



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating (2025): 4.61

VET 2025; 10(12): 260-265

© 2025 VET

www.veterinarypaper.com

Received: 21-10-2025

Accepted: 22-11-2025

Somy Mary Mathew

Ph.D., Scholar, Department of Food Science and Technology, Faculty of Ocean Science and Technology, Kerala University of Fisheries and Ocean Studies, Panangad, Kochi, Kerala, India

Blossom KL

Assistant Professor, Department of Fish Processing Technology, Faculty of Fisheries Science, Kerala University of Fisheries and Ocean Studies, Panangad, Kochi, Kerala, India

Dildeep V

Professor, Department of Animal Nutrition, CVAS, Mannuthy, Thrissur, Kerala, India

Megha KG

Toxicologist, CARE KERALAM Ltd, KINFRA Small Industries Park, Koratty, Thrissur, Kerala, India

Corresponding Author:

Blossom KL

Assistant Professor, Department of Fish Processing Technology, Faculty of Fisheries Science, Kerala University of Fisheries and Ocean Studies, Panangad, Kochi, Kerala, India

Safety and quality assessment of an enteral formula incorporated with fish protein hydrolysate in Wistar albino rats

Somy Mary Mathew, Blossom KL, Dildeep V and Megha KG

DOI: <https://www.doi.org/10.22271/veterinary.2025.v10.i12d.2828>

Abstract

The study evaluated the safety and quality of an enteral formula containing fish protein hydrolysate (ENFPH) in Wistar albino rats. The rats were divided into five groups and fed either a standard basal diet (control), a basal diet with 5 per cent or 7.5 per cent crude protein replaced by ENFPH, or a basal diet with 5 per cent or 7.5 percent crude protein replaced by a commercial peanut protein hydrolysate formula (PPH). Metabolic trial was conducted towards the end of study, and nutritional utilization was calculated. Haematological and serum biochemical analyses were performed at the end of the feeding trial. Gross pathology and histopathological examinations of tissues from internal organs were also conducted. No mortality, behavioural changes, or treatment-related toxicity were observed throughout the study. Feed intake was significantly higher in the 7.5 per cent ENFPH group, likely due to increased palatability. Haematological and biochemical parameters remained within normal physiological limits. ENFPH was found to be safe, non-toxic, and nutritionally comparable to both standard diets and commercial peanut protein hydrolysate formulations. These findings suggest ENFPH can be a sustainable and effective protein source for enteral feeds and dietary supplements for human nutrition and has potential in use in human nutrition trials.

Keywords: Fish Protein Hydrolysate (FPH), protein digestibility, biological value, tilapia

1. Introduction

Protein is an essential macro nutrient necessary for the upkeep, restoration, and overall functioning of the human body. In clinical nutrition, when patients might face metabolic stress, compromised digestion, or catabolic states, the significance of dietary proteins' quality, digestibility, and safety becomes crucial (Wischmeyer, 2017) ^[17]. Enteral nutrition (EN) is the preferred method of nutritional assistance for patients with functioning gastrointestinal tracts who cannot take in sufficient oral diets. Creating innovative, effective, and easily digestible enteral formulas is essential for enhancing health results in critically ill, malnourished, and older individuals.

Fish protein hydrolysates (FPHs) are gaining more attention as an emerging protein source because of their excellent digestibility, superior amino acid composition, and bio-active peptides. Tilapia (*Oreochromis niloticus*), a widely cultivated freshwater species, serves as a plentiful, economical, and sustainable source of protein. It is especially important for food security and functional nutrition, as it produces protein with high biological value (FAO, 1971) ^[7]. By controlled enzymatic hydrolysis, tilapia proteins may be degraded into smaller peptides and free amino acids, creating hydrolysates that are readily absorbed, hypoallergenic, and functionally bio-active (Chalamaiah *et al.*, 2012; He *et al.*, 2013) ^[5, 8].

