-conteúdo ruminal (SSRCM), enquanto (FM + 5% SSRCM), (GM + 5% SSRCM), (FM + 10% SSRCM), (GM + 10% SSRCM), (FM + 15% SSRCM) e (GM + 15% SSRCM) foram formulados com SSRCM em nível de inclusão de 5, 10 e 15% respectivamente com duas fontes de proteína animal (farinha de peixe e farinha de gafanhoto) com (FM + 0% SSRCM) servindo como dieta controle. Os resultados obtidos mostraram que não houve diferenças significativas ($p > 0,05$) entre a farinha de peixe e a farinha de gafanhoto no desempenho de crescimento de frangos de corte. O resultado também mostrou que não houve diferença significativa ($p > 0,05$) entre 0% SSRCM e 5% SSRCM no ganho de peso de frangos de corte, mas houve diferença significativa ($p < 0,05$) no desempenho de crescimento de frangos de corte conforme os

níveis de inclusão de SSRCM aumentou (10% e 15%). Com base nesses resultados, os frangos de corte podem apresentar bons resultados tanto com farinha de gafanhoto quanto com mistura de farinha de peixe e sucateamento de cana-de-açúcar com conteúdo ruminal de 5% em relação ao outro tratamento.

Palavras-chave: sucateamento de cana-de-açúcar, conteúdo ruminal, frangos de corte, gafanhoto, farinha de peixe.

1. Introduction

The current food insecurity situation (especially animal protein) prevailing in many developing countries have led researchers from all over the world to find alternative unconventional feedstuffs for animal nutrition. In developing nations like Nigeria, the cost of commercial livestock farming has become very expensive with feed cost accounting up to 70% of the total cost of poultry production (Adesina et al., 2011; Alagbe, 2017). This is mainly due to the fact that most of the protein ingredients such as fishmeal are imported while locally available alternatives like soybean and groundnut also serve as food for humans (Makinde, 2015; Alagbe, 2017).

The shortage and high price of animal protein have been aggravated by the high cost of conventional feed ingredients. The current high cost of commercial feeds is well known and reported by Oruseibio & Omu (2000), Gjedrem et al. (2012) and Richter et al. (2015). The low level of cereal and oil seed production and processing, the ravages of drought and the competition from direct human consumption have all contributed to the high cost of feed, which in turn has led to folding up of many poultry farms, especially small to medium-scale farms, and general decline in livestock production. Nutritionists have the long-term challenge for research into least cost rations in order to sustain the farmers in production (Oruseibio; Omu, 2000).

The largest dietary requirements for poultry are energy and protein (Kanyinji; Moonga, 2014). These are predominantly supplied by maize grain and soybean meal (SBM) in poultry diets. The high cost of these feed ingredients resulting from diverse usage in human diets as well as industrial applications makes it necessary to search for alternative replacements. According to Ayoade et al. (2007) and Licona-Aguilar et al. (2022), sugarcane peels is obtained by peeling the outer part of the stem with a sharp knife to remove the bark on the stem that affords protection to the underlying cells. The peeling is done to prepare the stem for chewing.

The peels consist of the wax, pigments and fibrous materials of the rind, and a small quantity of the underline parenchyma cells. After peeling, the material lies waste littering in both urban and rural settlements thereby constituting environmental pollution (Alu, 2012). The proximate and energy composition of sugarcane scrapping meal (SCSM) according to the findings of Ayoade et al. (2007) indicates that dry matter is about 87.6%, crude protein 3.2%, crude fiber 12.7%, ether extract 2.8%, ash 12.8%, nitrogen free extract (NFE) 77.1% and gross energy of about 2804 Kcal/kg^{-1}.

Due to the high cost of conventional protein source in poultry diets; the quest for an alternative feed ingredient that will reduce production cost with the aim of improving animal protein intake of consumers and increasing the profit margin of the producers is ongoing. This can only be achieved if the alternative feed ingredient is of comparative nutritive value to, and preferably cheaper than conventional protein source feed ingredients (Ahmed et al., 2018).

