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Effects of Utilization of Crushed, Boiled and Fermented Roselle Seeds *(Hibiscus sabdariffa)* on the Performance of Broiler Chickens

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Authors' contributions

All authors were involved in the design of the study, statistical analysis, wrote the protocol, and wrote the draft of the manuscript. The corresponding author MMA is the lead Researcher.

Original Research Article

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ABSTRACT

Aim of Study: The study examines the effects of utilization of crushed (CRRS), boiled (HTRS) and fermented (FRS) Roselle seeds (*Hibiscus sabdariffa*) on the performance of broiler chickens
Study Design: A total of 135 Anak day-old broiler chicks were randomly assigned to three (3) experimental groups of three (3) replicates using completely randomized design, data collected were subjected to ANOVA using SPSS and Likert scaling technique.
Place and Duration of Study: Livestock Complex, College of Agriculture, Lafia, Nasarawa state, Nigeria: February 2012 to April 2012.
Methodology: The effects of inclusion of differently processed Roselle seeds on performance traits of experimental birds were evaluated through feeding trials (1- 28 d) and (29- 50 d) at starter and finisher phases. Dietary treatments were as follows: D1, D2 and D3 representing Crushing of Raw Rosselle Seeds (CRRS); Hydrothermally Processed Rosselle Seeds (HTRS) and Fermented Rosselle Seeds (FRS) base diets.
Results: No significant (P=0.05) difference in the following parameters: initial weight, feed

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intake, FCR and survival percentage in the starter phase while the finisher phase significantly (*P*=0.05) differ only the performance index. Overall scoring of performance parameters showed those birds in D3 group were better than D2 and D1 in that order
Conclusion: Roselle seeds inclusion in broiler diets provides effective mechanism for the improvement in performance traits of broilers and fermentation of rosselle *(Hibiscus sabdarif)* is best processing method.

Keywords: Broilers; Rosselle seeds; Processing and Performance traits.

1. INTRODUCTION

Alternative plant protein sources and their nutritional potentials in the diets of monogastrics and human in developing countries like Nigeria have been highlighted [1, 2, 3 and 4]. *Hibiscus Sabdariffa* is fast gaining prominence as one of the replacement of rich plant proteins in human, livestock and fisheries nutrition on account of cost and nutritional composition [5]. Roselle seed meal is presently sold in some Nigerian markets at one third of the cost of soybean meal, thus Roselle seed meal represent attractive replacements for soybean meal in the diets of broilers from the standpoint of economics, availability and nutritional value.

Other nutritional benefits of Roselle seeds documented include the bioavailability of its nutrients particularly digestible protein (DP) and digestible energy (DE) [6,7]. However, these benefits are dependent on many factors, these include among others, sources and species of hibiscus and the processing method used before inclusion into the diets.

Therefore, the objectives of this study is to evaluate the effects of inclusion of raw, thermally processed and fermented Roselle seeds in the diets of broilers and its effects on performance traits.

2. MATERIALS AND METHODS

2.1 Experimental Site

This study was conducted at the Livestock Complex of College of Agriculture, Doma Road, Lafia which is located between latitude 8° and 9° North and longitude 80^{0} and 90^{0} East. The minimum temperature is 21.9°C and maximum temperature of 37.6^{0}C between January to June and the average annual rainfall is 823mm. The test ingredients were processed at both the Livestock Complex and the Nutrition Laboratory of the College, while the final feed was compounded at the feed mill unit of the complex.

2.1.1 Rosselle seed collection, processing and diet preparation

Rosselle seeds *(Hibiscus Sabdariffa)* was procured from a local market in Langtang South of Plateau State, Nigeria. The collected seeds were cleaned by winnowing and hand picking of stones and debris. The raw Roselle seeds were subjected to three processing methods viz: crushing of raw Roselle seeds (T1), hydrothermal (T2) and fermentation (T3). Each of these processing methods of Roselle seed served as test ingredient and was used as a replacement of soyabean meal in the broiler diets; these represent experimental treatment groups. The different processing methods of Roselle seed are described as thus:

2.1.1.1 Crushing of raw rosselle seeds (CRRS) - (T1)

Roselle seeds were cleaned by removing dust, stones and plant debris. The seeds were milled using a laboratory scale hammer miller and sieved through a 30mm mesh screen according to the methods described by [5]. The milled and bagged Roselle seed represents experimental treatment (1) (CRRS).

