E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 76.37
(GIF) Impact Factor: 0.549
IJFAS 2025; 13(1): 240-242

www.fisheriesjournal.com
Received: 16-12-2024
Accepted: 19-01-2025

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Growth performance and feed conversion ratio (FCR) of fingerlings *Catla catla* fed on Honey bee pupae meal

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DOI: https://www.doi.org/10.22271/fish.2025.v13.i1c.3049

Abstract
The excellent alternative to fish meal is the high dietary value of honey bee pupae meal, a waste product of the apiculture rearing industry. 46-50% of crude protein and 20-30% crude fat in dried pupae make up this premium insect protein source, which also contains a rich, balanced amount of important amino acids. Fish feed facilities are currently looking for additional sources of protein because traditional fish meals are becoming more and more expensive. Four distinct diets were employed to accomplish this goal: one was the control diet consisting of groundnut and maize, while the other three contained 25%, 50%, and 75% protein from the usual diet with honey bee pupae meal. In comparison to 25% and control feed, 50% and 75% honey bee pupae meal was found to have the best results. As a result, the study suggests using honey bee pupae meal in place of fish meal in *Catla catla* diets, either completely or in parts.

Keywords: Fish feed, IMCs, honey bee pupae meal

Introduction
In this both people and animals, fish is a great source of animal-based protein. Fish provides more than 40% of the protein that two thirds of the world's population consumes. The expanding global population is increasing the need for fish as a source of protein. Fish farming and aquaculture have grown significantly in the recent past due to the demand for protein from livestock.

The fish makes up 16% of the animal protein consumed by people globally, making it the most important single source of high-quality protein (Ahmed *et al*., 2012) [1]. The production and harvesting of aquatic life under strict control is known as aquaculture. In the face of diminishing natural fisheries reserves, aquaculture is necessary to meet the food demands of a growing global population, much like agriculture.

Fish farming has established itself as a legitimate commercial enterprise in numerous nations, including India. One of the most important inputs for fish growth and aquaculture productivity is fish feed (Oso and Iwalaye, 2014) [10]. The expansion of fish farming has led to an increase in the significance of fish feed in the aquaculture arrangement, both in terms of productivity of fish and cost.

Methodology
The materials and techniques employed in this study evaluate the growth performance of *Catla catla* at various developmental stages when fed specially formulated food including various live feed supplements. The research study was carried out in the lab during a ninety-day duration.

Experimental fish
The Indian major carp *Catla catla* is a fresh water edible fish has been selected for the present investigation

Collection and maintenance of *Catla catla*
The fingerlings that were healthy and alive were gathered from Prayas Fish Farm in

Chandpura, M.P., and the Fisheries Department's Matsya Mahasang Maryadit Bhopal. A polythene bag filled with oxygenated water was used to carry the gathered fish to the lab. The fish spent a month acclimating to the laboratory conditions in non-chlorinated water while housed in big aquarium tanks. Fish weighing 7 ± 0.5 gram of both genders was used. Fish were given control feed made in the laboratory once a day during adjustments, and the water was replaced every other day.

Experimental diets

Honey bee pupae for the preparation of honey bee meal was procured from Rajendra Prasad Agriculture University Pusa Bihar. Honey bee pupae meal (SWPM) is a protein-rich feed ingredient of animal origin with a high nutritional value. On dry matter (DM) basis its crude protein content ranges from 50% to more than 80% (defatted meal). The lysine (6-7% of the protein) and methionine (2-3% of the protein) contents are particularly high Fish meal. The other three ingredients groundnut cake and maize were purchased from the 1ocal market and silkworm pupae were produced from After passing each ingredient through a 400 µm sieve they were carefully hand-mixed with water for thirty minutes the combined ingredients were cooked at 105°C. After the dough was cooked it was run through a pelletizer to create 2.5 mm diameter pellets. These pellets were then dried at 60°C to less than 10% moisture content and wrapped in aluminium foil for storage.

Feed formulation

The basal experimental diet was formulated with the commonly available ingredients as presented in the proximate compositions of the commonly available ingredients in the experimental diets are presented in the proximate compositions of the formulated diet are presented in Four graded levels of feed 0%, 25%, 50% and 75% were included in the basal diet. The ingredients were ground, weighed, mixed, made dough of feed ingredients and pelleted with meat mincer through a 0.5 mm diameter. After pelleting, the feed was air dried and put in an airtight container and stored at 20 °C until fed.

