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PERFORMANCE OF WEANLING ALBINO RATS (*Rattus rattus*) FED SOME LOCAL ENERGY AND PROTEIN FEEDSTUFFS

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Target audience: Small scale livestock holders, feed millers and nutritionists.

ABSTRACT

A six weeks trial was conducted to evaluate the effect of replacing maize at 50 and 100 % levels with sorghum residue (SR), millet residue (MR), maize offal (MO), and tigernut meal (TGM) while replacing imported fish meal (IFM) at 50 and 100 % levels with local fish meal (LFM) and local blood meal (LBM) on performance, relative organ weights and nutrient digestibility of rats. Daily feed intake showed no significant variation within the energy feedstuffs (12.76 g/d - 15.08 g/d) but showed significant ($P < 0.05$) variations within protein feedstuffs (11.91 g/d - 15.02 g/d). Daily weight gain, feed conversion ratio and protein efficiency ratio showed significant variations among the test diets while relative organ weights were not significantly affected by dietary treatments. Also, nutrient digestibility values showed significant ($p < 0.05$) variations among the test diets, except for ether extract digestibility. Results indicated that maize could be replaced with SR and MO at 50 % level without any significant reduction in growth performance and nutrient utilisation while LBM at 50 % replacement level is comparable to IFM.

Key words: Rats; energy and protein; feedstuffs; performance

DESCRIPTION OF PROBLEM

One of the most serious problems facing the feed industry is inadequate supply of feed ingredients for animal production. Hence, it is imperative that more studies be carried out with the less known feedstuffs, which hopefully will supply the same or nearly the same kind and amount of nutrient supplied by the commonly used feedstuffs like maize and groundnut cake and at an affordable cost.

An earlier study (1) showed that good animal data are not available on many of the probable feedstuffs available in localised tropical areas, but that generally, feed grains are moderate in protein and phosphorus

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contents, low in calcium and variable in minerals. The nutrient profile of any feedstuff offers basic information on the ingredients that can be utilised in livestock feeding while biological evaluation shows the availability of the intrinsic nutrients present in a feedstuff especially when combined with other feed ingredients (2).

This study assessed the nutritional status of ten locally available energy and protein feedstuffs in a feeding trial with weanling rats. It is hoped that some of these feedstuffs will be able to partly or wholly replace existing feed ingredients commonly used in animal feeding.

MATERIALS AND METHODS

Forty-two weanling albino rats of the Wistar strain were allotted in a completely randomised design to fourteen experimental diets such that there were three rats per treatment in a six-week experimental period. Proximate composition of the test feedstuffs, test diets and faeces were determined according to AOAC methods (3).

Diets 1 - 8 (Table 1) were obtained by replacing maize at 50 and 100 % levels with sorghum residue (SR), millet residue (MR), maize offal (MO) and tigernut meal (TGM) while diets 10 - 14 (Table 1) were obtained by replacing imported fish meal (IFM) at 50 and 100 % levels with local fish meal (LFM). Feed and clean water were provided *ad libitum*. The control diet 9 contained maize (55 %) and IFM (4 %). Rats were housed in individual cages with facilities for feed, water and faecal collection. Data were collected on feed intake, body weight gain, feed conversion ratio and protein efficiency ratio.

Nutrient digestibility study was carried out during the 4th week of the study using one rat per treatment by total collection method which lasted for seven days. Faeces collected were dried in an oven at about 120 ^{o}C for 24 h. Dried faecal samples were bulked, thoroughly mixed and samples taken for proximate analysis. Two rats per treatment were slaughtered by cervical dislocation for carcass evaluation and organ weights, Data collected were subjected to one way analysis of variance (4) while significant differences between mean values were compared by Duncan's multiple range test.