According to Brah et al. (2018), Insects such as grasshoppers can be used as an alternative to fish meal in poultry feeds because of its high protein (43.9-77.1%) and calorie content. Grasshoppers, which are known to have a high capacity for destroying farm crops and causing great financial losses, could be turned into feed ingredients. Grasshoppers are available in the Northern part of Nigeria at affordable price and will serve as a very good substitute for fishmeal both in terms of cost, availability and quality. A strong economic incentive therefore exists for finding an alternative animal protein source for poultry feed in order to reduce the cost of feed and maximize the returns from poultry farming (Hassan et. al., 2009; Liu et al., 2012; Huis, 2022; Slimen et al., 2023).

Therefore, this study was carried out to ascertain the effect of animal protein sources (fishmeal and grasshopper meal) and sugarcane scrapping-rumen content mixture (SSRCM) on the performance of broiler chickens.

2. Materials and Methods

2.1 Experimental site

The study was carried out at the University of Abuja Teaching and Research Farm, Animal Science section, along airport road, Federal Capital Territory Abuja, Nigeria. The project site lies between latitude 8’55°N and

90°N and longitude 700°N and 750°E. Annual rainfall ranges from, 145-1,631mm. The experiment was carried out according to the ethics and procedures of the department of Animal Science, University of Abuja, Nigeria (ANS/1740103011).

2.2 Collection of test ingredients

Sugarcane scraping were collected from the local sugarcane marketers in Gwagwalada, Abuja, Nigeria. The scrapping was obtained by peeling the outer part of the stem of the sugarcane with a sharp knife to remove the bark on the stem that affords protection to the underlying cells. Bovine rumen content was collected as slaughter waste generated from slaughtering of cattle at Gwagwalada abattoir.

2.3 Processing of test ingredients

The freshly collected rumen content was mixed with the sugarcane scrapping in a 1:2 ratio. The sugarcane scrapping and rumen content were thoroughly mixed and transferred into airtight container for 96 h. The sample was sundried and sent to the laboratory for further analysis. Dried grasshoppers was bought at the local market in Maiduguri, Borno State, Nigeria thereafter it was grinded using a hammer mill to obtain the grasshopper meal. Proximate composition of experimental diet and test ingredients were analyzed according to the methods outlined by AOAC (2000).

2.4 Management of birds and experimental design

A total of two hundred and forty 1-day old broiler chicks (Arbo Acre) were used for this experiment. The experimental birds were obtained from a commercial hatchery with good records of birds' performance. The chicks were randomly selected, weighed and allotted into the eight experimental treatments. There were three replicates, each replicate had ten birds, comprising of 30 birds per treatment.

The chicks were allowed to adapt to their environment for 2 days before the commencement of the experiment. The experimental design was a Completely Randomized Design (CRD) in a 4 x 2 factorial arrangement (4 levels of SSRCM x 2 protein sources). The experiment lasted for 8 weeks (56 days). All routine management practices were adhered to throughout the experimental period. Vaccinations was administered, feed and clean drinking water were provided ad libitum.

2.5 Experimental diets

Eight broilers' starter and finisher diets were formulated as shown in (Table 1 and 2) respectively. Treatments T1 and T2 were formulated without sugarcane scrapping-rumen content mixture (SSRCM) (0%) while T3, T4, T5, T6, T7 and T8 were formulated with SSRCM at 5, 10 and 15% inclusion level respectively with two animal protein sources (fishmeal and grasshopper meal). Diets were formulated to meet the nutrient requirements of broiler starter and finisher as recommended by National Research Council (1994).

