INTERNSHIP PROJECT REPORT

"Fulfillment of gap's in FSMS guidance on milk and milk products/ meat and meat products and development of guidelines for safe use of water in food processing".

Submitted by

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With

Food safety and standards authority of India.

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I would like to express my deepest gratitude to my supervisor Shri. Kumar Anil, Advisor(Standards), FSSAI and Shri. P. Karthikeyan, Deputy director (Regulations/Codex), FSSAI for allowing me to carry out my internship in such an esteemed organization and for taking out time from there busy schedule to hear, guide and keep me on correct path during the training.

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I perceive this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on their improvement, in order to attain desired career objectives. Hope to continue cooperation with all of you in the future.

Date: Sheela P S

Place: ID No- FLH5043

CERTIFICATE

This is to certify that Ms. Sheela P S, ID No. FLH5043, a student of College Of Agriculture, Hassan has completed the internship report titled **“Fulfillment of gap’s in FSMS guidance on milk and milk products/ meat and meat products and Development of guidelines for safe use of water in food processing”** successfully under my supervision. To the best of my knowledge and as per her declaration the report is an authentic work on the issue carried out at Food safety and standards authority of India.

Guide	**Guide**
Ms. Anju Kavi	Ms. Pushpinder Jeet
Technical Officer (Standards)	Assistant Director (Codex)
FSSAI, New Delhi	FSSAI, New Delhi

About the Organization

Food Safety and Standards Authority of India (FSSAI) is an autonomous body established under the Ministry of Health & Family Welfare, Government of India. The FSSAI has been established under the Food Safety and Standards Act, 2006 which is a consolidating statute related to food safety and regulation in India. FSSAI is responsible for protecting and promoting health through the regulation and supervision of food safety.

FSSAI is headed by a non-executive Chairperson, appointed by the Central Government, either holding or has held the position of not below the rank of Secretary to the Government of India. Mrs. Rita Teaotia is the current Chairperson for FSSAI and Shri. Pawan Kumar Agarwal is the current Chief Executive Officer for FSSAI.

<u>Background</u>:

There was multiplicity of laws relating to Food in the country. There was need of an integrated Food Law. Following Laws were repealed on the enactment of FSS Act, 2006:

- Prevention of Food Adulteration Act,1954
- Fruit Products Order , 1955
- Meat Food Products Order,1973
- Vegetable Oil Products (Control) Order, 1947, Edible Oils Packaging (Regulation) Order 1988
- Solvent Extracted Oil, De- Oiled Meal and Edible Flour (Control) Order, 1967
- Milk and Milk Products Order, 1992

DIVISIONS IN FSSAI:

- Import Division
- International Co-operation
- Food Safety Management System (FSMS) Division
- Regulatory Compliance Division (RCD)
- Risk Assessment and R&D division (RARD)
- Information Education Communication (IEC) Division
- Regulation and Codex Division
- Quality Assurance (QA)/ lab Division
- HR division and Standards Division

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Abbreviation list:

WHO : World health organization

FSMS : Food safety management system

PRPs : Pre requisite programmes

HACCP : Hazard analysis and critical control point

FBO : Food business operator

FSSAI : Food safety and standards authority of India

ISO : International organization for standardization

FAO : Food and agriculture organization

1.0.Introduction:

Food safety: Food safety is used as a scientific discipline describing handle, preparation, and storage of food in ways that prevent food-borne illness. The occurrence of two or more cases of a similar illnesses resulting from the ingestion of a common food is known as a food-borne disease outbreak.

The five key principles of food hygiene, according to **WHO**, are:

1. Prevent contaminating food with pathogens spreading from people, pets, and pests.
2. Separate raw and cooked foods to prevent contaminating the cooked foods.
3. Cook foods for the appropriate length of time and at the appropriate temperature to kill pathogens.
4. Store food at the proper temperature.
5. Use safe water and safe raw materials.

1.1.Objective of food safety:

- ❑ protect the health and safety of consumers by reducing food-related risks
- ❑ help consumers make informed choices about food by making sure they have information they need and are not misled
- ❑ support public health by promoting healthy food choices; maintaining and enhancing the nutritional qualities of food and responding to specific public health concerns.

1.2.Food safety management system(FSMS):

A Food Safety Management System (FSMS) is a network of interrelated elements that combine to ensure that food does not cause adverse human health effects. These elements include programs, plans, policies, procedures, practices, processes, goals, objectives, methods, controls, roles, responsibilities, relationships, documents, records, and resources.

Section 16(2)(c) provides for the Mechanism for accreditation of certification bodies for Food Safety Management Systems and Section 44 of FSS Act provides for Recognition of organization or agency for food safety audit and checking compliance with Food Safety Management System required under the Act or the rules and regulation made there under.

The five basic key elements are:

- Good Practices/ PRPs
- Hazard Analysis /HACCP
- Management Element / System
- Statutory and regulatory requirements
- Communication

1.3.Purpose of FSMS:

Food Safety & Standards Authority of India (FSSAI) has developed a series of sector specific Food Safety Management System (FSMS) Guidance Documents with the intent to provide implementation guidance to food businesses (especially the small and medium businesses) involved in manufacturing, packing, storage and transportation to ensure that critical food safety related aspects are addressed throughout the supply chain.

This document is based on Part II of Schedule 4 of Food Safety & Standards (Licensing & Registration of Food Businesses) Regulation, 2011 which lays down general requirements on hygienic and sanitary practices to be followed by all Food Business Operators applying for License & indicate practical approaches which a business should adopt to ensure food safety.

This document is recommendatory in nature and also provides the basic knowledge and criteria for implementation of Hazard Analysis and Critical Control Point (HACCP) system by the food businesses. Sample HACCP Plans have been taken from some established practicing industries. These plans could be used as reference by the industry and modified or altered based on their operations.

It also includes inspection checklist for Food Business Operator to audit their facility & operations. The FBOs can evaluate themselves based on the indicative scoring. Also, it gives the important templates and forms to facilitate the FBOs to maintain the records. This includes mandatory forms as prescribed by FSSAI & few templates for maintaining records of processes critical for food safety.

According to the Food Safety and Standards Act, 2006, all food business operators must have an FSMS plan. A plan is required even if the food business has a food safety certification from HACCP, ISO or FSSC. At the same time, it is easy to prepare FSMS plans for businesses having these certificates. Irrespective of the type and size of the food business, FSMS plan is created. However, the nature of business will decide the complexity of the plan.

Certifications are growing in popularity. Now, a number of large retailers and manufacturers expect their customers to check for this certification before purchasing the product. This will help to prevent illness. Moreover, a standardized system for ensuring integrity and safety of each link involved in the food chain becomes critical when it comes to consumer protection.

2.0.Microbiological standards:

Principles for the establishment and application of microbiological criteria for foods

2.1.Introduction: These principles are intended to give guidance on the establishment and application of microbiological criteria for foods at any point in the food chain from primary production to final consumption.

The safety of foods is principally assured by control at the source, product design and process control , and the application of Good Hygienic Practices during production, processing (including labeling), handling, distribution, storage, sale, preparation and use, in conjunction with the application of the HACCP system. This preventive approach offers more control than microbiological testing because the effectiveness of microbiological examination to assess the safety of foods is limited.

Microbiological criteria should be established according to these principles and be based on scientific analysis and advice, and, where sufficient data are available, a risk analysis appropriate to the food stuff and its use. Microbiological criteria should be developed in a transparent fashion and meet the requirements of fair trade. They should be reviewed periodically for relevance with respect to emerging pathogens, changing technologies, and new understandings of science.

2.2.Definition :

A microbiological criterion for food defines the acceptability of a product or a food lot, based on the absence or presence, or number of microorganism including parasites, and/or quantity of their toxins/metabolites, per unit(s) of mass, volume, area or lot.

2.3.Purpose :

Microbiological criteria may be used to formulate design requirements and to indicate the required microbiological status of raw materials, ingredients and end- products at any stage of the food chain as appropriate. They may be relevant to the examination of foods, including raw materials and ingredients, of unknown or uncertain origin or when other means of verifying the efficacy of HACCP based systems and Good Hygienic Practices are not available.

Generally, microbiological criteria may be applied to define the distinction between acceptable and unacceptable raw materials, ingredients, products, lots, by regulatory authorities and /or food business operators.

