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RESEARCH ARTICLE

EFFECT OF PHOTOPERIOD ON THE GROWTH PERFORMANCE AND BEHAVIORAL PATTERN OF *ACHATINA ACHATINA* SNAIL

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ABSTRACT

The study was conducted to evaluate the effect of photoperiod on the growth performance and behavioral pattern of *Achatina achatina*. Ninety snails of uniform weights were used for the study which lasted for 56 days. The snails were randomly assigned to three treatments and each treatment was replicated three times with 10 snails per replicate. The snails were exposed to different light duration. Treatment 1 had 12 hours light and 12 hours darkness, Treatment 2 was subjected to 18 hours light and 6 hours darkness, Treatment 3 was subjected to 24 hours light. The data collected was analysed using one-way analysis of variance and Duncan multiple range test for significant mean separation. Data were collected on feed intake, weight gain, time of feeding and reproductive behaviors. The results of the experiment showed that there were no significant differences (P>0.05) in final weight gain, average daily weight gain, total feed intake, average daily feed intake, feed conversion ratio, duration of courtship, duration of feeding and cost of feed per kg weight gain between treatments. The results also showed that there were significant differences in number of eggs laid and mating duration between treatments. From the result, it was concluded that the best photoperiod for *Achatina achatina* is 24 hours light as it produced the lowest feed conversion ratio and cost of feed per kg weight gain and that was recommended for effective growth of *Achatina achatina.*

KEYWORDS

Achatina achatina, photoperiod, behavioral, growth, performance

1. INTRODUCTION

Achatina achatina are the largest land snails in the world. They are sometimes more difficult to breed than other African snails. Tigers are found within the dense forest floors in the forest zone of Ghana and also in the humid riparian forest floors. They are believed to have three-year breeding cycle which is longer than other snails. Average adult shell length is 18cm with an average diameter of 9cm. In exceptional cases the shell can grow to be 30cm long, but this is very unlikely, especially in captivity. Large ones may achieve a shell length of 22cm.

The Giant African Land snail is known to eat more than 500 different types of plant. Snails are strong and can lift up to 10 times their body weight in vertical position. When moving, snails leave behind a trail of mucus. This mucus acts as a lubricant to reduce friction against the surface where they pass. The life expectancy of snails depends on their habitat and the species. Some of them only live for about five years. However, others in captivity can live up to 25 years. Some species of snails hibernate during the dry months of the year. They cover their bodies with a thin layer of mucus which prevents them from drying out.

Some land snails feed on other terrestrial snails. The snails that just hatch the egg can eat their shells and even other eggs of snails. Land snails hatch from eggs. Some predators of terrestrial snails are beetles, rats, mice, turtles, salamanders and some birds.

The importance of snail meat cannot be over emphasized; it is a good source of animal protein containing about 18% crude protein of high biological value and can help sustain the average global per capita meat consumption at over 40kg, which has, doubled from the consumption in 1960 [1]. The meat contains all essential amino acids such as lysine, methionine, etc. The meat is highly prized, contains low fat content and low cholesterol levels which make it a good antidote for fat related diseases like hypertension, etc. The meat is rich in calcium, iron, phosphorus and potassium which are essential or macro- minerals needed for strong bones, osmo-regulation and metabolic activities in the body of man. Snail meat is a good source of vitamin A, B6, E and K which are required for proper utilization of primary nutrients such as carbohydrate, protein, fat and oil [2].

The study of animal behavior begins with understanding how an animal's physiology and anatomy are integrated with its behavior. Both external and internal stimuli prompt behaviors such as external information like threat from other animals, sounds and smells or weather conditions and internal information like hunger and fear [3]. Animals behave in certain ways for four basic reasons; to find food and water, to interact in social groups, to avoid predators and to reproduce. Behavior is anything an animal does involving action and a response to a stimulus. Animals are as intelligent as they need to be to survive in their environment. They often are thought of as intelligent if they can be trained to do certain behaviors. But animals do amazing things in their own habitats.

Lights duration and intensity play an important role in the regulation and control of production, reproduction, behavior and welfare of animals [4,5]. For individuals of many species, the annual cycle of changing photoperiod provides the environmental switch between seasonal phenotypes.

Animals will adapt to a change in day length. Learning ability of an animal depends upon the inheritance, but learning is important for developing a particular act in the organism. An organism possesses genes where in any change in a single unit of gene will bring about change in the behavioral pattern of that organism. Behavior of an organism or animal is achieved by the interaction of genes with environments and on the learning abilities of the organism. Memory is an essential part of learning in animal. Animal collects information about their surroundings in the learning process. Many behavioral patterns are controlled by the nervous system and are modified through learning. The present study was designed to know and determine the effect of photoperiod on the growth performance and behavioral pattern of *Achatina achatina* Snail.