Integrating tilapia Fish Protein Hydrolysate (FPH) into enteral formulas presents potential benefits for at-risk patients needing quick nutritional replenishment and reduced gastrointestinal strain. These hydrolysates are especially advantageous because of their improved solubility and rapid absorption, rendering them appropriate for those with digestive issues or inflammatory bowel disorders.

Furthermore, peptides derived from tilapia have shown properties such as antioxidant, anti-inflammatory, anti-hypertensive, and immunomodulatory effects, providing therapeutic possibilities that extend beyond standard nutrition (Ngo *et al.*, 2014) ^[12].

Even with these features, pre-clinical validation is crucial before recommending FPH-based enteral formulas for human trials. Key factors for pre-clinical evaluation include protein digestibility, indicating how effectively proteins are absorbed and used, and toxicity potential, which assesses safety with regular intake. Although *in vitro* assays provide initial insights, *in vivo* animal research offers a deeper understanding of physiological impacts, metabolic absorption, and potential toxicity (Schaafsma, 2009) ^[14].

Wistar albino rats are widely used in nutritional and toxicological studies due to their metabolic and physiological similarities to humans, their well-defined growth patterns, and consistent outcomes (Szkudelski, 2001) ^[15]. Assessing protein quality usually includes measures of body weight gain, nitrogen balance, digestibility, feed conversion ratio, and plasma protein concentrations, while toxicity evaluations emphasize clinical manifestations, haematological parameters, biochemical indicators of liver and kidney function and histopathological changes (OECD 408, 2018) ^[13].

Currently, few studies have examined the safety and digestibility of enteral formulas supplemented with tilapia fish protein hydrolysate utilizing validated *in vivo* models. The emphasis on both nutritional safety and effectiveness is crucial for converting FPH-based enteral products into regulated therapeutic diets.

This research seeks to assess the digestibility of proteins and the potential toxicity of a novel enteral formula that includes tilapia fish protein hydrolysate, utilizing Wistar albino rats as the model for experimentation. Our aim is to provide essential evidence for creating clinically safe, effective, and sustainably sourced enteral nutrition products, while enhancing the value of underused aquaculture resources such as tilapia.

2. Materials and Methods

2.1 Procurement of the sample and enzymatic preparation of fish protein hydrolysate (FPH) from Tilapia fish fillet

Fresh tilapia fillet was bought from Ernakulam fish markets and brought to the lab in containers with ice packs to keep the temperature at 4 °C. Fresh fillets of tilapia were kept between -18 °C and -20 °C. Before being processed to preserve its quality, the tilapia meat was frozen at -18 °C and used right away within 24 hours. The fresh tilapia fillets were rinsed with tap water and thawed (stored in a refrigerator at 4 °C for about 24 hours) before use.

Fish protein hydrolysate was produced from tilapia using flavourzyme, following a slightly modified procedure (Elavarasan *et al.*, 2014) ^[6]. The frozen mince was defrosted

at a temperature of 4±2 °C and was utilized in the hydrolysate preparation. The fish mince was combined with water in a 1:4 ratio (fish mince to water), (Jamshidi *et al.*, 2018) ^[10] and blended for 3 minutes with a mechanical homogenizer to create a slurry.

The mixture was heated to 85 °C for 30 minutes to ensure complete inactivation of the endogenous enzymes present in the substrate. After that, the temperature was reduced, and the following conditions were established for hydrolysis: a temperature of 50 °C, a pH of 6.5±0.2, a hydrolysis duration of 90 minutes, and the addition of one percent enzyme to initiate the reaction. Once incubation was completed, the slurry was heated to 90 °C for 15 minutes and then centrifuged at 7,500 g for 15 minutes at 4 °C. The resulting supernatant was freeze-dried to produce the fish protein hydrolysate (FPH). The freeze-dried product was stored at -21 °C (Elavarasan *et al.*, 2014) ^[6].

2.2 Standardization, development and sensory evaluation of fish Protein hydrolysate-based enteral formula

In developing the fish protein hydrolysate-based enteral formula, the freeze-dried fish protein hydrolysate was integrated with specific elements like pure medium-chain triglycerides (MCT), milk powder, powdered sugar, ascorbic acid, soy lecithin, potato starch, malto-dextrin, xanthan gum, cocoa powder, and salt. The product was optimized by adjusting the ratios of fish protein hydrolysate with the aforementioned ingredients, and selections were made based on sensory evaluations.

