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Effect of Concentrate Feed Supplementation Regime on the Growth Performance and Economics of Production of Grasscutter (*Thryonomys swinderianus*)

Gboshe, P.N.,[1] Carew, S. N.,[2] Shaahu, D. T.[2] and Okwori, A. I.[2]

[1]*Department of Animal Science, Cross River University of Technology, Faculty of Agriculture and Forestry, Obubra Campus, Cross River State , Calabar, Nigeria.*
[2]*College of Animal Science, Department of Animal Production, Federal University of Agriculture, Makurdi, Benue State, Nigeria.*

Corresponding Author: petergboshe72@gmail.com, ***Phone No.:*** +234-08136714602

Target Audience: Animal Scientists, Grasscutter breeders

Abstract

A feeding trial was conducted with Twenty (20) weaner grasscutters to investigate the effect of concentrate supplement when fed elephant grass as a basal diet. Weaner grasscutters used were randomly assigned to groups of T1, T2, T3, T4 and T5 in which concentrate was supplemented at 1, 3, 5, 7 and 9% of their weekly live weight, respectively. There were four grasscutters per treatment. Results of the experiment showed that, grass crude protein, crude fibre and Metabolizable energy were; 9.25%, 31.00% and 2187.17 kcal/kg, respectively while concentrate had; 17.85% CP, 5.07% CF and 2720.92 ME kcal/kg, respectively. The grasscutters were fed grass and given water ad-libitum for the twenty week experimental duration during which their performance and economic analysis were evaluated. Experimental diets promoted growth parameters measured with the best at 5% but depressed at 9% level. Average daily feed intake had a range of 92.98-148.76 g while average final weight range was 1392.50-2335 g. The economy analysis showed that, the estimated net revenue was the highest at 5% ¦ 1579.23 and lowest at 1% ¦ 674.52. It can be concluded that, elephant grass can be supplemented with 5% concentrate feeding regime in the feeding of grasscutter and not excess of it.

Keywords: Grasscutter, Growth Performance, Concentrate, Elephant grass, Economic production

Description of problem

Grasscutter production is becoming more popular in most developing countries like Nigeria. Hence cost of production associated with monogastric animal production such as poultry and pigs as a result of high cost of feed are now being encountered by grasscutter breeders who depend solely on conventional sources of energy and protein. The escalating prices of pellets and concentrates for feeding grasscutters in Nigeria constitute considerable constraints on the expansion of commercial grasscutters production. Thus, attention of animal nutritionists has been geared towards the utilization of alternative cheap feed sources (forages) with a concentrate regime in grasscutters production particularly now that a particular feeding regime and nutrient requirements have not been established.

It has been suggested the waste-to wealth approach which involves harnessing and utilization of by- products and wastes which are not directly utilized by human beings may be a logical step towards reducing competition

between human beings and animals (1). Use of feed materials such as cassava cake meal (2), brewers dried grain (3), kitchen materials, (4) have been suggested. There is no yet information on utilization of specific quantity of concentrate diet that can be combined with grasses which they are already adapted to so as to improve their performance. Therefore, the study investigated the effects of concentrate feed supplementation regime on the performance and economic of production of grasscutters.

Materials and Methods

Experimental site

The study was carried out in Obubra, Cross River State. This is located between longitude 8^0-9^0E and Latitude 6^0-7^0N of the equator. Obubra is located along the banks of the Cross River in the Southern Guinea Agro-Ecological Zone of Nigeria.

Preparation of test ingredients*:*

The elephant grass *(Pennesitum purpureum)* was harvested, wilted overnight about 18 hours, chopped, weighed using a Camry top loading weighing scale and fed unrestricted in mangers to the grasscutters.

Design and Management of experimental animals

A total of twenty (20) weaned grasscutters with average weight of 725 g were used for the experiment, the grasscutters were sourced from Cotuonu, Benin Republic. The grasscutters on arrival were allowed to acclimatize for 7 days and maintained on a similar diet. They were then weighed and randomly allocated to treatments. The grasscutters were assigned to five treatments in a Completely Randomized Design (CRD) with one grasscutter per replicate. They were then given their various levels of treatment daily for 20 weeks. The experimental diets were served daily in their feeding troughs at levels of 1, 3, 5, 7 and 9% of their weekly live body weight, while elephant grass and water were served *ad libitum* every morning at about 7-8 am in mangers. The grasscutters were housed individually in concrete pens measuring 60 x 40 x 40 cm and containing a feeder and a drinker. Pens were washed, disinfected and allowed for 2 weeks to dry out before the arrival of the grasscutters. Feed and water troughs used were also washed daily. Beddings were changed daily. Feed intake and weekly live weight of the animals were measured and recorded. Each grasscutter was inspected for good health. Standard health/sanitation procedures were strictly adhered to during the experiment.

