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EFFECTS OF DIFFERENT ENERGY LEVELS ON GROWTH OF GRASSCUTTER (*Thryonomys swinderianus*)

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This study investigated the effect of energy level on the growth of grasscutters and also nutrient retention of grasscutters. A total of 36 grasscutters were used for the study. The experimental animals were allowed two weeks of stabilization period and feeding trials lasted for eight weeks. Three diets having energy levels of 2800 (control), 2600 and 3000 kcal/kg respectively were used for the experiment. The results of the study showed significant differences (P<0.05) among the treatment in average daily weight gain, average daily feed intake, although there was no significant effect (P>0.05) on the feed conversion ratio. The effect of dietary treatment on feed intake were significantly different (P<0.05) in favour of grasscutters fed 3000ME. Also, other growth performance parameters – daily weight gain and final body weight were better (P<0.05) and higher for grasscutters fed 3000ME. The effect of dietary treatments also had a significant effect on the parameters for nutrient retention, the level of protein retained increased with increase in dietary energy levels, and other nutrients retained were all statistically significant (P<0.05). The cost of producing feed increased with increase in the energy level, although in terms of the cost of producing 1kg of body weight, it was lesser i.e. more economical in grasscutters fed 3000ME.

Keywords: Grasscutter, Energy, Growth performance, Nutrient retention

Globally, wildlife has great potentials for meat production and serves as important source of the highly desired animal protein to the people. Recently, efforts have been made to mobilize interest in the domestication of favourite wild animal species. Wildlife domestication according to Opara and Fagbemi (2008) has been suggested as a possible way of improving meat supply in Nigeria. The species advocated include: grasscutter (*Thryonomys swinderianus*), guinea fowl and the giant African snail. Among these aforementioned, grasscutter (cane rat) is the most preferred. Benjamin *et al*. (2006) asserted that unlike some animals which may not be killed or touched because of religious dictates, traditional taboos or prejudices, the grasscutter meat transcends religious prohibitions and Muslims who do not consume rabbit or guinea pig are known to consume grasscutter. The high demand for grasscutter meat and the economic benefit that accrues from its sale has resulted in aggressive hunting with complete disregard for conservation of the species and the environment.

Various authors had suggested that the shortage of animal protein in the third world countries could be ameliorated by improving the existing conservation programme of wildlife particularly the domestication of rodents that are tractable, prolific and widely acceptable to the public for consumption (Ajayi, 1971; Mbah, 1989; Oloyede, 2005). The grasscutter was reported by Clottey and John, (1981) as the most preferred among wild rodents with wider domestication as well as an alternative with a promising future.

The grasscutter (*Thryonomys swinderianus)*, also known as the greater cane rat, is an herbivorous mammal belonging to the order Rodentia, suborder *Hystricomorpha* and to the family *Thryonomidae*, with a single genus, *Thryonomys*. It is only found in Africa but mostly in the sub-Saharan part where it is vigorously hunted and exploited for food (Opara, 2010). Grasscutter is considered as delicacy meat for many Nigerians, hence its acceptability cut across all the geographical regions because of the absence of cultural bias and religious hindrance to its consumption. It constitutes an important healthy food product, because of its high protein, good taste and low fat cholesterol content (Williams *et al*., 2011).

Protein and energy are two important component of feed that generates a lot of interest and challenge to nutritionists. They are determinants in the evaluation of the performance and production coefficients of farm animals. Although a high energy diet is expensive, it has been shown to increase the feed conversion efficiency (FCE) in rabbits, a close relative of grasscutter (Parigi-Bini, 1968). An energy level of 2800kcal/kg was recommended as ideal for the growth of grasscutter under captive condition by (Adeniji, 2008). Increase in meat production can be achieved through proper nutrition, inclusion of feed ingredients at normal or required levels (Schrage and Yewadan, 1999). As the grasscutter comes into mainstream animal production, the nutrition of the animal, particularly protein and energy, assume greater importances (Adu *et al*., 1999). Energy levels have been shown to influence the feed intake, feed conversion efficiency, and ultimately, the growth and performance of livestock animals. It is therefore important to determine the appropriate energy level required for the optimum growth of grasscutter, in order to economically provide a diet which meets the animal's nutritional requirements. Energy levels have been shown to influence the feed intake, feed conversion efficiency, and ultimately, the growth and performance of livestock animals (Henry and Njume, 2008). It is therefore important to determine the appropriate energy level required for the optimum growth of grasscutter, in order to economically provide a diet which meets the animal's nutritional requirements. The study was aimed at investigating the use of different energy levels on the growth of grasscutters and their nutrient retention capabilities.

