

## Growth performance and physiological responses of *Physa acuta* fed on *Lemna minor* Under Laboratory Conditions

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### Abstract

The study aimed to evaluate the effect of feeding snails on the plant *Lemna minor* on growth and food consumption indicators of the snail *Physa acuta*, comparing the responses of two groups of snails collected different sites from of Baghdad and Basra. The nutritional treatments included a control treatment using lettuce and two treatments with *Lemna minor* at levels of 0.020 and 0.040 g. Growth indicators, daily food consumption rate and behavioural and vital observations within the tanks. The results showed significant differences between the nutritional treatments in growth and food consumption indicators, as the addition of *Lemna minor* led to gradual improvement in snail performance compared to the control treatment. A level of 0.040 g recorded the highest values for the rate of increase in length, reaching 2.12 and 3.88 mm in Baghdad and Basra, respectively. Moreover, the highest rate of increase in weight was 0.0263 and 0.0393 g, in addition to the highest specific growth rates for length and weight. The same level also recorded the highest daily food consumption rate, reaching 3.84 and 4.12 mg dry weight/snail/day in Baghdad and Basra, respectively. The snails from Basra showed relatively higher values for most growth and consumption indicators compared to the snails from Baghdad, especially at the level of 0.040 g. The results indicate that increased availability of *Lemna minor* at the tested levels was associated with improved food consumption and growth performance of *P. acuta*, with the 0.040 g level being the best among the studied treatments. These results support the potential use of *L. minor* as a plant-based food source in studies on the breeding and growth of *Physa acuta* under experimental conditions.

**Keywords:** Food Consumption, Growth, Laboratory Experiments, *Lemna Minor*, *Physa Acuta*



## Introduction

Controlled laboratory experiments are considered an essential part of modern ecology. They help us to understand complex interactions in aquatic ecosystems. Aquatic plants and invertebrates are essential in maintaining the ecological balance of freshwater aquatic environments. The relationships of living organisms in the aquatic environment are interwoven. These experiments are a very detailed scientific investigation designed to eliminate outside environmental variables so that we can look very carefully at the internal biological and physiological mechanisms of living organisms (Sasaki *et al.*, 2025).

Aquatic snails have become one of the most important model organisms that are widely used in environmental and aquatic toxicity research. These organisms are known to be able to adapt to a variety of aquatic environments and to directly interact with surrounding environmental components, either chemical pollutants or natural food sources. Snails are good biological indicators of water quality because they are benthic herbivores and thus are in constant contact with sediments, water and plants (De Freitas Tallarico, 2015).

Among the different types of snails, the *Physa acuta* snail (also known as *Physella acuta*) is one of the most cosmopolitan species of freshwater snails around the world. This snail is known for its exceptional capacity to endure extreme environmental conditions, such as waters with high nutrient loads and partial pollution (Taybi *et al.*, 2024). The *Fiza acuta* is a much favoured model for many researchers in environmental toxicology and population biology because it reproduces at a high rate, reaches sexual maturity quickly and is easy to breed in the laboratory (Bousset *et al.*, 2004).

The snail mainly feeds on aerial plants and large aquatic plants, fine algae and dead organic matter on the bottom (Cheung & Lam, 1998). The snail interacts with its food environment and alters the composition of the plant community in the aquatic environment by scraping surfaces with its serrated tongue (Miyahira *et al.*, 2023). The quality and type of food has been shown to affect the overall growth rate of snails, but also the size, density and resistance of their shells to breakage (Chaves-Campos *et al.*, 2012).

Moreover, nutrition affects the time of sexual maturation of snails and the size of their first egg, which has consequences for their overall reproductive capacity (Estoy *et al.*, 2002). Recent studies suggest that the type of food may influence the reproductive and physical lifespan of snails, pointing to the importance of providing a well-rounded diet that supports the entire physiology of the organism (Tchowan *et al.*, 2024). In this complicated food landscape, researchers are on the lookout for food sources that can mimic or even beat the natural diet while remaining easy to prepare and affordable in a lab setting. One of these sources is the plant *Lemna minor*. Its unique environmental and biochemical properties have made it a promising and unique option.

Common duckweed, scientifically named *Lemna minor*, is one of the smallest flowering plants on Earth. It is a member of the Araceae family and can be found floating on the surface of stagnant or slow-flowing freshwater (Daubs, 2011). *Lemna* plants are known for their remarkable ability to reproduce quickly through vegetative reproduction by division,

allowing them to cover large areas of water surface in a short time if the right conditions of light and nutrients are available. (Skillicorn *et al.*, 1993).

