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# THE STUDY OF GASTROINTESTINAL TRACT PARTS AND THE VISCERAL ORGANS OF GRASSCUTTERS FED ELEPHANT GRASS AS BASAL FEED WITH CONCENTRATE FEED SUPPLEMENTATION REGIMES

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**Abstract:**

A 24-weeks feeding trial was used to study the effect of different levels of concentrate feeding regimes on the gastrointestinal tract parts and the visceral organs weights of the grasscutter fed Elephant grass as basal feed. Twenty grasscutters aged 3 months were randomly assigned in equal numbers to five concentrate supplementary feeding regimes fed at their percentage weekly body live weight of 1, 3, 5, 7 and 9% for $T_1$, $T_2$, $T_3$, $T_4$, and $T_5$ respectively, using a Completely Randomized Design (CRD). The data collected were subjected to analysis of variance and significant difference, where observed, were separated at 5% level of probability. The results obtained showed that, the full length of the gastrointestinal tract (GIT) and its' components (empty stomach, small intestine, caecum and colon/rectum) expressed as percent live weight differed ($P<0.05$) significantly except Oesophagus. The weights, of the liver, kidneys, heart, spleen and gall bladders did not differ significantly ($P>0.05$) but the lungs and pancreas were significantly ($P<0.05$) different. It was concluded that, since all the organs were not damaged and there were no mortality or sign of distress among the grasscutters, it implies that, the feeding regimes of up to 9% did not have adverse effect on them. It is therefore recommended that, growing grasscutters on a basal diet of fresh wilted grass, such as elephant grass, should be supplemented with concentrate diet (18% CP; 2700 kcal/kg) at the daily rate of 5% of body weight.

**Key words**: concentrate feed Supplement, Elephant grass, GIT, Organs' weights

## Introduction

The micro or mini-livestock animals means a small amount of input per unit, which in turn means more flexible production. Backyard food production such as mini-livestock can be a major contributor to a more balanced diet for both rural and urban people. The domesticated animals of mini-livestock widely bred in Africa include; Grasscutters, Snails, Rabbits etc. The attributes of mini-livestock gives it the potential of contributing significantly to food security and meeting up the recommended dietary animal protein intake. Its small indigenous and flexible nature makes it a suitable livestock production that can be handled by women and children (Hardouin *et al.,* 2003). In recent times, raising of micro livestock breeding by rural household has become popular due to the fact, that the households have realized the need to diversify their source of income, thereby reducing the risk involved in depending on crop production as the main source of income.

Farmed 'bush-meat' is still highly ranked in terms of taste and preference, and there is no doubt that a market exist, if necessary intensive management techniques, including domestication, can be developed. Juste *et al.* (1995) for example, pointed to the demand for bush meat, including many mini-livestock in Africa particularly Equatorial Guinea. There is also clear evidence of an international demand for bush meat particularly grasscutter meat to supply ethnic restaurants around the world (Leake, 2000) which have a positive implication for the long-term profitability.

Grasscutter (*Thryonomys swinderianus*) are wild hystricomorph rodents found in Africa. Grasscutters are being domesticated in various West African countries as micro livestock and laboratory animals. The grasscutter is a monogastric herbivore. It can be found in the Guinea-Gulf savannah areas with tall grasses, particularly, those areas with elephant and guinea grasses that serve as their food. They are also found in forest clearing. They do not have any undesirable side-effects of rearing like the larger species such as cattle, sheep and goats in urban areas (i.e., traffic accidents, noise and odors). Grasscutter meat is considered a delicacy and most West African countries particularly Ghanaians relish it. Grasscutter farming and research started in Ghana in the 1960s. However, there were on ad hoc basis until 2000 when active grasscutter farming and research started.

Major hindrances to the development of the captive grasscutter include lack of improved breeding stock, lack of technical know-how, poor management practices, poor housing and lack of start-up capital. The productivity of captive grasscutters is also low due to poor reproductive performance and high mortality rates. There is a direct relationship between nutrition and reproduction and survival of mammals. Optimal reproductive performance also depends on survival of embryo, foetus and kids. Optimal nutrition results in faster growth rate, low mortality rate and high reproductive and survival rates.

