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UTILIZATION OF FERMENTED SORREL (*Hibiscus sabdariffa L.)* SEED MEAL BY WEANER RABBITS

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ABSTRACT

A 56-day study was conducted to determine the biochemical composition of fermented sorrel seed meal (FSSM) and its effect on the growth performance, carcass characteristics and internal organ weights of weaner rabbits. Forty (40) weaner rabbits with an average weight of 556.89 ±0.10g were randomly assigned to five treatment groups of 8 rabbits per treatment replicated four times with 2 rabbits per replicate in a completely randomized design (CRD) for eight weeks. Five experimental diets were compounded using FSSM at 0, 10, 20, 30 and 40% inclusion levels. The levels of inclusion were designated as Diets 1, 2, 3, 4 and 5 respectively. The results of the growth performance were not significant (P>0.05). The result also showed no significant differences (P>0.05) in carcass characteristics and internal organ weights. It was therefore concluded that fermented sorrel seed meal can be included in weaner rabbit diets up to 40% level.

Keywords: *carcass, fermented sorrel seed meal, growth, internal organs, weaner rabbits*

INTRODUCTION

Soybean meal (SBM) has been recognized as a conventional protein source in the formulation of poultry and rabbit ration Tang *et al.* (2012). However, high cost of SBM recently has necessitated animal nutritionists to search for alternative sources that are cheaper and readily available. Sorrel seed (*Hibiscus sabdariffa* L.) is consider as one of such plant. The plant is well adapted to both Guinea and Sudan savanna vegetation of Nigeria (Alagbejo, 2000). The raw seed on dry matter basis contains 35.90% crude protein, 10.14% ether extract, 10.09% ash and 15 - 17% crude fiber (Dashak and Nwanegbo 2002; Kwari *et al*., 2011) and also appreciable amount of minerals such as phosphorus, calcium and magnesium (Ismail *et al*., 2008). The seed has also been reported to possess anti-oxidative and anti-hypercholesterolemic properties (Ismail *et al.*, 2008; Mahadevan *et al.* 2009). However, the seed have been reported to contain anti-nutritional factors such as total phenols, tannins and phytic acid, saponins and alkoloids which have limited its utilization by monogastric animals (Diarra *et al.*,2011 and Wafar, 2013). Hence, proper processing of the seed to aid its utilization by non - ruminant animals is necessary.

Several processing methods have been employed towards reducing the anti-nutritional factors in sorrel seeds to make it useful especially to monogastric animals (Diarra *et al.* 2011, Kwari *et al*., 2011; Wafar 2013 and Ashom *et al.*, 2014). These authors concluded from their studies that sorrel seed can be improved through processing. One of the processing methods focused in this study is fermentation. According to Yakubu *et al.* (2017) fermentation is the breaking down of complex organic substances into simpler ones through the action of enzymes. Through fermentation, B- vitamin is synthesized, mineral extraction abilities increased, as well as reduction in anti-nutrient and fiber contents of feed materials (Oboh, 2006; Aro *et al.*, 2008; Badau *et al*. (2015). A study by Yakubu *et al.*, (2017) showed that natural fermentation of Jatropha seed improved its utilization in broiler chicken. Recently, Tuluen *et al.* (2011), reported that natural fermented mucuna seed replaced soyabeans meal in broilers chickens' diet up to 20% without any deleterious effects on their performance. These reports suggest that natural fermentation could be a promising method in detoxifying anti- nutritional factors in the leguminous seed. This study was therefore conducted to evaluate the growth performance, carcass yield and internal organs characteristics of weaner rabbits fermented sorrel seed meal.

MATERIALS AND METHODS

Sorrel seeds were procured from Yola market, Adamawa State, Nigeria. 50kg kapok seed was cleaned of debris and cooked for one hour using metallic pot. The pot was placed on a tripod stand having firewood as a source of heat. The timing of the cooking started at the point of boiling after the seeds were introduced. The water was drained immediately after cooking and the seeds packed in a polythene bag to allow natural fermentation to take place. The fermentation process lasted for 120 hours (5days). The fermented sorrel seeds were sundried and milled using hammer milling machine to produce fermented sorrel seed meal (FSSM).

