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PERFORMANCE OF GROWING GRASSCUTTERS FED DIETS WITH VARYING LEVELS OF SOYBEAN MEAL REPLACED BY BREWERS DRIED GRAIN

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ABSTRACT

The objective of this study is to contribute to knowledge on the intensive rearing of the grasscutter (Thryonomis swinderianus), which is cherished for its meat and as a source of protein. The study, which involves five treatments and four replicates in a Completely Randomized Design, aims at determining the optimum performance of growing grasscutters fed diets in which soybean meal is replaced by brewers dried grain. Twenty female grasscutters, four weeks old, and weighing between 1312g and 1315 g, were randomly allotted in groups of four to five treatment diets, in which soybean meal was replaced at 0, 25, 50, 75, and 100% levels by brewers dried grain. The grasscutters were supplied water and elephant grass (Pennisetum purpureum) ad libitum. All data was subjected to the analysis of variance, and significantly different means were separated using Duncan's Multiple Range Test. Results indicate significantly (P=.05) superior performance in respect of average daily forage intake (278.70g), average daily total feed intake (75.54g), final body weight (2145.30g), average daily weight gain (9.79g), feed conversion ratio (7.73) and cost to gain ratio (0.34) for grasscutters in the 50% diet group. It was concluded that the best growth performance was obtained when grasscutters were fed a diet in which 50% of soybean meal was replaced by 50% of brewers dried grain.

1. INTRODUCTION

The growing gap between the demand and supply of animal protein in the populations of Sub-Sahara Africa requires that urgent and efficient strategies are adopted to bridge that gap and reverse the threatening consequences of malnutrition. The farming of microlivestock has been identified as a valuable and sustainable strategy for improvement in food supply in this region (Assan, 2014). The farming of wildlife animal species and microlivestock, such as the grasscutter, therefore,holds promise as a veritable source of protein (NRC, 1991; Addo, 2002). The grasscutter is a large rodent and native to Sub-Sahara Africa; its meat, which is rich in protein and low in fat and cholesterol (Omole *et al.*, 2005) is popular in the diets of local populations. Though cherished for its meat by the rural poor and urban populations, the grasscutter (*Thryonomis swinderianus*) is aggressively hunted by various means, which include bush-burning, with disastrous consequencies to the forests and environment (NRC, 1991; Ntiamo-Baidu, 1998).

The grasscutter is a herbivorous rodent, which depends largely on green forage and other sources of fibre for its feed (Van Zeal and Delport, 2010). Supplementary feeding with energy (Wogar and Agwunobi, 2012) and protein (Wogar, 2011a) concentrates, formulated from inexpensive and easily available feedstuffs, has been shown to improve productivity in grasscutters. The feeding of formulated concentrates has been shown to positively affect growth of grasscutters in captivity (Wogar, 2011b). The productivity of grasscutter is enhanced by its capacity to convert

highly fibrous feedstuffs through caecal microbial fermentation into volatile fatty acids (Michalet-Doreau, 2002) which are synthesized into proteins and energy stores of the body (Kristensen, 2005).

The cost of feeding animals constitutes a major part of the daily cost of farm operations. Feed is the largest single item of cost, accounting for between 40 and 80% of the total cost of farm budgets (Webster, 1993)

Therefore, the production of cheap animal protein is predicated on the cost of feeding. The grasscutter presents an efficient process for the production of cheap meat from the utilization of cheap and easily available feedstuffs. It has been reported that the productive activities of grasscutters are positively affected by feeding agro-industrial by-products Wogar and Ayuk (2012) and various other sources of fibre feedstuffs (Wogar *et al*., 2011).

Brewers dried grain (BDG) and soybean meal (SBM) are by-products of the drinks and food industries. It is a by-product of the manufacture of drinks from barley. Brewers dried grain has a gross energy content of 3030-3170 kcal/kg (Oluponna *et al*., 2002) and a protein content of 27-33% (Lounoauci-Ouyed *et al*., 2008). It has been used in the diets of growing and breeder rabbits at levels ranging from 5% to 45% (Lounoauci-Ouyed *et al*., 2008) though it has been suggested that low grade barley feed and hulls are poor quality feedstuffs (FAO, 2014).

