

CREDIT SEMINAR

ON

Tilte : Chemical Adulteration In Fresh Fish

DOMENDRA DHRUVE

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Chairman : Dr. R. Shalini

DEPARTMENT OF FISH QUALITY ASSURANCE AND MANAGEMENT

FISHERIES COLLEGE AND RESEARCH INSTITUTE

TAMIL NADU Dr. JAYALALITHAA FISHERIES UNIVERSITY

THOOTHUKUDI – 62800

What is Adulteration?

Adulteration is defined as the process by which the quality or the nature of a given substance is reduced through the addition of a foreign or an inferior substance and removal of vital element.(Banerjee, 2017)The foreign and inferior substance is known as adulterants.

Food is declared adulterated if :

- A substance is injurious or deleterious to food.
- A cheaper or inferior substance is substituted
- An imitation substance is added.
- A substance used to improve the color or appearance
- A substance is injurious to human health.
- A substance of sub-standard quality.



Reasons for food adulteration

- To earn more profit
- To increase volume of trade by displaying lower prices.
- When supply is less than demand
- To cut down the product costs to meet the market competition.
- Shortage of authentic ingredients at affordable prices.
- Shortage of qualified personnel and no updation of processing techniques.
- Inadequate knowledge on the consequences and associated food safety risks.

- Lack of awareness and updation of the information on the adulteration related food safety outbreaks.
- **FSSAI has recommended stringent punishment to curb food adulteration**



Those adulterating food products could face **life imprisonment** and penalty of up to Rs 10 lakh as per the amendments proposed by the regulator **FSSAI** in its 2006 food safety and standards law.

The Food Safety and Standards Authority of India (FSSAI) has recommended stringent punishment to curb **food adulteration** following the Supreme Court order.

Why fish spoils quickly?

Fish spoil faster than meat for various reasons

- High NPN content
- High moisture content
- Handling abuse
- High microbial load



Why adulteration in fish ?

- Less availability
- Transportation
- High demand
- Fishing ban season
- Economic reasons

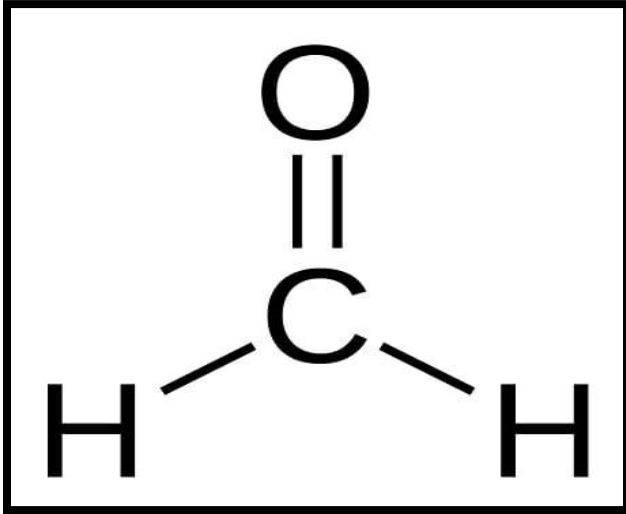
Some common chemical adulterants in fresh fish

- Formalin
- Ammonia
- Sodium Benzoate



Formalin as a chemical adulterant

- Formaldehyde is a single carbon molecule
- Formalin – 37% formaldehyde in water – stabilized by methanol



Use of formalin in fish culture systems

- Control external parasites
- Prevent bacterial growth in fish farm
- Effective against protozoa and trematodes
- As a disinfectant in culture system it can be used upto 1000 to 2000 mg/L



Illegal usage of formalin by the fish merchant and traders

- In India & SE Asian countries - illegally used to preserve fish
- To increase the shelf life of fish
 - i.e. 8-18 days in ice
- In refrigerated condition up to 2 days

