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Growth and Reproductive Performance of Grasscutter Does with Litter Fed Varying Levels of Cassava-based Energy Diet

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Aim: To determine the performance of grasscutter does with litter fed cassava-based energy diets.
Study Design: The Completely Randomized Design was used in this study.
Place and Duration of Study: The study, which lasted for 12 weeks, between March 2014 and June 2014, was carried out at the Grasscutter Research Unit, University of Calabar, Nigeria.
Methodology: Sixteen 13-months old grasscutters with litter were randomly allotted in groups of four to four treatment diets. The four experimental diets, each containing 18% crude protein, also supplied respectively 2000, 2200, 2400 and 2600 kcalME/kg. Weights of grasscutter does ranged from 3024.21 to 3054.23 g. Litter sizes ranged from 4 to 5 pups per litter, while the weights of pups ranged from 144.21 to166.22 g. Animals were supplied experimental diets, water and elephant grass (*Pennisetum purpureum*) *ad libitum*. Animals were weighed one day after parturition (i.e. after 4 weeks of adaptation), and every two weeks thereafter. Data collection commenced one day after kindling.
Results: Significantly (P<0.05) higher intake of forage (534.21 g), forage dry matter (63.44 g), experimental diet (340.23 g) and total feed intake (403.41 g), as well as significantly (P<0.05) higher daily weight gain of grasscutter pups (13.80 g/day), weaning weight of pups (729.21 g), and

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combined weight gain of does and litter (3.80 g) were recorded in the 2400 kcalME/kg diet group than in the other diet groups. Weight loss (-11.92 g/day) was significantly (P<0.05) higher in the 2200 kcalME/kg diet group than in the other diet groups. The Average daily cost of feeding grasscutters with the experimental diet increased significantly (P<0.05) with increase in the dietary energy. The average daily cost of diet per grasscutter was significantly (P<0.05) lower (13.34k) in the 2000 kcalME/kg diet group than in the other diet groups.

Conclusion: The findings of this study indicate that the best growth and reproductive performances were obtained when grasscutter does and their litters were fed cassava-based 2400 kcalME/kg diet.

Keywords: Grasscutters; growth; reproductive performance; cassava; energy diet.

1. INTRODUCTION

Intensive grasscutter (*Thryonomys swinderianus*) farming is a potential source of much-needed protein in the diets of populations in Sub-Sahara Africa. In the wild, the grasscutter supplements its high fibre diet with essential nutrients from wild and cultivated nutrient-rich feedstuffs. This feeding habit constitutes a nuisance to farmed crops and the environment [1]. Grasscutter farming will contribute to supplying protein in the diet, as well as reduce the destruction of the environment.

The grasscutter is biologically efficient in converting forage and other nutrient-deficient feedstuffs into meat. It utilizes fibre feedstuff [2] because of its specialized digestive system [3]. Fermentation by microorganisms in the caecum converts fibre feedstuffs to volatile fatty acids [4], which are essential in the production of metabolizable energy for the animal [5]. However, high levels of dietary crude fibre (CF) decrease digestibility and daily weight gain in grasscutters [6,7]. It is known that total feed intake is determined by the animal's physiological status, such as pregnancy and lactation [8,9] and feed type [10,11]. Weight gain has been reported to be higher in growing grasscutters fed with diets supplying 2800 kcalME/kg than in those fed with lower dietary energy levels [12]. These findings indicate the need to feed diets formulated to meet the physiological status of grasscutters in captivity.

The use of low-cost and easily available feed concentrates [13] would enhance production as it reduces dependence on expensive conventional livestock feeds [14]. Cassava is easily available, inexpensive and widely used as a source of energy in livestock feeds [15,16]. Soybean meal is rich in amino acids [17,18] and is used as a plant protein supplement. Wheat offal is widely used as a source of energy and fibre [19].

Changes in the physiological state of the animal, such as lactation, cause changes in nutrient requirement, which affects diet selection [20] and feed intake. The objective of this study is to determine the effect of cassava-based energy diets on the performance of grasscutter does with their litters.