MATERIALS AND METHODS

Sourcing of grasscutter (*Thryonomys swinderianus***):** A total of 36 weaned grasscutter of mixed sexes were purchased from The Republic of Benin. The animals were housed in a cage system and allowed 3weeks to acclimatize during which they were given a commercial feed (Pelleted Grower Topfeed[R]) twice daily and their water changed daily. The animals were dewormed with albendazole and treated with acaricide to guard against external parasites. Anti-stress was added to the water whenever the animals are weighed, antibiotics and multi-vitamins were given at intervals to the animals during the course of the experiment.

Experimental housing: The grasscutters were housed in a wooden two-tier cage having six cells in all. The cells were partitioned with wood, the floor of the cells was made with a wire mesh, and each cell had enough space to conveniently accommodate feeder and drinker for feeding purposes. A polythene bag was placed underneath the cage floor to allow for easy collection of waste feed and faeces. The cage was constructed in such a way that the each cell had two compartments, a compartment where the grasscutters could feed and also a compartment where the grasscutters could rest and groom themselves. This design also allowed for ease of management of the grasscutters.

Preparation of feed: The experiment was conducted at the small animal unit of the Biotechnology Laboratory of the Faculty of Agriculture, University of Ilorin, Nigeria. Conventional feedstuff were used to compound the experimental diet, conventional feedstuff such as maize, soya bean meal, fish meal, wheat offal, palm kernel cake, corn bran and groundnut cake.

All the feedstuffs were sourced from a reputable feed mill in Ilorin. The feedstuffs were mixed according to the calculated weight in kilograms for each diet. Also mixed were bone meal, oyster shell, salt and vitamin premix all at constant weight for all the diets. Three experimental diets were formulated for the animals. The three diets had a constant crude protein (CP) of 18 % but different energy levels of 2800Kcal/Kg, 2600Kcal/Kg and 3000Kcal/Kg for Treatment(s) A (control), B, and C respectively. The animals were fed majorly with the formulated diets for the whole duration of the experiment, with determined quantity of forages only introduced during the latter days of the experiment. The CP of 18% had been found to produce optimum results for grasscutter in terms of growth, weight gained and reproductive abilities (Kusi, *et al*., 2012).

Experimental design: The experiment followed a completely randomized design. Animals were randomly assigned into three groups (treatments), with each treatment having two replicates consisting of six animals per replicate. Animals in treatment A were fed with experimental diet containing energy level of 2800Kcal/Kg, while animals in the other treatment(s) B and C were fed with experimental diet(s) containing energy levels of 2600Kcal/Kg and 3000Kcal/Kg respectively. The experiment was conducted for 10weeks. Live weight was recorded weekly while feed intake was recorded daily in grams. Proximate analysis was carried out on all feed and faecal samples at the Animal Production Department Laboratory using the methods of Association of Official Analytical Chemists (A.O.A.C., 1990) to determine the moisture content, dry matter, crude protein, ether extract, crude fibre and ash. A nutrient retention trial was conducted at the end of the experiment. Faeces was collected thrice weekly throughout the duration of the experiment, and was bulked, dried and ground before the laboratory analysis. The cost of feed per kilogram of the diets and the cost of feed per kilogram of

Table 1: Composition of experimental diets (kg/100kg)