2.1.1.2 Hydrothermally processed rosselle seeds (HTRS) –T2

The method adopted by [8] was used. The cleaned seeds were poured into aluminum tower pot containing 50 litres of clean water in a batch of 50 Kg. The Roselle seeds sample was allowed to boil at 100^0C for 30 minutes before cooling by spreading on jute bags until stable weight was attained at room temperature. The cooked, milled and bagged Roselle seed represents experimental treatment (2) (HTRS).

2.1.1.3 Fermented Rosselle Seeds (FRS) –T3

The raw roselle seeds were sorted to ensure cleaned grains. The cleaned Roselle seeds were poured into a drum of 50 litres of boiling water per batch of 50kg Roselle seeds and allowed to boil at 100^oC for 30 minutes according to the method described by [2]. The boiled grains were drained, cooled to room temperature and placed in a leaf-lined basket covered with further leaves and kept for 48 hours. The products were sum dried and milled. The Fermented, milled and bagged Roselle seed represents experimental treatment (3) (FRS).

2.2 Experimental Treatment

A total of 135 Anak day-old broiler chicks were randomly divided into three (3) experimental groups of three replicates each. Dietary treatments were as follows: D1, D2 and D3 which had: Crushing of Raw Rosselle Seeds (CRRS); Hydrothermally Processed Rosselle Seeds (HTRS) and Fermented Rosselle Seeds (FRS) as replacement of soyabeans at both starter and finisher phases using completely randomized design. The incorporation of test ingredients served as the main source of variations. The starter diets were fed for four (4) weeks (1- 28 d) brooding phase and the finisher diets were fed for three (3) weeks (29- 50 d). The experimental feeds were formulated using a least cost feed formulation software *Feedwin*.

2.3 Data Collection

2.3.1 Performance parameters

The following parameters were measured and computed from the data generated from daily and weekly recordings during the feeding trials: feed intake, body weight, bodyweight gain, feed conversion ratio (feed: gain), mortality, survival percentages and performance index according to the methods adopted by [9].

2.3.2 Chemical analysis

The chemical composition of each of the processed rosselle seed samples and experimental diets were determined following standard methods [10]. Crude protein (N*6.25) was determined by the Kjeldahl method after acid digestion (Gerhardt, Königswinter, Germany).

Crude fat analysis without acid hydrolysis was determined by the ether-extraction method using a Soxtec System (Gerhardt, Königswinter, Germany). Moisture was determined by oven drying at 105°C until a constant weight was achieved. Ash content was estimated by incinerating the samples in a muffle furnace at 600 ^{0}C for 6 h. Total Carbohydrates (Nitrogen-free extract) was determined by difference and calculated thus: 100% - %(CP+ Ash + Crude Fat + Moisture).

2.4 Statistics

Data collected were subjected to One-way Analysis of Variance (ANOVA), means were separated (*P*=0.05) where there were significant differences using Duncan's Multiple Range Test [11] using SPSS 16.0 [12]. Qualitative evaluation techniques (Likert scaling) according to the methods described by [13] was used to draw conclusions on overall parameters measured.

3. RESULTS AND DISCUSSION

The chemical composition of the crushed, boiled and fermented Roselle seeds is presented in Table 1. Dry matter (DM) values ranged from 90.40 to 91.39% respectively for hydrothermal and crushed seeds while crude protein (CP) ranged from 19.54% to 23.43% for crushed and fermented seeds respectively. Crude fibre (CF) on the other hand had values ranging from 3.30% to 4.52% for fermented and crushed seeds respectively. The highest value of ether extract (EE) was obtained in fermented rosselle (6.58%) while the least (5.70%) was obtained in crushed seeds. Total ash ranged from 5.39% to 6.94% while total carbohydrates expressed as nitrogen free extract (NFE) ranged from 50.43 to 55.36%. The highest calcium (Ca) and phosphorous (P) values were 1.12 and 0.56% in hydrothermal and fermented Roselle seeds respectively. These findings are similar to the chemical composition of Roselle seeds reported by [14], [15] and [16].