Poku *et al.* (2013) and many other researchers have studied the effect of protein supplementations and varied energy requirements on growth, reproduction and carcass characteristics of grasscutters from birth to maturity. In their study, grasscutters were provided with protein supplement containing different levels of 10, 14, and 18%. However, the need to study the effect of concentrate supplementation feeding regimes on the gastrointestinal tract parts and visceral organs cannot be over emphasized considering the fact that, animal species apart from having their nutrient requirements, also have a particular feeding regime based on their physiological stage and grasscutter is still under study in these regards.

## Materials and methods

### Experimental location

The study was carried out in Obubra Local Government Area, Cross River State. This is located between longitude $8^0$-$9^0$E and Latitude $6^0$-$7^0$N of the equator. The mean annual rainfall of the area ranges from 500 to 1070 mm, with a warm weather and ambient temperature of about $20^{0c}$-$30^{0c}$ (Mfam, 2000). Obubra is located along the banks of the Cross River in the Southern Guinea Agro-Ecological Zone of Nigeria. The town is about 159 km from Calabar, the state capital of Cross River State, Nigeria.

### Experimental animals and design

A total of twenty (20) weaned grasscutters between the ages of 3-4 months obtained from a local farmer in Ibadan were used for the feeding trial. The grasscutters were put into groups of similar body weights and were randomly assigned to five treatments feeding regimes in a completely randomized design. There were four replicates of each treatment with an animal serving as a replicate. The animals were given elephant grass as basal feed *ad libitum* and formulated concentrate supplement at a feeding regime of 1, 3, 5, 7, and 9% for $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ respectively of their weekly live body weight throughout the period of the experiment.

**Housing and experimental procedure.**
The grasscutters were individually housed in clearly and properly-labelled concrete cells measuring 90 x 75 x 40 cm (length x width x height). There was only an opening at the top in order to eliminate cross-ventilation and prevent the adverse effect of cold, because grasscutters are very susceptible to pneumonia. The top was partly covered to create a darken area meant for hiding which is their habit. Each cell was provided with a feeder and a drinker. The cemented cells were constructed in a well-ventilated cement block walled house, roofed with asbestos sheets to protect the animals from bad environmental conditions such as rainfall and cold conditions. On introduction into the cells, the animals were provided with anti-stress (vitalyte) agents in drinking water. They were also dewormed and given cocciodiostat. Elephant grass (*Pennisetum purpureum*), were cut and allowed to wilt for about 12 hours, weighed and fed daily as basal diet. Water and elephant grass were supplied *ad libitum*. The animals were weighed weekly throughout the period of 24 weeks of the study. All cells were cleaned daily in order to ensure an adequate level of sanitation.

**Experimental diet**
A concentrate supplement diet was formulated to contain approximately 18% crude protein and a Metabolizable energy of 2961.47 kcal/kg (Table 1) which was used at different feeding regimes of 1, 3, 5, 7 and 9% of their weekly body live weight and fed with wilted Elephant grass as basal feed.

Table 1: Composition of concentrate feed

| 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 1122 mg, Calcium 27%, Phosphorus 10%, Iron 0.6%, Zinc 0.35%, manganese 0.25%, Copper 0.06%; Iodine 0.002%, Cobalt 26 ppm, Selenium 4 pp. ME = Metabolizable Energy

**Data collection**

Parameters measured included; morphometric measurements, gastrointestinal tract parts weight and the organ weights.

