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EVALUATION OF THE DISINFECTION REGIME EFFECTIVENESS IN THE FISH PROCESSING PLANT

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ABSTRACT

The hygienic conditions of food-contact surfaces must be properly examined. The most adopted strategies for controlling biofilms are sanitation procedures. Biofilm is a colonial structure formed by microorganisms in order to survive and adapt in adverse environmental conditions. Biofilms formed by bacteria in food processing facilities can lead to transmission of disease, food contamination, spoilage of food products, and damage to food production surfaces. Sanitation is a fundamental aspect of food safety, as safe food cannot be produced in the absence of hygienic conditions. Regular sanitation and disinfection of food processing plant premises are among to the most basic activities that contribute to the protection of the people health from the point of view prevention of food-borne diseases. We monitored the microbiological load of the environment in premises of the fish processing plant at different time intervals, during fish processing and after disinfection. From the microbiological parameters, the total numbers of microorganisms and coliform bacteria were evaluated. The monitored numbers of microorganisms were increased dynamically during operation on the different evaluated surfaces in the fish processing plant. We recorded the highest number of monitored microorganisms during the day at the floor, concreatly 5 CFU of the total count of bacteria (TCB) and 1 CFU of coliform bacteria. Based on all obtained microbiological results after disinfection taken from various monitored surfaces in the fish processing plant, we can conclude that the Forchem 36 with disinfectation effect used in a 2 % concentration with an exposure time of 20 minutes was effective on all evaluated surfaces with exception cutting

board no.2, where we detected 2 CFU of TCB, despite the fact that during fish processing we did not record any numbers of TCB on this surface. We consider the failure of the human factor as a potential source of this contamination.

KEYWORDS: Forchem 36, disinfection, microbiological swabs, fish processing plant.

INTRODUCTION

Food-borne diseases occur due to the ingestion of food contaminated by biological or chemical agents, consequently causing social, economic, and public health problems.[1,2] In the latest report on the burden of food-borne diseases, it was estimated that 1 in 10 people in the world become ill after ingesting contaminated food and approximately 420,000 people die each year,[3] a fact that requires the implementation of rigorous strategic prevention systems, control measures, and surveillance. For all these repercussions, which directly threaten public health and the world economy, it is important to invest in technologies that contribute to preventing food-borne diseases from occurring or to the early detection of threats in terms of food safety.[4] One of the most important prevention tools is the effective application of cleaning and disinfection methods to guarantee food safety.[5]

Biofilms contain microbial cells which are protected by a self-produced matrix and they firmly attach themselves to many different food industry surfaces. Due to this protection, microorganisms within biofilms are much more difficult to eradicate and therefore to control than suspended cells.[6]

Cleaning and disinfection, together known as sanitation, is undertaken to remove all undesirable material (food residues, microorganisms, foreign bodies and cleaning chemicals) from surfaces, to a level such that residues remaining are of minimal risk to the safety or quality of the product. Sanitation is, therefore, the major day to day control of the ‘surface’ factor of the environmental routes of food product contamination. When undertaken correctly, sanitation programmes are cost effective, easy to manage and can reduce the risk of microbial or foreign body contamination. This will become increasingly pertinent in the future given the intrinsic demand for higher standards of hygiene in the production of short shelf-life chilled foods, together with pressure from customers, consumers and legislation for ever increasing hygiene standards. Sanitation demands, therefore, the same degree of attention as any other key process in the manufacture of safe and wholesome food products.

In case of chemical disinfection, which is carried out using disinfectants, it is important to observe the prescribed concentration and exposure necessary to achieve the effect. The principle of rotation disinfectants is applied here, once every 2-3 months, in order to avoid the development of resistance.[7]

The most widely used disinfectants in the food industry's disinfection programmes are quaternary ammonium compounds, amphoteric compounds, hypochlorites, peroxides (peracetic acid and hydrogen peroxide).[8]

The work is focused on evaluation of the disinfection regime effectiveness, which was carried out with Forchem 36 agent in the premises of the fish processing plant from the point of view food-borne diseases preventing.

