MICROBIOLOGICAL QUALITY OF THE HANDS OF FOOD HANDLERS AND OF THE SANITIZER IN THE MEAT PROCESSING INDUSTRY

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ABSTRACT: The hygienic-sanitary quality of foods constitutes an essential factor for consumer food safety. Food is increasingly exposed to a series of dangers and opportunities for contamination by microorganisms due to inadequate handling practices during food processing. Most of the people involved with the handling of foods lack knowledge related to hygienic-sanitary care that should be taken. With the objective of verifying the microbiota of the handlers' hands in a meat industry, the microbiological monitoring was conducted before and after the sanitation of the hands. The collections were conducted in the deboning and cold cut sectors, with 20% participation of the handlers in each sector. There was presence of thermotolerant coliforms, total coliforms and *Staphylococcus aureus* before and after the sanitation of hands in the deboning sector. In the cold cut sector, the presence of thermotolerant coliforms was only verified before the sanitation, however the total coliform group was detected before and after sanitation. There was no presence of *S. aureus*. There was no presence of *Salmonella* spp in any of the analyzed samples.
KEYWORDS: Bacteria. Personal hygiene. Gastroenteritis.

QUALIDADE MICROBIOLÓGICA DAS MÃOS DE MANIPULADORES DE ALIMENTOS E DA SANITIZANTE NA INDÚSTRIA DE CARNE

RESUMO: A qualidade higiênico-sanitária dos alimentos constitui um fator essencial à segurança alimentar dos consumidores. Os alimentos estão cada vez mais expostos a uma série de perigos e oportunidades de contaminações por microrganismos, devido às práticas inadequadas de manipulação no processamento dos alimentos. A maioria das pessoas envolvidas com a manipulação de alimentos carece de conhecimentos relativos aos cuidados higiênico-sanitários que devem ser seguidos. Com o objetivo de verificar a microbiota das mãos de manipuladores em uma indústria de carnes, foi realizado o monitoramento microbiológico antes e após a higienização das mãos. As coletas foram realizadas nos setores da desossa e dos embutidos, com a participação de 20% dos manipuladores de cada setor. Na desossa, houve presença de coliformes termotolerantes, coliformes totais e Staphylococcus aureus antes e após a higienização das mãos. No setor dos embutidos, verificou-se a presença de coliformes termotolerantes somente antes da higienização, porém o grupo dos coliformes totais foi detectado antes e após a higienização, não houve presença de S. aureus. Em nenhuma das amostras analisadas ocorreu presença de Salmonella spp.
PALAVRAS-CHAVE: Bactérias. Higiene pessoal. Gastroenterite.

Introduction

A growing consumer concern has been observed regarding the quality of the food acquired and with the consequent health risks arising from foods contaminated with pathogenic microorganisms. With the growth of the food industries, the food become more exposed to microbial contamination associated to improper handling practices.

The food in satisfactory hygienic standards is essential to maintaining the quality of health because the foodborne diseases are currently responsible for most outbreaks of diarrhea in many countries. The enteric infections due to *Salmonella* infections cause gastrointestinal symptoms such as having abdominal pain, diarrhea, fever and vomiting are rare clinical cases fatal (MAIJALA et al., 2005). However, typhoid fever, caused by S. typhi, causes symptoms very serious and includes sepsis, high fever, diarrhea and vomiting. After infection, individuals may become carriers for months or years, then constituting a continuing source of infection. Example a standard bearer, Mary Typhoid, a cook at the City of New York in the early 1990, was responsible for about ten outbreaks at the time (SHINOHARA et al., 2008, MILLEZI et al., 2007).

The important items relative to food handler training are: personal hygiene - sanitation of hands, important information relative to body hygiene, general care taken with uniforms, food hygiene, in other words, correct application of the sanitation on surfaces, equipment and care with cross contamination between contaminated foods and foods free from contamination (VIEIRA et al., 1996; SILVA JR., 2005), others adds the item general concepts of Microbiology.

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Among the pathogenic microorganisms, S. *aureus* is the principal cause of food poisoning in man. The microorganism produces extracellular compounds such as the staphylococcal enterotoxins, coagulases, nucleases and lipases. (FUIEYO, MENDONZA, MARTÍN, 2005). The enterotoxins are responsible for food poisoning. The food poisoning by S. *aureus* is caused by the ingestion of foods that contain the toxins pre-synthesized by the bacteria (VARNAM; EVANS, 1994).