Table 1. Effect of processing on the Chemical composition of Rosselle (*Hibiscus sabdariffa*) seeds

	Chemical composition (%)							
Methods of Processing	**Dry Matter**	**Crude protein**	**Crude Fibre**	**Ether Extract**	**Total ash**	**NFE**	**Ca**	**P**
Crushing of raw seeds	91.39	19.54	4.52	5.70	6.27	55.36	0.71	0.38
Hydrothermal	90.40	21.84	3.60	5.85	5.39	53.72	1.12	0.56
Fermentation	90.68	23.43	3.30	6.58	6.94	50.43	0.30	0.56

The composition of the experimental diets is presented in Table 2. The experimental diets are within recommended range [17]. The variations in the nutrient composition of the experimental diets at both starter and finisher phases were also within recommended range for birds in the tropics as reported by [18].

The performance parameters of broilers fed crushed, boiled and fermented Roselle seeds (*Hibiscus sabdariffa*) based diets are presented in Table 3. Effects of different processing methods of Roselle seeds did not differ significantly (*P*=0.05) in the following parameters: initial weight, weight gain, FCR and survival percentage in the starter phase while the finisher phase significantly (*P*=0.05) differ only in the performance index. The best values for body weight gain were broilers fed Diets 2 and 3 (536.36g and 990.38g) at the starter and

finisher phases respectively. Diet 3 group presented higher feed intake values of 624.39g and 1272.67g in both the starter and finisher phase of the feeding trials. However, the best values recorded for FCR (1.18 and 1.41) in the starter and finisher phases were for diet 2 group. The survival percentage and performance index values were better with D3 group (94.67% and 4536.36) respectively in the starter phase while in the finisher phase D2 group presented better values of 96.5% and 8550.75 respectively for survival percentage and performance index.

Table 2. Composition of Experimental Diets

	Starter phase			Finisher phase		
	D1	**D2**	**D3**	**D1**	**D2**	**D3**
Maize	27.00	27.00	27.00	34.00	34.00	34.00
Maize Bran	3.25	4.00	4.00	3.25	3.25	3.25
Cassava	14.50	14.50	14.30	14.45	14.45	14.45
Soya toasted	18.55	17.80	18.00	13.00	13.00	13.00
CRRS	25.00	-	-	23.00	-	-
HTRS	-	25.00	-	-	23.00	-
FRS	-	-	25.00	-	-	23.00
Blood Meal	2.00	2.00	2.00	3.50	3.50	3.50
Fish Meal	5.00	5.00	5.00	3.00	3.00	3.00
Bone Meal	3.50	3.50	3.50	3.50	3.50	3.50
Palm Oil	0.50	0.50	0.50	1.60	1.60	1.60
L-Lysine	0.10	0.10	0.10	0.10	0.10	0.10
DL-Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
**Calculated						
ME/Kcal/kg	3126.85	3112..95	3104.73	3193.08	3185.74	3177.18
CP%	21.15	21.50	21.97	19.37	19.90	20.26
Determined analysis						
D M (%)	92. 73	92. 78	92. 69	92.95	93.43	92.83
CP (%)	21.05	21.33	21.73	19.83	19.95	20.17
CF (%)	4.82	4. 38	4.36	4.71	4.34	4.39
EE (%)	7.71	7.64	8.02	8.62	8.42	8.84
T Ash (%)	14.67	15.19	15.23	10.31	9.96	10.26
Ca	1.10	1.15	1.06	0.98	1.06	0.97
P	0.77	0.79	0.79	0.68	0.71	0.68
NFE (%)	43.93	43.04	34.08	49.48	50.76	49.17

