



Chapter 6

Quality Issues in Traditional/Ethnic Fishery Products and its Control Measures

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Introduction

Traditional fishery products hold a unique place in the country's rich culinary heritage. For generations, these products have not only served as a source of nourishment but have also been an integral part of cultural and regional identity. The major traditional fishery products include dried/salted fish products, smoked fish products, pickled/marinated fish products, fermented fish products, etc. Traditional fishery products also play a critical role in addressing food security and providing livelihoods to millions of people by providing employment opportunities, particularly in rural areas. They are a valuable source of protein, vitamins, and essential nutrients, making them essential for a balanced diet, especially in regions where alternative sources of protein are limited. While traditional fishery products hold immense cultural and economic value, they also face significant challenges in maintaining quality. The production, preservation, and distribution of traditional fishery products come with their fair share of challenges, leading to various quality issues. Quality issues in traditional fishery products poses a significant concern in the domestic and international markets causing huge economic losses. Traditional fishery products, often valued for their cultural heritage and artisanal production methods, face challenges related to product consistency, safety, and adherence to international quality standards. One of the primary challenges is the lack of standardized quality control measures. Unlike modern fishery practices, where quality can be closely monitored throughout the supply chain, traditional fishery products often pass through multiple intermediaries, increasing the risk of quality degradation. These issues can encompass various aspects, including the handling, processing, and storage of fishery products, as well as concerns regarding traceability and sustainability. Addressing these quality issues is crucial not only for the preservation of traditional culinary practices but also to ensure consumer confidence and access to safe and high-quality fishery products in an evolving global market. In this context, exploring the factors contributing to quality problems in traditional fishery products and developing strategies to overcome them is essential for the industry's sustainability and the satisfaction of consumers worldwide.



Common quality issues encountered in traditional fishery products

The common quality issues that afflict traditional fishery products that compromise their safety and quality attributes are discussed below.

1. Spoilage

Traditional fishery products are highly perishable, and improper handling, storage, or transportation can lead to rapid spoilage. Several factors are responsible for causing spoilage and affecting the quality of fish. Factors such as improper storage conditions, inadequate salting, drying, or smoking techniques, and exposure to contaminants can accelerate spoilage. The consequences of spoilage extend beyond the loss of product quality; they can also pose health risks to consumers. Foul odours, off-flavours, and changes in texture are common indicators of spoilage. To combat this issue, it's crucial to educate producers and consumers on proper preservation techniques and storage practices. Additionally, implementing modern technologies for monitoring and controlling the environmental conditions during production and distribution can help extend the shelf life of traditional fishery products, ensuring that they remain safe, enjoyable, and true to their cultural heritage.

2. Rancidity

Rancidity is a significant concern in traditional fishery products, particularly those subjected to long-term storage and preservation methods. The primary cause of rancidity in these products is the breakdown of fats and oils, which are abundant in fish. When exposed to air, light, and temperature fluctuations, the fats in fish can undergo oxidation, leading to the development of off-flavours and odours, ultimately rendering the product unpalatable. Traditional fishery products like salted fish, dried fish, or fermented fish are especially susceptible to rancidity if not properly stored in a cool, dark, and dry environment. To mitigate rancidity, traditional methods of preservation should be complemented with modern packaging and storage techniques, such as vacuum-sealing and refrigeration. Additionally, educating producers and consumers about the importance of proper storage and handling can help extend the shelf life of these valuable traditional products while preserving their unique flavours and cultural significance.

3. Contamination with physical, chemical and biological agents

Traditional fishery products can be susceptible to various forms of contamination, including physical, chemical, and biological sources. Physical contamination occurs when foreign objects, such as pieces of metals, glass, ceramics or quartz materials, come into contact with the fish during processing. These contaminants can compromise the safety and quality of the fishery products, leading to potential health risks for consumers. Chemical contamination is another concern, and it can arise from various sources. Pesticides and herbicides from agricultural runoff, heavy metals