*Lemna minor* is a true nutritional treasure. The protein content in the plant's dry weight ranges from 20% to 40%, a very high rate that exceeds that found in many traditional crops such as soybeans and alfalfa. What makes this protein special is that it contains all the essential amino acids that the body needs, in very balanced proportions compared to animal protein. This makes it an excellent source of support for tissue building and enzyme formation in the organisms that consume it (Chakrabarti *et al.*, 2018). The nutritional value of water lentils is not only in the proteins, they are also rich in essential minerals. Calcium is one of the most important minerals and is essential for the formation and maintenance of the shells of spiral molluscs. Besides calcium, the plant provides phosphorus, iron, zinc and copper, all of which are needed for metabolism and enzyme function (Miltko *et al.*, 2024).

*Lemna minor* plants are stable aquatic habitat for snails. In lab experiments, the snail waste causes an accumulation of nitrogen and phosphorus in the stagnant water of the small pond, leading to pH changes and undesirable growth of microalgae or bacteria. Introduction of small duckweed plant as natural system for pollution treatment. The plants effectively absorb these excess nutrients (Ceschin *et al.*, 2020; Landesman *et al.*, 2011). This keeps water quality within an appropriate range for the snail, reduces the need for frequent water changes, and, in turn, decreases the physiological stress caused by transferring the gastropods and changing their environment (Oloyede *et al.*, 2026).

Recent research shows that dietary changes directly affect the fertility and reproductive rates of snails such as the *Physa acuta* snail. For example, a study by Mondal *et al.* (2024) found that consuming certain aquatic plants affects the number of eggs laid by the snail and their hatching success. Due to the high protein content in the plant *Lemna minor* (20-40%), this plant provides the necessary amino acids for the formation of egg proteins and reproductive tissues.

Despite the increasing use of the snail *Physa acuta* as a biological model in aquatic ecology and ecotoxicology, and the evidence supporting the high nutritional value of the plant *Lemna minor* in bird diets and aquaculture, experimental studies evaluating the physiological responses of freshwater snails feeding on duckweed remain limited. In addition, the exceptional nutritional value of *Lemna minor* has not been systematically exploited compared to traditional feeds.

This study aims to evaluate the impact of using *Lemna minor* as a primary food source and how its environmental monitoring affects a range of biological and physiological parameters of the snail *Physa acuta*. Furthermore, the research aims to bridge the knowledge gap regarding the optimal use of *Lemna minor* in environmental laboratories and to provide evidence-based recommendations on the ideal quantity of this plant needed to support the growth of *Physa acuta* and ensure accurate and reliable results in aquatic ecology research.

## Materials And Methods

### Collection and Culture of Organisms

The experiment was conducted in the Aquatic Plants Laboratory of the Marine Science Center, University of Basra, Iraq. Samples of the snail *Physa acuta* were collected from two locations, Baghdad and Basra, from their natural environment a result of differences in physiological and nutritional adaptations linked to the environmental conditions of their habitats and transported to the laboratory, where they were placed in acclimation tanks containing dechlorinated, well-aerated tap water for 14 days before the experiment began. After acclimating to the new environment, the snails were fed in glass laboratory tanks on a standard diet while maintaining continuous aeration (Fig. 1).



Figure 1: *Physa acuta* (Draparnaud, 1805). Author's photograph.

The experiment was conducted in 1-liter glass tanks containing 0.5 litres of fully aerated water. The snails were randomly distributed among the experimental groups, with 10 snails per tank and 3 replicates per treatment. The experimental treatments included:

- 1- The snail is from two locations; Baghdad and Basra.
- 2- Feeding the snails with fresh *Lemna minor* plant only at a specific weight daily (0.020, 0.040) grams.
- 3- The control treatment: nutrition on decomposed lettuce leaves.

The physicochemical factors of the water were monitored: pH, dissolved oxygen, and temperature, and they were stabilised throughout the experiment using a multimeter.

-pH 7.5

-Dissolved oxygen > 6.0 mg/L

-Temperature 25°C ± 1

Standard experimental methods used in freshwater snail nutrition studies were followed (such as feeding experiments on aquatic plants in the laboratory) (Ismail *et al.*, 2021).

