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DETERMINING THE OPTIMUM COMBINATION OF PALM KERNEL CAKE AND WHEAT OFFAL AS MAINTAINING RATION FOR MATURED GRASSCUTTERS (*Thryonomus swinderianus)*

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ABSTRACT

Twenty (20) female grasscutters at 14 months of age were used for the study, which lasted for ten (10) weeks. The grasscutters were separated into five groups of 4 grasscutters each and fed five (5) diets, which differed in their levels of replacement of wheat offal at 0, 25, 50, 75 and 100% levels with palm kernel cake. Elephant grass and water were served ad libitum. All data were subjected to the analysis of variance. The results showed that forage intake was significantly ($P<0.05$) higher on the 100% (i.e. no replacement) wheat diet than on other diets. Concentrate (diet) intake and total feed intake were not significantly ($P>0.05$) affected by the level of replacement of wheat offal with palm kernel cake. The average daily weight gain was significantly ($P<0.05$) higher among grasscutters fed the 50% replacement diet than among those fed other diets. The results suggest that the synergistic effect of the biological values of wheat offal and palm kernel cake was significantly ($P<0.05$) higher at the 50% replacement level than at other levels.

KEY WORDS: Optimum Combination, High Fibre Feedstuffs, Growing Grasscutter

INTRODUCTION

There is growing interest in the intensive production of grasscutters as a less expensive source of animal protein in West African countries. Large scale commercial production of grasscutter would boost efforts at reducing the short-fall in the supply of animal protein for the ever-increasing population of the Sub-region (Adeboye, 2007). Further, grasscutter farming holds promise for easing the pressure in the hunting of endangered wildlife animal species for food and income among the rural rainforest populations. In order to advance this interest, it is important to develop inexpensive diets and methods for supplying the dietary requirements for the different physiological states of the grasscutter. In the wild, this large herbivorous rodent feeds mainly on roughages, such as grass, supplemented by wild or cultivated nuts, roots and tubers, berries and grains (Ayodele and Medunna, 2007). For optimum performance in captivity, it is important that inexpensive grasscutter diets are formulated to meet its physiological needs.

It has been reported (Ajayi and Tewe, 1980; Meduna, 2002) that the health as well as the growth and reproductive performance were enhanced when grasscutters were fed diets supplying needed nutritional requirements. The use of soybean meal, groundnut cake and blood meal as dietary supplements has been reported to have no significant effect on the performance of growing grasscutters (Adeniji, 2009). It has been shown that the use of wheat offal and palm kernel cake (PKC) in diets significantly affects feed intake and rate of attainment of puberty in growing grasscutters (Wogar, 2012).

Wheat offal and palm kernel cake have been widely used in the feeding of animals. These feedstuffs are easily available and inexpensive. Presently, conventional livestock feeds have become too expensive for the traditional farmer, which makes the use of inexpensive feedstuffs an important factor in the intensive production of the grasscutter (Ojewole *et al.*, 2005). In addition to being less expensive in our local markets by over one-third the price of wheat offal, palm kernel cake compares favourably with wheat offal in their chemical compositions. With a chemical composition, on dry matter basis, of 14.5-19.6% CP, 13-20% CF, 5-8% ether extract and 46.7-58.8% nitrogen free extract (Alimon and Hair-Bejo, 1995), palm kernel compares favourable with wheat offal, which has a chemical composition of 16.9% CP, 11.3% CF, 3.8% ether extract and 61.6% nitrogen free extract (Malau-Aduli *et al.*, 2003). Wheat offal and palm kernel cake are used as sources of energy and fibre in the diets of animals. When fed to growing pigs, palm kernel cake and wheat offal have similar apparent nutrient digestibility coefficient, energy utilization, nitrogen balance and protein utilization (Amaefule *et al*., 2009).

An inclusion rate of 40% palm kernel cake has been reported to be safe for broiler diet (Sundu *et al*., 2006). An inclusion rate of 15% palm kernel cake as an alternative protein source to groundnut cake and 2.5% wheat offal as an alternative to rice bran as a source of fibre in the diets of non-ruminants has been suggested by Tewe and Bokanga (2001). The findings of Wogar (2012) showed that average total feed intake was higher among grasscutters on the palm kernel cake diet than among those on the wheat offal diet and that the cost to gain ratio was lower for the palm kernel cake diet.