3.0. Fulfillment of gap's in FSMS guidance on milk and milk products

3.1.Introduction : Good quality milk is essential for production of good quality dairy products, taste and flavor, free from pathogens and long keeping quality. Good quality dairy products cannot and can never be made from poor quality raw milk.

Good quality raw milk must be:

- Free from debris and sediment.
- Free from off flavors.
- Low in bacterial numbers.

- Normal composition and acidity.
- Free of antibiotics and chemical residues.

In order for milk to reach the processor and ultimately the consumer still in good condition, a number of things must be observed right from the farm level to the processing factory, and thereafter to the retailers and consumer.

3.2. Objectives :

- This help to fulfillment gap's in FSMS guidance regarding milk and milk products .
- Help to ensure the hygienic condition during processing.
- These points may add weightage to present guidance.
- It will help to protect the consumer health and it ensure the safety to the consumers.
- It helps to extend the shelf life and storage life of products.
- It reduce the risk of a product or process suspension.
- It reduces the risk of food born illness.
- Reduced product reprocessing.
- Compliance with federal and commercial product specifications
- Reduced number of product rejections, returns, and/or complaints.

3.3. Materials used :

- Dairy equipment maintenance : Ministry of agriculture, livestock and marketing , Published by: FAO/TCP/KEN/6611 project, training programme for small scale dairy sector and dairy training institute, Naivasha.
- Dairy equipments – an overview – science Direct topics.
- Dairy plant design and layout text book.
- Receiving, transportation and storage of milk- e- notes
- Food safety, sanitation, and personal hygiene- magazine
- Employees health, Hygiene and hand washing – dairy extension e- notes.
- Wikipedia
- Codex code of practices for milk and milk practices.

3.4. Proposal :

CONCEPT	PROPOSAL	REASON
Building design and layout		
1) Walls and partitions	plastering using cement to sand ratio 1:2 or 1:3 is used for surface finish of walls.	It prevents deterioration and protects from atmospheric effects
	Paints with fungicide (solubilized copper quinolinolate)	To prevents mold growth on surface
2) Floors	Floors should have rounded corners	To ensure proper cleaning and disinfection and hence to prevent contamination
	Bitumen (asphalt or coal-tar pitch) membrane used for floor mainly in processing area	To make floor water proof and hence prevents growth of micro organism
3) Doors and windows	The height of door should be 2m (Except boilers , garages and workshop)	For easy passage of human being and to prevents some accidents which leads to contamination
	In lavoratory windows should be kept at about 2.5 feet over the floor level	It helps to give proper ventilation
Equipment design and installation	Installation of Bactofuge	Bactofugation is the process of removal of microorganisms from milk using centrifugal force. It is a special form of separation of microorganisms, mainly spore formers (Bacilli/Clostridia) to enable milk to be sterilized at lower temperature-time combinations. Most of the microorganisms are inactivated by pasteurization. However, the highly heat resistant spores survive pasteurization. They can lead to significant quality defects in hard cheese, semi-hard cheese or long-life products due to proteolysis, lipolysis and gas formation. Therefore, bactofugation is mainly used in the manufacture of these

		products. Which help to reduce 99% micro organism
	Proper and regular lubrication(with grease)	which helps to prevents equipment breakdown and also rusting and corrosion
	Enamel paint is used for equipments. It contains white lead or zinc white, oil, spirit and resins. It dries slowly and forms hard durable surface which is not affected by acids, alkalis, fumes, etc.	Water proof and heat resistance paint should be used to ensure quality of working
	Use anti- rusting tinned surface equipment. (This metal is used mainly as a 'coating' for milk/dairy product contact surfaces of cans, vats, etc. It will not taint milk although quite soluble in it. This metal is too soft to be used for any kind of equipment. Tin coating is not durable as it wears off readily by corrosion, abrasion, etc. However re-tinning process not at all difficult)	Because tin is a soft metal and easily scratched and eroded by abrasion . Hence abrasives such as Steel wool and washing powders shouldn't be applied.
	During sanitizing of equipments parameters like Temperature, Time and Concentration of sanitizer should be considered as important	To make sure that sanitization is done with requirements to ensure proper sanitation of equipments
	Use ball foot mounting with equipment such as tanks, freezers, fillers etc. on a pipe legs 6-12 inches long having a round foot	Ball-mounted Round Mount Adjustable Feet, designed to meet all Sanitary Foot Applications,(originally designed as pump base feet) also it gives anti vibrational effect
	Hot pipe shouldn't run in neighborhood piping that transports cold food product (Insulation of hot pipe necessary)	Because it can give rise to growth of food pathogens

Personal hygiene	Temperature of water should be at least 38 degree Celsius	The rationale for this is that hot water makes soap lather and helps to get rid of the germs.
1) Hand washing	Give proper information to employees regarding duration of hand washing (I.e 20 second)	It helps to stop the spread of disease causing germs
	steam water mixing valves and vats for washing bottles, cans and similar equipments are not used for hand washing	to prevents contamination
	Self drying hand sanitizer like 70 % IPA(Iso propyl alcohol) is used before entering the processing area	It help to protects against bacteria and viruses (antiseptic effect)
In house laboratory	Sample should be stored at temperature of 1-5˚C or in deep freezer temperature of < - 16 ˚C	To ensure safety handling of samples
	Sorting out the equipment which is not working from working one	To ensure Good house keeping and to ensure safety of processing
Storage facilities	Storage of large quantity of liquid milk silos are used which is made from SS316 or SS304.	Because SS highly resistant to Bacteria. Surface finishes on SS reduce bacterial attachment and bio film formation
	Milk storage vats or silos are refrigerated and come in various shapes and sizes. Milk is stored on farm at 4 degrees Celsius and less for no longer than 48 hours.	To minimize microbial growth
	while storing in silos /tank make sure that temperature between 1-4˚C	For control of micro organism
	Listeria in RTE foods (Dairy snacks: Processed cheese, cheese spread, butter and ghee. Dairy sweets: Gulab jamuns, kala jamun, Rasgullas, pedhas and burfis) can be prevents by storing foods at a temperature of 2-4˚C (not more than 6˚C)	
Transportation facilities	Vehicle used for transportation of	Because it may leads to

	milk and milk products should not be used for transportation of any other commodities	contamination of products
	Regularly clean and sanitize vehicle wheels	Because its get contaminated from soil (Clostridium)
Control of operations	1) Milk processing	To prevent contamination
	2) Water quality and treatment	To ensure proper elimination of solid particles from water
1) Packaging	Pigmented PET bottles are used	Its enhances versatility by protecting food from light, which help to protect food from oxidation
	Modified atmospheric packaging is used to enhance the shelf life of dairy products (Eg: 1. Whole milk powder can be prevented against oxidation by removing the oxygen in package and replaced it with 100% N2 or N2/CO2 mix and the powder is hermetically sealed in metal cans. 2. Cottage cheese is a high-moisture, low-fat product that is susceptible to a number of spoilage organisms including Pseudomonas spp. Use of N2/CO2 atmospheres showed significant extension of the shelf life of cottage cheese. Gas mixtures containing CO2:N2 in the proportion of 40:60 can increase the shelf life of cottage cheese significantly.	MAP has the potential to increase the shelf life of a number of dairy products like fat-filled milk powders, fat spreads and cheeses.
2) Laboratory personnel	Don't wear apron outside the laboratory areas such as canteen or toilets or common area	
	Don't insert fingers, pens or other laboratory objects in your mouth, ear or nose.	
Maintenance and sanitation	Windows, doors and ventilation openings shall be designed to minimize pest entry.	Windows shall be 3 track types with mosquito/ fly proof wire mesh

1) Animal and pest control	Rats and mice can be effectively controlled by use of mechanical and glue rat traps (it is not allowed to use food as a bait in a mouse trap because it will attract the pest from the outside to come inside)	Mechanical traps have an excellent reputation for effectively controlling mice and rats. They are inexpensive and easy to use. Once a rodent is caught in a glue trap, it will usually die of dehydration or suffocation.
	Fly catcher that have inbuilt sticky pad shall be located promptly at an appropriate height	
	Fumigation mainly done to orevent pests. The area to be fumigated must be sealed off. After the fumigation all processing equipments must be cleaned to remove any residual fumigating substances.	

