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The growth performance and haematology of cockerel chicks fed with sweet orange *(Citrus sinensis)* fruit peel meal

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ABSTRACT

This study was conducted to determine the growth performance and haematology of Isa Brown cockerels to graded levels of sun-dried sweet orange (Citrus sinensis) fruit peel meal (SOPM). Five different diets namely the control(T_0) and four test diets T_1, T_2, T_3 and T_4 in which SOPM replaced maize 0 %, 2.50 %, 5.0 %, 7.50 and 10.00 % respectively. Each diet served as a treatment and each treatment was replicated 3 times in a completely randomized design. There were 10 birds per replicate making a total of 150 birds for the study. The experiment lasted 8 weeks. The results obtained showed significant ($P < 0.05$) decrease in final weight, weight gain and feed intake as the level of SOPM in the diet increased. Feed conversion ratio and protein efficiency ratio were not affected. No mortality was recorded. The value of haematological parameters obtained in this study was not significantly ($P< 0.05$). The results of this study show that SOPM is not a suitable alternative to maize in the form it was used.

Key words: Sweet orange peel, growth performance, haematological parameters, cockerels.

INTRODUCTION

Nutrition plays an important role in intensive chicken production [8]. Feed represents between 70 – 80 % of the variable costs of production [2] in a typical poultry enterprise. Efforts are being made by animal nutritionists to explore the possibilities of incorporating unconventional feedstuffs either from protein or energy sources instead of the conventional feedstuffs such as fishmeal, soyabean meal and maize which constitute the largest part of balanced diet for livestock and poultry [10] [19]. Cereal grains especially maize which forms the bulk of energy in poultry feeds are in short supply as a result of industrial and human needs [6]. This has resulted in competition between human and animal for available feed resources, and hence high cost of animal production [4]. It is for these reasons that animal nutritionists try to replace part of maize as the main energy source by non-conventional energy sources such as peels of sweet orange [17] provided that the optimum energy level in the diet of chicken is attained. These workers also reported that sweet orange (*Citrus sinensis)* rind can be used to replace maize in the diet of broilers up to 15 % level without any adverse effect on performance and that inclusion of sun-dried sweet orange rind as a replacement of high cost maize in broiler diet reduced the cost of the diet. However one of the problems encountered in the utilization of sweet orange peel is the presence of anti-nutritional factors namely; limonene, saponin, tannin, oxalate, phytate which are able to impair nutrient utilization particularly by the monogastric animals [19]. Another

difficulty is its fairly high crude fibre content which has been reported to be in the range of 12.9 % to 14.6 % [18]. A number of processing techniques such as sun drying [16], toasting [26] soaking in water [25], cooking [3] roasting [14] and fermentation [18] have been reported to improve the nutritive value of many of the identified alternative feed resources with varied effects on the performance of farm animals.

The present study was aimed at evaluating the effect of replacement of maize by dried sweet orange peel meal as unconventional feedstuff on growth performance and haematological parameters of Isa brown cockerels.

MATERIALS AND METHODS

This study was carried out at the Dancel Poultry Farm, Makurdi (07^0, 41^1 N, $08^0 37^1$E) Benue State, Nigeria. The sweet orange fruit peels used for this experiment were obtained from orange retailers within Makurdi metropolis. The peels were immediately sun-dried for 36 hours on concrete platforms before milling. Samples of the peels were analysed for its proximate constituents using standard methods [5], (Table 1). The qualitative and quantitative presences of phytonutrients (Table 2) were determined with the methods described by [9], [21] and [23]. Experimental rations were formulated containing sweet orange peel meal (SOPM) at 0.0, 2.5, 5.0, 7.5 and 10.0 % respectively (Table 3). Each diet constituted a treatment and each treatment was replicated three times. There were 10 birds per replicate making a total of 150 birds for the study. The design was a complete randomized design. Feed and water were provided *ad libitum* in an experiment which lasted 8 weeks. The average initial weights of the birds were taken before the commencement of the experiment. The birds were subsequently weighed every week to determine the weight gain, feed intake and body weight gains. At the end of the 8 week of the feeding trial, five birds per replicate were bled for the evaluation of the blood parameters. Bleeding was done using a 2 ml syringe at the wing vein and about 2 ml of blood was obtained and was immediately poured in a bijou bottle which already contained EDTA as an anticoagulant and taken to Physiology laboratory for analysis of packed cell volume (PCV), haemoglobin concentration (Hb) and total erythrocyte concentration as described by [20].