MATERIAL AND METHOD

The fish processing plant is a smaller capacity operation in Eastern Slovakia. It processes frozen cod fillets-vacuum and crushed fillets of Alaskan cod, Argentine hake and blue cod, which are imported in the form of whole frozen blocks (Figure 1).

Figure 2: Alaskan cod.

Disinfection was carried out with a foaming alkaline cleaning agent with disinfection effect using Forchem 36. In the monitoring processing plant, the disinfection workflow was verified with Forchem 36 disinfectant, which was applied manually as well as by spraying.

The hygiene of selected surfaces in the premises of the fish processing operation was monitored and analyzed during production and after disinfection.

Sanitation in the evaluated fish processing plant is carried out according to the sanitation program, where the responsible employee keeps a record disinfection.

Forchem 36 is an alkaline cleaning concentrate with a broad-spectrum disinfection effect. Removes protein and fat pollution while simultaneously disinfecting the surface. It is characterized by high foaming and is easy to rinse. It is used in the food and beverage industry, veterinary hygiene as well as for the disinfection of walls and floors in private, public and industrial spaces. It is applied in the form of 2-5% aqueous solutions using a high-pressure device or a special foam generator at room temperature. Exposure time of the preparation is 15-20 min. Objects that come into contact with food after applying the preparation must be thoroughly rinsed with drinking water. It is suitable for stainless steel, tiles and oxidation-resistant plastics. It is not suitable for aluminum and non-ferrous metals. Forchem 36 is a solution of alkali metal hydroxide, anionic surfactant based on C_{12}-C_{15} sodium alkyl sulfate, sodium hypochlorite and additives. The manufacturer of Forchem 36 is Forex – SK, limited company, Lučenec, Slovakia.

To ensure regular daily hygiene in the premises of the fish processing plant, a solution of Forchem 36 in 2 % concentration was used with the exposure time 20 minutes, which is required to achieve a biocidal effect.

Control of the disinfection effectiveness is very important in practice and serves to verify the effectiveness and quality of disinfection procedures. The monitored and evaluated were different surfaces by using microbiological swabs, which taken by sterile template (Figure 2).

Figure 2: Collection of microbiological swab from area of 10 cm^2.

The samples were collected by the use of a sterile wet cotton swab taken from an area of 10 cm^2. When the individual evaluated surfaces were dry, a sterile cotton swab was immersed in a test tube with physiological solution, and then a 10 x10 cm area was wiped using a sterile template. Before inoculation, the tubes were electromagnetically disturbed. Using a pipette, the contents of the test tube in the amount of 0.1 ml were inoculated onto plates with solid nutrient medium, which were cultivated in a thermostat at 37 °C for 24 hours. After incubation, the grown colonies were quantitatively evaluated. Total count of bacteria were determined using meat peptone agar (MPA) by culturing at 37 ºC for 24 hours. MPA is a nutrient agar which is created from enzymatic digestion of animal tissues. The proteins in such tissues are broken down into amino acids and peptides to provide a nitrogen source for cultivated microorganisms. After inoculation, the MPA is incubated for 24 hours at 37 °C.[9]

Coliform bacteria (CB) were determined using Endo agar (EA), which was cultured at 37 ºC for 24 hours. These determinations were carried out according to the procedure of valid ISO standards. EA is a selective medium which can be used for cultivation of gram negative bacteria, mainly coliform bacteria such as *E. coli, Salmonella spp., Klebsiella spp*. and *Proteus spp*.. The medium also differs the colonies on their ability to ferment lactose. EA is composed of peptone, lactose, sodium sulfite, basic fuchsin and dipotassium phosphate. After inoculation, EA is incubated at 37°C for 24 hours.[10,11]

The values obtained from the microbiological swabs are the average values from 5 swabs taken and are expressed in CFU (colony forming units).

RESULTS AND DISCUSSION

In tables 1-3 are recorded the average values of microbiological swabs from individual monitored surfaces of the fish processing plant. In table 1 shows the results of microbiological swabs in during fish processing and after disinfection. We recorded higher numbers of TCB in the frozen fish production area during the day, specifically on the floor in the number of 150 CFU. We detected the highest number of coliform bacteria on the floor, in the number of 4 CFU.