3.5. Conclusion:

As mentioned above, if we included these points to our existing FSMS guidance on milk and milk products definitely it will add weightage to our guidance and also it will helps to maintain the hygienic condition during processing of the products by Food business operators. Hence it ensures the safety to the consumer who really need the products. These points may help to reduces the contamination during processing of milk and milk products and to gives a assurance of food safety to the consumer and hence it will helps to increases the Profit to the food business operator also. Hence recommendation to include these to ensure both hygiene and safety to meet microbiological standards on milk and milk products.

4.0. Fulfillment of gap's in FSMS guidance on meat and meat products

4.1. Introduction: A hygienic treatment of meat is highly important for the final quality of the meat. The used animals need to be kept clean before they reach the processing stage. The cleanliness of the animals is a major source of contamination. Failure of slaughter hygiene, meat handling or transportation, meat cutting, the hygiene of by-products in the process and additives in meat can contribute to quality losses, and moreover they final processed meat products will deteriorate. Hygiene is a very important factor in minimizing hazards and risks as much as possible since contaminated raw meat is unfit for further processing.

A lower level of hygiene in the meat production will have an impact on final products since end products which are made from unhygienic raw meat are tasteless, unattractive in color, untypical in taste and will have a shorter shelf life. Furthermore unhygienic meat production will always increase the risk of food poisoning microorganism- these small microorganism can pose a significant public health hazard. In regard to living animals, the muscle meat is as good as sterile, but other parts of the animals contain a massive number bacteria, such as their hooves and intestine. These bacteria are transferred to the carcass and contaminate the meat during the slaughter process, if the slaughter does not maintain good hygiene.

4.2.Objectives :

- It will helps to prevent microbial contamination of raw materials, intermediate (semi-manufactured) goods and final products during meat product manufacture through absolute cleanliness of tools, working tables, machine as well as hands and outfits of personnel.
- Helps to minimize microbial growth in meat and meat products by ensuring hygienic processes during slaughtering and processing of meat.
- This will gives a processor to clear idea about what all are the processes they need to follow in order to reduced the contamination.
- Also it helps to gives safety assurance to the consumer and hence protects consumer health.

4.3.Materials used:

- APEDA Executive Manual – Sanitary and Phyto-sanitary Requirements in Export oriented meat processing plants.
- Slaughter house cleaning and sanitation materials- e-notes
- Materials used in slaughterhouses and meat processing plants including equipments e-notes.
- FAO- meat hygiene
- Slaughter house disinfection e- notes

- Codex code of practices in meat and meat and meat processing.

4.4. Proposal :

CONCEPT	PROPOSAL	REASONS
ESTABLISHMENT-DESIGN AND FACILITIES	The factory premises have adequate separation between clean (white zone) and semi clean(black zone)	To prevent cross contamination. The layout should have a bio-security built-in in the Plant where two zones should be clearly demarcated namely, black zone and white zone. There should not be any cross movement of trucks/animals. The trucks carrying the animals for slaughter should enter through the black zone. The trucks carrying animals should never be allowed to enter through the white zone which is meant for exit of finished product only.
	At the black zone the tyres of trucks are allowed to dip the disinfectants(1% formalin)	so as to exclude the contamination entering into the plant.
	The factory has to have a reception area. The common visitors are prohibited entry in the slaughter and deboning halls	To avoid contamination from human being
Construction, Design and Layout		
Resting area (Lairage)	Keep for 24hrs before slaughter in pens where adequate water and shade are provided to alleviate the stress of the animals during their transportation.	To restore their physiological condition otherwise quality get affected
	Animals should be provided adequate space for resting 2 square meter for large animals and 0.8 square meter for sheep/goats	Because insufficient resting period may affect the quality of carcass
	Premises should have an isolated pen where suspected animals can be kept for detailed examination	To prevent cross contamination between healthy and unhealthy animals carcasses which is a important

		factor of safety.
	Floors are paved or slatted and allow good drainage	
	Floor should be constructed of concrete and sloping towards drains	In order to facilitate proper cleaning and to avoid unhygienic condition
	1) System to ensure that only animals that are sufficiently clean are slaughtered 2) System to ensure that feed has been appropriately withdrawn before slaughter	To prevent contamination and to ensure quality of carcass
Slaughter hall	Usually 10m from lairage	To prevent contamination from lairage where animals rest
	The truck carrying animals for slaughter should enter the black zone	To disinfecting truck tires with 1% formalin
1) Bleeding area	Carcass after slaughtering is hanged to bleed for 5-6 min	Because blood is a source of contamination hence to prevent contamination, proper and complete bleeding is important
	The minimum diameter of blood drain shall be 150mm and shall be sloped not less than 170mm per meter to the discharge point	To ensure proper and complete bleeding and to make sure that less chances of contamination
	The bleeding trough for large animals shall be at least 1.5m wide and 1.1- 1.2m for small animals and swine	For proper bleeding process
	Bleeding trough should be made from SS	Because SS acts as a corrosion resistant
	A hand wash basin and knife sterilizer should be provided in this area	For sterilization of knife before commencing work help to ensure safety
	Trachea and esophagus should remain intact during bleeding except in case of ritual slaughter	To prevent contamination from environmental air
2)Dressing area	Dressing of carcass should not be done on floor	To prevents contamination from floor
	The hides and skins should never be spread on slaughter floor for inspection	It leads to contamination
	Floor wash point, adequate number of hand wash basins with sterilizers and hot and cold water outlets	To ensure proper hygienic facilities are available to prevents cross contamination

	should be provided	
	Lactating and obviously diseased udder should be removed from carcasses at earliest opportunity	To maintain safety
	Gas skinning and de-hiding only be permitted if it can be achieved with minimal contamination and meets require microbiological criteria	
	Exterior doors don't open directly into the area	To prevents contamination from external environment
	Adequate facilities are provided for severe storage of chemicals (cleaning materials, lubricants, branding inks) and other hazardous substances	So, as to prevent accidental contamination of meat
	Appropriately designed and insulated room should be available as necessary for cooling, chilling and freezing of meat	To prevent microbial growth
	After carcass have been inspected it washed with hot water and sanitized with 20ppm chlorine and kept in chiller 1-4˚C /24hrs	For maintaining both quality and safety of meat
Evisceration	A sufficient number of sterilizers for hand tools, knives etc, must be available in the evisceration area	To ensure proper sanitation at place
	It should be separates from packaging area	To prevent cross contamination
	Wood may be used in rooms for curing, smoking, maturing and pickling when essential for technological reasons, as long as meat hygiene requirements are not compromised	
Internal Structure		
1) Floor	The junction between floor and walls must be rounded (not rectangular)	In order to facilitate proper cleaning. It helps to reduce the residues which left in corners of floor.
2) Walls	Internal wall of abattoir should also impervious, glazed up-to at least height of 5m large and 2m for small ruminants	Glazing helps to make walls waterproof and gives resistance to environmental effects.
	Materials which can be cleaned by	To ensure proper cleaning and

	water are recommended(stone, lava blocks, bricks or concrete)	disinfection and hence to prevent contamination
3) Roof	Common roofing materials like aluminum or asbestos, corrugated iron and tiles are used	Aluminum roofing does not warp, crack, or burn and, unlike steel, it is extremely corrosion-resistant and does not rust
4) Windows	Wall windows must be positioned at least 2m high over floor level	In order to allow profound washing and disinfection of floors and walls
	Windows frames should be of non-corrosive material (Eg: Aluminum or similar materials and must not be painted)	
Equipment & Containers	Working table should be of SS with no corrosion	
	Each freezer/ cold storage compartment used to store and hold food use thermometer	To indicate the temperature regulations
	Equipments should be self draining design	So pools of water or liquids don't accumulates on any surfaces
	Seams on food contact surface shall be smoothly bonded	To minimize accumulation of food particle, dirt and organic matter hence micro organism
Facilities & Utilities		
1) Drainage system	Provide that there is not backflow from or cross connection between piping system that discharge waste water or sewage and piping that carry water for food or food manufacturing	To prevent cross contamination
2) Cleaning Facilities	The abattoir and deboning area are cleansed and washed with detergents and hot potable water	
	Floor and walls are scrubbed and washed with soap and hot water (65˚C) dried by wipers and sanitized with chlorine thereafter	
	Tables are cleaned, washed with hot water(65˚C) and mopped with chlorine (100- 150 ppm)	
3) Personnel Facilities	Providing self closing doors	

