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MONITORING THE EFFICIENCY OF SANITATION OF EQUIPMENT INVOLVED IN THE MIXING AND DRYING PROCESS OF DAIRY COMPOUND POWDER USING THE SWABS METHOD

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Abstract: Evaluation of the hygiene efficiency of the equipment involved in the mixing process, drying of the powdered dairy compound after CIP cleaning, samples from the environment in the filling room of the product to be dried. Analyzes of aerobic mesophiles, molds and yeasts, total coliforms and fecal coliforms of the swabs collected from the equipment were performed. The Exhaust Duct equipment showed values above the standard, tanks 1 and 3 had total coliform counts above the standard of $2{,}0x10^{1}$ UFC/cm^2 and $1{,}5x10^{1}$ UFC/cm^2.
Keywords: Good Manufacturing Practices, Swabs, Equipment sanitation. Spray dryer.

INTRODUCTION

Quality management tools, Good Manufacturing Practices (GMP), Standard Operating Hygiene Procedures (PPHO) and Hazard Analysis and Critical Control Points (HACCP) must be used within industrial sectors as a risk control strategy. quality and increased productivity (JUNIOR, 2017). In the dairy industry, appropriate product manufacturing technologies must be applied. Alongside the technological contribution represented, mainly, by the adoption of hygienic practices, implementation of changes in the technological area of production, adequate methods of conservation and innovation in the production of derivatives, the industries must incorporate and become an obligatory part of the control system of quality (FIGUEIREDO et al., 2016). Hygiene control of equipment, utensils, facilities and the health of handlers from the raw material to the final product are necessary to guarantee the quality and microbiological safety of these foods. After processing, effective temperature control during storage ensures that the shelf life of the product is maintained. Failures during aseptic filling can allow the entry not only of microorganisms, but also of air

that is necessary for the multiplication of several deteriorating aerobic microorganisms (CARVALHO et al., 2016).

Cleaning and sanitizing equipment are important steps in sanitary control (ANDRADE, 2008). Thus, constantly evaluating the microbiological conditions of the environments related to the pre-preparation and preparation of food is fundamental to avoid its contamination, therefore, it is necessary to evaluate the environmental conditions in which food is prepared, analyze the contact surfaces at all stages of preparation, since food can become contaminated through contact with poorly sanitized utensils, surfaces and equipment (SILVA JUNIOR., 2007). As one of the ways to assess the level of surface contamination, routine microbiological analyzes of equipment used in production must be carried out. Obtaining samples through the surface swab and the subsequent counting of microorganisms allows detecting the degree of cleanliness, as well as evaluating the hygiene conditions of the handlers' hands (NOGUEIRA., 2016).

Swabs is the oldest method used to assess environmental microbiological conditions, developed in 1917 by Manheimer and Ybanez and is now considered by Apha (2001) as a standard methodology for microbiological analysis. Andrade (2008) elucidates the swab technique, which consists of: Defining an area to be analyzed, delimiting it with the aid of a sterilized mold, which is positioned with an inclination of approximately 30° on the surface, making circular movements with constant pressure.

The type of spoilage microorganisms differs among dairy products because of the selective effects of the steps applied during production, formulation, processing, packaging, storage, distribution and handling. Some spore-forming and thermoduric microorganisms can survive heat treatments and compromise the quality of concentrated and dehydrated products.

Drying is one of the oldest methods used to preserve foods such as meat, fruit and milk, with several advantages, such as reducing food mass, removing moisture, reducing water activity, in order to inhibit microbial growth, thus preventing spoilage. (FELLOWS, 2006; LOPES, 2013).

Powdered dairy compounds are products obtained from the mixture of milk and other products or food substances of dairy origin or not, also obtained by technologically appropriate processes. (BRASIL, 2007).

The operation scheme of the spray dryer drying system is characterized by the transformation of a liquid product into powder through a relatively short drying time. This liquid is sprayed using a high-pressure system, whereby product droplets come into contact with the hot air flow of the powder (FERRARI; RIBEIRO; AGUIRRE, 2012).

The objective of this work was to evaluate the hygiene efficiency of the equipment involved in the process of mixing and drying the powdered dairy compound after general cleaning and analysis of environmental samples in the filling room of the product to be dried through the swab method.

MATERIAL AND METHODS

The samples were collected from the equipment involved in the process of mixing and drying the powdered dairy compound after the general cleaning of an industry. The collection points are described in Table 1.

