



A Study on the Effect of Graded Levels of Locust Beans (*Parkia biglobosa*) Seed Meal on the Performance of “Broiler” in Usmanu Danfodiyo University Sokoto Teaching and Research Farm Nigeria

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Authors' contribution

This work was carried out in collaboration among all authors. Author AYK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors BAA and IMM managed the analysis of the study. Author AAM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The study was carried out to evaluate the effect of feeding locust bean (*Parkia Biglobosa*) seed meal (LBSM) at graded levels on the performance of broilers. Two hundred and forty broilers were used which were randomly allotted to four treatment groups, each replicated four times in a completely randomized design. The diets contained 0% level of LBSM which served as the control,

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while other three diets contained 5, 10 and 15% levels of LBSM. The experiment lasted for 28 days. Significant differences of ($P < 0.05$) were observed in feed intake (g/b/d) water intake ml/b/d, final body weight (g/b), body weight gain (g/b) averaged daily gain (g/b/d) and feed conversion ratio (FCR). While no significant effect of locust bean seed meal (LBSM) in broilers diets provide effective mechanism for better performance. But live weight was significantly influenced ($P < 0.05$) by LBSM. Analysis of variance (ANOVA) was used to determine significant difference between treatment groups in term of performance parameters. Where significant difference existed, Duncan's multiple range test was applied to separate the means. Data analysis was carried out using (SPSS (SPSS, 2013 version 20.0)). It is concluded that LBSM can be included in the diet of broilers at starter phase from 5-15% inclusion levels while at finisher phase, diets containing 10 and 15% level of inclusion would be used for better performance without any deleterious effect on the growth performance. It could be recommended that, diets containing 10 and 15% LBSM level of inclusion would be used for better performance and economic benefit with better feed conversion ratio.

Keywords: Effect; graded levels; locust beans seed meal; performance; broiler birds.

1. INTRODUCTION

The biggest constraint to poultry production in Nigeria is cost of feed, which accounts for about 60-80% of the recurrent expenditures in intensive poultry production [1]. This is because feed stuffs that are used in formulating diets for poultry have high demand for human consumption and industrial uses [2] thus, alternative resources need to be explored. At present, the high cost of conventional feed stuffs has brought about the need to have alternative feed stuffs that can replace the expensive ones in order to reduce the cost of livestock production [3,4]. In order to overcome this situation, several researchers have proposed the use of the little known non-conventional products as feed ingredient [5,6]. These feed stuffs are underutilized; less popular, cheap, and easily obtainable. Examples of such ingredients include: *Acacia Sieberiana*, [7], locust bean [8], *Azalia Africana* [9], lablab [10], Pigeon Pea [11], and *Mucuna* beans [12] and [13,14]. More attention has been given to economically important species of tree plants especially *Parkia biglobosa* in recent years for a sustainable use and integrated management due to an increase in recognition of its contribution to fulfil basic need of the people, house hold economics, feed security and conservation of natural resources [15]. The Nigerian Study/Action Team (NEST, 1991) submitted that leaves, fruits, nuts and oils obtained from wild plants have provided food for humans, livestock and wildlife in many parts of the country.

In the search for plant protein and vitamin substitutes, the African locust bean (*Parkia biglobosa*) has been found to be very popular and used especially in the fermented form dawadawa, which is the product of the seeds.

However, the yellow dry powdery fruit pulp called 'Dorowa' in Hausa has not attracted much attention. The aim of the study is to evaluate the effects of feeding locust beans (*Parkia Biglososa*) seed meal at graded levels on the performance of broilers at starter and finisher phase.

2. MATERIALS AND METHODS

2.1 Study Area

The four weeks experiment was conducted at poultry production and research unit of the department of Animal science, Usman Danfodiyo University, Sokoto. Sokoto state is located between latitudes 12° and 13° N and Longitudes 4° and 6° E in the northern part of Nigeria at an altitude of 350m above sea level [16]. The state falls within the Sudan savannah vegetation zone with alternating wet and dry seasons. The hot dry spell extends from March to May and sometimes to June in the extreme northern part. A short, cool, dry period (Harmatan) occurs between late October and late February [17].

