

Original Research Article

Biological Value of Cassava-based Energy Diet for Grasscutter Doe with Litter.

ABSTRACT

Aim: To determine the energy requirement for lactation and growth of grasscutter doe and litter on cassava-based energy diets.

Study design: The Completely Randomized Design was used in this study.

Place and duration of study: Grasscutter Research Unit under the supervision of the Department of Animal Science, University of Calabar, Nigeria, between March 2014 and June 2014.

Methodology: Sixteen 13-months old grasscutters with litter were randomly allotted in groups of four to four treatment diets formulated to supply respectively 2000, 2200, 2400 and 2600 kcalME/kg, and 18% crude protein each. Grasscutter does weighed between 3024.21 and 3054.23 g. Litter sizes were between 4.00 to 5.00 pups per litter, while the pups weighed between 144.21 and 166.22g. Animals were supplied experimental diets, water and elephant grass (*Pennisetum purpureum*) *ad libitum*. Animals were weighed, at the beginning of the study and every two weeks thereafter. Data collection commenced one day after kindling. .

Results: Significantly ($P=.05$) higher intake of forage (534.21g), forage dry matter (63.44g), experimental diet (340.23g), and total feed intake (403.41g) was recorded among grasscutters on the 2400kcalME/kg diet than among those on the other diets. Weight loss was significantly ($P = .05$) higher (-11.92g/day) among does fed the 2200 kcalME/kg diet than among those on the other diets. Daily weight gain of grasscutter pups was significantly ($P=.05$) higher (13.80g/day) among pups fed the 2400kcalME/kg than among those on the other diets. The weaning weight of pups was significantly ($P = .05$) higher (729.21g) on the 2400 kcalME/kg diet than among those on the other diets.. The combined weight gain of doe

and litter was significantly ($P=.05$) higher (3.80) among does and pups fed the 2400 kcalME/kg diet than among those fed the other diets. The Average daily cost of feeding grasscutters with the experimental diet increased significantly ($P=.05$) with increase in the dietary energy. The Average daily cost of diet per grasscutter was significantly ($P=.05$) lower (13.34k) among does and pups fed the 2000 kcalME/kg diet than among those fed the other diets

Conclusion: It is concluded that the energy requirement for lactating grasscutter doe with litter is 2400 kcalME/kg..

Keywords: Grasscutters; litter; energy requirement; cassava; fibre feedstuff;

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1. INTRODUCTION

Intensive farming of the grasscutter ((*Thryonomys swinderianus*)) holds promise as a potential source of much-needed protein in the diets of populations in the countries of Sub-Saharan Africa. The diet of the grasscutter in the wild consists mainly of forage, which it supplements with other essential nutrients from wild and cultivated nuts, berries, roots, fruits, and tubers. Its feeding habit in the wild therefore, constitutes a nuisance to farmed crops. Efforts by subsistent and rural farmers to control the nuisance through hunting, trapping and bush burning are destructive to the environment. While grasscutter farming will contribute to supplying protein in the diet, it will also reduce the destruction of the forests and natural habitats.

The grasscutter is biologically efficient in converting forage and other nutrient-deficient feedstuffs into meat, which factor is important in its commercial production. It utilizes fibre feedstuff (1) because of its specialized digestive system (2). This makes it an important animal in the drive to produce animal protein using less expensive feedstuffs.

Fermentation by microorganisms in the caecum, like in the rumen, converts fibre feedstuffs to volatile fatty acids (3), which can be utilized. The volatile fatty acids (VFA) are substrates

53 in the production of metabolizable energy for the animal (4). The feeding of high levels of
 54 crude fibre (CF), however, decreases digestibility and daily weight gain in grasscutters (5,6).
 55 Intensive farming, therefore, requires that total feed intake of the grasscutter is determined
 56 by the animal's physiological status, such as pregnancy and lactation (7,8) and feed type
 57 (9,10). Weight gain has been reported (11) to be higher among growing grasscutters fed
 58 diets supplying 2800 kcalME/kg than among those on lower dietary energy levels.
 59 Supplements are, therefore, required in the diets of grasscutters in captivity because of the
 60 low energy content of fibre feedstuffs.

61 Feed type and cost are as important in the profitability as they are important in the type of
 62 animal production. The use of low-cost and easily available feed concentrates (12) would
 63 enhance production as it reduces dependence on expensive conventional livestock feeds
 64 (13). A number of easily available feedstuffs, which may be important in grasscutter diets
 65 have been identified. Cassava is easily available, inexpensive and widely used as a source
 66 of energy in livestock feeds (14,15). Soybean meal is rich in amino acids (16,17) and is used
 67 as a plant protein supplement in animal feeds. Wheat offal is widely used as a source of
 68 energy and fibre in the diets of animals (18)..

