EFFECT OF DAYLIGHT HOURS ON PERFORMANCE OF GROWING GRASSCUTTERS

G. S. I. WOGAR, L. N. AGWUNOBI AND B. E. UBOM

ABSTRACT

The grasscutter (*Thryonomysswinderianus*) holdspromise as a source of increased protein for populations of Sub-Sahara African countries. It is inexpensive to feed and features the feed utilization characteristics of ruminants and monogastrics. It is nocturnal in its activities, especially feeding. This experimentwas carried out to determine the effect of daylight hours or photoperiod on growing grasscutters under intensive rearing conditions. The effect of daylight hours on growing grasscutters was determined using sixteen 8-months old femalegrasscutters. The grasscutters were separated into four groups and allotted to four treatments of varying daylight hours. The treatments included; zero (0) hours of daylight and twenty four (24) hours (6.00 am-6.00 am) of darkness (0L:24D), six ante-meridiem (am) hours (6.00 am-12.00 noon) of daylight and eighteen (18) hours (12.00 noon-6.00 am) of darkness (6L(am):18D), six post-meridiem (pm) hours (12.00 noon-6.00 pm) of daylight and eighteen (18) hours (6.00 pm-12.00 noon) of darkness (6L(pm):18D) and twelve (12) hours (6.00 am-6.00 pm) of daylight and twelve (12) hours (6.00pm-6.00am) of darkness (12L:12D).Allgrasscutters were fedadiet containing 2200kilocalories metabolizable energy per kilogram (KcalME/kg) and crude protein (CP) level of 20%. Cassava root meal and wheat offalwere the main sources of energy, while soybean meal was the main source of protein in the diets. Elephant grass was fed as basal diet.The results showed thatforage, concentrate (diet) and total feed intake, and daily weight gain were significantly (P<0.05) higher under the 6 post-meridiem hours of daylight and 18 hours of darkness (6L(pm):18D) than under other conditions. It was, therefore, concluded that the optimum daylight conditions required for the rearing of growing grasscuttersare the six (6) hours of post-meridiem daylight, followed by eighteen (18) hours of darkness.

KEY WORDS: Daylight hours, Photoperiod, Performance, Grasscutters

INTRODUCTION

The farming of grasscutter offers promiseof less expensive intervention, in the supply of animal protein in thediets of the populations of the countries of Sub-Sahara Africa, than is possible with conventional livestock. Presently, most African diets consist of starchy foods, which are highly deficient in protein (African Farming, 1996). The challenge of protein deficiency can be mitigated by the farming of unconventional livestock such as the grasscutter.

An importantfactor in favour of the intensive farming of thegrasscutter (*Thryonomysswinderianus*) is its biological efficiency. The grasscutter is an efficient converter of almost any form of roughage (Pich and Peters, 1985) because of its specialized digestive system (Emmons, 1987). This makes it an important animal in the drive to produce animal protein using less expensive feedstuffs. The utilization of fibre diets by microbes of the caecum of the grasscutter is similar to that of rumen microbes. Fibreand simple nitrogen compounds are converted to volatile fatty acids (Michalet-Doreau, 2002) and microbial cells, which serve as precursors for much of the metabolizable energy (Kristensen 2005) and other chemical components of the body.

The grasscutter is actively nocturnal and is killed by hunters and trappersfrom the wildfor 'bushmeat'. The 'bushmeat' market is dominated by grasscutter (Falconer, 1992), which provides an estimated 20%, and accounts for about 0.5g per caput per day intake, of animal protein in Nigeria (FAO, 1995).Grasscutter meat is an important source of protein and a cherished delicacy in all cultures (Jori*et al.*, 1995) in the West African Sub-region.The popularity of its meat in West Africa is generating great interest in the farming of grasscutter.Intensive production of the grasscutter requires, not only an adequate knowledge of its nutritional requirements but also an adequate understanding of its requirements as a nocturnal animal.