Table 1: Codes used for the culture tanks

Ingredients	Treatments	Composition (%) of Groundnut cake & Maize (1:1 ratio)	Composition (%) Of honey bee pupae meal
Control	C (0%) T-1	100	0
Honey bee pupae meal	SWP-1 (T-2) 25%	75	25
	SWP-2 (T-3) 50%	50	50
	SWP-3 (T-4) 75%	25	75

Results and discussion

The water quality was maintained throughout the investigation by routinely analyzing the physicochemical parameters. Throughout the trial, the water's temperature varied between 26 °C and 32 °C. Ammonia (0.25 ppm), free CO2 (0.44-0.61 ppm), dissolved oxygen (8.06-10 ppm), pH (7.6-8.4), and other water quality metrics were all within the ranges that were ideal for carp development. The weight gain in *Catla catla* was measured during the 90-day experiment setup period at 15-day intervals. The findings indicated that the *Catla catla* fed the T-4 diet (Honey bee pupae meal) gained the most weight (130.23±0.23g), whereas the control-fed fishes gained the least weight (115.87±0.79g). When compared to control feed, the weight gain difference between *Catla catla* with various live feed additives in formulated feed diets during the trial was statistically important (p<0.05).

There was an increase in net length of fishes fed with different experimental diet during the study. The maximum length gains 15.00±0.022 cm was obtained with T-4 diet (honey bee pupae meal) fed fishes and minimum length gain 10.30±0.002cm was recorded in the control feed fishes in 90 days of the experiment during the study. Fishes fed with different experimental feeds differs significantly (P<0.05) in their length gain than the control fishes. In the present investigation, the food conversion ratio (FCR) was 1.52 using 75% SPM diet with highest protein efficiency ratio (14.24) and survival rate 99.87% in T-4 tank (Table 2).

During the study, the length gains 10.30±0.002cm was obtained in T-1 (control); 14.40±0.019cm was gained in in T-2 (25%) and 15.10±0.006cm in T-3(50%) diet fed fishes was recorded in 90 days of experiment. The weight gain in *Catla catla* was obtained 102.98±0.78g in T-1 (control); 130.97±0.51g was gained in T-2 (25%) and 140.23±0.23g in T-3(50%) diet fed fishes was recorded during the study

Table 2: Overall growth of fish (over 90 days) and its indicators and apparent digestibi1ity of diets

Species	Diet	Mean final weight[a] (g)	Survival (%)	Mean specific growth rate	Food conversion ratio	IBL (cm)	FBL (cm)	Protein efficiency ratio
Catla catla	A (T-1)	102.98±0.78	96.98±0.45	3.57±0.75	1.94±0.05	6.4±0.006	10.30±0.002	4.87
	B (T-2)	115.87±0.79	97.98±0.45	3.87±0.27	1.88±0.00	6.4±0.06	14.40±0.019	12.35
	C (T-3)	120.97±0.51	98.35±0.22	4.32±0.24	1.79±0.32	6.4±0.06	15.10±0.006	13.16
	D (T-4)	130.23±0.23	98.47±0.35	4.58±0.13	1.75±0.21	6.4±0.06	15.00±0.022	14.24

This was confirmed in this work by the significant increase in growth performance HBP fed fish. HBP inclusion in the diet reduced the mortality. This protection is undoubtedly attributed to the enhanced non-specific immune responses and the antioxidant effects of HBP through its constituent flavonoids which have antibacterial activity (Pietta, 2000).

Similarly, previous work has demon started that tilapia administered with propoli sextracts andahot water extract of Chinese mahogany experienced reduced mortalities when challenged with A hydrophila. In conclusion honey bee pollen incorporation into diet improves growth rate, enhances non-specific immunity and is beneficial for controlling A. hydrophila infections in tilapia (S. K., and Giri, S. S. (2017). Certainly previous studies using honey bee meal demonstrated its effectiveness in increasing body weight and other growth performance parameters of fish (Meurer *et al*.,

2009) [8]. Perhaps the improved growth of HBP fed fish may be attributed to the components of HBP namely vitamins, minerals and enzymes or co enzymes which enhance digestion and assimilation of the food (Xu *et al*., 2009) [5]. In addition, there may be increased intestinal absorptive capacity through the longer and thicker villi in animals fed pollen in association with higher protein anabolism (Attia *et al*., 2011) [3].

Conclusion

It is concluded that Honey bee pupae meal is a major source of protein in fish meal and can serve as an excellent alternative source of protein in fish meal, either completely or in part. It is cheaper and qualitative feed that is available to culture fish species in the aquaculture.

Acknowledgements

The authors are thankful to Department of Zoology and Applied Aquaculture, Barkatullah University Bhopal for providing experimental set up spaces in laboratory

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