

ISSUE OF FORMALIN IN FISH

SUMMARY

The consumption of fish has lately seen an upward trend and with it, the issue of adulteration of fish with unapproved chemicals and additives has also come into the light. Formalin (formaldehyde in water) is a common adulterant in fish. Traders and suppliers use it to extend the storage life of fresh or chilled fish and artificially improve the sensory attributes. The FSSAI Referral Laboratory on fish and fish products, Central Institute of Fisheries Technology (CIFT) - Kochi, has reported the presence of residues of these chemicals in freshly marketed fish, inter-state fish consignments and even in ice used during transportation. Although, the amount of formalin in fish decreases overtime during storage but cannot be removed completely. Consumption of fish adulterated with formalin can cause health conditions such as abdominal discomfort, vomiting, renal injury, etc. This guidance note has been prepared jointly by FSSAI and ICAR-CIFT to guide consumers, traders and food testing laboratories on the best practices to avoid, restrict and detect formalin adulteration in fish, respectively.

KEY TAKEAWAYS

- Formaldehyde is soluble in water and hence, consumers should wash fish thoroughly with running tap water to remove the formaldehyde naturally present in the fish, especially marine fish.
- Cook fish thoroughly to an internal temperature of 75°C or above, as heat from cooking can also aid the removal of any naturally present formaldehyde.
- Consumers can check the fish for adulteration using rapid detection kit "CIFTTest" developed by ICAR-CIFT.
- Traders should refrain from using any unapproved chemical/additive, including formalin during any stage of storage, transport or supply. It is best to screen fish for formaldehyde content during procurement.
- ICAR-CIFT, Kochi has developed a rapid detection kit "CIFTTest". The method is simple, rapid, and consumer friendly, detects only the added formaldehyde present in the fish.
- Ingesting large amounts of formaldehyde can generally cause severe abdominal pain, vomiting, coma, renal injury and possible death.
- The International Agency for Research on Cancer (IARC) of WHO classifies formaldehyde as "carcinogenic to humans", with sufficient evidence for causing nasopharyngeal cancer in humans.
- Formaldehyde is not permitted for use in foods as per Food Safety and Standards Regulations 2011.

I. INTRODUCTION

Fish consumption pattern has seen an upward trend in recent days keeping in view the wide publicity of health benefits of fish consumption.

The issues of rampant adulteration of fresh fish using unapproved chemicals and additives have come into picture both through print and electronic media. Several instances of adulteration of fresh fish/fishery products with hazardous chemicals like formaldehyde, ammonia; and, illegal use of additives like sodium benzoate has been highlighted in the mainstream media.

Monitoring studies by the Central Institute of Fisheries Technology (CIFT) - Kochi, the FSSAI referral laboratory for Fish and Fish products, reported the presence of residues of these chemicals in freshly marketed fish, inter-state fish consignments and even in ice used during transportation.

Presence of hazardous chemicals such as formaldehyde in freshly marketed fish seriously compromises health of consumers and needs immediate intervention from the enforcement agencies involved in ensuring availability of safe food to consumers.

As such, Formaldehyde is not permitted for use in foods as per Food Safety and Standards Regulations, 2011.

II. WHY TRADERS TEND TO ADULTERATE FISH WITH FORMALIN?

- The underlying motive of using formalin on fish (either as a dip or through ice laced/or made with formalin as an ingredient) is:
 - (a) to extend the storage life of fresh or chilled fish
 - (b) to artificially improve the sensory attributes i.e. appearance, so as to give a façade of fresh fish.
- In most cases, dishonest traders use formaldehyde to prevent spoilage and keep fish marketable condition.
- Unavailability of good quality ice at harvest centres, inadequate insulation during domestic transport and lack of warehousing facility for bulk storage of fish are some of the compelling reasons for rampant use of formaldehyde in domestic fish marketing.
- The added formaldehyde content in fish will decrease during storage due to loss along with ice-melt water, but cannot be fully removed.
- As this solution is widely available in market, fish traders and suppliers have easy access to this chemical for adulteration.