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Wheat offal and palm kernel cake are by-products of agro-industrial processing. These high fibre feedstuffs are relatively inexpensive in comparison to the cost of conventional feedstuffs. Microorganisms in the caecum of grasscutter convert fibre and simple nitrogen compounds to volatile fatty acids (Michalet-Doreau, 2002) and microbial cells, which can be utilized by the host (Kristensen 2005). The objective of this study is to determine the effect of combining the relatively higher performing wheat offals with the less expensive palm kernel cake in diets for grasscutter production.

MATERIALS AND METHODS

The study was carried out at the Grassccutter Research Farm at Calabar, under the supervision of the Department of Animal Science, University of Calabar, Calabar, Nigeria. Calabar is at latitude 3^0 North and longitude 7^0 East. It has an annual rainfall of 2650 to 3000 mm and relative humidity of 57 to 93%. The annual temperatures are between 25 and 32^0 C. The study, which lasted for ten (10) weeks, was conducted between the months of September and December, 2009.

Experimental diets: The grasscutters were fed five different diets, which differed in their levels of replacement of wheat offal at 0, 25, 50, 75 and 100% levels with palm kernel cake . The energy content of the experimental diets ranged from 2,644 to 3,074 kilocalories of metabolizable energy per kilogram (KcalME/kg), while the crude protein (CP) content ranged from 12.25 to 16.18%, depending on the rate of replacement. The energy contents of the diets were calculated from the energy density of each ingredient of the diets. Cassava meal served as the main energy source as well as a binding agent in the diets. Soybean meal was the main source of protein in the diets. All the ingredients used were purchased from the local market in Calabar. A thick paste of the ingredients was pelleted in a pelleting machine and dried in a kerosene-fired oven at 75^0C. The composition of the test diets is shown in Table 1, while the proximate composition of the diets is shown in Table 2.

Management of research animals: Twenty (20) grasscutters 14 months old and weighing between 3.03 and 3.45 kg were used in the study. The grasscutters were individually housed in clearly-labelled concrete cells measuring 150 x 75 x 35cm (length x width x height). The housing provided for only one opening (35 high x 45cm wide) into the cell in order to eliminate cross-ventilation and prevent the adverse effect of cold on grasscutters, which are very susceptible to pneumonia. Temperatures in the cells were in the range of 25 - 31^0C during the experimental period.

The grasscutters were randomly allotted, in groups of four, to the five treatment diets. Each group was randomly fed one of the five diets. There were four replicates per treatment, with one (1) grasscutter per replicate. The grasscutters were fed the experimental diet for 7 days before records of observations commenced. This was to minimise stress due to the transfer to the experiment diet. The animals were dewormed and provided with anti stress agents in drinking water as they were introduced into the experimental housing. Elephant grass (*Pennisetum purpureum*) was fed daily as basal diet after it had been cut and allowed to wilt for two days. Water, diet and elephant grass were supplied *ad libitum*.

The animals were weighed, at the beginning and every two weeks thereafter, during the 10 weeks of the study. All cells were cleaned daily in order to ensure an acceptable level of sanitation.

Data collection and statistical analysis: Records were kept of the following observations: average daily forage intake (g); average daily forage dry matter intake (g), which was estimated as 12% Dry Matter content of elephant grass; average daily diet intake (g); average daily total feed intake (g), which was the total intake of forage dry matter and diet; average daily weight gain of grasscutters (g) and cost of diet (N.K).

The grasscutters were of the same age. The differences between the weights of grasscutters used in the study were within a close range. The grasscutters were, therefore, randomly allocated to the five test diets from a pool without consideration to differences in weight and age. The design of the experiment was the Completely Randomized Design. All the data collected during the period of the experiment was subjected to analysis of variance, using the Genstat (2007) software. Significant means were separated by Duncan's Multiple Range test (Steel and Torrie, 1980).

Table 1. The Composition of Experimental Diets.

Ingredients	% Replacement Level of PKC				
	100	**75**	**50**	**25**	**0**
Cassava	32	32	32	32	32
Wheat offal	0	11.50	23	34.50	46
Palm kernel cake	46	34.50	23	11.50	0
Soybean meal	18	18	18	18	18
Vitamin premix	0.50	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25	0.25
Bone meal	0.80	0.80	0.80	0.80	0.80
Total	100	100	100	100	100

RESULTS AND DISCUSSION

Proximate Composition of Experimental Diets.