1.1 Statement of problem

The feeds of these animals are very cheap to procure. Their faeces do not smell like other animals whose droppings make people uncomfortable and cause environmental pollution. Farmers complain that it is difficult to raise snails because they do not know their behavioral pattern.

1.2 Objectives of the study

The objective of this study is to determine the effects of different photoperiods on the growth performance and behavioral pattern of *Achatina achatina.*

1.3 Specific objectives of study

1. To evaluate the effect of different photoperiods on the feed intake of *Achatina achatina* snails
2. To evaluate the effect of different photoperiods on the weight gain of *Achatina achatina* snails
3. To evaluate the effect of different photoperiods on the reproductive behaviors of *Achatina achatina* snails
4. To evaluate the effect of different photoperiods on the cost of producing *Achatina achatina* snail

2. MATERIALS AND METHOD

2.1 Location and duration of study

The experiment was carried out at Umuriam village Nawfia in Njikoka Local government area. It is located near the capital of Anambra state, Awka. Awka lies within the coordinates 6°12N and 7°0E in the tropical zone of Nigeria. It experiences two seasons brought about by the two predominant winds, the south western monsoon wind from the Atlantic Ocean and the North Eastern dry wind from across the Sahara Desert. The temperature is generally hot and humid within the range of 27-28°c during July through December but rises to 35°c between February and April [6]. The experiment lasted for 9 weeks (63 days) including one week of acclimatization.

2.2 Procurement of experimental animals

Ninety grower snails (*Achatina achatina*) of average weight were got from a local snail trader at Ochanja market, Onitsha, Anambra state. They were transported in well aerated jute bag from the place they were procured to the experimental site. The jute bag used in the transportation contained little garden (loamy) soil to reduce the stress of transportation. They were protected from direct rays of sunlight during transportation. The jute bag was placed in a bowl to reduce heat from the vehicle.

2.3 Acclimatization of the experimental animals

On arrival, the snails were placed in their improvised housing which is a basket. The snails were covered very well to prevent them from escaping. After two days, they were placed in the plastic bowl which was covered with a mosquito net and tied with a twine rope to prevent the snails from escaping and also prevent pests and predators from attacking the snails. The bowls were filled with one third of sterilized loamy soil got from the farm. The snails were fed with paw-paw leaves and plantain leaves during the one week of acclimatization.

2.4 Formulation of diets

Feed was compounded for the snails using maize, sorghum, wheat offal, groundnut cake, soya bean meal, palm kernel cake, fish meal, bone meal, limestone, premix (vitamin and trace minerals), methionine and lysine. The three treatments were fed with the same feed. The ingredients used in compounding the feed were measured using a sensitive scale of model SF 400 and capacity 5000×1g/17702×o.102. The place where the feed was compounded was well swept to avoid contamination of the feed. The feedstuffs were mixed thoroughly after measuring out the required quantity to be used. The gross composition of the diet is given in table 3.1below:

Table 1: Feed Formula

Feedstuff	Quantity in kg
Maize	24
Sorghum	12.25
Wheat Offal	17
Groundnut Cake	15
Soya bean Meal	15
Palm Kernel Cake	6
Fish Meal	5
Bone Meal	3
Limestone	2
Vit/Min Premix	0.25
Lysine	0.25
Methionine	0.25
Total	100
% Crude Protein	24.1375
% Energy (k/cal)	2220.54

2.5 Experimental design

The experimental design was completely randomized design (CRD). The treatments were formed based on the period of light the snails were subjected to. The three treatments were labeled treatment 1(T1), treatment 2 (T2) and treatment 3 (T3). The treatment 1, was subjected to 12 hours of light and 12 hours of darkness which equally served as the control, treatment 2 (T2), was subjected to 18 hours of light and 6 hours of darkness while treatment 3 (T3) was subjected to 24 hours of light. Each of the treatments consists of three replicates R1, R2 and R3 and 10 snails were placed in each replicate.

2.6 Identification of the experimental animals

The experimental animals were numbered on their shells using an indelible marker (igle) having a fine needle type metal nip of 0.8mm. They were placed in the bowl according to their numbers.

Treatment one: T1R1; 1-10, T1R2; 11-20 and T1R3; 21-30

Treatment two: T2R1; 31-40, T2R2; 41-50 and T2R3; 51-60

Treatment three: T3R1; 61-70, T3R2; 71-80 and T3R3; 81-90

2.7 Management of the experimental unit and animals

The management practices that were carried out during the experiment include; sweeping of the experimental unit, removing the snails from the

bowl in order to remove their feaces, weighing the remaining feed, checking for Mortality, feeding the animals, discarding the remaining feed, sprinkling lukewarm water on the snails in a very cold weather, sprinkling water on the soil, turning the soil, checking for eggs, weighing of the snails and placing of the weighed feed for the snails.

