Food and Agriculture Organization of the United Nations

World Health Organization

Joint FAO/WHO Expert Meeting on Microbiological Risk Assessment (JEMRA) on the Safety and Quality of Water Used in the Production of Fishery Products

Virtual meeting

14 June – 2 July, 29 July, 30 August, 14 October 2021

SUMMARY

Issued on 1 November 2021

A virtual meeting of the Joint FAO/WHO Expert Meeting on Microbiological Risk Assessment (JEMRA) on the Safety and Quality of Water Used in the Production of Fishery Products was convened from 14 June to 2 July 2021 with three additional sessions on 29 July, 30 August, and 14 October 2021. This meeting was the fourth in a series of meetings examining appropriate and fit-for-purpose microbiological criteria for water sourcing during food production with application to fishery sectors. The main purpose of the meeting was to consider the safe use of water in the production of fish and fishery products and to identify possibilities for the reuse of water (note: a JEMRA meeting on the Safety and Quality of Water Used in the Production of Dairy Products was convened concomitantly).

If conditions had permitted, this meeting would have been held at WHO headquarters in Geneva, Switzerland. Because of the travel restrictions and lock-downs due to the COVID-19 pandemic in many countries, the joint FAO/WHO secretariat was unable to convene a physical meeting. Therefore, the meeting was held as a videoconference using a virtual online platform.

Dr Rob de Jonge served as Chairperson.

Dr Carlos Campos served as Rapporteur.

This document summarizes the conclusions of this meeting. The full report will be published as part of the FAO and WHO Microbiological Risk Assessment (MRA) Series. The meeting participants are listed in Annex 1 of this summary report.

More information on this work is available at:

http://www.fao.org/food-safety/en/

and

https://www.who.int/foodsafety/en/

Background and objectives

In 2020, the 43rd session of Codex Alimentarius Commission approved the new work entitled "Development of Guidelines for the Safe Use and Reuse of Water in Food Production" proposed at the 51st Session of the Codex Committee on Food Hygiene (FAO and WHO, 2020a). To support this work, JEMRA was asked to provide scientific advice on sector-specific applications and case studies for determining appropriate and fit-for-purpose microbiological criteria for water sourcing, use and reuse in:

- fresh produce,
- fish and fishery products from primary production to retail, and
- in the dairy sector from milk harvest to manufacturing.

The purpose of this meeting was to develop clear and practical guidance on the criteria and parameters that can be used to determine if water is fit-for-purpose for sourcing, use and reuse in the fish sector – the production of fish and fishery products across the food chain (primary production, including shellfish farming, and processing) from the fishing vessel or freshwater production site and throughout processing facilities using a risk-based approach.

Situation analysis concerning water use and reuse in the production and processing of fishery products

Water is a key element in the production and processing of fishery products. Water can be sourced from the sea or rivers or, in the case of land-based fish farming systems, from springs, wells, rivers, lakes, or other drinking water supply systems. These waters can be subject to many detrimental effects from climate change, pollution associated with population growth and development, and higher demands for food production and other uses. In the fish/shellfish production and processing industry, water is used:

- for rearing or harvest,
- as an ingredient,
- to transport/convey products,
- to wash, cool down and cook foods,
- to clean and sanitize facilities, utensils, containers, and equipment,
- to make ice and glazed products, and
- for drinking.

There is a need to implement more sustainable practices for the management and efficient use/reuse of water resources in the fish production process, as well as a need to preserve and protect aquatic ecosystems.

Any source of water can be used in primary production of fish and other aquatic organisms, provided that the risks are previously assessed, its quality is monitored, and it complies with quality criteria pre-defined by a risk assessment approach.

The experts agreed that there are multiple opportunities for re-using water in the fish and fishery industry sector, especially in processing activities, many of which have not yet been materialized by the industry. While there are commercially available water treatment technologies to achieve the desired safety and quality attributes for specific applications, economic and environmental impact assessments are needed

to facilitate decision-making by fish processors. The application for which water is intended to be reused determines whether that water is fit-for-purpose and/or a specific treatment is required before it can be used.