The proximate compositions of the experimental diets and elephant grass are presented in Tables 2 and 3 respectively. The results show that, while there were no differences between experimental diets in respect of their percentage composition of dry matter, ether extract, ash and nitrogen free extract, there were significant differences ($P<0.05$) in respect of their composition of crude protein, crude fibre and metabolizable energy. The significant differences in the dietary composition of crude protein, crude fibre and energy reflect the significant differences ($P<0.05$) between treatments in respect of forage intake, average daily weight gain and final weight of grasscutters. These findings suggests that the performance of grasscutters was affect by the dietary content of crude protein, crude fibre and energy.

Table 2. The Proximate Composition of Experimental Diets.

Parameter	% Replacement Level of PKC				
	100	75	50	25	0
Dry matter	84.2	85.7	83.1	84.1	81.2
Crude protein	16.18	12.68	12.25	12.68	14.87
Crude fibre	14.50	23.00	22.00	20.00	8.50
Ether extract	0.50	0.50	0.50	0.75	1.0
Ash	4.0	3.0	4.0	4.0	6.0
Nitrogen free extract	64.82	60.82	61.25	62.57	60.63
Calculated Metabolizable energy (kcalME/kg)	2908	2644	2644	2726	3074

Table 3. The Proximate Composition of Elephant Grass

Parameter	% Composition
Dry matter	12.5
Crude protein	8.25
Crude fibre	65.50
Ether extract	1.80
Ash	10.75
Nitrogen-free extract	13.70

The Effects of Replacing Wheat Offal with Palm Kernel Cake (PKC) are presented in Table 4.

Growth Performance

Feed intake

The results show that forage intake by grasscutters was significantly affected by the level of replacement of wheat offal with palm kernel cake. Grasscutters fed lower than 75% palm kernel cake in their diets consumed significantly ($P<0.05$) more forage than those fed the higher levels of palm kernel cake. Though differences in forage intake among grasscutters fed the 50, 25 and 0% palm kernel cake were not significant, forage intake increased significantly ($P<0.05$) with decreasing levels of palm kernel cake in the diet.

Dietary levels of crude protein, crude fibre and energy have been shown to affect feed intake in animals. Wogar (2011) reported that forage intake was higher on the 12% CP diet than on the 8, 16 and 20% dietary crude protein levels. It is suggested that the internal environment of grasscutters created by the 50% replacement diet had enhanced microbial fermentation in the caecum and large intestine. This could have resulted in more efficient conversion of fibre to the volatile fatty acids (VFAs) and simple microbial cells utilized by the grasscutters. The feed conversion ratio (FCR), which was significantly ($P<0.05$) different among treatments, was best among grasscutters on the 50% replacement diet.

It has been reported that high fibre diets tend to increase feed intake in rabbits (Jokthan *et al.* 2006), as the high dietary fibre causes a decrease in the caloric density of the diet.The higher forage intake on the 50% replacement diet, therefore, could be due to the relatively high fibre content of that diet. This finding suggests that the increased forage intake was an adjustment to satisfy the energy demands of the grasscutters in this experiment. This agrees with the report of NRC (1977) that rabbits voluntarily adjust their feed intake in order to satisfy energy demand.

It was observed that differences in concentrate (diet) intake and total feed intake among grasscutters were not significantly affected by the level of replacement of wheat offal with palm kernel cake. This finding may be due to the similarities between palm kernel cake and wheat offal in respect of their apparent

nutrient digestibility coefficient, energy and protein utilization and nitrogen balance (Amaefule *et al.,* 2009). The average daily total feed intake of 231.8 to 251.6g obtained under the conditions of this experiment was within the range of 150 to 250g reported by Mensah (1995).

Average daily weight gain

Grasscutters fed lower than 75% palm kernel cake in their diets had significantly (P<0.05) higher average daily weight gain. The highest average daily weight gain (19.3g) was obtained when grasscutters were fed the 50% replacement diet, while the least average daily weight gain (-5.0g) was obtained when grasscutters were fed the 100% replacement diet.

