**Effects of Varying Diet Compositions on the Reproductive Performance of *Archachatina marginata***

**ABSTRACT**

Reproduction is an important factor in ensuring the sustainability of snail farming. Feeding on the other hand is essential in achieving this cause. The nutritional quality of a diet is associated with the diet’s ingredient. Hence, the study was carried out to assess the reproductive rate of *Archachatinamarginata* (Swaison) species fed with varying diets for optimum yield and sustainable management. A total of 60 snails were randomly assigned to five feed (treatments), each with four replicates. The experiment was laid in a completely randomized design. The treatments used are: cucumber (T1); 21% crude protein (T2); 23% crude protein (T3); 21% crude protein + cucumber (T4); and 23% crude protein + cucumber (T5). Data on the egg number,weight and size of snails were collected and analyzed using descriptive statistics and one way analysis of variance. The result showed significant difference (p < 0.05) in the number, weight and size of eggs obtained from the various treatments. T5 and T4 showed highest output in the three reproduction parameter while T1 gave the lowest output. No significance difference was observed on the reproductive performance for *A. marginata* species fed with the mixture of cucumber + 21% crude protein (T4) and cucumber + 23% crude protein (T5). Furthermore, the study recommended the diet mixture of cucumber and 21% crude protein for reduced cost of production and optimal reproductive performance of *A. marginata.*

**Keywords:** Reproduction**,** *Archachatina marginata,* Diet, Health

**INTRODUCTION**

Snails are soft bodied invertebrates belonging to the phylum Mollusca and class Gastropod. They are bilaterally symmetrical invertebrates with soft segmented exoskeleton in the form of acalcareous shell (Ejidike and Adewuyi, 2018) and they serve as the micro livestock that has recently attracted attention among farmers in Nigeria as an aftermath of the alarm raised by FAO on animal protein deficiency among Nigerians (Merlin *et al*., 2023). They are comprised of several species such as *Achatina achatina, Archachatina marginata, Achatina fulica* amongst others. African land giant snails (*Archachatina marginata*) are mostly preferred because they are highly economical and have high demand due to their size.

*Archachatina marginata*, commonly known as the giant African land snail, is a terrestrial mollusk of great economic, nutritional, and ecological importance, particularly in West and Central Africa (Ejidike and Adewuyi, 2018). In countries like Nigeria, Ghana, and Cameroon, snail farming also known as heliciculture has become increasingly recognized as a sustainable form of animal husbandry due to its low input requirements and high market demand (Manet *et al*., 2022). These snails are a rich source of animal protein, containing essential amino acids, minerals like calcium and iron, and low levels of fat and cholesterol, making them a healthy dietary option (Oyeagu *et al*., 2018). Additionally, their mucin has medicinal and cosmetic uses, and their shells can be processed for ornamental or calcium-rich animal feed purposes (Adikwu, 2019).

One of the key factors influencing the productivity and profitability of snail farming is reproductive performance. Snails are hermaphroditic, capable of producing both sperm and eggs, which makes reproduction relatively flexible (Mahfuz *et al*., 2021). However, successful breeding depends heavily on environmental conditions, especially nutrition. Among other factors like temperature, humidity, and soil composition, the type and quality of diet provided to snails directly affect their growth rate, maturity, egg-laying capacity, hatchability, and survival of the offspring (Swelum *et al*., 2021).

Despite the growing interest in snail farming, there is still limited research on the optimal dietary compositions needed to maximize the reproductive output of *A. marginata*. Most smallholder farmers rely on readily available kitchen waste or local vegetables, which may not meet the full nutritional needs of the snails, especially during the breeding season.

Different diets vary in their content of proteins, carbohydrates, fats, vitamins, and minerals that are all essential for reproductive health, gamete development, shell formation and egg calcification, hormonal activities as well as immune response.

Therefore, it is important to systematically assess how varying dietary inputs affect the reproductive efficiency of *A. marginata*. This study seeks to bridge that knowledge gap by evaluating the reproduction rate of snails fed with different diet types, aiming to recommend a nutritionally balanced feeding strategy that enhances egg-laying frequency, hatchability, and offspring viability in snail farming systems.

**MATERIALS AND METHODS**

**Procurement of Experimental Animals**

Sixty African giant point of lay land snails (*Archachatina marginata*) were used in the experiment. The matured snails were purchased from a University of Ibadan and the study that lasted for eight weeks. The snails were housed in twenty medium bowls, each containing three snails. The bowl was first filled with loamy soil; the soil was sieved to remove dirt and any harmful substance. The soil was topped to half of the bowl and covered with a net. Finally a wire mesh was used to cover the bowls with stones kept at each edge to secure the wire mesh properly.