Soybean meal is one of the best sources of protein in livestock feeds. It has a metabolizable energy of 2,000-2,317 kcal/kg, a crude protein content of 46.4-48.2% (Ravindran *et al*., 2014) a good balance of amino acids and a high biological value. A major challenge in the use of soybean meal is its content of anti-nutritional factors, principally urease and trypson inhibitor, which are however, destroyed by heat during the process for the extraction of oil (FAO, 2014).

Brewers dried grain has been used as partial replacement for soybean meal in the diet of Holstein cows (Cozzi and Pollan, 2004) and other dairy animals and reported to be safe and palatable (Amoah, 1985). The digestibility of BDG in livestock diets has been evaluated (Yaakugh and Tegbe, 1990). The present high cost of conventional feedstuffs cannot sustain the production of protein from animal sources in developing countries. The by-products of breweries and food industries present opportunities for utilizing the benefits of the combined effects of the range of nutrients in the different by-products to produce low cost animal feeds (Westendorf and Wohlt, 2002).

It is known that the grasscutter is a pseudo-ruminant, combining the digestive strategies of ruminant and monogastric animals. The ability of the grasscutter to synthesise protein from volatile fatty acids produced by caecal microbial fermentation (Michalet-Doreau, 2002; Kristensen, 2005) suggests that the grasscutter requires less expensive sources of protein feedstuffs in its diet. However, there is the need to optimise the growth potential of the grasscutter and increase the profitability of grasscutter farming. This suggests that feedstuffs, which are known to contain high amounts of high quality nutrients, should be incorporated in the diets (Crawshaw, 2001; Westendorf and Wohlt, 2002) of the grasscutter in amounts that are consistent with productivity and profit.

Current prices in the Nigerian market show that the cost of soybean meal is nine times the cost of brewers dried grain. This study seeks to determine the optimum level of replacing soybean meal with brewers dried grain in a diet that is consistent with optimum growth performance of grasscutters and profitability of grasscutter farming.

2. MATERIALS AND METHODS

2.1. Study Design

The study involved five treatments and four replicates, in a Completely Randomized Design. Twenty (n=20) male grasscutters, four weeks old and weighing between 1312g and 1315g were randomly allotted to the five (n=5) experimental diets, such that there was one grasscutter per replicate. Litter mates from does, which had kindled within 5 days of each other were used in order to reduce the differences between grasscutters in respect of their weights.

2.2. Place and Duration of Study

The experiment was conducted at the Animal Research Farm, Department of Animal Science, University of Calabar, Nigeria. Calabar is located at longitude $8^0$17' East and latitude $4^0$58' North. The average annual rainfall is between 30,000-35,000mm, with relative humility of 57-93%, and annual temperatures ranging between 27-30^0C. The experiment, was carried out between February, 2014, and May, 2014, and lasted for 12 weeks.

2.3. Housing

The grasscutters were individually housed in well ventilated cement cells of dimensions 120cm x 75cm x 35cm for length, breadth and height respectively. The one door into each cell measures 40cm x 35cm allowing for free flow of air within the unit. A floor-slope gradient of 5cm allows for easy flow of urine and water out of the cell. Temperatures within the cell ranged between 27^0C and 30^0C during the period of the experiment.

2.4. Experimental Diets and Feeding

The grasscutters were fed treatment diets, in which soybean meal was replaced at 0, 25, 50, 75, and 100% levels by brewers dried grain. Wheat offal, soybean meal, and brewers dried grain served as sources of protein, energy and fibre in the diets. In addition to serving as a source of energy, cassava also served as the binding agent in the pelleted diets. The proximate composition of the experimental diets was analysed using the AOAC (AOAC, 1990) methods. The gross composition and the nutrient composition of the test diets are shown in Tables 1 and 2 respectively. The metabolizable energy content of the diets was calculated from the energy densities of each ingredient used in the diets.The grasscutters were also supplied water and elephant grass (*Pennisetum purpureum*) *ad libitum*. The formulated diet and water were served in concrete troughs. Weighed quantities of diet and grass were served regularly each morning. Left-over diet and grass were recovered the next morning for calculation of average daily intake.

2.5. Digestibility Trial

At the end of the 12^{th} week of the feeding trial a digestibility trial was carried out. No faeces were collected during the first 3 days of the 10 days digestibility study. Known weighs of feed intake and faecal samples were collected daily during the last 7 days of the study. Samples of faeces from each of the grasscutters were oven-dried at 65^0C. The dried faeces was packed in plastic bags and stored in a refrigerator, for proximate analysis. Faeces collected from each replicate were pooled, and samples taken for proximate analysis using the AOAC (AOAC, 1990) methods. The apparent digestibility coefficients (%) of nutrients of the experimental diets are shown on Table 3.