The nocturnal activities of thegrasscutter are determined by changes indaylength or photoperiod. Photoperiod depends on the rotation of the earth around the sun anddetermines the time of the year (Gwinner, 1986). The biologically controlled rhythm in theactivities of many organisms, known ascircadian rhythms, are based on biological clocks, whichare synchronized by photoperiod (Bromage*et al.,* 1993). In the temperate regions, photoperiod serves as the trigger of various processes such as hibernation in mammals, migration in birds and breeding cycles for most mammals (Gwinner, 1986).

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It has been found that photoperiod induces the secretion of melatonin in the night and that the mechanisms and effects of photoperiod-controlled rhythmicity are best known in vertebrates (Sumpter, 1990). Melatonin is produced in the pineal gland (Peter, 1983) and by a variety of peripheral cells such as bone marrow cells (Maestroni, 2001), lymphocytes and epithelial cells of most animals. It plays a role in the regulation of circadian rhythms of several biological functions (Altun and Ugur-Altun, 2007). Melatonin functions through the activation of melatonin receptors (Boutin*et al*., 2005) and through its role as a pervasive and powerful antioxidant (Hardeland, 2005) particularly important in the protection of nuclear and mitochondria DNA.Many animals use the daily variation in the duration and quantity of melatonin production as a seasonal clock (Lincoln and Loudon, 2003). The change in the duration of secretion serves as a biological signal for the organization of daylength-dependent functions such as reproduction, behavior, coat growth and camouflage colouring in some animals (Arendt and Skene, 2005).

Circadian rhythms involve an approximate daily or 24-hour cycle of chemical, physiological and behavioral processes in the biological system. The physiological reaction todaylight hours and the role of the circadian system is vital to the organism (Zivkovic, 2007). Feed intake by animals is affected by photoperiod. Tucker *et al.*(1984) found that increasing daily exposure to light increased feed intake when sheep or cattle were fed ad libitum. Lactating cows exposed to long day photoperiod (LDPP) have been shown (Dahl and Petitclerc, 2003) to have higher dry matter intake (DMI) than those without extended light exposure. It has been reported (Dahl *et al.,* 2000) that lactating cows exposed to 16-18 hours of daylight (i.e. long day photoperiod-LDPP) have greater milk yield than those on a typical light schedule of natural photoperiod. Other studies have shown that differences in the response to daylength exposure or photoperiod are determined by the physiological status (Auchtung*et al.,*2005), age (Zinn*et al.,*1986) or species (Tucker *et al.*, 1984) of the animal.For now, no literature has been found on the effect of photoperiod on the growth and reproductive performance of grasscutters.

The grasscutter is active during night hours and spends the daylight hours sleeping or resting. The length ofdaylight hours of exposure could affect the chemical and physiological basis of grasscutterbehaviour and, therefore, the performance of grasscutter.The objective of this study was, therefore, to investigate the growth performance of intensively rearedgrasscutters under varying daylight conditions.

MATERIALS AND METHODS

The study was carried out at the Grasccutter Research Farm inCalabar, in the Department of Animal Science, University of Calabar, Calabar, Nigeria. Calabar is at latitude 3^0 Northand longitude 7^0 East. It has an annual rainfall of 2650 to 3000 mm and relative humidity of 57 to 93%. The annual temperatures are between 25 and 32^0 C (Calabar Travel Guide, 2010). The study, which lasted for twelve (12) weeks, was conducted during the late Dry Season between the months of January and April, 2009.

Experimental diets

The grasscutter diet was formulated to supply dietary energy content of 2200kilocalories metabolizable energy per kilogram (KcalME/kg) and crude protein (CP) level of 20%. Cassava root meal and wheat offal served as the sources of energy, while soybean meal was the main source of protein in the diets.Cassava also served as a binding agent in the diet. Elephant grass was fed as the basal diet. The energy contents of the diets were calculated from the energy density of each ingredient of the diets. All the ingredients used were purchased from a local market in Calabar. A thick paste of the ingredients was pelleted in a pelleting machine and dried in a kerosene-fired oven at 75^0C. The composition of the test diet is shown in Table 1, while the proximate composition of the diet is shown in Table 2.