69 The physiological status, nutrient and feed requirements of the lactating grasscutter are
 70 influenced by the demands of lactation. In order to optimize the benefits of grasscutter
 71 farming, a management program, which requires the feeding of the right quantity and quality
 72 of feed, must aim at reducing the time interval between births. Weaning age of 6 weeks has
 73 been suggested (19), but weaning at 4 weeks has been achieved with low-post weaning
 74 mortality rate (20) under good farm management practices. Mensah (21) reported mortality
 75 rates of 2–10% among young grasscutters (pups), indicating also that weaning may be
 76 achieved at 2–6 weeks, but best at 4 weeks of age. The reproductive cycle of the female
 77 grasscutter (doe) is reported to be 29 weeks (21).

78 Changes in the physiological state of the animal, such as lactation, cause changes in
 79 nutrient requirement, which affects diet selection (22) and feed intake. Energy requirements
 80 of the lactating doe are determined by the demands of lactation, maternal welfare, and

81 growth of the pre-weaning grasscutter pups. The objective of this study is to determine the
82 energy requirement of grasscutter with litter on cassava-based energy diets.

83 2. MATERIALS AND METHODS

84 The study was carried out at the Grasscutter Research Unit of the Department of Animal
85 Science, University of Calabar, Calabar, Nigeria, between March, 2014 and June, 2014.

86 2.1. Experimental diets

87 The study involved the feeding of sixteen (16) grasscutter does with their litters on four, but
88 different, experimental energy diets. The experiment lasted for twelve (12) weeks.

89 Four experimental diets supplying respectively 2000, 2200, 2400 and 2600 kcalME/kg, but
90 each containing 18% crude protein, were formulated using cassava, wheat offal and
91 soybean meal. The main source of energy in the diet was cassava, which also served as the
92 binding agent in the pelleted diets. The proximate composition of the experimental diets was
93 analysed using the AOAC (23) methods. The gross composition and the proximate
94 composition of the test diets are shown in Tables 1 and 2 respectively.

95 **Table 1: Composition of Experimental Diets for Determination of Energy**
96 **Requirements of Grasscutter with litter.**

Ingredients	Experimental diets (kcalME/kg)			
	2000	2200	2400	2600
Cassava	16.10	29.60	43.00	56.50
Wheat offal	66.70	46.70	27.00	7.00
Soybean meal	13.20	19.70	26.00	32.50
Vitamin premix	0.50	0.50	0.50	0.50
Bone meal	3.00	3.00	3.00	3.00
Salt	0.50	0.50	0.50	0.50
Total	100	100	100	100

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Table 2: Proximate Composition of Experimental Diets for Determination of Energy Requirements of Lactating Grasscutter with litter.

Nutrients (%DM)	Experimental diets (kcalME/kg)			
	2000	2200	2400	2600
Dry matter	85.58	86.46	86.37	86.44
Crude protein	18.15	18.35	18.60	18.75
Crude fibre	21.45	13.86	7.80	4.35
Ether extract	4.24	2.42	1.20	0.25
Ash	12.54	12.58	10.52	7.39
Nitrogen free extract	29.20	39.25	48.25	54.95
Calculated ME (kcalME/kg)	2025.46	2205.34	2434.35	2694.38

2.2. Research animals

Sixteen 13-months old grasscutters with litter were randomly allotted in groups of four to the four experimental diets. The weights of grasscutter does were between 3024.21g and 3054.23g. The litter sizes were between 4.00 to 5.00 pups per litter, while the pups weighed between 144.21 and 166.22g.

2.3. Management of Research Animals

Each grasscutter was housed in a well ventilated concrete cell in which the temperature fluctuated between 25 - 31⁰C during the experimental period. Four grasscutters with their litters were randomly allotted to one of the four experimental diets. Each of the four grasscutters with litter constituted one of the four replicates per treatment. Feeding of experimental diets was commenced four weeks to the end of gestation in order to minimise stress that could result from any change in diet during the transition from gestation to lactation. The use of drugs was limited to dewormers and anti stress agents supplied in

114 drinking water in the last week of pregnancy. Wilted elephant grass (*Pennisetum purpureum*)
 115 was fed daily as basal diet. Animals were supplied experimental diets, water and elephant
 116 grass *ad libitum*. The animals were weighed, at the beginning and every two weeks
 117 thereafter, during the experimental period. Sanitary and humane conditions were maintained
 118 in all cells of the grasscutter housing.