**Premix to provide the following per KG of diet: Vitamin A, 9,000 IU; Vitamin D3, 2,000,IU; vitamin E, 18 IU; vitamin B1, 1.8 mg; vitamin B2, 6.6 mg B2,; vitamin B3, 10 mg; vitamin B5, 30 mg; vitaminB6, 3.0 mg; vitamin B9, 1 mg; vitamin B12, 1.5 mg; vitamin K3, 2 mg; vitamin H2, 0.01 mg; folic acid, 0.21 mg;nicotinic acid, 0.65 mg; biotin, 0.14 mg; Choline chloride, 500 mg; Fe, 50 mg; Mn, 100 mg; Cu, 10 mg; Zn, 85 mg;I, 1 mg; Se, 0.2 mg.*

*** Calculated using feedwin software*

****DM (Dry Matter); CP (Crude Protein); CF (Crude Fibre); EE (Ether Extract); T Ash (Total Ash); Ca (calcium); P (phosphorous); NFE (Nitrogen Free Extract)*

*****Crushed Raw Rosselle Seeds (CRRS); Hydrothermally Processed Rosselle Seeds (HTRS); Fermented Rosselle Seeds (FRS)*

Table 3. Effects of utilization of crushed, boiled and fermented roselle seeds (*Hibiscus sabdariffa*) on the performance of broiler chickens

Parameters	D1 Starter diets	D2	D3	SEM	D1 Finisher diets	D2	D3	SEM
Initial weight(g)	40.70[a]	41.32[a]	41.16[a]	±0.27	561.88[a]	580.66[a]	655.75[a]	±33.55
Feed intake(g)	544.33[b]	545.32[b]	624.39[a]	±16.78	1184.39[b]	1139.79[c]	1272.67[a]	±24.70
Weight gain(g)	408.44[a]	486.12[a]	536.36[a]	±45.60	812.66[a]	940.44[a]	990.38[a]	±136.25
FCR	1.34[a]	1.18[a]	1.22[a]	±0.10	1.54[a]	1.41[a]	1.44[a]	±0.20
Survival percentage (%)	91.00[a]	92.67[a]	94.67[a]	±0.67	94.00[a]	96.50[a]	94.57[a]	±0.48
Performance index	2798.20[a]	4207.58[a]	4536.36[a]	±724.51	5507.23[a]	8550.75[a]	8056.34[a]	±2082.24

[abc]means in the same row with the same superscript are not significantly (P>0.05) different
SEM: Pooled Standard Error of Mean

A qualitative evaluation represented by overall scoring of performance parameters measured showed that the lowest mean score was 1.17 for D1 group in both the starter and finisher phases while the highest mean score was 2.83 and 2.67 all recorded in D3 group in the two phases of the experiment respectively.

The observed similarities in most of the performance evaluation traits in both the starter and finisher phases was as a result of the absence of major anti nutritional factors as reported by [14] and [2] and the nutrient balance of the experimental diets [17] at both the starter and finisher phases. Another factor of interest is the nutritional characteristics of Roselle seeds which supports the bioavailability of nutrients, particularly digestible protein and digestible energy [6, 7].

A qualitative comparison of the dietary treatment groups showed the nutritional superiority of fermented Roselle seed based diet. This was due to the fermentation process which is recognized as converter of food compounds into structurally related but financially more viable food through the activities of microbial cells [2]. This finding is supported by various reports on the effect of different fermentation methods on the health and growth responses of broiler chickens [1]. The synergistic effect of beneficial fermentation microbes and host microorganisms must have led to reduction in the count of pathogenic bacteria and increased the population of useful micro flora in gut, resulting to improvement in the gastrointestinal health and performance of boilers as reported by [14] and [2]. Other factors that may be responsible could be the positive effects of fermentation originating from the enzymes of the seed itself.

4. CONCLUSION

This study showed that Roselle seed is a rich source of nutrients that will provide useful replacement of conventional oilseeds in broiler feeds. Fermentation of Roselle *(Hibiscus sabdarif)* is thus an effective mechanism for the improvement of performance traits of broilers. Therefore, fermentation could be introduced as a safe and natural process for improving the utilization of Roselle seeds in broiler diets.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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