EXPERIMENTAL DIETS, DESIGN AND MANAGEMENT

Five experimental diets containing 0, 10, 20, 30, and 40% FSSM were formulated (Table 1). Forty (40) weaner rabbits with an average weight of 556.89 ±0.10g were randomly assigned to the five treatment groups of 8 rabbits per treatment replicated four times with 2 rabbits per replicate in a completely randomized design. The rabbits were housed in cage measuring 150cm x100cm x120cm in a three-tier hutch system raised 90cm above the floor. The cages were fitted with aluminum feeders and drinkers. The animals were treated against internal and external parasites using Endovef® (Ivermectin) at the dose of 0.3 mg/kg subcutaneously and also treated prophylactally against coccidiosis with Amprole 200® according to the manufacturer's prescription.

DATA COLLECTION

GROWTH PERFORMANCE MEASUREMENTS

Feed intake was determined as the difference between the quantity of feed offered and feed leftover. Similarly, total body weight gain was determined as the difference between the final body weight and initial body weight recorded at the beginning of experiment. Feed conversion ratio was calculated the ratio of feed intake to weight gain.

CARCASS AND INTERNAL ORGANS EVALUATION

One rabbit from each replicate was randomly selected for carcass and internal organs evaluation according to the method described by Yakubu and Wafar (2014). The rabbits were weighed individually, slaughtered and de-pelted completely to obtain pelt weight. The internal organs were removed carefully and weighed using electronic sensitive scale and expressed as percentages of their live bodyweight. The dressing percentage was calculated as a ratio of carcass weight and live weight multiplied by 100.

Table 1: Ingredient Composition of experimental diets (8 weeks)

	Dietary treatments				
Ingredient	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	T5 (40%)
Maize	53.50	53.50	53.50	53.50	53.50
FSSM	0.00	2.50	5.00	7.50	10.00
Soyabean (fullfat)	25.00	22.50	20.00	17.50	15.00
Fishmeal	3.00	3.00	3.00	3.00	3.00
Maize Offal	15.00	15.00	15.00	15.00	15.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Determined analysis					
Dry matter	90.67	90.12	90.34	90.04	90.12
Crude protein	17.79	17.78	17.76	17.75	17.74
Crude fibre	4.28	4.37	4.46	4.55	4.65
Ether extracts	7.20	6.88	6.59	6.24	5.92
Ash	4.29	4.37	4.46	4.55	4.65
NFE	66.44	66.60	66.73	66.91	67.04
ME (Kcal/kg)	3118.00	3117.02	3116.03	3115.05	3114.07

Vitamin-mineral premix provider per kg the following: Vit. A 1500 IU; Vit.D_3 3000 IU; Vit.E 30 IU; Vit. K 2.5 mg; Thiamine 3 mg; Riboflavin 6 mg; Pyrodoxine 4 mg; Niacin 40 mg; Vit. B_{12} 0.02 mg; Pantothenic acid 10 mg; Folic acid 1 mg; Biotin 0.08 mg; Chloride 0.125 mg; Mn 0.0956 g; Antioxidant 0.125 g; Fe 0.024 g; Cu 0.006 g; Se 0.24 g; Co 0.240 g,
ME= Metabolizable energy

LABORATORY ANALYSIS

The proximate composition of raw, fermented sorrel seed meal and experimental diets were determined according to methods described by AOAC (1990).

STATISTICAL ANALYSIS

Data generated were subjected to one-way analysis of variance (ANOVA) according to Steel and Torrie, (1980) and significant differences between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSION

PROXIMATE COMPOSITION OF RAW AND FERMENTED SORREL SEED MEALS

Table II showed the result of proximate composition of raw and fermented sorrel seed meal. Raw sorrel seed meals (RSSM) recorded 88.37% dry matter (DM) content and it increased to 91.32% after fermentation. FSSM recorded higher crude protein (CP) content of 36.95% compared to the raw seed (30.23%). The ash content increased from 4.12% in the raw seed to 7.22% in the fermented seed. Higher ether extracts (EE) (5.25%) was observed in the fermented sorrel seed meal as against 4.23% in the raw seed. Crude fibre (CF) content (14.32%) was higher in the raw seed compared to 9.22% in the fermented seed. Nitrogen free extract was 41.39% in the fermented as against 47.10 in the raw. The values for alkaloid, phenol, glycosides, flavonoids, tannin and saponins were 2.16, 3.14, 2.84, 2.56, 2.13 and 1.72mg/100g in the raw seed respectively while fermented seed values were 1.00, 1.32, 0.99, 1.03, 0.93 and 0.62mg/100g respectively.