### Measuring Growth and Feeding Parameters

Growth and length measurement: Measurements were conducted on snails of similar size and weight before and after laboratory feeding. The total shell length of each snail was

measured weekly using a digital Vernier calliper. The wet weight of each snail was recorded after lightly drying it with filter paper. The specific growth rate (SGR) was calculated.

### Consumption Rate and Nutrition Efficiency

A precisely measured amount of *Lemna minor* was provided for each tank. After 24–48 hours, the remaining uneaten plants were removed, superficially dried, and weighed. The Daily Consumption Rate (DCR) was calculated using a snail-free control tank to correct for changes in plant biomass.

### Statistical Analysis

Data were expressed as mean  $\pm$  standard error. The results were subjected to one-way ANOVA to test for significant differences between treatments, followed by Tukey's HSD Test for post hoc comparisons at a significance level of ( $P < 0.05$ ). The statistical analyses were conducted using SPSS version 19—the program (R Core Team, 2025).

## Results

### Effect of nutrition with the plant *Lemna minor* on the growth rates and dimensional changes of the snail *Physa acuta*

The results of the statistical analysis showed significant differences ( $P < 0.05$ ) in the growth indicators of the *Physa acuta* snail according to the type of dietary treatment and the collection site of the snail. Variations in the type and amount of food provided affected final length, the rate of increase in length ( $\Delta L$ ), and the specific growth rate of length (SGRL). These results generally indicate that increasing the amount of *Lemna minor* in the diet led to significantly improved growth compared with the lettuce-based control. Throughout the 28-day experimental period, as shown in Table (1):

Table 1: Length growth indices of *Physa acuta* (mean  $\pm$  standard error)

| Snail Collection Site | Dietary Treatment | Initial Length, Li (mm) | Final Length, Lf (mm) | Length Increment, $\Delta L$ (mm) | Specific Growth Rate for Length, SGRL (% day <sup>-1</sup> ) |
|-----------------------|-------------------|-------------------------|-----------------------|-----------------------------------|--------------------------------------------------------------|
| Baghdad               | Control (lettuce) | 1.92 $\pm$ 0.04         | 3.52 $\pm$ 0.08       | 1.60 $\pm$ 0.06 <sup>^c</sup>     | 2.16 $\pm$ 0.05 <sup>^c</sup>                                |
| Baghdad               | 0.020 g L. minor  | 1.86 $\pm$ 0.05         | 3.74 $\pm$ 0.11       | 1.88 $\pm$ 0.09 <sup>^b</sup>     | 2.50 $\pm$ 0.07 <sup>^b</sup>                                |
| Baghdad               | 0.040 g L. minor  | 1.82 $\pm$ 0.03         | 3.94 $\pm$ 0.14       | 2.12 $\pm$ 0.12 <sup>^a</sup>     | 2.76 $\pm$ 0.09 <sup>^a</sup>                                |
| Basra                 | Control (lettuce) | 2.68 $\pm$ 0.06         | 5.08 $\pm$ 0.12       | 2.40 $\pm$ 0.10 <sup>^c</sup>     | 2.28 $\pm$ 0.06 <sup>^c</sup>                                |
| Basra                 | 0.020 g L. minor  | 2.60 $\pm$ 0.05         | 5.72 $\pm$ 0.16       | 3.12 $\pm$ 0.14 <sup>^b</sup>     | 2.81 $\pm$ 0.07 <sup>^b</sup>                                |
| Basra                 | 0.040 g L. minor  | 2.54 $\pm$ 0.04         | 6.42 $\pm$ 0.19       | 3.88 $\pm$ 0.17 <sup>^a</sup>     | 3.31 $\pm$ 0.08 <sup>^a</sup>                                |

Note: Different superscript letters (<sup>^a</sup>, <sup>^b</sup>, <sup>^c</sup>) within the same column and geographical location indicate statistically significant differences according to Tukey's post hoc test ( $P < 0.05$ ).