and Toilets		
	laundry facilities for cleaning workers uniform should be provided	For maintaining personal hygiene and hence to prevent contamination
4) Storage facility	Complete plant specific storage records or product identification, so product will be used on a FIFO basis or according to plant product rotation/ inventory control schedule	
	Utilize all fresh product within 7 days of fabrication. Utilize all frozen product within 6 months of fabrication	To ensure safety of food (I.e food free from microbial growth)
	Store products to maintain package/ pallet integrity	
CONTROL OF OPERATIONS		
Establishment-Maintenance and Sanitation	Swab examination is done randomly from butchers hands, knives, hands of workers working on packaging table	For microbiological examination
	All the butchers working in the deboning hall must wash their hands with soap and sanitize their hands and knives with chlorinated water at 20ppm before entering area	
Pest control	Automatic closing windows (chutes) in the slaughter hall	It protects area from insects and high temperature
	NUVAN is regularly sprayed throughout utility building	They require no mixing or preparing are easy to use and may be applied for long-lasting control of many crawling and flying pests.
	Regular cleaning of toilets and keeping of naphthalene balls	To prevents the flies and mosquito entry in the plant

4.5.Conclusion :

Above mentioned points will helps to improves the present guidance on meat and meat products hence it will helps to reduce the microbiological contamination during processing of meat and so it meets the microbiological standards on meat and meat processing. These also helps to include the points which are missing in guidance which are help in giving weightage. Hence recommendation to inclusion of these to maintain both quality and safety to the consumer.

6.0. Suggestion to modification in food safety and standard (food product standard and food additives) regulation, 2011

6.1. Objectives:

- ❑ To remove the microbiological standards which are already revised and still not removed from compendium
- ❑ This will helps to identify the all microbiological standards for commodities at the single point.
- ❑ It is make ease of identification and gives completeness to the document.

1)Present in both compendium and appendix B

Proposal objectives: This microbiological limits are already revised under regulation. Below mentioned microbiological standards present both in compendium and appendix b hence it recommended to remove these all are from compendium in upcoming amendment.

2.1.19 Food for infant nutrition

- ➢ Infant formula
- ➢ Infant Foods
- ➢ Follow-Up Formula-Complementary Food

2.5.2 Meat and Meat Products:

- ➢ Canned corned beef
- ➢ Canned luncheon meat
- ➢ Canned cooked ham
- ➢ Canned chopped meat
- ➢ Canned chicken
- ➢ Canned mutton and goat meat

2.6. Fish and Fish Products:

- ➢ Dried shark fins

This microbiological limits are yet to revised in regulation. Hence it recommended to removal of this information from compendium and insertion to appendix B when it will revised.

2.4.11 Malted and malt based foods

- Malted milk foods
- Malt based foods(malt food)

2.4.13 solvent extracted flours

- Solvent extract soy flour
- Solvent extracted groundnut flour
- Solvent extracted sesame flour
- Solvent extracted coconut flour
- Solvent extracted cotton seed flour

2.10.6 Beverages non alcoholic- carbonated

- Carbonated water

2.10.7 Mineral water

23[2.10.8 Packaged Drinking Water (other than Mineral Water)

7.0. Guidelines preparation on safe use of water in food processing

7.1. Introduction: Water is essential to sustain life, and a satisfactory (adequate, safe and accessible) supply must be available to all. Improving access to safe drinking-water can result in tangible benefits to health. Every effort should be made to achieve drinking-water that is as safe as practicable. Diseases related to contamination of process using drinking-water constitute a major burden on human health. Interventions to improve the quality of drinking-water provide significant benefits to health. The potential health consequences of microbial contamination are such that its control must always be of paramount importance and must never be compromised. Particular attention should be directed to a water safety framework and implementing comprehensive water safety plans to consistently ensure drinking-water safety and thereby protect public health.

Now a days peoples are more concerned about their health . Hence it is important to the food business operator to produce a safer foods to meet the requirements of consumers. Water quality during processing play a important role to meet this requirements.

The main source through which the human population may be exposed to infectious agents or toxic chemicals during processing are:

• The ingestion of contaminated water incorporated into foods.

• The ingestion of foods that have come into contact with contaminated water during processing.

However, there are contaminants that can result in quality problems, such as off-flavors deriving from by-products of algae or actinomycetes in raw water.

This document helps to gives a clear idea about how to use safe drinking water in food processing and also reuse of that water after processing and treatment.

7.2. Objectives:

The main objectives of this document is to give a guidelines to the Food business operator (Small, medium and large scale) regarding how to use the water efficiently in food processing to produce safe and quality foods to consumer. Hence they play a role in protecting consumer health from water malpractices during food processing. It also help them to fetch a good market demand and price for their products.

Food producers and processors require a framework based upon sound science that permits them to assess the potential for optimizing water use and to determine the potential impact of using different levels of water quality on their businesses. The third edition of the WHO Guidelines for drinking water quality set microbial and chemical quality targets for potable water (WHO, 2004), and these are updated annually. Water in the food industry is currently often classified as either potable or non potable, with most legislation simply requiring the use of potable water with little consideration of the application. It would seem logical to modify this classification to include a category that considers “suitability for intended use” to allow for the use of water of appropriate quality for a particular application.

7.3. Materials used:

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- FSSAI Guidelines on quality of water used in food processing.

7.4.Conclusion and recommendation :

- Water is an essential but diminishing resource globally. Its use in food processing should be managed to ensure safety while avoiding unnecessary consumption and waste and the associated costs for the community and the environment.
- In food processing using water of potable or drinking water quality may be the safest option in food processing; however, requiring potable water use exclusively is not always a feasible, practical or responsible solution to safe water use in food supplies. Potable water is not always available, one-time use of potable water and the potential for unnecessary waste is unacceptable, and other types of water could be fit for some purposes provided they do not compromise the safety of the product for the consumer.

- Hence it is recommended to use safe drinking water during processing of food products to ensure the safety to the consumers and the quality of final products. It will helps the food business operator to fetch a good market to their products in the country and hence it increases the income of the operator.

8.0. Comparison of various countries drinking water standards with FSSAI

8.1. Introduction:

Drinking water quality standards describes the quality parameters set for drinking water. Despite the truth that every human on this planet needs drinking water to survive and that water may contain many harmful constituents.

Water quality refers to the chemical, physical , biological and radiological characteristics of water. The standards was adopted by the Bureau of Indian Standards with the following objectives

- To assess the quality of water resources, and
- To check the effectiveness of water treatment and supply by the concerned authorities.

The various parameters covered include color, odor, pH, total dissolved solids, hardness, alkalinity, elemental compounds such as iron, manganese, sulphate, nitrate, chloride, fluoride, arsenic, chromium, copper, cyanide, lead, mercury, zinc and coli form bacteria.

The standard categorizes various characteristics as essential or desirable. It mentions the desirable limit and indicates its background so that the implementing authorities may exercise their discretion, keeping in view the health of the people, adequacy of treatment etc. All essential characteristics should be examined either when a doubt arises or the potability of water from a new source is to be established.

The standards are strict and include wide safety margins. They cover:

• micro-organisms
• chemicals such as nitrate and pesticides
• metals such as lead and copper
• the way water looks and how it tastes

8.2. Objectives:

- To compare the various countries drinking water standards with FSSAI standards.
- It helps to gives the fulfillment of gap's in FSSAI drinking water standards.
- Comparison helps us to know about the gap's and it will gives a idea about how to fulfill those gap's.
- It maintains the both quality and safety of water.
- It reduces the food born illness and ensure the safety to consumer.

8.3. Materials used:

- National water quality management strategy : Australian Drinking Water Guidelines 6 2011
- European standards for drinking water- second edition
- Drinking water quality standards in Japan (April 2015)
- Singapore Drinking Water quality (Jan 2018- Dec 2018)- Singapore's national water agency.
- FSSAI standards for drinking water.
- WHO standards for drinking water.