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like mercury and lead from polluted water bodies, and chemicals used in fishing practices such as preservatives or cleaning agents can all find their way into traditional fishery products. These chemical contaminants can accumulate in the fish and pose health risks when consumed by humans. Biological contamination involves the presence of pathogen like bacteria, viruses, and parasites in traditional fishery products. These pathogens can thrive in unhygienic processing environments or when fish are stored improperly. Consuming fish contaminated with harmful microorganisms can lead to foodborne illnesses, making it essential to maintain strict sanitation practices throughout the supply chain. To ensure the safety and quality of traditional fishery products, it is crucial to implement rigorous quality control measures, adhere to food safety regulations, and promote sustainable fishing practices that minimize contamination risks. Monitoring and testing for physical, chemical, and biological contaminants are vital steps in safeguarding the integrity of these products and protecting the health of consumers.

4. Textural changes

Textural changes in traditional fishery products are a critical aspect of their overall quality and consumer appeal. Freshly caught fish often have firm and resilient textures, but over time, post-harvest processes such as drying, salting or smoking can alter these textures. Drying or smoking removes moisture from the fish, leading to a firmer and denser texture, which is highly prized in some traditional products like salted fish or smoked salmon. Maintaining the desired texture in traditional fishery products is a delicate balance that requires precise control of processing parameters and careful handling. Texture plays a pivotal role in determining the overall sensory experience and consumer satisfaction.

5. Flavour changes

Over time, traditional fishery products may undergo aging and fermentation processes, intensifying their flavours and creating a more pronounced umami profile. The maturation of these products can be highly valued by regular consumers, as it adds depth and complexity to their taste. But at the same time, some undesirable flavour changes do occur due to improper handling and storage condition leading to poor consumer preference.

6. Discolouration

Discoloration is a common issue that traditional fishery products may encounter during their production and storage. It can affect both the appearance and, in some cases, the quality of these prized culinary items. Discoloration in fishery products can manifest in various ways, often due to factors such as exposure to oxygen, enzymatic reactions, or microbial activity. One of the most noticeable forms of discoloration is the browning or darkening of fish flesh when exposed to air.

Additionally, fish tissues can result in colour changes due to the enzymatic breakdown of



pigments. Microbial activity can also contribute to discoloration, as bacteria can produce pigments that alter the appearance of fishery products. This is often seen in the form of slimy or off-coloured surfaces, which can be indicative of spoilage and pose food safety concerns. To mitigate discoloration in traditional fishery products, various strategies are employed, including vacuum sealing, packaging in a protective atmosphere, or the use of antioxidants to prevent oxidation. Maintaining proper temperature and hygiene throughout the supply chain is crucial in minimizing the risk of discoloration and preserving the product's visual appeal and quality. Addressing discoloration not only ensures the aesthetics of traditional fishery products but also helps maintain consumer trust by delivering products that are not only safe but also visually appealing and appetizing.

7. Disintegration

The issue of disintegration in traditional fishery products can be a significant concern, affecting their overall quality and consumer satisfaction. Disintegration refers to the loss of structural integrity in the product, leading to it falling apart or breaking down prematurely. This problem can manifest at various stages, from production to consumption. During processing, traditional fishery products may be susceptible to disintegration if they are not handled with care. Overly aggressive handling can result in disintegration issues. This not only affects the product's appearance but also its texture and eating experience. Traditional dishes often rely on the texture and structural integrity of these products, so disintegration can compromise the authenticity of the cuisine. To mitigate disintegration issues, producers can focus on optimizing processing techniques to maintain the product's structural integrity.

8. Loss of Nutritional value

The loss of nutritive value in traditional fishery products is a concern that can arise from various factors, including processing methods and storage conditions. Traditional fishery products, when processed and preserved improperly, can experience a reduction in their nutritional content. Processing techniques, like smoking or drying, may lead to nutrient loss due to the exposure of fishery products to high temperatures or extended drying periods. Another consideration is the impact of storage conditions. Traditional fishery products that are not adequately stored can be susceptible to oxidation, which can lead to the degradation of healthy fats like omega-3 fatty acids. Moreover, improper storage can result in nutrient loss through the action of enzymes or the growth of microorganisms. To address the issue of lost nutritive value, traditional fishery product producers can ensure proper storage conditions and distribution channel.



