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Effects of Dietary Tryptophan Manipulation on Growth and Survival of African Catfish (*Clarias gariepinus*) Larvae

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ABSTRACT

The African catfish (*Clarias gariepinus*) is a popular aquaculture species owing to its rapid growth, high fecundity, and tolerance to low-oxygen conditions. However, its tendency toward cannibalism during early development often leads to inconsistent larval production. Despite its well-documented biological and environmental adaptability, certain nutritional factors, such as tryptophan, that influence early development remain unexplored. Tryptophan, as an essential amino acid involved in growth and behavioural regulation, is still not fully understood in the context of fish larvae. This study aimed to investigate the effects of dietary tryptophan on the larval growth and survival of *C. gariepinus*. A total of 1000 larvae were produced from artificial stripping induced with hormone Ovaprim (0.5–1.0 ml/kg). Fertilized eggs were incubated in hatching tanks before transfer to aquaria. Larvae were distributed into 20 aquaria under five dietary treatments with four replicates: control (T_0), 2.5 g/kg ($T_{2.5}$), 5.0 g/kg ($T_{5.0}$), 7.5 g/kg ($T_{7.5}$), and 10.0 g/kg ($T_{10.0}$). Growth, survival, and behavioural interactions were monitored. Results indicated that larvae fed $T_{2.5}$ diets exhibited significantly higher survival and improved growth compared to the control and other treatments. While higher tryptophan levels ($T_{7.5}$ and $T_{10.0}$) did not enhance performance, $T_{2.5}$ supplementation reduced cannibalistic behaviour and promoted stable interactions among larvae. This study shows the moderate dietary tryptophan supplementation (2.5 g/kg) optimizes larval growth and survival. These findings highlight the potential of dietary tryptophan manipulation as a nutritional strategy to enhance larval rearing technique and sustainability in aquaculture.

Keywords: African catfish, *Clarias Gariepinus*, growth, survival, tryptophan

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INTRODUCTION

Aquaculture contributes significantly to global food security, especially in developing countries, by supplying affordable protein (Pradeepkiran, 2019). In Malaysia, African catfish (*Clarias gariepinus*) is a major species due to its rapid growth and resilience (Ali et al., 2022). However, seed production is constrained by high larval mortality from early cannibalism (Wubie & Dagne, 2022). While environmental and genetic factors have been studied, the nutritional role of amino acids remains less explored. Tryptophan, a precursor of serotonin that regulates growth, stress, and behaviour may improve larval survival (Umanah & David, 2025). This study examines the effect of dietary tryptophan on enhancing hatchery performance in *C. gariepinus* larvae.

Problem Statement

Current knowledge of tryptophan's role in *C. gariepinus* larvae is limited, particularly regarding growth, survival, and stress. Undefined dietary levels and scarce behavioural research hinder feeding strategies and aquaculture success.

Research Question

Based on the identified gaps, this study seeks to answer the following questions: What are the effects of different dietary tryptophan concentrations on the growth performance of larvae? What is the optimal dietary concentration of tryptophan required to enhance growth and improve overall larval survival?

MATERIALS AND METHODS

The study was conducted at the Hatchery and Aquatic Laboratory, Faculty of Bioresources and Food Industry (FBIM), Universiti Sultan Zainal Abidin (UniSZA), Malaysia (5.1234° N, 103.4567° E), with ethical approval from UniSZA's Animal Ethics Committee (UAPREC/008/025).

Experimental Setup

Two broodfish pairs were acclimatized and underwent a breeding phase to produce fish larvae. These were evenly distributed into 20 aquariums (7 L capacity), each containing 5 L of freshwater and 50 larvae (Wenzel et al., 2022). Each tank was aerated and equipped with a thermometer. Larvae were fed 10 g of pellets mixed with L-tryptophan at five concentrations: 0 (T_C), 2.5 ($T_{2.5}$), 5.0 ($T_{5.0}$), 7.5 ($T_{7.5}$), and 10.0 g/kg ($T_{10.0}$).

Larval Assessment and Data Analysis

Larvae were monitored daily for growth, survival, and behaviour, including feeding, movement, and resting. Size changes were examined microscopically, and key parameters were calculated using the method described by Wenzel et al. (2022). Statistical analysis was performed using one-way ANOVA with post hoc tests at a 95% significance level (Minitab® Statistical Software, Version 19.1).