RESULTS AND DISCUSSION

Agronomical description and nutrient composition of the feedstuffs used in this study are shown in Tables 2 and 3 respectively while dietary composition and performance characteristics, nutrient digestibility, relative weights of organs and carcass are shown in Tables 1 and 4. Average daily feed consumption by rats fed energy-feedstuff diets showed significant ($P < 0.05$) variation among diets with rats on diet 3 (100 % MR) recording the lowest values. These results agree with an earlier report (5) which stated that feed intake was significantly depressed when maize was

Table 1: Percntage Composition of Experimental diets (%)

	100% SR 1	50% SR 2	100% MR 3	50% MR 4	100% MO 5	50% MO 6	100% TGN 7	50% TGN 8	Control 9	50% LFM 10	100% LFM 11	50% LBM 12	100% 13	50% LBM 14
* Maize	-	27.5	-	27.5	-	27.5	-	27.5	55	55	55	55	55	55
*Sorghum residue (SR)	55	27.5	-	-	-	-	-	-	-	-	-	-	-	-
* Millet Residue (MR)	-	-	55	27.5	-	-	-	-	-	-	-	-	-	-
* Maize offal (MO)	-	-	-	-	55	27.5	-	-	-	-	-	-	-	-
Tigernut Meal (TFN)	-	-	-	-	-	-	55	27.5	-	-	-	-	-	-
* Fish Meal (imported)	4	4	4	4	4	4	4	4	4	2	-	2	-	-
* Local Fish Meal (LFM)	-	-	-	-	-	-	-	-	-	2	4	-	-	2
* Local Blood Meal (LBM)	-	-	-	-	-	-	-	-	-	-	-	2	4	2
Groundnut Cake (GNC)	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
Rice husk (RH)	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Bone Meal (BM)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Oyster shell (OS)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Mineral/ Vitamin Premix	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Metabolisable energy (Kcal/g)	2.65	2.78	2.39	2.64	2.37	2.63	2.28	2.59	2.89	2.90	2.89	2.91	2.90	2.90
+DETERMINED (DM-B)														
Crude Protein (%)	25.52	24.97	26.07	25.25	24.97	24.7	23.32	23.87	24.42	24.25	24.07	24.92	25.42	24.7
Ether Extrcat (%)	9.53	7.61	8.98	7.33	10.08	7.88	12.83	9.26	5.68	5.66	5.65	5.60	5.53	5.59
Crude fibre (%)	4.34	3.45	4.11	3.33	5.65	4.10	3.85	3.21	2.56	2.56	2.55	2.56	2.55	2.55
ash (%)	3.82	3.08	3.68	3.01	3.93	3.14	4.10	3.22	2.38	2.31	2.24	2.14	1.90	2.07
Calcium (%)	0.32	0.32	0.33	0.32	0.51	0.41	0.40	0.36	0.32	0.34	0.36	0.20	0.09	0.22
Phosphorus (%)	0.39	0.31	0.37	0.30	0.47	0.35	0.56	0.40	0.28	0.34	0.40	0.28	0.28	0.33

* Metabolisable energy value were obtained from Aduku (1993)

Table 2: Description of test feedstuffs used in this study

Feedstuff	Local Name	Scientific Name	Processing Method	Texture	Colour	Smell
Maize (M)	Masaar	Zea mays	Milling	Granular	Creamy	Characteristic maize smell
Maize offal (M.O.)	Dusa	Zea mays	Dehulling maize grain	Chaffy	Creamy	Characteristic maize smell
Sorghum residue (SR)	Dusa	Sorghum bicolar	Dehulling white sorghum	Chaffy	Creamy	Characteristic sorghum smell
Millet residue (MR)	Gero	Pannisetum typhoides	Dehulling	Grannular	Brownish	Charateristic millet smell
Tiger nut meal (TGN)	Aya	Cyperrus rotundus, L	Milling	Grannular	Brownish	Charactersitic tigernut smell
Local fishmeal (LFM)	Kifi	Tilapia Lazaria	Milling local fish residues	Powdery	Dirty brown	Characteristic fish meal smell
Local blood meal (LBM)	Gini	Blood	Milling, salting, drying milling	Grannular	Black	Characteristic blood smell

Table 3: Nutrient Composition of Feedstuffs Used in the study (DM- basis)