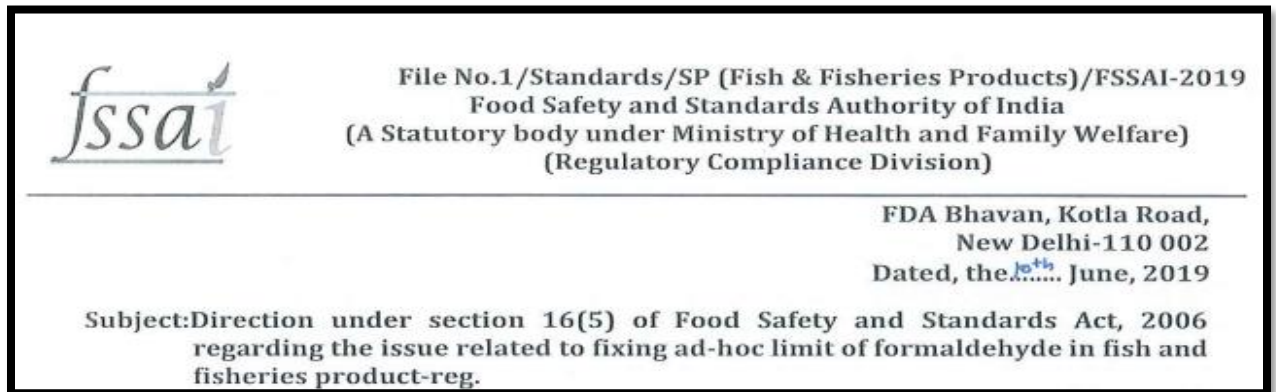
Toxic effects of formalin

- Formaldehyde is added to the fish as free formaldehyde.
- Formaldehyde causes - nasopharyngeal cancer (IARC, 2006).
- Formaldehyde at higher levels can lead to severe abdominal pain, vomiting, coma, renal injury and possible death.
- In food handlers, it can lead to sensory irritation of eye and lungs, dermatitis and asthma (CIFT 2019).



Legislation for formaldehyde level in fish

- Under section 16(5) of Food Safety and Standards Act, 2006, the level of formaldehyde
- For freshwater fish should not exceed 4.0 mg / kg
- For brackish water and marine fish should not exceed 100 mg / kg.



Recent problem with formalin contaminated fish- News paper headline

- Fish dried illegally with formalin in Odisha (*Down To Earth* 2019)
- Instances of formalin use reported from Kerala, Goa and Andhra Pradesh (The Indian express 2019)
- Fish from Andhra Pradesh, West Bengal banned in Bihar because of formalin contamination (*Down To Earth* 2019)

In Kerala the State's food safety department conducted inspections across the State's 14 districts and seized thousands of tones of fish kept in formalin (The Hindu business line 2018)

Some studies about formalin adulterant

- An study was carried out by Lipi et al., (2014) in Myanmar and India A total of 500 fish samples were collected to detect the presence of formalin in fish. Formalin was found in 4.2% of total sampled fish.

Among 300 freshwater fish sample tested, 15% were formalin treated. In marine fish, out of 200 samples, 10.50% were formalin treated fish.

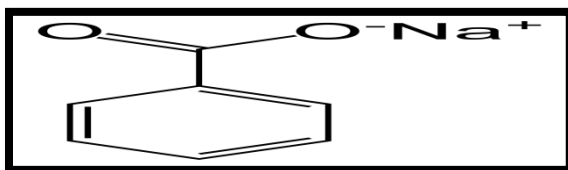
- Uddin et al.,(2011) tested the fishes (Rohu, Mrigal, Catla, olive barb) from different markets of Bangladesh for formalin The study indicated that 70% rohu fish was formalin contaminated and almost 50% of fish samples contained formalin.

Impact of toxic formaldehyde in human body

- Ross et al., (2002) have studied the consumption pattern of formalin preserved fish and reported that it may cause uncontrolled cell growth or cancer in any part of body like stomach, lung and respiratory system.
- Hossain (2011) reported that spraying or injecting formalin over a long period of time is likely to cause blindness, asthma and even lung cancer.

