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Research Article

Utilization of Roselle Seeds (*Hibiscus sabdariffa*) as a Protein Source for Broilers

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Abstract

Background and Objective: Groundnut seed cake and cotton seed cake are conventional ingredients to provide protein in poultry feed. Developing alternative protein sources for poultry nutrition will reduce the pressure on these key protein sources, as well as promote the development and sustainability of the poultry industry. The present experiment was carried out to evaluate the effect of different dietary levels of Roselle seed (*Hibiscus sabdariffa*) on broiler growth performance. **Materials and Methods:** One hundred and 28 days old unsexed hybrid broiler chicks were purchased from Ommat Commercial Company. Birds were distributed randomly into 16 pens (8/pen) as replicates, each treatment with 4 replicates in a complete randomized design. Four experimental diets were formulated with four levels of Roselle seed content of (0, 5, 10 and 15%). Feed and water were provided *ad libitum*. Feed intake, body weight was weekly recorded. Weight gain and feed conversion ratio (FCR) were calculated. Mortality was daily recorded. The experiment lasted for 42 days. Five birds from each treatment were randomly selected, weighed and slaughtered to determine carcass dressing percentage and internal organs weights. **Results:** Average feed intake by birds abating the experimental period were 3310, 2889, 3135 and 3145 g for treatments 0, 5, 10 and 15%, respectively. However, the increased body weight for the four treatments was 1413, 1338, 1333 and 1323 g, respectively. The conversion ratio for the four treatments was 2.20, 2.16, 2.39 and 2.41, respectively. The dressing percentage was 67.58, 67.23, 68.21 and 68.17, respectively. **Conclusion:** The results obtained showed that Roselle seeds can be used as the protein source in broiler diets up to 15% without any adverse effects.

Key words: Roselle seed, protein source, broiler, feed intake, growth performance, carcass, internal organs

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Sudan is one of the biggest countries in Africa, with nearly one million square miles of area, it also has one of the largest livestock populations on the continent which is estimated as 120 millions heads of cattle, sheep, goat and camel¹. The livestock industry is of great importance to the Sudanese economy as the main resource of food and employment cash. Proper utilization of livestock resources can contribute greatly towards the alleviation of the present world decrease in animal protein which is expected to grow continuously due to low livestock productivity adhered deficiency gent increases in consumption of meat due to improvement in the live standard and human population increased in the world². Protein and energy comprise a large proportion of the feed cost of livestock production. Protein is one of the critical nutrients in young growing animals. Improving efficiency increases the availability of eggs and poultry meat to supply the protein needs of populations in countries with expanding demand.

Hibiscus sabdariffa L. (Roselle) belongs to the Malvaceae family which is widely grown in many countries and is cultivated for multipurpose use³. Roselle seeds (*Hibiscus sabdariffa* L.) are considered to be a good source of protein (23%) with a high level of amino acids lysine and tryptophan³.

Roselle is often grown in tropical and subtropical regions and Sudan produces the best Roselle but the quantity is low⁴. Conventional protein supplements in Sudan are the main oilseed industry by-products. Thus, as a result of agriculture intensification, diversification and industrialization policies, developing alternative protein sources for poultry nutrition will reduce the pressure on these key protein sources. One of such protein sources is the Roselle seed cake. Available data on using Roselle seed cakes as an alternative protein source is inconclusive.

Therefore, the objective of the present study was to evaluate the influence of dietary feeding of different levels of Roselle seed as a source of protein on broiler performance and carcass characteristics.

MATERIALS AND METHODS

Study area

Experimental housing and management: The study was carried out at Poultry Research Unit, Faculty of Animal Production, University of Khartoum, Sudan from September to November, 2020 during the time of the experiment, the ambient temperature ranged from 26.5-37.6. The experiment was carried out in an open-sided deep litter poultry house. Four inches thick layer of wood shaving material was laid on the floor of each pen with the allocation of on tubular feed trough and one round fountain drinker, the light was provided for 24 hrs.

Experimental birds: One hundred twenty-eight, one-day-old, unsexed (hybrid) broiler chicks were randomly divided into 4 groups of 32 chicks. Each group was further subdivided into replicates with 8 chicks per pen. For experimental diets were formulated to evaluate the nutritive value of Roselle seed for broiler chicks as a source of protein graded levels of Roselle seed were added, being: 0.0, 5, 10 and 15% (on a dry matter basis) to the basal diet. The ingredients and chemical composition of the experimental diets are presented in Table 1 and 2.

Growth performance

Feed intake: Total feed offered and residue for each pen were recorded daily to calculate group feed intake by difference.