The DM value observed were within the range of 87.90 - 94.30% for raw seeds and differently processed sorrel seed by Duwa *et al.* (2012). The increase in DM content of sorrel seed meal after processing has been reported by Ari *et al.* (2015). Higher CP content observed in fermented seed could possibly be due to the modification effect of the fermentation process that leads to crude protein improvement. The CF content of the raw and fermented sorrel seed is within the value of 13.01 – 15.50% CF reported by Duwa *et al.* (2012) for raw and differently processed sorrel seed meal, but higher than the range of 5.55 – 6.16% reported by Ari *et al.* (2015).The variations in the nutrient composition when compared to other studies could be attributed to the differences in agronomic practices, laboratory analysis and edaphic factors (Taiwo *et al.,* 2005).

The result of the anti-nutritional factors (ANFs) in the seed showed that the raw seed has the highest concentration of all the ANFs. It is an indication that fermentation influenced the concentration of ANFs and increased the nutrient composition of sorrel seed, but did not influence the complete removal of the ANFs. The finding is in line with the report of Makkar *et al.* (1998), Wafar (2013) and Yakubu *et al.* (2017) when they subjected tropical legume seeds to different processing methods and recorded partial reduction of ANFs in the seeds

Table 2: Proximate composition of raw and fermented sorrel seed meal (FSSM) (8 weeks)

Parameters (%)	Raw	Fermented
Dry matter	88.37	91.32
Crude protein	30.23	36.95
Crude fibre	14.32	9.22
Ether extracts	4.23	5.25
Ash	4.12	7.22
Nitrogen free extracts	47.10	41.36
*ME Kcal/Kg	3133.19	3260.68
Anti- nutritional factors (mg/100g)		
Tannin	2.13	0.93
Saponin	1.72	0.62
Phenol	3.14	1.32
Alkaloid	2.16	1.00
Glycosides	2.84	0.99
Flavonoids	2.56	1.03

*ME(Kcal/kg) was calculated using the formula of Pauzenga (1985). ME = 37 × CP + 81× EE + 35.5 × NFE

GROWTH PERFORMANCE OF WEANER RABBITS FED FERMENTED SORREL SEED MEAL

The result of the growth performance of rabbits fed processed fed fermented sorrel seed meal is presented in Table III. The result showed no significant differences (P>0.05) between the dietary treatments for the parameters measured. Final body weight varied from 1770.12 – 1784.91g/rabbit. Average daily feed intake (ADFI) ranged from 100.56g in T2 to 102.56g in T4 while average daily weight gain (ADWG) and Feed conversion was between 21.65g in T3 to 21.94g in T1 and 4.62 in T1 and T2 to 4.74 in T4. The daily feed intake of rabbits observed were higher than range of 23.78 to 24.04g/day reported by Amaefule *et al.* (2004) and 64.72 -76.07 g/day reported by Biobaku and Dosumu, (2003) for rabbit raised under tropical conditions. However, the values are within the range of 91.25 – 175.41 reported by Kpanja *et al.* (2016) for rabbits fed fermented castor seed meal. Also, the daily weight gain and final body weight were higher than the range of 16.19 to 20.11 g/day and 1154.00 to 1185.63g reported by Ani and Ugwuowo, (2011) and Yakubu and Wafar, (2014). The non- significant differences in growth parameter measured could be due to the fact that fermentation reduced the ANFs in the sorrel seeds to a level that could not cause deleterious effect on the rabbit.

