Eco. Env. & Cons. 31 (4) : 2025; pp. (1587-1590)

ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2025.v31i04.038
Website: www.envirobiotechjournals.com

Comparative Evaluation of Chicken Offal Meal and Fish Meal as Protein Sources on Growth Performance of *Labeo rohita* (Hamilton, 1822)

Vinay Gautam[1], *Dinesh Kumar[1], Laxmi Prasad[2], Puneet K. Patel[1], Sumit Kumar[3], Pradip Kumar Maurya[4], Vikalp[5], Suraj Verma[1] and Vikas Kushwaha[1]

[1]Department of Aquaculture, College of Fisheries, ANDUA&T, Kumarganj, Ayodhya 224 229, U.P., India
[2]Department of Aquaculture, College of Fisheries, DUVASU, Mathura 281 0011, U.P., India
[3]Department of AEM, College of Fisheries, ANDUA&T, Kumarganj, 224 229, U.P., India
[4]Department of FPT, College of Fisheries, ANDUA&T, Kumarganj, 224 229, U.P., India
[5]Department of Aquaculture, College of Fisheries, RPCAU, Dholi, Muzaffarpur 843 121, Bihar, India

(Received 3 August, 2025; Accepted 8 October, 2025)

ABSTRACT

The present study evaluated the replacement of fish meal with chicken offal meal (intestine) in the diet of *Labeo rohita* fingerlings with respect to water quality, growth, carcass composition, and hematological indices. A 90-day feeding trial was conducted using triplicate groups of fingerlings (mean initial weight 5.3 ± 0.1 g; length 8.4 ± 0.2 cm) reared in aquaria (150 L, 10 fish each). Three iso-nitrogenous and iso-calorific diets were prepared: T1 (control, rice polish + mustard oil cake), T2 (fish meal-based), and T3 (chicken offal meal-based) having 28% CP. Water quality remained within optimal ranges (temperature 26.5–28.9 °C, DO 5.4–6.4 mg L{^{1}, pH 7.1–7.6). Fish fed T3 exhibited significantly higher weight gain (279.7%), SGR (1.48% day{^{1}), PER (0.53), and lower FCR (1.46) compared to T2 and T1. Proximate analysis showed higher carcass protein (73.5%) and lipid (12.3%) in T3. Hematological parameters (Hb, PCV, TEC) also improved under T3, reflecting better health status. These results demonstrate that chicken offal meal is an effective, sustainable, and economical substitute for fish meal in *L. rohita* diets.

Key words: Labeo rohita, *Chicken offal meal, Growth performance, Proximate composition, Hematological parameters*

Introduction

Aquaculture accounts for more than 50% of the world's fish supply and plays a critical role in ensuring global food security (FAO, 2024). In India, freshwater aquaculture is dominated by Indian Major Carps (*Catlacatla*, *Labeo rohita*, *Cirrhinus mrigala*), with *L. rohita* being highly preferred due to its fast growth, herbivorous feeding, and consumer acceptance (GOI, 2023).

Protein is the most expensive component of aquafeed and directly influences growth performance, feed conversion, and fish health (Lovell, 1989; Bureau & Cho, 2006). Fish meal (FM) has traditionally been the principal animal protein source because of its high digestibility and balanced amino acid profile (Tacon and Metian, 2008). However, rising costs, limited availability, and sustainability concerns necessitate the search for alternative protein sources (Naylor *et al.*, 2021).

Chicken offal meal (COM), prepared from poultry intestines and viscera, contains 55-64% protein, essential amino acids, and digestible lipids (Jia *et al.*, 2022; Zhu *et al.*, 2024). Its incorporation into aquafeeds reduces feed costs and supports recycling of poultry industry waste (Al-Souti *et al.*, 2019). Studies in tilapia, catfish, and flounder demonstrated successful partial or complete substitution of FM with poultry by-product meals (El-Sayed, 1998; Kim *et al.*, 2021). However, data on COM utilization in *L. rohita* are limited.The present study was conducted to (i) compare the efficacy of chicken offal meal and fish meal in *L. rohita* diets, (ii) evaluate their effects on water quality, growth performance, proximate composition, and hematological indices, and (iii) assess the feasibility of chicken offal meal as a sustainable fish meal substitute in carp aquaculture.

Materials and Methods

Experimental design and fish husbandry

The study was carried out in the Wet Laboratory, College of Fisheries, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, during August–October 2024. Fingerlings of *L. rohita* (5.3 ± 0.1 g; 8.4 ± 0.2 cm) were acclimatized for 7 days and then stocked (10 fish per aquarium) in nine 200-l aquaria (150 l water).

Diet formulation

Three isonitrogenous diets (28% crude protein) were prepared (Table 1). Feed ingredients were oven dried, ground, mixed, steamed (121 °C, 15 min), pelletized (1 mm), sun dried, and stored. Fish were fed at 5% body weight daily in two equal meals.

Water quality

Temperature, pH, dissolved oxygen (DO), free CO_2, alkalinity, hardness, and total dissolved solids were analysed weekly following APHA (2005).