The fish protein hydrolysate-based enteral formula underwent a sensory evaluation with 20 participants acting as judges (Viriyajaree, 1992) ^[16]. The acceptability of the ready-to-reconstitute fish-based enteral formula was tested at differing concentrations (%) of tilapia fish protein hydrolysate (5, 10, 15, 20, 25, and 30). Participants recorded their preferences regarding color, fishy odor, fishy flavor, sweetness, bitterness, and overall enjoyment. Sensory assessment was carried out using both a 9-point hedonic scale and a 9-point "just about right" scale. The hedonic scale ranged from 1 to 9, while the "just about right" scale spanned from too weak to too strong.

2.3 Protein digestibility and Toxicity assessment

2.3.1 Animals trials and diet

All experimental procedures were approved by the Institutional Animal Ethics Committee, CARE Keralam Ltd (1620/PO/c/12/CPCSEA) and conducted as per CPCSEA guidelines. Twenty-seven Male Wistar Albino rats (150-200 g) were housed at Care Keralam, under standard laboratory conditions (22±3 °C, 60-70% humidity, 12-h light/dark cycle), provided with a standard pellet diet and water ad libitum, and acclimatized for seven days. The treatment group were as follows.

Table 1: Treatment of animals in different groups

Groups	No of animals	Treatment
Group I	3	Basal Diet (24 per cent crude protein)
Group II	6	Basal Diet with 5.0 per cent of crude protein replaced by enteral formula incorporating fish protein hydrolysate
Group III	6	Basal Diet with 7.5 per cent of crude protein replaced by enteral formula incorporating fish protein hydrolysate
Group IV	6	Basal Diet with 5.0 per cent of crude protein replaced by commercial enteral preparation containing Peanut protein hydrolysate
Group V	6	Basal Diet with 7.5 per cent of crude protein replaced by commercial enteral preparation containing Peanut protein hydrolysate

The diets were formulated as per ICAR (2013) standards. Feed and water intake were monitored daily. Body weight was recorded before treatment, weekly thereafter, and at the time of terminal sacrifice, while food and water intake were monitored regularly. Duration of study was for 28 days.

2.3.2 Digestibility parameters

A three-day metabolic trial was conducted at the end of the feeding trial, during which urine and feces were collected by

the total collection method. Proximate composition of treatment diet and feces were analysed (AOAC, 2016) ^[2] and nitrogen content of urine was also assessed. Digestibility parameters were calculated. The dry matter (DM) and protein digestibility (PD), biological value (BV), net protein utilization (NPU) and protein efficiency ratio (PER) were calculated using the formula.

DM digestibility = $\frac{\text{DM intake} - \text{DM output}}{\text{DM intake}} \times 100$
Protein Digestibility = $\frac{\text{CP intake} - \text{CP output}}{\text{CP intake}} \times 100$
Biological Value $\text{Biological Value} = \frac{\text{N intake} - [\text{Fecal N} - \text{MFN}] - [\text{Urinary N EUN}]}{\text{N intake} - [\text{Fecal N} - \text{MFN}]} \times 100$ MFN – Metabolic Fecal Nitrogen EUN – Endogenous Urinary Nitrogen MFN = 2mg/g DMI (Mitchell, 1924) EUN (mg/day) = 146 W^{0.72}kg (Brody <i>et al.</i>, 1934)
Protein efficiency ratio: $\frac{\text{Gain in body mass (g)}}{\text{Protein intake (g)}}$
NPU = $\frac{\text{Biological Value} \times \text{Digestibility}}{100}$

2.3.3 Hematological, biochemical parameters and toxicological assessment

At the end of the study, blood was collected for hematological (hemoglobin) and serum biochemical analyses (glucose, creatinine, albumin, globulin, AST, ALT). Animals were then euthanized by carbon dioxide inhalation, procedure followed by autopsy and gross pathological examination. Internal organs were collected and weighed. Organs, including the gastrointestinal tract, liver, and lungs, were excised, weighed, and preserved in 10 per cent neutral buffered formalin for histopathological processing and H&E staining (Bancroft & Gamble, 2013) ^[3]. Both gross and microscopic examinations were performed on control and treatment groups to evaluate systemic and organ-specific toxicities, alongside the digestibility outcomes.