Ingredients	**A**	**B**	**C**
Maize	50.00	34.00	65.00
SBM	12.00	12.00	12.00
FM (72%)	1.00	1.00	1.00
W/Offal	11.45	16.00	1.50
PKC	7.00	8.00	3.95
Corn Bran	6.00	18.45	2.00
GNC	8.00	6.00	10.00
Bone meal	2.50	2.50	2.50
Oyster shell	1.00	1.00	1.00
Vitamin premix	0.25	0.25	0.25
Total	100.00	100.00	100.00
Feed cost/Kg (N)	88.80	83.80	93.20
Proximate composition			
Crude Protein	18.44	18.26	18.16
Crude	8.60	14.95	6.11
Crude Fat	2.61	3.14	4.76
Ash	9.32	11.84	7.95
Dry matter	89.62	71.24	88.88
Calculated ME (Kcal/kg)	2810.67	2623.51	3026.16

TABLE 2: Growth performance of grasscutters fed diets of different energy levels

Parameters	DIETS		
	DIET A 2800 ME	DIET B 2600 ME	DIET C 3000 ME
Initial body weight (g)	1300.00±0.48	1325.50±0.53	1275.09±0.37
Final body weight (g)	1580.12±0.68	1636.73±0.34	1670.10±0.70
Average daily weight gain (g)	5.00 ±0.25[b]	5.55±0.22[b]	7.05 ±0.62[a]
Average daily feed intake (g)	35.52±0.60[b]	44.66±1.12[a]	48.72± 3.72[a]
Feed conversion ratio	7.11±0.24	8.05±0.53	6.91±0.08

[abc] = Means ± SD on the same row with different superscripts are significantly ($P<0.05$) different.

Table 3 Nutrient Retention of Grasscutters Fed Diets of Different Energy Level

Parameters	DIETS		
	DIET A 2800 ME	DIET B 2600 ME	DIET C 3000 ME
Protein	69.96±0.70[b]	63.82±0.23[c]	74.49±0.47[a]
Crude fat	48.98±0.18[c]	62.20±0.70[b]	67.43±0.23[a]
Crude Fibre	92.08±0.25[a]	70.66±0.70[c]	85.36± 0.46[b]
Ash	90.89±0.23[a]	81.71±0.23[b]	71.87±0.23[c]

[abc] = Means ± SD on the same row with different superscripts are significantly ($P<0.05$) different.

Table 4 Cost Analysis of Grasscutter Fed Different Energy Levels

	A	B	C
Feed Cost (N/kg)	88.80	83.80	93.20
Average Total Intake	1.99	2.50	2.73
Average Total Feed Cost (N)	176.63	209.60	254.32
Feed Cost/ Weight gain	317.50[a]±15.98	269.60[ab]±11.03	236.85[b]±21.14

Keys: A= 2800ME; B= 2600ME; C=3000ME, [abc] = Means ± SD on the same row with different superscripts are significantly ($P<0.05$) different.

the body weight gained were determined using the price of the feed ingredients as obtainable during the period the project was carried out. This was done in order to estimate the economic value of the diets in relation to weight gained.

At the end of the experiment, three animals per treatment group were euthanized and blood sample was collected for haematological and serum biochemical examination. The serum total protein was determined by the Biuret method using a commercial kit (Randox Laboratories Ltd, U.K), while albumin value was obtained by bromocresol green method. The globulin and albumin-globulin ratio were determined according to the method of Coles (1986). The serum creatinine and urea nitrogen were estimated by deproteinisation and Urease-Berhelot colorimetric methods, using a commercial kit (Randox Laboratories Ltd, U.K). Also the free cholesterol was determined by nonane extraction and enzymatic colorimetric methods, respectively using commercial kit (QuimicaClinicaApplicada, S.A), while the serum enzymes; Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) were obtained using the Randox Laboratories Ltd, UK test kits.