8.4. Results and discussion :

Parameters	FSSAI	WHO	SINGAPORE	AUSTRALIA	JAPAN	EUROPE
Lead (Pb)	0.01 PPM	0.01ppm	<0.0005ppm	0.01ppm	0.01ppm	0.1ppm
Arsenic(Ar)	0.01PPM	0.01ppm	<0.0005ppm		0.01ppm	0.05ppm
Cadmium(Cd)	0.003PPM	0.003ppm	<0.0002ppm	0.002ppm	0.003ppm	0.01ppm
Cyanide	Absent	-	<0.03ppm	0.08ppm	0.01ppm	0.05ppm
Phenolicompounds(as phenol)	Absent	-				<0.001
Nitrate(NO3)	45ppm	-		50ppm	10ppm as nitrogen	Not more than 100ppm
Copper (Cu)	0.05ppm	2ppm	<0.002-	2ppm	1ppm	0.05ppm

			0.003ppm			
Iron(Fe)	0.1ppm	-	<0.003-0.022ppm	0.3ppm	0.3ppm	0.1ppm
Sulfate(SO4)	200ppm	-	11-167ppm	250ppm		250ppm
Manganese(Mn)	0.1ppm	-	<0.002-0.014ppm	0.5ppm	0.05ppm	0.05ppm
Selenium	0.01ppm	0.04ppm	<0.0005ppm	0.01ppm	0.01ppm	0.01ppm
Chloride	200ppm	-	0.005-0.038ppm	200ppm		200ppm
Aluminium	0.03ppm	-	<0.019-0.082ppm	0.2ppm	0.2ppm	
Boron	5ppm	2.4ppm	0.007-0.036ppm	4ppm	1ppm	
Chlorine	0.2ppm	5ppm	2.00-2.80ppm	0.6ppm		
DDT	-			0.009ppm		
Zinc	5ppm		5ppm	3ppm	1ppm	
Nitrite	0.02ppm			3ppm		
PAH	not detectable			0.00001ppm		
Fluoride	1ppm	1.5ppm	0.37-0.59ppm	1.5ppm	0.8ppm	
Mercury	0.001ppm	0.006ppm	<0.00003ppm		0.0005ppm	
Chromium	0.05ppm	0.05ppm	<0.005ppm		0.05ppm	
Nickel	0.02ppm	0.07ppm	<0.003ppm			

8.5. Conclusion and recommendation: This comparison helps to do changes in our existing FSSAI drinking water standards if it is necessary. It will gives a idea about existing drinking water standards in different countries and helps in comparison so we can easily understand the existing gap's hence it will helps to identify the requirements for fulfillment of that gap's if it is present.

Annexure 1 :

Development of guidelines for safe use of water in food processing

Index

Abbreviation list:

CAC : Codex alimentarius commission

FSSAI : Food safety and standards authority of India

WHO : World health organization

BOD : Biochemical oxygen demand

FAO : Food and agriculture organization

CCFH : Codex committee on Food hygiene

HACCP : Hazard analysis and critical control point

GHP : Good hygienic practices

FSMS : Food safety management system

RA : Risk analysis

EFSA : European food safety authority

GMP : Good manufacturing practices

List of tables :

1.0 Abstract

Water of high quality is or will become a scarce commodity in many areas. Food processing require large amounts of water of varying quality. Water reuse during food processing occurs and will likely increase in the future. Awareness of the close association between water and food-borne disease is growing and thus there is a need to develop rational water use management plans within the food industry that maximize health protection. The food processing industry has long used hazard analysis and critical control point (HACCP) programmes to make their products safer.

2.0 Aim

The aim of this paper is to discuss the how to use a safe drinking water in food processing and also reuse of that water after treatment to make sure that safe food is served to the consumer.

3.0 Introduction

3.1. Background : Water, like a food, is a potential vehicle for the direct transmission of agents of disease and continues to cause significant outbreaks of disease in developed and developing countries. For example , pond water was identified as the source of a significant and fatal outbreak of *Vibrio cholera* in India (Haibatpur village, purba medinipur district , west Bengal , 2012) This is because of the use of contaminated pond water for preparing fermented rice and other domestic uses and it increases the number of diarrhea cases.

Another example : The hawker who runs an idli stall on the pavement could be seen fetching water from a toilet to prepare the chutney, which is served as an accompaniment with the dish(Mumbai Borivali Railway Station).

Hence it is important to maintained both safety and quality of water during food processing to ensure the safer food is served to the public.

3.2.Scope : Now a days peoples are more concerned about their health . Hence it is important to the food business operator to produce a safer foods to meet the requirements of consumers. Water quality during processing play a important role to meet this requirements.

The main source through which the human population may be exposed to infectious agents or toxic chemicals during processing are:

• The ingestion of contaminated water incorporated into foods.

• The ingestion of foods that have come into contact with contaminated water during processing.

However, there are contaminants that can result in quality problems, such as off-flavors deriving from by-products of algae or actinomycetes in raw water.

This document helps to gives a clear idea about how to use safe drinking water in food processing and also reuse of that water after processing and treatment.

The Codex Alimentarius (CAC , 2006) framework of risk analysis has been accepted and is recommended as the basis on which this document might be used. The risk analysis process consists of three components: risk assessment, risk management and risk communication. Risk assessment is dependent upon the correct identification of the hazards, the quality of the data used and the nature of the assumptions made to estimate the levels of risk. However, pragmatic and practical decisions can be made that will be essential in the development of practical risk management strategies. While minimizing risk is the primary goal and extremely low levels of risk are achievable, zero risk is not considered to be attainable. Throughout the entire process, risk communication should assure the continuous information exchange among all involved parties.

3.3. Objectives: The main objectives of this document is to give a guidelines to the Food business operator (Small, medium and large scale) regarding how to use the water efficiently in food processing to produce safe and quality foods to consumer. Hence they play a role in protecting consumer health from water malpractices during food processing. It also help them to fetch a good market demand and price for their products.

Food producers and processors require a framework based upon sound science that permits them to assess the potential for optimizing water use and to determine the potential impact of using different levels of water quality on their businesses. The third edition of the WHO Guidelines for drinking water quality set microbial and chemical quality targets for potable water (WHO, 2004), and these are updated annually. Water in the food industry is currently often classified as either potable or non potable, with most legislation simply requiring the use of potable water with little consideration of the application. It would seem logical to modify this classification to include a category that considers "suitability for intended use" to allow for the use of water of appropriate quality for a particular application.

4.0.Water source

Drinking water is supplied to the food industry either publicly by local government authorities or privately by the food business itself. Across India the majority of drinking water supplied to the food industry, comes from public supplies. However, the source of the water used to supply the drinking water can come from a variety of sources including surface water (e.g. streams, rivers, and lakes), groundwater (e.g. natural springs, wells), rainwater and seawater (treated at a desalination plant).

It is the source of water which generally determines the quality of the water and if treatment of the water is required to ensure it meets drinking water standards and is safe to be used in food processing. (i.e. safe for human consumption).

5.0.Water demand and use:

The major demands for water during food processing are:

• Washing / cleaning of (raw) products : Washing and cleaning both are very important preliminary steps during processing . These helps to remove dirt, soil and metal contaminants from the raw material. washing can be done in combination with a disinfectant treatment to reduce microbial contamination.

• Dissolving of ingredients : During preparation of brine and syrup (used in canning, carbonated beverages and pickling) . The quality of water is very important to meet the final products quality.

• Cooling processes : During chilling and freezing the quality of raw material used for preparing ice i.e water that reflects the quality of final products.

• Steam generation : steam is used in drying , steaming and canning purposes. Hence good quality water used to produced a quality steam.

• Cleaning / rinsing of equipment: It will help to remove the hazards to safer level hence quality of water during these processes is very important.

• Sanitation: This is very important step followed in food industries to remove microbial contaminants from surface of equipments which is used for food processing.

6.0. Assurance of water quality

Commonly, E. coli and total coliforms are used to assess the microbiological quality of post-harvest wash water even though their suitability for this role is controversial. Total coliforms are considered unreliable indicators of faecal contamination because some species (e.g., *Klebsiella* spp. and *Enterobacter spp*.) are not necessarily of faecal origin and can multiply in various plant-related environments under favorable conditions.

6.1.Sources of water contamination :

The principle ways in which water can impact on contamination of the food products in the factory are:

• The incoming water itself.

• The factory environment including the water storage and distribution system.

• Factory workers.

These are the main sources through which water get contaminated hence the proper attention should be given to reduced these problems during food processing by food business operator.

