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COMPARATIVE INVESTIGATIONS ON THE EFFECT OF DISINFECTION IN TWO MEAT PROCESSING ENTERPRISES

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Summary

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Comparative investigations were carried out in two meat processing plants in order to determine the effect of disinfection on contact surfaces prior to and after the procedure on the basis of the total number of mesophilic microorganisms. It was found out that during production, the surfaces of most meat processing machines in the plant manufacturing freshly cooked and dried sausages from red and white meat were more contaminated than those in the plant manufacturing dry sausages from red meat. In both enterprises, the total number of mesophilic organisms was higher on the surface of mechanical meat processing units than on the surface of thermal processing, drying and storage equipment, whereas the contamination of hands of cutter operators was almost identical. After the sanitation, mesophilic microflora was reduced to amounts, many times lower than normatively allowed. The effect of disinfection was more pronounced in the plant manufacturing freshly cooked and dried sausages from red and white meat, where the contamination of operational surfaces with mesophilic organisms was higher. In both plants, the effect of disinfection was higher with regard to the equipment with initially more contaminated and smoother surfaces.

Key words: disinfection, food safety, meat processing, total mesophilic microflora

INTRODUCTION

The low numbers of mesophilic microorganisms and the lack of pathogenic microflora are of utmost importance for meat products safety (Surkiewicz *et al.*, 1972; Duffy *et al.*, 2001; Bremer *et al.*, 2004). During production, there is a risk for cross contamination with saprophytic, putrefaction and pathogenic microflora between raw products and contact surfaces of technological equipment (Nerbrink & Borch, 1993; Korkeala & Björkroth, 1997; Palá & Sevilla, 2004; Sachindra *et al.*, 2005; Temelli *et al.*, 2005). The development and implementation of effective systems of self-control, providing a high hygiene of production and efficient disinfection, could reduce this risk to acceptable levels. According to Kunev *et al.* (1981), disinfection decreases considerably the total microbial counts on contact surfaces in meat processing plants, but a complete disinfection is not achieved. Karadzhov *et al.* (2004) established a similar effect after burning paraformaldehyde briquettes that varies between 83% and 100% in the air of the treated premise.

In the scientific literature, there are no specific data about the type of microflora

on contact surfaces of meat processing equipment and its reduction following disinfection.

The aim of the present study was to perform a comparative investigation on the effect of disinfection, carried out in accordance with the programme for cleansing contact surfaces and operational premises from the good manufacturing and hygiene practices, in two meat processing enterprises.

MATERIALS AND METHODS

In this study, two meat processing plants, conditionally named *enterprise P* (producing dry sausages from red meat) and *enterprise C* (producing freshly cooked and dried sausages from red and white meat) were included. In accordance with the microbiological criteria for foodstuffs (Commission Regulation EC No 2073/2005; Anonymous 2005), swabs were obtained six times according to ISO 18593 (Anonymous, 2004).

The samples were from identical areas of the contact surfaces of the following equipment: the guillotine knife in enterprise C, respectively the deboning table in enterprise C, the mincer funnel, the cutter bowl, the hands of the cutter operator, the wall of the premise near to the cutter machine, the stuffing machine funnel, the smoking rods, the inner surface of the steam cooker chamber, the dryer wall and the refrigerator wall. Washing samples were obtained by means of sterile cotton swabs with an area of 100 cm^2, according the BSS ISO 3100-1 (Anonymous, 2002). Then, each swab was placed in a tube containing 9 mL peptone water. The tubes with swabs were transported to the laboratory at a temperature of 0–2˚C. The samples were processed within an hour from the sampling. The determination of the total number of mesophilic microorganisms was performed according to ISO 18593 (Anonymous, 2004).