Sodium benzoate

- Sodium benzoate is a sodium salt represented by the chemical formula $C_7H_5NaO_2$
- Molecular weight is 144.1
- An odorless compound and soluble in water and ethanol.
- It is typically used as a preservative in cosmetic, pharmaceutical and food industries (Lennerz et al., 2015).



- Sodium benzoate is used in foods and beverages, as it is effective to inhibit the growth of fungi and bacteria during storage, besides providing easy application (Tsay et al., 2007).
- In FRESH FISH, this chemical should not be used (Bruna et al., 2018)

Route of absorption of sodium benzoate

Sodium benzoate



Absorbed in GI tract



Sodium benzoate conjugates with glycine



Forms pyruvate in liver

- Once it enters the cell (liver), sodium benzoate converts to benzoyl-CoA



- Ingestion of this preservative causes an increase in the serum benzoate and pyruvate (Akintonwa et al., 2007).

Legislation for sodium benzoate

- The FAO and WHO, the ADI for foods with sodium benzoate is 5 mg/kg body weight (Zhang and Ma, 2013; Lennerz et al., 2015).

- The maximum limit of sodium benzoate as preservative is 0.05 g/100 mg or 0.05 g/100 mL (Zhang and Ma, 2013).
- European Food Safety Authority (ESFA), prescribes the Lethal Dose (LD50) as 2000 mg/kg (EFSA, 2017).

Toxic effect of sodium benzoate

Sodium benzoate may cause

- Allergies, urticaria (Gören et al.,2015)
- Hyperactivity (Beezhold et al., 2014;)
- Attention deficit/hyperactivity disorder (ADHD)(McCann et al., 2007),
- Toxic and genotoxic (Yavav et al., 2016).
- Sodium benzoate can have side effects, including nausea, vomiting and abdominal pain.
- Benzene can be formed when sodium benzoate is heated in presence of citric acid.

Ammonia

- Ammonia is colorless inorganic compound of nitrogen and hydrogen with the formula NH_3 .
- In fresh fish the ammonia is used to slow down the melting of ice used to preserve the fish.

Toxic effect of ammonia

- Exposure to high concentrations of ammonia can cause immediate burning of the eyes, nose, throat and respiratory tract and can result in blindness, lung damage or death. ... Skin or eye contact with concentrated ammonia can also cause irritation and burns

Recent problem with contaminated Sodium benzoate and Ammonia fish- News paper headline

- In Kozhikode district of Kerala fish is preserved with toxic chemicals, mainly sodium benzoate. This has been found from the 47 fish samples collected by the officials of FSSAI from various parts of the district (FSSAI 2017)
- Ammonia that is generally used as fertilizer in agriculture are among the chemicals locally alleged are used in fish that is currently available in the market. (Mangalore Today 2018)
- In banned season, most of the fish available in the local markets here is iced and arrives from tamil nadu and kerala (Mangalore Today 2018)
- According to FSSAI There are reports that sodium benzoate is widely used in fish coming from Karnataka, Goa, Maharashtra and Andhra Pradesh.(The Hindu 2020)

Statistics on food adulterant

- 2 crore people suffering for kidney diseases
- 76% foods are adulterated
- Burden on public health
- Diarrhea
- 3 million cases reported (DGHS, 2005-09)
- Responsible for 15% of mortality in children under 5 years (2011)

Impact of adulteration

Child health

Health of pregnant women

Other diseases

Detection method of these toxic chemical

- Formaldehyde

Spectrophotometric method

GC-MS

HPLC

Rapid detection kit

- Sodium benzoate

UV-vis spectrophotometry

HPLC

GC

- Ammonia

Spectrophotometric determination

Calorimetric method

CIFTest rapid detection kit

Conclusion

- Use of adulterants are currently on rise
- The authorities should adopt stringent measures to combat this issue
- Consumers should be made alert regarding chemical abuse and subsequent health problems.

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