The rate of increase in spiral length at the Baghdad site was 1.60 mm in the control treatment, then rose to 1.88 mm with the addition of 0.020 grams of *Lemna minor*, while the highest rate recorded was 2.12 mm with the use of 0.040 grams of *Lemna minor*. The specific growth rate of length followed the same trend, increasing from 2.16% day<sup>-1</sup> in the control treatment to 2.50% day<sup>-1</sup>, reaching a maximum of 2.76% day<sup>-1</sup> at the highest addition level. The different letters accompanying the values indicate significant differences between the nutritional treatments, as the 0.040 grams *Lemna minor* treatment significantly outperformed the 0.020 grams and control treatments. In contrast, the intermediate treatment was better than the control. The same trend was observed in the snails from the Basra site, but with relatively higher growth values. The rate of increase in length rose from 2.40 mm in the control treatment to 3.12 mm with the addition of 0.020 grams of *Lemna minor*, reaching the highest value of 3.88 mm at the level of 0.040 grams. The specific growth rate of length also increased from 2.28% day<sup>-1</sup> in the control treatment to 2.81% day<sup>-1</sup> and then to 3.31% day<sup>-1</sup>, confirming that the increase in the amount of *Lemna minor* was associated with improved length growth of the snail.

The results of Table (2) showed clear variation in the weight growth indicators of the *Physa acuta* snail by dietary treatment and collection site. In the Baghdad snail, the treatment of 0.040 grams recorded the highest final weight compared to the other treatments. The control treatment (lettuce) recorded the lowest weight gain rate, reaching 0.0170 grams, while the highest value was 0.0263 grams at the 0.040 gram level. The significant letters indicated the presence of significant differences between treatments: the 0.040-gram treatment significantly outperformed the 0.020 gram treatment and the control treatment, while the intermediate treatment outperformed the control treatment. The specific growth rate of weight in the Baghdad snail followed the same trend, reaching 2.42 % day<sup>-1</sup> in the control treatment, then rising to 3.05 % day<sup>-1</sup> with the addition of 0.020 grams of *L. minor*, and recording the highest value of 3.19 % day<sup>-1</sup> at the 0.040-gram level.

As for the Basra snail, the final weight increased from 0.0535 grams in the control treatment to the highest final weight of 0.0698 grams at the level of 0.040 grams. Similarly, the feeding treatment at the level of 0.040 grams excelled in recording the highest value for the weight gain rate, which reached 0.0393 grams compared to the control treatment. The values of the specific growth rate of weight in Basra also showed the same upward trend, reaching 1.62 % day<sup>-1</sup> in the control treatment, and then the highest value of 2.96% day<sup>-1</sup> when adding 0.040 grams.

Table 1: Weight growth indices of *Physa acuta* (mean  $\pm$  standard error)

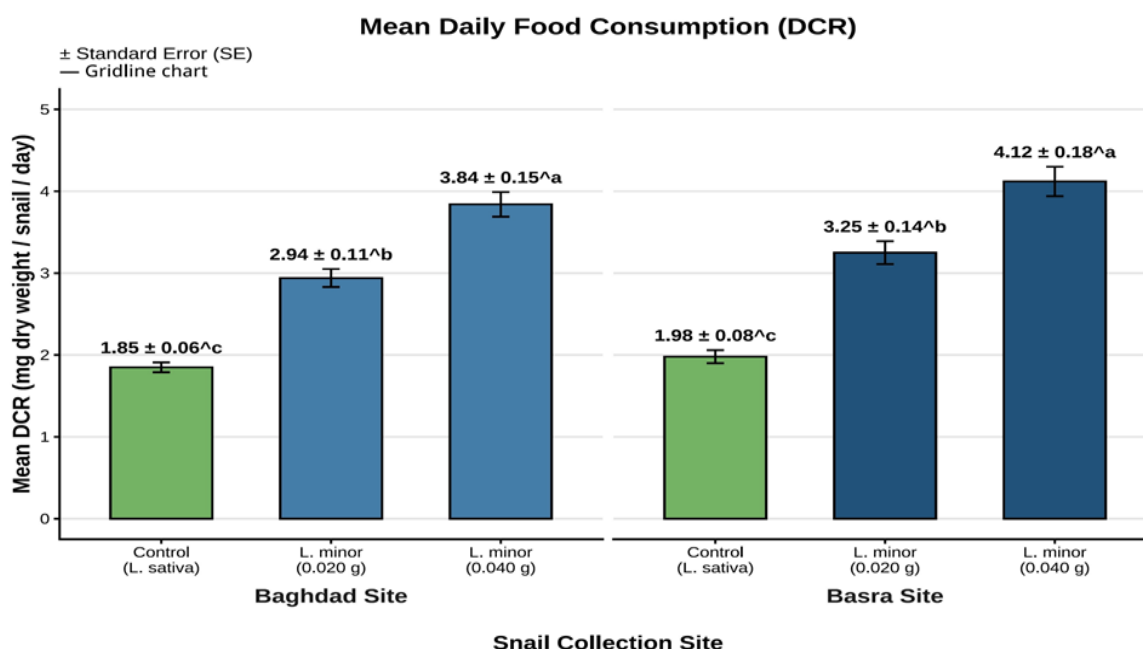
| Snail Collection Site | Dietary Treatment | Initial Weight, Wi (g) | Final Weight, Wf (g) | Weight Increment, $\Delta W$ (g) | Specific Growth Rate for Weight, SGRW (% day <sup>-1</sup> ) |
|-----------------------|-------------------|------------------------|----------------------|----------------------------------|--------------------------------------------------------------|
|-----------------------|-------------------|------------------------|----------------------|----------------------------------|--------------------------------------------------------------|