Table-1. Gross Composition of Experimental Diets Containing Soybean Meal Replaced by Brewers Dried Grain at Varying Levels.

Ingredients	**Replacement levels [%]**				
	0	**25**	**50**	**75**	**100**
Wheat offal	30.00	30.00	**30.**00	**30**.00	**30**.00
Soybean	16.40	**12.30**	8.20	4.10	0.00
Brewers dried grain	0	4.10	8.20	12.30	16.40
Palm kernel cake	20.00	20.00	20.00	20.00	20.00
Cassava meal	30.70	30.70	30.70	30.70	30.70
Salt	0.40	0.40	0.40	0.40	0,40
Bone meal	2.00	2.00	2.00	2.00	2.00
Vitamin premix	0.50	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Metabolizable Energy (kcalME/kg)	2319.89	2290.37	2260.85	2231.33	2201.81

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Table-2. Proximate Composition of Experimental Diets Containing Soybean Meal Replaced by Brewers Dried Grain at Varying Levels

Nutrients	Replacement level [%]					SEM
	0	25	50	75	100	
Dry matter	85.65	84.79	84.88	83.56	83.25	8.10
Crude protein	17.15	15.30	13.10	8.10	7.50	0.23
Crude fibre	8.60	8.92	9.32	9.65	9.85	0.11
Ash	4.22	4.29	4.32	4.44	4.49	0.13
Ether extract	3.45	3.61	3.72	3.76	3.78	0.17
Nitrogen free extract	66.58	67.88	69.54	74.05	74.28	6.18

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2.6. Sanitation and Medication

Grasscutters were dewormed four weeks before the commencement of the experiment. The drug used for deworming was Piperin WS (produced by Interchemie Werchen of Holland). An anti stress drug, Anagess (WSM), (also called Vet Glucose, produced by Agritech of India) was administered one day before animals were weighed for the start of the experiment.The anti stress drug was used in order to reduce the stress on grasscutters, which are ordinarily prone to trauma injuries during handling. The drugs were served in drinking water. The cells were washed with a mild detergent (Omo) and sprayed with a mild insecticide (Mobil insecticide) one day before the commencement of the experiment. The animals were weighed, at the beginning of the experiment and every week thereafter, during the period of the experiment. Cells were cleaned every morning, as sanitary conditions were maintained in all cells of the grasscutter housing.

2.7. Statistical Analysis

Data collection was started after two weeks of adjustment of grasscutters to the experimental diet and the housing environment. Measurements were made of forage intake, concentrate intake, and weekly weights of the grasscutters. The average daily forage dry matter intake (g) was estimated as 12% of the elephant grass (Moran, 2011) consumed. All data was analysed using the GenStat (2005) software for General Analysis of Variance. The Duncan's Multiple Range test (Steel and Torrie, 1980) was used to separate significant means.

3. RESULTS AND DISCUSSION

3.1. Proximate Composition of Diets

The chemical analysis (Table 2) shows that the nutrient composition of the experimental diets were observably different. The nutrient contents of the experimental diets reflected the levels of replacement and nutrient contents of soybean meal and brewer's dried grain in the diets. It was observed that while the crude protein content decreased, the crude fibre and nitrogen free extract contents increased, with increase in the level of replacement of soybean meal by BDG in the diets. The dietary content of CP decreased with decrease in the levels of soybean in the diets, while the dietary CF and NFE contents increased with increase in the levels of BDG in the diets.

3.2. Digestibility Trial

The apparent digestibility coefficients (ADC) of nutrients of experimental diets are on Table 3. There were significant ($P<0.05$) differences between treatments in the apparent digestibility coefficients of all nutrients, except DM. Though there were significant ($P<0.05$) differences between the experimental diets in the ADC of all nutrients, except DM, the minimal differences in the standard errors of mean (SEM) between treatments indicate that the effect of these differences on grasscutters were minimal.