The average daily weight gain of grasscutters was significantly (P<0.05) affected by the crude fibre (CF) content of the diets. Grasscutters fed the 50% replacement diet (containing 22% crude fibre) had the highest average daily weight gain. Grasscutters fed diets containing more or less than 22% crude fibre had lower average daily weight gains. The significantly (P<0.05) higher amount of forage consumed by gestating grasscutters on the 50% replacement diet could explain the higher average daily weight gain on that diet. Microorganisms in the caecum of grasscutter are able to convert fibre and simple nitrogen compounds to volatile fatty acids (Michalet-Doreau, 2002) and microbial cells, which can be utilized by the host (Kristensen 2005). These findings indicate that the percentage digestibility of the dietary crude fibre fractions (ADF and NDF) on the 50% replacement diet (containing 22% CF) was higher than on diets with higher or lower dietary CF fibre contents. The findings of Karikari and Nyameasem (2009) suggest that daily weight gain among grasscutters decreased with increase in dietary levels of CF, ADF and NDF, while Low fibre diets have been reported to have prolonged retention times in the caecum resulting in reduced feed intake and weight gain (Bawa *et al.*, 2008).

The average daily weight gain of grasscutters was significantly (P<0.05) affected by the energy content of the diets. Grasscutters fed the 50% replacement diet (supplying 2644 kcalME/kg) had the highest average daily weight gain. Grasscutters fed diets with higher than 2644 kcalME/kg had lower average daily weight gains. Since high fibre diets are associated with decreased caloric density, they have been reported to increase feed intake in rabbits (Jokthan *et al*., 2006). Grasscutters on low energy diets increase their feed intake in order to satisfy their energy demands (NRC, 1977; Meredith (2010). The higher weight gain on the lower energy diet (i.e. the 50% replacement diet) in this study was due to higher forage intake, since concentrate and total feed intake were not significantly different among grasscutters. The high energy diets in this study were associated with lower than 22% crude fibre contents, which may explain the reduced weight gain on the higher dietary energy diets (Taiwo *et al*., 2005). The findings of this study indicate that the high energy diets were associated with the low fibre diets. Low fibre diets have been reported to have prolonged retention times in the caecum resulting in reduced feed intake and weight gain (Bawa *et al.*, 2008).

The average daily weight gain (19.30g) was significantly (P<0.05) higher for grasscutters fed the 50% replacement diet containing 12.25% CP. Wogar (2011) reported that the optimum crude protein requirement for growing grasscutters was 12%. The findings of this study suggest that replacement levels, resulting in higher than the optimum dietary crude protein (12.25% CP) requirement of grasscutters, were not consistent with higher average daily weight gain. At higher and lower than the optimum dietary protein level, growing grasscutters adjust feed intake and digestibility to meet nutrient requirements (NRC, 1966; Lebas et al., 1996).

CONCLUSION

The performance of growing grasscutters in respect of forage intake, feed conversion ratio and average daily weight gain was significantly (P<0.05) affected by the level of replacement of wheat offal with palm kernel cake. The findings of this study indicate that forage intake, feed conversion ratio and average daily weight gain were best among grasscutters fed a diet in which 50% of wheat offal was replaced by palm kernel cake. The results show that at the 50% optimum level of replacement of wheat offal with palm kernel cake, the dietary nutrient contents of 12.25% CP, 22.00% CF and 2600 kcalME/kg energy were significantly (P<0.05) different from other diets. It is, therefore, recommended that advantage could be taken of the Biological Value of wheat offal and the relatively less expensive palm kernel cake, especially at the 50% replacement level (i.e. 50% wheat : 50% palm kernel cake), in the formulation of relatively inexpensive diets for grasscutter production.

Table 4. Effect of Replacement Level of Wheat Offal with Palm Kernel Cake (PKC) On Grasscutters

Parameter	% Replacement Level of PKC					
	100	75	50	25	0	SEM
Initial body weight (g)	3100	3225	3025	3075	3450	76.24
Final body weight (g)	2750^{c}	3250^{b}	4375^{a}	3700^{ab}	3150^{b}	277.3
Average daily weight gain (g)	-5.0^{c}	0.4^{c}	19.3^{a}	8.9^{ab}	-4.3^{b}	4.1
Forage intake (g)	227.1^{c}	252.2^{b}	257.9^{ab}	254.9^{ab}	292.4^{a}	10.43
Concentrate intake (g)	203.1	209.9	204.3	208.4	195.6	2.50
Total feed intake (g)	232.7	251.6	237.8	240.3	231.8	3.56
Feed conversion ratio	-5.01^{c}	-1.0^{c}	1.97^{ab}	8.18^{a}	-0.19^{b}	2.17

^{abc}Means on the same row with different superscripts are significantly (P<0.05) different.

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