Eight experimental broiler diets formulated as follows:

Treatment 1: Control (Fishmeal + 0% SSRCM)

Treatment 2: Grasshopper Meal + 0% SSRCM

Treatment 3: Fishmeal + 5% SSRCM

Treatment 4: Grasshopper Meal + 5% SSRCM

Treatment 5: Fishmeal + 10% SSRCM

Treatment 6: Grasshopper Meal + 10% SSRCM

Treatment 7: Fishmeal + 15% SSRCM

Treatment 8: Grasshopper Meal + 15% SSRCM

2.6 Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) using SPSS (25.0) and significant means were separated using *T-test* and *Duncan* multiple range tests (Duncan, 1955) significant will be declared at $p \leq$

0.05.

3. Results

Table 1 shows the percentage composition of the experimental diet for the initial phase (0-4 weeks).

Table 1. Percentage composition of experimental diet for broiler starter (0-4 weeks).

Ingredients (%)	FM + 0% SSRCM	GM + 0% SSRCM	FM + 5% SSRCM	GM + 5% SSRCM	FM + 10% SSRCM	GM + 10% SSRCM	FM + 15% SSRCM	GM + 15% SSRCM
SSRCM	0	0	5	5	10	10	15	15
Fish Meal	2.5	0	2.5	0	2.5	0	2.5	0
Grasshopper Meal	0	2.5	0	2.5	0	2.5	0	2.5
Maize	54.07	53.34	53.38	52.66	48.55	47.83	43.70	43.01
Groundnut Cake (GNC)	33.98	34.71	34.66	35.39	34.50	35.22	34.34	35.04
Wheat Offal	5	5	0	0	0	0	0	0
Bone Meal	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Limestone	1	1	1	1	1	1	1	1
**Vitamin/Mineral-Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Methionine	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	100	100	100	100	100	100	100	100
Calculated Analysis								
Metabolizable Energy (Kcal/kg^{-1})	2909	2905	2923	2919	2915	2912	2910	2903
Crude Protein (%)	23	23	23	23	23	23	23	23
Crude Fiber (%)	4.47	4.53	5.31	5.36	5.59	5.64	5.92	5.94
Ether Extract (%)	5.51	5.50	5.35	5.36	5.24	5.22	5.19	5.17
Lysine (%)	1.22	1.21	1.21	1.19	1.20	1.18	1.16	1.16
Methionine (%)	0.53	0.54	0.54	0.53	0.53	0.51	0.52	0.52
Calcium (%)	1.02	1.01	1.03	1.02	1.04	1.05	1.06	1.05
Phosphorus (%)	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61

Note: **Bio Mix Starter Premix containing the following per kg: Vitamin A: 10,000,000 IU, Vitamin D3: 2,000,000 IU, Vitamin E: 23,000 mg, Vitamin K3: 2,000 mg, Vitamin B1: 1,800 mg, Vitamin B2: 5,500 mg, Niacin: 27,500 mg, Pantothenic Acid: 7,500 mg, Vitamin B6: 3,000 mg, Vitamin B12: 15 mg, Folic Acid: 750 mg, Biotin: 60 mg, Choline Chloride: 300,000 mg, Cobalt: 200 mg, Copper: 3,000 mg, Iodine: 1,000 mg, Iron: 20,000 mg, Manganese: 40,000 mg, Selenium: 200 mg, Zinc: 30,000 mg and Antioxidant: 1,250 mg. Source: Author, 2024.

Table 2 shows the percentage composition in the experiment with experimental diet for the final phase (5-8 weeks).

Table 2. Percentage composition of experimental diet for broiler finisher (5-8 weeks).