Fish and fishery products are generally regarded as safe, healthy, and nutritious foods. However, these products have been associated with infections and intoxications mediated by viruses (as norovirus and Hepatitis A), bacteria (as vibrios and *Salmonella*), protozoans (as *Giardia* and *Cryptosporidium*), and helminths (as *Anisakis*). The causes of such seafood safety concerns are diverse, ranging from contamination of primary production environments to poor hygiene practices during processing and consumption.

The burden of illnesses associated with fish and fishery products is highly uncertain due to a lack of data. However, it is evident from the epidemiological evidence that water (including direct contact, indirect contact, and accidental water) is a very important vehicle for attribution purposes, often acting as a vector to transmit pathogens among food items, thus increasing the number of people exposed to the pathogens. Pathogens can remain infectious in sources of water for a considerable time and affect the suitability of a site to harvest or produce fishery products. Populations/communities and fish producers and processors served by inadequate levels of water treatment are potentially more vulnerable to the microbial hazards relevant to seafood products.

To mitigate these health risks, the use of water in the production and processing of fishery products should be subject to a risk-based approach covering the whole water system from the source or catchment area to storage, distribution and up to the point of use (from “source to tap”). In this context, sanitary surveys/profiling and an HACCP based approach such as water safety plans (WSP) are important to determine water fitness and the likelihood of contamination in the production and processing systems. To prevent contamination, good hygiene practices should be applied at all steps of the chain, from harvesting, processing, storage, and distribution. The requirements for hygienic practices constitute the prerequisite programmes that are essential for any food operation prior to the implementation of HACCP systems.

It was noted that, in many parts of the world, existing regulations limit the use of fit-for-purpose water and may not reflect current technological capabilities of water treatment. Additionally, many regulations do not sufficiently consider the widespread use of brackish- and seawater in the fish and fishery sector. Development of new regulations and/or improvement of existing ones on quality and safety criteria for water sources, as well as minimum requirements for use in fish production and processing would assist definition of fit-for-purpose water from different water sources and reuse applications.

Analysis of case studies for different risk-based water use and reuse processing scenarios and species

Experts were asked to appraise international case studies representing a range of risk-based water use and reuse scenarios and fish and shellfish species. From the selected case studies, the experts noted that:

- In aquaculture, selecting a source of continuous high-quality water is critical to any successful farm operation as the source determines the quality of production water. Fish require large quantities of unpolluted water to grow rapidly and maintain their wellbeing.

- While integrated aquaculture-treated wastewater systems are becoming more common in geographies with limited access to public/municipal source or private wells, presently there is insufficient evidence to consider the use of treated municipal wastewater as a suitable source of safe water for fish farming.
- To preserve the sanitary quality of fish and fishery products on board vessels and in processing factories, precautionary measures must be applied to control any cross-contamination and temperature abuse occurring from capture to market.
- The canning industry uses large volumes of water in multiple processing steps (e.g., cleaning, washing, cooling, thawing, ice production/removal). Each of these steps should comply with internationally recommended standards to control physical, chemical, and biological hazards that could affect the safety and quality of the products.

Water quality monitoring and the use of non-culture based microbiological methods

Water monitoring is a core element of food safety management systems and is required to ensure water quality and safety and to define fit-for-purpose water in the seafood sector (FAO and WHO, 2020b). Worldwide, most seafood industries monitor the quality of the water used in production and processing of fish and understand the concept of water fitness, but monitoring practices are not always incorporated into a safety management system. Ideally, such safety management systems should be risk-based and consider historical data and expertise of the safety manager. While much good practice guidance on monitoring has been elaborated for primary production environments, there is no agreed definition of what constitutes an appropriate monitoring programme for direct and indirect contact waters in the fish processing environments.