Experimental diets

The concentrate supplement was formulated to obtain 18% crude protein and Metabolizable energy of 2961.47 kcal/kg with the ingredients as shown in Table 1

The experimental treatments were represented by T1, T2, T3, T4 and T5 representing five different feeding regimes of 1, 3, 5, 7 and 9% of live weight, respectively.

Table 1: Ingredients and Nutrient Composition of experimental diet (%)

Ingredients	%
Maize	58.41
Soybean meal	27.59
Rice offal	10.00
Bone meal	3.00
Vitamin-min-premix*	0.50
Common salt	0.50
Total	100.00
Calculated nutrients composition.	
Crude Protein	18.00
Metabolizable Energy (/kcal/kg)	2961.47
Crude fibre (%)	6.97
Calcium (%)	1.16
Phosphorus (%)	0.89

Each 1kg of vitamin/mineral premix manufactured by BEAUTS Co. Inc. Man, U.S.A., contains Vitamin A 220,000, Vitamin D 66,000, Vitamin E 44, 014; Vitamin K 88 mg; Vitamin B 12; 0.76 mg; Niacin 1 122 mg, Calcium 27%, Phosphorus 10%, Iron 0.6%, Zinc 0.35%, manganese 0.25%, Copper 0.06%; Iodine 0.002%, Cobalt 26 ppm,Selenium 4pp. ME = Metabolizable Energy,

Metabolizable Energy of the concentrate was calculated according to the formula of (5). That is, ME = (37 x %CP + 81 X %EE + 35.5 X %NFE) Kcal/kg Where ME = Metabolizable Energy, CP = Crude Protein, EE = Ether extract, NFE = Nitrogen Free Extract

Chemical analysis

The proximate composition of concentrate and elephant grass were determine according to the procedures outlined by (6). The characterization of the crude fibre of elephant grass was done as described by (7).

Data Collection

Average daily Feed Intake (FI)

The grasscutters in each treatment were fed weighted amounts of their group diets daily. Feed intake was determined by obtaining the differences between the quantity of feed offered and the left over weekly. The average daily feed intake of all the grasscutters was obtained by dividing the total feed intake of the grasscutters during the period under study by 140 days.

Average daily Weight Gain (ADWG)

The animals were weighed at the beginning of the experiment and weekly thereafter to obtain the weekly weight in order to determine the growth rate. The average daily weight gain per grasscutter was obtained by subtracting the initial weight from the final weight of each grasscutter and dividing by 140 days.

Feed Conversion Ratio (FCR)

FCR was calculated as the ratio of average daily feed intake to average daily weight gain.

FCR = (Weight of feed intake/Weight gain)

Economy of feed conversion:

The cost of feed per kilogram (₦/kg) was computed as cost per kg of feed using the prevailing market prices of ingredients and cost of the elephant grass. The cost of feeding the grasscutter on a particular diet for the period of the study was also calculated as the product of the cost per kilogram of the diet and feed intake. Feed cost/kg weight gain was also calculated by dividing the cost of feed intake/grasscutter by the average total weight gain (kg). The cost of production was estimated as the total cost (TC) incurred in the

production of the animal. The total revenue (TR) was calculated by the price of meat (₦/kg) multiplied by final body live weight (kg)/ manure harvested.

The net profit was computed as the selling price of grasscutter less the total cost of production. Consideration was given to cost of medication, labour, feeders and drinkers.

Statistical Analysis

All data obtained were subjected to Analysis of Variance (ANOVA) using (8)

Results and Discussion

The proximate composition of elephant grass and concentrate

The proximate composition of elephant grass and concentrate is presented in Table 2. Results for elephant grass showed that, the dry matter, crude protein, crude fibre, crude fat, ash, nitrogen free extractives (NFE) and metabolizable energy contents were; 34.30%, 9.25%, 31.00%, 1.17%, 9.28%, 49.30% and 2187.17 kcal/kg, respectively while that of concentrate supplement, were; 86.98%, 17.85%, 5.07%, 3.20%, 10.12%, 50.74% and 2720.92 kcal/kg, respectively. The proximate constituents determined in this study for elephant grass were mid-range for all parameters with few variations which may be as a result of environmental factors such as season when the grass were collected. The following values; 28.6-41.0 (DM), crude protein 2.81-22.7%, crude fibre 25.5-43.2%, ether extract 2.7-9.1% and ash 3.9-25.10% have been reported (9).