Ingredients (%)	FM + 0% SSRCM	GM + 0% SSRCM	FM + 5% SSRCM	GM + 5% SSRCM	FM + 10% SSRCM	GM + 10% SSRCM	FM + 15% SSRCM	GM + 15% SSRCM
SSRCM	0	0	5	5	10	10	15	15
Fish Meal	2.5	0	2.5	0	2.5	0	2.5	0
Grasshopper Meal	0	2.5	0	2.5	0	2.5	0	2.5
Maize	59.59	58.86	58.91	58.18	54.10	53.39	49.27	48.53
Groundnut Cake (GNC)	28.46	29.19	29.14	29.87	28.95	29.66	28.78	29.52
Wheat Offal	5	5	0	0	0	0	0	0
Bone Meal	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Limestone	1	1	1	1	1	1	1	1
**Vitamin/Mineral-Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Methionine	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	100	100	100	100	100	100	100	100
Calculated Analysis								
Metabolizable Energy (Kcal/kg^{-1})	2953	2945	3008	2997	2982	2971	2955	2945
Crude Protein (%)	21	21	21	21	21	21	21	21
Crude Fiber (%)	5.28	5.32	6.23	6.25	6.58	6.59	6.92	6.94
Ether Extract (%)	6.20	6.19	5.93	5.92	5.75	5.76	5.66	5.68
Lysine (%)	0.98	0.99	1.00	0.98	1.02	1.01	1.03	1.04
Methionine (%)	0.43	0.43	0.42	0.42	0.41	0.40	0.40	0.39
Calcium (%)	0.92	0.91	0.93	0.92	0.94	0.95	0.96	0.95
Phosphorus (%)	0.61	0.61	0.61	0.62	0.62	0.62	0.62	0.62

Note: **Bio Mix Starter Premix containing the following per kg: Vitamin A: 8,500,000 IU, Vitamin D3: 1,500,000 IU, Vitamin E: 10,000 mg, Vitamin K3: 1,500 mg, Vitamin B1: 1,600 mg, Vitamin B2: 4,000 mg, Niacin: 20,000mg, Pantothenic Acid: 5,000 mg, Vitamin B6: 1,500 mg, Vitamin B12: 10 mg, Folic Acid: 500 mg, Biotin: 750 mg, Choline Chloride: 175,000 mg, Cobalt: 200mg, Copper: 3,000 mg, Iodine: 1,000 mg, Iron: 20,000 mg, Manganese: 40,000 mg, Selenium: 200 mg, Zinc: 30,000 mg and Antioxidant: 1,250 mg. Source: Author, 2024.

Proximate composition of sugarcane scrapping-rumen content mixture (SSRCM) and grasshopper meal. The result on the proximate composition of sugarcane scrapping-rumen content mixture (SSRCM) is presented in (Table 3). The result showed that, SSRCM has contained dry matter (91%), crude protein of 10%, ether extract (1%), crude fiber (15%), ash (2%) and metabolizable energy (2877 Kcal/kg^{-1}) while those of grasshopper meal is presented in Table 4 revealed the presence of crude protein (61%), ether extract of 13%, crude fiber (5%), dry matter (90%), ash (1%) and metabolizable energy of 2685 Kcal/kg^{-1}.

Table 3. Proximate composition of sugarcane scrapping-rumen content mixture (SSRCM).

Test Ingredient	Parameter	Result
Sugarcane scrapping-rumen content mixture (SSRCM)	Energy (Kcal/kg^{-1})	2877.4
	Crude protein (%)	10.05
	Crude Fiber (%)	15.18
	Ether Extract (%)	1.11
	Ash (%)	2.64
	Nitrogen Free Extract (%)	62.02
	Dry Matter (%)	91.00
	Moisture (%)	9.00

Source: Author, 2024.

Table 4 shows the proximate composition of the sugarcane scraping-ruminal content mixture and the proximate composition of grasshopper flour.

Table 4. Proximate composition of grasshopper meal.

Test Ingredient	Parameter	Result
Grasshopper Meal	Energy (Kcal/kg^{-1})	2685.6
	Crude protein (%)	61.45
	Crude Fiber (%)	5.44
	Ether Extract (%)	13.11
	Ash (%)	1.98
	Nitrogen Free Extract (%)	8.02
	Dry Matter (%)	90.00
	Moisture (%)	10.00

Note: Growth performance of broiler chickens fed animal protein sources and sugarcane scrapping-rumen content mixture (SSRCM). Effect of animal protein sources on the growth performance of broiler chickens. Source: Author, 2024.