3. Statistical Analysis

The data on body weight, feed and, water intake, nutrient digestibility, protein quality parameters, haematological and serum biochemistry values were subjected to computer statistical analysis using Graph Pad Prism software, Version 5.00, USA (2007). A one-way ANOVA with Dunnett's post-test was used to compare the data.

4. Results

4.1 Sensory evaluation of fish Protein hydrolysate-based protein supplement powder

Twenty panellists judged the organoleptic evaluation of fish protein hydrolysate-based enteral formula at various concentrations of tilapia fish protein hydrolysate (5 per cent, 10 per cent, 15 per cent, 20 per cent, 25 per cent, and 30 per cent) and the results are presented in Table 2, where five per cent concentration was selected for the development of fish Protein hydrolysate-based protein supplement powder.

Table 2: Sensory scores obtained for fish protein hydrolysate-based enteral formula with different ratios of tilapia protein hydrolysate

Concentration	Appearance	Taste	Consistency	Flavour	Overall acceptability
0	7.5	7.5	7.5	7.5	7.5
5	8.5	8	8.5	8.5	8.4
10	7.5	7.5	7.5	7	7.4
15	7.5	7	7	7	7
20	7.5	7	7	7	7
25	7.5	6.5	6	5.5	6.3
30	6.5	5	5	5	5.3

4.2 Toxicity and Digestibility Assessment

4.2.1 Clinical signs and pre-terminal death

There were no clinical signs of toxicity or mortalities in the experimental animals. There was no adverse effect on the behavioural responses of the tested rats. Physical observations indicated no signs of changes in the skin, fur, eyes, mucous membrane, and behavior patterns of the rats.

4.2.2 Feed, water intake and body weight gain

Weekly average water intake, feed intake and body weight are presented in the Tables 3, 4, and 5, respectively. Feed and water intake was unaffected ($p > 0.05$) by the treatments. The body weight was significantly ($p < 0.01$) higher in all experimental groups (I, II, III, IV, V) when compared to control. The body weight is comparable in groups fed with

enteral preparation containing fish protein hydrolysate and commercial enteral preparation containing peanut protein hydrolysate. The finding clearly shows positive effect of fish

protein hydrolysate based enteral formula on body weight gain in experimental rats.

Table 3: Weekly average water intake of experimental rats (g)

Week	Groups					P-Value
	Group I	Group II	Group III	Group IV	Group V	
1	21.76±0.61	20.57±0.34	18.85±0.48	19.66±0.75	18.07±0.49	0.237 ^{ns}
2	21.52±1.03	21.88±0.51	19.59±0.56	19.69±0.63	18.23±0.21	0.223 ^{ns}
3	26.52±0.41	26.61±0.51	24.00±1.13	22.61±0.52	23.61±0.50	0.098 ^{ns}
4	23.38±1.04	19.85±0.75	20.38±0.31	19.64±0.54	21.69±0.48	0.249 ^{ns}

NS-Non-Significant ($p>0.05$)

Table 4: Weekly average feed intake of experimental rats (g)

Week	Groups					P-Value
	Group I	Group II	Group III	Group IV	Group V	
1	20.71±0.72	19.63±0.17	19.94±0.36	19.52±0.32	20.04±0.28	0.330 ^{ns}
2	21.24±0.23	20.44±0.37	20.32±0.31	20.57±0.29	20.04±0.44	0.435 ^{ns}
3	20.93±0.23	21.04±0.33	21.10±0.16	20.33±0.26	21.25±0.52	0.746 ^{ns}
4	21.29±0.35	19.47±0.09	20.50±0.18	19.94±0.40	20.59±0.28	0.407 ^{ns}

