

Microbial Guidelines and Standards in Fishmeal Production

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Fishmeal refers to processed animal protein obtained from aquatic animals, excluding sea mammals. Fish meal is a high-protein powder made by cooking, drying, and grinding fish or fish processing waste. It is widely used as an ingredient in animal feeds, especially in aquaculture, poultry, and livestock diets, because it provides essential nutrients like protein, amino acids, and omega-3 fatty acids that promote healthy growth. Fish meal can be produced from whole fish or from by-products such as fish heads, bones, and offcuts, making it an important way to add value and reduce waste in the fishing and processing industries. Fish and shrimp meal and feed, classified as non-edible dried products, ranked as the third-largest category in the export portfolio. It generated ₹3,684.79 crore (equivalent to US\$449.17 million), representing 15.89% of the total export volume and 6.08% of the total dollar earnings in 2023-24 (MPEDA, 2024).

Indian and European Union standards are available for analysing the microbiological quality of fish meal. The first Indian standard for fish meal was published in 1967 and subsequently revised in 1983, resulting in IS: 4307-1983, which was reaffirmed in 2024. The Indian standard (IS: 4307) specifies only two microbiological criteria: the absence of visible fungal growth and the requirement that the material be free from *Salmonella*. Additionally, the material must be inspected to ensure it is free from visible adulterants, arthropod infestations, and other harmful substances. EU Regulation (EC) No. 142/2011 describes clearly about the microbiological standard for fish meal. There are four micro-organisms, viz., *Salmonella*, *Enterobacteriaceae*, *E. coli* and *Enterococcaceae* need to be checked.

Salmonella

Salmonella is a pathogenic microorganism capable of causing severe foodborne illnesses in both humans and animals. Even minimal contamination can result in infection, as no safe level of *Salmonella* presence is permitted in food or feed. Consequently, *Salmonella* is regarded as a "zero-tolerance" hazard under numerous food safety regulations. ISO 6579-1:2017 is the latest method for the detection of *Salmonella*. A 25 g sample has to be taken for the testing of *Salmonella*.

A two-class sampling plan must be applied for the detection of *Salmonella*, i.e., Absence in 25 g:

Totally 5 number of samples to be tested, i.e., $n = 5$, $c = 0$, $m = 0$, $M = 0$

n = Number of samples to be tested

c = Maximum number of samples allowed to have unacceptable results (usually presence of a pathogen)

Enterobacteriaceae

Testing for *Enterobacteriaceae* serves as a valuable indicator for evaluating improvements in manufacturing hygiene. However, the mere presence of *Enterobacteriaceae* does not conclusively confirm the presence of pathogens but indicates a heightened risk. Areas within plants that exhibit high counts of *Enterobacteriaceae* are often sites where *Salmonella* can proliferate. These bacteria are effective markers of processing quality, hygienic conditions, and potential post-processing contamination in heat-treated food products.

ISO 21528-1:2017, Microbiology of the food chain — Horizontal method for the detection and enumeration of *Enterobacteriaceae* — Part 1: Detection of *Enterobacteriaceae*. Is a recent method for the detection of *Salmonella*.

Enterobacteriaceae serve as indicator organisms rather than direct pathogens, meaning their presence and concentration provide insight into the hygiene standards maintained during production and handling. Therefore, a class-based sampling plan is necessary for establishing microbiological criteria.

Enterobacteriaceae: $n = 5$, $c = 2$, $m = 10$, $M = 300$ in 1 g

n = Number of samples

m = Maximum acceptable level (in CFU/g)

M = Maximum allowable level (above which it's considered unsafe)

c = Number of samples allowed to be between m and M

Clostridium perfringens

As per European Commission Regulation (EC) No. 1774/2002 (Method 7), the approval of fishmeal processing methods by the competent authority is based on certain microbiological parameters. It requires the authority to verify that the final product is

tested daily over a period of one month to ensure compliance with the following microbiological standards: Samples of material taken immediately after heat treatment must show the absence of *Clostridium perfringens* in 1 gram of the product.

ISO 7937:2004, (Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of presumptive *Clostridium perfringens* — Colony-count technique) will be a suitable method for the enumeration of the *C. perfringens*

References

MPEDA, 2024. https://mpeda.gov.in/wp-content/uploads/2024/06/Export-performance_2023-24-approved_V5.pdf

IS 4307:1983 — Specification for Fish Meal (For Use as Animal Feed).

EC, Commission Regulation (EC) No 142/2011, Laying down detailed rules for the implementation of Regulation (EC) No 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal by-products and derived products not intended for human consumption.

Council Regulation (EC) No 1774/2002, *Laying down health rules concerning animal by-products not intended for human consumption*. This regulation sets out the rules for the processing and use of animal by-products, including fish meal, ensuring their safe handling and preventing risks to animal and public health.

ISO 6579-1:2017 — Microbiology of the food chain — Horizontal method for the detection, enumeration and serotyping of *Salmonella* — Part 1: Detection of *Salmonella* spp.