**Chemical assay**

The proximate content of the diet and elephant grass were determined according to the procedures described byAOAC (2010)

**Gastrointestinal tract parts evaluations.**

At the end of the 24th week of the feeding trial, two grasscutters from each treatment group with live weight approximate their treatment mean live weight were selected for slaughter for evaluation. Prior to slaughtering, the animals were deprived of food overnight but had access to water. Depriving these grasscutters of food for this duration before slaughter will aid to reduce the volume of the gut contents and therefore reduce the risk of contamination of the organs. Each grasscutter was weighed and then slaughtered by severing transversely across the trachea, oesophagus, large carotid arteries and jugular veins with a sharp knife (at the neck region). There were suspended head down and allowed to bleed to death completely under gravity. After being slaughtered, the carcasses were eviscerated for the study.

**Organ weights**

The sensitive digital weighing scale was used to take the weights of the liver, kidneys, heart, lungs+ trachea, spleen, pancreas and gall bladder and expressed as percentage of the live weight. The weight of the full GIT, oesophagus, empty stomach, empty small intestine, empty caecum and empty colon/ rectum to the body live weight were obtained. The intestines were emptied using a 10 ml syringe to pump water through them.

**Statistical analysis**

Data collected was subjected to analysis of variance (ANOVA) using Mini-tab statistical software (2014), where means were significant, there were separated at 5% significant level using least significant difference according to the procedures contained in the software.

**Results**

**Proximate composition of the concentrate feed supplement and Elephant grass.**

The crude protein content of the experimental diet analyzed was similar to the calculated value and met the crude protein requirements of growing grasscutters (18%) (Kusi *et al.*, 2012). Elephant grass has low protein content of 8.18%, high fibre content of 27.19% and ether extract content of 1.18%, thus necessitating the use of formulated concentrate. The results of proximate analysis is similar to that of Onyeanusi *et al.* (2007) and Wogar *et al.* (2007) with some few variations which may be due to soil nutrients or period of harvest.

The results of the proximate composition of the formulated diet and elephant grass used for the study are presented in Tables 2

Table 2: Proximate composition of elephant grass and concentrate supplement

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

**NFE≈ Nitrogen free extractives, ME/Kcal.kg≈ Metabolizable energy per kilocalories per kilogram**

**The effect of concentrate supplement feeding regime on morphometric components**

The effect of concentrate supplement feeding regime on morphometric measurements of the gastrointestinal tract (GIT) is presented in Table 3. The oesophagus length, small intestine length and caecum length expressed as percentage of the entire gastrointestinal tract length did not differ significantly (P>0.05) between the dietary treatments. Whereas the morphometric characteristics of the entire GIT length, stomach and colon/rectum were significantly different (P<0.05) between the feeding regime treatments. The GIT length of grasscutters were similar (P>0.05) in $T_1$ – $T_4$ except $T_5$. The stomach length of the grasscutters in $T_1$ were significantly (P<0.05) different from $T_4$ and $T_5$ but did not differ (P>0.05) from those in $T_2$ and $T_3$. The measurement of the colon/rectum length showed a similarity (P>0.05) in $T_1$. $T_2$ and $T_4$ except $T_1$ and $T_5$ which were not significant to each other (P>0.05).

Table 3: Effect of concentrate supplement feeding regime on the GIT morphometric of grasscutter.

| Organ Lengths* | $T_1$(1%) | $T_2$(3%) | $T_3$(5%) | $T_4$(7) | $T_5$(9%) | SEM |
|---|---|---|---|---|---|---|
| GIT (cm) | $335.00^{b}$ | $352.50^{ab}$ | $368.00^{ab}$ | $387.00^{ab}$ | $411.00^{a}$ | 18.48 |
| Oesophagus | 3.75 | 4.11 | 4.08 | 3.88 | 3.40 | 0.39 |
| Stomach | $3.75^{a}$ | $2.40^{ab}$ | $3.53^{ab}$ | $2.97^{bc}$ | $2.67^{c}$ | 0.19 |
| Small Intestine | 47.77 | 50.21 | 44.71 | 48.24 | 45.92 | 2.47 |
| Caecum | 9.57 | 4.39 | 6.99 | 5.65 | 6.93 | 1.49 |
| Colon/Rectum | $33.62^{b}$ | $37.87^{ab}$ | $40.40^{a}$ | $39.25^{ab}$ | $39.89^{a}$ | 1.69 |