6.2. Guidelines for quality of water used in processing of food products

As per FSSAI guidelines:

- Only potable water, with appropriate facilities for its storage and distribution shall be used as an ingredient in processing and cooking.
- Water used for food handling, washing, should be of such quality that it does not introduce any hazard or contamination to render the finished food article unsafe.
- Water storage tanks shall be cleaned periodically and records of the same shall be maintained in a register.
- Non potable water can be used provided it is intended only for cleaning of equipment not coming in contact with food, which does not come into contact with food steam production, fire fighting & refrigeration equipment and provided that pipes installed for this purpose preclude the use of this water for other purposes and present no direct or indirect risk of contamination of the raw material, dairy products or food products so processed, packed & kept in the premise.
- Non potable water pipes shall be clearly distinguished from those in use for potable water.
- For Cleaning Utensils / Equipments: Adequate facilities for cleaning, disinfecting of utensils and equipments shall be provided. The facilities must have an adequate supply of hot and cold water if required.
- Washing of Raw materials: Adequate facilities for washing of raw food should be provided. Every sink (or other facilities) for washing food must have an adequate supply of hot and/or cold water. These facilities must be kept clean and, where necessary, disinfected. Preferably, sinks which are used for washing raw foods shall be kept separate and that should not be used for washing utensils or any other purposes.
- Ice and Steam: Ice and steam used in direct contact with food shall be made from potable water and shall comply with requirements specified. Ice and steam shall be produced, handled and stored in such a manner that no contamination can happen.

As per WHO guidelines

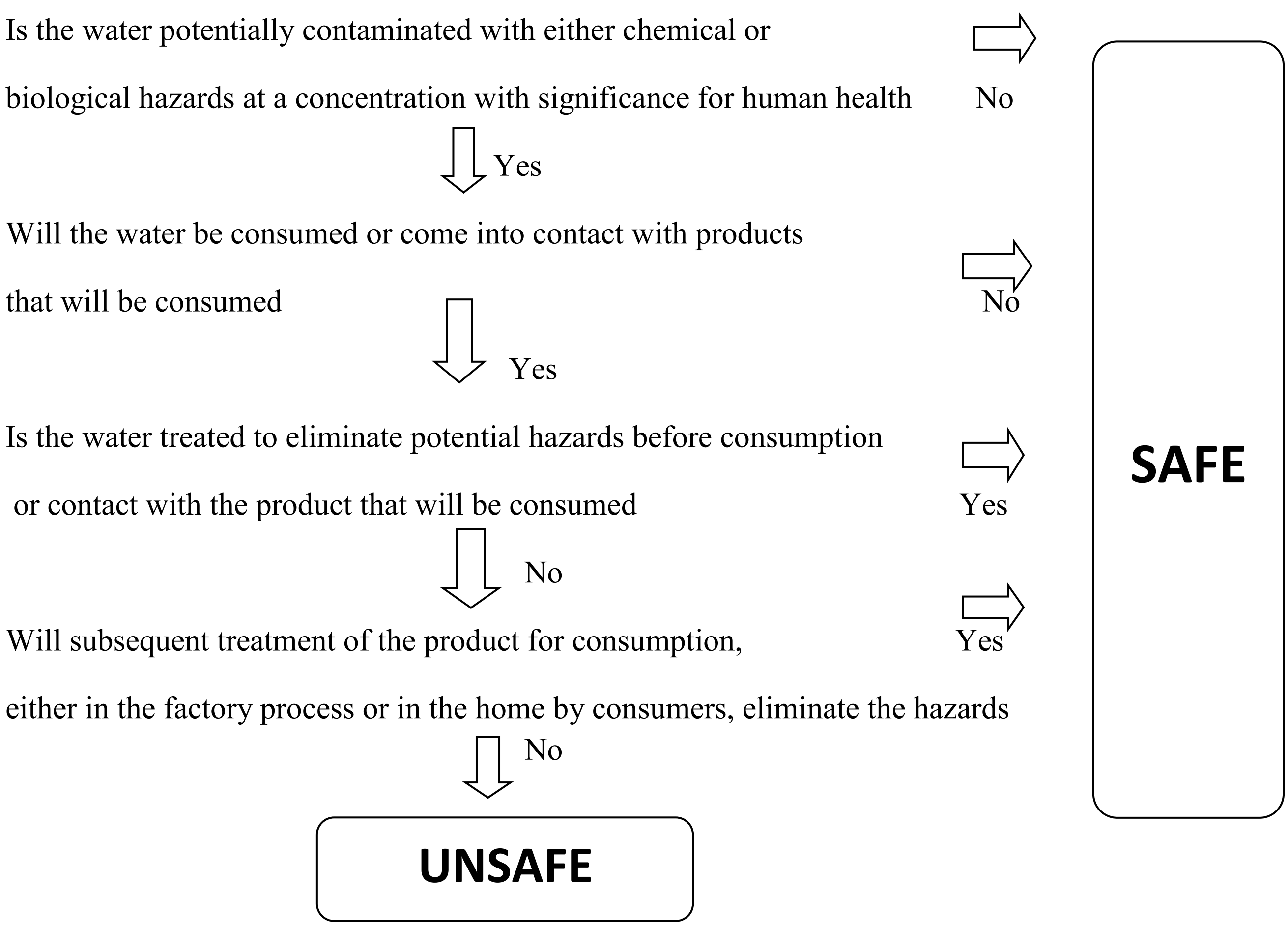
- The quality of water defined by the Guidelines is such that it is suitable for all normal uses in the food industry. Some processes have special water quality requirements in order to secure the desired characteristics of the product, and the Guidelines do not necessarily guarantee that such special requirements are met.

- Poor quality drinking-water may have a severe impact in food processing and potentially on public health. The consequences of a failure to use water of suitable quality in food processing will depend on the use of the water and the subsequent processing of potentially contaminated materials.

- To reduce microbial contamination, specific treatments (e.g. heat) capable of removing a range of pathogenic organisms of public health concern may be used in food processing. For example, water that is used in canning will usually be heated to a temperature that is at least equivalent to pasteurization.

- Information on deterioration of the microbial or chemical quality of a drinking water supply should be promptly communicated to food and beverage production facilities.

7.0. Decision tree for assessing the suitability of water for intended use



8.0.Potential intervention strategies:

8.1.Water Disinfection/ Treatment : To implement potential intervention strategies, it is critical to understand the process for water disinfection and for validating its efficacy for the safety of a specific produce product.

Critical points and challenges to consider include:

- Simply washing products is not an effective mechanism for removing contamination – i.e. it cannot remove or kill pathogens that naturally seek out protective surface niches on products, that adhere to surfaces and/or that may have infiltrated the product.
- The goal of water disinfection is to prevent cross-contamination by avoiding the transfer of microorganisms from process water to fresh produce and from one produce item to another during post-harvest handling.
- Process water in the fruit and vegetable sector is highly variable in terms of water quality parameters, such as dissolved solids, chemical oxygen demand and microbiological quality, which makes it a challenge to implement a standard treatment option fit for all.

8.2. Water treatment technology:

The fundamental purpose of water treatment is to protect the consumer from pathogens and from impurities in the water that may be injurious to human health or aesthetically unpleasant. Where appropriate, treatment should also remove impurities which, although not harmful to human health, may make the water unappealing, damage pipes with which the water may come into contact, or render operation more difficult or costly (WHO, 1996a). These purposes are achieved, by introducing successive barriers, such as coagulation, sedimentation, filtration and advanced treatments, to remove pathogens and impurities. The final barrier is often disinfection (WHO, 1996a). Water treatment is the important requisite programme before reuse of that water.