RESULTS AND DISCUSSION

Larval Growth

Figure 1 shows larval growth over 14 days under different tryptophan treatments. Growth increased after Day 3, with $T_{2.5}$ performing close to the control (T_C), while higher doses ($T_{5.0}$-$T_{2.5}$) suppressed growth, especially $T_{10.0}$. Similar findings were reported in Asian seabass, where 1.0% L-tryptophan improved growth and survival (Khan et al., 2023), and in crucian carp, where supplementation enhanced growth and immunity (Fu et al., 2021). These results highlight that tryptophan benefits larval growth only at optimal levels, while excess reduces performance.

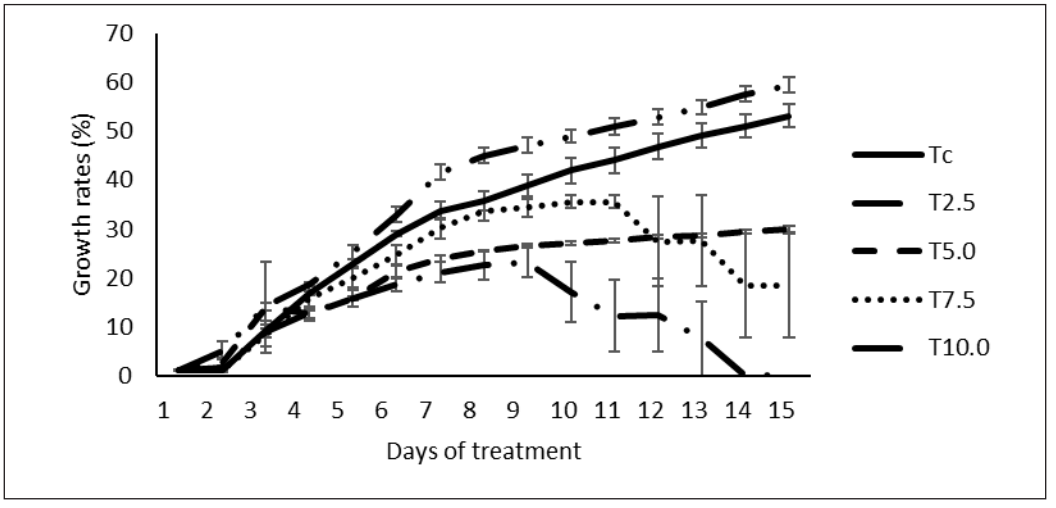

Figure 1. Growth rate of the larvae in a 14-day experiment

Larval Survival Rates

Figure 2 shows larval survival of *C. gariepinus* improved from 28.57±7.71% (control) to 45.36±6.61% at $T_{2.5}$ but declined sharply at higher levels (7.86±1.89% at $T_{5.0}$, 1.79±1.07% at $T_{7.5}$, and 0% at $T_{10.0}$). This indicates a narrow optimal range, with $T_{2.5}$ as the most effective level, while excess tryptophan proved detrimental.

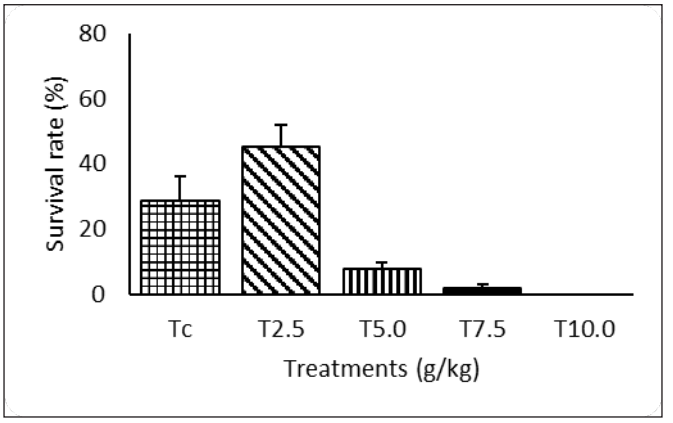

Figure 2. Survival rate of the larvae in a 14-day experiment

Previous studies confirm the threshold effect of dietary tryptophan, with optimal requirements reported in *Channa argus* (0.45-0.46%), blunt snout bream (0.33-0.36%), and silver catfish (2.5-3.4 g/kg) (Ji et al., 2019; Miao et al., 2021; Pianesso et al., 2015). Tryptophan has also been linked to reduced cannibalism, stress, and improved survival in Asian seabass (Khan et al., 2022). In this study, survival of *C. gariepinus* larvae peaked at $T_{2.5}$, confirming that moderate supplementation is beneficial, while excess levels are detrimental.

CONCLUSION

This study shows that dietary tryptophan improved *C. gariepinus* larval performance, with the highest survival (45.36±6.61%) and growth $T_{2.5}$ compared to control (28.57±7.71%). Higher levels reduced performance, with total mortality at $T_{10.0}$, confirming $T_{2.5}$ as optimal.

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