Research animals

Sixteen (16)growing grasscutters aged 8 months, average weight of 1.59 – 2.00 kg were used in the study. They were individually housed in clearly-labelled concrete cells measuring 150 x 75 x 35cm (length x width x height). The housing provided for only one opening (35 high x 45cm wide) into the cell in order to eliminate cross-ventilation and prevent the adverse effect of cold on them as they are susceptible to pneumonia.By boarding up the only opening (or door) into each cell with paper boards, which were cut from cartons, it was possible to create darkness in the cells.The temperatures in the cells were in the range of 28 - 33^{0}C during the experimental period.

The grasscutters were randomly allotted in groups of four to four daylight hours treatments;zero (0) hours of daylight and twenty four (24) hours (6.00 am-6.00 am) of darkness (0L:24D), six ante-meridiem (am) hours (6.00 am-12.00 noon) of daylight and eighteen (18) hours (12.00 noon-6.00 am) of darkness (6L(am):18D), six post-meridiem (pm) hours (12.00 noon-6.00 pm) of daylight and eighteen (18) hours (6.00 pm-12.00 noon) of darkness (6L(pm):18D) and twelve (12) hours (6.00 am-6.00 pm) of daylight and twelve (12) hours (6.00pm-6.00am) of darkness (12L:12D). The 6 postmeridiem hours of daylight and the 18 hours of darkness in this study involved the extension of night hours by 6 antemeridiem dark hours, while the 6 antemeridiem hours of daylight and 18 hours of darkness involved creating 6postmeridiem dark hours before the night hours.

Each group was liberally fed the concentrate diet. There were four replicates per treatment, with one (1) grasscutter per replicate.The growing grasscutters were fed the test diet along with elephant grass (*Pennisetumpurpureum*) for one week before data collection. This was to minimise stress that could be caused by the change in diet. The animals were dewormed and provided with anti stress agents in drinking water before commencement of experiment. Elephant grass (*Pennisetumpurpureum*) was fed daily as basal diet after it had been cut and allowed to wilt for two days. Water, diet and elephant grass were supplied *ad libitum*.

The animals were weighed at the beginning and every two weeks thereafter during the study period. All cells were cleaned daily in order to ensure an acceptable level of sanitation.

Data collection and statistical analysis

Data collection on: daily forage intake (g); daily forage dry matter intake (g), which was estimated as 12% Dry Matter content of elephant grass; daily diet intake (g); daily total feed intake (g), which was the total intake of forage dry matter and concentrate; daily weight gain of growing grasscutters and cost of concentrate (N.K) served as the parameters.

They were randomly allocated to the four daylight hours treatments. The design of the experiment was the Completely Randomized Design. All the data collected were subjected to analysis of variance using the Genstat (2007) software. Significant means were separated using Duncan's Multiple Range test (Steel and Torrie, 1980).

Table 1: Composition of Experimental Diet for Growing Grasscutters.

Ingredients	% Composition
Cassava 27.00	
Soybean meal	9.00
Palm kernel cake	40.00
Wheat offal	20.00
Vitamin premix	0.50
Bone meal	3.00
Salt	1.00
Total	**100.00**

Table 2: Proximate Composition of Experimental Diet

Nutrients	Composition (DM)
Crude protein	18.56
Crude fibre	9.50
Ether extract	4.75
Ash	4.10
Nitrogen free extract	49.24
Dry matter	86.15
Metabolizable energy (kcalME/kg)	2,226

RESULTS AND DISCUSSION

The effects of varying daylight hours on the performance of the growing grasscutters are presented in Table 3.

Growth Performance

Forage intake: The resultsindicate that forage intake was significantly ($P<0.05$) higheringrasscutters raised under the 6 postmeridiem daylight hours and 18 hours of darkness (6L(pm):18D) than in those raised under other daylight conditions.

The lowest forage intake was observed under conditions providing 24 hoursof darkness((0L:24D). This finding suggests the need for, and importance of daylight in the foraging activity of growing grasscutters.

