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(IJIREV)**www.gaexcellence.com/ijirev**SIGNIFICANCE OF PREY SIZE AND FEEDING CAPACITY
ON THE EARLY DEVELOPMENTAL STAGES OF ANABAS
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Abstract:

Anabas testudineus is an economically and nutritionally important inland fish species widely distributed in Southeast Asia. It serves as both a food fish and an ornamental species, with consistent demand as a valuable source of animal protein through both wild capture fisheries and aquaculture production. For the development of an effective culture protocol, successful larval rearing is a critical factor, as the growth and survival of A. testudineus fry are highly dependent on the availability of suitable live feed, particularly during the initial feeding period. This study investigated the feeding preferences of A. testudineus fry toward different sizes of live feed, Moina, and determined its consumption by fry at different developmental stages. The use of Moina was found to effectively support the growth and survival of newly hatched A. testudineus fry. The results demonstrated that fry at 3–6 days after hatching (DAH) exhibited a significant preference ($p < 0.05$) for Moina neonates over adult Moina. From 7 to 9 DAH, fry consumed both Moina neonates and adults without significant preference ($p > 0.05$). However, from 10 DAH onwards, fry showed a significantly higher preference ($p < 0.05$) for adult Moina. In terms of consumption capacity, 3 DAH fry consumed an average of two Moina neonates daily. Feed consumption increased gradually throughout early development, reaching an average intake of 11 individuals of mixed Moina neonates and adults per day at 8 DAH. A marked increase in feeding capacity was observed at 10 DAH, when fry consumed an average of 54 adult Moina per day. By 30

DAH, the feeding capacity of *A. testudineus* fry had increased substantially, with an average consumption of 192 adult *Moina* per day. These findings highlighted the importance of providing appropriately sized live feed according to larval developmental stages, which is crucial for optimizing feeding strategies during the early larviculture of *A. testudineus*.

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Keyword:

Anabas Testudineus, Larviculture, *Moina*, Neonates, Prey Size Preference



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Introduction

Anabas testudineus is often called climbing perch; it is a very adaptable tropical freshwater fish that belongs to the family Anabantidae (Jalilah et al., 2026; Pavlov, 2023). *A. Testudineus* is a type of freshwater teleost that does not require stable aquatic conditions and can live in unstable environments, such as shallow wetlands, stagnant ponds, floodplains and oxygen-depleted water bodies (Manon et al., 2023). The above ecological advantages are due to the special accessory respiratory system that can take oxygen from the air in addition to dissolved oxygen in the water. The labyrinth organ and the adjacent respiratory system increase the efficiency of oxygen absorption and provide an oxygen-deprived environment. In addition to the ecological role, *A. testudineus* is also a food and commercial resource for aquatic life. It is a relatively abundant food source across Asia, and due to its good meat quality and rich nutrients, it is highly valued in the diet. Nutritional studies have also added to the list of essential nutrients and minerals and thus provided supporting evidence for its use as food fish (Khalili Tilami & Sampels, 2018). In addition to being used to produce food, climbing perch has also begun to be raised for ornamental purposes and is now an economic driver (Dhar & Ghosh, 2015). Due to its tolerance of various environments, low-input aquaculture systems are likely to be developed in areas with adverse conditions for the maintenance of ideal cultivation environments.

High-quality fry is required for the successful operation of aquaculture production, and the stage that impacts hatchery efficiency is relatively sensitive to changes in larvae. Early in development, fish larvae have undergone considerable changes in their physiology and morphology and need good feeding conditions. Prey preference and feeding ability are related to the growth rate and survival of larvae and their utilisation of food resources (Graeb et al., 2004). The above reasons are particularly prominent in the period after the start of external feeding, as the larvae need to consume sufficiently large and nutritious prey for rapid growth.