119 2.4. Statistical analysis

120 Data collection commenced one day after kindling. This allowed the does to recover from
 121 the stress of kindling while the young pups adjusted to their new environment. Records were
 122 kept of parameters of interest. Daily forage dry matter intake (g) was estimated as 12% of
 123 elephant grass consumed. The Completely Randomized Design was used in the study. All
 124 data was analysed using the Genstat (24) software method of the analysis of variance. The
 125 Duncan's Multiple Range test (25) was used to separate significant means.

126 3. RESULTS AND DISCUSSION

127 The results of chemical analysis (Table 2) shows that the composition of crude fibre, ether
 128 extract, ash and nitrogen free extract were observably different between the experimental
 129 diets. The dry matter and crude protein contents of the diets were not that different between
 130 treatments.

131

132 3.1. Growth Performance

133 The performance of lactating grasscutters and pups is presented in Table 3.

134 **Table 3. Effect of Varying Dietary Energy Levels on Lactating Grasscutters with litter.**

Parameters	Experimental diets (kcalME/kg)				SEM
	2000	2200	2400	2600	
Initial weight of does (g)	3040.10	3054.23	3024.21	3035.13	88.40
Weight of does at end of lactation (g)	2737.23	2174.32	2174.32	2500.21	69.00
Average daily weight gain/loss of does (g/day)	-5.61 ^b	-11.92 ^a	-7.11 ^b	-10.52 ^{ab}	1.30

Initial weight of pups (g)	144.21	160.11	159.50	166.22	8.21
Average daily weight gain of pups (g/day)	13.13 ^a	13.33 ^a	13.80 ^a	11.81 ^b	1.42
Average weaning weight of pups (g)	687.32 ^b	699.23 ^{ab}	729.21 ^a	648.13 ^c	686.62
Average daily weight gain of doe and litter (g/day)	2.51 ^{ab}	1.61 ^b	3.80 ^a	0.81 ^c	0.91
Average daily forage intake (g/day)	512.12 ^a	526.13 ^a	534.21 ^a	440.11 ^b	39.228
Average daily forage DM intake (g/day)	62.61 ^a	63.44 ^a	63.44 ^a	52.71 ^b	4.91
Average daily diet intake (g/day)	334.14 ^a	337.21 ^a	340.23 ^a	265.22 ^b	27.00
Average daily total feed intake (g/day)	396.63 ^a	400.41 ^a	403.41 ^a	317.72 ^b	31.51
Feed conversion ratio	98.00	106.12	136.01	107.10	70.21
Average daily cost of diet/grasscutter (K)	13.34 ^c	20.20 ^b	27.18 ^a	23.85 ^{ab}	0.79
Cost to gain ratio (K/g)	5.45 ^b	5.32 ^b	9.16 ^a	8.35 ^a	0.82
Initial litter size (No. of pups/litter)	4.00	5.00	4.31	4.50	0.50
No. of pups weaned/litter	4.00	5.00	4.31	4.50	0.50
Mortality among pups (%)	0	0	0	0	0

1. ^{bc}Means along the same row with no common superscript differ significantly at $P=0.05$.

2. N.K = Naira.Kobo (Nigerian currency); US\$1.00 = N158.00 (as at April, 2014).

135 3.1.1. Feed intake

136 Intake of forage, forage dry matter, experimental diet (concentrate), and total feed intake
 137 (forage dry matter and concentrate) was significant different ($P=.05$) among grasscutters fed
 138 four different energy diets. Intake of all feedstuffs was highest among grasscutters fed the
 139 2400kcalME/kg diet. There was increase in feed intake with increase in energy levels to
 140 2400 kcalME/kg. The decrease in feed intake at energy levels higher than 2400 kcalME/kg
 141 suggests that feed intake by grasscutters with litter was determined by their requirement to
 142 satisfy dietary energy for growth and lactation. This finding is consistent with reports of other

studies (26;27) that feed intake in rabbits (a pseudoruminant cousin of the grasscutter) is determined by the concentration of energy and other nutrients in their feed and by the need to satisfy demands. The lower feed intake at the higher (2600kcalME/kg) energy level was associated with weight loss. The lower weight at the higher dietary energy level may be due to sustained demands of lactation inspite of reduced feed intake. These findings agree with the findings(28) that feeding rabbit does the high-energy fattening diet did not prevent body energy deficit in the doe.

It is suggested, therefore, that the higher intake (of forage, forage DM, energy diet, and total feed) on the lower dietary energy levels was a modification by lactating grasscutters with litter to balance intake of dietary energy and other dietary nutrients with the nutrient demands of lactation.

3.1.2. Daily weight loss of lactating does

There were significant ($P=.05$) differences in weight loss among lactating grasscutters fed different diets. Daily weight loss among the does increased with increase in dietary energy levels. The negative weight change with increased dietary energy levels was due to increased demands of lactation. This finding is consistent with the report (29) that postpartum physiological demands result in negative weight change in animals. Studies have shown that lactating rabbits are susceptible to body energy deficit (30), and that feeding the high-energy fattening diet to rabbit does did not prevent body energy deficit in the doe (28).

