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Performance, apparent nutrient digestibility responses and the economics of feeding Nigerian rice milling by-products to weaner rabbits

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Target audience: *Rabbit producers, Feed millers, Monogastric animal nutritionists.*

Abstract

An eighty-four (84) day feeding trial was conducted to evaluate the effect of feeding rice milling by-products (rice offal, rice bran and rice grain rejects) on growth performance and production economics of crossbred (New Zealand white X Chinchilla) weaner rabbits with mean live weight of 347g. The rabbits were randomly allotted, 5 each, to five experimental diets, with each animal serving as a replicate. The diets were designated D1, D2, D3, D4 and D5. Diet D1 contained no rice milling by-products and served as the control, D2 contained 20% rice offal, D3 20% rice bran, D4 20% rice grain rejects and D5 10% rice bran + 10% grain rejects. Feed and water were provided ad-libitum. Daily feed intake, daily weight gain and feed conversion ratio (67.94-79.42g, 13.50-15.97g, and 4.71-5.67 respectively) were not affected (p>0.05) by inclusion of rice milling by-products in the diets. Apparent nutrient digestibility indices, except for Nitrogen Free Extract (NFE), were also not influenced (p>0.05) by treatments. NFE digestibility was depressed by the feeding of rice offal (p<0.05). Feed cost per kg of weight gain was highest for the rabbit fed the control diet (₦587/kg) and lowest (p<0.05) for those on diet containing rice bran (₦436/kg). Gross margin between total production cost and revenue was highest for rabbits fed a combination of rice bran and rice grain rejects(₦701.18/rabbit), and lowest (₦561.62/rabbit) for the diet that contained no rice milling by-products. It was, therefore, concluded that the use of these rice milling by-products can be recommended for meat rabbit production. However, further studies should be carried out to elaborate the chemical properties and feed potential of this class of feed ingredients.

Key words: *Feed intake, weight gain, Feed conversion ratio, Nutrients digestibility, Rice milling by-products*

Description of Problem

The serious decline in the capacity of the agro-industries in Nigeria has brought about inadequacies in the availability of agro-industrial by-products of cereal grains and oil seeds. The gap between demand and supply of the cereals and oil seeds has led to competition for these agro-commodities between man and farm animals and consequently very expensive (1). Feed constitutes at least 60-70% of the total production cost of most farm animals (2). High cost of feed would, therefore, bring about under feeding of the farm animals and consequently poor animal productivity that brought about expensive animal products, hence widened the animal protein consumption gap in the country. Sub-optimal animal protein is often associated with poor physical and mental development in man. (3). In Nigeria, the increase in rice production across the country with the objective of eliminating its import and also supported by government

policies has resulted in corresponding increase in the rice by-products from the milling process. These by-products include, rice offal, rice bran and rice rejects that are produced at different stages of the processing of paddy rice.

The aim of this study is to investigate the feed values of these rice milling by-products in rabbits' diets.

Materials and Methods

The study was conducted at the Livestock Teaching and Research Farm, University of Agriculture, Makurdi. Makurdi is the capital city of Benue State of Nigeria.

Twenty-five (25) crossbred (New Zealand white X Chinchilla) rabbits of both sexes, with a weight range 345.00-348.00g were used for the experiment. The rabbits were housed in individual pens and allowed an acclimatization period of 7 days before commencement of the study. During this period, each rabbit was treated with *Ivomectin*®, subcutaneously, at the rate of 200µg/kg body weight to control internal and external parasites.

Table 1: Chemical composition of experimental diets (%)

	Diet 1	Diet 2 (20% RO)	Diet 3 (20% RB)	Diet 4 (20% GR)	Diet 5 (10%RB + 10% GR)
Maize	30.55	15.55	15.55	15.55	15.55
Full fat Soybean	26.13	26.13	26.13	26.13	26.13
Brewers dried grains	23.69	18.69	18.69	18.69	18.69
Rice offal, (RO)	-	20.00	-	-	-
Rice bran, (RB)	-	-	20.00	-	10
Grain rejects, (GR)	-	-	-	20.00	10
Soybean straw meal.	14.55	14.55	14.55	14.55	14.55
Bone charcoal	4.10	4.10	4.10	4.10	4.10
Methionine	0.43	0.43	0.43	0.43	0.43
Table Salt	0.25	0.25	0.25	0.25	0.25
*Vit/Min premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.05	0.05	0.05	0.05	0.05
Calculated Analysis					
Crude Protein,(%)	19.81	18.32	19.72	18.17	18.94
Metabolizable Energy,(kcal/kg)	2735.00	2619.18	2714.28	2770.47	2742.91
Crude Fibre,(%)	11.31	16.92	12.72	11.12	11.92
Ether Extract,(%)	4.67	4.91	6.70	5.06	5.88
Lysine, (%)	0.97	0.92	0.99	0.89	0.94
Methionine + Cysteine (%)	0.83	0.77	0.84	0.74	0.79
Arginine. (%)	1.19	1.10	1.15	1.05	1.10
Calcium,(%)	1.36	1.37	1.35	1.34	1.37
Phosphorus,(%)	0.94	0.96	1.22	0.76	1.04

