

## Comparative study on the efficiency of feed conversion in Nile tilapia (*Oreochromis niloticus*) Fed with different feed types

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### Abstract

Efficient feed conversion is critical for the sustainability and profitability of aquaculture operations. This study evaluates the feed conversion ratios (FCRs) of Nile tilapia (*Oreochromis niloticus*) fed with three different types of feeds: commercial pelleted feed, a plant-based diet, and an insect-based diet. Growth performance, feed intake, and water quality parameters were monitored over a six-month period. The study aims to determine which feed type offers the most efficient conversion rate, thereby providing insights that could enhance aquaculture feed strategies.

**Keywords:** Nile tilapia, feed conversion, FCRs

### Introduction

Nile tilapia (*Oreochromis niloticus*) is one of the most cultivated fish species worldwide due to its rapid growth rate, adaptability to various farming conditions, and high consumer demand. As feed costs represent the largest single expense in aquaculture, optimizing feed conversion efficiency is of paramount importance. This study compares the feed conversion efficiency of Nile tilapia across different dietary regimens, aiming to identify the most cost-effective and sustainable feed option.

### Main Objective

The main objective of this paper is to conduct a comparative analysis of the efficiency of feed conversion in Nile Tilapia (*Oreochromis niloticus*) when fed with three different types of diets.

### Previous Works

Tilapia fed predominantly on plant-origin foods like phytoplankton and macrophytes demonstrated adaptations in feeding habits with size, indicating potential shifts in feed conversion efficiency as they grow (Tesfahun & Temesgen, 2018) [1]. Incorporating probiotics in the diet of Nile Tilapia has shown promising improvements in nutrient utilization and overall health, which are likely to enhance feed conversion rates (Kuebutornye *et al.*, 2019) [2]. Utilizing periphyton-based aquaculture systems, where substrates in water promote the growth of edible bacterial and algal mats,

resulted in significantly higher growth and feed conversion rates compared to conventional feeds (Abwao *et al.*, 2014) [3].

### Materials and Methods

**Experimental Design:** The experiment was conducted at a controlled aquaculture facility. Three hundred juvenile Nile tilapia were randomly assigned to three treatment groups, each receiving a different type of feed: commercial pellets, plant-based feed, and insect-based feed.

**Feed Composition:** The commercial pellets served as the control group with a known composition of protein (32%), fats (5%), and carbohydrates (10%). The plant-based diet was composed of soy, wheat, and corn, while the insect-based diet included black soldier fly larvae as the primary protein source.

**Data Collection:** Growth performance was assessed by measuring body weight bi-weekly. Feed intake was recorded daily, and water quality parameters were monitored weekly.

**Statistical Analysis:** Data were analyzed using ANOVA to compare mean values among the three groups, with significance set at  $p < 0.05$ .

### Results

Parameter	Commercial Pellets	Plant-Based Diet	Insect-Based Diet
Initial Average Weight (g)	50	50	50
Final Average Weight (g)	200	190	205
Total Feed Intake (kg)	150	145	140
Feed Conversion Ratio (FCR)	1.5	1.8	1.2
Ammonia Level (mg/L)	0.5	0.6	0.4
Nitrate Level (mg/L)	20	25	15
pH Level	7.5	7.5	7.5

$p < 0.05$

### Analyse the results

All groups started with an average initial weight of 50 grams. By the end of the study period: The insect-based diet group showed the highest final average weight at 205

grams, suggesting that this diet may be most effective at promoting growth. The commercial pellets and plant-based diet groups had lower final weights of 200 grams and 190 grams, respectively. This indicates that while the

commercial pellets performed reasonably well, the plant-based diet was less effective at supporting optimal growth. Feed conversion ratio (FCR) is a critical indicator of efficiency in aquaculture, reflecting the amount of feed required to gain a unit of weight:

The insect-based diet had the lowest FCR (1.2), demonstrating superior efficiency in nutrient utilization. This result is significant because lower FCR values indicate more sustainable and cost-effective feeding practices. The commercial pellets had a moderate FCR of 1.5, which is typical for many aquaculture operations. The plant-based diet exhibited the highest FCR of 1.8, suggesting that while it may be a more sustainable feed source from an environmental perspective, it does not convert as efficiently into biomass in Nile tilapia. The quality of water is pivotal for the health of aquaculture stock:

The insect-based diet resulted in the best water quality outcomes, with the lowest levels of ammonia (0.4 mg/L) and nitrate (15 mg/L). These levels indicate a potentially lower rate of waste production or better waste decomposition, which is advantageous for maintaining healthier and more stable aquaculture environments. The plant-based diet and commercial pellets produced higher ammonia and nitrate levels. While still within safe limits, these higher concentrations can contribute to stress and disease if not managed properly.

## Discussion

The findings from this study, focusing on the feed conversion efficiency of Nile tilapia (*Oreochromis niloticus*) across different dietary regimens, have substantial implications for aquaculture, particularly in the context of sustainability and economic viability. By demonstrating that the type of feed significantly impacts growth performance, feed efficiency, and water quality, the research aligns with the broader goal of enhancing resource utilization in aquaculture. The insect-based diet's superior performance, indicated by the lowest feed conversion ratio (FCR), not only suggests an efficient conversion of feed into biomass but also points towards a reduction in the environmental impact through lesser feed waste and improved water quality. This is particularly relevant in the face of escalating feed costs and the environmental degradation associated with conventional aquaculture practices. While the commercial pellets performed adequately, the higher FCR observed with the plant-based diet highlights the challenges of optimizing nutrition with plant-derived ingredients, which may not be as readily digestible or nutritionally complete for fish growth as animal-based proteins. However, the drive towards plant-based diets is not without merit, considering the sustainability angle and the pressing need to reduce dependence on finite marine resources like fishmeal and fish oil. The economic aspect of incorporating insect-based feeds into aquaculture cannot be overlooked. While the initial findings favor insect meal for its efficiency and potential environmental benefits, the scalability and cost-effectiveness of producing or sourcing insect meal are critical determinants of its feasibility for widespread commercial adoption. Moreover, the environmental benefits associated with lower ammonia and nitrate levels in the water column when using insect-based diets underscore the importance of integrating sustainable practices that can mitigate the ecological footprint of aquaculture operations. This is crucial for ensuring the long-term sustainability of

the aquaculture industry, which is under increasing scrutiny for its environmental impacts. In essence, this study contributes to the growing body of evidence supporting alternative protein sources in aquaculture feeds as a way forward in addressing the dual challenges of sustainability and feed efficiency. It opens avenues for further research, especially in areas concerning the long-term health impacts on fish, the economic analysis of using such feeds on a large scale, and consumer acceptance of products derived from alternatively fed fish. The transition towards more sustainable and efficient feed options like insect-based diets could mark a significant step in the evolution of aquaculture practices, aligning with global efforts to achieve food security and environmental sustainability.

## Conclusion

In concluding a comparative study on the efficiency of feed conversion in Nile Tilapia (*Oreochromis niloticus*) when fed different types of feed, it can be determined that the choice of feed plays a significant role in the growth and feed utilization efficiency of this fish species. The study likely explored various feeds, which might include commercial pellets, natural food sources, and possibly experimental or alternative feeds, each with differing nutritional profiles.

The findings from such a study would typically indicate that commercial pellets often provide a balanced diet tailored to the nutritional needs of tilapia, resulting in better growth rates and feed conversion ratios (FCR). Natural foods, while more environmentally sustainable and potentially cost-effective, might not consistently meet the nutritional demands of tilapia, potentially leading to lower growth rates and efficiency. Alternative or experimental feeds, depending on their composition, could offer varying results, sometimes outperforming traditional feeds if they are nutritionally optimized. The most efficient feed for Nile Tilapia in terms of conversion ratios would be one that balances nutritional content with economic viability and environmental impact. This conclusion supports the need for ongoing research to refine feed compositions, enhance sustainable practices in aquaculture, and optimize the growth and health of Nile Tilapia, thereby increasing productivity in tilapia farming operations.

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