Original Article

A Comparative Microbiological Quality Assessment of Frozen and Fresh Fishes from Erbil City

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Abstract

Background: Since ancient times, the majority of humans have been categorized as pescatarians, depending mostly on seafood and fish as well as their byproducts. Fish is currently in greater demand as it is a good source of protein, which is necessary for maintaining the health of muscles, organs, and blood vessels. Due to their sensitive tissues and aquatic environment, fish are especially prone to microbial infections. It has been suggested that one way to assess the quality of fish is through the monitoring of these bacteria. **Objectives:** The current study aimed to examine the microbiological quality of fresh and frozen fishes. **Materials and Methods:** A comparative study was conducted to evaluate the microbial quality of fresh and frozen common carps to raise food safety concerns, Iraq-Erbil city. A total of 50 samples of fishes were collected from local markets and breeding ponds from September 2021 to January 2022. The most probable number (MPN) method was used for the estimation of the total coliform, whereas the horizontal method was used for the enumeration of *Salmonella* spp. **Results:** In this study, 53% of frozen samples contaminated with the coliform, whereas 15% of the fresh common carps were contaminated with coliform and passed the acceptable range (<100 MPN/g). *Salmonella* spp. was not found in any fresh samples, although it was recorded in 20% of the frozen common carps. **Conclusion:** Further investigations are required with molecular techniques including polymerase chain reaction to determine the species and type of contamination in frozen fishes.

Keywords: Bacteria, coliform, common carp, frozen, market, pathogen

Introduction

Seafood is important to world nutrition as it is a valuable source of key nutrients.[1] Seafoods are highly digestible and have a high biological value.[2] Thus, requirements on the sea food have been increased over the past few decades.[3,4] Various benefits of seafoods have been investigated and reported; seafood, especially fish, is an excellent source of important micronutrients such as iron, zinc, and selenium, and it is also bioavailable.[1] A good source of long-chain omega-3 highly unsaturated fatty acids including eicosapentaenoic acid and docosahexaenoic acid, which have been associated with a range of health benefits, is fish.[5-7] Furthermore, compared with most terrestrial meats, aquatic animal food products are a better source of numerous essential water and fat soluble vitamins.[8]

Fish are extremely susceptible to microbial infection due to their soft tissues and aquatic habitat.[9] During transportation, handling, processing, and storage, fish may get contaminated.[10-12] Three types of pathogens from various bacterial taxa that are present in seafoods and related items include the following: In the environment of the consumed species, bacteria such as *Vibrio* spp., non-proteolytic *Clostridium botulinum*, *Plesiomonas shigelloides*, and *Aeromonas* spp. are frequently encountered; in the environment, bacteria such as *Listeria monocytogenes*, proteolytic *C. botulinum*, *C. perfringens*, and *Bacillus* spp. are frequently encountered; and finally, bacteria such as Salmonella are encountered.[13-15] Consumption of these contaminated fish may cause infection or intoxication to the consumers.[12]

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However, fresh seafood is perishable, and the bacteria that deteriorate fish kept in an aerobic environment are often Gram-negative psychrophilic non-fermenting rods.[16] Therefore, *Shewanella putrefaciens* and *Pseudomonas* spp. make up the majority of the flora in aerobic ice storage, and it has been suggested that one way to assess the quality of fish is through the monitoring of these bacteria.[17] In order to raise concerns about food safety in Erbil City, the present study was done to examine the microbiological quality of fresh and frozen fish.

Materials and Methods

Fifty fishes *Cyprinus carpio* with the weight range of 2–3 kg addressed in the present study included 30 frozen fishes and 20 fresh fishes; the frozen fishes were collected from local markets, whereas fresh fishes were collected from Garda Rash (latitude 36°1142644′/longitude 44°0136382′, which is 6 km away from the Erbil city center) breeding ponds from September 2021 to January 2022. Samples were collected with sterile glassware (121°C, 15 psi, 20 min), and 50 g from various fish parts was collected in triplicate and then blended, homogenized individually, and digested into 225 mL of buffered peptone water in a sterile mixer for 30–60 s.[18]

Bacteriological analysis

Two methods have been used for the detection and enumeration of total coliform (TC) and *Salmonella* spp., as described by previous studies.[12,16] For the aforementioned purpose, the most probable number (MPN) method was used for the estimation of the TC in both frozen and fresh fishes; autoclave was used for preparing and sterilizing lauryl tryptose broth (LTB), and the sterilized tubes contained 9 mL of media and serial dilution prepared.[19] Finally, each tube contained media, inverted Durham's tube, and 1 mL of sample which was incubated at 37°C for 48 h; Durham's tubes that produce gas are regarded as advantageous or positive.[20]