2. MATERIALS AND METHODS

The twelve weeks study was carried out at the Grasscutter Research Unit of the University of Calabar, Nigeria, between March, 2014 and June, 2014.

2.1 Experimental Diets

The study involved sixteen (n=16) grasscutter does with their litters, which were fed with four experimental energy diets. The four experimental diets, each containing 18% crude protein, and supplying respectively 2000, 2200, 2400 and 2600 kcalME/kg, were formulated using cassava, wheat offal and soybean meal. The main source of energy in the diet was cassava, which also served as the binding agent in the pelleted diets. The proximate composition of the experimental diets was analysed using the AOAC [21] methods. The gross composition and the nutrient composition of the test diets are shown in Tables 1 and 2 respectively.

2.2 Research Animals

Sixteen (n=16) 13-months old grasscutters with litter were randomly allotted in groups of four to the four (n=4) experimental diets. The weights of grasscutter does ranged from 3024.21 g to 3054.23 g. The litter sizes ranged from 4.00 to 5.00 pups per litter, while the weights of pups ranged from144.21 to 166.22 g.

Table 1. Gross composition of experimental diets for evaluation of reproductive and growth performance of grasscutter does 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**

2.3 Management of Research Animals

Four grasscutters with their litters were randomly allotted to one of the four experimental diets. Each grasscutter with litter was housed in a well ventilated concrete cell, in which the temperature fluctuated between 25 - 31ºC during the experimental period. Feeding of experimental diets was started 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 (Piperin WS, produced by Interchemie Werchen of Holland) and anti stress drugs (Anagess (WSM), also called Vet Glucose, produced by Agritech of India). The drugs were supplied in drinking water in the last week of pregnancy. Animals were supplied experimental diets, water and elephant grass (*Pennisetum purpureum*) *ad libitum*. The animals were weighed, at the beginning and every two weeks thereafter, during the experimental period. Sanitary conditions were maintained in all cells of the grasscutter housing.

2.4 Statistical Analysis

Data collection was started one day after kindling in order to allow the does to recover from the stress of kindling while the young pups adjusted to their new environment. Measurements were made of forage intake, concentrate intake, and weekly weights of the grasscutters. Based on its dry matter content, daily forage dry matter intake (g) was estimated as 12% of elephant grass consumed [22]. The Completely Randomized Design was used in the study. All data was analysed using the Genstat [23] software method of the analysis of variance. The Duncan's Multiple Range test [24] was used to separate significant means.

3. RESULTS AND DISCUSSION

The results of chemical analysis shows that the composition of crude fibre, ether extract, ash and nitrogen free extract were observably different between the experimental diets. The dry matter and crude protein contents of the diets were not different between treatments.

3.1 Growth Performance

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

3.1.1 Feed intake

Intake of forage, forage dry matter, experimental diet (concentrate), and total feed intake (forage dry matter and concentrate) was significant different (P<0.05) between treatments. Intake of all feedstuffs was highest in the 2400 kcalME/kg diet group. There was increase in feed intake with increase in energy levels to 2400 kcalME/kg. The decrease in feed intake at energy levels higher than 2400 kcalME/kg suggests that feed intake by grasscutters with litter was determined by their requirement to satisfy dietary energy for growth and lactation. This finding is consistent with reports of other studies 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 [25,26]. The lower total feed intake in the higher (2600 kcalME/kg) energy diet group was associated with weight loss. This finding suggests that intake of the higher energy diet caused decreased intake of the forage and diet, resulting in decreased total feed intake in the 2600 kcalME/kg diet group. Therefore, the weight loss in the 2600 kcalME/kg diet group was due to the decreased total feed intake in that diet group. Further, the weight loss of does in the 2600 kcalME/kg diet group was aggravated by the demands of lactation. These findings agree with the findings that feeding rabbit does with high-energy fattening diet did not prevent body energy deficit [27]. It is suggested that the higher intake (of forage, forage DM, energy diet, and total feed) in the lower energy diet groups was a modification by lactating grasscutters 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<0.05) differences in weight loss between the diet groups. Daily weight loss in does increased with increase in dietary energy levels from 2000 to 2400 kcalME/kg. The weight loss with increased dietary energy levels was due to decreased total feed intake along with the demands of lactation. This finding is consistent with the report that postpartum physiological demands result in negative weight change in animals [28]. Studies have shown that lactating rabbits are susceptible to body energy deficit [29], and that feeding the high-energy fattening diet to rabbit does did not prevent body energy deficit [27]. Findings of this study suggest a similar tendency in lactating grasscutters fed different levels of dietary energy. The suggested body energy deficit in lactating grasscutters involves the modification of body reserves, especially fat. Such suggested modification includes the stimulation of intake in order to reduce energy deficit during lactation. These observations indicate that lactating grasscutters adjusted more effectively when fed with lower energy diets. Conversely, the indication is that feeding higher than required dietary energy levels resulted in lower feed intake. Consequently, the increased demand on body reserves of nutrients resulted in loss of weight during lactation.