|         |                         |                 |                 |                               |                           |
|---------|-------------------------|-----------------|-----------------|-------------------------------|---------------------------|
| Baghdad | Control (lettuce)       | 0.0175 ± 0.0002 | 0.0345 ± 0.0006 | 0.0170 ± 0.0005 <sup>^c</sup> | 2.42 ± 0.05 <sup>^c</sup> |
| Baghdad | 0.020 g <i>L. minor</i> | 0.0164 ± 0.0001 | 0.0385 ± 0.0008 | 0.0221 ± 0.0007 <sup>^b</sup> | 3.05 ± 0.07 <sup>^b</sup> |
| Baghdad | 0.040 g <i>L. minor</i> | 0.0182 ± 0.0003 | 0.0445 ± 0.0011 | 0.0263 ± 0.0009 <sup>^a</sup> | 3.19 ± 0.08 <sup>^a</sup> |
| Basra   | Control (lettuce)       | 0.0340 ± 0.0004 | 0.0535 ± 0.0009 | 0.0195 ± 0.0008 <sup>^c</sup> | 1.62 ± 0.04 <sup>^c</sup> |
| Basra   | 0.020 g <i>L. minor</i> | 0.0315 ± 0.0003 | 0.0612 ± 0.0012 | 0.0297 ± 0.0011 <sup>^b</sup> | 2.37 ± 0.06 <sup>^b</sup> |
| Basra   | 0.040 g <i>L. minor</i> | 0.0305 ± 0.0002 | 0.0698 ± 0.0014 | 2.96 ± 0.07 <sup>^a</sup>     | 2.96 ± 0.07 <sup>^a</sup> |

Note: Different superscript letters (<sup>^a</sup>, <sup>^b</sup>, <sup>^c</sup>) within the same column and geographical location indicate statistically significant differences according to Tukey's post hoc test ( $P < 0.05$ ).

### Effect of nutrition with the plant *Lemna minor* on the daily food consumption rates of the snail *Physa acuta*

The results of Figures (1, 2) showed significant differences in the daily food consumption rate between the dietary treatments in the snails of Baghdad and Basra, as consumption gradually increased with higher levels of *Lemna minor*. The 0.040 gram treatment recorded the highest consumption rate, reaching 3.84 and 4.12 mg dry weight/snail/day in Baghdad and Basra, respectively, while the control treatment recorded the lowest values 1.85 and 1.98 mg. Snails from Basra also showed relatively higher consumption than snails from Baghdad, and these results were consistent with the increased indicators of length and weight growth recorded in Tables (1) and (2).



**Figure 1 :** Daily food consumption rate (mg dry weight / snail / day) according to the three treatments (mean ± standard error)