**Experimental Diet and Design**

Both natural feed and compounded feed was used. The natural feed used is cucumber and the compounded feed contains different percentage of the various components. 11 g of concentrate was used for the diet having combination of natural and compounded feed while 22g of concentrate was given to the treatment using compounded feed alone. Table 1 shows the percentage composition of the compounded feed.

**Table 1: Percentage composition of crude protein of the compounded feed**

|  |  |  |
| --- | --- | --- |
| **Ingredients** | **Percentage**  **21% 23%** | |
| Maize | 60.50 | 54.00 |
| Soya bean | 33.50 | 40.00 |
| Dicalcium phosphate (DCP) | 1.50 | 1.50 |
| Fish meal | 2.00 | 2.00 |
| Limestone | 1.55 | 1.55 |
| Salt | 0.10 | 0.10 |
| Lysine | 0.10 | 0.10 |
| Methonine | 0.10 | 0.50 |
| Vitamin premix | 0.25 | 0.25 |
| Total | 100.00 | 100.00 |
| Calculated composition |  |  |
| Metabolizable Energy (Kcal/kg) | 3038.06 | 2990.50 |
| Crude protein (CP) (g/kg) | 209.50 | 231.00 |
| Calcium (g) | 12.80 | 11.40 |

**Experimental Design**

Five dietary treatments were tested, each replicated four times, with three snails per replicate. It involved random assignment of snails to five treatments with four replications each thus having twenty experimental units.

**Table 2: Experimental Layout**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **REPLICATE SNAIL** | | **TREATMENT (FEEDING)** | | | | |
|  | | T1 | T2 | T3 | T4 | T5 |
|  | A |  |  |  |  |  |
| R1 | A | T1R1 | T2R1 | T3R1 | T4R1 | T5R1 |
|  | A |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | B |  |  |  |  |  |
| R2 | B | T1R2 | T2R2 | T3R2 | T4R2 | T5R2 |
|  | B |  |  |  |  |  |
|  |  |  |  |  |  |  |
| R3 | C | T1R3 | T2R3 | T3R3 | T4R3 | T5R3 |
|  | C |  |  |  |  |  |
|  | C |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | D |  |  |  |  |  |
| R4 | D | T1R4 | T2R4 | T3R4 | T4R4 | T5R4 |
|  | D |  |  |  |  |  |

Where: A, B, C and D = Snails, R= replicate, T= Treatment

(Tl=cucumber, T2= compounded feed 21% concentrate, T3= compounded feed 23% concentrate, T4= cucumber + compounded feed 21% concentrate, and T5= cucumber + compounded feed 23% concentrate)

Completely randomized design for equal replication was used for the experiment. The statistical model for this design is as given below:

Xij = µ+ Tj + ∑ij

Where;

Xij =Individual observation (i.e observation of jth treatment in jth observation).

µ=the population mean

Tj = the effect of the Tj treatment

∑ij= the random error present in the i-th on the j-th treatment.

**Sanitation**

Fresh, mold-free feed was provided to the snails. Left over feed was removed and also clean feed was supplied once in two days. The feces were also removed from the bowl to prevent microbial infestation.

**Parameters measured**

**Egg size**

Due to the delicate nature of egg, the egg size was first measured with a thread before spreading it on a ruler.

**Number of eggs**

The number of eggs laid by each replicate was counted and recorded.

**Weight of eggs**

The weight of the eggs was measured with the aid of a sensitive weighing balance.

**Data analysis**

Data collected was subjected to analysis of variance (ANOVA) for Completely Randomized

Design (CRD). The data collected was computed using Statiscal package for social science (SPSS).

**RESULTS AND DISCUSSION**

From table 3, the snails that were fed with T5 (23% Crude protein + cucumber) produced the highest number of eggs of 9±1.075, followed by T4 (21% crude protein and cucumber) with number of 8±0.686, then T3 (23% Crude protein) produced the number of 7±0.733, followed by T2 (21% crude protein) with number of 6±0.88 and T1 (Cucumber) produced the least number of 4±0.523.

**Table 3: Result of the descriptive statistics of the effect of different diets on the number of eggs laid by *A. marginata***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Source of variation | Mean | Std. Error | Mini | Max |
| Number of eggs | Cucumber (T1) | 4 | 0.523 | 2 | 7 |
| 21% Crude protein(T2) | 6 | 0.88 | 4 | 11 |
| 23% Crude protein(T3) | 7 | 0.733 | 2 | 10 |
| 21% Crude protein+ Cucumber (T4) | 8 | 0.686 | 5 | 14 |
| 23% Crude protein+Cucumber (T5) | 9 | 1.075 | 2 | 16 |
| Total | 6.91 | 0.407 | 2 | 16 |

Table 4 shows the mean weight of eggs produced by A marginata fed with varying diet ranging from 18±2.16g (23% crude protein + cucumber), 16.5±1372g (21% crude protein + cucumber), 13 ±1.449g (23% Crude protein), 12.75 ±1.759g (21% crude protein) and 7.75±1.047g (cucumber).