Statistical Analysis: The experiment followed a completely randomized design (CRD). The data obtained were analyzed by the Generalized Linear Model procedures of SAS Version 9.2 software (SAS, 2008). Means differences were considered significant at p<0.05 and separated by Duncan multiple range test (Duncan, 1995).

RESULTS

The growth performance of grasscutters fed different energy level is presented in Table 2. The effect of diets on average daily weight gain and average daily feed intake were significant (P<0.05), while it had a non significant effect (P>0.05) on the feed conversion ratio. Grasscutters fed 3000ME had the highest daily weight gain (7.05 ±0.62) and differed significantly (P<0.05) from those fed energy levels of 2800ME and 2600ME which had comparable daily weight gain of 5.00 ±0.25 and 5.55±0.22 respectively.

Grasscutters fed the 3000ME had the highest (P<0.05) average daily feed intake of 48.72± 3.72, and is comparable to those fed 2600ME energy level 44.66±1.12; while the average daily feed intake for grasscutters fed 2800ME was 35.52±0.60 which significantly differed (P<0.05) from those of 2600ME and 3000ME.

The effects of diets on feed conversion ratio was not significant (P>0.05), however feed conversion ratio increased with increasing energy level. Feed conversion ratio (6.91±0.08) of grasscutters fed Diet C (3000ME) was the lowest, i.e. the most efficient, it was followed by that of the control, Diet A (2800ME) (7.11±0.24) and with the feed conversion ratio of Diet B (2600ME) being the highest (8.05±0.53).

The nutrient retention in grasscutters fed different energy levels of 2800ME, 2600ME and 3600ME respectively are as shown in Table 3. It was observed that the percentage of the protein retained increased with increase in the dietary energy level, diet B (2600ME) had the lowest level of protein retained (63.82±0.23), diet A (2800ME) had a value of 69.96±0.70, while diet C had the highest value of 74.49±0.47. All these values were significantly different (P<0.05).

The effects of diets had a significant effect (P<0.05) on the percentage of fat retained by the grasscutters. Diet C (3200ME) had the highest level of fat retained (67.43±0.23), followed by diet B (2600ME) with a value of 62.20±0.70, diet A (2800ME) had the lowest level of fat retained (48.98±0.18).

The effects of diets also had a significant effect (P<0.05) on the crude fibre retained by the grasscutters. Diet A had the highest percentage of crude fibre retained (92.08±0.25), followed by diet C, with a value of 85.36± 0.46, while diet B had the lowest value of 70.66±0.70.

Diet A had the highest percentage of ash retained (90.89±0.23) and was significantly different (P<0.05) from that of diets B and C respectively. Diet B had a value of 81.71±0.23 retained by the grasscutters, this was also significantly different (P<0.05) from that of Diet C which had the least value of ash retained (71.87±0.23).

The economics of production (Table 4) shows that the cost of feed was highest for diet C (N93.20/kg) and decreased with decreasing level of energy in the diet, diet A had a cost of (N88.80/kg), with diet B having the lowest cost (N83.80/kg). Figures were based on the existing market prices of ingredients as at the time of the study.

Analysis of the feed cost per kg of body weight gained showed a significant effect (P<0.05) amongst the different dietary treatments. Diet A had the highest feed cost per kg of body weight gained (317.50±15.98) and was significantly different (P<0.05) from that of diet C, diet B had a value of (269.60±11.03), this was similar (P<0.05) to that of diets A and C respectively. Diet C had the lowest feed cost per kg of body weight gained (236.85±21.14).

RESULTS AND DISCUSSION

The proximate analysis of the diet as presented in Table 1 showed that the diets all had crude protein levels relative to the predetermined standard of 18. The crude fibre content was the highest in diet B with 14.95, followed by diet A with 8.60; diet C had the lowest with 6.11. Diet B had the highest ash content with 11.84 followed by diet A with 9.32 and diet C with 7.95. The dry matter content was the highest in diet A with 89.62; diet C had a slightly lower value of 88.88, while diet B had a value of 71.24. The calculated energy levels were 2810.67, 2623.51, and 3026.16 for diets A, B and C respectively, all within range of the stated energy levels.