Table-3. Apparent Digestibility Coefficients [%] of Nutrients of Experimental Diets Containing Soybean Meal Replaced by Brewers Dried Grain at Varying Levels

Nutrients	Replacement Levels [%]					SEM*
	0	25	50	75	100	
Dry matter	83.17	82.56	83.57	82.36	82.70	1.97
Crude protein	82.59^{c}	85.64^{b}	85.70 ^{b}	87.85^{a}	83.15^{c}	0.95
Crude fibre	87.19^{a}	76.52^{c}	79.52^{c}	80.66^{b}	82.03^{b}	0.21
Ash	78.31^{a}	79.19^{a}	81.08^{a}	69.15^{b}	71.86^{b}	3.80
Ether extract	73.61^{b}	66.69^{c}	75.07^{ab}	76.57^{ab}	78.11^{a}	1.88
Nitrogen free extract	89.45^{a}	88.93^{ab}	88.53^{b}	86.87^{c}	89.30^{b}	0.46

* ^{abc}Means on same row with different superscript differ significantly(P<0.05.)

3.3. Growth Performance

The performance of growing grasscutters fed different experimental diets is presented in Table 4.

3.3.1. Feed Intake

There were significant (P<0.05) differences between treatments in respect of average daily forage intake, average daily forage dry matter intake, ave rage daily diet intake, and average daily total feed intake. Significantly (P<0.05) higher average daily forage intake (278.70g), average daily forage dry matter intake (34.80g), average daily diet intake (40.74g) and average daily total feed intake (75.54g) were obtained in grasscutters fed the 50% replacement diet than in grasscutters fed other diets. The higher feed intake in the 50% diet group may be due to improved physical characteristics of the diet. The significantly (P<0.05) higher average daily total feed intake (75.54g), was enhanced by improved physical characteristics (Omede *et al*., 2011) such as palatability, particle size, bulk density and water holding capacity of the 50% replacement diet. Improvement in the physical characteristics was due to the replacement of soybean meal with 50% brewers dried grain.

Brewers dried grain has been used to replace maize at 75% inclusion level in grasscutter diet without negative effects (Banjo *et al*., 2012). However, it has been reported that feed intake decreased when replacement of soybean meal with brewers dried grain increased in broiler finisher diets (Rez *et al*., 2013). This linear relationship between decreasing feed intake and increase in the level of brewer's dried grain in broiler finisher diets may be ascribed to the decreasing palatability of these diets. The findings of this study did not show a defined linear relationship between feed intake and the level of replacement of soybean meal by brewers dried grain in the diets of growing grasscutters.

3.3.2. Daily Weight Gain of Growing Grasscutters

Average final body weight (FBW) and **a**verage daily weight gain (ADG) were significantly (P<0.05) different between treatments. Significantly (P<0.05) higher FBW (2145.30g) and ADG (9.79g) were obtained when grasscutters were fed a diet in which SBM was replaced by BDG at the 50% level than at other levels of replacement. This finding indicates that the significantly (P<0.05) higher FBW and ADG in the 50% diet group is due to the significantly (P<0.05) higher feed intake on that diet than on other diets. Partial replacement of soybean meal by brewers dried grain in the diet of Holstein cows has been found to yield improved performance (Cozzi and Pollan, 2004). Faster weight gain has been reported in Japanese quails fed a diet in which brewer's dried grain was substituted for maize and soybean meal (Garwood and Diehl, 1987). Other studies have reported that dietary protein significantly (P<0.05) influences daily weight gain and final weights of animals. Feed DM intake and weight gain of growing grasscutters have been found to increase significantly (P<0.05) with increase in dietary CP levels from 14 to 20% (Obi *et al*., 2011; Kusi *et al*., 2012). The best feed efficiency in this study was obtained when soybean meal was replaced by 50% brewers dried grain resulting in a diet containing 13% CP, which is higher than the 12% dietary CP reported to be adequate for optimum performance of growing grasscutters (Wogar *et al*., 2011). The results of this study indicate that replacement of soybean meal by brewers dried grain in the 50% replacement diet resulted in the

significantly (P<0.05) higher feed intake, significantly (P<0.05) higher final body weight, and significantly (P<0.05) higher average daily weight gain in grasscutters fed that diet than in those fed other diets.

