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OMISSIONS IN THE DISINFECTION OF A CRAFT-SLAUGHTERHOUSE

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Abstract: The aim of this study was to establish the difference in the total number of bacteria present on some surfaces after disinfection was performed either by a professional or a layman employed at the slaughterhouse. Based upon the obtained results it can be concluded that there were omissions in the disinfection procedure. The study material consisted of wet and dry swabs taken during a five week period, before and after disinfection was performed either by a professional or a laymen. The following surfaces were sampled: meat carving knife, meat hooks, floor of the stunning area, and corridor floor. The procedure for wet swabs was carried out in accordance with the standard ISO 18593 method. The number of bacteria was estimated from each sample with the standard ISO 4833 method. Disinfection was performed with a 0.02% chlorine solution; the exposition time was 30 min. According to the obtained results it can be concluded that after disinfection was carried out by a professional- veterinarian, or by a layman, all surfaces which were previously treated correctly (mechanical cleaning and sanitary washing), and disinfected measured a significant decrease in the number of total bacteria (log cfu/cm2). The results for the total number of bacteria obtained after disinfection of the stunt area indicate on possible omissions as the number of bacteria did not decrease.

Key words: disinfection, omissions, craft slaughterhouse

Introduction

Implementation of good hygiene practice in slaughterhouses and procedures based on hazard analysis and critical control point (*Hazard Analysis Critical Control Points*) principles are essential to prevent microbial carcass contamination in order to ensure meat safety (*Lindblad and Berking, 2013*). The food business operators (FBOs) have the primary responsibility of ensuring food safety. Adequate meat hygiene is the result of the implementation of conditions and procedures based on HACCP principles. The predetermined conditions are crucial for the implementation of HACCP principles, and should be accomplished prior to HACCP. The main goal is to avoid the possibility that a low risk hazard evolves into a high risk food hazard. In addition to all other requirements, the pre-requisites include sanitation (cleaning, washing and disinfection) aimed at preventing possible sources of contamination, as well as reducing the total number of bacteria to the lowest possible extent (*Bunčić, 2009*).

Disinfection includes daily and constant disinfection of the equipment, utensils, desktops, as well as sanitary facilities. A daily and conscientious disinfection routine is needed in order to avoid the microbial contamination of the carcasses as different microorganisms are introduced into the slaughterhouse in large numbers on a daily basis. Primary microbial contamination can occur in the pen or stable, as the animal comes into close contact with feces. A further source of contamination can be the transport vehicle that has not been properly disinfected (*Rostagno and Callaway, 2012; Mannion et al., 2008*). Lairage can be a major source of contamination as it is the place where a large number of animals with different epizootiological status are gathered. Thereon, the microorganisms can be transferred from the skin onto the animal carcasses subsequently produced (*Small et al., 2006*). *De Busser et al. (2011*) indicate that the lairage area is a primary source of *Salmonella* in slaughter pigs and that carcass contamination originates from the environment rather than from the pig (inner contamination). Contamination of the carcasses is possible by contamination with gastrointestinal contents, or during the slaughter process it may occur as a result of direct or indirect contact with contaminated tools and equipment, personnel clothing and shoes, hands, floors, sewage outlets, air or water (CVPH, 2001; *Eustace et al., 2007; Gun et al., 2003*). *Haileselassie at al. (2013)* carried out a study in order to assess the food safety and practices in meat handling, and to determine the microbial load and pathogenic microorganisms present in the meat. He established that the microbial profile was higher compared to standards set by *WHO* as the result of inadequate sanitation as in the abattoir there was no hot water, nor sterilizing and cooling facilities. *Boughton et al. (2007)* and *Small et al. (2007)* reported that routine cleaning and washing of the lairage with cold water are not sufficient for the removal of pathogenic microorganisms. Total aerobic viable counts and Enterobacteriaceae (mean levels) from the samples was critical to surfaces in contact with meat (splitting equipment) and indicated an inadequate application of good manufacturing and hygiene practices during slaughtering and sanitization (*Piras at al., 2014*). *Haileselassie et al. (2013)* reported that among bacterial contaminants of meat isolated in a study carried out at the municipality abattoir and butcher shops the predominant organisms included *E. coli, S. aureus* and *B. cereus*. The higher rate of contamination of meat with these bacteria is an indication of a deplorable state of hygienic and sanitary practices employed starting from slaughtering, transportation, butcher shops and processing. Pig carcass contamination can result from the intestinal carriage of Salmonella in the pig itself, but also from contact with other surfaces at the slaughterhouse (*Botteldoorn et al., 2003*). Hygiene varies between abattoirs and can have an important impact on carcass contamination (*McDowell et al., 2007*).