**Table 4: Result of the descriptive statistics of the effect of different diets on the weight of eggs laid by *A. marginata***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Source of variation | Mean | Std. Error | Mini | Max |
| Weight of eggs | Cucumber (T1) | 7.75 | 1.047 | 4 | 14 |
| 21% Crude protein(T2) | 12.75 | 1.759 | 4 | 22 |
| 23% Crude protein(T3) | 13 | 1.449 | 4 | 20 |
| 21% Crude protein+ Cucumber (T4) | 16.5 | 1.372 | 10 | 28 |
| 23% Crude protein+Cucumber (T5) | 18 | 2.16 | 4 | 32 |
| Total | 13.6 | 0.805 | 4 | 32 |

Table 5 shows the mean size of the eggs laid by *A. marginata* under different treatment ranging from 22.825 ±2.6523cm (T5) to 21.144 ±1.9cmn (T4) to 17.963 ±l.9608cm (T3} to 16.869 ±2.3235cm (T2) to 10.569 ±1.4179cm (Tl)

**Table 5: Result of the descriptive statistics of the effect of different diets on the size of**

**eggs laid by A. marginata**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Source of Variation | Mean | Std. Error | Mini | Max |
| Weight of eggs | Cucumber (T1) | 10.569 | 1.4179 | 5.5 | 19.1 |
| 21% Crude protein(T2) | 16.869 | 2.3235 | 10.5 | 29.7 |
| 23% Crude protein(T3) | 17.963 | 1.9608 | 5 | 26.8 |
| 21% Crude protein+ Cucumber (T4) | 21.144 | 1.9 | 12.9 | 36.7 |
| 23% Crude protein+Cucumber (T5) | 22.825 | 2.6523 | 5.5 | 37 |
| Total | 17.874 | 1.0288 | 5.5 | 37 |

The result of the one way analysis of variance (ANOVA) for number of eggs laid by different *A. marginata* fed with varying diets is presented in table 6. The result revealed that there were significant differences in the number of eggs among the treatments since (P <0.05).

**Table 6: Results of ANOVA for the number of eggs laid by *A. marginata* fed with varying**

**diets**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Source of variation | Sum of Squares | Df | Mean Square | F | P-Value |
| Number  of eggs | Treatment | 273.45 | 4 | 68.363 | 6.651 | 0.000 |
| Error | 770.938 | 75 | 10.279 |  |  |
| Total | 1044.388 | 79 |  |  |  |

The result of the one way analysis of variance (ANOVA) for number of eggs laid by different *Archachatina marginata* fed with varying diets is presented in Table 7. The result revealed that there were significant differences in the number of eggs among the treatments since (P <0.05).

**Table 7: Results of ANOVA for the weight of eggs laid by *A. marginata* fed with varying**

**diets**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Source of variation | Sum of Squares | Df | Mean Square | F | P-Value |
| Weight  of eggs | Treatment | 1009.2 | 4 | 252.3 | 6.14 | 0.00 |
| Error | 3082 | 75 | 41.093 |  |  |
| Total | 4091.2 | 79 |  |  |  |

The result of the one way analysis of variance (ANOVA) for number of eggs laid by different *Archachatina marginata* fed with varying diets is presented in Table 8. The result revealed that there were significant differences in the number of eggs among the treatments since (P<0.05).

**Table 8: Results of ANOVA for the size of eggs laid by *A. marginata* fed with varying diets**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Source of variation | Sum of Squares | Df | Mean Square | F | P-Value |
| Size  of eggs | Treatment | 1433.419 | 4 | 358.355 | 5.114 | 0.001 |
| Error | 5255.756 | 75 | 70.077 |  |  |
| Total | 6689.175 | 79 |  |  |  |

Table 9 presents the results of mean separations (Duncan tests). The result indicated that there were significant differences in the number of eggs produced between Cucumber, 21% Crude protein, 23% Crude protein, 21% crude protein + cucumber and 23% crude protein + cucumber.

However there was no significant difference between 21% crude protein, 23% crude protein and 21% crude protein + cucumber, and also between 21% crude protein + cucumber and 23% crude protein + cucumber.

**Table 9: Duncan results for number of eggs laid by *A. marginata* fed with varying diets**

|  |  |  |  |
| --- | --- | --- | --- |
| Treatments | Mean Number of Eggs | | |
| Cucumber | 4a ±0.523 |  |  |
| 21% Crude protein |  | 6b ±0.880 |  |
| 23% Crude protein |  | 7b ±0.733 |  |
| 21% Crude protein + Cucumber |  | 8bc ±0.686 |  |
| 23% Crude protein + Cucumber |  |  | 9c ±1.075 |

*Means bearing non identical letters in a column are significantly different from one another at 5%.*

Table 10 presents the results of mean separations (Duncan tests). The result indicated that there were significant differences in the number of eggs produced between cucumber, 21% Crude protein, 23% Crude protein, 1/% crude protein + cucumber and 23% crude protcin + cucumber. However there was no significant difference between 21% crude protein, 23% crude protein and 21% crude protein + cucumber, and also between 21% crude protein + cucumber and 23% crude protein + cucumber.