RESULTS

Table 1 shows that during operation, the contamination with mesophilic microflora was over 1000 CFU/cm^2 for 6 out of 10 studied surfaces in enterprise C, whereas in enterprise P – in only three. In enterprise C, 1.5 times more microorganisms were isolated from the surface of mincer

Table 1. Total number of mesophilic microorganisms in studied meat processing enterprises during the operation

Enterprise P			Enterpise C		
Sample	CFU/cm^2	Lg10	Sample	CFU/cm^2	Lg10
Guillotine	512.90	2.71	Table	7060.67	3.85
Mincer	1570.55	3.20	Mincer	2368.61	3.37
Bowl cutter	297.17	2.47	Bowl cutter	5413.50	3.73
Hands	1183.50	3.07	Hands	1110.00	3.05
Premise	1204.60	3.08	Premise	402.67	2.60
Stuffer	431.38	2.63	Stuffer	10181.50	4.01
Smoke rod	400.01	2.60	Smoke rod	6662.42	3.82
Steam cooker	2.06	0.31	Steam cooker	18.75	1.27
Dryer	61.41	1.79	Dryer	6.14	0.79
Refrigerator	10.00	1.00	Refrigerator	37.63	1.58

Table 2. Total number of mesophilic microorganisms in studied meat processing enterprises after the disinfection

Enterprise P				Enterpise C			
Sample	CFU/cm^2	Lg10	%*	Sample	CFU/cm^2	Lg10	%*
Guillotine	2.88	0.46	0.56	Table	1.82	0.26	0.03
Mincer	2.46	0.39	0.16	Mincer	2.86	0.46	0.12
Bowl cutter	4.60	0.66	1.55	Bowl cutter	1.15	0.06	0.02
Hands	1.42	0.15	0.12	Hands	3.19	0.50	0.29
Premise	3.53	0.55	0.29	Premise	1.48	0.17	0.37
Stuffer	0.29	–0.54	0.07	Stuffer	0.05	–1.30	0.0005
Smoke rod	2.93	0.47	0.73	Smoke rod	4.32	0.64	0.06
Steam cooker	0.06	–1.22	2.91	Steam cooker	0.05	–1.30	0.27
Dryer	1.29	0.11	2.10	Dryer	0.49	–0.31	7.98
Refrigerator	0.66	–0.18	6.60	Refrigerator	0.43	–0.37	1.14

* percentages vs respective data from Table 1.

Table 3. Effect of disinfection in studied meat processing enterprises, presented via the reduced total number of mesophilic microorganisms

Enterprise P				Enterpise C			
Sample	CFU/cm^2	Lg10	%*	Sample	CFU/cm^2	Lg10	%*
Guillotine	510.02	2.25	99.44	Table	7058.85	3.59	99.97
Mincer	1568.09	2.81	99.84	Mincer	2365.75	2.92	99.88
Bowl cutter	292.57	1.81	98.45	Bowl cutter	5412.35	3.67	99.98
Hands	1182.08	2.92	99.88	Hands	1106.81	2.54	99.71
Premise	1201.07	2.53	99.71	Premise	401.19	2.43	99.63
Stuffer	431.09	3.17	99.93	Stuffer	10181.45	5.31	100.00
Smoke rod	397.08	2.14	99.27	Smoke rod	6658.10	3.19	99.94
Steam cooker	2.00	1.54	97.09	Steam cooker	18.70	2.57	99.73
Dryer	60.12	1.68	97.90	Dryer	5.65	1.10	92.02
Refrigerator	9.34	1.18	93.40	Refrigerator	37.20	1.94	98.86

* percentages vs respective data from Table 1.

funnel compared to the same site in enterprise P. The bowl of the cutter in enterprise C showed a contamination rate, 18 times higher than that in enterprise P. Similar results were obtained in the investigation of the stuffing machine funnel, the smoking rods, the inner surface of the steam cooker door and refrigerator wall in enterprise C.

In enterprise P, however, the premise wall and the dryer wall were considerably more contaminated than those in enterprise C.

The hands of cutter operators from both enterprises showed similar number of mesophilic microorganisms, yet the hands of the operator in enterprise P were slightly more polluted.

According to the data from Table 2, the opposite situation was observed after the disinfection, i.e. in enterprise P, 6 of all studied surfaces showed higher total residual microbial counts against only 2 in enterprise C.