Indicator species (e.g., *E. coli*) have been used in monitoring programmes to indicate the presence of specific pathogens for assessing microbiological fitness of water used in fish production and processing. The use of indicator microorganisms (process indicators, faecal indicators, index organisms) has been successful in assessing the fitness of water for its intended use(s) and in reducing human exposure to microbial hazards. However, irrespective of the fish production and processing step, today we recognize that on a sample-by-sample basis, there is rarely a direct correlation between coliform bacteria and indigenous marine pathogenic bacteria such as vibrios, enteric protozoans or viruses.

Physical or chemical parameters provide more timely results, to base ongoing monitoring or the need to take immediate corrective action, than microbial indicator species. Given that the microflora relevant for the reuse of water is operation-specific, it is generally not appropriate to rely solely on testing of microbiological parameters, when these are not relevant in the context of a particular fish processing operation. It is more appropriate to conduct an operation-specific assessment to determine which indicator(s) could be used to control the reuse water generation process or the need to take corrective actions. Since water disinfection, in particular chlorination, is commonly used to ensure water safety in fish processing plants, frequent monitoring of this stage, or on-line measurement of the disinfectant residual, is recommended.

The Experts also noted that despite significant developments in non-culture based microbiological methods (PCR, WGS, microbiome analysis) for detection and quantification of enteric pathogens in water, there is currently insufficient information on method performance, harmonization, and standardization to enable their use in regulatory monitoring.

Recommendations concerning the safety and quality of water used in fish production and processing

Water use and reuse needs to be tailored to the particular conditions of the specific fish production or processing operation it is applied to, considering its potential reusable water sources, the various applications of the reused water, available recovery and treatment technologies, and the capabilities of the operator. Frequently, relevant information on source water quality can be obtained from water suppliers. For each possible water reuse scenario considered for implementation, it is recommended that operators consider the following in assessing and managing microorganisms in water use and reuse:

- Ensure the safety of water used in the production and processing of fishery products using a risk-based approach covering the whole water system from the source to the point of use. Additionally, characterization of surface or groundwater quality in abstraction points should be extended upstream, to include the whole water catchment area.
- Coastal sources, used for abstraction of seawater in land-based establishments, cannot be guaranteed to be free from pathogens from the marine biota or from faecal contamination, and cannot be classified as a fit-for-purpose source. Seawater from offshore sources are generally considered safe. However, depending on the geographical region and temperature, seawater can hold indigenous potentially pathogenic bacteria, such as Vibrio, that may require control.
- Elaborate and put in place risk assessment and management procedures and implement efficient monitoring plans according to recognized guidelines or standards. The risk management is validated by both compliance with official control limits/standards in water or finished products and additional self-controls of production and processing steps.
- In the risk assessment, consider the specific waterborne hazards (e.g., marine microbial contaminants) that may impact the safety and quality of the fishery product(s). Where necessary, develop and apply a risk-based approach in line with the WSP framework.
- Where disinfection forms part of the water treatment, ensure that the efficiency of the disinfection applied is validated. The same applies to any other water treatment that may be applied to the water used in the industry.
- Hazards and hazardous events at the level of the catchment area were found to determine water fitness for different sources of surface and groundwater. Operators should assess all possible contamination risks from the immediate area of the catchment and seasonal/climatic factors affecting source water quality through regular testing and development of farm-specific profiling and precautionary measures. Take every precaution to protect the source water from any contamination. In some regions, this can be particularly relevant during the rainy season.

- Implement operational monitoring of the water used in the production and processing of fishery products to provide insight into process performance and associated water quality issues, enabling rapid remedial action in the event of non-conformity.
- Control the microbiological stability of finished products to confirm that food safety criteria are respected before marketing.
- Implement good hygiene practices throughout primary production and processing. Provide training on good hygiene practices to all staff and eliminate the potential for littering and faecal contamination (e.g., in areas without sewerage systems or where open defecation is observed).
- Regulatory agencies and other relevant organizations should provide examples and training on how to use food safety plans and risk assessments to define water quality targets for fit-for-purpose water.
- Regulators, processors, and consumers have a negative perception about the use of fit-for-purpose water. Strategies to overcome misconceptions should be considered.
- Some countries lack water management and supervision strategies to protect and effectively use water sources to provide for other regions with low water availability. As safe water recycling and recuperation are currently improbable due to technical and financial barriers, ensuring the protection and sustainability of these sources should be of utmost importance. In remote areas, provision of water wells and toilets for the local population will further reduce the risk of human exposure to pathogens and help regulate access and use of water sources.
- Ensure that there is an adequate supply of drinking (potable) water and facilities for its storage and distribution to ensure the safety and quality of food.