Food microbiology and animal feed ingredients (ISO 6579, 2002) offer a horizontal approach for enumerating *Salmonella* spp. and a horizontal method is used for detecting *Salmonella* spp. For pre-enrichment, samples were diluted in 225 mL buffered peptone water and incubated at 37°C for 18 h. Following plating on XLD, Rambach, and XLT-4 agar (37°C for 24 h), further selective enrichment was performed in Rappaport-Vasiliadis peptone broth (41°C for 24 h) and Muller–Kaufmann tetrathionate broth with Novobiocin.[16]

Ethical approval

The study protocol and the subject information and consent form were reviewed and approved by a local Ethics Committee (Salahaddin University-College of Agricultural) 24/102 (2021).

Results

Regarding the incidence and distribution of TC from common carps presented in Table 1, 53% of frozen samples contaminated with the coliform, whereas 15% of the fresh common carps were contaminated with coliform and passed the acceptable range (<100 MPN/g).

As shown in Table 2, incidence and distribution of *Salmonella* spp. from common carps showed that fresh samples are superior to the frozen samples as no incidence of *Salmonella* spp. was detected in fresh samples, whereas *Salmonella* spp. were recorded in 20% of frozen samples.

The comparison chart showed the incidence rate of both coliform and *Salmonella* spp. in both the groups. Totally, the incidence of coliform was higher in fresh samples, whereas the *Salmonella* spp. were observed in 20% of the frozen samples, as shown in Figure 1.

Discussion

The common carp (*Cyprinus carpio*) is the major species that is currently cultured in Iraq and Kurdistan region as well.[21] There are many reasons that this type became very popular, including tolerating a wide range of temperatures (1–35°C) and pH values.[5-9,22] Moreover, carps are omnivorous fish that dwell in large concentrations in small ponds, cages, or tanks, and their food consists of water plants, benthic invertebrates, insects, crustaceans, and artificial meals.[21] In contrast, common carps are extremely susceptible to microbial infections due to their soft tissues and aquatic habitat.[9] During transportation, handling, processing, and storage, fish may get contaminated.[10-12] Thus, this study compared microbiological quality of fresh and frozen fish to suggest the best with minimum bacterial contaminations in Erbil city.

The acceptable limits of TC for fresh and frozen fish are <100 MPN/g.[23] Accordingly, for the above range, the

Table 1: Incidence and distribution of total coliform from common carps

Type of common carps	Number of samples	Number of positive samples	Positive samples (%)
Fresh	20	3	15
Frozen	30	16	53

Table 2: Incidence and distribution of *Salmonella* spp. from common carps

Type of common carps	Number of samples	Number of positive samples	Positive samples (%)
Fresh	20	0	0
Frozen	30	6	20

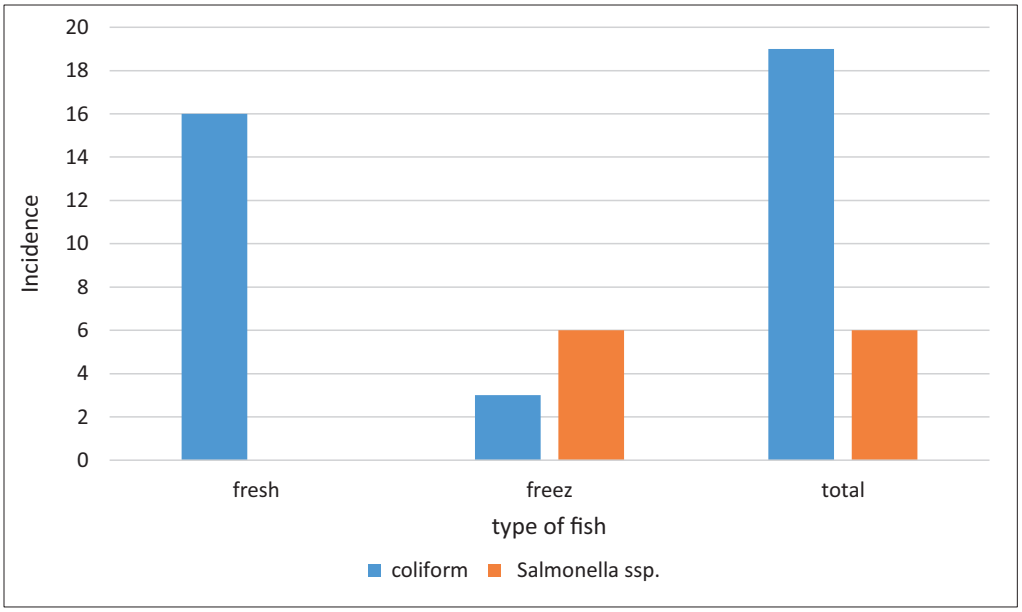

Figure 1: The incidence of coliform and *Salmonella* spp.