One of the food safety key elements is adequate disinfection. The aim of our research was to determine the efficiency of disinfection in a craft-slaughterhouse by determining the number of bacteria on a surface prior to and after disinfection was carried out either by a non-professional employed at the abattoir or a professional i.e. veterinarian.

Material and methods

Testing of the disinfection efficacy performed by a non-professional and a professional was done under field (abattoir) and laboratory conditions. The material used in this study consisted of wet-dry swabs taken prior to and after disinfection of the determined surfaces. Surfaces (carving knife, meat hook, stunting pen floor, corridor floor) treated by the veterinarian were samples every week (1st week- Monday; 2nd week- Tuesday; 3rd week – Wednesday; 4th week- Thursday; 5th week- Friday). Swabs were taken from the same surfaces after disinfection has been performed by a non-professional (1st week- Tuesday; 2nd week- Wednesday; 3rd week- Thursday; 4th week- Friday; 5th week- Monday). The procedure was performed according to the standard method SRPS ISO 18593 (*Microbiology of food and animal feeding stuffs − Horizontal methods for sampling techniques from surfaces using contact plates and swabs*). The total number of present bacteria was estimated by the standard SRPS ISO 4833 -1:2014 method *(Microbiology of food and animal feeding stuffs − Horizontal method for the enumeration of microorganisms − Colony-count technique at 30°C)* at the Department of Food Hygiene, Veterinary Institute, Banja Luka. Disinfection of the slaughterhouse was carried out with a chlorine preparation (sodium dichlorisocyanurate dihydrate) at a concentration of 0.02% and an exposure time of 30 minutes. The interpretation of the results was based on the limit values in the assessment of the hygiene of equipment, tools and work surfaces, as disclosed in Commission Decision 471/2001 / EC.

Basic data processing was performed using variation statistical methods, and testing the differences between experimental groups was done by means of t-test. The significance of the differences was determined at significance levels of 5% and 1%. The results obtained are tabulated. Statistical processing of the obtained results was done with the statistical package PrismaPad 4.00.

Results

The difference in the total number of bacteria (log CFU / cm2) on the examined surfaces in the craft-slaughterhouse before disinfection was carried out by the unskilled employee of the slaughterhouse and the expert i.e. the veterinarian was not statistically significant (p> 0.05).

The results of the total number of bacteria (log CFU / cm2) obtained after disinfection of a knife used for meat processing carried out by the unprofessional and the veterinarian are shown in Table 1.

Table 1. Total numbe of bacteria on the carving knife after disinfection *(log cfu/cm2)*

Week	Unprofessional person		Professional person-veterinarian	
	$\overline{X} \pm Sd$	CV%	$\overline{X} \pm Sd$	CV%
1.	1.87 ± 0.55^{x}	29.34	1.11 ± 0.15^{x}	13.83
2.	2.00 ± 0.96^{y}	48.02	0.94 ± 0.15^{y}	16.13
3.	1.99 ± 0.85^{z}	42.70	0.93 ± 0.14^{z}	14.64
4.	1.83 ± 0.60^{q}	32.73	$0.87^{y} \pm 0.12^{q}$	13.32
5.	2.13 ± 0.41^{w}	19.18	0^{w}	-

Statistically significant differences are shown by the same letters p< 0.01 x, y, z, q, w; p< 0.05 a, b, c; ns- not significant

From the obtained results, it can be seen that the decrease in the total number of bacteria (log CFU / cm2) was significant (p <0.01) after expert disinfection during all V experimental weeks versus the total number of bacteria identified on the knife after disinfection performed by an unskilled person.

The results of the total number of bacteria on the hooks after disinfection carried out by the unprofessional face of the slaughterhouse and the expert veterinarian can be seen in Table 2.

Table 2. Total numbe of bacteria on the meat hooks after disinfection (log cfu/cm2)

Week	Unprofessional person		Professional person-veterinarian	
	$\overline{X}$ ± Sd	CV%	$\overline{X}$ ± Sd	CV%
1.	2.34±0.17[x]	7.11	1.63±0.42[x]	25.79
2.	2.31±0.18[y]	7.93	1.07±0.08[y]	7.65
3.	1.54±0.43[z]	27.72	1.05±0.14[z]	13.75
4.	1.84±0.51[q]	27.59	1.25±0.49[q]	39.60
5.	2.60±0.47[w]	18.14	0.90±0.00[w]	0.00

Statistically significant differences are shown by the same letters p< 0.01 x, y, z, q, w; p< 0.05 a, b, c; ns-not significant

By analyzing the obtained results, we have determined a significantly lower (p <0.01) total number of bacteria (log CFU / cm2) during all V experimental weeks after disinfection of the hook was carried out by the veterinarian, compared to the number of bacteria when disinfection was carried out by the unprofessional person.