Table 2: Proximate Composition of Elephant Grass and Concentrate Supplement

Materials	Dry matter	Crude protein	Crude fibre	Ether extract	Ash	NFE	ME/kcal/kg
Elephant grass							
% composition	34.30	9.25	31.00	1.17	9.28	49.30	2187.17
Concentrate							
% composition	86.98	17.85	5.07	3.20	10.12	50.74	2720.92

Mean values of three (3) determinations

Metabolizable energy was calculated using the following equation. ME=37 X% CP) + (81 X% EE) + (35.5 % NFE) + (5.07 x 0.2% CF) (5) as modified by Carew (2015).

Characterization of the crude fibre fractions of elephant grass

The characterization of the crude fibre fractions of elephant grass is presented in Table 3. The characterisation of the crude fibre fractions of elephant grass showed a marked variation from other researchers. These variations in this study and others authors may be due to the season or age of harvest of the elephant grass. It is known that lignification of forages depend on the seasons and particularly the age because the cell wall gets more lignified as the plant matures (10).

Table 3: Characterization of the Crude Fibre Fractions of Elephant Grass (*Pennisetum purpureum*)

Constituents	Proportion (%)
Neutral detergent fibre (NDF)	66.95
Cellulose	39.91
Hemicellulose	20.82
Acid detergent fibre (ADF)	41.91
Acid detergent lignin (ADL)	35.10

Mean values of three (3) determinations

Growth performance of grasscutters fed elephant grass supplemented with different levels of concentrate

The data on feed intake, weight gain, feed conversion ratio and other parameters measured are presented on Table 4. The grasscutters were equalized in weight before they were assigned to the various diets. The daily feed intake (ADFI) was significantly ($P<0.05$) affected by the percentages of the feeding regimes. It showed that, the highest (148.75 g) average daily feed intake (ADFI) was T5with 9% concentrate supplement while the lowest was in T1 (92.98 g) with 1% concentrate supplement. The highest feed intake of 148.75 g recorded in this study was less than that reported by (11) which were 213.88 g, 207.94 g and 161.97 g. It was observed that the ADFI did not follow any particular trend. This could be as a result of the feed acceptability and preference by the individual grasscutters. The varying feed intake could be attributed to the relatively high levels of crude fibre in the diet. This is in consonance with earlier reports that high fibre diets tend to increase and vary feed intake in rabbits (12) and grasscutter have a similar gastrointestinal tract which is expected to have a similar mode of feed intake. The average daily body weight was significant ($P<0.05$) in this study. The average daily weight gain of 15.93 g was highest for grasscutters in T3 and lowest (4.77 g) for T1. This daily weight gains observed in this study were similar to that of (13) 13.27%, 14.28 g, and 15.00 g and higher than 9.41 g and 10.88 g reported by (2).

Total weight gain (TWG) obtained in this study (Table 4) was significantly affected ($P<0.05$) by the feeding regimes. The highest value of 2190 g was obtained in T3 while the lowest value of 670 g was recorded in T1. No particular pattern was followed as expected based on the increased concentrate supplementation. Several authors have reported various values for total weight gain of grasscutters. Onyeanusi *et al* (13) reported values of 650 g, 700 g, 750 g and 850 g when the grasscutters were fed varying levels of dietary protein. Annor *et al* (14) reported values of 225 g, 275 g and 625 g as total weight gain for grasscutters at the end of an experiment that lasted for 24 weeks with leaf and stem fractions. In another study by (15) where performance of grasscutters were assessed when fed four different conventional forages, the weight gain reported were between 1024 g and 1121 g. Karikari and Nyameasem (16) reported values of 650 g, 1110 g and 1190 g as weight gain for grasscutters fed concentrate diets containing varying level of guinea grass. Henry *et al* (11) reported 993.14 g, 1182.72 g and 982.53 g when they fed elephant grass as basal feed and a mixed feeding regime with crude protein of 24% and metabolize energy of 2340 kcal.

It was also observed in these various studies that grasscutters performed better when fed forages as basal feed supplemented with concentrate and not concentrate alone. This

agrees with the report by (17) and (18) that the grasscutter is a herbivorous animal which in captivity could be fed green or dry forages which are accompanied with concentrates and that the fermentation of fibre in the green or dry forages in the guts of herbivorous results in the production of volatile fatty acids (VFAs) which are absorbed across the epithelial membrane which account for much of the Metabolizable energy supply to the animals.

