Histamine poisoning is one of the most common forms of intoxication caused by the ingestion of fish and fishery products. Cooking, canning, or freezing cannot reduce the levels of histamine because this compound is heat stable. All humans are susceptible to histamine and its effects can be described as intolerance or intoxication depending on the severity of the symptoms. The amount of histamine in food, the individual sensitivity, and the detoxification activity in human organism represent the main factors affecting the toxicological response in consumers. Histamine is the only biogenic amine with regulatory limits set by European Legislation, up to a maximum of 200 mg/kg in fresh fish and 400 mg/kg in fishery products treated by enzyme maturation in brine.

**Keywords:** histamine, fishery products, food poisoning, regulation
REGULATORY LIMITS

According to Commission Regulation EC No 2073/2005 (Regulation 2073/2005/EC) the limits for histamine have been established in fish species associated with a high amount of histidine, i.e., the families of Scombridae, Scombresosidae, Clupeidae, Engraulidae, Coryphaenidae, Pomatomidae, both fresh and treated by enzyme maturation in brine. The sampling plan consists of a number of units comprising the sample (n) equal to nine and a number of sample units (c) equal to two, giving values between m and M. In particular the examined batch will be satisfactory when: (i) the mean value is less or equal to m; (ii) a maximum of c/n values are between m and M; (iii) no values exceed M. The sampling scheme of Food and Drug Administration offers more confidence that non-conforming lots will be detected, as reported in Table 1. Moreover EU assessed the limits of histamine for fishery products which have undergone enzyme maturation with brine manufactured from fish species associated with a high amount of histidine equal to 200 mg/kg and 400 mg/kg, for m and M, respectively.

For the detection of histamine also single samples may be taken at retail level. In such cases the whole batch should not be deemed unsafe based only on the result of one sample, unless the result is above M, as reported in Commission Regulation EU No 1019/2013 (Regulation 1019/2013/EU). The last Regulation amended Annex I to Regulation EC No 2073/2005 adding a maximum value for fish sauce produced by fermentation of fishery products, equal to 400 mg/kg. Since fish sauce is a liquid fishery product, histamine can be expected to be evenly distributed then a single sample can be examined.

The reports on histamine intoxication generally involve only a small number of individuals, so it is difficult to estimate the dose/exposure level in order to construct quantitative assessment of dose versus adverse response. A model used in the dose/response assessment can be based on volunteer challenge study, as reported by the EFSA biogenic amines report [European Food Safety Authority (EFSA), 2011]. In particular these studies aim to investigate the minimal dose of histamine that causes poisoning or intolerance symptoms, carefully monitored by medical professionals. Results from the limited number of studies suggested a potential no observed adverse effect level (NOAEL) of 50 mg histamine for the symptoms headache and flushing, but this was based on limited number of individuals: 66 healthy and 74 sensitive. Some healthy individuals did not show symptoms at concentrations up to six times higher than the NOAEL [European Food Safety Authority (EFSA), 2011]. Based on the above mentioned NOAEL and the consumption of a portion/size of 250 g of fish, the maximum concentration of histamine that would not cause an adverse effect would be equal to 200 mg/kg [Food and Agriculture Organization/World Health Organization (FAO/WHO), 2012].

PREVENTIVE AND HYGIENIC MEASURES

The risk of histamine poisoning could be controlled by applying basic Good Manufacturing and Hygiene Practices associated to an appropriate Hazard Analysis Critical Control Point (HACCP) system. According to European Legislation fish must be maintained at a temperature approaching that of melting ice as soon possible after harvest, in order to comply with freshness criteria and to avoid the growth of spoilage and histamine producing bacteria. All operations (heading, gutting, filleting, or cutting, etc.) should be carried out hygienically on board vessels. Moreover fresh fishery products must be kept at the above mentioned temperature during storage and transport in such a way as not adversely to affect food safety.

CONCLUSION

Fishery products can be involved in foodborne outbreaks by histamine when the application of Good Hygiene Practices and proper temperatures of storage failed to comply during the food chain. The regulatory systems have developed control strategies and monitoring procedures, such as sampling plan for fish species with a high amount of histidine, in order to assure seafood safety.

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