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## The hand hygiene of workers from the aspect of the process hygiene in retail sale of food

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### Introduction

Improvement of the hand hygiene of workers who come into direct contact with food, during retail sale of food, is of great importance in prevention of foodborne diseases. It greatly depends on the understanding of the importance of proper execution of hand sanitation by workers themselves. Hand hygiene of workers is checked by taking swabs after washing and sanitation of hands. In this way, the proper procedure of washing and sanitation is evaluated, as well as efficiency of the disinfectant used. Hands of workers, from the aspect of hygiene, must comply with hygienic conditions and requirements when coming in direct contact with food in production and sale, especially food which will be consumed without additional heat treatment. Pathogenic microorganisms from workers' organisms as well as from the environment can be transferred to food by workers (Paulson, 2000). Research conducted by Guzewich and Ross (1999) proclaimed that 81 cases of diseases which occurred in humans were caused by contaminated food, due to improper hand washing practice. The objective of this paper was determination of the hygiene status of workers' hands during eleven months in one year, based on aerobic colony count and *Enterobacteriaceae* count.

### Materials and Methods

Sampling was done in retail butcher shops, and was performed by taking swabs from the workers who served the customers and came into direct contact with fresh poultry meat. Swabs were taken from sanitized hands of workers, according to pre-determined dynamics, at monthly level. The study lasted in total 11 months. When feasible, swabs were taken before and after work hours, and when it was not feasible, workers were instructed to carry out the hand sanitation according to procedure, and then swabs were taken from their wet hands. When taking swabs, special attention was directed to the following: swabs were not taken immediately after sanitation, but hands were allowed to drip and workers were not allowed to touch any objects during that time. When swabs were taken, special attention was focused on less accessible regions where the possibility for retention of microorganisms was higher (area between fingers, finger tips, parts of the palm close to the hand root). Swabs were subsequently transported in a cool box at 4° C to the laboratory where they were tested/analysed the same day. Swabs were analysed using standard accredited methods, SRPS ISO 21528-2 (*Enterobacteriaceae*) and SRPS ISO 4833 (aerobic colonies count) and the number of colony forming units was determined (cfu). Results were interpreted according to the instruction from the Guidelines for application of microbiological criteria for food (Anon, 2011).

### Results and Discussion

Results of the 11 month study of workers' hand hygiene are presented in Table 1. The number of analysed swabs per month was from 17 to 23. The limit of acceptance for aerobic colony count was 200 cfu/cm<sup>2</sup>. Of 225 analysed hand swabs, 37 or 16.4 % were non-compliant due to unacceptably high levels of aerobic colony count. The frequency of finding *Enterobacteriaceae* on workers' hands was significantly lower. Of the total number of 225 analysed swabs from workers' hands, only 7 or 3.1 % contained *Enterobacteriaceae*. The limit for acceptance for *Enterobacteriaceae* was < 1 cfu/cm<sup>2</sup>. During five of the months, *Enterobacteriaceae* were not detected in any hand swab. Unacceptably high levels of *Enterobacteriaceae* were not found alone but, as would be expected, were detected in the hand swabs together with non-compliant aerobic colony count levels.

**Table 1.** Results of the control of workers' hand hygiene

Month of sampling	N	Non-compliant swabs which exceeded limits			
		Aerobic colony count		Aerobic colony count and <i>Enterobacteriaceae</i>	
		n	%	n	%
1	18	4	22.2	/	/
2	17	5	29.4	1	6
3	18	3	16.7	/	/
4	20	4	20	1	5
5	20	6	30	2	10
6	19	2	10.5	/	/
7	22	1	4.5	/	/
8	22	3	13.6	1	4.5
9	23	3	13	1	4.3
10	23	4	17.4	/	/
11	23	2	8.7	1	4.3
Total	225	37	16.4	7	3.1

N – total number of collected swabs, n – number of non-compliant swabs

The results obtained indicate the fact that variations of the aerobic colony count were considerably lower compared to variations of *Enterobacteriaceae* count. This points to the fact that increased aerobic colony count occurs as the result of presence of bacteria from the environment, whereas the variation of *Enterobacteriaceae* should be associated with the working mode or work practice of workers. *Enterobacteriaceae* on worker's hands are often of faecal origin and can be indicators of bad hand washing practice after using a toilet, or dirty toilet conditions (door handlers, taps, towels, soap dispensers etc).

Special attention should be directed to hand hygiene of workers since awareness of workers and their conscientious attitude towards food as very sensitive raw material greatly contributes to its microbiological status, evaluation by consumers and sustainability.

Workers who come in contact with food must be trained, informed and competent for food handling. Especially important is constant attention and compliance with norms of good hygienic practice within HACCP, since it is apparent that when workers become less attentive it reflects immediately on hygiene results. Non-compliant swabs results are obtained in cases when workers do not refer enough attention to execution of work procedures/operations in washing of hands (Green and Selman, 2005). In spite of all the training which is mandatory for workers, there is still a very high level of food poisoning occurring as a consequence of inadequate handling of food at sale (Lues, 2007). The U.S. Food and Drug Administration (2004) has published the information that in 73% of cases the identified cause was inadequate/non-compliant procedure of washing of hands of employees. Protection of hands with gloves is perceived by a number of authors as an efficient way of prevention of transfer of bacteria on food (Michaels et al. 2004; Montville et al. 2001). However, other authors state that use of gloves can contribute to rarer hand washing sanitation practice (Fendler et al. 1998; Lynch et al. 2005). For example, studies point out that some workers feel that when using gloves it is not necessary to wash hands (Green and Selman, 2005). Proper sanitation should help to reduce the presence of pathogenic microorganisms which may disrupt the microbiological status of the food stuff (Dimitrijević, 2000). There is a strong correlation between safety and sustainability of meat, hygienic conditions present in the sale of meat and personal hygiene of employees (Nikolaos et al., 2012). In studies by Nikolaos et al. (2012), the level of contamination of chopped meat was determined:  $6.8 \pm 1.0 \log_{10}$  CFU/cm<sup>2</sup> for aerobic colonies count and  $3.6 \pm 1.2 \log_{10}$  CFU/cm<sup>2</sup> for *Enterobacteriaceae*. A significant correlation between established microbiological status of the meat and hand hygiene of workers preparing the meat was established. In the current study, there was no pronounced seasonal variation in the bacterial counts obtained from hand swabs, so proper execution of hand sanitation procedure is of paramount importance at all times.

## Conclusions

Based on results of the study, the following was established:

- Of total number of 225 analysed hand swabs, 16.4 % were non-compliant, because of aerobic colony count exceeding the limit.
- The limit for *Enterobacteriaceae* was exceeded in 3.1 % of analysed hand swabs.

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