Research has shown that early-stage larvae grow and live better on a diet of live organisms, such as *Moina* and *Artemia*, than on artificial diets (Halpati et al., 2024; Peng et al., 2023). Therefore, the purpose of this study is to examine the feeding ability and prey preference of *Anabas testudineus* fry in a laboratory setting with *Moina* as food. By offering different types of prey (e.g., *Moina* neonates or adult *Moina*) at different stages of development, this study will determine the size preference and feeding ability of fry for *Moina*.

Materials And Methods

Production Of Anabas Fry

Broodstock of *Anabas testudineus* were obtained from the Hatchery unit, Institute of Bioscience, Universiti Putra Malaysia, Serdang, Selangor, Malaysia. These broodstocks were maintained in a controlled laboratory environment for conditioning, provided with a stable diet and good water quality, and made reproductively mature. Two males and one female were selected for induced breeding and intramuscular injections of OVATIDE were administered (Hemmo Pharmaceuticals PVT.). A dose of 0.25 mL/kg was used for males and 0.5 mL/kg for females in India Ltd. After injection, the broodstock was moved to a spawning tank measuring 76 x 40 x 38 cm, and under a low-light environment, dark netting was placed over the top of the tank to reduce stress and improve spawning efficiency. After spawning, the broodstock was taken out of the tank to prevent egg predation and ensure the survival of embryos. Spawned eggs hatched in about 15 hours.

Feed Preparation

Both neonate and adult *Moina* were used as live feed sources in this study. *Moina* were purchased from a local aquarium supplier located in proximity to the experimental facility in Seri Kembangan, Selangor, Malaysia. The adult and neonate stages were separated using a 250-um-mesh sieve. Following separation, *Moina* cultures were maintained in glass tanks under controlled conditions with continuous aeration and temperature regulation provided by 150W submersible heaters (Aquael, Poland). Baker yeast (Mauripan, Malaysia) was used in this study to maintain the availability of *Moina* populations.

Prey Size Preferences Experiment

This experiment was conducted to evaluate the prey size preference of *Anabas testudineus* fry during the early developmental stages. *Moina* neonates and adults were used as prey. Feeding trials were performed on 3, 4, 5, 6, 7, 8, 9, 10, and 11 days after hatching (DAH). On each sampling day, ten individual fry were randomly selected from the rearing tank and transferred into ten individual cylindrical plastic containers measuring 7 cm in diameter and 8 cm in height, containing 75 ml of seasoned tap water. Each fry was simultaneously provided with ten neonates and ten adult *Moina* as prey choice. After a 30-min feeding period, fry was returned into the rearing tank, and the remaining numbers of neonate and adult *Moina* were counted to determine the prey size preference of *A. testudineus*.

Feeding Capacity Experiment

Subsequently, this experiment was conducted to determine the feeding capacity of *Anabas testudineus* fry at developmental stages of 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and

30 days after hatching (DAH). On each experimental day, ten fry were randomly selected from the rearing tank and transferred into ten individual plastic containers measuring 7 cm in diameter and 8 cm in height containing 75 ml of seasoned tap water. Each container was initially supplied with ten *Moina* individuals. When the fry had completely consumed the prey, an additional ten *Moina* were introduced. This procedure continues for 7 h in order to quantify the maximum feeding capacity of each individual fry. At the end of the experimental period, the total number of *Moina* consumed by each fry was recorded, tabulated, and presented as the average number of preys consumed per day (7 h period). Based on the earlier prey size preferences experiment, fry at 3, 4, 6, and 8 DAH were given only *Moina* neonates, while fry at 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30 DAH were given a mixture of *Moina* neonates and adults. Early-stage *A. testudineus* fry with small mouth gape were unable to ingest adult *Moina*, whereas at a later stage they demonstrated an increased ability to catch larger prey, adult *Moina*. Therefore, *Moina* neonates were provided during the early fry stages, while adult *Moina* were used later to ensure prey size suitability and accurate assessment of feeding capacity.