Critical research gaps and policy developments

- Limited information was found on artisanal production and processing practices. This is true for quantities of fish, applied technologies and quantities of water used. Scarce information was also found on the volumes of water used in industrial fish processing. This limits the ability to assess the effects and opportunities of water reuse.
- Detailed characterization (microbial and chemical) of individual outlet water from different unit operations is limited in peer-reviewed literature. Yet, such information is critical to design effective water conservation strategies, assess the need for treatment and its extent, and conduct risk assessments for hazard control and robust WSP.
- There is a lack of information on how to design operational water monitoring plans. These should be site specific and must consider the relevant hazards and hazardous events and the outcomes of a risk assessment of the water system.
- There is a need for clear and simple standard operating procedures for water monitoring in vessels, primary production and processing facilities of fish and fishery products.

- Improved and/or new regulations on quality and safety criteria for water sources are needed, including minimum requirements for use in production and processing of fish products. International regulatory bodies should aim to harmonize guidelines on the use of brackish- and seawater during transport and processing, and revise guidelines for the safe use of water in the fish and fishery sector. This was also identified in the previous meeting (FAO and WHO, 2019).
- There is a need to obtain more data on seawater quality and to harmonize the types and quality of water used in the different steps of fish production and processing, particularly on board of vessels.
- Research should be carried out to define suitable criteria for characterizing water quality and safety of waters used in the production and processing of fishery products.
- There is also a need to improve analytical methodologies and establish quality criteria for verifying the quality of seawater, when used for production and processing of fishery products.
- Further research is needed to determine the pathogen reduction efficiencies in water treatments, relationships between water quality parameters tested in fish production environments, pathogen infectivity and health effects on fish producers/processors and fish consumers.
- There is a lack of information on the impacts of public (municipal) wastewater reuse in the primary production of fishery products, namely in aquaculture.
- Lack of information on hazards and hazardous events in the catchment area of different water sources (namely in surface- and groundwater).

References

[1] FAO and WHO. 2020a. *Codex Alimentarius Commission*. Report of the 51st Session of the Codex Committee on Food Hygiene. Guidelines for the Safe Use and Reuse of Water in Food Production. http://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FMeetings%252FCX-712-51%252FReport%252FREP20_FHe.pdf.

[2] FAO and WHO. 2020b. Code of Practice for Fish and Fishery Products. Rome. https://doi.org/10.4060/cb0658en.

[3] FAO and WHO. 2019. Safety and Quality of Water Used in Food Production and Processing – Meeting report. Microbiological Risk Assessment Series no. 33. Rome. https://www.fao.org/3/ca6062en/CA6062EN.pdf

Annex 1: List of participants

EXPERTS

Dr Rob de Jonge, the Netherlands

Dr Bjørn Tore Lunestad, Norway

Dr Yulie Meneses, the United States of America

Dr Voniarisoa Razafindramary Rahanjavelo, Madagascar

Dr Maria do Rosario Coelho, Portugal

RESOURCE PERSONS

Dr Jose Emilio Esteban, the United States of America

Ms Mirian Yamileth Bueno Almendarez, Honduras

Ms Constanza Vergara, Chile

Ms Esther Garrido Gamarro, FAO, Italy

Ms Lingping Zhang, Codex, Italy

SECRETARIAT

Dr Carlos Campos, New Zealand

Ms Haruka Igarashi, WHO, Switzerland

Ms Christine Kopko, FAO, Italy

Dr Jeffrey LeJeune, FAO, Italy

Dr Kang Zhou, FAO, Italy