Table 1: Ingredient and chemical composition of experimental diets

Ingredients	Dietary treatments			
	A	B	C	D
Sorghum	62.90	59.86	54.47	52.46
Groundnut cake	16.77	16.99	17.30	17.31
Sesame cake	10.00	8.00	6.20	4.20
Roselle seed	0.0	5.00	10.00	15.00
Wheat bran	1.75	1.10	2.04	0.75
Super concentration	5.00	5.00	5.00	5.00
Lime stone	0.86	0.94	1.00	1.08
NaCl	0.30	0.30	0.30	0.30
Vegetable oil	1.50	1.86	2.70	2.86
Dicalcium phosphate	0.61	0.65	0.69	0.74
Premix	0.30	0.30	0.30	0.30
Total	100	100	100	100

A: Control diet without Roselle seed supplement, B: 5% Roselle seed supplement, C: 10% Roselle seed supplement and D: 15% Roselle seed supplement

Table 2: Chemical composition of Roselle seed

Ingredients	Percentage
Dry matter	95.56
Fat	27.74
Crude protein	30.62
Crude fiber	10.27
Ash	6.49
N.F.E	20.44
Kcal/g (ME) K joule/g	4.186

Live weight gain: The chicks were weighed weekly using a spring balance. Mortality rates and temperatures were recorded throughout the experimental period. At the end of the experimental period, five birds from each replicate were selected randomly, weighed individually, live and hot carcass weight.

Experimental design and statistical analysis: The experiment was conducted using a complete randomized design. Data obtained (feed intake, body weight gain and feed conversion ratio) were tabulated and subjected to Analysis of Variance (one-way ANOVA) using the GLM procedure of SAS⁵. The differences between treatment means were determined using Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Effect of dietary Roselle seeds on broiler performance: The date of average feed intake, body weight gain and feed conversion ratio are summarized in Table 3. Feed consumption increased with an increasing level of Roselle seed in ratio. The group 15% high-level seed consumed more feed (3145.00 g/chicks) than that consumed by group 5% lower Roselle (2889.00 g/chicks). The average body weight at the end of the experimental period showed no significant difference ($p > 0.05$). Performance of broiler chicks in terms of feed consumption, feed conversion and live weight gain showed that the addition of Roselle seeds increased feed consumption with significant results in the 1st and 2nd weeks. Dietary Roselle seed has no significant effect on live body weight ($p > 0.05$). There was no increase in the level of Roselle in diet so the heavy birds were in the group (5% low Roselle to (1338 g) birds in the group (15%) content gained weight (1323 g).

Feed intake: Data showing the effect of feed graded levels of Roselle seeds *Hibiscus sabdariffa* on weekly feed intake is presented in Table 4 the result revealed that the dietary treatment had a significant effect in the 2nd week, ($p < 0.05$) on feed intake in 10% (Roselle) improved feed intake compared diet during the 2nd week. The data showed that

week's first, third, fourth, fifth and sixth had no significant effect on feed intake. The result in these tables showed that feed intake was increased by increasing levels of seed (5, 10 and 15 %) were significantly different ($p < 0.05$) improved feed intake during the 2nd week. This result agreed with⁶. Broiler breeder males showed lower apparent digestibility of Roselle in the 1st week of life than the 2nd and 3rd weeks of the edge. This variation may be due to the chemical composition of Roselle seed used in this study indicated that it contained higher crude protein (30.26%) than the values of 23.8 and 25.2% reported earlier by Owosibo *et al.*⁶ and Ismail *et al.*⁷, who reported protein content levels of 23.8 and 25.2%, respectively. Similarly, the crude fibre content observed in this study was also higher than levels reported by the same authors. The discrepancies might be attributed to the variety of Roselle seeds, geographical location or methods of processing.

Bodyweight: Bodyweight gain data is given in Table 5 showing weekly weight gain as affected by the addition of Roselle to the diet. Birds fed 0% Roselle grew better than those fed higher levels of Roselle (15%). Bodyweight gains were not significantly affected during the last week. Improved body weight gain, was similar to the results of the previous studies⁸. This positive response may be related to the reduction of the fibre content of the Roselle level. The reduction in feed intake may be due to the bitter taste resulting from the saponin content of the raw roselle seed meal⁹. They attributed the effect to the acid test of Roselle that might interfere with the palatability of rations. The poor body weight gain of chicks fed 10 and 15% Roselle observed during the first 3 weeks may be related to the poor feed consumption observed during this period.