Table 1 : provides an overview of water treatment technologies and their applications

Process	**Description**	**Application**
Solid –liquid separation		
Sedimentation	Gravity sedimentation of particulate matter, chemical floc, and precipitates from suspension by gravity settling	Removal of particle from turbid water that are larger than 30 µm
Filtration	Particle removal by passing through sand or other porous medium	Removal of particles from water that are larger than about 3 µm. Frequently used

		after sedimentation or coagulation/flocculation
Biological treatment (waste water)		
Aerobic biological treatment	Biological metabolism of wastewater by microorganism in an aeration basin or bio film process	Removal of dissolved and suspended organic matter from wastewater
Oxidation pond	Ponds up to 1m in depth for mixing and sunlight penetration	Reduction of suspended solids, BOD, pathogenic bacteria, and ammonia from wastewater
Biological nutrient removal	Combination of aerobic, anoxic, and anaerobic processes to optimize conversion of organic and ammonia nitrogen to molecular nitrogen (N_2) and removal of phosphorus	Reduction of nutrient content of reclaimed water
Waste stabilization ponds	Ponds system consisting of anaerobic, facultative and maturation ponds linked in series to increase retention time	Reduction of suspended solids, BOD , pathogens and ammonia from waste water
Disinfection	The inactivation of the pathogenic organism using oxidizing chemicals , ultraviolet light , caustic chemicals, heat or physical separation processes (eg; membranes)	Protection of public health by removal of pathogenic organisms
Advanced treatment		
Activated carbon	Process by which contaminants are physically adsorbed onto the surface of activated carbon	Removal of hydrophobic organic compounds
Air stripping	Transfer of ammonia and other volatile compounds from water to air	Removal of ammonia and some volatile organics from water
Ion exchange	Exchange of ions between an exchange resin and water using a flow through reactor	Effective for removal cation such as calcium, magnesium, iron ,ammonium, and anions such as nitrate
Chemical coagulation and precipitation	Use of aluminum or iron salts, polyelectrolyte, and/or ozone to promote	Removal of particles by sedimentation and filtration

	destabilization of colloidal particles from reclaimed water and precipitation of phosphorus	
Lime treatment	The use of lime to precipitate cations and metals from solution	Used to reduce scale-forming potential of water, precipitate phosphorus, and modify pH
Membrane filtration	Microfiltration, nano filtration, ultra filtration	Removal of particles and microorganisms from water
Reverse osmosis	Membrane system to separate ions and particles from solution based on reversing osmotic pressure differentials	Removal of dissolved salts and minerals from solution; also effective for pathogen removal

For further information on disinfection of water for use in food production and processing, see FAO/WHO (2009).

8.3. Effects of water quality on end products

- Inferior quality of water may produces inferior quality of final products.
- It may affects on health of the consumers.
- Food operator losses his brand and company image.
- It decreases market price for the products .
- It increases the microbiological loads in food products hence it is a serious concern.

9.0. Water reuse in the food processing industry : An increasing number of companies in varying food industry sectors – e.g. dairy, poultry and pig slaughter, seafood, oils, meat, beverage – are now reusing different types of water for intentional food contact applications, as well as water that may come in contact with food unintentionally and water used for technical purposes in food manufacturing establishments. Reuse water is applied for various purposes, depending on the food processing operations and food types.

- Types of reuse water can include water that is reclaimed from food, recycled from food operations or re-circulated in a closed loop system. Where necessary, reuse water is reconditioned to make it fit for purpose in microbiological terms.
- Compared to drinking water, there is only very limited and scattered information in the scientific literature on water reuse within food operations and it is not always apparent whether the processes described are experimental or in regular use.
- The latest official document on water reuse from the CAC dates back to 1996 and was revised in 2003 (CAC, 2003b); it states that reuse of water in food processing and handling is allowed in exceptional situations, where its use does not compromise the (microbiological) safety of the food product.
- CCFH discussed appropriate guidelines (CCFH, 1999; CCFH, 2001), and although this work was not consolidated and formally issued, the CCFH drafts have served as model guidelines in various countries worldwide.

- Other guidelines for water reuse include HACCP principles and risk-based process control programmes. HACCP principles can be applied to both potable water and water reuse. In the case of applying HACCP to water reuse, it is essential to clearly define the exact first use case of the water and its quality to aid in the identification of appropriate hazards and their suitable control points.
- WHO Guidelines for Drinking Water Quality (WHO, 2017) recommend a risk-benefit approach that considers protection of public health and availability of water supplies in a site-specific context in determining requirements. These guidelines may be extrapolated and useful for water reuse in the fresh produce industry.

Table 2: Definitions of various water types used in food operations

First use water	Potable water from an external source that can be used in any food processing operation.	
Reuse water	Water that can has been recovered from a processing step within the food operation, including from the food components and /or water that, after reconditioning treatment(s) as necessary, is intended to be (re-) used in the same, prior or subsequent food processing operation .	
	Reclaimed water	Water that was originally a constituent of a food material, which has been removed from the food material by a process step and is intended to be subsequently reused in a food processing operation. Examples: Water that was originally part of a raw material or food (e.g. sugar beet or tomato juice evaporated and condensate water collected; condensate water from milk or whey evaporate; reverse osmosis permeate water from whey).
	Recycled Water	Water, other than first-use or reclaimed water, which has been obtained from a food processing operation, or water that is reused in the same operation after reconditioning. Examples: brine, scalding water and water for transporting or washing of raw materials, such as vegetables and fruits, in subsequent units, for which first-use water is used initially and then reused in previous units until it is used for cleaning of product coming from the field before being discarded or reconditioned.
	Re circulated Water	Water reused in a closed loop for the same processing operation without replenishment. Example: a cooling or heating system in which water circulates, (e.g. condenser or pasteurizer cooling water).

9.1.Requirements for water reuse

This is a complex subject area that might be subdivided into the following components:

9.1.1.Regulatory requirements (Reference – Codex alimentarius)

In some cases, water can be reused without pre-treatment (e.g. the use of condensates as washing water or extraction water within the sugar production process). However, in most cases, water that is recycled or reused will need to be treated to improve its quality, particularly when it comes into contact with food or beverage products or is used to clean surfaces that will come in contact with the products. The Codex Alimentarius Commission draft document "Proposed draft guidelines for the hygienic reuse of processing water in food plants" (Codex Alimentarius, 2004) provides a basis for decision making.

Among other requirements, the Codex guidelines specify the following:

• Reuse water shall be safe for its intended use and shall not jeopardize the safety of the product through the introduction of chemical, microbiological or physical contaminants in amounts that represent a health risk to the consumer.

• Reuse water should not adversely affect the suitability of the product.

• Reuse water intended for incorporation into a food product shall at least meet the microbiological and, as deemed necessary, chemical specification for potable water. In certain cases physical specifications may be appropriate.

• Reuse water shall be subjected to ongoing monitoring and testing to ensure its safety and quality. The frequency of monitoring and testing are dictated by the source of the water or its prior condition and the intended reuse of the water; more critical applications normally require greater levels of reconditioning than less critical uses.

• The water treatment system(s) chosen should be such that it will provide the level of reconditioning appropriate for the intended water reuse.

• Proper maintenance of water reconditioning systems is critical.

• Treatment of water must be undertaken with knowledge of the types of contaminants the water may have acquired from its previous use.

• Container cooling water should be sanitized (e.g., using chlorine) because there is always the possibility that leakage could contaminate the product.

9.1.2.Public health issues

Personal health and hygiene play a critical role in controlling microbial contamination. Faecal contamination and orally transmitted diseases are of primary concern. Workers can spread these diseases during the growing, harvesting, sorting, processing and packaging of foods. Infected workers have been implicated as the source of several food-borne outbreaks (EEA/WHO, 1997).

9.2. Gaps and challenges in developing guidelines on water reuse

- Water reuse definitions can be ambiguous (e.g. the terms: reused, recycled, reconditioned, reclaimed, re-circulated) and this may constitute a problem for regulatory compliance and the perception of water reuse applied in the food industry, both in terms of customer acceptance and food safety assurance.
- Resources and expertise are required to establish a water reuse system in a food manufacturing establishment and to manage it appropriately within an effective GHP/HACCP-based food safety management system (FSMS).
- Challenges and knowledge gaps in water reuse include a broad range of issues related to environmental impacts, economic considerations, legislative approaches, technological treatments, treatment performance targets, types and reliability of water quality assessments, consumer perceptions, food industry practices and academic/industry relationships.

Some of the most critical data gaps with regard to microbiological hazards include the following:

- Limited specific understanding of the microbiological status of the different types of water reuse within a specific establishment, including the impact of storage and transport of reuse water. There is little published literature on the typical sources, initial quality and subsequent quality of the used water in the reuse water schemes of various sectors; furthermore, existing guidelines mostly do not provide an adequate level of detail.
- A need for better understanding of pathogen reduction efficiencies, performance variation of (single or multi-barrier) treatments, process optimization for water reconditioning under the specific conditions of the establishment and intended system performance targets. Currently, there are many descriptions of the “average” efficiency of various treatment processes for removal or inactivation of bacteria, parasites and viruses, and these have wide ranges of performance efficacy. Furthermore, differences may exist between specific types of equipment and water from different sources within establishments, which may cause very large variations in system performance and performance targets.
- Lack of information or practical guidelines to assist various food establishments, especially small operations, for validation at the full operational scale and in daily verification of processes used for recovery and, where necessary, reconditioning of reuse water.