The mean annual rainfall is about 700mm. The rainy season starts from June to early October but some time ends in September with a peak in August. Potential evapotranspiration has been reported to be 162 mm. The maximum temperature of 41°C has been reported in April and maximum of 13.2°C in January [18].

2.2 Processing and Sources of Locust Beans Seeds and Other Feeding Stuffs

The locust bean seeds used in the feeding trial were obtained from Kaiama in Kaiama Local

Government Area of Kwara State. The seeds were removed from the pods and washed to clean it of the yellow pulp and dry under the Sun, the seeds were then decorticated by putting them in a large pots on open fire to reduce or destroy the anti-nutritional factors, dried in an open air for five days before they were ground into meal and transported to Sokoto for storage before the start of the experiment. Other ingredients for the experimental diet formulation which include Maize, Groundnut cake, Wheat offal, Bone meal and Soya bean were sourced from Kara market in Sokoto town while methionine, lysine and vitamin premix were sourced from established vendors within Sokoto metropolis. The proximate composition of experimental diet fed to the broilers is presented in Table 1 while the gross and chemical composition of the diet is shown in Table 2, respectively.

2.3 Experimental Design and Diets

Four experimental diets were formulated; the first diet contained zero level of locust bean seeds and served as the control. The tree remaining

diets were formulated to contained locust bean seed meal (LBSM) at 5, 10 and 15% level of inclusion, respectively. The diet served as the experimental treatments that were fed to broilers during the feeding trail which lasted for four weeks.

Two hundred and forty (240) day-old chicks were randomly allotted to four experimental treatment groups each replicated four times.

2.4 Management of Experimental Birds

The day-old flock of broilers were sourced from Agric Tech farm (farm well) in Ibadan Oyo state and used for the experiment. The birds were raised on deep litter with open sided wall and cemented floor. The house was cleaned, fumigated and disinfected a week before the arrival of chicks, litter materials (wood shavings) were spread on the floor two days before the arrival of chicks. Charcoal was used as the source of heat and electricity (light). Feeding trays and drinkers were used for the chicks.

Table 1. Gross composition of experimental diets fed to the broiler starter (0-4weeks)

Ingredients	Diet I (0%)	Diet II (5%)	Diet III (10%)	Diet IV (15%)
Maize	50.00	50.00	45.80	45.00
Soya BM	19.00	16.05	14.00	10.00
LBSM	0.00	5.00	10.00	15.00
GNC	11.73	11.05	10.00	10.00
W/offal	13.50	13.75	15.00	14.95
Bone meal	1.50	1.20	2.50	2.50
Vitamin premix*	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Fish meal	2.97	1.85	1.65	1.50
TOTAL	100.00	100.00	100.00	100.00

Chemical Composition estimated in different groups

Metabolizable Energy (Kcal/kg)	3000	3000	3041	3033
Crude protein (%)	23.00	23.10	23.00	23.40
Lysine (%)	1.30	1.20	1.10	1.10
Methionine (%)	0.60	0.50	0.50	0.50
Calcium (%)	0.40	0.40	0.20	0.60
Available P (%)	0.40	0.40	0.30	0.40
Ether Extract (%)	4.20	3.90	3.70	3.40
Crude fiber (%)	4.00	3.90	3.60	3.40
Feed cost ₦ / Kg	139	134	132	130

*Vitamin/mineral premix contained; Vitamin A, 1000 I.U Vitamin D1, 3000 I.U., Vitamin E8.0 I.U., Vitamin K, 2.0 mg; Vitamin B1, 2.0 mg; Vitamin B6, 1.2 mg; Vitamin B12, 0.2 mg; Pantothenic acid, 7.0 mg; Mg, 1000 mg; Cu, 8.0 mg and Se, 0.1 mg per Kg of diet.