Table 2. Proximate composition of experimental diets for evaluation of reproductive and growth performance of grasscutter does 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**

Table 3. Effect of varying dietary energy levels on reproductive and growth performance of grasscutter does 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 does 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}	23.85a^{b}	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 = N205.00 (as at March, 2015)

3.2 Reproductive Performance

3.2.1 Daily weight gain and weaning weight of pups

Daily weight gain was significantly (P<0.05) different between treatments. The daily weight gain increased with increase in dietary energy levels to 2400 kcalME/kg, but decreased at the higher energy level. The increase in weight gain with increased dietary energy levels to 2400 kcalME/kg is related to increase in feed intake up to 2400 kcalME/kg. Higher daily weight gain has, however, been reported in growing grasscutters fed the 2800 kcalME/kg diet than in those fed with lower dietary energy diets [12]. Other studies [7] have shown that daily weight gain among grasscutters decreased with increase in dietary levels of crude fibre. In this study, the higher crude fibre content of the lower energy diets did not significantly result in lower weight gain in those diets than in the higher 2400 kcalME/kg diet.

There were significant differences (P<0.05) between the treatments in the weaning weights of grasscutter pups. Weaning weight increased with increase in dietary energy levels to 2400 kcalME/kg, but decreased at the higher energy level. The increase in weaning weight with increased dietary energy levels to 2400 kcalME/kg is related to increase in feed intake up to 2400 kcalME/kg. The higher crude fibre content of the lower energy diets did not significantly result in lower weaning weight in those diets than in the higher 2400 kcalME/kg diet.

The lower weight gain and weaning weight on the 2600 kcalME/kg diet can be explained by the decreased total feed intake.

3.2.2 Mortality and litter size at weaning

There were no differences between treatments in the litter size weaned, and no mortalities were observed during the period of the experiment. The absence of mortalities and the very 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 [30] and 2 to 6 [31] pups per litter.

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. Except for the decreased weight in the 2400 kcalME/kg diet group, weights of does increased with increase in dietary energy levels. The decreased weight of dose in the 2400 kcalME/kg diet group, inspite of higher feed intake, is related to the significantly (P<0.05) higher average weaning weight of pups in that diet group. The higher average weaning weight in that diet group was at the expense of the does, since feed intake by the does also supplies the needs of suckling grasscutter pups. The findings of this study support the findings that maternal nutrition is important in the survival of neonate rabbits [28,29].

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 in the higher energy diet groups. The weight loss of grasscutter does in all diet groups was partly due to the demands of lactation, which also partly explains the poor feed conversion ratio in all diet groups.

3.4 Cost to Gain Ratio

There were significant differences (P<0.05) between treatments in respect of the cost of diet per unit weight gain. The cost to gain ratio increased as dietary energy levels increased. The indication is that the cost of energy supplementation per unit weight gain increased with increase in dietary energy levels. The increase in cost to gain ratio was the result of weight loss in the does.

4. CONCLUSION

The findings of this study indicate that the best growth and reproductive performances were obtained when grasscutter does and their litters were fed cassava-based 2400 kcalME/kg diet.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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