Table 3 shows the results of the total number of bacteria on the floor of the box for stunning after disinfection was carried out by the responsible person of the slaughterhouse and the expert veterinarian.

Table 3. Total number of bacteria on the stunning pen floor after disinfection (log cfu/cm2)

Week	Unprofessional person		Professional person-veterinarian	
	$\overline{X}$ ± Sd	CV%	$\overline{X}$ ± Sd	CV%
1.	2.34±2.10	35.52	2.10±0.14	6.73
2.	2.45±0.51	20.68	2.40 ±0.24	9.99
3.	2.76±0.51	18.41	2.91±0.79	27.06
4.	3.19 ±0.71	22.29	2.61 ±0.45	17.17
5.	3.24 ±0.58	17.86	2.93 ±0.23	7.91

Statistically significant differences are shown by the same letters p< 0.01 x, y, z, q, w; p< 0.05 a, b, c; ns- not significant

Results of the total number of bacteria on the floor of the corridor after disinfection was carried out by the unskilled and the professional-veterinarian are shown in Table 4.

Table 4. Total number of bacteria on the corridor floor after disinfection (log cfu/cm2)

Week	Unprofessional person		Professional person-veterinarian	
	$\bar{X}$ ± Sd	**CV%**	**$\bar{X}$ ± Sd**	**CV%**
1.	$4.36±0.10^{x}$	6.48	$2.58±0.12^{x}$	4.53
2.	$3.29±0.47^{y}$	14.22	$2.48±0.13^{y}$	5.25
3.	$3.16 ±0.57^{\mathbf{a}}$	18.14	$2.64±0.33^{\mathbf{a}}$	12.33
4.	$3.16 ±0.57^{ns}$	18.14	$2.65 ±0.45^{ns}$	17.17
5.	$3.49 ±0.37^{z}$	10.57	$2.44 ±0.22^{z}$	8.94

Statistically significant differences are shown by the same letters p< 0.01 x, y, z, q, w; p< 0.05 a, b, c; ns- not significant

During the first and second week after disinfection was carried out, we determined a very significantly lower (p <0.01) and significantly lower (p <0.05) total number of bacteria after disinfection was done by the veterinarian compared to the total number of bacteria after disinfection by an unskilled person (p <0.01). In the fourth week, there were no differences, while in the fifth week the differences were significant (p <0.01) because the total number of bacteria after disinfection was carried out by the veterinarian was lower compared to the values obtained by the responsible person at the slaughterhouse.

Discussion

Proper disinfection and rinsing of the disinfected surfaces are integral parts of every operation and every stage of the production process in the slaughter industry, as well as one of the important elements of food safety.

The results of the total number of bacteria (log CFU / cm2) obtained after disinfection of the hook and meat knife indicate that the professional veterinarian properly carried out all the disinfection phases, as well as the disinfection itself, since the total number of bacteria was significantly lower (p <0.01) during the course of all five weeks, in relation to the number of bacteria after disinfection by an unprofessional person. Properly conducted disinfection and replacement of knives during work are very important because studies have shown that the most common way of meat contamination is with dirty hands and dirty tools (*Haileselassie et al., 2013; Piras at al., 2014; Abdalla et al., 2009; Svobodová et al., 2012; Gun et al., 2003*). In the slaughterhouses the knives are washed in a traditional manner by rinsing with water at a temperature of 20˚-40˚C, followed by a brief immersion in a bath (sterilizer) in which the water temperature is below 82˚C (EC Regulation 853/2004). *Eustace et al. (2007)* found microorganisms on 20 knives out of the 230 (8.7%) tested in the slaughterhouse after such a traditional method of washing knives and short dipping (sterilizer). The British Meat Producers Association (BMPA) indicated that, in laboratory trials, alternative procedures such as knife immersion in water at temperatures of 72 ° C / 15s and 75 ° C / 10s led to 3-4 log10 reductions in *E.coli*. It suggests that different procedures may be effective at different points of the process and suggests a 3 log10 reduction in E. coli as a performance standard for disinfection of meat knives (ACM / 817).