Table 2. Gross composition of experimental diets fed to the broiler finisher (5-8 weeks)

Ingredients	Diet I (0%)	Diet II (5%)	Diet III (10%)	Diet IV (15%)
Maize	50.00	50.00	45.80	45.00
Soya bean meal	19.00	16.05	14.00	10.00
LBSM	0.00	5.00	10.00	15.00
GNC	11.73	11.05	10.00	10.00
W/offal	13.50	13.75	15.00	14.95
Bone meal	1.50	1.20	2.50	2.50
Vitamin premix*	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
G/oil	2.97	1.85	1.65	1.50
TOTAL	100.00	100.00	100.00	100.00

Calculated chemical composition

Metabolizable Energy(Kcal/kg)	3000	3004	3000	3022
Crude protein (%)	20.00	20.00	20.00	19.98
Lysine (%)	1.16	1.29	1.45	1.57
Methionine (%)	0.54	0.60	0.67	0.74
Calcium (%)	0.49	0.40	0.75	0.94
Available P (%)	0.42	0.51	0.82	0.94
Ether Extract (%)	3.80	3.90	3.90	4.00
Crude fiber (%)	3.97	3.81	3.70	3.50
Cost of feed/gain in ₦/kg	289	284	282	280

*Vitamin/mineral premix contained; Vitamin A, 1000 I.U Vitamin D1, 3000 I.U., Vitamin E8.0 I.U., Vitamin K, 2.0 mg; Vitamin B1, 2.0 mg; Vitamin B6, 1.2 mng; Vitamin B12, 0.2 mg; Pantothenic acid, 7.0 mg; Mg , 1000 mg; Cu, 8.0 mg and Se, 0.1 mg per diet.

Experimental birds were kept for three days after their arrival to reduce stress due to transportation. During the said period, anti-stress drugs such as Vitalyte were administered to the birds. After three days the birds were weighed and allotted to their treatment and replicate groups. Routine vaccination and medications were administered throughout the course of the trial as recommended by [1]. Feed and water were served to the chicks in ad-libitum.

2.5 Data Collection

Daily feed and water intake was recorded by subtracting feed and water left over from the quantity given. Weight gain was recorded on weekly basis by deducting previous body weight from the current weight for each week. Record of feed intake and weight gain was used to calculate the feed conversion ratio for each replicate. Rate of mortality was recorded as it occurs.

Proximate analysis of Locust bean seeds (*Parkia Biglobosa*) was conducted in the soil science

laboratory of Usman Danfodiyo University Sokoto using the method of [18] in order to determine the proximate composition of test ingredients (Ca, Ma, P, K and Fe), Atomic Absorption Spectrometer (AAS) was used for Ca, Mg and Fe determination, spectrophotometer for P, and Plane Photometer was used for K determination. Samples of the experimental fed were also analyzed for proximate composition and mineral matter of the test ingredient. The proximate composition of LBSM is presented in Table 3.

2.6 Determination of Anti-Nutritional Factors

Determination of anti-nutritional factor was conducted in biochemistry laboratory of Usman Danfodiyo University Sokoto. The Okolate content of *Parkia* seeds was determined using the method described by [19]. Tannin content was determined using the standard method described by [20,21,22,23] and [24]. The anti-nutritional factors present in *Parkia* seed is presented in Table 4.

2.7 Data Analysis

Analysis of variance (ANOVA) was used to determine significant difference between treatment groups in term of performance parameters. Where significant difference existed, Duncan's multiple range test was applied to separate the means. Data analysis was carried out using the computer software of the statistical package for the social sciences [25].

3. RESULTS AND DISCUSSION

3.1 Proximate Composition and Content of some Anti- nutritional Factors in Locust Bean Seed Meal

The Proximate Composition and the composition of some anti- nutritional factors of Locust Bean Seed Meal (*Parkia biglobosa*) are shown in Tables 3 and 4, respectively.

The dried locust bean seeds contain about 96% dry matter. Crude protein and crude fibre contents are 30% and 1%, respectively. The seed has moderate level of carbohydrate (47.07%) while the ether extracts content is 17.0%. LBSM seed is rich in minerals and this is showed by the ash content which is 5%.