Equipments
Main Cyclone
Auxiliary Cyclone
Exhaust duct
Fluidized bed 01
Fluidized bed 02
Sieve
Filling tube
Filling nozzle
Tank 1
Tank 2
Tank 3

Table 1. Swab collection points.

The samples were placed under refrigeration in styrofoam boxes, being transported under refrigerated conditions to the premises of: Universidade Tecnológica Federal do Paraná - UTFPR.

To carry out the microbiological analyzes, the Microbiology Laboratory of the UTFPR - Campus Medianeira.

Analyzes of aerobic mesophiles, total coliforms and fecal coliforms of the swabs collected from the equipment involved in the mixing and drying process of the powdered dairy compound were carried out, and environmental samples were collected in the filling room of the product to be dried, and were The following microbiological analyzes were performed on swabs of mesophilic aerobes and molds and yeasts. The collection was carried out during the production process and for this purpose a plate containing standard Agar for counting (PCA) for mesophilic aerobes is left for 15 minutes in the filling room, which is then incubated at 36± 1°C for 48 hours. For analysis of molds and yeasts, a ready-made plate called Compact Dry YM was used, which already has the culture medium and allows counting after incubation at 25°C ± for 3 days. The plates were left on a stainless-steel table present in the bottling room, with a height of 1 meter. Figure 1 shows the layout of the filling room and the position of the plates. All analyzes were carried out in accordance with the provisions of Normative Instruction number 62, of 2003 (BRASIL, 2003) makes official the Methods Official Analytical for Microbiological Analysis for Control of Products of Animal Origin and Water. All analyzes were performed in duplicates.

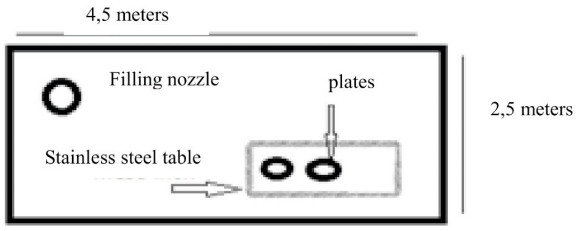

Figure 1. Filling room layout.

RESULTS AND DISCUSSION

The Ministry of Agriculture in its Normative Instruction nº 28 (BRAZIL, 2007) establishes microbiological standards for dairy compounds and derivatives, which help in the interpretation and conclusion of microbiological analysis results. However, that resolution does not establish criteria for surfaces and equipment.

Once the analyzes were concluded and in view of the absence of a national standard for the parameters analyzed in surface swabs, the results obtained were evaluated considering, for mesophilic aerobes, the international standards of the Pan American Health Organization (PAHO) and the World Health Organization (WHO), according to Table 2.

International standards of the Pan American Health Organization (PAHO) and World Health Organization (WHO)	
OPAS	50 UFC/cm² (5000UFC/100cm²)
OMS	50 UFC/cm² (5000UFC/100cm²)

Table 2. Pan American Health Organization (PAHO) and World Health Organization (WHO) international standards.

Source: Pan American Health Organization (PAHO) and World Health Organization (WHO)

The standards used for total and thermotolerant coliforms were based on those established by Tondo and Bartz (2013) who consider the absence of total and thermotolerant coliforms in clean equipment. The results obtained are shown in Table 3.

Equipment	Aerobic Mesophiles (UFC/cm²)	Total coliforms (UFC/cm²)	Thermotolerant coliforms (UFC/cm²)
Main Cyclone	< 1,0x10¹	<1,0x10¹	<1,0x10¹
Auxiliary Cyclone	< 1,0x10¹	<1,0x10¹	<1,0x10¹
Exhaust duct	1,5x10²	<1,0x10¹	<1,0x10¹
Fluidized bed 01	1,0x10¹	<1,0x10¹	<1,0x10¹
Fluidized bed 02	1,5x10¹	<1,0x10¹	<1,0x10¹
Sieve	< 1,0x10¹	<1,0x10¹	<1,0x10¹
Filling tube	1,5x10¹	<1,0x10¹	<1,0x10¹
Filling nozzle	< 1,0x10¹	<1,0x10¹	<1,0x10¹

Table 3. Results of analysis of equipment swabs.

The results for total and thermotolerant coliforms were satisfactory for all equipment according to the standard proposed by Tondo and Bartz (2013). As for aerobic mesophiles, 87.5% of the results are in accordance with the standard recommended by the Pan American Health Organization (PAHO) and the World Health Organization (WHO).