*Vitamin/Mineral Premix (Animal Care®) Vitamin A12000000IU, Vitamin D_3 3000000IU, Vitamin E 30000mg, Vitamin K_3 25000mg, Folic Acid 1000mg, Niacin 40000mg, Vitamin B_2 5000mg, Vitamin B_{12} 20mg, Vitamin B1 2000mg,Vitamin B6 3500mg, Biotin 80mg, Antoxidant 125000mg, Cobalt 250mg, Selenium 250mg, Iodine 1200mg, Iron 40000mg, Manganese 70000mg, Copper 8000mg, Zinc 60000mg Choline chloride 200000mg . RO= Rice Offal; RB=Rice Bran, GR=Grain Rejects.

Table 2: Proximate composition of rabbit diets containing rice milling by-products

	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Nutrients (%)	Control	20% RO	20% RB	20% GR	10%GR+10%RB
DM	90.91	91.89	91.23	91.25	91.25
Crude protein	18.81	19.69	21.00	18.81	19.69
Ether Extract	6.64	6.31	8.76	6.54	9.78
Crude fibre	9.17	16.10	11.06	10.57	10.05
Ash	15.05	16.82	11.70	12.77	13.70
NFE	41.29	32.97	38.71	42.56	38.06
ME,(Kcal/kg)	2723.04	2410.08	2860.77	2736.59	2871.89

RO Rice Offal; RB Rice Bran; GR Grain Rejects; NFE Nitrogen Free Extract; DM Dry Matter

Feed and water were offered, *ad libitum*, twice daily in the morning and evening. Body weights and left-over of feeds for each animal were measured weekly, and used to calculate feed intake, growth rate and feed conversion ratio. Feeders and drinkers were cleaned every day and disinfected every week. The chemical composition of the experimental diets are shown in Table 1. The feeding trial lasted for 84 days.

The rabbits were randomly assigned to five experimental diets designated D_1 (0% rice milling by-products and served control), D_2 (20% rice offal), D_3 (20% rice bran), D_4 (20% rice grain rejects) and D_5 (10% rice bran + 10% grain rejects). Each treatment was replicated five times, with each rabbit serving as a replicate. The allocation of animals to treatments were balanced for body weight and sex (three males and two females per treatment), in a completely randomized design experiment.

The rice milling by products and the experimental diets were analyzed for dry matter and proximate composition using the methods of (4). The metabolizable energy contents of the test ingredients, and feeds were calculated using the Pauzenga equation (5) [37 x % CP + 81 x % EE + 35.5 x % NFE + 35.5 x (0.22) % CF] as modified by (6) to reflect the fact that rabbits use caecal micro-organisms to digest approximately 22 % feed CF into NFE (7; 8).

Fifteen rabbits, three from each treatment, were used for the digestibility trial. The animals were offered 90% of their daily feed intake for a period of 5 days. Polythene mesh was attached under the cages to collect faecal pellets. Every morning faecal pellets were collected from under each cage and placed in labelled paper bags after any feed particles present have been removed. The paper bags were placed in an oven and dried at 70^0C for 24 hours. The paper bags containing the faecal pellets were placed in polythene bags, which were put in a tightly covered plastic barrel. At the end of the trial, all the faecal samples for each rabbit were pooled, dried to constant weight at 100^0C, weighed, milled, thoroughly mixed, and sampled for proximate analysis as outlined by (4). The apparent nutrient digestibility was calculated using the formula:

Apparent digestibility = [(Nutrient intake – Nutrient voided)/Nutrient intake] X 100.

Cost of production and profitability are presented in Table 4, and were calculated as follows:

(i) Cost of diet (₦/kg) = Summation of market price of each ingredient multiplied by the proportion of the

ingredient in the diet.

(ii) Feed cost (₦/kg weight gain) = Cost of diet(₦/kg) multiplied by feed conversion ratio

(iii) Gross Margin was obtained as mean market price of rabbits less mean total cost of production (costs of feed, labour, drugs and chemicals, housing and equipment depreciation and transportation).

Data obtained were subjected to analysis of variance using Minitab statistical software, 16thedition (9) and where significant differences existed between treatment means they were separated using Fisher's LSD method.

Results and Discussion

Results from proximate analysis of experimental diets are shown in Table 2. The crude protein, crude fibre and metabolizable energy were within the range recommended for meeting the nutritional requirements of weaner rabbits for good performance (10). These proximate values are also comparable with those reported by (1).

No significant effect of inclusion of rice milling by-products ($p<0.05$) was observed on daily feed intake, daily weight gain and feed conversion ratio. This similarity in performance between treatments is an indication of similar nutrient availability in the various diets and thus, shows that the rabbits efficiently utilized nutrients in the rice milling by-products. The values for these basic performance indicies are similar to those observed by (11) and (13), who utilized diets containing similar amounts of rice offal as employed in this study. Rice bran and grain rejects are products that are only recently becoming available to livestock producers in appreciative quantities.