III. ADVISE TO CONSUMERS

- Wash all food thoroughly with running tap water, as formaldehyde is soluble in water and washing can aid the removal of formaldehyde that is naturally present, to a larger extent.
- Wash your fish thoroughly before cooking and discard the water.
- Cook your fish thoroughly to an internal temperature of 75°C or above, as heat from cooking can also aid the removal of any formaldehyde that is present naturally, because it is a volatile. Also, check the flesh to see whether it has turned opaque and can be separated easily.
- After repeated washing also, if there is any kind of obnoxious smell or texture, report to concerned food safety authorities; as this indirectly represents added formalin.
- Generally, formaldehyde is naturally present in marine fishes (like mackerel, Bombay duck etc) and shellfishes (shrimps and brackish-water prawns) and it is very minimal (<4 mg per kg) or absent in freshwater fish. Any freshwater fish testing positive, either through the rapid test or through laboratory analysis indicates added formalin. Consumers should clearly take note of this.
- Consumers can check the fish for adulteration using rapid detection kit “CIFTest” developed by ICAR-CIFT. The method is simple, rapid, and consumer friendly, detects only the added formaldehyde present in the fish.

IV. ADVISE TO THE TRADE (INCLUDING RETAILERS)

- Source food products from credible sources.
- In general, traders should refrain from using any un-approved chemical/additive, including formalin during any stage of storage, transport or supply.
- Do not add formaldehyde to food in general, and fish in particular
- If formalin is added intentionally or unintentionally due to lack of awareness, it is illegal and punishable.
- Ensure that cold chain or proper icing is practiced while transporting fish and shellfish through longer distances.
- Ensure integrity of product throughout the supply chain
- It is a good practice if the fish is screened for **formaldehyde content** during procurement.

V. ADVISE TO THE FOOD TESTING LABORATORIES FOR DETECTING FORMALDEHYDE ADULTERATION

- **Sample condition:** Fish samples collected for formaldehyde detection must not be in direct contact with ice. While collection of sample, preferably gel ice packs should be used. If frozen gel ice packs are not available, fish samples can be wrapped with polythene and subsequently covered with adequate amount of ice.
- **Sample preparation:** Edible portions of fish (muscle along with skin) should only be taken for analysis. Preferably, minimum 100g of tissue should be taken for homogenization.
- **Screening methods:** Screening for free formaldehyde can be done with the rapid test kit “CIFTest” developed by ICAR-CIFT, Cochin. The rapid kit is paper strip based which qualitatively determines the presence of formaldehyde within 2 minutes. The paper strip has to be swabbed over the surface of fish 3-4 times in different areas followed by addition of one drop of reagent. Colour developed within 1-2 minutes is compared with standard chart provided.

- **Confirmatory methods:**
 - Any validated method that estimates **free formaldehyde** can be used to detect the level of adulteration.
 - Don't use any method that employs steam distillation or treatment with strong acids for extraction. Use sonication based aqueous extraction protocols.
 - Non-specific co-elution of other aldehydes as well as high matrix interferences are possible in HPLC based methods.
 - GC-MS based method that includes prior derivatization with 2,4-dinitrophenylhydrazine (DNPH) can be used to determine free formaldehyde.
- **Suggested methods:**
 - **HPLC Method:** Wahed P., Razzaq, M. A., Dharmapuri, S. and Corrales M. (2016). Determination of formaldehyde in food and feed by an in-house validated HPLC method. Food Chemistry, 202: 476-483.
 - **GC-MS Method:** Yeh, T-S., Lin, T-C., Chen, C-C. and Wen, H-M (2013). Analysis of free and bound formaldehyde in squid and squid products by gas chromatography-mass spectrometry Journal of Food and Drug Analysis, 21: 190-197

VI. RAPID TEST KIT DEVELOPED BY CIFT

- ICAR-CIFT, has developed a rapid detection kit "CIFTTest". The method is simple, rapid, and consumer friendly, detects only the added formaldehyde present in the fish.
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- The technology of manufacturing kits has been given under licence to M/s HiMedia, and interested laboratories, traders & consumers can source these kits at specified cost from M/s Hi Media, A-516, Swastik Disha Business Park, via Vadhani Industrial Estate, L.B.S. Marg, Mumbai, Maharashtra 400086.
For further details, please visit www.himedialabs.com

VII. BRIEF ON FORMALDEHYDE

a) What is formaldehyde? and, how is it related to formalin?