The result of the effect of different animal protein sources on the growth performance of broiler chickens is presented in (Table 5). The result of the growth performance of broiler chickens fed different animal protein sources showed that there were no significant ($p > 0.05$) difference in all the parameters (final weight gain, average daily weight gain, feed intake, feed conversion ratio, and mortality) measured. However, birds fed diet containing fishmeal had numerically higher final weight, average weight gain, feed intake and better feed conversion ratio.

The growth performance characteristics of broilers fed animal protein sources (fishmeal and grasshopper meal) at different inclusion level of SSRCM is shown below. The result showed that birds fed diet containing fishmeal has the highest final body weight (1647.40 g) and feed intake (3073.5 g) while grasshopper meal had the lowest final body weight (1629.13 g) and feed intake (3062.5 g). Grasshopper meal had the lowest feed conversion ratio (FCR) while fishmeal had the highest feed conversion ratio (FCR).

Table 5. Effect of animal protein sources on the growth performance of broiler chickens.

Parameters	Fish Meal	Grasshopper Meal	SEM	LOS
Initial Weight (g/bird)	45.0	44.98	0.02	NS
Final Weight (g/bird)	1647.40	1629.13	22.08	NS
Weight Gain (g/bird)	1602.4	1584.15	22.04	NS
ADWG (g/bird)	28.60	28.29	0.32	NS
Feed Intake (g/bird)	3073.5	3062.5	6.12	NS
FCR	1.92	1.93	0.03	NS
Mortality (%)	25.0	25.0	1.50	NS

Note: SEM = Standard error of mean; LOS = Level of significance; NS= Not significantly different ($p > 0.05$); FCR = Feed conversion ratio; ADWG = Average daily weight gain. Effect of sugarcane scrapping-rumen content mixture (SSRCM) on growth performance of broilers.

The result of the effect of SSRCM based diet on the growth performance of broilers is presented in (Table 6). The result showed that there was no significant ($p > 0.05$) in the initial live weight. However, significant difference ($p < 0.05$) exist in the final weight, weight gain, feed intake, feed conversion ratio and mortality rate. The Final weight of birds fed 0% and 5% SSRCM were similar and significantly higher than those of birds fed 10% SSRCM.

Also, birds fed 10% SSRCM had significantly ($p < 0.05$) higher final body weight than those fed 15% SSRCM. It was observed that average weight gain, feed intake and feed conversion ratio followed the same trend as the final body weight. The result showed that 0% SSRCM had the highest final body weight (1993.50 g) and feed intake (3371.5 g) while 15% SSRCM had the lowest final body weight (1022.90 g) and feed intake (2655 g). 0% SSRCM had the lowest feed conversion ratio (FCR) while 15% SSRCM had the lowest feed conversion ratio (FCR). 0% SSRCM had no mortality (FCR) while 15% SSRCM had the highest mortality.

Table 6. Effect of SSRCM levels on the growth performance of broiler chickens.

Parameters	0% SSRCM	5% SSRCM	10% SSRCM	15% SSRCM	SEM	LOS
Initial Weight (g/bird)	44.97	45.00	44.97	45.00	0.03	NS
Final Weight (g/bird)	1993.50^{a}	1970.00^{a}	1566.65^{b}	1022.90^{c}	26.04	**
Weight Gain (g/bird)	1948.5^{a}	1925.0^{a}	1521.71^{b}	977.9^{c}	26.02	**
ADWG (g/bird)	34.80^{a}	34.38^{a}	27.14^{b}	17.44^{c}	0.43	**
Feed Intake (g/bird)	3371.5^{a}	3362^{a}	2883.5^{b}	2655^{c}	10.20	**
FCR	1.73^{c}	1.75^{c}	1.89^{b}	2.72^{a}	0.06	**
Mortality (%)	0.00a	0.00a	8.36b	41.67c	2.33	**

Note: Note: a, b, c means on the same row with different superscript are significantly different ($p < 0.05$). SEM = Standard error of mean; LOS = Level of significance; NS = Not significantly different ($p > 0.05$); FCR = Feed conversion ratio; ADWG = Average daily weight gain; SSRCM = Sugarcane scrapping-rumen content mixture effect of animal protein sources and SSRCM interaction on the growth performance of broiler chickens. Source: Author, 2024.