Among the Gram-negative that produce gastroenteritis of food origin, the most important are the representatives of the genus *Salmonella*. *Salmonella* occur in humans, warm and cold-blooded animals, foods and in the environment, it is pathogenic to humans, being an agent of Typhoid fever, enteric fevers, gastroenteritis and septicemia (FORTUNA; FRANCO, 2005; GURSOY et al., 2009). People and animals are direct sources of food contamination with salmonella.

The objective of this work was to analyze the microbiota of the hands of food handlers in order to evaluate the efficiency of the sanitizer Biguatin and the sanitation process through the microbiological monitoring of the hands before and after the use of the sanitizer.

Materials and Methods

Local and conduction of the experiment

Samples collection was conducted in the city of Frederico Westphalen, Rio Grande do Sul, in a pork processing industry. After the collection, the samples were immediately transported to the Food Microbiology Laboratory of the Universidade Regional e Integrada do Alto Uruguai e das Missões, where the microbiological analyses were conducted.

Observation of activities in the industry

The hand sanitation activities of the handlers in the deboning and cold cut sectors were accompanied for a period of 6 months.

Hand hygiene of the food handlers

For the hand sanitation process, the handlers first used common neutral detergent, water at room temperature and a 2% concentration of Biguatin 400 (Hexamethylene biguanide) as a biocidal antiseptic.

Microbiological Analysis

Collections were carried out through sterilized plastic bags containing 200 milliliters of 0,1% peptonated saline water. Each manipulator dipped the two hands (the whole surface) in the plastic bag for 30 seconds, first, before the sanitation of the hands and afterwards another plastic bag was used for the collection after the sanitation (MILLEZI et al., 2007).

The methodology used for microbiological analysis was according with Silva, Junqueira, Silveira, 2010. As a presumptive test for total coliforms the Lauryl Sulfate Tryptose (LST) Broth was used. As confirmative test of total coliforms the Brilliant Green Bile Broth (BB) was used and the Escherichia coli Broth (EC) as confirmative test of thermotolerant coliforms. To detect the presence of coagulase-positive staphylococci, Baird-Parker Agar (BP) was used. Suspected colonies were submitted to the coagulase production test, submitting the cultures to additional catalase and thermonuclease tests. For evaluation of *Salmonella* sp, Buffered Peptonated Water was used as pre-enrichment, and as enrichment, the Selenite and Rappaport broths and Rambach Agar for isolation. Suspected colonies were striated in tubes containing Triple Sugar Iron Agar (TSI) and Lysine Iron Agar (LIA). The TSI and LIA tubes that presented typical *Salmonella* reactions were submitted to biochemical tests of the API 20 test kit.

Collections were conducted in the cold cut and the deboning sectors (before and immediately after sanitation).

Results and Discussion

The cold cut and deboning sectors are locals where the product is manipulated directly and *in natura*, without passing through any cooking or boiling process that can reduce the microbial load, when present in high numbers.

In table 01 it can be observed that there was a thermotolerant coliform presence only in sample 8, demonstrating that most of the handlers in that sector possessed appropriate hygienic practices, as far as the contamination of fecal origin aspect is concerned, since contamination by thermotolerant coliforms indicate contact with feces contaminated material.

In relation to contamination by total coliforms, samples 2, 3, 4, 5 and 8 were positive in 62.5% of the samplings.

An aspect considered positive was the absence of *S. aureus* and *Salmonella* sp in the analyzed samples of the hands in the cold cuts sector, before (table 01), as well as after their sanitation (table 02). *S. aureus* are microorganisms used as indicators of inadequate handling. Approximately 20% of individuals are colonized by some type of strain of *S.*

aureus while 60% harbor *S. aureus* with varying frequency (SILVA; GANDRA, 2004).

Table 01: Microbiological analysis of the hands of the manipulators in the cold cut sector prior to the sanitation with Biguatin 400 sanitizer

SAMPLE	MICROORGANISM CFU / HAND			
	TERMOTOLERANT COLIFORMS	TOTAL COLIFORMS	*S. aureus*	*Salmonella spp*
1	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
2	< 1.0×10^1	8.23×10^2	< 1.0×10^1	Absence
3	< 1.0×10^1	1.0×10^1	< 1.0×10^1	Absence
4	< 1.0×10^1	5.0×10^1	< 1.0×10^1	Absence
5	< 1.0×10^1	5.1×10^1	< 1.0×10^1	Absence
6	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
7	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
8	3.3×10^1	1.0×10^1	< 1.0×10^1	Absence

After the sanitation of the hands, as table 02 demonstrates, there was no presence of thermotolerant coliforms, S. *aureus* and *Salmonella sp.* There was a reduction of total coliforms in samples 2, 3, 5 and 8, however, the counts were higher in sample 4 and those microorganisms were detected in sample 7, in the which there was no presence before sanitation. During the monitoring of the company activities, some inadequate food handling practices were observed, such as the drying of hands on the uniform after their sanitation, since the clothes can be vehicle of cross contamination. Another improper practice was the use of ornaments, such as rings, which can also harbor microorganisms and hinder sanitation, besides being characterized as a physical danger.