Statistical analysis

Data collected were subjected to analysis of Variance (ANOVA) using [13] the Minitab Statistical Software Release 14.2 (2000). Where significant effects of the experimental diets were obtained, means were separated by the least significant difference (LSD) procedure as outlined by [22].

RESULTS AND DISCUSSION

The result of the chemical composition of SOPM used for the experiment is as shown in (Table 1) while the laboratory analysis to screen for phytochemicals in SOPM is in (Table 2) the composition of the diets containing graded levels of SOPM (Table 3) and the performance of cockerels (Table 4) are presented below respectively. The result obtained from the proximate analysis showed that dried SOPM *(Citrus sinensis)* contain 86.20 % DM, 7.40 % CP, 13.50 % CF, 7.19 % EE, 8.19 % Ash and 62.65 % NFE (Table 1). The crude protein content in the peel was lower than 9.25 % CP in maize [24], while the crude fibre level of 13.50 % in the peel was higher than 2.20 % CF reported for maize [24]. The CF value obtained in this study agrees with CF content of 13.66 - 14.99 % for orange peels by [18]. The ether extract is fairly high which indicate that SOPM can contribute significantly to the energy content of the diets in which it is incorporated.

The laboratory analysis to screen for phytochemicals revealed the presence of flavonoids, alkaloids, phytate, saponin, taninin and oxalate. This observation has been reported in literature [18] [19]. Their concentrations were small and below the levels already reported in literature to have adverse effect on farm animals. [12] reported a wide range of 1 – 20 % and a level of 3 % for saponin. Phytate (0.08 %) and oxalate (0.04 %) concentrations in the sweet orange peel were insignificant compared with 146 – 353 mg % of phytate in maize and 0.275 % in beet roots [7].

The final live weight (Table 4) showed a significant ($P < 0.05$) difference between treatment means. There was a corresponding decrease in final live weight and weight gain as the level of SOPM in the diets increased. There was also a significant ($P < 0.01$) decline in total feed intake (g-bird^{-1}) and it was observed that as the level of SOPM increased in the diets, there was a corresponding decrease in feed intake. The presence of saponin and tannins in SOPM may have conferred bitter taste on the SOPM based diets, thereby reducing the feed intake of birds on these diets and this may have likely affected feed intake which also rendered the chicks to obtain adequate nutrients needed from feed consumed to make their growth rate comparable with the control. This observation agree with the

reports by [19] and [15] who fed SOPM to in diets for broiler chicken and pullet chicks, respectively and observed reduction in feed intake as the level of SOPM in the diets increased. However [19] argued that decrease in feed intake cannot be linked to the presence of any of the anti-nutritional factor because the concentrations of these phyto-nutrients in the orange peels are safe for broiler starter. Poor palatability, aroma and other intrinsic anti-nutritional factors have been identified as factors that affect intake of feeds that contain unconventional grain legume seed meals [11]. These same factors may as well be responsible for the decreased feed intake in SOPM based diets.

Table 1: Proximate Composition of Sweet orange Fruit *(citrus sinensis)* Peel Meal (SOPM) and Maize (%DM)

Nutrients	Sweet Orange Peel Meal	Maize[1]
Dry matter	86.20	86.50
Crude protein	7.40	9.00
Ash	8.19	1.30
Ether extract	7.19	4.00
Crude fibre	13.50	2.70
Nitrogen free extract	62.65	83.00
Metabolizable energy[2] (Kcal/Kg)	3674.44	3432.00

[1]*Aduku (1993)*

[2]*Calculated metabolisable energy using Carpenter and Clegg(1956) formula: ME(Kcal/Kg) = 53+38(%CP+2.25%EE+1.1%nFE+0.22%CF).*

Table 2: The Phytochemical Analysis of Phytonutrients in Sweet orange (*Citrus sinensis)* fruit peel meal.