Forage intake ingrasscutters raised under the 12 hours of daylight and 12 hours of darkness (12L:12D) was lower than forage intakeingrasscutters raisedunder the 6 postmeridiem daylight hours and 18 hours of darkness (6L(pm):18D). This finding suggests that the 12 hours of daylight was higher than the maximum of 6 hours of daylight required by growing grasscutters for optimum forage intake.

Significant ($P<0.05$) differences were observed between grasscutters raised under the 6 antemeridiem hours of daylight and 18 hours of darkness (6L(am):18D)and those raised under the 6 postmeridiem hours of daylight and 18 hours of darkness (6(pm):18D). It was found that though each of the two treatments provided 6 hours of daylight and 18 hours of darkness, forage intake was significantly ($P<0.05$) higher ingrasscutters raised under conditions, which included the 6 postmeridiem hours of daylight (6L(pm):18D).

These findings suggest that under the conditions of this study,6 postmeridiem daylight hours followed by 18 hours of darkness provided optimum conditions for forage intake by growing grasscutters. It was also noted that the significantly (P<0.05) higher forage intake during the 18 hours of darkness under the 6L(pm):18D conditions included the extention of thedark foraging hours by 6antemeridiem hours.This finding is important as foraging constitutes a primary activity and highlights the observation that darkantemeridiem hours are necessary for optimizing the foraging activities of grasscutter.

Diet (concentrate) intake: In the wild, intake of concentrate feedstuffs (roots and tubers, cereals, berries, nuts) is part of the foraging and browsing activity of the grasscutter. The results of this study indicate that concentrate intake was significantly (P<0.05) higher ingrasscutters raised under the 6 postmeridiem daylight hours and 18 hours of darkness (6L(pm):18D) than in those raised under other daylight conditions.

It was observed that concentrate intake under the 6L(am):18D and 12L:12D conditions, which involved6antemeridiem daylight hours and 12 daylight hours respectively, was significantly (P<0.05) lower than under the 6L(pm):18D and 0L:24D, which involved theextention of night hours by6antemeridiem dark hours and 12dark hours respectively. These observations suggest that the significantly (P<0.05) higher concentrate intake during the 18 and 24 hours of darkness under the 6L(pm):18D and 0L:24D conditions, respectively were due to the extention of night hours by 6 to 12 darkhours. This finding highlights the observation that dark hours are important in optimizing concentrate intake by grasscutter.

Total feed intake: The results of this study indicate that total feed intake was significantly (P<0.05) higher ingrasscutters raised under the 6 postmeridiem daylight hours and 18 hours of darkness (6L(pm):18D) than ingrasscutters raised under other daylight conditions. The results underscore the importance of daylight conditions, which include 18 hours of darkness (specifically, from 6.00 pm to 12.00 noon) and 6 daylight hours (specifically, from 12.00 noon to 6.00 pm) for foraging and feeding by growing grasscutters.

The findings of this study indicate that the effects of photoperiod on feed intake of growinggrasscutter are determinedby specific durationand time of exposure to daylight hours. These results suggest that short daylight hours, specifically the 6 daylight hours of 12.00 noon to 6.00 pm followed by 18 hours of darkness increased feed intake in growing grasscutters. Studies with other animals are more concerned with duration than with time of exposure to daylight hours. Tucker *et al.*(1984) found that increasing daily exposure to light increased feed intake when sheep or cattle were fed ad libitum. Similarly, lactating cows exposed to long day photoperiod were found to have higher dry matter intake (DMI) than those without extended light exposure (Dahl and Petitclerc, 2003). The results of this study show that while daylight hours were important for increased feed intake, the dark hours immediately following daylight exposure were equally as important.