Data Collection and Analysis

The total body length of the *Moina* neonate and adult was determined prior to the experiment to categorize the size variation. Statistical comparison of fry preference for the two prey categories was conducted using an independent samples t-test. All values are expressed as mean $\pm$ standard error (S.E.). As for feeding capacity, the number of *Moina* (either neonate only or a mixture of neonate and adult) consumed for all ten fry for the 7 h feeding period was tabulated and presented as an average for each of the respective developmental stages.

Results

As shown in Table 1, substantial differences in body length were observed between *Moina* neonates and adults. The neonates had an average body length of 0.216 ± 0.032 mm, while adults reached an average length of 0.425 ± 0.043 mm. The difference between the two prey stages was statistically significant ($p < 0.05$), categorized into two size classes for the investigation on prey size preferences of *Anabas testudineus* fry.

Table 1: Average Size Differences Between *Moina* Neonate and Adult

Stage	Neonate	Adult
Means $\pm$ SE (mm)	0.216 ± 0.032	0.425 ± 0.043
T-test	$0.001 (p < 0.05)$	

Prey Size Preferences Experiment

Preferences of *Anabas testudineus* fry between *Moina* neonates and adults during early development is illustrated in Table 2. For fry from 3 to 11 days after hatch (DAH), the consumption of both prey types gradually increased with fry growth. At 3 DAH, fry consumed an average of 1.70 *Moina* neonates (Table 2), which was significantly higher than the consumption of *Moina* adults ($p < 0.05$). A similar pattern was observed for fry from 4 to 6 DAH with ingestion of 2.70, 3.00, and 2.70 neonates, respectively, compared with only 0.80, 1.20, and 1.20 for *Moina* adults (Table 2). The significantly greater consumption of neonates

during this period indicated a preference for smaller prey items at the early developmental stage ($p < 0.05$).

Fry at 7, 8, and 9 DAH, prey consumption for the two Moina size classes became less pronounced. Fry consumed an average of 2.60, 3.00, and 2.22 neonates, while adult Moina consumption reached 1.80, 2.40, and 2.11 individuals, respectively (Table 2). Although neonates remained slightly more frequently consumed, no significant differences were detected between the two prey types ($p > 0.05$), suggesting a gradual shift in prey acceptance as fry feeding structures developed.

A major shift in prey size preferences was observed at 10 and 11 DAH. During these stages, fry consumed significantly more Moina adults than neonates ($p < 0.05$). The consumption of Moina adult increased to 7.20 and 8.70 individuals, respectively, whereas neonate consumption was 5.10 and 6.00 individuals (Table 2). Overall, the t-test demonstrated a clear ontogenetic shift in prey size preference of *A. testudineus* fry.

Table 2: T-test of Moina Size Preferences of Anabas Fry

DAH	Moina neonate	Moina Adult	T-test	
Means±SE				
(Average number of prey consumed)				
3	1.70±0.37	0.00±0.00	0.001	S
4	2.70±0.37	0.80±0.25	0.000	S
5	3.00±0.37	1.20±0.36	0.002	S
6	2.70±0.37	1.20±0.25	0.004	S
7	2.60±0.40	1.80±0.50	0.222	NS
8	3.00±0.33	2.40±0.37	0.245	NS
9	2.22±0.28	2.11±0.46	0.837	NS
10	5.10±0.41	7.20±0.53	0.006	S
11	6.00±0.42	8.70±0.40	0.000	S

Note: DAH – day after hatch; S – Significant; NS – Not significant

Feeding Capacity Experiment

The results of the seven-hour feeding capacity experiment demonstrated a clear age-dependent increase in the Moina consumption of *Anabas testudineus* fry (Figure 1). During the earliest developmental stages, fry feeding activity remained relatively low. At 3 DAH, fry consumed only 2.1 Moina neonates for the 7-h period, with consumption increasing slightly to 2.6 and 3.0 neonates at 4 and 6 DAH, respectively (Figure 1).