Findings of this study suggest a similar tendency among lactating grasscutters fed different levels of dietary energy. The suggested body energy deficit involves the modification of body reserves, especially fat, by lactating grasscutters to stimulate intake in order to reduce the energy deficit during lactation. These observations suggest that lactating grasscutters adjusted more effectively when fed the lower energy diets. Conversely, these results suggest that feeding higher than required dietary energy levels resulted in lower feed intake, but

169 increased demand on body reserves of nutrients with consequent loss of weight during
170 lactation.

171 **3.2. Reproductive Performance**

172 **3.2.1. Daily weight gain and weaning weight of pups**

173 Daily weight gain was significantly ($P=.05$) different among grasscutter pups fed different
174 experimental diets. The daily weight gain of pups, however, increased with increase in
175 dietary energy levels to 2400 kcalME/kg, but decreased at the higher energy level. The
176 increase in weight gain of pups with increased dietary energy levels to 2400kcalME/kg is
177 related to increase in feed intake up to 2400 kcalME/kg.

178 Significant differences ($P=.05$) in weaning weights were recorded among grasscutter pups
179 fed different energy diets. Weaning weight of grasscutter pups increased with increase in
180 dietary energy levels to 2400 kcalME/kg, but decreased at the higher energy level. The
181 increase in weaning weight of pups with increased dietary energy levels to 2400kcalME/kg is
182 related to increase in feed intake up to 2400 kcalME/kg.

183 Higher daily weight gain has, however, been reported among growing grasscutters on the
184 2800 kcalME/kg diet than among those on the lower dietary energy diets (11). Othe studies
185 (6) have shown that daily weight gain among grasscutters decreased with increase in dietary
186 levels of crude fibre. In this study, the higher crude fibre content of the lower energy diets
187 (Table 2) did not significantly result in lower weight gain and weaning weight on those diets
188 than on the higher (2400kcalME/kg) dietary energy level, but the lower weight gain and
189 weaning weight on the 2600kcalME/kg diet can be explained by the decreased total feed
190 intake.

191 **3.2.2. Mortality and litter size at weaning**

192 Differences between treatments in the litter size weaned were not significant. No mortalities
193 were observed during the period of the experiment. The absence of mortalities and the very
194 marginal differences in litter size weaned suggest that grasscutter pups are capable of

adjusting intake and growth performance within a wide range of dietary energy levels. The litter size of 4.00 to 5.00 pups/litter at weaning is within the range of 3.8 to 5.7 and 2 to 6 pups per litter reported by Mensah (21,31) respectively.

3.2.3. Weight of grasscutter does at end of lactation

There were no significant differences between treatments in respect of the weight of grasscutter does at the end of lactation. The weight of grasscutter does at the end of lactation is a measure of maternal well-being. Except for the lower weight at end of lactation on the 2400 kcalME/kg diet, weights of does increased with increase in dietary energy levels. It is suggested that the lower weight of does on the 2400 kcalME/kg diet inspite of higher feed intake was due to competition between doe and litter mates (pups) for feed. The significantly ($P=.05$) higher average weaning weight of pups on the 2400 kcalME/kg diet was at the expense of the doe. This explains the depressed weight of does on that diet at the end of lactation, since feed intake by lactating does also supplies the needs of grasscutter pups. The findings of this study support the findings that maternal malnutrition compromises the survival of neonate rabbits (329,32).

3.3. Feed conversion ratio

There were no significant differences between the treatments in the amount of feed consumed by grasscutter does per unit weight gain. Feed conversion ratio was higher on the higher (2400 and 2600 kcalME/kg) energy diets. The weight loss of grasscutter does on all diets was partly due to the demands of lactation, which also partly explains the poor feed conversion ratio on all diets.

3.4. Cost to gain ratio

There were significant differences ($P=.05$) in the cost of diet per unit weight gain among does fed different experimental diets. The cost to gain ratio increased as dietary energy levels increased. The indication is that the cost of energy supplementation per unit weight gain of grasscutters with litter increased with increase in dietary energy levels. The increase in cost to gain ratio was the result of weight loss among the does.

4. CONCLUSION

The findings of this study indicate that growth and reproductive performances of grasscutters and their litters were significantly ($P=0.05$) higher on the 2400 kcalME/kg diet than among grasscutters on the other diets.. These results, therefore, suggest that the dietary energy requirement of grasscutter doe with litter is 2400 kcalME/kg , under our experimental conditions.,

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