The result of the laboratory analysis obtained in the study showed that *Parkia biglobosa* seed has high Crude protein (CP) content of 29.90%,

compared to the values available in literature. The high CP content of *Parkia seed* obtained in the present study is not comparable with 33.50% reported by [26], 34.3% reported by [27] and 30.00% reported by [28,29,30,31,32]. The Crude Fibre content of *P. biglobosa* seed was 1.0, which is not comparable with 2.00 reported by [30], 4.66 reported by [26]. The fat content of the *P. biglobosa* seed was 17.00, which is lower than 49.20 as reported by [26] but higher than 4.0 as reported by [31,28]. The carbohydrate content of the *P. biglobosa* seed was 47.07, which is lower than 49.00 reported by [32]. The Ash content was found to be 5.0, which is higher than 4.81 reported by [26] and also 2.0 reported [32].

Results of the laboratory analysis of anti-nutritional factors present in the locust bean seed showed that the content of phytate and saponin contents were higher than other chemical components. Phytate content is 4.90mg while saponin content is 1.4mg. The levels of oxalate content and hydrogen cyanide are comparatively low.

All the values obtained from the said study did not agree with the values reported by [26], who reported 0.47 Oxalate, 1.30 Phytate, 0.51tannin, 0.92 Saponin and 0.00 Cyanide content. The differences may be due to the different geographical locations and the soil on which they were cultivated or as a result of the method of processing as well as difference in cultivar.

Table 3. Proximate composition of *Parkia biglobosa* seed

Parameter (%)	Composition
Dry matter	95.93
Carbohydrate	47.07
Crude Protein	29.93
Crude Fibre	1.0
Ether extracts	17.0
Ash	5.0

Table 4. Anti-nutritional factors present in *Parkia biglobosa* seed

Parameter	Composition mg/100g
Oxalate	0.0045
Phytate	4.90
Tannin	0.39
Hydrogen cyanide	0.010
Saponin	1.14

3.2 Effect of Diet Containing Graded Levels of Inclusion of Locust Bean Seed Meal on Performance Characteristics of Broiler Birds (0 – 4 weeks) and (5 – 8 weeks)

The performance characteristics of broiler chickens fed diets containing graded levels of Locust Bean Seed Meal during the Starter phase and Finisher phase are shown in Table 5 and 6, respectively.

Result of feeding trials to determine the effect of LBSM on performance characteristics of broilers fed graded levels of the test ingredient at the starter phase showed that the feed intake of birds fed with 15% LBSM. (46.57 g/b/day) was significantly higher ($P<0.05$) as compared to those fed with the control (42.97 g/b/day), 5% LBSM (45.31 g/b/day) and 10% LBSM (45.33g/b/day). However, birds fed with 10% LBSM had significantly higher average body weight gain ($P<0.05$) of 557.16 g/b which was similar to those fed with 15% LBSM (470.28g/b). Similarly, broilers fed with 5% LBSM had similar body weight gain (381.71g/b) with those fed with 15% LBSM. Broilers fed 5% LBSM also had similar body weight gain compared to those fed the control diet.

3.3 Feed Conversion Ratio

Feed conversion ratio followed a different pattern because broilers fed 10% LBSM had the best FCR of 2.43 compared to those fed the other test diets. This was followed by broilers fed 15% LBSM which had 3.08 that was similar to those

fed the control diet (3.44) but also significantly different ($P<0.05$) from those fed 5% LBSM which had 3.64. The FCR of broilers fed with control diet and those fed with 5% LBSM did not differ significantly ($P<0.05$). This findings was not in line with [33] who reported no significant difference ($P>0.05$) in FCR of birds among the treatment groups. The feed cost per kilogram gain was similar and better birds fed 10% and 15% LBSM (₦132 and ₦130 respectively). There was no significant difference ($P>0.05$) with respect to mortality. However, the percentage mortality rate across all the treatments could be attributed to disease outbreak in the flock (Newcastle Disease)

3.4 Water Consumption

The inclusion of LBSM in the diets influenced water intake. Broilers fed the control diet consumed least amount of water (57.54ml/b/day) ($P<0.05$), while those fed 15% LBSM consumed more water (78.53 ml/b/day) compared to those fed 10% LBSM (69.71ml/b/day) ($P<0.05$) but similar to the water consumption of birds fed 5% LBSM (72.87 ml/b/day). Birds on 5% LBSM and those fed 10% LBSM had similar water consumption rate ($P>0.05$).