A marked enhancement in fry feeding activity was observed from 8 DAH onwards. The number of Moina neonates consumed increased substantially to 11.3 individuals at 8 DAH. Fry at 10 DAH was able to consume an average of 54.5 individuals (mixture of neonate and adult), indicating a rapid improvement in feeding performance during this developmental period. Subsequently, Moina consumption continued to rise, reaching 73.9, 93.6, and 98.7 individuals at 12, 14, and 16 DAH, respectively.

From 18 to 30 DAH, fry feeding capacity continued to increase progressively. The total number of *Moina* (mixture of neonate and adult) consumed during the seven-hour feeding period reached 106.2, 112.7, and 126.4 individuals at 18, 20, and 22 DAH, respectively. A further increase was recorded during the later stages, with consumption values of 153.5, 157.8, and 174.2 individuals at 24, 26, and 28 DAH, respectively, before reaching the highest level of 192.8 individuals at 30 DAH (Figure 1).

Overall, the feeding capacity of *A. testudineus* fry increased progressively throughout development, reflecting improvements in feeding performance associated with larval growth. The rapid increase in prey consumption observed between 8 and 14 DAH suggests a key developmental transition period, during which fry acquire enhanced prey capture efficiency and feeding competence.

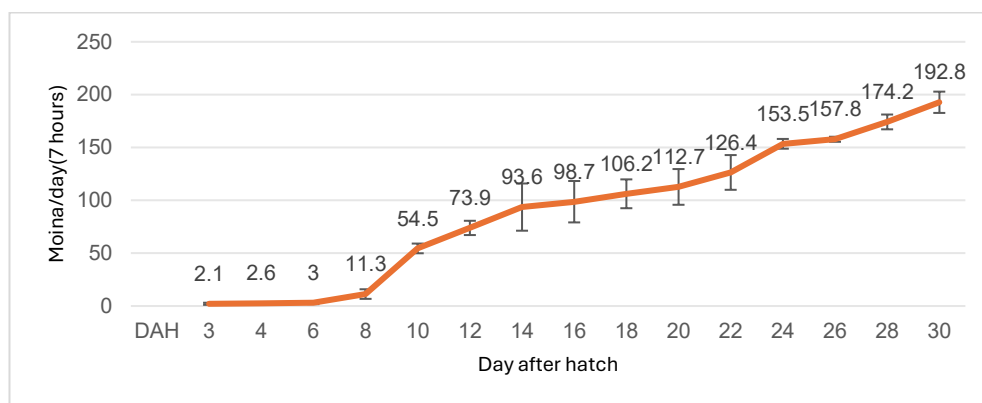


Figure 1: Feeding Capacity Of Anabas Fry At Different Developmental Stages

Discussion

Feeding performance during the early larval period is a critical factor influencing survival, growth, and successful recruitment in aquaculture species. For *Anabas testudineus*, an economically important freshwater fish widely distributed in Southeast Asia, establishing suitable feeding protocols during larval development is essential for improving hatchery efficiency and promoting sustainable production. The present study provides new insights into the ontogenetic changes in prey preference and feeding capacity of *A. testudineus* larvae, providing valuable information for optimizing live-feed management strategies.

The present results demonstrated a clear developmental shift in prey size selection between 3 and 30 DAH. During the earliest feeding stages (3–6 DAH), *A. testudineus* fry showed a significant preference for *Moina* neonates over adults. This preference is likely associated with the limited feeding capability of fry at the initial feeding stage, particularly due to restricted mouth gape and underdeveloped prey-capture ability. Previous studies have shown that prey size is a major factor influencing fry feeding success, as fry at initial feeding are generally unable to efficiently consume prey exceeding their mouth gape (Sánchez-Hernández et al., 2011).

In addition, the immature locomotory and neuromuscular systems during the early developmental stage may limit swimming performance and prey capture efficiency, resulting in restricted capture of larger prey items (Berg et al., 2018). Therefore, the preference for

smaller *Moina* neonates observed in the present study suggests that prey size compatibility is essential for maximizing feeding success during the initial feeding stages.