NS-Non-Significant ($p>0.05$)

Table 5: Weekly average body weight of experimental rats (g)

Week	Body weight					P-Value
	Group I	Group II	Group III	Group IV	Group V	
0	161.66±4.41 ^a	166.66±6.03 ^a	170.83±4.18 ^a	169.16±6.27 ^a	169.16±5.99 ^a	0.894
1	194.66±4.67 ^a	198.83±4.12 ^a	200.83±1.54 ^a	212±5.51 ^a	195.66±3.46 ^a	0.045*
2	215.66±4.63 ^a	230.5±5.35 ^a	244.83±2.35 ^b	245.83±5.33 ^b	221.83±3.07 ^a	0.000*
3	235.33±6.07 ^a	254.83±6.64 ^b	285.83±3.84 ^b	269.5±1.90 ^b	253.83±4.10 ^a	0.000*
4	265.33±5.78 ^a	289.66±5.29 ^b	309.5±4.09 ^b	293.66±2.01 ^b	287.5±3.67 ^b	0.000*

NS-Non-Significant ($p>0.05$)

*-Means bearing different superscripts within a row differ significantly ($p<0.05$)

4.2.3 Haematological and biochemical parameters

The haematological and biochemical parameters are depicted in Table 6. Blood hemoglobin, serum glucose, AST, ALT, creatinine and protein values were comparable ($p>0.05$) among the groups. The albumin values in group V were

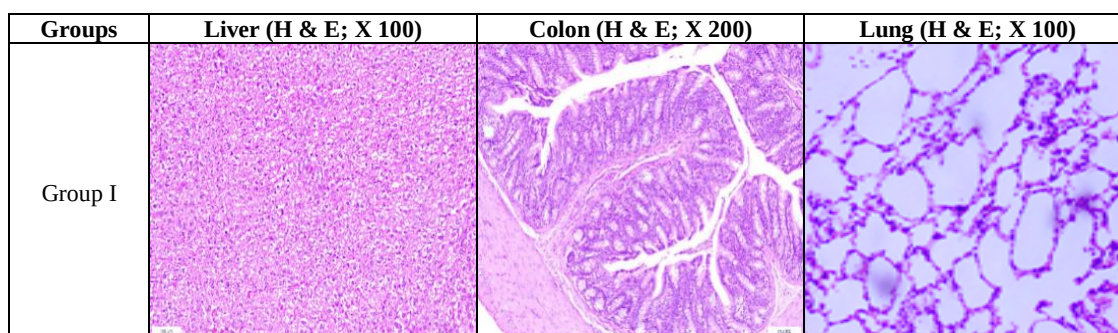
significantly ($p>0.05$) lower than the other groups. All parameters stayed within the normal physiological range, indicating the safety and tolerability of FPH based enteral formulation. The finding was in accordance with Aamir *et al*, 2019^[1].

Table 6: Hematological and biochemical parameters

Parameters	Groups					P-Value
	I	II	III	IV	V	
Hemoglobin (mg/dl)	14.3±0.97	14.36±0.66	14.63±0.62	14.73±0.35	14.86±0.38	0.955 ^{ns}
Glucose (mg/dl)	110.22±2.17	159.73±21.86	129.78±16.69	131.46±8.51	144.08±24.59	0.55 ^{ns}
AST (U/L)	88.24±2.11	104.83±2.63	101.41±6.99	105.6±7.62	107.65±10.61	0.610 ^{ns}
ALT (U/L)	69.2±18.40	88.45±6.26	80.7±2.82	94.4±4.70	83.83±10.41	0.370 ^{ns}
Creatinine (mg/dl)	0.61±0.08	0.52±0.02	0.52±0.04	0.69±0.05	0.59±0.12	0.460 ^{ns}
Albumin (g/dl)	3.6 ^b ±0.05	3.63 ^b ±0.02	3.4 ^b ±0.07	3.45 ^b ±0.02	3.3a±0.07*	0.010*
Protein	6.54±0.12	6.73±0.15	6.85±0.07	6.96±0.18	6.64±0.10	0.320 ^{ns}