Results from this study showed significant differences in the mean daily feed intake of grasscutters (P<0.05). The highest value (48.72±3.72) was recorded by the grasscutters fed diet containing 3000ME, followed by those fed 2600ME (44.66±1.12), while those fed 2800ME had the lowest value (35.52±0.60). The higher value obtained for animals fed 3000ME was unusual as animals generally feed to meet their energy needs, this might however be due to the fact that the grasscutters consumed more in order to obtain more fibre as feed consumption is always affected by level of crude fibre of the diet. The higher the crude fibre of the feed, the lower the feed consumed and vice versa (Henry and Njume, 2008; Taiwo *et al*., 2009). Proximate analysis showed that diet C (3000ME) had the lowest crude fibre content (6.11%). It was also affirmed by Keunen *et al*. (2002) that changes in energy requirements of the animal depend on the physiological and productive status of the animal. These factors cause feed intake to change according to the nutrient requirements of the animals (Baumgardt, 1970; Agwunobi *et al*., 2009). The values obtained for grasscutters fed 2600ME and 2800ME suggests that the animals fed to meet their energy requirements and this agrees with the findings of Meredith (2010) that rabbits eat to satisfy their energy requirement and also, Adeniji (2009) that grasscutters feed to satisfy their energy requirements.

Results from this study showed significant differences in the mean daily weight gain (P<0.05) of the grasscutters among treatments with grasscutters fed 3000ME having a higher value (7.05±0.62) than the others, the daily weight gain was however comparable (P<0.05) for diets containing 2800ME (5.00±0.25) and 2600ME (5.55±0.22) respectively. The significantly (P<0.05) high amount of feed consumed by grasscutters on the 3000 ME diet could explain the higher weight gain on that diet. Also, Parigi-Bini (1968) and Abu *et al*. (2008) found greater weight gain with high energy diet when compared to low energy diet in rabbits, a similar animal to the grasscutter. This could also explain the similar weight gain grasscutters fed 2800ME recorded alongside those fed 2600ME despite having a significantly different (P<0.05) lower feed intake. The performance of the animals fed 2800ME is also in agreement with the work of Adeniji (2009), where grasscutters fed 2800ME recorded higher average daily weight gain despite having been fed lesser quantity of feed.

There was a non significant effect (P>0.05) with the feed conversion ratio, however it was observed that feed conversion ratio increased as the energy level decreased. Grasscutters fed 3000ME had the lowest feed conversion ratio i.e. the most efficient (6.91±0.08), this indicated the ability of grasscutters to efficiently utilize the diet for their growth. Grasscutters fed 2800ME followed in terms of the feed conversion ratio obtained (7.11±0.24), with those fed 2600ME having the highest feed conversion ratio (8.05±0.53). This indicates that energy level is a factor in how well feed are efficiently utilized by animals, as typified by the fact that grasscutters fed 2800ME had a more efficient feed conversion ratio than those fed 2600ME despite recording a lesser and significantly different (P<0.05) feed intake. This was in agreement with the work done by Adeniji (2009), where grasscutters fed 2800ME had the most efficient feed conversion ratio despite having consumed lesser than those fed diets of lower energy levels.

Furthermore, Table 3 showed that there was a significant effect (P<0.05) of the different energy levels on the nutrient retention trial carried out. The level of protein retained by the animals increased as energy levels increased. This also corresponds to the better daily weight gain and feed conversion ratio recorded by grasscutters fed higher dietary energy levels. This suggests that energy level had an influence on the protein retained by the animals as high energy diet tended to retain more protein. Van Zyl *et al.* (1999) and Henry and Njume (2008) reported that energy had a significant effect on the protein retained in pigs. The higher level of protein retained in comparison to the energy level suggests that energy had been relatively sufficient in guarding against protein being used as an energy source instead of being converted into body protein.