2.7.1 Cleaning of the experimental materials

The feeding trough was cleaned and washed with clean water. The mosquito nets were washed without any detergent. The plastic bowl (housing pen) was kept clean by removing the feacal materials and some drop of feed inside the plastic bowl. The washed feeding trough was dried with a clean towel before placing feed for the snails to prevent the feed from caking.

2.8 Data collection

Feed intake and weight gain were measured using sensitive weighing balance (electronic kitchen scale). Data on the behavioral pattern was collected everyday by closely observing the snails 2 hours in the morning, afternoon and night.

2.9 Light Duration for the experimental treatments

The three treatments were subjected to different light period.

T1; 12 hours light and 12 hours darkness

T2; 18 hours light and 6 hours darkness; the light source was white bulb and electric rechargeable lantern from 06.00p.m to 12.00a.m every day.

T3; 24 hours light; the light source was white bulb and electric rechargeable lantern from 06.00p.m to 07.00a.m.

2.10 Statistical analysis

The data collected were subjected to Analysis of variance (ANOVA) using SPSS analytical package and significant means were separated using Duncan's New Multiple Range test, at 5% probability level [7].

3. RESULTS

One experimental diet was used in the study. The proximate analysis shows that it contained crude protein value of 19.50 % which is high enough to support proper growth and development of *Achatina achatina.* The ash, fat, crude fiber and nitrogen free extract of the diet were high and enough to support snail growth.

Table 2: Proximate Analysis of Feed fed to the Experimental Animals

Dry matter	90.64
Moisture	9.36
Ash	8.96
Crude Protein	19.50
Fat	6.70
Crude Fiber	7.34
Nitrogen Free Extract	48.14

Table 3: Effect of Photoperiod on the Growth Parameters

Parameters	T1	T2	T3
Initial body weight(g)	49.03±2.82	38.06±2.22	46.23±1.35
Final body weight(g)	67.53±7.71	55.66±7.95	64.20±3.70
Total body weight gain (g)	18.50±10.31	17.60±5.74	17.96
Average daily weight gain(g)	0.33±0.18	0.31±0.10	0.32±0.90
Total feed intake (g)	52.5±4.00	54.23±3.13	53.23±2.23
Average daily feed intake (g)	0.93±0.06	0.97±0.05	0.95±0.04
Feed conversion ratio	3.94±3.08	3.30±1.00	3.10±0.76

Means with different superscript are statistically different (P<0.05).

The initial weights of the animals that were used for the experiment were almost the same. There were also no significance differences (p> 0.05) in other growth parameters that were measured during the experiment.

Table 4: Effect of Photoperiod on reproductive behaviors

Parameters	T1	T2	T3
Duration of courtship(minutes)	52.00±44.53	67.66±22.07	88.00±23.06
Duration of mating (minutes)	125.66±4.04[b]	176.00±28.21[a]	192.33±24.17[a]
Duration of feeding (minutes)	93.33±30.23	57.00±17.69	83.00±22.64
No of eggs laid	89.00±32.74[b]	102.00±36.59[b]	233.00±73.91[a]

Means with different superscript are statistically different (P<0.05).

There were differences in reproductive behaviour of snails exposed to the various photoperiods. The snails mated longer when exposed to 24 hours light than in the other treatments. Duration of courtship did not show significance difference, but courtship was equally longer under 24 hours light. Snails under 24 hours light also laid more eggs than snails in other treatments.

There were no significance differences (p> 0.05) in the cost of feed and cost of feed per kg weight gain of the snails raised under the various photoperiods. Feed cost was almost the same among treatments but cost of feed per kg weight gain was lowest under 24 hours of exposure to light.

Table 5: Effect of Photoperiod on the Cost of Production

Parameters	T1	T2	T3
Cost of feed intake (#)	7.15±0.54	7.38±0.42	7.25±0.03
Cost of feed per kg weight gain (#)	28.51±23.09	24.39±7.26	22.38±4.55

Table 6: Effect of Photoperiod on the time of feeding

Time	T1	T2	T3
12.00a.m	Feeding	Feeding	Feeding
02.00a.m	Feeding	Feeding	Feeding
06.00a.m	Few active	Feeding	Feeding
07.00a.m	Few active	No feeding	No feeding
Cloudy weather 09.00a.m	Feeding	Feeding	Feeding
Cloudy weather 11.00a.m	Few active	Few active	Few active
12.00p.m	No activity	No activity	No activity
01.00p.m	No activity	Few active	No activity
Cloudy weather 06.00p.m	Feeding	Feeding	Feeding
11.00p.m	Feeding	Feeding	Feeding

The table shows that the snails were more active feeding during the morning and in the evening. The snails were less active during the afternoon. The table also shows that snails like feeding under cloudy weather especially in the morning and afternoon.