The 78.53 ml/b/d of water consumption obtained in this study was lower than that finding of [34] who reported that 145 ml/b/d for 3 weeks old broilers. This value is also lower than the range of 121.26-130.04 ml/b/d reported by [35]. The differences in water consumption could be attributed to environmental differences and diet offered to the birds.

Table 5. Effects of Graded Level of LBSM on the performance characteristics of broiler birds (0 - 4 weeks)

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	SEM
	Control	5%LBSM	10%LBSM	15%LBSM	
Initial Body Weight (g/b)	90.00	90.00	90.00	90.00	0.85
Total Feed Intake (g/b)	1203.17 ^b	1268.81 ^b	1269.36 ^b	1303.85 ^a	23.83
Feed Intake (g/b/d)	42.97 ^b	45.31 ^b	45.33 ^b	46.57 ^a	0.85
Final Body Weight (g/b)	453.85 ^c	471.54 ^{bc}	647.16 ^a	560.28 ^{ab}	24.13
Body Weight Gain (g/b)	363.85 ^c	381.71 ^{bc}	557.16 ^a	470.28 ^{ab}	23.99
Average Daily Gain (g/b/d)	12.50 ^b	12.59 ^b	18.81 ^a	15.85 ^{ab}	0.85
Feed Conversion Ratio	3.44 ^{bc}	3.64 ^c	2.43 ^a	3.08 ^b	0.16
Total Water Intake (ml/b)	1611.07 ^b	2040.38 ^a	1951.75 ^{ab}	2198.70 ^a	79.13
Water intake (ml/b/d)	69.57 ^b	72.87 ^{ab}	69.71 ^b	78.53 ^a	2.83
Mortality (%)	13.33	23.33	23.33	20.00	3.10

Means along the same row with different superscripts are significantly different ($P<0.05$)

Although the % mortality was higher than the normal accepted level, post-mortem analysis did not show the effect of the test ingredients. Mortality occurred across all treatment groups despite the fact that the control group had the lowest mortality of 13%.

3.5 Body Weight gain

The performance characteristics of broilers chickens fed diets containing graded levels of locust bean seed meal (LBSM) at the starter phase is shown in Table 5. The result of the study of feeding trial to determine the effects of LBSM on performance characteristics of broilers fed graded levels of testing ingredient at starter phase showed that the feed intake of birds fed 15% LBSM was significantly higher ($P < 0.05$) compared to those fed the control diet. This assertion is in agreement with the work reported by [33], who reported a significant effect of cooked African locust beans seed feed during starter phase of broilers chickens. The findings is also in line with the work reported by [36], who stated that broilers feed with boiled soya bean meal performed better when compared with those fed raw soya beans diet. However, the result of the study contradicts the work of [37] who reported that cooking time had no significant effect on feed intake. The author also observed that 20% dietary inclusion level of African locust beans seed meal in the diet might be too high during the starter phase because of the presence of residual anti-nutritional factors in cook beans.

The inclusion of LBSM in the diets influenced water intake, broilers fed the control diet consumed least amount of water while those fed 15% consumed more water while those fed 10% LBSM but similarly to the water consumption of birds fed 5% LBSM. The 78.53ml/b/d of value obtained in this study was lower than the finding of [34] who reported that 145ml/b/d for 3 weeks old broilers. This value is also lower than the range of 121.26-130.04ml/b/d reported by [35]. The differences in water consumption could be attributed to environmental differences and diet offered to the birds.

