

## **7. Histamine content in fish meal and control measures**

Laly, S. J., Jeyakumari, A., Abhay Kumar and L. Narasimha Murthy

Mumbai Research Centre of ICAR- Central Institute of Fisheries Technology, CIDCO

Admin Building, Sector I, Vashi, Navi Mumbai, Maharashtra - 400 703

### **Introduction**

Fishmeal, a prime protein source of the feed industry due to balanced level of essential amino acids, excellent palatability properties, and high protein digestibility nature. The major ingredients of feed of Indian origin include groundnut oil cake, cotton seed cake, soyabean meal and fish meal. The quality of fishmeal can vary depending on the fish species used, fishing method applied, type of raw materials included (whole fish, processing by-products or by-catch), freshness of raw material, and fishmeal processing method etc. Fishmeal prepared from stale raw materials with a high content of biogenic amines has previously been shown to reduce the specific growth rate (SGR) of cultured fishes, feed consumption and final biomass compared to fishmeal produced from fresh raw materials. Also the occurrence of bacterial and fungal toxins can limit the shelf life and quality of feed. High quality fishmeal is considered to be low in biogenic amines and lead to a high protein digestibility. Histamine is a biogenic amine (BA) present in a large number of foods. The formation of histamine in fish products is directly correlated with the concentration of histidine in tissues and the level of microorganisms present in the product.

Histamine poisoning (scombroid fish poisoning) is related to the

ingestion of some histidine rich fish species such as tuna, mackerel, sardine, herring and anchovy. These species are characterised by having relatively high levels of histidine in their flesh. During spoilage, certain bacteria produce decarboxylase enzymes, which act on free histidine and other amino acids in the fish muscle to form histamine and other biogenic amines. Histidine levels vary from 1 g/kg in herring to as much as 15 g/kg in tuna. Fresh fish contains negligible quantities of histamine, usually <0.1 mg/100 g.

### **Toxicological responses in animals due to Histamine content in feed**

Histamine is used as a quality criterion for fish meals manufactured principally from warm water species such as anchovy, mackerel and sardine. The presence of histamine in foods and feed stuffs at high levels is considered to be toxic and ingestion causes effects such as mortality, decreased weight gain and feed consumption in chickens. The toxicity effect of histamine to chickens is called gizzard erosion (GE) or black vomiting due to the presence of black vomit in gizzards of affected chickens. There are many reports on the role of fish meal and histamine on gizzard erosion in broilers. The other amines such as putrescine and cadaverine which are elevated along with histamine in abused fish meal, were also known to induce clinical changes in gastric morphology of chickens and may potentiate the effects of histamine in vivo by inhibiting intestinal histamine-catabolizing enzymes. A substance named as gizzerosine that was formed by the reaction of histamine or histidine and

lysine during overheating of brown fish meal which can also lead to gizzard erosion in broilers. High level of biogenic amines in fishmeal is linked to impaired growth performance and may give rise to metabolic alterations. The level of total BAs in fishmeal has higher impact on growth performance than protein quality parameters. Histamine levels of 1-2 g/kg are considered sufficient for development of toxic effects in chickens and fish as per the reports available. The most effective histamine dose which induced severe gizzard lesions and elevation of serum enzyme activities was established at 10 mg/kg body mass.

### **Toxicological responses in humans**

Histamine toxicity or 'scombroid poisoning' in humans is well documented. Fishmeal can be a source of histamine poisoning in humans if high-quality raw materials and hygienic conditions are not applied during processing. Histamine poisoning among people handling fishmeal containing high levels of histamine is reported. A case of epidemic histamine poisoning due to inhalation and skin contact with a fish meal highly contaminated with histamine among harbour workers is also reported.

### **Histamine content during storage of fish meal**

Histamine level in stored feedstuff is a product of complex enzymatic activity involving microbial histidine decarboxylase, microbial and endogenous proteolytic enzymes and microbial diamine oxidases. Enzyme activity depends on amino acid content and microbial contamination in the feedstuff, and storage conditions, such as temperature, pH and oxygen

availability.

### **Control measures**

The high histamine content in fish meal can be due to the use of spoiled raw material and/or poor hygienic practice during the production and packing of fish meal, in combination with storage and transportation conditions facilitating histamine formation (dark anaerobic condition, high temperature, enough time). The recommended quantity of biogenic amines for a high quality fishmeal, should be less than 1000 ppm for histamine, and the total sum of all four of the main biogenic amines (cadaverine, putrescine, tyramine and histamine) should be less than 2000 ppm (Pike and Hardy, 1997). According to European Union regulations, histamine is not declared as undesirable or harmful substance in animal food (EU Directive 32/2002) and no maximal permissible level is set. But the histamine level in fish meal and feedstuffs is designated as an indicator for freshness of the raw material, and as quality criterion. Inclusion of fish meal and other feedstuff with high content of histamine should be considered as potential long-term health hazard for poultry and other animals if it is used as a feed ingredient. Histamine content in raw material and final product should be considered as a long-term quality and safety indicator in feed-processing industry.