positive samples were recorded. In the present study, 53% of frozen samples contaminated with the coliform, whereas 15% of the fresh common carps were contaminated with coliform and passed the acceptable range. The presence of TC indicates contamination during the processing process, transport, and handling. Furthermore, contamination could result from the water used for washing or icing.[24] The result regarding TC from fresh fishes in the present study disagrees with the results of the another study, which was conducted in Bangladesh which recorded low incidence of TC in frozen fishes.[12] The findings in this study are in line with the findings of other studies.[25]

Food-poisoning outbreaks have been linked to *Salmonella* spp., *Shigella* spp., *Escherichia coli*, *Vibrio parahaemoliticus*, and *Listeria monocytogenes*.[26] According to the previous study, the probability of *Salmonella* and Shigella *infections* was lower in marine fish than in freshwater fish, which could carry these organisms if captured in contaminated streams, rivers, or lakes as a result of sewage contamination, land runoff, and other factors.[27] In this study, the quality of the collected samples was good; no incidence of *Salmonella* spp. was detected in fresh samples, whereas in 20% of the frozen samples *Salmonella* spp. were observed. The Centers for Disease Control and Prevention (CDC) recently revealed that 62 people from 11 states in the USA were infected with *Salmonella paratyphi* B variant L(+) tartrate(+) bacteria (which was formerly known as Salmonella Java) after eating frozen raw tuna; the symptomatic infections including diarrhea, abdominal cramps, and fever were recognized after 12–72 h of exposure.[28,29]

Overall, in this study, the incidence of coliform was higher than that of *Salmonella* spp., as shown in Figure 1; this led to an explanation that the type of contamination of fresh fish was sewage. The incidence of coliform is high during sewage contamination, whereas the probability of *Salmonella* spp. was low.

Conclusions

- TC contamination could result from the water used for washing or icing.
- Low incidence of TC is reported for fresh fishes when compared with frozen fishes.
- The quality of fresh common carps was at good, and no incidence of *Salmonella* spp. was detected.
- Further investigations are required with molecular techniques including polymerase chain reaction to determine the species and type of contamination in frozen fishes.

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Conflicts of interest
There are no conflicts of interest.

References

1. Hicks CC, Cohen PJ, Graham NAJ, Nash KL, Allison EH, D'Lima C, *et al*. Harnessing global fisheries to tackle micronutrient deficiencies. Nature 2019;574:95-8.
2. Kok B, Malcorps W, Tlusty MF, Eltholth MM, Auchterlonie NA, Little DC, *et al*. Fish as feed: Using economic allocation to quantify the fish in: fish out ratio of major fed aquaculture species. Aquaculture 2020;528:735474.
3. FAO. Fisheries and Aquaculture topics. FAO: The State of World Fisheries and Aquaculture (SOFIA). Ghana. Fishing canoes and gear in the Canoe Basin, Tema. 2019. p. 213.