Estimates of digestibility of feed dry matter and nutrients are presented in Table 3. Digestibility of dry matter and nutrients, except for NFE, was similar for all diets, and consistent with normal rabbit physiology (7; 8). Digestibility of NFE was significantly ($p<0.05$) depressed by addition of rice offal to the diet. There are indigestible cell wall substances such as hemicellulose and pectins, which are indigestible but are soluble to reagents used in proximate analysis, and consequently appear in the NFE fraction. Rice offal may contain more of this class of substances, hence the depression in NFE digestibility in the diet that contains rice offal.

The exceptionally low digestibility for diet 2 dry matter and NFE (Table 4) may be due to experimental error. In this regard, it is noteworthy that NFE is calculated, rather than directly estimated.

Cost/kg of feed was highest ($p<0.05$) for the control diet and reduced in the order D_4, D_5, D_3 and D_2. That is, inclusion of rice milling byproducts reduces cost of feed. Feed cost/kg weight gain was also lower for diets containing rice milling by-products. The lower cost of the diets containing rice milling by-products observed in this study can be ascribed to the low cost of rice milling by-products. Agro-industrial by-products are usually cheaper as feed component when not in competition for other uses such as human food or industrial raw materials. The reduction of feed cost because of the use of byproducts in the diet has been reported by earlier workers (12, 13).

Gross margin, as represented by the difference between total production cost and revenue, was highest for animals fed diet 5, to which rice bran and reject grains were added, and lowest for the control diet, which contained no rice milling byproducts. This difference can be explained by the high cost of maize, the main energy source in the control diet, relative to rice milling by-products. These same cost/benefit relationship when most by-products are used in feed have been observed

by 11, 12, 13, and 14. An outstanding advantage of the rice milling by-products used in this study over many other unconventional feedstuffs is that they require no processing before use.

Table 3: Growth performance and the economics of feeding rice milling by-products to weaner rabbits

	Diet 1 Control	Diet 2 20%RO	Diet 3 20%RB	Diet 4 20%GR	Diet 5 10%RB+10%GR
Mean total feed intake (kg)	5.71	6.15	6.41	5.80	6.67
Cost of Feed/kg (₦/kg)	116.88	86.98	91.18	95.18	93.18
CFC (₦/rabbit)	667.38	534.93	584.46	552.04	621.51
TPC (₦/Rabbit)	1213.42	972.60	1062.65	1003.71	1130.02
Market price (₦/rabbit)	1775.04	1906.80	2024.16	1947.60	1831.20
Gross Margin (₦/rabbit)	561.62	934.20	961.51	943.89	701.18

RO Rice offal; RB Rice bran; GR Grain rejects
CFC Cost of feed consumed; TPC Total production cost.

Table 4: Apparent nutrient digestibility by weaner rabbits of feed containing rice milling by-products

	Diet 1 Control	Diet 2 20%RO	Diet 3 20%RB	Diet 4 20%GR	Diet 5 10%RB+10%GR	P-value	SEM
MDFI (g)	67.94	73.23	76.32	69.00	79.42	1.73	0.22
MDWG (g)	13.50	14.78	15.97	15.19	14.01	0.35	0.23
FCR	5.03	4.96	4.78	4.71	5.67	0.14	0.09
Digestibility (%)							
Dry Matter	73.50	59.31	65.46	77.43	71.51	0.23	2.46
Crude Protein	86.02	81.88	78.06	83.98	89.28	0.47	1.45
Ether Extracts	90.46	84.07	89.46	92.29	84.15	0.12	1.07
Crude Fiber	58.26	64.65	58.12	74.28	59.39	0.53	3.36
Nitrogen Free Extracts	79.34[a]	44.99[b]	68.90[a]	78.90[a]	68.14[a]	0.03	2.94

[abc] Means with different superscripts are significantly different from each other ($p<0.05$); RO Rice Offal; RB Rice Bran, GR Grain Rejects; SEM Standard Error of Mean.
MDFI Mean daily feed intake; MDWG Mean daily weight gain; FDR Feed conversion ratio

Conclusions and Applications

The results obtained in this study suggest that:

1. For growing rabbits, there are no differences in growth rate and feed conversion when the nutrients of rice milling by-products are fed in the form of rice offal, rice bran or grain rejects. Thus, rabbits can utilize nutrients contained in rice offal, rice bran, reject rice grains and 50:50 bran/reject mixture up to 20% in the diets for normal growth and support normal weight gain.
2. The inclusion of rice offal, rice bran, grain/ rejects, and rice bran/grain rejects at 20% reduced the cost of producing growing rabbits.
3. The use of rice bran, rice offal, grain rejects and rice bran/grain rejects at 20% is therefore recommended as source of energy to partially replace maize and for a profitable rabbit production.

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