Only the Exhaust Duct equipment showed values above the standard (1,5x10² UFC/cm²), referring to the possibility that cleaning was not well performed at this point. This is explained by the fact that this equipment is difficult to access, as it is a curved cylindrical outlet that connects the drying chamber to the main cyclone.

Similar results for aerobic mesophiles were found by Espich (2014) in a study of the effectiveness of cleaning in an industry that produces candies (chewing candies), where the results after cleaning the equipment did not exceed the count of 1,0 x10¹ UFC/cm².

Table 4 shows the results of the swab analyzes for mesophilic aerobes, total and thermotolerant coliforms in the tanks used for mixing and storage of the liquid mixture process of the dairy compound.

The highest result found for mesophiles is 1,6x10² UFC/cm², while the lowest value found is < 1,0x10¹/UFC/cm².

Tanks 1 and 3 had total coliform counts above the standard established by Tondo and Bartz (2013), 2,0x10¹ UFC/cm² and 1,5x10¹ UFC/cm² respectively, such results can be explained by the possible contamination of the water used in the final CIP rinse step or some factor of the previous CIP steps were not met, which could be the very low acid or sodium hydroxide concentration or even the pressure of the CIP system, which may not reach effectively all points of the tank and thus also explaining the presence of contamination by aerobic mesophiles, where values of up to 1,6x10² UFC/cm² in tank 1. For thermotolerant coliforms the value for all tanks was <1,0x10¹ UFC/cm².

Equipments	Aerobic Mesophiles (UFC/cm²)	Total coliforms (UFC/cm²)	Thermotolerant coliforms (UFC /cm²)
Tank 01	1,6x10²	2,0x10¹	<1,0x10¹
Tank 02	9,5x10¹	< 1,0x10¹	<1,0x10¹
Tank 03	< 1,0x10¹	1,5x10¹	<1,0x10¹

Table 4 - Result of tank swab analysis.

The presence of coliforms in environments, surfaces or food products provides information about hygienic-sanitary conditions and may be an indicator of the possible presence of pathogens (ANDRADE, 2008).

It is observed that the results obtained are in accordance with the current legal legislation Normative Instruction No. 28 (BRASIL, 2007). In addition, they indicate good quality hygienic-sanitary conditions during product processing, showing the importance

of maintaining the Good Manufacturing Practices Programs (GMP) and following the standard procedures for operational hygiene (PPHO) in the food industry.

Silva et al. (2011) when evaluating the microbiological quality of equipment and utensils of a dairy in Minas Gerais, found that all samples had levels of total and thermotolerant coliforms (maximum counts of $5x10^5$ NMP/cm^2). Evaluating the efficiency of equipment and utensils cleaning procedures is a constant need to prevent food contamination (CAMPDEPADRÓS et al., 2012).

CONCLUSION

The results for total and thermotolerant coliforms were satisfactory for all equipment. For aerobic mesophiles, 87.5% of the results are in accordance with the standard recommended by the Pan American Health Organization (PAHO) and the World Health Organization (WHO).

Only the Exhaust Duct equipment showed values above the standard (1.5x102 CFU/cm2), referring to the possibility that cleaning was not well performed at this point. This is explained by the fact that this equipment is difficult to access, as it is a curved cylindrical outlet that connects the drying chamber to the main cyclone.

Tanks 1 and 3 had total coliform counts above the standard of 2.0x101 CFU/cm2 and $1.5x10^1$ CFU/cm2 respectively, such results can be explained by the possible contamination of the water used in the final rinse step of the CIP, or the solutions used have very low concentrations, or the pressure of the CIP system does not effectively reach all points in the tank, enabling the presence of contamination by aerobic mesophiles, where values of up to 1.6x102 CFU/cm2 were found in tank 1. thermotolerant coliforms the value for all tanks was $<1,0x10^1$ UFC/cm^2.

It is concluded that regarding the manual cleaning of equipment and use, training must be carried out for employees who carry out cleaning and maintenance/adaptation of the CIP System to improve the efficiency of the process, punctuating all the procedures described in the company's PPHO, as failures in this operation may compromise the microbiological quality of the product. There is a need for greater control of the CIP system and manual cleaning, and constant monitoring of the concentration of the chemicals used. Being that in the equipment of easy access, the cleaning was efficient.

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