*% of GIT length a, b and c means within rows with similar superscripts are not significantly different (p>0.05), SEM= Standard Error of mean, GIT= Gastrointestinal tract,

**Effect of the concentrate feeding regime in the gastrointestinal tract parts of grasscutters.**

Table 4 shows the effects of the treatments on the gastrointestinal tract parts weights. With the exception of the oesophagus weight, the weight of the gastrointestinal tract (GIT), empty stomach, empty small intestine, empty caecum, and empty colon/rectum expressed as percentages of live weights were significantly different (P<0.05) between the dietary treatments. The entire gastrointestinal tract (GIT) of grasscutters in $T_5$ were significantly (P<0.05) different from all other treatments which were all similar (P>0.05). The oesophagus values of the grasscutters showed no significant variation (P>0.05) between treatments. The relative empty stomach weights of grasscutters fed $T_1$, $T_2$ and $T_5$ were comparable (P>0.05) to each other but differed significantly (P<0.05) from T3 and $T_4$ which were also similar (P>0.05) to $T_2$ and $T_5$. The average weights of the empty small intestine of the grasscutters followed the same pattern of significance like the full GIT. The caecum of the grasscutters fed the different feeding regime were all alike in weight except those fed $T_4$ regime which however, were similar (P>0.05) to $T_1$, $T_2$, and $T_3$. Empty colon /rectum weights $T_5$ was significantly higher (P<0.05) than all others treatments. The grasscutters fed $T_1$, $T_2$ and $T_4$ feeding regime were similar (P> 0.05) but differed (P<0.05) from $T_3$.

Table 4: Effect of concentrate supplement feeding regime on the gastrointestinal tract part weights of grasscutters expressed as percentage live weight (%LW)

| Gastro-Intestinal tracts | T1 | T3 | T5 | T7 | T9 | SEM |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| parts Indices | | | | | | |
| Full GIT WT | $3.33^{b}$ | $3.30^{b}$ | $2.82^{b}$ | $2.77^{b}$ | $4.07^{a}$ | 0.193* |
| Oesophagus | 0.065 | 0.045 | 0.035 | 0.195 | 0.060 | $0.061^{ns}$ |
| Stomach wt. | $0.505^{a}$ | $0.345^{ab}$ | $0.275^{b}$ | $0.280^{b}$ | $0.365^{ab}$ | 0.053* |
| Small Intestine | $0.875^{b}$ | $1.035^{b}$ | $0.920^{b}$ | $0.970^{b}$ | $1.280^{a}$ | 0.049* |
| Caecum wt. | $0.895^{ab}$ | $0.770^{ab}$ | $0.835^{ab}$ | $0.555^{b}$ | $0.970^{a}$ | 0.111* |
| Colon/Rectum | $1.040^{b}$ | $1.105^{b}$ | $0.770^{c}$ | $0.985^{b}$ | $1.395^{a}$ | 0.038* |

a, b and c means within rows with similar superscripts are not significantly different (p>0.05), SEM= Standard Error of mean, * = significant level (0.05), GIT= Gastrointestinal tract, WT=weight


g. 1: Grasscutter (*in situ*) showing the visceral organs: intestine: jejunum (1), colon (2) and Urinary bladder and fecal balls in the colon


Fig. 3: The gross anatomy of the stomach of the grasscutter showing its parts: cardiac (1), fundus (2) and pylorus (3)


'ig. 2: The gastrointestinal tract of the grasscutter showing the stomach (1), the small intestine: Duodenum (2), jejunum (3) and ileum (4). The large