Feedstuff	*M.E. (Kcal/g)	Protein (%)	Fibre (%)	Exther (%)	Ash (%)	NFE (%)	Ca	P
Maize(whole)	3.43	10.00	2.00	4.60	1.30	76.31	0.01	0.07
Sorghum residue	3.00	12.0	5.23	1.32	3.92	58.60	0.02	0.29
Maize offal	2.47	11.0	7.61	2.65	4.13	55.52	0.36	0.43
Tigernut meal	2.31	8.0	4.35	17.35	4.44.	60.00	0.16	0.60
Fishmeal (imported)	2.87	65.0	1.31	4.70	17.00	8.66	6.10	3.00
Local fish meal	2.54	56.00	1.06	4.60	11.46	17.55	7.00	3.21
Local blood meal	2.77	79.0	0.97	1.00	1.05	7.40	0.25	0.15
Groundnut cake	2.53	48.0	3.81	9.16	1.51	22.52	0.20	0.60
Rice husk	1.32	6.0	3.30	5.60	11.60	58.00	0.17	0.49

*M. E - Metabolisable energy (Aduku, 1993)

replaced with millet in broiler diets. Also there were significant ($P < 0.05$) variations in the average daily feed intake of rats fed protein-feedstuff diets with the control diet (diet 9) recording the highest value. This could be attributed to the bony and palatable nature of the local fish included in the diet.

Weight gain per rat per day varied significantly among test diets. Among the energy feedstuffs, diets 3 and 4 gave significantly ($P < 0.05$) lower values. The poor utilisation of diets 3 (100 % MR) and 4 (50 % MR) could probably be due to the presence of tannins, oxalate and phytate in millet, which would obviously lead to reduced growth and efficiency of feed utilisation (6). Among the protein feedstuffs, rats on diet 12 (50 % LBM) had an almost equal value with the control, thus 50 % replacement of imported fish meal with local blood meal had an efficiency of feed utilisation comparable with that of the control diet.

Results of feed conversion and protein efficiency ratios showed significant ($P < 0.05$) variations among the test diets. Among the energy feedstuffs, diet 2 (50 % SR), diet 6 (50 % MO) and the control diet supported better performance while among the protein feedstuffs diet 12 (50 % LBM) recorded the best value. It must be noted that diet 13 (100 % LBM) gave lower values than diet 12 and this trend could be attributed to amino acid deficiency and imbalance especially of isoleucine in blood meal (8) while the better performance of rats on diet 12 could be as a result of the high crude protein and lysine contents in blood meal. Although blood meal is deficient in methionine, the fish meal present in the diet must have made up for this deficiency.