4. Molajou A, Afshar A, Khosravi M, Soleimanian E, Vahabzadeh M, Hajes V, *et al*. A new paradigm of water, food, and energy nexus. Env Sci Pollut Res 2021:1-11.
5. Tacon AG, Mjrifs M. Food matters: Fish, income, and food supply—A comparative analysis. Aquaculture 2018; 26:15-28.
6. Calder PC. Conference on "The future of animal products in the human diet: Health and environmental concerns." Plenary Lecture 3 n-3 PUFA and health: Fact, fiction and the future. Very long-chain n-3 fatty acids and human health: Fact, fiction and the future. Proc Nutr 2019;77:52–72.
7. Spiller P, Hibbeln JR, Myers G, Vannice G, Golding J, Crawford MA, *et al*. An abundance of seafood consumption studies presents new opportunities to evaluate effects on neurocognitive development. Prostagland Leukot Essent Fatty Acids 2019;151:8-13.
8. Namwanje M. Changes in Nutritional Quality and Microbial Safety, Makerere University. 2018.
9. Al Shabeeb SS, Ibrahim MM, Gajijocm R, Sciences A. A comparative microbial quality assessment among fishes, prawns and cuttlefishes collected from Dammam fish market. Int J Curr Microbiol Appl Sci 2016;5:405-18.
10. Bryan FL. Epidemiology of foodborne diseases transmitted by fish, shellfish and marine crustaceans in the United States, 1970–1978. J Food Protect 1980;43:859-76.
11. Gangarosa EJ, Bisno AL, Eichner ER, Treger MD, Goldfield M, DeWitt WE, *et al*. Epidemic of febrile gastroenteritis due to Salmonella Java traced to smoked whitefish. Am J Public Health Nations Health 1968;58:114-21.
12. Sanjee SA, Karim ME. Microbiological quality assessment of frozen fish and fish processing materials from Bangladesh. Int J Food Sci 2016;2016:8605689.
13. Huss HH. Assessment and Management of Seafood Safety and Quality. Italy: Daya Books; 2007.
14. Dib AL, Agabou A, Chahed A, Kurekci C, Moreno E, Espigares M, *et al*. Isolation, molecular characterization and antimicrobial resistance of Enterobacteriaceae isolated from fish and seafood. Food Control 2018;88:54-60.
15. Ismail AH, Abed BS, Abdul-Qader S. Application of multivariate statistical techniques in the surface water quality assessment of Tigris river at Baghdad stretch. J Babylon Univ 2014;22:450-62.
16. Topić Popović N, Benussi Skukan A, Džidara P, Čož-Rakovac R, Strunjak-Perović I, Kozačinski L, *et al*. Microbiological quality of marketed fresh and frozen seafood caught off the Adriatic coast of Croatia. Vet Med 2010;55:233-41.
17. Chouliara I, Savvaidis I, Panagiotakis N, Kontominas MJFM. Preservation of salted, vacuum-packaged, refrigerated sea bream (*Sparus aurata*) fillets by irradiation: Microbiological, chemical and sensory attributes. Food Microbiol 2004;21:351-9.
18. Andrews W, Hammack TJ. Food sampling and preparation of sample homogenate. Bacteriological Analytical Manual, 2003:1-10.
19. Niewolak S, Tucholski SJF, Life A. Sanitary and bacteriological evaluation of common carp, tench and crucian carp reared in a pond supplied with biologically treated sewage. Fish Aquat Life 2000;8:35-48.
20. Feng P, Weagant SD, Grant MA, Burkhardt W, Shellfish M, Water BJ. BAM: Enumeration of *Escherichia coli* and the Coliform Bacteria. Food and Drug Administration (FDA), Bacteriological Analytical Manual Online. 8th ed. Berlin: Silver Spring; 2002;13.
21. Ahmed AR, Al-Zewar JM, Fawzi NA-M, Abulhasan AA. Culture of common carp (*Cyprinus carpio* L.) in Basrah Governorate, southern Iraq: Current status and suggestions for developmentEcol Env Conserv 2020;26:824-31.
22. Woynarovich A, Bueno PB, Altan O, Jeney Z, Reantaso M, Xinhua Y, *et al*. Better management practices for carp production in Central and Eastern Europe, the Caucasus and Central Asia. 2011;202:12-8.
23. Stewart GJM. Micro-organisms in Food-2. Sampling for Microbiological Analysis: Principles and Specific Applications ICMSF. Oxford: Blackwell Scientific Publications; 1986. p. 310, 315.
24. Boyd CE. Water quality in ponds for aquaculture. Aquaculture 1990;141-56.
25. Shafi J, Waheed KN, Zafarullah M, Mirza ZS, Yaqoob SS. Effect of icing on quality of silver carp during frozen storage. J Food Process Preserv 2020;44:e14654.
26. Pamuk S, İnat G, Sırıken B. Prevalence, serotypes distribution and characterization of *Salmonella* in common carp (*Cyprinus carpio*), Afyonkarahisar Province, Turkey. 2019.
27. Basti AA, Salehi TZ, Bokaie S. Some bacterial pathogens in the intestine of cultivated silver carp and common carp. In: Developments in Food Science. Vol. 42. Elsevier; 2004. p. 447-51.
28. Hassan R, Tecle S, Adcock B, Kellis M, Weiss J, Saupe A, *et al*. Multistate outbreak of *Salmonella paratyphi* B variant L (+) tartrate (+) and *Salmonella weltevreden* infections linked to imported frozen raw tuna: USA, March–July 2015. Epidemiol Infect 2018;146:1461-7.
29. Hassuny AA, Kadhim IJKAH. Molecular characterization of *Salmonella typhi* isolated from typhoidial humans. Int J Bacteriol 2015;12:646-652.