**Table 10: Duncan results for weight of eggs laid by *A. marginata* fed with varying diets**

|  |  |  |  |
| --- | --- | --- | --- |
| Treatments | Mean Weight of Eggs | | |
| Cucumber | 7.75a ±0.407 |  |  |
| 21% Crude protein |  | 12.75b ±1.047 |  |
| 23% Crude protein |  | 13.00b ±1.759 |  |
| 21% Crude protein + Cucumber |  | 16.50bc ±1.372 | 16.50bc ±1.372 |
| 23% Crude protein + Cucumber |  |  | 18.00c ±2.160 |

Table 11 presents the results of mean separations (Duncan tests). The result indicated that there were significant differences in the number of eggs produced between Cucumber, 21% Crude protein, 23% Crude protein, 21% crude protein + cucumber and 23% crude protein + cucumber.

However there is no significance difference between 21% crude protein, 23% crude protein, 21% crude protein + cucumber and 23% crude protein + cucumber.

**Table 11: Duncan results for size of eggs laid by *A. marginata* fed with varying diets**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Mean Size of Eggs (cm)** | | |
| Cucumber | 10.569a ±1.4179 |  |  |
| 21% Crude protein |  | 16.869b ±2.3235 |  |
| 23% Crude protein |  | 17.963b ±1.9608 |  |
| 21% Crude protein + Cucumber |  | 21.144b ±1.9000 |  |
| 23% Crude protein + Cucumber |  | 22.825b ±2.6523 |  |

*Means bearing non identical letters in a column are significantly different from one protein + cucumber.*

**Discussion**

There was significant difference in the number of eggs produced between treatments. T5 (23% crude protein + cucumber) has the highest mean number (9 ±1.075) followed by T4 (21% crude protein + cucumber) having mean of 8±0.686, this agrees with Nyameasem and Borketey, (2024) who stated that the performance of snail is enhanced with high protein content in the diet. T1 (cucumber) has the lowest mean (4 ±0.523), this may be due to the fact that cucumber is a sole diet and is not nutritionally balanced enough to meet snails requirement for reproduction.

However there was no significant difference between 21% crude protein, 23% crude protein and 21% crude protein + cucumber, and also between 21% crude protein + cucumber and 23% crude protein+ cucumber.

There was significant difference in the weight of eggs between treatments. T5 (23% crude cucumber) has the highest mean weight (18.00 ±2.160) followed by T4 (21% crude protein + cucumber) having mean weight of 16.50 +1.372, this may be due to the high nutrient contained in the feed, according to Oyeagu *et al*., 2018, the most important factor influencing the performance of animals under captivity, all other factors being constant, is the quality of diet offered to the animals. T1 (Cucumber) has the lowest mean weight of 7.75a 0.407; this may be due to poor nutrient in the diet. Thompson and Sheldon (2014) reported that poor nutrition affects snail growth and causes a drop in reproductive performance.

There was no significant difference between 21% crude protein, 23% crude protein and also between 21% crude protein + cucumber and 23% crude protein + cucumber.

There was significant difference in the weight of eggs between treatments. T5 (25% crude protein + cucumber) has the highest mean size (22.825 2.652) followed by T4 (21% crude protein + cucumber) having mean size of 21. 144 +1.900, this agrees with Ejidike and Adewuyi (2018) who reported that both growth and reproductive performance of *Archachatina marginata* werebetter when their diets are supplemented with natural diet than the snails that were placed onpure artificial diet. Treatment 1 (cucumber) resulted in lowest size of egg, according to Eniolorunda *et al*. (2017), the nutritional quality of diets is associated with diets of better ingredient combinations which were utilized more efficiently when fed to the animals.

However there is no significance difference between 21% crude protein, 23% crude protein, 21% crude protein + cucumber and 23% crude protein + cucumber.

**CONCLUSION**The result obtained from this experiment showed that snails fed with different diet performed  
differently in their rate of reproduction. Snails fed with 21% crude protein cucumber (T5) and  
21% crude protein cucumber (T4) performed better in terms of the number, size and weight of eggs while snails fed with only cucumber recorded the lowest, this shows that the inclusion of high percent of protein between 21-23% is necessary in the diet of snail for their optimum performance and consequently boost the availability and consumption of snail meat while enhancing rural livelihoods and contributing to local protein supply.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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