Between 7 and 9 DAH, the differences in consumption between *Moina* neonates and adults became less pronounced. Although larvae continued to consume slightly more neonates, the lack of a significant difference indicates a transitional phase in feeding behavior. This period may represent an important stage of morphological and physiological development, during which improvements in digestive capability and feeding structures (mouth gape) gradually expand the range of acceptable prey sizes. Similar developmental changes in digestive system maturation have been reported to contribute to dietary shifts during fish larval ontogeny (Hien et al., 2025).

A significant shift in prey preference occurred at 10–11 DAH, when fry consumed more *Moina* adults than neonates. This coincided with the increase of nutritional requirements associated with rapid larval growth and enhanced swimming activity. Compared with *Moina* neonates, *Moina* adults provide greater biomass and potentially higher energy intake per prey item, which may better satisfy the increasing metabolic demands of developing fry (He et al., 2001). The increased ability to utilize larger-size prey is likely related to the progressive development of morphological and physiological characteristics, including increased mouth gape, improved prey-capture efficiency, and enhanced digestive capacity (Arevalo et al., 2023).

In addition to changes in prey size preferences, feeding capacity increased substantially throughout fry development. The number of *Moina* consumed during the 7-h feeding trials increased from only 2.1 individuals (neonates) at 3 DAH to 192.8 individuals (mixture of neonates and adults) at 30 DAH, demonstrating a continuous improvement in feeding performance. This increase may be attributed to multiple developmental processes, including improved swimming ability, enhanced prey detection and capture efficiency, and maturation of digestive functions. These physiological improvements enable fry to exploit greater quantities of food and support increased energy requirements for growth processes.

The findings of this study have important implications for the larval rearing of *A. testudineus*. The early fry stage represents a critical period in which inappropriate feed size or insufficient nutrient availability can result in reduced survival and growth retardation. Therefore, supplying appropriately sized live prey, such as *Moina* neonates, during the initial feeding period may improve feeding success and enhance larval performance (Suhaimi et al., 2022). As fry develop, gradual replacement with larger prey should be implemented according to their morphological and feeding capabilities to improve feed utilization efficiency and reduce feed wastage (Kestemont et al., 2003).

Based on the observed transition in prey size preferences, a gradual shift from *Moina* neonates to adults between approximately 8 and 10 DAH fry may be recommended for the larviculture of *A. testudineus*. Such a feeding strategy could provide a balance between prey accessibility and nutritional supply, preventing both insufficient food intake and excessive energy expenditure associated with capturing smaller-size prey. Instead, energy efficiency can be improved by providing larger sized prey. Furthermore, adjusting feeding quantity according to the increasing feeding capacity of fry may help minimize uneaten feed accumulation and maintain better water quality, thereby reducing potential stress caused by deteriorating culture conditions (Okomoda et al., 2019).

Overall, this study contributes to a better understanding of the feeding ecology and ontogenetic dietary transition of *A. testudineus* fry. Considering the increasing aquaculture potential of this species for both food production and ornamental purposes, the optimization of larval feeding regimes based on prey size and developmental feeding capacity may improve hatchery performance and enhance production efficiency.

Conclusion

This study offers new information on the ontogenetic changes in prey size preference and feeding ability of *Anabas testudineus* during early development. Therefore, the feeding behaviour of the larvae was affected by the time of development and prey size. In the early larval stage (3-6 DAH), the fry preferred smaller prey, but after 10 DAH, there was a considerable increase in the size of preferred prey. As for the feeding capacity, prey consumption increases from 2-11 *Moina* neonates at 3-8 DAH, then there is a sudden surge to 54 *Moina* (a mixture of neonates and adults) from 10 DAH onwards. The following feeding reached 153 *Moina* (a combination of neonates and adults) at 24 DAH. The above modifications are likely to improve the fry's mouth-gaping and feeding capacity. In short, this paper presents a feasible feeding system for *A. testudineus* larvae culture based on prey-size selection and developmental feeding requirements. These results help improve the management plan for live-feed and provide relevant data to enhance the survival rate, growth speed and production efficiency of this economically important type of aquaculture.

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