NS-Non-Significant ($p>0.05$)

*-Means bearing different superscripts within a row differ significantly ($p<0.05$)



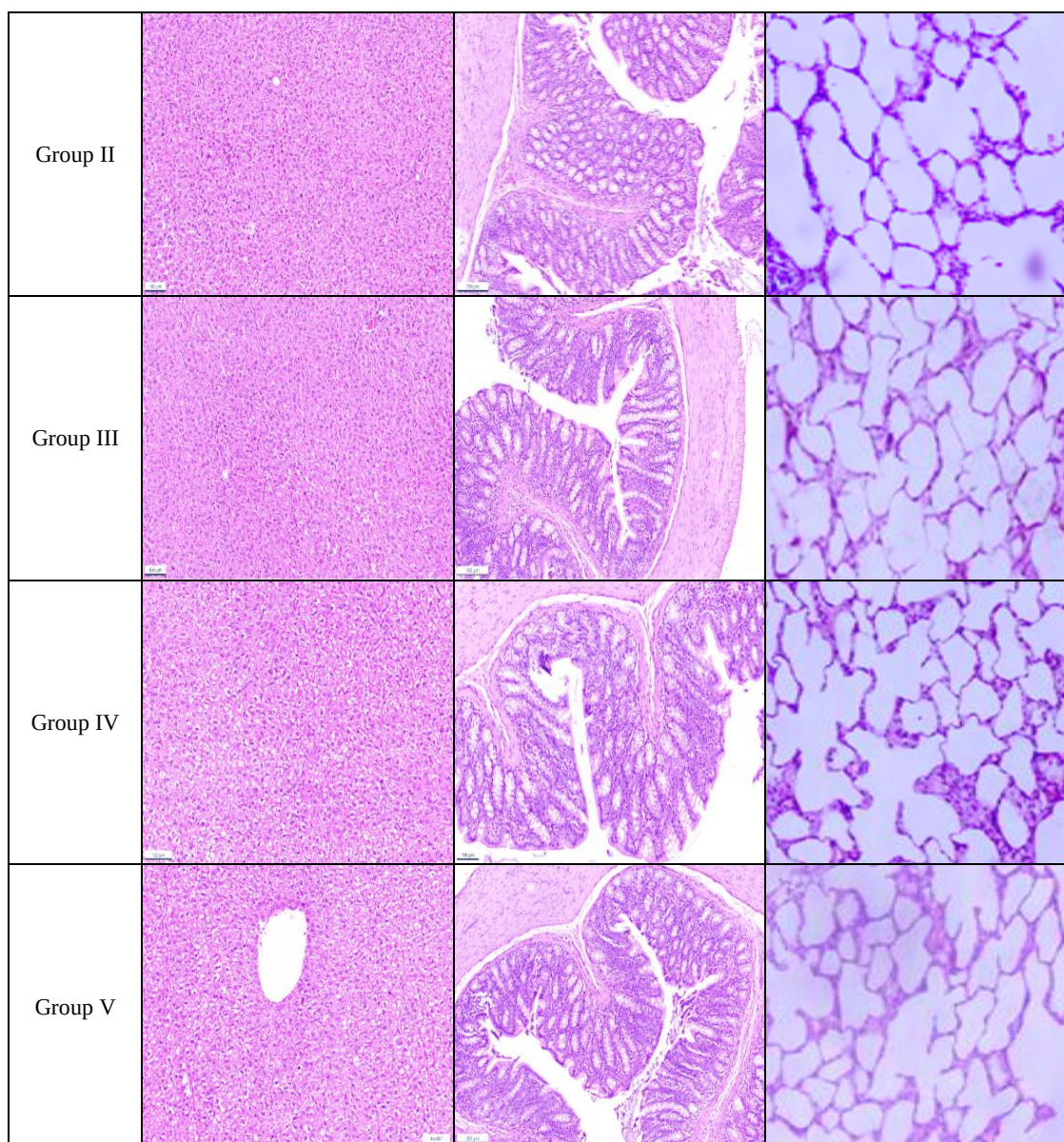


Fig 1: (H&E): Photomicrographs of tissues from internal organs (Liver, colon, lung)