Phytonutrients	Qualitative presence	Quantitative presence
Flavonoids	+	1.64
Alkaloids	+	0.16
Phytate	+	0.08
Tannin	+	0.14
Saponin	+	0.66
Oxalate	+	0.04

Table 3: Composition of Cockerel chicks Diets

Ingredients	T_0	T_1	T_2	T_3	T_4
SOPM	-	1.0	2.00	3.00	4.00
Maize	40.00	39.00	38.00	37.00	36.00
Groundnut cake	34.00	34.00	34.00	34.00	34.00
Palm kernel cake	10.00	10.00	10.00	10.00	10.00
Maize grain	12.00	12.00	12.00	12.00	12.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Vitamin/mineral	0.30	0.30	0.30	0.30	0.30
Common Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated					
Metabolisable energy (Kcal/Kg)	2763.00	2765.00	2767.84	2770.26	2772.68
Crude Protein	21.50	21.47	21.44	21.41	21.39
Calcium[2]	1.20	1.20	1.20	1.20	1.20
Phosphorus[3]	0.73	0.73	0.72	0.72	0.72
Methionine	0.48	0.48	0.48	0.47	0.47
Lysine	1.00	1.00	0.99	0.99	0.99

[2,3] *Values did not include the contributions from sweet orange fruit peel meals.*

The effect of the diet on the feed conversion ratio (FCR) and Protein efficiency ratio (PER) were not significant. There was no mortality in any of the treatment groups throughout the feeding trial.

The trend of BWG is similar to that of feed intake and cummulative effect of BWG in each of the diet groups over the period of the feeding trial is reflected in the final mean live weight. It seems the depressed feed consumption in the orange peel based diets impaired the growth rate of the birds thereby making the control group to record a faster growth rate. This can be attributed to the inability of the experimental chicks to obtain adequate nutrients needed

from the feed consumed to make their growth rate at least comparable with the control. There was no mortality recorded during the course of the experiment. This could be attributed to good management and to the safety of the test ingredient. The obtained haemoglobin value of 10.39 ± 0.26 g/dl in the control group was not significantly ($P < 0.05$) different from the recorded value of 9.22 ± 0.26 g/dl in T_4 while the recorded PCV followed similar trend. The lowest value was obtained for total erythrocyte count in T_4 which was not significantly ($P < 0.05$) higher than the value obtained in the control. The value of haematological parameters obtained in this study is within the normal range value reported in avian species elsewhere [27]. The fact that the parameters were not significantly different is an indication that SOPM don't pose any nutritional stress to the chicken and thus the health of the chicken is not affected as it is pertinent to consider the health status of the animals used in various feeding trial, and one of the best way is to assess the haematological parameter [1].

Table 4: Performance of Cockerel Chicks Fed Sweet Orange (*Citrus sinensis)* Fruit Peel Meal based Diets

Parameters	Experimental Diets					
	T_0	T_1	T_2	T_3	T_4	SEM
Initial body weight (g/bird)	0.95	0.95	0.95	0.96	0.95	-
Final body weight (g/bird)	464.00^a	420.32^b	417.33^b	397.33^b	399.00^b	5.31^*
Daily body weight gain (g/bird)	8.79^a	7.89^b	7.67^b	7.18^b	7.21^b	0.13^*
Daily feed intake (g/bird)	38.24^a	37.00^a	36.90^a	34.07^b	34.36^b	0.34^*
Feed conversion ratio	0.94	1.01	1.01	1.02	1.02	0.02^{ns}
Mortality	0.00	0.00	0.00	0.00	0.00	-

Table 5: Haematological Parameters of Cockerel Chicks Fed Sweet orange Fruit *(Citrus sinensis)* Peel Meal

Parameters	T_0	T_1	T_2	T_3	T_4	SEM
Haemoglobin (g/dl)	10.39	9.00	8.50	9.97	9.22	0.26^{ns}
Packed Cell Volume (%)	31.17	28.17	24.50	29.33	27.67	0.75^{ns}
Total Erythrocyte count ($x10^6 mm^{3)}$	1.76	1.63	1.36	1.58	1.53	0.06^{ns}

ns not significant (P < 0.05)
SEM- Standard Error of Mean

CONCLUSION

Sweet orange (*citrus sinensis)* fruit in the form it was used in this study yielded a feeding stuff inferior in nutritive quality to maize as a dietary energy source. Further research is required to determine appropriate processing methods that will enhance its potential as feed resource in cockerel chicken production.

The use of sweeteners is recommended to dilute the bitterness of SOPM to make the feed more palatable and thus encourage feed consumption of birds thereby resulting in their enhanced performance.

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