The effect of animal protein sources and SSRCM interaction on the growth performance of broiler chickens is summarized in (Table 7). The result of the effect of animal protein sources and SSRCM interaction on the growth performance of broiler chickens showed that there were no significant ($p > 0.05$) difference in the initial live weight. However, significant difference ($p < 0.05$) exist in the final weight, weight gain, feed intake, feed

conversion ratio and mortality rate.

The Final weight of birds fed 0% and 5% SSRCM were similar and significantly higher than those of birds fed 10% SSRCM. Also, birds fed 10% SSRCM had significantly ($p < 0.05$) higher final body weight than those fed 15% SSRCM. It was observed that average weight gain, feed intake and feed conversion ratio followed the same trend as the final body weight. The result showed that the highest final body weight (2000.0 g) was recorded at the control diet (FM + 0% SSRCM). The lowest final body weight was however recorded at (GM + 15% SSRCM) diet which also had the highest feed conversion ratio as compared to the other diet. Birds on the control diet (FM + 0% SSRCM) had the highest feed intake of 3373g/bird while birds on (GM + 15% SSRCM) diet had the least value (2643 g/bird^{-1}).

Mortality was recorded in (FM + 10% SSRCM), (GM + 10% SSRCM), (FM + 15% SSRCM) and (GM + 15% SSRCM) diets respectively while no mortality was recorded in (FM + 0% SSRCM), (GM + 0% SSRCM), (FM + 5% SSRCM) and (GM + 5% SSRCM) diets respectively.

Table 7. Effect of animal protein sources and SSRCM interaction on the growth performance of broiler chickens.

Parameters	FM + 0% SSRCM	GM + 0% SSRCM	FM + 5% SSRCM	GM + 5% SSRCM	FM + 10% SSRCM	GM + 10% SSRCM	FM + 15% SSRCM	GM + 15% SSRCM	SEM	LOS
Initial Weight (g/bird)	44.97	44.97	45.00	45.01	45.00	44.93	45.01	45.00	0.03	ns
Final Weight (g/bird)	2000.0^{a}	1987.0^{a}	1973.0^{a}	1967.0^{a}	1583.3^{b}	1550.0^{b}	1033.3^{c}	1012.5^{c}	29.46	**
Weight Gain (g/bird)	1955.0^{a}	1942.0^{a}	1928.0^{a}	1922.0^{a}	1538.3^{b}	1505.1^{b}	988.3^{c}	967.5^{c}	29.45	**
ADWG (g/bird/day)	34.91^{a}	34.68^{a}	34.43^{a}	34.32^{a}	27.47^{b}	26.88^{b}	17.65^{c}	17.28^{c}	0.53	**
Feed Intake (g/bird)	3373^{a}	3370^{a}	3364^{a}	3360^{a}	2890^{b}	2877^{b}	2667^{c}	2643^{c}	13.69	**
FCR	1.73^{c}	1.74^{c}	1.74^{c}	1.75^{c}	1.88^{b}	1.91^{ab}	2.70^{a}	2.73^{a}	0.14	**
Mortality (%)	0.00	0.00	0.00	0.00	6.67	10.00	43.33	40.00	3.33	**

Note: a, b, c, Means on the same row with different superscript are significantly different ($p < 0.05$). SEM = Standard error of mean; LOS = Level of Significance; ns = Not significantly different ($p > 0.05$); FCR = Feed Conversion Ratio; ADWG = Average daily weight gain; SSRCM = Sugarcane scrapping-rumen content mixture FM = Fishmeal; GM = Grasshopper meal. Source: Auhor, 2024.