Feed conversion ratio: Table 6 shows feed conversion/g, feed consumed/g and body weight gain/g as affected by the addition of Roselle seeds. Data collected showed that feed conversion ratio decreased with increasing level of Roselle seed in diets and with increasing age of chicks (2.20, 2.16, 2.23 and 2.41), respectively for the four treatments, these findings were agreed with results reported earlier⁹⁻¹², affected by increasing of Roselle seed during the whole period, had no significantly different effect. During 6 weeks experimental period, feeding graded levels of Roselle had no significant effect on feed conversion ratio. The influence of dietary treatments on chick's weight gain, feed intake, feed conversion ratio and final body weight Although chicks consuming the control diets showed relatively higher weight gain, none of the treatments had a significant effect on any of the measured parameters.

Table 3: Effect of Roselle seed supplement on the overall performance of broilers

Parameters	Dietary treatments				SEM
	A	B	C	D	
Total feed intake (g)	3110	2889	3135	3145	0.82
Weight gain (g)	1413	1338	1333	1323	0.69
Feed conversion ratio	2.20	2.16	2.39	2.41	1.42
Dressing percentage (%)	67.58	67.215	68.204	68.174	5.08

A: Control diet without Roselle seed supplement, B: 5% Roselle seed supplement, C: 10% Roselle seed supplement, D: 15% Roselle seed supplement, values are means of 4 replicates of 8 birds and SEM: Standard error of means

Table 4: Weekly feed intake (g/bird/week) as affected by the addition of different levels of roselle seeds

Age (weeks)	A	B	C	D	SEM
1	117	119	121	125	12.38
2	271	278	301	256	27.65
3	363	336	360	363	35.53
4	564	503	545	578	54.76
5	697	621	670	673	66.52
6	898	788	855	888	85.72

A: Control diet without Roselle seed supplement, B: 5% Roselle seed supplement, C: 10% Roselle seed supplement, D: 15% Roselle seed supplement, values are means of 4 replicates of 8 birds and SEM: Standard error of means

Table 5: Weekly body weight gain (g/bird/week) as affected by addition of roselle seeds

Age (weeks)	A	B	C	D	SEM
1	60.50	60.50	60.25	56.25	56.25
2	139	139	145	142	9.00
3	207	188	204	210	12.00
4	323	304	314	305	12.00
5	259	252	251	302	37.00
6	426	397	362	308	55.00

A: Control diet without Roselle seed supplement, B: 5% Roselle seed supplement, C: 10% Roselle seed supplement, D: 15% Roselle seed supplement, values are means of 4 replicates of 8 birds and SEM: Standard error of means

Table 6: Effect of dietary Roselle seeds on weights of internal organs

Parameters	A	B	C	D	SEM
Hot Carcass weight	1042.450	951.600	1014.400	1028.000	33.463
Cold Carcass weight	1021.350	914.150	975.100	997.850	33.493
Liver	35.090	32.829	36.188	34.915	1.214
Heart	7.794	5.552	8.381	7.870	2.75
Intestine	60.771	59.899	59.861	63.314	2.993
Gizzard	34.775	29.861	32.890	35.847	1.547
Abdominal	28.548	24.990	27.240	26.570	1.860
Intestine length	174.000	178.350	172.700	175.650	4.805

A: Control diet without Roselle seed supplement, B: 5% Roselle seed supplement, C: 10% Roselle seed supplement, D: 15% Roselle seed supplement, values are means of 4 replicates of 8 birds and SEM: Standard error of means

Internal organs: Table 6 illustrates the effect of dietary Roselle seeds (*Hibiscus sabdariffa*) on weights of internal organs and percentage (g). Dietary treatments had no effects on internal organs such as the liver and spleen, which is in line with the previous reports¹³.

Overall, the use of Roselle seed as a protein source for broiler chicken up to 15% without any adverse effect, suggesting that Roselle seed could be a local, low cost and available alternative protein source for the poultry industry replacing other high-cost sources like fish meal and meat

meal. More research is required to investigate meat quality and the economical value of replacing conventional protein sources with Roselle seeds in broiler diets.

CONCLUSION

The results have shown that the inclusion of Roselle (*Hibiscus sabdariffa*) seeds in broiler diets up to 15% had no adverse effect on feed intake, feed conversion ratio, growth performance, carcass characteristics or internal organs.

SIGNIFICANCE STATEMENT

This study discovered that the *Hibiscus sabdariffa* seeds could be added to broiler's diets as an alternative protein source. Although the highest level used in this study had no significant effect on the growth performance of broilers, however, this study will help the researchers to reveal locally available protein sources for broiler chickens.

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