Animals fed the 2800ME had the highest level of crude fibre retained (92.08±0.25), the high value obtained suggests that the animal had to retain more crude fibre as the fibre content of the diet was relatively lower as shown in Table 1.. This also explains the higher level (85.36±0.46) of crude fibre retained by animal fed 3000ME, the crude fibre content of the 2600ME was the highest as also shown in the table, thus explaining the significantly (P<0.05) lower level (70.66±0.70) of crude fibre retained, suggesting the animals had enough amount of crude fibre. Abioye *et al.*, (2008) and Van Zyl and Delport (2010) confirmed that increasing dietary fibre levels had adverse effect on nutrient absorption as evidenced by the significant reduction in the retention of dry mattter crude fibre and nitrogen free extract in broiler chicks and rabbits respectively. Fitzinger (1995) and Adeniji (2008) attributed such depression in apparent nutrient digestibility to higher rate of passage of digester in animals fed on high fibre diets, as a matter of fact, the content of crude protein and digestibility of dry matter decreased. Also a study carried out on rabbits confirmed that the digestibility of dry matter and crude fibre was significantly (p<0.05) higher in the high energy group than in the low energy group (Onadeko, 1996; Fatokun *et al*., 2010).

The level of fat retained varied amongst the three dietary energy levels, with that of animals fed 3000ME having the highest value (67.43±0.23), the animals fed 2600ME followed with (62.20±0.70), while those fed 2800ME had the lowest value (48.98±0.18). This suggests that the animals retained fat according to their nutritional needs with the energy levels not being the major determinant.

Values obtained for the ash retained also indicated that energy level wasn't the dominant factor in determining the level of ash retained. The highest value was recorded for animals fed 2800ME (90.89±0.23), animals fed 2600ME also recorded a relatively higher value (81.71±0.23), while those fed 3000ME recorded the lowest value (71.87±0.23). This suggests that the diets (2800ME and 2600ME) had a lower concentration of minerals in them, which prompted the animals to retain a larger percentage of minerals, while the diet (3000ME) had a higher concentration of minerals, thus the reason why the animals retained a lesser percentage of minerals.

The economics of production (Table 4) showed that the cost of feed was highest for diet C (N93.20/kg) and decreased with decreasing level of energy in the diet, diet A had a cost of (N88.80/kg), with diet B having the lowest cost (N83.80/kg). The values obtained were comparative to those obtained by Benjamin et al. (2006) and Ogunjobi and Inah (2008). Analysis of the feed cost per kg of body weight gained showed a significant effect (P<0.05) amongst the different dietary treatments. Diet A had the highest feed cost per kg of body weight gained (317.50±15.98) and was significantly different (P<0.05) from that of diet C, diet B had a value of (269.60±11.03), this was similar (P<0.05) to that of diets A and C respectively. Diet C had the lowest feed cost per kg of body weight gained (236.85±21.14). Based on this research, it would be more economical and better to use diet C in terms of the grasscutter's body weight and daily weight gain. Figures were based on the existing market prices of ingredients as at the time of the study.

CONCLUSION

In conclusion therefore, the results from this study showed that energy level has a significant effect (P<0.05) on the feed intake and weight gain of growing grasscutters, although there was no significant effect (P>0.05) on the feed conversion ratio. Grasscutters fed 3000ME had the best performance in terms of the weight gain and feed conversion ratio, despite having a lesser daily feed intake, animals fed 2800ME had a comparable weight gain but with a more efficient feed conversion ratio than animals fed 2600ME, although not significant (P>0.05), thus highlighting the significance of a high energy level. In terms of the nutrient retained by the animals, it was shown that the level of protein retained increased with increase in dietary energy levels, which suggests why animals fed the higher energy level recorded better weight gain and more efficient feed conversion ratio. Other nutrients retained by the animal followed a non-linear trend, with values obtained all statistically significant (P<0.05). The cost of producing feed increased with increase in the energy level, although in terms of the cost of producing 1kg of body weight, it was lesser i.e. more economical in grasscutters fed 3000ME.

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