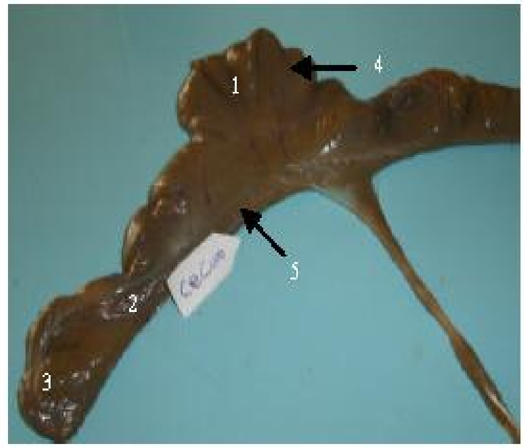


Fig. 4: The gross anatomy of the cecum of the grasscutter showing its three parts: Base (1), body (2) and apex (3). The teniea (4) and the haustra (5)

**Effect of the concentrate feeding regimes in the visceral organ weights**

The effect of concentrate supplement feeding regime on visceral organs weight is presented in Table 5. The weight of visceral organs namely; liver, kidney, heart, spleen and gall bladder expressed as percentages of grasscutter body weight were not significantly different (P>0.05) among the feeding regime treatments while the lung and the pancreas weights of the grasscutters weight were significantly different (P<0.05) among the treatments. The grasscutters lungs weight in $T_4$ were significantly higher (P<0.05) than those in $T_1$ and $T_2$ but similar to $T_3$ and $T_5$. The lungs weight in $T_1$, $T_2$ and $T_3$ were similar (P>0.05) as well as those of $T_2$, $T_3$ and $T_5$. The pancreas weight of $T_1$, $T_2$ and $T_5$ were significantly (P<0.05) higher than $T_3$ and $T_4$ which were only similar (P>0.05) to $T_5$

Table 5: Effect of concentrate supplement feeding regime on the visceral organs weight expressed as percentage live weight (%LW)

| Visceral Indices | T1 | T3 | T5 | T7 | T9 | SEM |
|---|---|---|---|---|---|---|
| Liver | 1.275 | 1.190 | 1.625 | 1.245 | 1.300 | $0.14^{ns}$ |
| Paired Kidney | 0.335 | 0.320 | 0.250 | 0.310 | 0.330 | $0.02^{ns}$ |
| Lungs | $0.520^{c}$ | $0.540^{bc}$ | $0.690^{abc}$ | $0.870^{a}$ | $0.835^{ab}$ | 0,09* |
| Heart | 0.390 | 0.420 | 0.405 | 0.425 | 0.485 | $0.06^{ns}$ |
| Pancreas | $0.045^{a}$ | $0.045^{a}$ | $0.030^{b}$ | $0.030^{b}$ | $0.040^{ab}$ | 0.003* |
| Spleen | 0.110 | 0.140 | 0.110 | 0.080 | 0.155 | $0.03^{ns}$ |
| Gall bladder | 0.045 | 0.065 | 0.030 | 0.045 | 0.040 | $0.01^{ns}$ |

a, b, and c means within rows with similar superscripts are not significantly different (p>0.05), SEM= Standard Error of mean, * = significant level (0.05), ns = Non-significant (p 0>05)

## Discussion

The average length of the gastrointestinal tract (GIT) of the grasscutter in this study varied from 335.00 to 411.00 cm and it was significant. The longest length was in $T_5$ while the shortest was in $T_1$. The length was slightly longer than 343.1 cm (Olomu, *et al.,* 2003). The measurements of each of the GIT constituents namely Oesophagus, small intestine, and caecum were comparable among the treatments while the stomach and the colon differed (P<0.05) among the treatments. The morphometric value of the stomach, small intestine, caecum and colon are comparable with 3.35-3.6 cm (stomach), 50-52.6 cm (small intestine), 5.5-7.8 cm (caecum), and 33-38.4 cm (colon/rectum) recorded by (Olomu, *et al.,* 2003). They were also comparative to the values recorded by Byanet *et al.* (2008) apart from the caecum length (19-22 cm) which was longer than 8-17 cm recorded by them when they studied the macroscopic structure of the grasscutter gastrointestinal tract. It was however, observed numerically that, the caecum length in relation to live weights of the grasscutter presented a definite picture of the extent to which the feeding regimes affected this organ though not statistically significant. As observed from the results on the table, grasscutters fed 1% concentrate feed supplement recorded the highest value of 9.57%. The increased proportion of the caecum for grasscutters in this treatment could be explained to be as a result of compensatory growth of this organ to accommodate the intake of forage consumed by the animals. These findings generally suggested that the feeding regimes had a significant effect (P<0.05) on some morphometric traits of the grasscutter GIT.

