

## ***Biogenic amine content in fish feed prepared from Tilapia fish waste***

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**F**ish waste, which is a by-product of fish markets/fish processing industries, generally represents 30-70% of the original weight of fish, depending on the processing method employed (Ahuja et al., 2020). The large quantity of fish waste thus produced can become a source of environmental pollution. Converting this waste into useful products is one of the means of increasing the profitability of the seafood industry in addition to reducing environmental impact. Several fish waste-derived biomolecules with excellent chemical, structural and functional properties have found applications in food and pharmaceutical industries. Among various applications, converting fish waste into feed is an emerging area of research with considerable commercial interest, which will also help to attain the Sustainable Development Goals (SDGs) by 2030 (Thirukumaran et al., 2022), primarily Goal 2 (Zero Hunger), Goal 12 (Responsible Consumption and Production), Goal 14 (Life Below Water) and Goal 8 (Decent Work and Economic Growth). As in the case of fish meal, quality of fish waste is very important as a raw material for feed making. The freshness of

the raw materials significantly impacts the growth performance when utilized as a feed ingredient in fish diets. The content of biogenic amines serves as an indicator of the freshness of raw materials.

Biogenic amines (BAs) are low molecular weight organic bases that are generated through the microbial decarboxylation of specific amino acids or the transamination of aldehydes and ketones by amino acid transaminases. Improper storage conditions or temperature abuse of fish waste can lead to the formation of BAs due to microbial enzymatic action. The most commonly encountered BAs in fish are histamine, tyramine, putrescine, and cadaverine. Low levels of BAs in fish meal were reported to contribute to improved protein digestibility (Jasour et al., 2018). Conversely, higher levels of BAs in fish diets can lead to reduced fish growth and diminished feed intake (Mundheim et al., 2004).

In the present study, floating fish feed was prepared from Tilapia (*Oreochromis mossambicus*) fish waste along with other ingredients listed in Table 1.

Table 1. Ingredients used for fish feed preparation

Sl. No.	Ingredients	Quantity
1.	Rice bran	1000 g
2.	Corn starch	1500 g
3.	Soya flour	500 g
4.	Wheat flour	900 g
5.	Sunflower oil	50 ml
6.	Tilapia Fish waste	1300 g

The Bureau of Indian Standards (BIS) has published five standards specifically for aqua feed; 1) IS 16150 (Part 1): 2023 fish feed - specification, part 1 carp feed, 2) IS 16150 (Part 2): 2014 fish feed - specification, part 2 catfish feed, 3) IS 16150 (Part 3): 2014 fish feed - specification, part 3 marine shrimp feed, 4) IS 16150 (Part 4): 2014 fish feed - specification, part 4 freshwater prawn (*Macrobrachium rosenbergii*) feed and 5) IS 16150 (Part 5): 2023 fish feed — specification, part 5 pangasius feed. All these standards provide the requirements for aquafeed.

The biogenic amine content of the fish feed was analyzed by high-performance liquid chromatography (HPLC) as per ISO 19343: 2017 (E). The results are given in Table 2. Cadaverine (417 ppm) was the most prevalent BA in the fish feed, followed by Tyramine (222 ppm). Histamine was present at a concentration of 30 ppm. According to a previous study, when choosing fish meal for shrimp diets, especially for very young juveniles and carnivorous species, it is crucial to consider the freshness of the raw materials (Ricque-Marie et al., 1998). As

suggested by the authors, the freshness can be determined by assessing the TVN (Total Volatile Nitrogen) levels in the raw material, which should be below 30 mg N/100 g. Another important quality parameter is the sum of amine contents in the final product, which should be less than 2000 mg/kg (Ricque-Marie et al., 1998). In the present study, the sum total of BAs in the fish feed was 788 ppm, which is way less than 2000 ppm indicating the good quality of the raw material. Although the BIS standards for aqua feed do not specifically address the presence of BAs, including histamine, they still assume importance as indicators of the quality of raw materials used in the preparation of fish feed. Also, elevated levels of these amines can adversely impact fish by affecting their feed intake and growth rate.

Table 2. Biogenic amine content of feed prepared from Tilapia fish waste

Sl. No.	Biogenic amine	Value (ppm)
1	Putrescine	85
2	Cadaverine	417
3	Spermidine	22
4	Spermine	12
5	Histamine	30
6	Tyramine	222

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