Growth performance

Growth indices were calculated as:

- Weight gain (%) = (Final wt – Initial wt)/Initial wt × 100
- SGR (% day{^{1}) = [ln(Final wt) – ln(Initial wt)]/ days × 100
- FCR = Feed intake/Weight gain
- PER = Weight gain/Protein intake

Proximate analysis

Moisture, protein, lipid, fibre, and ash in feeds and fish carcass were determined (AOAC, 1995).

Hematology

Blood was collected from three fish per replicate. Parameters included Hb, PCV, TEC, TLC, and erythrocyte indices using an automated haematology analyser.

Statistical analysis

Data were analysed by one-way ANOVA (SPSS v29). Means were compared using Duncan's test at $p < 0.05$.

Results

Water quality

Water quality remained within favourable ranges for carp culture (Table 2). DO was slightly higher in T3, while free CO_2 was lowest in T2. Alkalinity was marginally higher in T3.

Growth performance

Fish fed T3 attained significantly ($p < 0.05$) higher final weight, weight gain, SGR, and PER, with the lowest FCR (Table 3).

Proximate composition

Carcass analysis revealed significantly higher pro-

Table 1. Diet composition (% dry matter basis)

Ingredients	T1 (Control)	T2 (Fish meal)	T3 (Chicken offal meal)
Rice polish	45	35	30
Mustard oil cake	45	35	30
Fish meal	–	25	–
Chicken offal meal	–	–	30
Binder (wheat flour)	5	3	5
Vitamin-mineral mix	5	2	5
Total	100	100	100

Table 2. Water quality parameters

Parameter	T1	T2	T3	Optimal range*
Temperature (°C)	27.5 ± 0.3	27.6 ± 0.4	27.8 ± 0.2	24–30
pH	7.2 ± 0.1	7.3 ± 0.1	7.4 ± 0.1	6.5–8.0
DO (mg L{^{1})	5.8 ± 0.2	5.9 ± 0.1	6.0 ± 0.1	>5.0
Free CO (mg L{^{1})	2.2 ± 0.1	1.9 ± 0.2	2.3 ± 0.2	<5.0
Alkalinity (mg L{^{1})	112 ± 2.5	115 ± 3.1	118 ± 2.8	75–150
Hardness (mg L{^{1})	198 ± 1.8	200 ± 2.1	202 ± 1.9	100–300

*Boyd and Tucker, 2012

Table 3. Growth performance of *L. rohita*

Parameter	T1	T2	T3
Final weight (g)	15.2 ± 0.4a	18.7 ± 0.5b	20.2 ± 0.6c
% Weight gain	186.8 ± 4.1a	252.8 ± 5.0b	279.7 ± 6.2c
SGR (% day{^{1})	1.10 ± 0.02a	1.35 ± 0.03b	1.48 ± 0.04c
FCR	2.10 ± 0.05c	1.75 ± 0.04b	1.46 ± 0.03a
PER	0.35 ± 0.02a	0.47 ± 0.01b	0.53 ± 0.01c

tein and lipid in T3-fed fish (Table 4).

Table 4. Carcass proximate composition (% dry matter)

Component	T1	T2	T3
Protein	66.8a	70.2b	73.5c
Lipid	9.2a	11.0b	12.3c
Ash	8.5a	9.1b	9.5b

Hematology

Hematological indices improved significantly in T3-fed fish, indicating better physiological status (Table 5).

Table 5. Hematological parameters

Parameter	T1	T2	T3
Hb (g dL{^{1})	6.8a	7.5b	8.3c
PCV (%)	30.2a	33.5b	36.8c
TEC (×10v/µL)	2.5a	2.8b	3.1c
TLC ($\times 10^3$/µL)	9.5a	10.2b	10.8c

Discussion

The present study clearly demonstrated that chicken offal meal enhanced growth performance of *L. rohita* fingerlings compared to fish meal and plant-based control diets. The superior performance of T3 can be attributed to several factors

Protein and amino acid profile- Chicken offal contains high-quality protein and essential amino acids, including lysine and methionine, often deficient in plant proteins (Jia *et al.*, 2022). Balanced amino acid intake likely improved muscle accretion and feed utilization, reflected in lower FCR and higher PER.Lipid contribution- Higher lipid deposition in T3-fed fish suggests that chicken offal provided additional energy, sparing protein for growth. Similar results were reported in tilapia fed poultry by-product meal diets (El-Sayed, 1998).Digestibility and palatability- Chicken offal meal may have been more palatable, resulting in better feed intake. Bureau *et al.* (1999) reported that animal protein ingredients improve digestibility compared to plant proteins.Water quality stability: Despite higher lipid content, water quality remained stable, showing that chicken offal did not deteriorate culture conditions. Hematological responses- Higher Hb, PCV, and TEC in T3-fed fish indicate enhanced oxygen-carrying capacity and improved health status. Hematological parameters are widely used as biomarkers of fish wellbeing (Hrubec and Smith, 2010).