The food handlers training is a fundamental condition to avoid contamination and consequently assure the quality and innocuousness of the produced foods (PISTORE; GELINSKIB, 2006). The description of the operations conducted by the establishment based on the Manual of Good Food Handling Practices and the availability of Standardized Operational Procedures is extremely necessary. In other words, objective written procedures establishing the sequential instructions for the accomplishment of routine and specific food handling operations is indispensable (FAÇANHA, 2003).

Table 02: Microbiological analysis of the hands of the manipulators in the cold cut sector after sanitation with Biguatin 400 sanitizer

SAMPLE	MICROORGANISM CFU / HAND			
	TERMOTOLERANT COLIFORMS	TOTAL COLIFORMS	*S. aureus*	*Salmonella spp*
1	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
2	< 1.0×10^1	1.0×10^1	< 1.0×10^1	Absence
3	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
4	< 1.0×10^1	6.0×10^1	< 1.0×10^1	Absence
5	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
6	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
7	< 1.0×10^1	1.16×10^1	< 1.0×10^1	Absence
8	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence

In table 03 the results of thermotolerant coliform CFU/hand, total coliforms, *S aureus*, and *Salmonella* sp found on the deboning sector handlers hands before sanitation are expressed.

Table 03: Microbiological analysis of the hands of the manipulators in the deboning sector prior to the sanitation with Biguatin 400 sanitizer

SAMPLE	MICROORGANISM CFU / HAND			
	TERMOTOLERANT COLIFORMS	TOTAL COLIFORMS	*S. aureus*	*Salmonella spp*
1	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
2	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
3	1.12×10^2	1.7×10^1	< 1.0×10^1	Absence
4	1.0×10^1	1.0×10^1	< 1.0×10^1	Absence
5	< 1.0×10^1	1.0×10^1	< 1.0×10^1	Absence
6	< 1.0×10^1	< 1.0×10^1	3.81×10^4	Absence
7	< 1.0 x 101	1.16×10^1	7.1×10^3	Absence
8	< 1.0 x 101	< 1.0×10^1	< 1.0×10^1	Absence
9	< 1.0 x 101	< 1.0×10^1	< 1.0×10^1	Absence
10	< 1.0×10^1	< 1.0×10^1	< 1.0 x 101	Absence
11	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence
12	< 1.0×10^1	1.65×10^2	1.3×10^4	Absence
13	< 1.0×10^1	< 1.0×10^1	1.7×10^3	Absence
14	< 1.0×10^1	< 1.0×10^1	3.3×10^1	Absence
15	1.18×10^2	3.6×10^2	< 1.0×10^1	Absence
16	< 1.0×10^1	< 1.0×10^1	< 1.0×10^1	Absence

The thermotolerant coliform group was found in lower incidence (samples 3, 4 and 15); total coliforms were the microorganisms detected in a larger number of samples: 3, 4, 5, 7, 12 and 15; S. *aureus* was present on the hands of handlers 6, 7, 12, 13 and 14, and in samples 6 and 7 the counts were the highest, 3.81×10^4 and 7.1×10^3 CFU/hand respectively. In a study, the incidence of *S. aureus* in samples

from food handlers' hands was 88% (6). In relation to the bacterium *Salmonella* sp, its presence was not detected.

Table 04 shows the results of the microbiological analyses conducted from the samples from the hands after the food handler sanitation procedures.