9. Packaging issues

Packaging issues in traditional fishery products present a significant challenge to both producers and consumers alike. One key concern is the preservation of product quality and safety. Traditional packaging methods often lack the protective properties needed to keep fishery products free from contamination during storage and transportation. Inadequate packaging can lead to spoilage, bacterial growth, and loss of product integrity, ultimately impacting the product's marketability and consumer satisfaction. Moreover, traditional packaging may not provide proper labeling and information for consumers regarding product origin, ingredients, and expiration dates, which is essential for making informed choices and ensuring food safety. Additionally, the environmental impact of traditional packaging materials, such as plastic and non-biodegradable materials, is a growing concern as they contribute to pollution and harm marine ecosystems. Addressing these packaging issues is crucial to maintain the quality and safety of traditional fishery products, support the livelihoods of fishermen, and meet the growing demand for these products in domestic and international markets.

Factors contributing to quality issues in traditional fishery products

Several factors are responsible for the deterioration of quality in traditional fishery products. These factors are given below.

1. **Improper handling practices:** Improper handling of fishery products leads to physical damage, bruising, or contamination. These practices can significantly impact product quality.
2. **Poor hygiene and sanitation:** Poor hygiene and Sanitation during processing and packaging can introduce bacteria and pathogens, leading to spoilage and potential health risks for consumers.
3. **Temperature and humidity:** Drying or smoking, may not provide adequate protection against environmental factors like humidity, temperature fluctuations, or pests, which can compromise product quality and safety.
4. **Water activity:** High water activity ($a_w > 0.75$) in traditional fishery products create a favourable environment for the growth of microorganisms, including bacteria, molds, and yeasts. As a result, traditional fishery products with high water activity are at an increased risk of spoilage, which can lead to off-odours, flavours, and textures.
5. **Environmental contaminants:** Contamination with dust, dirt, and others pollutants are common issues found in traditional fishery products.
6. **Processing methods:** Traditional fishery products often rely on time-tested processing methods, such as drying, smoking, salting, or fermenting. While these methods can impart unique flavours and characteristics to the products, they also come with specific challenges. For Training Manual on 'Quality Assurance of Fish and Fishery Products, ICAR-CIFT, Cochin-29 (18-29 Sep., 2023)



- example, inadequate drying or smoking can result in uneven product quality, leading to variations in taste and texture. Improper salting can result in overly salty or under-preserved products. Fermentation, if not controlled carefully, can lead to spoilage or off-flavours.
7. **Use of chemical additives:** Traditional fishery products may be treated with preservatives, antioxidants, or antimicrobial agents to extend their shelf life. However, if these additives are not used in accordance with regulatory guidelines or exceed permissible limits, they can pose health hazards to consumers. Ingredients like salt and vinegar have been used for centuries to preserve fishery products, such as salted fish or pickled herring. In modern times, synthetic preservatives like sodium nitrite are also used to prevent bacterial growth and maintain product safety. Common antioxidants include ascorbic acid (vitamin C) and tocopherols (vitamin E). While chemical additives serve important functions in traditional fishery products, their use is subject to regulatory standards to ensure safety.
 8. **Poor storage conditions:** The way traditional fishery products are stored can significantly impact their quality and shelf life. Improper and unhygienic storage conditions can lead to issues such as mold growth, spoilage, or loss of flavour and texture.
 9. **Cross-contamination:** Traditional fishery products produced in less controlled environments has a higher risk of cross-contamination. This can occur when different types of fish or seafood, or even non-seafood items, come into contact with each other, potentially transferring harmful bacteria, allergens, or flavours. Cross-contamination can happen during handling, processing, storage, or even transportation, and it poses a significant risk to product quality and consumer safety.
 10. **Variability in raw materials:** Traditional fishery products often depend on seasonal availability, which can lead to fluctuations in product quality and quantity throughout the year.
 11. **Lack of quality standards:** In some cases, traditional fishery products may not be subject to the same regulatory oversight as their modern counterparts, allowing for quality control issues to persist.
 12. **Inadequate packaging system:** Traditional packaging materials and methods might not offer the same level of protection and preservation as modern packaging, making the products susceptible to moisture, air, and light exposure.
 13. **Traditional knowledge:** Traditional knowledge and practices may not always align with best practices for ensuring product quality and safety, creating a gap in quality control.