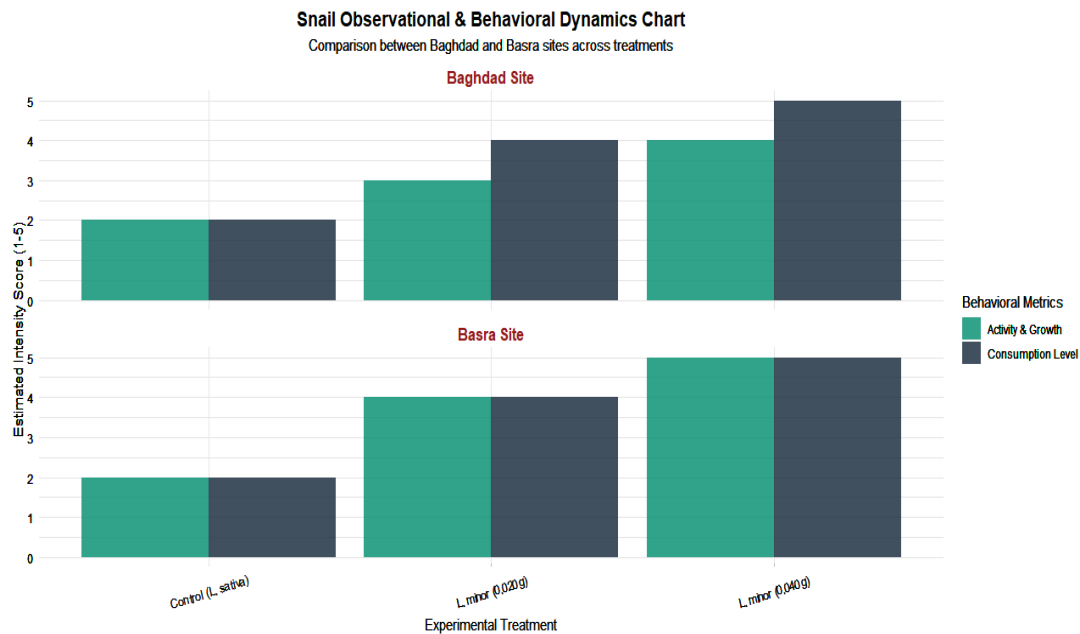


Figure 2 : Snail Observational & Behavioral Dynamics Chart

## Discussion

The results of the current study demonstrate the high nutritional efficiency of duckweed (*Lemna minor*) in supporting the longitudinal extension rates of the freshwater snail shell (*Physa acuta*) compared with traditional feeding on lettuce, with clear variation in growth response among snail sources (Table 1).

This finding matches the growing nutritional evidence about the food value of duckweed plants in aquatic animals. A systematic review covering 18 fish species showed that *Lemna* types, especially *L. minor*, were the most commonly used duckweed plants in fish feeding. Adding duckweed to fish diets, particularly at levels between 15-30% in several studies, led to positive results in growth and feed conversion efficiency without clear negative effects on survival rates (Minich & Michael, 2024).

The clear significance of the nutritional treatments with the plant *Lemna minor* (especially at its higher weight of 0.040 grams) is attributed to the exceptional content of bioavailable total proteins, essential amino acids, and minerals present in the tissues of this floating plant, which clearly surpasses the relatively poor content found in lettuce leaves (Xu et al., 2023). The abundant availability of these essential nutrients stimulates the mantle edge cells in the snail, which are primarily responsible for secreting the organic material (Conchiolin) and depositing the calcium carbonate necessary for the balanced construction and elongation of the helical shell (Dimock & Dillon, 2000). On the other hand, the interaction analysis revealed a variation in growth response between geographical locations at the same nutritional level; the Basra snail recorded the highest specific growth rate in length  $4.23 \text{ \% day}^{-1}$  compared to the Baghdad snail  $3.78 \text{ \% day}^{-1}$ . The variability can be due to the high physiological flexibility and advanced metabolic adaptations of the snails in southern Iraq/Basra owing to their habitation in aquatic

environments with different temperatures, salinity and productivity. They are more efficient than central Iraqi snails in converting ingested dry matter to locomotor and structural growth (Ali *et al.*, 2020). These findings are in line with McQuirk *et al.* (2025) who observed that the digestive efficiency and metabolic exploitation of protein-rich foods differed greatly between populations of the same species of aquatic snail based on their geographical environmental history.

The results of Table (2) showed that the type and quantity of food influenced the weight growth of the snail *Physa acuta*, as the final weight, weight gain rate, and specific growth rate gradually increased with increasing amounts of *Lemna minor*. The trend was more pronounced in the Basra snail, which recorded higher values compared to the Baghdad snail. This response indicates that the increased availability of *Lemna minor* improved weight gain within the tested nutritional levels. This trend matches what earlier research found when testing *L. minor* in fish feed. A study by Achoki *et al.* (2024) showed that adding this plant to Nile tilapia diets caused real differences in growth, specific growth rate, and feed conversion ratio across different amounts used. The best results appeared at certain middle levels rather than just using more and more of the plant.