The amount of mesophilic organisms having survived the disinfection, presented as percentages, not always corresponded to absolute counts (Tables 2 and 3). For instance, in enterprise P, the largest amount of microorganisms were observed on refrigerator wall (6.60%), whereas the identical surface in enterprise C showed only 1.14%, i.e. approximately 6 times lower numbers. In enterprise C, the highest percentage of residual microflora (7.98%) occurred on the dryer wall, whereas in enterprise P, the dryer wall showed 2.10%, or 4 times less. In enterprise P, the inner surface of the steam cooker chamber showed 2.92% residual microflora that was 11 times more than that on the same location in enterprise C (0.27%).

Table 3 presents data about the effect of disinfection as a difference between the initial mesophilic microbial counts prior to the procedure and after it. In enterprise P, the mesophilic microflora was the most significantly reduced on the mincer funnel surface, whereas the same location in enterprise C showed a 1.5 time higher reduction rate. In enterprise C, the highest mesophilic microflora reduction rate was achieved on stuffer surface, whereas in enterprise P the destroyed microorganisms were about 24 times less numerous.

DISCUSSION

According to our results, the disinfection of all studied surfaces resulted in more than 90% reduction of the total number of mesophilic organisms. Its effect was the highest on stuffer funnels. The lowest effects of sanitation was observed on refrigerator wall in enterprise P (93.40% reduction), whereas the same place in enterprise C, the reduction rate was relatively high (98.86%). A very good disinfection (over 99.5% reduction) was achieved for the hands of cutter operators, mincer funnels and wall of premises. A lower effect (90–99%) was established on the cutter bowl, dryer wall and the inner surface of the steam cooker in enterprise P, and the lowest effect occurred on dryer wall in enterprise C (92.02%).

It should be noted that in both enterprises, the total numbers of mesophilic organisms were considerably higher on mechanical processing equipment and considerably lower on studied points from the equipment of thermal processing, drying and storage of products. A number of authors (Rantsiou *et al.*, 2005; Temelli *et al.*, 2005; Corbière *et al.*, 2006) outlined the mechanical processing equipment (deboning and cutting knifes, containers, mincers and stuffers, operators' hands, the air in premises) as primary factors of contamination and recontamination.

After disinfection, 6 of all studied surfaces in enterprise P (the guillotine knife, the cutter bowl, the stuffer funnel, the premise, dryer and refrigerator walls) showed higher total residual microbial counts compared to the respective points in enterprise C. Only the cutter operator hands and the smoking rods exhibited less microorganisms compared to enterprise C. This was partly valid for the mincer funnel surface, but not for the inner surface of the steam cooker, where the values were almost identical. More than 1% residual microflora was detected on points in enterprise P (refrigerator wall, inner surface of the steam cooker, dryer wall and cutter bowl), whereas in enterprise C there were

only two (dryer and refrigerator walls). The residual mesophilic microflora was under 1% for 5 studied points in enterprise P (smoking rods, guillotine knife, premise wall, mincer funnel and cutter operator's hands) and 4 points in enterprise C (premise wall, cutter operator's hands, inner surface of the steam cooker door and mincer funnel). A very small amount of microorganisms (under 0.1%) persisted on stuffer funnel in enterprise P but in 4 points in enterprise C (smoking rods, deboning table, cutter bowl and stuffer funnel).

Our data suggest that in studied enterprises, the disinfection procedure was precisely performed. After that, the residual total mesophilic microbial counts ranged between 4.60 CFU/cm^2 on the cutter bowl in enterprise P to 0.05 CFU/cm^2 on stuffer funnel and the inner surface of steam cooker door in enterprise C. Compared to the normatively allowed counts of 100 CFU/cm^2 these values were many times lower.

In conclusion, the effect of disinfection for all studied surfaces in both enterprises was over 90%. It depended on the initial contamination and was relatively lower in surfaces with lower initial pollution. A strong effect of disinfection was observed in more polluted, but smooth surfaces such as the guillotine knife, the deboning table, the cutter bowl and the stuffer funnel.

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