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Estimation of Microbiological Variations in Minced Lean Fish Products

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Abstract: Lean fish is suitable for mince production. Minced fish is more susceptible for microbial spoilage than whole fish due to greater surface are of minced fish. Strict hygiene standards must therefore be applied in mincing process. Storage conditions of -30 degree seem to be good for minced fish to maintain high quality. Accepted quality evaluation (microbiological and chemical variation) for mince fish was evident after stored frozen for 50 days.

Key words: Lean Fish % Minced Fish % Microbiological control % Escherichia coli % Salmonella Sp % and Shigella sp

INTRODUCTION

Pathogenic and potentially pathogenic bacteria associated with fish include myco-bacteria, *Streptococcus iniae*, *Vibrio vulnificus*, Vibrio spp., aeromonads, Salmonella spp. and others. Most important of the varieties are in below:

In this family there are many pathogens, such as *Escherichia coli*, Salmonella Sp. and Shigella sp. *Escherichia coli* and other faecal coliforms are found in the fecies of humans and other warm blooded animals. *E.coli* is a typical mesophile growing at 7-50°C with an optimum temperature of 37°C. *E. coli* grows below pH4.4 and with water activity at 0.92 [1]. Shigella sp. is the cause of shigellosis and more common in warmer climates and in travelers returning from warmer climates. Optimum temperature for Shigella growth is 37°C and pH minimum is 5.5 [1] Salmonella sp. are regarded as human pathogens, although they differ in the characteristics and the severity of the illness they cause. The most severe Salmonella infection is Typhoid fever. Optimum temperature for Salmonella growth is 37°C and pH minimum is 4.0 and water activity is 0.92 [1]. Characteristics of interobactericeae are shown in Table 1.

Psychrotrophic bacteria grow at much lower temperatures than Interobacteriaceae. The pathogenic psychrotrophic bacteria can grow below 5°C and common ones are *Aeromonas hydrophila*, *Clostidium botulinum* type E and nonproteolytic type B and F, *Listeria monocytogenes*, *Vibriocholera*, *Yersinia enterocolitica*. The major psychrotrophic bacteria are found in milk, meats and poultry and fish and other seafood [2].

Table 1: Growing condition of some Interobacteriaceae (Adams and Moss 1995)

Bacteria	Tem.(°C) optimum	pH minimum	Water activity minimum
E. coli	37	4.4	0.95
Shigella sp.	37	5.5	0.95
Salmonella	37	4	0.92

Food Borne Pathogens Associated with fish and fish Products: From the standpoint of microbiology, fish and related products are a risk foodstuff group. Particularly *Clostridium botulinum* type E and *Vibrio parahaemolyticus* rank among pathogenic bacteria associated with fish. Other potentially pathogenic bacteria associated with fish and shellfish include C. perfrin-gens, Staph. spp., Salm. spp., Shigella spp., V. cholerae and other vibrios. Outbreaks usually occur due to the ingestion of insufficiently heat-treated fish or products contaminated a−er/during their processing. Freezing fish and related products in the seawater, intensive handling, long-time transport or cooking in fishing containers straight on the deck contributes to their contamination with microorganisms [3].

Temperature and pH are limiting factors for the survival of bacteria in fish products; these facts are used during the processes of pasteurization and heat treatment, particularly of offal [4]. In the technology of marine animal processing by cooking, the following critical aspects of marine animals are significant: the duration of cooking, temperature of steam, water and other media used for the cooking, thickness of the cut cooked, accuracy of thermometer and other monitoring and timing devices.

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Microbiological criteria, including samples plans and methods of analysis, are laid down when there is a need to protect public health. Microbiological criteria for fish and fishery products include quantification of the counts of *Escherichia coli*, thermo-tolerant coliform, mesophilic aerobic bacteria and pathogenic *V. parahaemolyticus* is performed during the production. At the finished product stage, the measure monitored is the quantification of the count of *Staph. aureus* and detection of bacteria of Salmonella genus as their presence indicates recon-tamination of a finished product.

***Escherichia coli*:** *E. coli* is a classic example of enteric bacteria causing gastroenteritis. *E. coli* including other coliforms and bacteria as *Staphylococcus* spp. and sometimes enterococci are commonly used as indices of hazardous conditions during processing of fish. Such organisms should not be present on fresh-caught fish [5]. The contamination of food of fish origin with pathogenic *E. coli* probably occurs during handling of fish and during the production process [6,7].

E. coli was described in Japan [8]. The illness was strongly associated with eating tuna paste. Brazilian authors [9] isolated 18 enterotoxigenic strains of *E. coli* (ETEC) from 3 of 24 samples of fresh fish originating from Brazilian markets; 13 of them produced a thermolabile en-terotoxin.

The authors explained the presence of toxic strains of *E. coli* in samples collected from fish (not from water) from one fish market by a longer survival of bacteria on an adequate substrate, i.e. inside the living organism. The isolation of 317 *E. coli* isolates tested for thermostabile (ST) and thermolabile (LT) toxins has been described in another Brazilian study [8] only one produced ST and none produced LT toxin. Infection with verocytotoxin-producing strains of *E. coli* (VTEC) a−er ingestion of fish was recorded in Belgium An outbreak caused by salted salmon roe contaminated, probably during the production process, with enterohaemorrhagic *E. coli* (EHEC) O157 occurred in Japan in 1998 [9]. The roe was stored frozen for 9 months, but it appears that O157 could survive freezing and a high concentration of NaCl and retained its pathogenicity for humans [10].