The results however, showed that, concentrate supplement feeding at 5% level with *Pennisetum purpureum* (ADG 15.93 g) was superior to 7% level (ADG, 13.72%) though did not differ significantly different ($P>0.05$). This shows that, at 5%, the quantity of concentrate supplement was able to combine with a low quality roughage to yield the highest daily weight gain. Roughage diets have shown to aid digestion in cattle (19). The grasscutters digestive tract includes the well-developed caecum, which fills 60% of the abdominal cavity and functions in much the same way as the four- chambered stomach of cattle. As a monogastric herbivore (pseudo-ruminant), the grasscutter is able to use the advantage associated with the efficient utilization of concentrate by monogastric animals. However, it was observed that at the level of 9% concentrate supplementation, the daily weight gain of 11.45 g was inferior to that at 7% though not significantly ($P>0.05$) from it. It was observed that at 9% level of concentrate feeding, there was a negative influence on the daily weight gain, an observation contrary to normal based on the increased concentrate supplement, this cannot be attributed to anything yet. This finding agrees with the report by (20) and (21) who observed that concentrate can be supplemented to grasscutters feeding but in low quantity so as to avoid a negative influence on the animals.

In this study 1% of their weekly body live weight concentrate supplementation had an inferior daily weight gain (4.77 g). This could be attributed to the fact that, 1% level of concentrate supplementation did not supply adequate nutrients to meet up the dietary requirement of the grasscutters to meet optimal growth. The result for feed conversion ratio (FCR) in this study ranged from 8.64 to 19.49 and it differed significantly ($P<0.05$) among the treatments. The grasscutters in T3 had 8.64 which was the best FCR. Differences in FCR depend on two factors, namely growth rate and feed intake and both are affected by the quality of the diet. A good FCR is obtained when feed intake is low and growth rate is high as would happen with a balanced diet and that was observed in T3. The FCR 19.94 noticed in T1 in this study could be as a result of insufficient nutrient utilization by the grasscutters. This FCR values appeared to increase with the level of concentrate feed supplementation obtained in this research are lesser than the values of 543.24, 82.30 and 119.38 reported for grasscutters at the end of a 24 weeks feeding trial (14). These values are however, higher than value ranges of 1.66 - 3.52 (2), 4.86-5.04 reported by (15) and 4.8-7.5 recorded by (16).

The energy intake in this feeding trial were significantly affected ($P<0.05$) and the intake appear to increase with the level of concentrate feed supplementation. The highest value was obtained in (T5) while the lowest was in T1 an indication that grasscutters in T5 had more dietary energy intake than their counterparts in their diets.

Protein intake on daily basis tended to increase from 12.25 g/animal (T1) to 17.56 g/grasscutter (T5). Value for the remaining treatment was in between. It followed the same pattern of trend like the feed intake. The highest value of protein intake was in T5. This could be attributed to the highest percentage level of concentrate that was offered in T5 which also led to the highest feed intake by grasscutters. This may be due to palatability and availability of the concentrate.

The ECR which is the amount of energy utilized per unit of gain varied between 0.24 (T1) to 0.66 (T3) and it differed significantly p (<0.05). A particular pattern was not followed,

The protein efficiency ratio PER values varied from 0.39-0.97 and it showed a significant P<0.05) difference though did not follow any particular pattern. The variation may be due to differences in the crude protein intake among the animals. The highest PER was in T3 (0.97) while the lowest was in T1 (0.39). This could be attributed to the fact that, there was more protein intake in treatment three.

Table 4: Effects of concentrate supplement regimes on the growth performance of grasscutter

Parameter	T1 (1%)	T2 (3%)	T3 (5%)	T4 (7%)	T5 (9%)	SEM
Average Initial wt (g)	725	723	724	723	725	
Average Final wt (g)	1392.50^{c}	2042.50^{b}	2910.00^{a}	2657.50^{ab}	2335.00^{ab}	206.10
Average Total wt Gain (g)	667.50^{c}	1317.50^{b}	2185^{a}	1932.50^{a}	1610.00^{ab}	197.47
Feed intake* (g/head/day)	92.98^{c}	109.07^{b}	137.71^{a}	136.01^{a}	148.75^{a}	10.31
Average Daily wt gain (g/head)	4.77^{d}	9.23^{c}	15.93^{a}	13.72^{ab}	11.45^{bc}	1.39
Feed/gain ratio	19.49^{c}	11.82^{b}	8.64^{a}	9.91^{a}	12.99^{b}	1.89
Av. Daily Energy intake (Mcal/)	2.82^{b}	2.92^{b}	3.32^{a}	3.27^{a}	3.48^{a}	0.13
Av. Daily Protein intake g)	12.25^{b}	13.60^{b}	16.46^{a}	16.23^{a}	17.56^{a}	0.99
Energy conversion ratio	0.24^{a}	0.45^{b}	0.66^{c}	0.59^{b}	0.46^{b}	07.89
Protein efficiency ratio (PER)	0.39^{c}	0.68^{b}	0.97^{a}	0.85^{a}	0.65^{b}	0.09