Table-4. Growth Performance of Grasscutters Fed Experimental Diets Containing Soybean Meal Replaced by Brewers Dried Grain at Varying Levels

Parameter	Replacement levels [%]					SEM
	0	25	50	75	100	
Initial body weight (g)	1315.00	1305.00	1312.00	1318.00	1312.00	2.19
Final body weight (g)	1793.00^{c}	1815.00^{c}	2145.30^{a}	1999.70^{b}	1935.50^{b}	65.43
Average daily forage intake (g)	259.80^{c}	259.80^{c}	278.70^{a}	267.60^{b}	271.40^{ab}	3.65
Average daily forage dry matter intake (g)	32.40^{c}	32.40^{c}	34.80^{a}	33.30^{b}	33.60^{b}	0.45
Average daily diet intake (g)	41.64^{a}	36.24^{d}	40.74^{ab}	38.81^{c}	39.90^{b}	0.94
Average daily total feed intake (g)	74.04^{ab}	68.64^{c}	75.54^{a}	72.11^{b}	73.50^{ab}	0.18
Average daily weight gain (g)	5.65^{e}	6.02^{d}	9.79^{a}	8.07^{b}	7.58^{c}	0.75
Feed conversion ratio	13.10^{a}	11.40^{b}	7.73^{d}	8.93^{c}	9.69^{c}	1.09
Average daily cost of feed intake (*N.K/g)	3.93^{a}	3.17^{b}	3.34^{b}	2.88^{c}	2.71^{c}	0.22
Cost to gain ratio (N.K/g)	0.69^{a}	0.53^{b}	0.34^{c}	0.35^{c}	0.36^{c}	0.07

1. ^{abc}Means on same row with different superscript differ significantly (P<0.05). 2. US$1.00 = *N199.00 Nigerian naira (as at October, 2015).

3.3.3. Feed Conversion Ratio

The amount of feed consumed per unit weight gain (7.73g) was significantly (P<0.05) lower for grasscutters in the 50% diet group than in other groups. The superior feed conversion ratio was the result of the significantly (P<0.05) higher average daily total feed intake (75.54g), which was enhanced by the physical characteristics (Omede *et al.*, 2011) such as palatability, particle size, bulk density and water holding capacity of the 50% replacement diet. Improvement in the physical characteristics was due to the replacement of soybean meal with 50% brewers dried grain. It has also been reported that feed DM intake and weight gain of growing grasscutters increase significantly (P<0.05) with increase in dietary CP levels from 14 to 20% (Obi *et al.*, 2011; Kusi *et al.*, 2012). The best feed efficiency in this study was obtained when soybean meal was replaced by 50% brewers dried grain resulting in a diet containing 13% CP, which is higher than the 12% dietary CP required by growing grasscutters for optimum growth (Wogar *et al.*, 2011). The replacement of soybean meal by brewers dried grain in the 50% replacement diet, therefore, resulted in the significantly (P<0.05) higher feed intake, significantly (P<0.05) higher final body weight, and significantly (P<0.05) lower amount of feed consumed per unit weight gain than in other diets.

3.3.4. Average Daily Cost of Feed Intake (N.K/G)

The results indicate that feed cost decreased significantly (P<0.05) with increase in the level of replacement of soybean meal with brewers dried grain. This trend reflects the reduction in the cost of diets as the level of replacement of the more expensive SBM with the less expensive BDG increases. The results show that the cost of feeding when soybean meal is replaced by brewers dried grain at the 50% replacement level is N3.34 per gram of diet. This cost of feed was consistent with the significantly (P<0.05) lower cost of feed per unit weight gain obtained when soybean meal was replaced by brewers dried grain in the diet at the 50% replacement level.

3.3.5. Cost to Gain Ratio

The lowest cost to gain ratio (N0.34/g) was observed when soybean meal was replaced in the diet at the 50% level by brewers dried grain. The use of soybean meal as a source of protein in livestock feeds is associated with high feed cost and is limited by increasing demand for soybean in human diet and industry (Jimoh *et al.*, 2013). The finding of this study indicates that a significantly (P<0.05) lower cost to gain ratio was obtained when soybean meal was replaced by BDG at the 50% level in the diet of growing grasscutters than at other levels of replacement.Therefore, the 50% replacement diet was more cost effective than other diets in this study.

4. CONCLUSION

The findings of this study indicate that grasscutters fed a diet in which 50% soybean meal was replaced by brewer's dried grain recorded significantly ($P<0.05$) higher performance in respect of average final body weight, average daily forage intake, average daily total feed intake, average daily weight gain as well as best feed conversion ratio and cost to gain ratio. Therefore, it was concluded that the diet in which 50% of soybean meal was replaced by 50% brewers dried grain is more consistent with optimum growth performance of grasscutters than diets of other replacement levels in this study.

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