QUALITY ISSUES IN DRIED FISH

- Shrinkage- due to moisture loss



- Case hardening occurs in dried fish when high air temperature but low Relative Humidity (RH) forming dry impervious layer and preventing further diffusion of moisture. This make the final product into brittle.
- Denaturation of protein caused loss of juiciness of muscle leading to toughening of texture.
- Poor rehydration in dried fish- denatured protein-loss of WHC
- Changes in colour and Flavor- pigments & fats oxidized-non enzymatic browning (Maillard reaction)-free sugars react with free amino groups- produce brown colour.
- Contamination- Physical, Chemical, Biological
- Loss of Nutritional Value- Protein, lipid, vitamin, etc.

Spoilage of fish during drying and storage

- Infestation with flies (sundried), commonly blowflies- *Chrysomya* spp., *Lucilia* spp., *Sarcophaga* spp., etc.
- Infestation with insects-beetle- *Dermestes* spp. Can grow even at 15% moisture content.
- Moulds growth (both salted and unsalted) if moisture content is high; RH is > 75%, and temp. is in 30-35°C range.
- Rancidity-if fatty fish are used for drying

Control Measures - Hygiene and Sanitation

- Implementation of PRPs (GMP, GHP, SSOP)
- Implementation of HACCP (Hazard Analysis Critical Control Points)
- Effective cleaning and sanitizing procedures
- Regular staff training

Control Measures - Quality Control

- Case hardening can be controlled by maintaining sufficient high RH in drying atmosphere (mechanical) and controlling drying temperature
- Rancidity can be controlled by air tight packaging
- Use of flies traps and mesh at ventilators
- Regular Inspection and monitoring during drying
- Hygienic Handling and Processing
- Proper sanitation of the facilities
- Use of approved additives and preservatives
- Trained quality assurance team.

Control Measures - Storage and Packaging

- Maintaining proper storage temperature and RH.



- Used of appropriate packaging materials- resistant to mechanical abrasion and puncture; impermeable to moisture, oxygen & insects- e.g. Polypropylene.
- Vacuum Sealing and Oxygen Absorbers
- Proper Labelling and Date Coding

SPOILAGE IN SALTED FISH

Microbial spoilage:

a. Pink or Red

- Surface becomes covered with red/pink slime that gives off an unpleasant odour.
- Caused by halophiles (Temp. > 42°C and salt > 10%) such as Halobacterium salinarum, H. cutirubum, Sarcina morrhuae, S. littoralis and Micrococcus rosens

b. Dun

- Develops in heavily salted fish-coloured spots-black, grey or brown on the surface.
- Caused by Sporendonema epizoum

c. Saponification

- Malodorous slime on the surface caused by aerobic micro-organisms active even at low temperature.
- Occur in light salted fish, commonly boxed herring when in contact with air.

d. Putrefaction

- Flesh near backbone becomes 'tanned' or 'reddened' accompanied by offensive putrid smell.

Control Measures – Pink/Red and Dun

- To prevent Pink- Keep the fish out of contact with air. Store at lower temperature (<10°C).
- Dip treatment in sodium metabisulphite/sodium or calcium salts of propionic acid are also effective for Pink.
- For Dun- dip in 0.1% sorbic acid will provide some protection
- Used of good quality salt as it is main source of contamination.
- Storage at optimum RH, ventilated and cool & dry place.

Control Measures – Saponification and putrefaction

- To prevent saponification, the fish can be kept in brine for some time containing vinegar.
- Any pre-salting operation which can accelerate penetration of salt to the interior of the flesh such as gutting, splitting, etc. can prevent development of tanning.