The entire gastrointestinal tract (GIT) and some of its components (empty stomach, empty small intestine, empty caecum and colon/rectum) expressed as percentages of their live weight differed in all the treatments apart from Oesophagus and no particular sequence was followed. It was observed in this study that the relative weights of entire GIT and it components (empty small intestine, empty caecum and empty colon/Rectum in $T_5$ had a superior weight and they were significantly (P<0.05) different from other treatments, which could be attributed to the high feed consumption which might have led to more crude fibre (CF) intake which was responsible for the increase in size and the weight of the various segments of the grasscutters as an adaptation to accommodate more feed. The variation within these values could also be attributed to the level of development of the digestive system of each group of grasscutters with reference to the nature of feed taken in. Xicatto *et al*. (2003) had reported that caecal fermentation increases as a consequence of increased intake of solid feed.

The entire (GIT) weight in this study that ranged from 2.77 to 4.07% are less than the value of 8.30% recorded by Olomu *et al.* (2003) and the value range of 5-10.2% recorded by Henry *et al.* (2012). The variation observed in this study with that of other authors could be attributed to the ages the animals were slaughtered.

The weights of the liver, kidneys, heart, spleen and gall bladders expressed as percentages of live body weight were similar whereas that of the lungs and pancreas were significantly (P<0.05) different. The weight of the liver obtained (1.19-1.63%) is in agreement with value of 1.42-1.47% reported by Henry *et al.* (2012), but slightly less than 1.7-1.8% reported by Olomu *et al.* (2003). The kidneys weight 0.25-0.34% are in harmony with 0.28%-0.33% (Olomu *et al.,*2003) but less than 0.38-0.49% (Henry *et al.,* 2012). The values of weight of the lungs (0.52 to 0.87%) are comparable to 0.56 to 0.69% (Henry *et al*., 2012) and 0.62 to 0.67% (Olomu *et al.*, 2003). The heart weights recorded 0.39 to 0.48% are in line with 0.44-0.50% (Olomu *et al.*, 2003), but less than 0.56 to 0.67% recorded by (Henry *et al.,* 2012).

The pancreas weight which ranged in this study from 0.03-0.045 was significantly (P<0.05) different among the treatments. The average spleen weights 0.08-0.155% is less than 0.27-0.34% reported by Olomu *et al.* (2003). The weight of the gall bladder obtained ranged from 0.04-0.065% and were not significantly influence by the feeding regimes. These results shows that none of the visceral organs in the experimental grasscutters were damaged by the feeding regimes since most organs were comparable to other researcher's reports. It is known that these organs help to ascertain the health status of farm animals (Carew, 1981). The author added that, liver size is known to increase in response to several factors especially deficiency of amino acids It was observed in this study that, this feeding regime up to 9% of their weekly body live-weight did not compromise the health status negatively. There was no record of loss of any grasscutter in any treatment neither was there any sign of distress among the grasscutters.

## Conclusion

The results obtained in this study revealed that, all the organs in the experimental grasscutters were not damaged by the feeding regimes. That is, the health status of growing grasscutters in terms of excess elongation/enlargement (as indicated in the morphometric indices, the weight of the (GIT) and Visceral organs weights were not negatively affected by concentrate supplementation with fresh wilted grass diets. It is therefore recommended that, growing grasscutters on a basal diet of fresh wilted grass, such as elephant grass, should be supplemented with concentrate diet of (18% CP and Metabolizable energy of 2700 kcal/kg) at the rate of 5% weekly body weight.

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