Average daily weight gain: Average daily weight gain was significantly (P<0.05) higher ingrasscutters raised under the 6 postmeridiem daylight hours and 18 hours of darkness (6L(pm):18D) than ingrasscutters raised under other daylight conditions.The higher average daily weight gain ingrasscutters under the 6L(pm):18D daylight conditions could be due to the higher intake of forage and concentrate. It was observed that the 6 daylight hours and 18 hours of darkness supportedthe higher average daily weight gain, and that the 6postmeridiem daylight hours of 12.00 noon to 6.00 pm probably contributed to the higher daily weight gain. The observed requirement of 6 postmeridiem daylight hours and 18 hours of darkness involved the extension of the night hours by 6 antemeridiemdark hours (from 6.00 am to 12.00 noon). Average daily weight gain was reduced underall otherdaylight conditions.

The findings of this study indicate that the effects of photoperiod on average daily weight gain of growing grasscutter are probably determined by specific duration and time of exposure to daylight hours..Theseresults suggest that short daylight hours, specifically the 6 daylight hours of 12.00 noon to 6.00 pm followed by 18 hours of darkness could increase daily weight gain in growing grasscutters.Studies with unrelated animals are more concerned with duration, than with time, of exposure to daylight hours. The findings of studies (Zinn et al., 1986) with other animals indicate that photoperiod did not affect average daily weight gain in prepubertal Holstein heifers, while postpubertal heifers exposed to short day photoperiod (SDPP) had greater average daily weight gain than those exposed to long day photoperiod (LDPP).Increasing daylight exposure from 8 to 16 hours has been found to increase average daily weight gain of sheep and Holstein cattle but reduced gains of white-tailed doe fawns (Tucker *et al.,* 1984).The average daily weight gain of growing grasscutters (8.53g) under the 6postmeridiem daylight hours was within the 8 to 13g range reported by Jori and Chardonnet (2001) and 7 to 12g reported by Mensah (1995) for grasscutters under natural photoperiod.

The results of this study show that while the 6 postmeridiem daylight hours were important for increased average daily weight gain, the 18 dark hours immediately following the daylight exposure were equally very important.

Feed conversion ratio;Cost togain ratio: The amount of feed consumed by growing grasscutters per unit weight gain (or feed conversion ratio) did not differ significantly among grasscutters from the different treatments. Similarly, the cost to gain ratio of raising growing grasscuttersdid not differ significantly between the different treatments.

Table 3: Performance of Growing Grasscutters under Varying Daylight Hours

Parameters	0L:24D	6(am):18D	6L(pm):18D	12L:12D	SEM
Initial weight of grasscutters (g)	1767.50	1770	1770	1770	45.60
Final weight of grasscutters (g)	2402.50	2326.67	2543.33	2402.50	69.10
Average daily forage intake (g)	306.90^c	313.70^{bc}	377.60^a	346.00^{ab}	13.10
Average daily forage dry matter intake (g)	38.35^c	39.22^{bc}	47.20^a	43.25^{ab}	1.64
Average daily diet intake (g)	68.80^{ab}	63.20^b	75.90^a	62.10^b	2.68
Average daily total feed intake (g)	105.70^b	101.40^b	121.80^a	104.10^b	2.90
Average daily weight gain (g)	7.56^b	6.21^c	8.53^a	7.53^b	1.04
Feed conversion ratio	17.10	23.20	19.80	14.80	5.40
Average daily cost of diet (N.K/day)	3.85^{ab}	3.53^b	4.25^a	3.48^b	0.15
Cost per unit gain (N.K/g)	0.63	0.86	0.71	0.48	0.21

1. ^{abc}Means along the same row having no common superscript differ significantly at $P<0.052$. N.K = Naira.Kobo (Nigerian currency; N155.00 = US$1.00)

CONCLUSION

The results of this study indicate that average daily forage intake, average daily concentrate intake, and average daily weight gain increased when growing grasscutters were exposed to 6 postmeridiem daylight hours (specifically from 12.00 noon to 6.00 pm) followed by 18 hours of darkness.These findings suggest that while a photoperiod of 6 postmeridiemdaylight hours was important for increased growth performance, the 18 dark hours immediately following the daylight exposure were equally very important.It was, therefore, concluded that the optimum daylight conditions required for the rearing of growing grasscutterswere the six (6) hours of post-meridiem daylight followed by eighteen (18) hours of darkness.

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