Non-microbial spoilage

- a) Maggots infestation



- Cheese flies *Drosophila* spp. are commonly encountered.

b) Rust

- Appearance of colour similar to that of rusted iron on surface due to oxidation of lipid.
- Beside colour, unpleasant taste and rancid odour are seen.
- Fatty fish such as sardine, mackerel, etc. are prone to rusting.

c) White spots

- White spots occur on surface occasionally due to disodium hydrogen phosphate derived from enzymatic breakdown of nucleotide.
- Occurs when initial spoilage of fish took place prior to salting.
- And also exposure to dry air during storage.

d) Fragmentation

- Becomes brittle and break during storage and transportation.
- Occurs when protein get denatured, hollowing of fish by insect attacks, used of spoiled fish for processing, etc.

Control measures of non-microbial spoilage

- To prevent maggots, dip in brine is effective.
- Flies trap installation
- Maintaining processing premises
- Rust can be reduced by washing using dilute solution of sodium bicarbonate.
- Best is to prevent from occurrence by keeping away fish from contact with air.
- White spots and Fragmentation can be prevented by using fresh fish for processing and proper packaging.

COMMON QUALITY ISSUES IN FERMENTED FISHERY PRODUCTS

The common quality issues found in fermented fishery products are given below.

- Histamine formation in favourable environment
- Mycotoxin formation in poorly stored products
- Botulinum toxin production in favourable condition
- Contamination with foodborne pathogens when handled unhygienically
- Growth of parasites
- Strong odour and flavour
- Production of high volatile nitrogen compounds
- Rancidity
- Dehydration and dryness



- Occurrence of sand particles
- Discolouration

Potential food safety hazards in fermented fishery products

- Histamine - chemical hazard
- Pathogenic Escherichia coli - biological hazard
- Coagulase positive Staphylococci aureus and its enterotoxin - biological hazard
- Salmonella - biological hazard
- Botulinum poisoning - biological hazard
- Parasites (in low salted product)- biological hazard
- Heavy metals and chemical residues - chemical hazard
- Biotoxins (if marine reef fishes are used) - chemical hazard

Preventive measures for histamine formation

Use fresh raw material transported at chilled condition. Gutting and gilling of susceptible fish. Refrigerated storage and freezing of unused raw material. Using suitable starter cultures and/or their enzymes. When fresh fish was used for ripening, histamine formation in anchovy products did not occur (Herrero et al., 1999). FSSR (2011) notified for fermented fishery products that out of 9 samples only 2 samples may have 200 mg/kg histamine and no sample should possess equal to or more than 400 mg/kg histamine.

Preventive measures for botulinum toxin

Maintaining pH 4.5 or below, or having NaCl content of 15% and above would prevent growth of C. botulinum and formation of toxin. Therefore, the low level of incidence of C. botulinum poisoning in fermented fishery products may be mainly attributed to the high level of salt usage, activities of proteolytic enzymes and cooking before consumption.

Preventive measures for foodborne pathogen

Adoption of effective Good Manufacturing Practises (GMP) and Sanitation Standard Operating Procedure (SSOP) in the manufacturing unit will prevent the cross contamination of the fermented fishery products with foodborne pathogenic bacteria. Examples such; Food handlers must wash hand thoroughly after using the lavatory. Food handlers must maintain personal hygiene, etc.

Prevention measures for Biotoxin (Ciguatera)

To ensure that incoming fish have not been caught in an area for which there is a CFP advisory or for which there is knowledge that CFP is a problem.



QUALITY ISSUES IN SMOKED FISH

Biological hazards

- *Listeria monocytogenes*-cold smoking (22-28°C)
- *Clostridium botulinum*
- Parasites-nematodes, cestodes, trematodes

Chemical hazards

- Polycyclic Aromatic Hydrocarbons (PAHs): Accumulation of carcinogenic compound-benzopyrene on the surface of fish.
- Histamine
- Biotoxins

Control Measures

- *Listeria monocytogenes*- can be prevented by sufficient heat treatment, proper hygienic handling and cold chain maintenance during distribution
- Preventing *C. botulinum*- proper salt concentration, proper refrigeration, and reduced oxygen packaging like MAP can prevent the occurrence of *C. botulinum* in smoked fish and fishery products.
- Salt along with smoke effectively prevents the toxin formation.
- To prevent parasite- attention needs to be paid to cold smoked or smoke-flavoured products, which should be frozen before or after smoking if a parasite hazard is present.
- The PAH contamination in smoked products can be significantly reduced by using indirect smoking process instead of direct smoking of the fish. Use of liquid smoke is a better option.