4.2.4 Histopathological Evaluation

When compared to control group animals, ENFPH-treated animals (Group II and Group III) and commercially available protein-treated groups (Group IV and Group V) animals did not result in any unfavorable effects or pathologically

significant alterations in tissue structures, according to gross and histopathological evaluation of vital organs presented in the Figure 1.

4.2.5 Digestibility coefficient

Table 7: Dry matter and crude protein digestibility of different groups

Parameters	Groups					P-Value
	Group I	Group II	Group III	Group IV	Group V	
Dry matter	75.98±1.57	76.66±1.36	75.80±0.77	75.92±1.54	75.57±1.36	0.980 ^{ns}
Crude Protein	82.23±0.99	81.97±1.05	81.48±0.59	82.09±1.14	80.63±1.08	0.855 ^{ns}

NS-Non-Significant ($p>0.05$)

The dry matter and crude protein digestibility were similar ($p<0.05$) for all groups.

4.2.6 Biological value (BV), net protein utilization (NPU) & protein efficiency ratio (PER) values during metabolic trial period:

The Biological value (BV), net protein

utilization (NPU), and protein efficiency ratio (PER) were calculated, and the values showed no significant difference when compared to the control group.

Table 8: Biological value (BV), net protein utilization (NPU) & protein efficiency ratio (PER) values of different groups

Parameters	Groups					P-Value
	Group I	Group II	Group III	Group IV	Group V	
BV	88.13±2.07	83.27±1.45	86.30±0.87	86.30±1.59	84.91±1.56	0.346 ^{ns}
NPU	66.61±2.68	62.03±2.07	62.92±1.17	64.59±2.57	61.60±2.14	0.595 ^{ns}
Per Value	0.94±0.07	0.97±0.08	0.87±0.03	0.78±0.05	0.78±0.05	0.109 ^{ns}

NS-Non-Significant ($p>0.05$)

There were no significant differences ($p>0.05$) between the groups in the BV, NPU & PER values indicating that the fish protein hydrolysate based enteral preparation was comparable to basal diet and peanut protein based commercial preparation. Consistent with earlier research on protein hydrolysate-enriched diets, the results show that all diets promoted effective protein digestion and utilization, validating their utility as balanced feed options for growth performance in experimental animals.

5. Conclusion

The present study evaluated the *in vivo* protein digestibility and potential toxicity of ENFPH, an enteral formula incorporating fish protein hydrolysate, in Wistar albino rats. Dietary supplementation with ENFPH at both 5 per cent and 7.5 per cent crude protein replacement levels showed no mortality, behavioral abnormalities, or treatment-related adverse effects during the 28-day feeding period. Feed and water intake, body weight gain, organ weights, hematological and biochemical parameters, and gross pathology remained within normal physiological ranges. Although Group III animals exhibited higher feed intake, this was attributed to increased palatability rather than toxicological effects. Histopathological examinations of gastrointestinal tissues, liver, and lungs confirmed the absence of pathological changes.

Nutritional indices, including dry matter digestibility, protein digestibility, Biological Value (BV), Net Protein Utilization (NPU), and Protein Efficiency Ratio (PER), were comparable between ENFPH-supplemented groups and controls. Furthermore, ENFPH showed equivalent nutritional performance when compared with a commercial peanut protein hydrolysate-based enteral formula.

In general, the findings demonstrate that ENFPH is non-toxic and nutritionally comparable to conventional protein sources. Thus, ENFPH may be considered a safe and effective alternative protein ingredient for incorporation into enteral feeds and dietary supplements intended for human nutrition.

6. Acknowledgement

We gratefully acknowledge the support and facilities provided by Kerala University of Fisheries and Ocean Studies (KUFOS), Panangad, Kochi, Kerala, and CARE Keralam Ltd, Koratty.