4. DISCUSSION

4.1 Proximate Analysis of Feed fed to the Experimental Animals

Table 2 shows the result of the proximate analysis of feed fed to experimental animals. The result on the proximate analysis of feed fed to the experimental animals shows that the experimental diet had a crude protein of 19.50; fat content of 6.70; ash content of 8.96; dry matter content of 90.64; moisture content of 9.36 and nitrogen free extract of 48.14. The crude protein was higher than 15-25% crude protein that was reported by a scholar for snails especially on intensive commercial snailery [8].

4.2 Effect of Photoperiod on growth parameters of Achatina achatina snail

Table 3 above presents the result on the effect of photoperiod on growth parameters of *Achatina achatina* snail. The table shows that there were no significant differences (P> 0.05) in initial weight, final body weight, total body weight, average daily weight gain, total feed intake, average daily feed intake and feed conversion ratio. The result obtained may be attributable to the fact that one diet was used for the experiment, but the different photoperiods did not affect their weight gain and feed intake which also depends on the palatability of the diet [9].

It was noted that treatment 1 compares favourably with treatment 3 in total feed intake. This also agrees to what was reported by a researcher that exposure of snails to continuous light at night increases their activity and rate of feed consumption and promote rapid growth [10].

There was no significant difference (P> 0.05) in average daily feed intake of the treatments. There was also no significant difference between treatments in feed conversion ratio. Treatment 1 had the highest feed conversion ratio of 3.94±3.08 while treatment 3 had the lowest feed conversion ratio of 3.10±0.76.

4.3 Effect of Photoperiod on the reproductive behaviors

The table 4 above shows no significant difference (P>0.05) in duration of courtship among treatments. Treatment 3 had 88.00±23.06 minutes as the highest duration of courtship while treatment 1 had the lowest duration of 52.00±44.53 minutes. They used their tentacles in finding a mate. If the tentacle is withdrawn during this process, it might be that that particular one already had a mate. The ones courting seem to feed or eat from the same side of the feeding trough. It was also observed that their tentacles seem to stand still during courtship if they like each other but sometimes it is crossed. It was also observed that *Achatina achatina* expands their posterior and exterior invagination during courtship display and also when they are excited. When one of the courting mates is on heat, it will start bringing out it's love dart to notify the other one that it's on heat (sex drive).

There was significant difference (P>0.05) in duration of mating among treatments. Treatment 3 had the highest duration of 192.33+_ 24.17 minutes while treatment 1 had the lowest duration of 125.66+_4.04 minutes. This may be due to the regular exposure to light.

It was observed that the one on top during mating produces or releases mucus first which lubricates the love dart and keeps their body moist when it is becoming dry.

During mating, the one beneath crosses the love dart first having its head inside the shell while the other twists its head to the position that will be comfortable for the mating. The love dart is situated on the right-hand side of the snails.

After mating, the one that have the love dart under separates first followed by the one on top. There was significant difference (p<0.05) in the number of eggs laid from the different treatments during the experiment. Treatment 3 had the highest number of eggs with 233.00±73.91 while treatment 1 had the lowest number with 89.00±32.74. This rhymes with what was reported in the work of a researcher which said that natural photoperiod favours maximum egg production output in giant snails.

4.4 Effect of Photoperiod on the cost of production

The table 5 shows no significant difference (P>0.05) in the cost of feed intake among treatments with treatment 2 having the highest cost of #7.38 ±0.42 while treatment 1 had the lowest cost of #7.15±0.54. It equally shows no significant difference (P>0.05) in cost of feed per kg weight gain among treatments with treatment1 having the highest cost of feed per kg weight gain of #28.51±23.09 while treatment 3 had the lowest cost of feed per kg weight gain of #22.38±4.55. The economic implication of this is that it is cheaper to make snail add 1kg of flesh under treatment 3 than under treatment 1.

4.5 Effect of Photoperiod on the time of feeding

The table 6 above shows that snails eat more when the environment is cool and when the weather is cloudy. They burrow into the soil when the weather is hot. They freely move their tentacles during feeding. They do not chew pawpaw leaves rather they bit and swallow immediately but in formulated feed, they chew it a little. When water is sprinkled on them, they move their body right and left and then bring out their headfirst followed by their full body. It was observed that snails are not distracted by slow and melodious music when eating.

5. CONCLUSION

The results had shown that exposing snails to 24 hours of light seems to have favoured their growth performance and reproduction in terms of duration of mating and number of eggs produced during the experiment. Furthermore, the result also showed that snails feed very well when the weather is cool and cloudy and also enjoys a slow and melodious music when feeding.

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