a, b and c means within rows with similar superscripts are not significantly different (p>0..05), SEM= Standard Error of mean, AV. = Average, Wt = weight, * Dry matter

Economic Analysis of grasscutters fedconcentrate supplement regimes using elephant grass as basal feed.

The result of the economic analysis of the grasscutters fed different levels of concentrate supplement is presented in Table 5. Feeding dietary treatments resulted in a positive net revenue of ₦ 674.52 to ₦ 1579.23 per grasscutter. The results showed that the cost of feed with 1% level of concentrate supplementation was highest in T1 (₦134.85/kg) while the cost of feed consumed was the lowest (₦12.54). This was due to the high level of forage that was consumed in that treatment that had a lower cost. The least cost of feed (₦132.85/g) was obtained in T4 while the highest cost consumed was ₦19.78/grasscutter. The trend did not follow any pattern as expected, that, as the level of percentage of concentrate supplement increases the cost should also increase which would have been in agreement with (13), when they assessed the performance of grasscutters using varying levels of dietary protein but instead the cost was relatively similar among the feeding regimes. This was as a result of the various quantity of elephant grass consumed that was attached a financial cost and used for the computation. It was also observed that, total cost of production (₦170.22) which was the highest in T5 had an inferior daily weight gain of 11.45 g when compared to T3 (₦ 168.77) with 15.93 g daily weight gain. The estimated profit also revealed that the highest revenue may also be gotten from T3 with 5% concentrate supplement which suggested that 5% concentrate feeding regime was the best since it had the best performance, marginally lower cost of production when compared to T5 and the highest profit margin of ₦1579.23. The cost of feed ₦/kg in this study that ranged from ₦132.85-₦134.85 was higher than (₦48.47 –

₦75.64) reported by (2). The disparities between this study and that of previous authors may be as a result of different market prices of various feedstuffs used in the different studies.

Table 5: Cost- benefit analysis of grasscutters fed concentrate supplement regimes using elephant grass as basal feed.

	T1 (1%)	T2 (3%)	T3 (5%)	T4 (7%)	T5 (9%)
Cost of Weaner N/kg	0.45	0.45	0.45	0 .45	0.45
Miscellaneous (N)	150.00	150.00	150.00	150.00	150.00
Feed cost (N/kg)	134.85	133.48	133.11	132.85	132.97
Total daily feed Intake (kg/grasscutter)	0.093	0.109	0.138	0.136	0.148
Cost of feed consumed (N/kg/grasscutter)	12.54	14.56	18.33	18.07	819.7
Total cost (TC)	162.98	164.99	168.77	168.51	170.22
Revenue sale (N/kg)	600.00	600.00	600.00	600.00	600.00
Final body live weight(kg)	1.3925	2.0425	2.910	2.6575	2.335
Manure sale (N/kg)	2.00	2.00	2.00	2.00	2.00
Total Revenue (TR)	837.50	1227.50	1748.00	1596.50	1403.00
Profit (TR-TC)	674.52	1062.51	1,579.23	1,427.99	1,232.78

Conclusion and Applications

1. The data on performance showed that the grasscutters gained weight in all the treatments but was highest in T3 and T4 but numerically T3 had the highest values in growth parameters.
2. The cost- benefit analysis revealed that, concentrate supplement fed with elephant grass as basal feed, had highest estimated profit at 5% level and it also cost less to produce 1kg live weight of grasscutter when compared to 9% level.
3. Concentrate supplementation at 5% of the live body weight to a basal diet of elephant grass stimulate daily weight gain and feed conversion ratio of the grasscutter. It can therefore be concluded that, 5% concentrate supplement should be used in rearing grasscutters.
4. Further studies should be carried out with other grasses presumed to be eaten by grasscutters using different levels of concentrate supplement.

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