DISCUSSION

Spoilage of fish and fishery products can be attributed to the following: 1-Micro-organisms and their enzymes.

- Chemical spoilage such as lipid oxidation (rancidity).
- Autolysis(enzymes from fish).

The main spoilage of thawed mince is due to bacteria. Keeping mince at 0°C or over results in rapid growth of psychrotrophic bacteria and same of these bacteria are active spoil agents. They produce various enzymes which result in the production of various chemicals which give bad smell and taste. Best known of these reactions is the bacterial breakdown of TMAO to TMA. The main constituents of TVB-N are TMA and ammonia (NH_3). In this project, Atlantic Pollock was found to have fat content in the range of 0.3-0.4%. That means that this species of fish is very lean which makes spoilage due to lipid oxidation (rancidity) very unlikely [11].

Spoilage due to autolytic enzyme in this product should be of minor importance compared to bacterial spoilage since such enzymes are mainly found in the intestine of the fish. This could be a big problem in fish, whereas the intestines are not removed prior to mincing. There are several important processing factors which are involved in the manufacture of minced fish. They include processing steps such as deheading, gutting or filleting for medium size fish (Pollock), fish temperature and moisture content in the minced fish and the processing line was partly responsible for increase in microbiological measurements. Since quality assessment can not be done under deep frozen conditions, minced fish must be thawed [12].

There are four main reasons for the increase in the total, H_2S-producing psychrotrophic bacteria and total coliforms and faecal coliforms for raw material and minced fish after thawing:

- Temperature increase in the processing line that affects psychrotrophic bacterial growth and growth of the coliforms.
- Improper cleaning system can be lead to high bacterial counts. It is of great importance to clean all machinery thoroughly before and after processing. Floors, walls, etc. should also be cleaned.
- Water can be contaminated.
- Low hygiene of staff for processing the mince can be a reason for increasing total coliforms and faecal bacteria. Clean gloves and clothes are essential in fish processing. People suffering from bad colds or stomach illnesses should not work in food production.

The observed low total and faecal coliform count for thawed minced fish might have been due to the sharp drop of temperature from -30°C to room temperature. This sharp drop could have caused stress to the bacteria resulting in low metabolic rate of the bacteria [5]. This decrease was probably also due to competition to the growth of psychrotrophic bacteria. Temperature was kept at 1 - 2°C and coliforms do not grow at low temperature. Although there can be a high bacterial count in the initial mince fish products, this is not problem for they can be inactivated in heat processing. The coliforms bacteria are all killed during heat processing of mince product like fish burger, sausage, etc.

Keeping food frozen prolongs the shelf-life of the food and also inhibits the growth of micro-organisms. It is worth noting that for minced products -30°C is the best temperature for prolonging shelf-life.

The reasons for decreasing bacterial count of the frozen minced fish are different tolerance of bacteria to low temperature. Micro-organisms differ in their responses to freezing. Some survive unharmed, while others are sensitive to freezing and freezer storage. Most micro-organisms are killed in the temperature range from -2 -10°C. It is however apparent from this study that some bacteria were killed during the 50 day storage of the mince at -30°C. Coliforms were very sensitive. TMA and TVB- N did not change significantly in this project during freezer storage [4].

CONCLUSIONS

- This study shows that a lean fish and good raw material for the preparation of minced fish products, which include fish sausage, fish burger, fish ball, etc. and it also gives an attractive colour. The final product is cheap and can be used for consumption.
- Many categories of fish are suitable for the production of minced fish but lean fish is considered the best. Fatty fish muscle can also be used for minced products, but thorough washing is necessary for removing the excess fat globules.
- The results indicate that the -30°C is the optimum temperature for the storage of minced fish to have longer shelf-life.
- Minced fish compared to whole one has much larger surface area, which makes it more vulnerable to environmental factors. Thus, the mincing process must have a corresponding higher standard to quality control. The initial relatively high bacterial count isn't very important in the mince and raw material, because further processing will take place such as cooling which reduces microbial contamination considerably.
- Bacterial count of minced fish is usually higher than other fish products. To avoid high bacterial content it is advisable that processing plant constantly check temperature, cleaning system and staff hygiene during processing.

Most outbreaks of food poisoning associated with fish derive from the consumption of raw or insuffi-ciently heat treated fish, which may be contaminated with bacteria from water environment (Vibrio spp., *C. botulinum*) or terrestrial sources (*C. perfringens*, Salmonella spp., Shigella spp., Staphylococcus spp., *V. cholerae*), or fish products recontaminated aGer heat processing. Wound infections, caused particularly by mycobacteria, *Strep. iniae*, Erys. rhusiopathiae or Ph. damselae and V. alginolyticus are seen a−er injury during handling fish or a−er exposure of open wounds to water environment.

In the case of poor hygiene, the contamination of fish and fish products may increase due to unsanitary procedures, the rotation of the assigned duties of workers and airborne microorganisms during packing of the product.

Hot smoking in mild conditions at a temperature in the fish not exceeding 65°C and a low concentration of salt does not inactivate all pathogens or inhibit bacteria during storage. Thus the required safety can be obtained only by using very fresh fish handled in hygienic conditions, controlling the processing and the plant hygiene at critical control points and chilling of the product to about 2°C.

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