At the end of the feeding trial, there was significant difference ($P < 0.05$) between the treatment groups in the final body weight (FBW). However, birds fed 10% LBSM had significantly higher average body weight gain ($P < 0.05$) of 557.16g/b which was similar to those fed 15% LBSM (470.28g/b). Similarly, broilers

fed 5% LBSM had similar body weight gain (381.71g/b) with those fed 15% LBSM. Broilers fed 5% LBSM also had similar body weight gain compared to those fed the control diet. The result was in line with the findings of [33], who reported significant difference in final body weight and body weight gain at starter phase with 7.5 15 and 22.5% levels of inclusion of cooked African locust bean seed meal in broiler chickens. This observation also agreed with the work of [36] who reported that broilers fed boiled soy beans performed better than those fed raw soy beans diets. However, the results of the study contradict the work of [37] who reported that cooking time had no significant effect on feed intake. The author also observed that 20% dietary inclusion level of African locust bean seed meal in the diet might be too high during the starter phase because of the present of the residual anti-nutritional factors in the cooked beans. The author also find that moist cooking resulted in better performance of broilers. The observation found in this study also agreed with the work of [38] who reported better performance of broilers fed with boiled pigeon pea meal based diets compared to those fed diets containing raw pigeon pea seeds based diets.

3.6 Mortality

There was no significant difference ($P > 0.05$) with respect to mortality. Although the % mortality was higher than the normal accepted level, post-mortem analysis did not show the effect of the test ingredients. Mortality occurred across all treatment groups despite the fact that the control group had the lowest mortality of 13%.

Analysis of data generated during the feeding trial at the Finisher phase (5 – 8 weeks) indicated that the feed intake of broiler fed 10% LBSM (129.21 g/b/day) and those fed 5% LBSM (119.05 g/b/day) and 15% LBSM (117.78 g/b/day) were not significantly different ($P > 0.05$) from one another. However, broilers fed the control diet (0% LBSM) had lowest feed intake of 100.66 g/b/day which was significantly lower ($P < 0.05$) from other dietary treatments.

In terms of body weight gain, broilers finisher fed diet containing 5% and 10% LBSM had better gain of 1188.13 g/b and 1161.04 g/b ($P < 0.05$) compared to those fed 15% LBSM which had 975.14 g/b. Broiler Finisher on the control diet had the poorest body weight gain of 743.61 g/b ($P < 0.05$).

Table 6. Effects of graded level of LBSM on the performance characteristics of broiler birds (5 - 8 weeks)

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	SEM
	Control	5%LBSM	10%LBSM	15%LBSM	
Initial body weight(g/b)	653.61	655.28	654.58	655.42	0.38
Total feed intake(g/b)	2818.59 ^b	3333.61 ^a	3618.02 ^a	3297.93 ^a	89.45
Feed intake (g/b/d)	100.66 ^b	119.05 ^a	129.21 ^a	117.78 ^a	3.19
Final body weight(g/b)	1397.22 ^b	1843.40 ^a	1815.62 ^a	1630.56 ^{ab}	59.84
Body weight gain(g/b)	743.61 ^c	1188.13 ^a	1161.04 ^a	975.14 ^b	59.66
Average daily gain(g/b/d)	26.56 ^b	42.43 ^a	41.47 ^a	34.83 ^{ab}	2.13
Feed conversion ratio	3.92 ^{bc}	2.83 ^a	3.15 ^{ab}	3.46 ^b	0.17
Total water intake(ml/b)	7380.58 ^b	8139.69 ^a	8468.61 ^a	8123.16 ^a	120.86
Water intake(ml/b/d)	263.59 ^b	290.70 ^a	302.45 ^a	290.13 ^a	4.32
Mortality (%)	0.00	8.33	5.56	0.00	1.33

Means along the same row with different superscripts are significantly different (P<0.05)

Feed conversion ratio was better for broiler finisher fed with 5% LBSM (2.83) which was similar to value obtained for birds fed 10% LBSM (3.15) (P>0.05). Broiler fed 15% LBSM had FCR of 3.46 and it did not differ from the FCR value obtained from the birds fed 10% LBSM and the Control Diet (3.15 and 3.92 respectively). Values obtained from birds fed 5% LBSM was significantly better (P<0.05) than that obtained from birds that were fed the Control Diet.