4. Discussion

The growth performance of broiler chicken fed animal protein sources and SSRCM at different inclusion levels showed that fishmeal diets gave highest values in all the parameters but there was no significant difference ($p > 0.05$) in all the parameters (final weight gain, average weight gain, feed intake, feed cost per kg, feed conversion ratio, and mortality) measured. However, birds fed diet containing fishmeal had numerically higher final weight, average weight gain, feed intake and better feed conversion ratio.

The result agrees with the report of Liu & Lian (2003); Alagbe (2017), that there was no effect on body weight gain (BWG) and feed intake (FI) when grasshopper meal (GM) replaced fishmeal (FM) in broilers diet. This is not also far from the recommendation of Ojewola et al. (2003), who recommended that 2.5% grasshopper meal in broiler diet was appropriate and a cheaper alternative against the imported fishmeal.

The growth performance characteristics of broilers fed animal protein sources (fishmeal and grasshopper meal) and different inclusion level of SSRCM showed that birds fed diet containing fishmeal has the highest final body weight (1647.40 g) and feed intake (3073.5 g) while grasshopper meal had the lowest final body weight (1629.13 g) and feed intake (3062.5 g). Grasshopper meal had the lowest feed conversion ratio (FCR) while fishmeal had the highest feed conversion ratio (FCR).

The result of the effect of sugarcane scrapping-rumen content mixture (SSRCM) based diet on the growth

performance showed that there was significant difference ($p < 0.05$) in the final weight, weight gain, feed intake, feed conversion ratio and mortality rate. The Final weight of birds fed 0% and 5% SSRCM were similar and significantly higher than those of birds fed 10% SSRCM. Also, birds fed 10% SSRCM had significantly ($p < 0.05$) higher final body weight than those fed 15% SSRCM. It was observed that average weight gain, feed intake and feed conversion ratio followed the same trend as the final body weight.

The result showed that 0% SSRCM had the highest final body weight (1993.50 g), ADWG (34.80 g), feed intake (3371.5 g) and weight gain (1948.50 g) while 15% SSRCM inclusion gave least final body weight (1022.90 g), ADWG (17.44 g), feed intake (2655 g) and weight gain (977.90 g). However, the highest (3.03) feed conversion ratio (FCR) was observed in 15% SSRCM inclusion.

The significant difference observed for the dietary interactive effect in final weight and feed intake in broiler chickens is indicative of the acceptability of the feed which translated to lower weight gain and feed intake as the inclusion levels increased. This shows that the growth performance of broiler chickens will be affected negatively when fed diet with higher levels of SSRCM (10% and 15%). This result is not consistent with the findings of Ari et al. (2016) which was reported that higher inclusion levels of sugarcane scrapping at 15 % in the diet will not negatively affect growth performance in broiler chicken. The result agreed with the report of Okorie (2005) that at 10% inclusion there was a significant decrease in the growth of the birds.

5. Conclusions

The findings of this study revealed that sugarcane scrapping rumen content mixture (SSRCM) have a high metabolizable energy content of 2877.4 Kcal/kg^{-1} and can support the growth of broiler chickens especially when optimized at 5% inclusion level. There was no significant difference between 5% and the treatment fed 0% inclusion interms of average daily weight gain of birds as well as feed intake. Result obtained in 0% and 5% were higher than the other treatments.

Similarly, there was no significant difference between fishmeal and grasshopper meal in growth performance of broilers fed the experimental diets which means that grasshopper meal can replace fishmeal in the diets of broiler chickens. SSRCM and grasshopper meal are potential alternatives to maize and fishmeal respectively.

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7. Authors' Contributions

Effiong Erikanobong: project writing, experiments, data analysis, article writing, post-evaluation review and publication.

8. Conflicts of Interest

No conflicts of interest.

9. Ethics Approval

Yes applicable. The experiment was carried out according to the ethics and procedures of the Department of Animal Science, University of Abuja, Nigeria (ANS/1740103011).

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