Forchem 36 agent with disinfection effect belongs to substances witch use for disinfection of premises in food processing plants, efficacy of this agent was also confirmed by the results from microbiological swabs obtained from evaluated surfaces in monitored fish processing

plant. We recorded zero total count of bacteria and coliform bacteria on all tested surfaces after disinfection.

Table 1: Average values of microorganisms taken from selected surfaces in frozen fish production.

Place of collection	MPA TCB During fish processing	EA CB During fish processing	MPA TCB After Disinfection	EA CB After disinfection
Floor	150	4	0	0
Wall	2	1	0	0
Working desk	1	0	0	0
Door	3	1	0	0
Glaze container	1	0	0	0

Cleaning and disinfection are the major day-to-day controls for hard-surface vectors in food product contamination. If effective, they can reduce hazards within the processing environment.[6]

The table 2 shows the results of microbiological swabs, which were taken from the surfaces of the evaluated technological equipment. We recorded the highest number of TCB on single blade saw no.2, specifically 12 CFU. We did not detect coliform bacteria on the surfaces of the monitored devices either during processing or after disinfection.

Table 2: Average values of microorganisms taken from surfaces of technology equipments in frozen fish production.

Place of collection	MPA TCB During fish processing	EA CB During fish processing	MPA TCB After disinfection	EA CB After disinfection
Single blade saw no.1	1	0	0	0
Single blade saw no.2	12	0	0	0
Three blade saw	1	0	0	0
Pressure press	0	0	0	0

The food industry has major concerns regarding the sanitation of equipment because it is directly linked to human health. Food-borne pathogen microorganisms are targeted for elimination because they can cause illness outbreaks. There are also spoilage microorganisms that can modify the organoleptic properties of the products. Therefore, the sanitation of equipment is mandatory, since it promotes microbial reduction using cleaning processes and disinfecting agents. Food industry surfaces are usually wet, making them an adequate

environment for microbial contamination, particularly for the development of biofilms. Consequently, new techniques and sanitizers have been developed to control biofilms.[12]

The results from the microbiologicla swabs of the tools used in frozen production are evaluated in table 3. The highest TCB was detected on knife no.2 during fish processing. The hygiene of all observed tools surfaces was excellent after disinfection, with the exception of cutting board no.2. We detected 2 CFU of TCB on cutting board no.2 after disinfection, despite the fact that during fish processing we did not record any numbers of TCB on this surface. The cause of this condition could also be the failure of the human factor. The numbers of coliform bacteria on all monitored devices surfaces during fish processing and after disinfection were zero.

Table 3: Average values of microorganisms taken from the surfaces of tools used in frozen fish production.

Place of collection	MPA	EA	MPA	EA
	TCB During fish processing	CB During fish processing	TCB After disinfection	CB After Disinfection
Knife no.1	1	0	0	0
Knife no.2	2	0	0	0
Cutting board no.1	1	0	0	0
Cutting board no.2	0	0	2	0

Current evidence suggests that a substantial number of food-borne illnesses occur through poor food handling practices involving food workers.[13] Poor hand hygiene is a leading cause for the spread of food-borne illnesses in the food service industry. A series of complex motivational interventions must be employed to permanently change the behavior of workers, to increase their compliance and sustain appropriate levels of proper hand hygiene.[14]

By following the correct principles of workers hand hygiene working in food processing plants, we will prevent undesirable consequences in terms of food-borne diseases.

CONCLUSION

Sanitation is the creation and maintenance of hygienic and healthy conditions. It is an applied science that incorporates principles regarding the design, development, implementation, and maintenance of hygienic practices and conditions. Sanitation is also considered to be a foundation for food safety assurance systems. The effectiveness of disinfection depends on the correct choice, as well as on the concentration and time exposure of the disinfectant.

From the results of the microbiological swabs obtained after disinfection in monitored premise of fish processing plant, we can conclude that the Forchem 36 agent with disinfection effect used was effective enough in a 2 % concentration and a time exposure of 20 minutes with exception cutting board no.2., where were detected 2 CFU of TCB, despite the fact that during fish processing we did not record any numbers of TCB on this surface. The hygiene of employees' hands is also very important from the point of view of preventing food-borne diseases.

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