After disinfection of the stunning box floor during the five weeks of the trial we did not detect a significant reduction in the total number of bacteria, thus indicating that the disinfection was not well performed by both contractors. Reduction of the total number of bacteria on the corridor floor during 4 experimental weeks was described only after disinfection was done by the professional. The unqualified person used cold water for sanitary washing, so the sanitation was not efficient in the disinfection phase. Problems arising from unprofessionally conducted disinfection lie in the ignorance of the very measure, their ineffective implementation, and the inadequate education of the workers or direct executors of these jobs (*Naglić and Hajsig, 2005; Haileselassie et al., 2013*).

The first phase of disinfection is mechanical cleaning by which from the surface 25-50% microorganisms can be removed. The next stage is sanitary washing, which removes the residue of impurities and organic matter that weaken the power of the disinfectant. Sanitary washings should be done with hot water and under pressure (*Jankovic et al., 2017, Veljić and Rajković, 2012*). When the water temperature is 50^0C with the addition of surfactants or detergents, a high number of microorganisms (90% and more) can be removed from the surfaces (FAO). The use of disinfectants on surfaces where all the preceding disinfection phases were not well implemented can hardly produce results, because the disinfectant will not be able to penetrate the microorganisms. There is very little data in the literature on the effectiveness of the disinfection conducted on the floor of the stunning box and the corridor. *Swanenburg et al. (2001)* collected samples by swabbing floor and wall surfaces and collecting the residing fluids on the floor throughout the lairage. In 70 to 90% of the samples Salmonella was isolated when pigs were present. The usual cleaning and disinfection reduced the level of contamination with Salmonella to 25% positive samples, whereas improved cleaning and disinfection reduced this level to 10% positive samples. It is concluded that the usual cleaning and disinfection of the lairage were not sufficient to eliminate this risk, whereas an improved procedure for cleaning and disinfection was still unsatisfactory. In the literature, most authors point to the fact that a significant reduction in the level of microorganisms in the slaughterhouses can be achieved only when effective sanitary washing with hot water is carried out prior to disinfection (*Piras at al., 2014; McDowell et al., 2007; Rajkowski et al., 1998).*

Conclusion

Studies have shown that after disinfection was done by an unprofessional person or by an expert veterinarian, on the examined surfaces mechanical cleaning and sanitary washing, as well as disinfection have been properly carried out, the total number of bacteria (log / CFU cm2) decreased significantly. The obtained results of the total number of bacteria after disinfection of the floor of the stunning box indicate failure in the implementation of disinfection because the number of bacteria has not significantly decreased ($p > 0.05$). It is necessary to improve procedures that precede disinfection, which among other things include the obligatory use of hot water for washing of the surfaces to be disinfected.

Propusti u sprovođenju dezinfekcije u zanatskoj klanici

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Rezime

Cilj rada je bio da se na osnovu dobijenih rezultata utvrdi da li postoje razlike u ukupnom broju bakterija na određenim površinama posle dezinfekcije stučnog i nestručnog lica zanatske klanice i da se na osnovu toga zaključi da li su postojali propusti u sprovođenju dezinfekcije. Materijal za istraživanja su bili uzorci vlažno-suvih briseva uzetih tokom V nedelja, pre i posle dezinfekcije nestručnog i stručnog lica i to sa: noža za obradu mesa, kuka, poda boksa za omamljivanje i poda koridora. Postupak uzimanja vlažno-suvog brisa je urađen prema standardnoj metodi ISO 18593. Iz uzetih uzoraka određen je ukupan broj bakterija standardnom metodom ISO 4833.Dezinfekcija je vršena sa 0.02% hlornim preparatom pri vremenu ekspozicije od 30 min. Na osnovu podataka dobijenih ovim istraživanjem utvrđeno je da je posle dezinfekcije nestručnog lica zanatske klanice i dezinfekcije stručnog lica-veterinara na ispitivanim površinama na kojima su pravilno sprovedene faze dezinfekcije (mehaničko čišćenje i sanitarno pranje) i dezinfekcija, došlo do značajnog smanjenja ukupnog broja bakterija (log cfu/cm2). Dobijeni rezultati ukupnog broja bakterija posle dezinfekcije poda boksa za omamljivanje ukazuju na propuste u sprovođenju dezinfekcije jer se broj bakterija nije značajno smanjio (p>0.05).

Ključne reči: dezinfekcija, propusti, zanatske klanice

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