Quality issues in fish pickle

Pickling imparts unique and characteristic taste, flavor and texture to fish, but the change occurring during storage should be carefully monitored.

PROBLEMS	CAUSE
Soft, slippery slimy pickles (discard pickles, spoilage is occurring)	Hard water, acid level too low, cooked too long or at too high a temperature, bacteria not destroyed, jars not airtight, jars in too warm a resting place



Shrivelled, tough pickles	Pickles overcooked, syrup too heavy, too strong brine or vinegar solution
Dark, discoloured pickles	Iron utensils used, copper, brass, or zinc cookware used, Hard water, Metal lid corrosion, High quantity of powdered and dried spices used.
There is white sediment on the bottom of the jar	Harmless yeasts have grown on the surface and then settled to the bottom, Additives in table salt.
Pickles have a strong, bitter taste	Spices were old, they were cooked too long in the vinegar or the quantity was excessive, vinegar used was too strong, salt substitutes contain potassium chloride, which is naturally bitter

Other quality issues in fish pickle

- Another issue in fish pickle is biogenic amines such as histamine, tyramine, tryptamine, putrescine, cadaverine, spermidine and spermine.
- The outbreaks of foodborne pathogens such as E. coli O157:H7 and Salmonella sp. in acidified foods were reported recently.
- Clostridium botulinum is another food born pathogen of concern in pickled products.
- Pickling can reduce parasite hazard in fish but cannot eliminate it.
- For example, nematode larvae can survive for 28 days in 21% salt by weight (FDA, 2020).

Control Measures

- Time-temperature (<math><4^{\circ}</math>) control of raw material during processing inhibit histamine formation.
- In fermented pickles, starter culture or probiotic strains (e.g., L. plantarum, L. casei, E. faecium and Pediococcus sp.) may reduce the biogenic amine formation.
- By controlling the pH level to 4.6 or below, salt to 5% wps(water phase salt) or more, water activity to 0.97 or below, or combination of these barriers sufficiently prevents the growth of C. botulinum.

Regulatory standards

Regulations and standards specific for dried/salted and fish pickles are as following:

- CODEX STAN 167-1989 – Standard for salted fish and dried salted fish of the Gadidae family of fishes
- CODEX STAN 236-2003 - Standard for Boiled Dried Salted Anchovies



- CODEX STAN 244-2004 Standard for salted Atlantic herrings and salted Sprats
- Indian Standard (IS 14950:2001)- Dried and dry salted fish
- Indian Standard (IS 14515:1998)- Fish pickles
- Food Safety and Standards Regulations (FSSR), 2011

Conclusion

Ensuring quality is not only a matter of preserving culinary traditions but also vital for economic sustainability. High-quality traditional fishery products can command premium prices in both domestic and international markets, contributing to the livelihoods of local fishing communities. Addressing quality issues is essential from a public health perspective, as sub-standard products can pose risks to consumers. By implementing measures to enhance the quality and safety of traditional fishery products, we not only safeguard cultural heritage but also promote economic prosperity, food safety, and consumer trust, ultimately benefiting both producers and consumers alike. One key approach as control measures is to establish quality standards and regulations that encompass various aspects of production, from sourcing and handling to processing and packaging. Regular inspections and audits by relevant authorities can help ensure compliance with these standards. Additionally, promoting good manufacturing practices and providing training to fishermen and processors can enhance their knowledge and skills, leading to improved product quality. Emphasizing proper hygiene, temperature control, and traceability measures in the supply chain is essential to prevent contamination and ensure product integrity. Encouraging sustainable fishing practices also contributes to quality by maintaining the health of fish stocks. Overall, a comprehensive approach involving regulation, education, and sustainability efforts is essential to effectively control quality issues in traditional fishery products and uphold their cultural and economic significance.