This can be explained by the high nutritional value of the plant, as nutritional composition studies of *Lemna minor* have shown that it to contain significant amounts of protein, fats, carbohydrates, and minerals, with its nutritional composition varying according to growth conditions and the availability of nutrients in the medium (Ullah *et al.*, 2022).

The current results are consistent with studies showing that the type of food directly affects the vital performance of *Physa acuta* (Auld & Henkel, 2014) found that snails fed Spirulina achieved a larger size and began reproducing at a larger size compared to snails fed lettuce, confirming that differences in food quality can clearly be reflected in the growth and life traits of the snail. It is also noted that Basra snails recorded higher values than Baghdad snails in final weight, weight gain rate, and SGR, especially at 0.040 grams of *L. minor*. This may reflect differences in the physiological condition of the snails at the time of collection or variations in previous environmental conditions.

Figures (1,2) shows significant differences in the daily food consumption rate between the treatments, as consumption increased with the higher level of *Lemna minor* in both spirals. This increased consumption can be partially explained by differences in the plant's nutritional properties; studies have shown that *Lemna minor* contains a relatively high percentage of protein compared to several other aquatic plants, supporting its value as a food source (Kalita *et al.*, 2007). These results support the potential use of *Lemna minor* as a plant-based food source in laboratory studies related to the growth of *Physa acuta*, with the need of link this in the future to its conversion efficiency and chemical properties.

## Conclusions

The results showed that the addition of the plant *Lemna minor* led to a significant improvement in the growth and food consumption of the snail *Physa acuta* compared to

the control treatment. The 0.040 gram level was the best among the tested treatments, recording the highest values for length and weight increase, specific growth rates, and daily food consumption. The Basra snails also showed relatively better performance than the Baghdad snails. The results indicate the potential use of *Lemna minor* as a suitable food source for *Physa acuta* under experimental conditions.

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## أداء النمو والاستجابات الفسيولوجية لحلزون *Physa acuta* المُغذَّى على نبات *Lemna minor* تحت الظروف المختبرية

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### المستخلص

هدفت الدراسة إلى تقييم تأثير تغذية القواقع بنبات العدس المائي *Lemna minor* على مؤشرات النمو واستهلاك الغذاء لدى *Physa acuta*، وذلك بمقارنة استجابات مجموعتين من القواقع جُمعتا من بغداد والبصرة. شملت المعاملات الغذائية معاملة ضابطة باستخدام الخس، ومعاملتين باستخدام عدس الماء بتركيز 0.020 و 0.040 غرام. تمت مراقبة مؤشرات النمو، ومعدل استهلاك الغذاء اليومي، والسلوك، والمؤشرات الحيوية داخل الأحواض. أظهرت النتائج فروقاً معنوية بين المعاملات الغذائية في مؤشرات النمو واستهلاك الغذاء، حيث أدت إضافة عدس الماء إلى تحسن تدريجي في أداء القواقع مقارنةً بالمعاملة الضابطة. سجل تركيز 0.040 غرام أعلى قيم لمعدل الزيادة في الطول، حيث بلغ 2.12 ملم في بغداد و 3.88 ملم في البصرة. علاوة على ذلك، بلغ أعلى معدل للزيادة في الوزن 0.0263 و 0.0393 غرام، بالإضافة إلى أعلى معدلات نمو نوعية للطول والوزن. سُجِّلَ أعلى معدل استهلاك يومي للغذاء عند نفس المستوى، حيث بلغ 3.84 و 4.12 ملغ من الوزن الجاف/حلزون/يوم في بغداد والبصرة على التوالي. وأظهرت حلزونات البصرة قيماً أعلى نسبياً لمعظم مؤشرات النمو والاستهلاك مقارنةً بحلزونات بغداد، لا سيما عند مستوى 0.040 غرام. تشير النتائج إلى أن زيادة توافر نبات *Lemna minor* عند المستويات المختبرة ارتبطت بتحسين استهلاك الغذاء وأداء نمو حلزون *Physa acuta*، حيث كان مستوى 0.040 غرام هو الأفضل بين المعاملات المدروسة. تدعم هذه النتائج إمكانية استخدام نبات عدس الماء كمصدر غذائي نباتي في دراسات تربية ونمو الحلزونات في ظل ظروف تجريبية.

**الكلمات المفتاحية:** استهلاك الغذاء، النمو، التجارب المختبرية، *Lemna minor*، *Physa acuta*