- **Formaldehyde** is a chemical commonly used in industry for the manufacturing of plastic resins that can be used in wood, paper and textile industry. Formaldehyde is a highly flammable, colourless gas with pungent and irritating odour and is normally commercially sold as 30 – 50% (by weight) aqueous solutions. **Formalin**, which is a solution of about 37% formaldehyde, serves as disinfectant and preservative for household products.
- **Globally, formaldehyde is identified as one of the top 25 most widely produced chemical substances** because of its high reactivity, colourless nature, purity, and low cost.
- It can decompose at a temperature above 150°C. It readily dissolves in water, alcohol and other polar solvents. In the case of aqueous solutions, it exists as methylene glycol, polyoxymethylene and hemiformals.
- The chemical characteristics of this compound, particularly its germicidal activity, make it a product of extensive industrial applicability.
- Aqueous solutions of formaldehyde usually contain 7 to 8 percent of methanol as the stabilizing agent in addition to various metabolic impurities. It is a highly reactive chemical which can undergo quick polymerization. It is also known as methanal, methylene oxide, oxymethylene, methyl aldehyde, oxomethane, and formic aldehyde. The other trade names of formaldehyde include Formol, Fannoform, Lysoform, Morbucid acid and Superlysoform.
- Formaldehyde is widely present in the environment as it is **produced naturally** in various foods/biological systems including living organisms; and, also **produced through manmade sources**. Major manmade sources of formaldehyde include combusting materials (engine exhausts, firewood burning, power plants, incineration of wastes etc.), building materials and wood/tobacco smoke.
- The major exposure to formaldehyde is through occupational exposures in industrial settings. The other major exposure route in case of general population is through inhalation of air polluted with smoke. Other sources of exposure in the general population, other than smog, could be gas cookers, open fire places, textiles, papers, cosmetics, pharmaceuticals etc. One can also be exposed to this chemical indoors through recently installed building materials and furnishings.
- Formaldehyde exists in many animal and plant species as a product of their normal metabolism. Formaldehyde is documented to be naturally present in many common food items, including fruits and vegetables (~20 to 60 mg per kg in fruits/vegetables), meats (~5 – 20 mg per Kg), fish (~5 to 140 mg per Kg), crustacean (~10 to 100 mg per Kg) and mushrooms (~60 in fresh to as high as 400 mg per Kg in dried shitake mushrooms) etc. In most marine fishes, formaldehyde is a natural breakdown product of a chemical known as trimethylamine oxide (TMAO) that exists in their bodies. Once the fish harvested, TMAO breaks down into formaldehyde and dimethylamine in equal parts during the post-mortem. It can also accumulate in certain marine fish and crustacean during frozen storage.
- Extensive studies on the levels of naturally occurring formaldehyde in foods are not available and hence data may not be available for every food.

- Being water soluble, foods – especially dried types – thorough soaking during preparation should reduce the risk of formaldehyde considerably. Food should also be washed and cooked thoroughly before consumption as a precautionary measure.
- Ingestion of a small amount of formaldehyde is unlikely to cause acute effect, but ingestion of a large amount of formaldehyde can generally cause severe abdominal pain, vomiting, coma, renal injury and possible death.
- However, according to the World Health Organization (WHO), "the general population is exposed to formaldehyde mainly by inhalation."
- The main health concern of formaldehyde is its cancer causing ability. The WHO, on the other hand, has indicated that formaldehyde was not carcinogenic upon ingestion.

b) **Why consuming formaldehyde or formalin can be bad for health?**

- The International Agency for Research on Cancer (IARC) of WHO classifies formaldehyde as "carcinogenic to humans", with sufficient evidence for causing nasopharyngeal cancer in humans with occupational exposure, although no carcinogenicity is so far established through ingestion route.
- Presence of formaldehyde in food at higher levels can lead to severe abdominal pain, vomiting, coma, renal injury and possible death. For food handlers, it can lead to sensory irritation of eye and lungs, dermatitis and asthma.
- As per the United States Environmental Protection Agency (USEPA) the maximum daily dose reference (RfD) is 0.2 mg per Kg body weight. European Food Safety Authority or EFSA (2014) recommends an oral exposure to formaldehyde as 100 mg formaldehyde per day, corresponding to 1.7 and 1.4 mg per Kg body weight per day in case of humans weighing 60 kg and 70 kg, respectively. The estimated average dietary exposure is about 11 mg per Kg food per person per day [Agence Francaise de Securite Sanitaire des Aliments (AFSSA)].

c) **Uses and regulatory status of formalin**

- In case of food industry, it is used as a bacteriostatic agent in cheese preparation (IARC, 1995); as a food additive in caviar preparation in Scandinavian countries; as an anti-parasitic agent in case of cultured fish; and, as an anti-fungal in cases of hatcheries to control aquatic fungi.
- An approved aquaculture drug as per USFDA for the control of parasites and fungi in marine fish farming. Its **usage is not permitted for aquaculture in Australia, Europe and Japan** due to its carcinogenic effect.
- **Formaldehyde is not permitted for use in foods** as per Food Safety and Standards Regulations, 2011.