These findings are consistent with studies in tilapia (Yones and Metwalli, 2015), catfish (Al-Souti*et al.*, 2019), and flounder (Kim *et al.*, 2021), where poultry by-product meals successfully replaced fish meal. Importantly, use of chicken offal meal supports sustainability, by reducing dependence on fish meal and recycling poultry waste into aquafeeds (Tacon and Metian, 2008; Naylor *et al.*, 2021).

Conclusion

Chicken offal meal significantly improved growth, feed conversion, protein and lipid deposition, and hematological indices in *L. rohita* compared to fish meal and control diets, without compromising water quality. It can therefore be recommended as a sustainable, cost-effective protein source in carp aquafeeds. Large-scale trials in ponds and farms are suggested to validate these findings under field conditions.

Acknowledgements

The authors acknowledge the Dean, College of Fisheries, ANDUAT, Kumarganj, Ayodhya, for providing facilities and support during this study.

Conflict of Interest- None

References

AOAC, 1995. *Official Methods of Analysis of AOAC International*, 16th edn. Association of Official Analytical Chemists, Arlington, VA, USA.

APHA, 2005. *Standard Methods for the Examination of Water and Wastewater*, 21st edn. American Public Health Association, Washington, DC, USA.

Al-Souti, A., Al-Shehhi, M.R., Al-Mazrooei, N.A., Al-Jufaili, S., Al-Belushi, K.I. and Ambu-Ali, A.A. 2019. Utilization of poultry by-product meal in diets of juvenile yellowfin seabream Acanthopagrus latus (Houttuyn, 1782*). Aquaculture Research*. 50(11): 3224–3235.

Boyd, C.E. and Tucker, C.S. 2012. *Pond Aquaculture Water Quality Management*. Springer Science & Business Media, New York, USA.

Bureau, D.P. and Cho, C.Y. 2006. Strategies for formulation of practical diets for rainbow trout: Meeting the challenges of costs and production. *Proceedings of the 7th International Symposium on Fish Nutrition and Feeding*, pp. 12-20.

Bureau, D.P., Harris, A.M. and Cho, C.Y. 1999. Apparent digestibility of rendered animal protein ingredients for rainbow trout (*Oncorhynchus mykiss*). *Aquaculture.* 180(3-4): 345-358. https://doi.org/10.1016/S0044-8486(99)00210-0

El-Sayed, A.F.M. 1998. Total replacement of fish meal with animal protein sources in Nile tilapia (*Oreochromis niloticus*) diets. *Aquaculture Research*. 29(4): 275-280.

FAO, 2024. The State of World Fisheries and Aquaculture 2024. Blue Transformation in Action. Food and Agriculture Organization of the United Nations, Rome.

Government of India (GOI), 2023. Handbook on Fisheries Statistics 2023. Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, New Delhi.

Hrubec, T.C. and Smith, S.A. 2010. Hematology of fish. In: Weiss, D.J. and Wardrop, K.J. (eds.), *Schalm's Veterinary Hematology*, 6th edn. Wiley-Blackwell, Ames, IA, USA, pp. 994-1003.

Jia, Y., Wu, Y., Zhao, W., Zhang, W. and Zhang, H. 2022. Effects of replacing fish meal with poultry by-product meal on growth, feed utilization, and intestinal health in fish. *Aquaculture Reports.* 26: 101269. https://doi.org/10.1016/j.aqrep.2022.101269

Kim, K.D., Lee, S.M., Kim, K.W. and Bai, S.C. 2021. Evaluation of poultry by-product meal as an alternative protein source in diets for olive flounder Paralichthys olivaceus. *Aquaculture Nutrition.* 27(5): 1421-1430.

Lovell, R.T. 1989. *Nutrition and Feeding of Fish*. Van Nostrand Reinhold, New York, USA.

Naylor, R.L., Hardy, R.W., Buschmann, A.H., Bush, S.R., Cao, L., Klinger, D.H., Little, D.C., Lubchenco, J., Shumway, S.E. and Troell, M. 2021. A 20-year retrospective review of global aquaculture. *Nature.* 591(7851): 551-563.

Tacon, A.G.J. and Metian, M. 2008. Global overview on the use of fish meal and fish oil in industrially compounded aquafeeds: Trends and future prospects. *Aquaculture.* 285(1-4): 146-158.

Yones, A.M.M. and Metwalli, A.A. 2015. Effects of fish meal substitution with poultry by-product meal on growth performance, nutrient utilization, and blood contents of juvenile Nile tilapia (*Oreochromis niloticus*). *Journal of Aquaculture Research and Development.* 7(1): 389. https://doi.org/10.4172/2155-9546.1000389

Zhu, B., Xu, W., Dai, Z., Shao, C., Hu, Y. and Chen, X. 2024. Effects of dietary garlic (*Allium sativum*) supplementation on growth performance, immune response, and intestinal microbiota of Nile tilapia (*Oreochromis niloticus*). *Reviews in Aquaculture.* 16(1): 55-70.