Table 04: Microbiological analysis of the hands of the manipulators in the deboning sector after sanitation with Biguatin 400 sanitizer

SAMPLE	MICROORGANISM CFU / HAND			
	TERMOTOLERANT COLIFORMS	TOTAL COLIFORMS	*S. aureus*	*Salmonella spp*
1	< 1.0 x 10^1	< 1.0 x 10^1	2.3 x 10^1	Absence
2	< 1.0 x 10^1	< 1.0 x 10^1	< 1.0 x 10^1	Absence
3	8.05 x 10^2	8.1 x 10^2	9.9 x 10^1	Absence
4	< 1.0 x 10^1	2.85 x 10^2	2.5 x 10^3	Absence
5	< 1.0 x 10^1	< 1.0 x 10^1	< 1.0 x 10^1	Absence
6	< 1.0 x 10^1	< 1.0 x 10^1	< 1.0 x 10^1	Absence
7	< 1.0 x 10^1	< 1.0 x 10^1	< 1.0 x 10^1	Absence
8	< 1.0 x 10^1	< 1.0 x 10^1	< 1.0 x 10^1	Absence
9	< 1.0 x 10^1	< 1.0 x 10^1	2.0 x 10^2	Absence
10	< 1.0 x 10^1	< 1.0 x 10^1	1.4 x 10^3	Absence
11	< 1.0 x 10^1	< 1.0 x 10^1	3.6 x 10^2	Absence
12	< 1.0 x 10^1	< 1.0 x 10^1	< 1.0 x 10^1	Absence
13	< 1.0 x 10^1	< 1.0 x 10^1	< 1.0 x 10^1	Absence
14	< 1.0 x 10^1	< 1.0 x 10^1	< 1.0 x 10^1	Absence
15	2.9 x 10^2	4.0 x 10^2	6.93 x 10^2	Absence
16	< 1.0 x 10^1	2.0 x 10^1	< 1.0 x 10^1	Absence

According to the data presented in table 04, two situations are verified which are similar to the cold cuts sector when analyzing the microbial load present before and after hand sanitation. In some samplings, it can be observed that there was a total reduction of the bacteria after the hand hygiene. On the other hand, in the analysis of thermotolerant coliforms, in sample 3, there was an increase of the microbial counts after the sanitation and in sample 15, little reduction was observed. For total coliforms, in the samples 3, 4 and 5, the microbial load was higher, and in samples 3 and 4 that increase was of one logarithmic cycle, a cause for concern, since there is a high possibility to transmit the microorganisms to the manipulated food. The same situation occurred in the analyses of *S. aureus*, a total reduction of the bacterium after sanitation in the samples 6, 7, 12, 13 and 14 occurred, however there was presence in 43.75% of the samplings. Satisfactory microbiological results for hand hygiene are absence of thermotolerant coliforms, coagulase-positive staphylococci, among others (SILVA JR, 2005).

Oliveira et al. (2008) observed that the hands of five food handlers, handlers of meat in establishments in Lavras, MG, were found contaminated since the number of coagulase-positive staphylococci varied from 2.6 x 10^3 to 1.4 x 10^5 CFU/hand and thermotolerant coliforms from 1.5 x 10 to 4.6 x 10^3. The handlers also demonstrated contamination with high concentrations of mesophilic aerobic microorganisms and coagulase-positive staphylococci. The presence of mesophilic microorganisms on the hands varied from 2.8 x 10^4 to 5.85 x 10^6 CFU/hand. Those values can be increased by the intimate contact of the hands with the meat, which might have come from the suppliers already contaminated.

In a study by Shutz; Velazquez; Abegg (2008), samples of herbal drugs showed *E. coli* and *S. aureus*, indicating post-sanitizing contamination or post-process, as well as sanitation and hygiene practices at odds with the required standards. According to these authors, presumably, the contamination occurred due to inadequate practices of food handlers in compounding pharmacies.

Data related by the Center for Disease Control relative to the outbreak of food poisoning in these services in the USA, point to the food handler as being responsible for 26% of those outbreaks. Studies demonstrate that under normal conditions the microbiota of the skin is completely reestablished one week after antisepsis; therefore the use of non-skin irritating germicides, with a lingering residual effect, is recommended. (SHENNA; STILES, 1983). The antiseptic should not be chosen only based on its activity against Gram-positive bacteria, since the handlers' hands can harbor Gram-negative bacteria, such as *Salmonella* and *Escherichia coli* (ALMEIDA et al., 1995).

Conclusions

According to works in the literature and the results found in this research, it can be concluded that even the most rigorous washing of the hands does not guarantee that they are free from microorganisms. However, the first requirement of personal hygiene is that the handlers wash their hands rigorously and respect the application procedures of the sanitizing agent.

At the concentration used, the antiseptic sanitizer Biguatin decreased or destroyed the vegetative forms of the microorganisms previously found on the hands of the handlers, however there are cases of contamination after the sanitation of the hands that probably occurred due to the inadequate handling

practices

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