Conflict of Interest

Not available

Financial Support

Not available

Reference

1. Aamir K, Khan HU, Hossain CF, Afrin MR, Shaik I, Salleh N, Arya A. Oral toxicity of arjunolic acid on haematological, biochemical, and histopathological investigations in female Sprague Dawley rats. *PeerJ*. 2019;7:e8045.
2. AOAC International. *Official methods of analysis of AOAC International*. 20th Ed. Rockville (MD): AOAC International; 2016.
3. Bancroft JD, Gamble M. *Theory and practice of histological techniques*. 7th Ed. Philadelphia (PA): Churchill Livingstone/Elsevier; 2013.
4. Brody S, Procter RC, Ashworth US. Growth and development with special reference to domestic animals. XXXIV. Basal metabolism, endogenous nitrogen, creatinine, and neutral sulphur excretions as a function of body weight. Columbia (MO): University of Missouri, College of Agriculture, Agricultural Experiment Station; 1934.
5. Chalamaiah M, Hemalatha R, Jyothirmayi T. Fish protein hydrolysates: proximate composition, amino acid composition, antioxidant activities and applications: a review. *Food Chem*. 2012;135(4):3020-3038.
6. Elavarasan K, Kumar VN, Shamasundar BA. Antioxidant and functional properties of fish protein hydrolysates from freshwater carp (*Catla catla*) as influenced by the nature of the enzyme. *J Food Process Preserv*. 2014;38(3):1207-1214.
7. Food and Agriculture Organization of the United Nations, World Health Organization. *Methods of estimating protein quality. In: Energy and protein requirements: report of a joint FAO/WHO expert consultation*. Rome: FAO/WHO; 1971.
8. He S, Franco C, Zhang W. Functions, applications and production of protein hydrolysates from fish processing co-products (FPCP). *Food Res Int*. 2013;50(1):289-297.
9. Indian Council of Agricultural Research. *Handbook of animal husbandry*. 4th Ed. New Delhi: Directorate of Knowledge Management in Agriculture; 2013.
10. Jamshidi A, Shabanpour B, Pourashouri P, Raeisi M. Evaluation of different proportions of distilled water to substrate on functional properties, antioxidant, and nutritional quality of Bigeye Ilisha (*Ilisha megaloptera*) protein hydrolysate. *J Gorgan Univ Med Sci*. 2018;6(3):24-39.
11. Mitchell HH. A method of determining the biological value of protein. *J Biol Chem*. 1924;58(3):873-903.
12. Ngo DH, Ryu B, Kim SK. Active peptides from skate (*Okamejei kenojei*) skin gelatin diminish angiotensin-I converting enzyme activity and intracellular free radical-mediated oxidation. *Food Chem*. 2014;143:246-255.
13. Organisation for Economic Co-operation and Development (OECD). *Test No. 408: repeated dose 90-day oral toxicity study in rodents*. OECD Guidelines for the Testing of Chemicals, Section 4. Paris: OECD Publishing; 2018, DOI: 10.1787/9789264070707-en.
14. Schaafsma G. Safety of protein hydrolysates, fractions thereof, and bioactive peptides in human nutrition. *Eur J Clin Nutr*. 2009;63(10):1161-1168.
15. Szkudelski T. The mechanism of alloxan and streptozotocin action in B cells of the rat pancreas. *Physiol Res*. 2001;50(6):537-546.
16. Viriyajaree P. *Sensory planning and analysis*. 1st Ed. Chiang Mai: Chiang Mai University; 1992.
17. Wischmeyer PE. Tailoring nutrition therapy to illness and recovery. *Crit Care*. 2017;21(Suppl 3):316.

How to Cite This Article

Mathew SM, Blossom KL, Dildeep V, Megha KG. Safety and quality assessment of an enteral formula incorporated with fish protein hydrolysate in Wistar albino rats. *International Journal of Veterinary Sciences and Animal Husbandry*. 2025;10(12):260-265.

Creative Commons (CC) License

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.