Table 4: Performance of rats fed experimental diets

Parameters	Energy Feedstuffs						CONTROL			Protein Feedstuffs				±SE
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	100%SR	50%SR	100%MR	50%MR	100%MO	50%MO	100%TGN	50%TGN	CONTROL	50%LFM	100%LFM	50%LBM	100%LBM	50%LBM	
Daily feed intake (g / rat)	14.47ab	13.10b	12.76c	13.55b	14.01b	13.07b	13.17b	13.95b	15.02a	14.40ab	11.84d	14.60ab	13.90b	13.75b	0.24
Daily weight gain (g / rat)	2.46bc	2.62b	1.77d	1.79d	2.39c	2.48bc	2.05c	2.20c	3.31a	2.77bc	2.00c	3.29a	3.05a	2.69b	0.39
Feed conversion ratio	5.88c	5.00c	7.21a	7.57a	5.91c	5.27c	6.57b	6.37b	4.54d	5.20c	5.92c	4.44	4.56d	5.11c	0.31
Protein efficiency ratio	0.67c	0.90a	0.53d	0.52d	0.68c	0.77b	0.64c	0.65c	0.90a	0.79b	0.70b	0.90a	0.86a	0.79b	0.90
Dressing percentage %	82.84	81.99	85.79	82.38	83.65	87.11	87.30	83.31	85.33	78.01	71.67	85.70	84.07	75.11	0.67
Empty carcass weigth (g)	122.40	126.35	103.99	99.24	120.83	131.23	116.35	113.82	157.14	124.64	91.51	156.10	144.60	118.37	5.62
Liver (g)	3.94	4.30	4.98	4.91	4.21	4.00	4.56	4.11	3.91	4.67	4.99	4.80	4.23	4.19	0.14
Kidney (g)	1.02	1.05	1.09	0.99	1.02	1.04	1.09	0.94	0.97	1.15	1.11	0.96	0.90	1.01	0.02
Heart (g)	0.38	0.36	0.45	0.44	0.38	0.40	0.51	0.40	0.35	0.43	0.46	0.48	0.42	0.47	0.02
Spleen (g)	0.46	0.38	0.31	0.43	0.30	0.23	0.40	0.40	0.32	0.51	0.49	0.33	0.35	0.34	0.03
Dry matter digestibility (5)	75.00b	76.14b	73.16bc	74.81bc	77.51b	78.23b	71.00c	70.78c	84.00a	77.34	80.99a	84.22a	83.55a	82.71a	1.07
Crude protein digestiblity (%)	67.00c	69.10c	60.73c	60.50c	65.00c	69.22c	61.17c	61.93a	89.03b	75.36b	72.36b	87.24a	84.04a	75.99b	2.98
Ether extract digestibility (%)	84.48	85.36	85.70	89.18	88.62	89.26	86.73	85.97	87.30	88.67	86.63	89.00	87.48	90.14	0.56
Crude fibre digestibility (%)	84.09a	85.00a	62.00b	63.42b	83.30a	84.80a	60.21b	62.05b	90.11a	86.63	89.80a	87.00a	87.53a	88.00a	4.19

a-d Means denoted by different superscripts horizontally are significantly different ($p < .05$).

SR = Sorghum residue; MR = Millet residue ; MO = Maize offal; TGN = Tigernut meal; LFM = Local fish meal, LBM = Local blood meal

Dressing percentage and relative organ weights showed no significant variations among the test diets. However, the relative weights of the liver in diets 3 and 4 were highest suggesting the presence of anti-nutritional factors, hence poor utilisation of the diets. Nutrient digestibilities showed slight variations among the test diets with millet residue (diets 3 and 4) and tigernut meal (diets 7 and 8) having the least dry matter, protein and fibre digestibilities among the energy feedstuffs.

Results from the energy feedstuffs indicate that maize could be comfortably replaced by sorghum residue and maize offal at 50 and 100 % levels, respectively, without any significant reduction in growth performance and nutrient utilisation. Although the performance of rats fed tigernut meal was not impressive, its high fat content suggests that it could be a cheaper and potential energy feedstuff for poultry and pig feeding. The comparable nutrient utilisation of rats on tigernut meal, millet residue and the control diet agree with the observation which showed a difference in nutrient utilisation of rats fed wheat bran and barley husk (9).

It can be adduced from the results that local blood meal could replace fish meal at 50 and 100 % levels without any significant reduction in performance. The performance of rats fed local blood meal as the only supplemental source of animal protein (diet 13) was however not as impressive in comparison with diet containing only imported fish meal (diet 9) and that containing imported fish meal/local blood meal (diet 12), possibly due to synergistic effect and amino acid balance. This not withstanding, it has been reported that performance of birds increased as the dietary blood meal level increased to eight percent and that protein and fibre levels in the diet exert fundamental effects on the performance and intestinal tract components of rats (11).

CONCLUSION AND APPLICATIONS

It can be concluded that:

1. Sorghum residue and maize offal can be used to replace 50 % of maize without any significant reduction in productive performance of rats.
2. Utilisation of tigernut meal and millet residue should be encouraged via further research involving use of catalytic enzymes.
3. Local blood meal can be used to replace imported fish meal at 50 % level without any significant reduction in performance characteristics.
4. Processing of local fish meal needs improvement to enhance nutritive value comparable to imported fish meal.

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