3.7 Feed Intake

There were significant difference (P<0.05) in total feed intake (TFI) among the treatment groups. This result was in line with [35] who stated that the optimum dietary inclusion of African locust bean seed meal for finisher diet was 10%. However, observation in this work disagreed with [33] who observed that there was no significant difference (P>0.05) on broiler finishers fed with cooked African locust bean seed meal. It was equally observed in this study as significant reduction in Feed Intake as the level of LBSM was increased to 15% when compared to other treatments. This observation was in line with [39] who observed that at 75% replacement level, the smell of fermented locust bean seed mask the smell of other ingredients, making the diet unacceptable and unpalatable to rabbits. [40], reported a similar observation when he fed rumen content to broilers. However, [41] reported that feed intake increases in animals if the aroma of their diet is pleasant. This could be because; animals detect the acceptability and palatability potential of their feed through nasal sensory perception.

3.8 Body Weight Gain

At finisher phase, there were significant differences (P<0.05) in the body weight gain

among the treatment groups. Broiler finishers fed diets containing 5 and 10% LBSM had better body weight gain compared to those fed with 15% LBSM. Broilers fed the control diet had the poorest body weight gain. This results agrees with that of [33] who observed significant difference in finishers fed cooked African locust bean seed meals at 0, 7.5, 15 and 22.5%. Decrease in Body Weight Gain observed in this study which may be due to high smell of LBSM in the diet. This assertion is in agreement with [42] who reported a decreased body weight gain for broiler finishers, as the level of lablab in their diet was increased. Similar observation was reported by [33] as the level of cooked African locust bean seed meal was increased to 30% there was decrease in the FBW and BWG of broiler finishers.

3.9 Water Consumption

At the finisher phase, the average water intake was significantly different (P<0.05) among the treatment groups. The amount of water consumed was similar in treatment 1, 2, and 4 (263.59 ml/b/d, 290.70 ml/b/d and 290.13 ml/b/d respectively). Treatment 3 recorded higher value (302.45 ml/b/d) which may be attributed to the higher feed consumption. The results were in line with [1] who reported that water intake increase as the feed intake increased. Water consumption in treatment 1, 2, and 4 were in agreement with 285.72 ml/b/d recommended by [43] but lower than 574 ml/b/d reported by [44].

3.10 Feed Conversion Ratio

The Feed Conversion Ratio at finisher phase showed that the broilers fed 5% LBSM had the best FCR of 2.83 while other treatments

recorded similar values of 3.92, 3.15 and 3.64 respectively. The result obtained agreed with findings of [45] who reported a significant difference ($P < 0.05$) among broiler finishers fed crushed, boiled and fermented roselle seed (*Hibiscus sabdariffa*). However, the result disagreed with [33] who reported no significant difference ($P > 0.05$) in the FCR of broiler finishers fed cooked African locust bean seed meal. Also, disagreed with the earlier work of [46] who reported no significant difference ($P > 0.05$) among broiler finisher fed fermented *Parkia biglobosa* seed meal. The feed cost per kilogram gain followed the same trend of the starter with similar value but better for broiler fed 5% LBSM.

3.11 Mortality

There was no significant difference ($P > 0.05$) with respect to mortality rate within the treatment groups. Birds fed with the control diet and those fed with 15% inclusion level of LBSM had zero mortality rate. Treatment 3 had normal recommended level of 5% LBSM [1] while treatment 2 recorded slightly higher value than the above accepted level.

4. CONCLUSION

At the end of the experiment, it was concluded that LBSM can be included in the diet of broilers at starter phase from 5-15% inclusion levels while at finisher phase, diets containing 10 and 15% level of inclusion would be used for better performance and economic benefit with better feed conversion ratio, without any deleterious effect on the growth performance of birds.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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