Table 3: Growth performance of weaner rabbits fed fermented sorrel seed meal (8 weeks)

	Dietary treatments						
Parameter	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	T5 (40%)	SEM	p-value
Initial body weight (g)	556.30	556.50	555.60	557.37	556.85	0.55	0.12[ns]
Final body weight (g)	1784.91	1775.18	1767.78	1770.12	1783.17	1.77	1.45 [ns]
Total body weight (g)	1228.61	1218.68	1212.18	1212.75	1226.32	1.21	1.82 [ns]
Average daily weight (g)	21.94	21.76	21.65	21.66	21.90	0.02	0.34 [ns]
Average daily feed intake (g)	101.43	100.56	101.67	102.56	101.45	0.10	0.67 [ns]
Feed conversion ratio	4.62	4.62	4.70	4.74	4.63	0.04	0.11 [ns]

ns = not significant (P<0.05), SEM= Standard error mean

CARCASS CHARACTERISTICS AND INTERNAL ORGANS WEIGHTS OF WEANER RABBITS FED FSSM

The results of carcass characteristics and internal organs weights are shown in Table IV. The result showed no significantly (P>0.05) different in all the parameters evaluated. This is similar to the finding of Tuleun *et al.* (2011) who reported no significant effect in carcass characteristics of broiler chicken fed naturally fermented mucuna seed meal. The live body weight values obtained in this study are higher than the range 1603.00 – 1621.00g reported by Tarimbuka *et al.* (2017) but within the range 985.08-1960.08 recorded by Omoikhoje *et al.* (2016). The dressed weight observed is higher than the range of 550 -820 g reported Tarimbuka *et al*. (2017) and 499.0- 592.00 g recorded by Wafar and Tarimbuka, (2016). The result of internal organs expressed as percentage of live weight were not significantly (P>0.05) affected by the level of FSSM in the diets. This suggests that cooking and fermentation process have rendered the level of anti- nutrients in raw sorrel seed inactive. Several studies have shown that the presence of anti-nutrients in high concentration causes growth depression and hypertrophy of organs such as liver and kidney. It is evident that feeding weaner rabbit with fermented sorrel seed meal did not affect these organs.

Table 4: Carcass characteristics and internal organs weight of weaner rabbits fed FSSM (8weeks)

Parameter	D1 (0%)	D2 (10%)	D3 (20%)	D4 (30%)	D5 (40)	SEM	p-value
Live body weight (g)	1782.11	1770.12	1742.9	1768.1	1781.67	1.76	0.24 ns
Pelt weight (g)	110.67	111.78	112.89	110.45	109.58	0.11	0.89 ns
Dressing weight (g)	980.9-	981.78	979.90	980.56	981.6	0.98	0.23 ns
Dressing %	55.04	55.46	56.22	55.46	55.09	0.56	0.13 ns
Internal organ weights (% live weight)							
Lungs	0.47	0.48	0.46	0.53	0.51	0.10	1.78 ns
Heart	0.21	0.18	0.18	0.20	0.20	0.10	0.45 ns
Liver	2.29	2.15	2.06	2.39	2.16	0.49	0.43 ns
Kidney	0.51	0.52	0.55	0.54	0.55	0.15	0.42 ns
Stomach	4.23	4.20	4.28	4.13	4.39	0.14	0.78 ns
Small intestine	6.13	6.08	6.36	6.21	5.82	0.06	1.69 ns
Large intestine	3.56	3.23	3.56	3.51	3.45	0.03	0.45 ns
Ceaca	0.38	0.37	0.35	0.37	0.38	0.07	0.24 ns
Small intestine length (cm)	65.89	65.23	64.34	67.34	64.89	0.65	0.34 ns
Large intestine length (cm)	18.78	18.67	17.99	18.03	18.67	0.18	2.45 ns

ns = not significant (P<0.05), SEM= Standard error mean

CONCLUSION

The result from this study showed that fermentation improves the crude protein content of sorrel seed meal as well and as well reduced the anti-nutritive factors. The growth performance parameters, carcass characteristics and internal organs were similar across the dietary treatments. In conclusion, fermented sorrel seed meal can be included in rabbits' diet up to 40% levels without adverse effect on performance, carcass characteristics and internal organs of rabbits.

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