- Absence of or deficiencies in suitable microbiological indicators and surrogates that can be used for validation and verification purposes – e.g. to monitor process performance in reuse scenarios and develop suitable monitoring approaches and analytical methods for their measurement during operation.

9.3. Conclusions and recommendations

The reuse of water in the food industry is becoming a conventional practice. The costs of raw water or wastewater discharge and the availability of water are the main drivers that lead to water reuse/recovery practices.

- Treatments for reuse water for a fit-for-purpose use will depend on assessment of the risk of the reuse water. The RA and resulting risk management plan must meet the food operation's capacity to deal with any risks of reuse water identified and should be considered with other factors such as meeting regulatory requirements for microbiological parameters, costs and benefits. The focus here is on microbiological hazards, although it is noted that chemical hazards are also important and can involve consideration of worker occupational safety.
- Access to education and training, which could include workshops and e-learning material, is of paramount importance both for quality managers as well as for regulatory staff and inspection services.

Water can be a vector to transmit pathogens from a single food product specimen to a large number of products, thus increasing the number of people exposed and the potential health impact. Hence reuse water should be cleaner than the food it comes into contact with, such that the food does not become more contaminated through this contact and the target level of cleanliness of the food is met after contact.

10.0. Water use in different sectors: Fishery products

10.1.Map of where water is used: Source from which water is collected for carrying various processing operations in fish is very important because it act as a primary source of contamination in food chain hence it should be free from any kind of contamination to ensure the safety of final products.

The various processes where water is used are:

- Washing
- Chilling
- Freezing
- Canning
- Mincing

10.2.Water safety/quality targets

There are no consistent definitions of the microbiological criteria for clean water for use with fishery products.

- Guidelines specific for fish and fishery products are provided by the CAC Code of Practice for Fish and Fishery Products (CAC/RCP 52-2003) (CAC, 2016) and are applied by the competent authorities in the fisheries sector and other agencies; however, there is no uniform definition for the type and quality of water to be used in specific steps of fish handling and processing.

- Some fishery documents specify that clean water should meet the same microbiological criteria as potable water, whereas the CAC Code of Practice (CAC, 2016) adopts the definition of clean water as 'clean water is water from any source, where harmful microbiological contamination, substances and/or toxic plankton are not present in such quantities that may affect the safety of fish, shellfish and their products intended for human consumption'.
- Choice of water quality requirements at a processing step may be supported by application of HACCP principles and assessment of the health risk.
- In 2012, the European Food Safety Authority (EFSA) report, "Scientific opinion on the minimum hygiene criteria to be applied to clean seawater and on the public health risks and hygiene criteria for bottled seawater intended for domestic use", included an assessment of the microbiological and chemical hazards of using seawater in fish handling and processing and the formulation of microbiological criteria for clean seawater, depending on its use (EFSA, 2012).

FSSAI guidelines for water quality used in processing of fish and its products

- Establishment shall use own supply of fresh or sea water or other water sources and shall have an efficient water treatment plant. Sufficient quantity of water should be available for daily activities for maintaining proper hygiene.
- Water used shall be of potable nature and shall meet the requirements of latest edition of BIS standard on drinking water (IS 10500-2012). Potable water shall be analyzed at least semi-annually to confirm that it meets the requirements of this standard.
- Where it is necessary to store potable water, availability of appropriate facilities including the storage tanks and water pipes should be available. They shall be adequately designed, made of material that is non-toxic and corrosion resistant and periodically cleaned and maintained to prevent contamination and records of the same should be maintained. It is recommended to construct water storage tanks with food grade PVC or HDPE tiles using porcelain as inner lining. The tanks shall be covered to prevent access by animals, birds, pests and other extraneous matter.

- The taps having hose connections shall be fitted with non- return valves to prevent contamination of water in the tank by back suction. They should be numbered for proper monitoring.
- Non-potable water lines should be clearly identified and separated from potable water to avoid contamination. Colour coding is recommended.
- Should be sufficient quantity of potable water available for day to day work as well as cleaning at the end of the schedule for maintaining hygiene

Ice:

- Suitable and adequate facility should be provided for storage and/or production of ice using potable water (IS10500-2012) to protect it from contamination.
- Block ice should be manufactured only in non-corrosive containers like Stainless Steel.

Steam:

- For operations that require steam, an adequate supply at sufficient pressure should be maintained.
- Steam used in direct contact with fish or shellfish and its products or food contact surfaces should not constitute a threat to the safety or suitability of the fish and fish products

10.3. Effects of water quality on end products

- Heterotrophic plate counts as well as E. coli and Enterococci counts have been used to monitor hygiene and sanitary practices on board and on shore.
- E. coli and L. monocytogenes counts have also been recommended to monitor quality of water used during production.
- Washing and washing/filleting fish that may be consumed raw in contaminated seawater has been shown experimentally to increase contamination on fish surfaces and gills while hygienic washing reduced contamination levels.

10.4. Risk reduction options (sector-specific)

CAC Code of Practice (CAC, 2016) describes the use of HACCP principles for fish storage and processing in combination with good hygiene practices (GHP).

Regardless of the source, the supply must be monitored with sufficient frequency commensurate with the level of risk to assure that the water is safe for use on fishery products and food contact surfaces, and corrective action taken when monitoring detects a problem.

Table 3: Fish-associated pathogens considered due to relevance in relation to water quality

Fish-associated pathogens	Relevance in relation to water quality
Parasites (trematodes)	Relevant if product is eaten raw; mitigation is product freezing; temperature control is an important CCP; specific guidance should be consulted regarding control of fish parasites by freezing.
Vibrio parahaemolyticus	Very relevant; outbreak data available; FAO/WHO risk assessment studies available (FAO 2011).
Listeria monocytogenes	Relevant for fish consumed raw (cold smoked fish, sushi, ceviche, etc.) Existing codes of practice, hygiene codes and Codex standards would not sufficiently deal with this hazard.
Vibrio cholerae	Important risk factors postharvest are: pathogen presence in raw fish; the status of hygiene or lack thereof during preparation; and inappropriate storage, especially time and temperature conditions
Aeromonas	Pathogen present in estuarian and fish-processing environments. Based on WHO fact sheet GDWQ (2017) it appears that *Aeromonas spp*. from fish and production/processing systems is not a likely human health concern from water used for fish producing on processing, as fish associated aeromonas are different species and strains than virulent strains of A. *hydrophila* and other species that cause human infections.
Plesiomonas *Shigelloides*	Risk of infection from raw or undercooked fish and shellfish is uncertain, although considered low based on paucity of reported outbreaks of illness.

10.5.Conclusions and recommendation :

- Fish is a perishable commodity it prone to more spoilage by microorganisms than other commodities hence it is important to maintain the quality and safety during processing of fish by using safe drinking water.

- Fish processing is help to increases the shelf life of products as well as reduces the microbial contamination which are having serious health concerns.

- Also water wastage is more in fish industry hence it is recommended to reuse of that water after proper treatment could be done.

- Follow GHP and GMP during processing in plants help to reduced the microbial load and ensure the safety to the consumers.

11.0. Conclusions
General conclusions and recommendations:

- Water is an essential but diminishing resource globally. Its use in food processing should be managed to ensure safety while avoiding unnecessary consumption and waste and the associated costs for the community and the environment.
- In food processing using water of potable or drinking water quality may be the safest option in food processing; however, requiring potable water use exclusively is not always a feasible, practical or responsible solution to safe water use in food supplies. Potable water is not always available, one-time use of potable water and the potential for unnecessary waste is unacceptable, and other types of water could be fit for some purposes provided they do not compromise the safety of the product for the consumer.

- Hence it is recommended to use safe drinking water during processing of food products to ensure the safety to the consumers and the quality of final products. It will helps the food business operator to fetch a good market to their products in the country and hence it increases the income of the operator.

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