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The microbiological status of carcasses from wild boar in Serbia

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Abstract

In this study, the microbiological status of wild boar carcass meat and the likely sources of its contamination were investigated. Wild boar carcasses (125) were analysed for Total Viable (TVC) and *Enterobacteriaceae* Count (EBC). The mean TVC and EBC on the skin were 3.5 and 2.1 $\log_{10}$ cfu/cm², whereas higher levels of 4.3 and 2.9 $\log_{10}$ cfu/cm² were determined on carcass meat, respectively. No difference was determined when TVC and EBC were compared between animals shot in the abdominal region and those shot elsewhere, indicating that inadequate hygiene in carcass handling was the reason for high level of microbiological contamination.

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Keywords: wild boars; microbial contamination; game meat; carcass; hunting

1. Introduction

Consumption of wild boar meat is very common among many hunter families and their friends and relatives, and to some extent among other members of the population. Wild boar meat in Serbia is often consumed in the form of home-made traditional meat products that are cured, cold smoked and dried (dried meats and fermented sausages), but not subjected to any heat treatment. That indicates the necessity of having raw meat of good microbiological

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quality and presumably low risk of being contaminated with foodborne pathogens such as *Salmonella* spp. and/or *Yersinia* spp.[1] The microbiological quality of game meat depends on several factors, among which the most important are the health of the animal before being shot, the skill and the attitude of the hunter including the anatomical shooting location, and the level of hygiene applied during handling carcasses (including collection, evisceration, skinning and chilling)[2]. Several authors have investigated the microbiological status of wild boar carcass meat, considering the level of general contamination (Total Viable Count, TVC) and faecal contamination (*Enterobacteriaceae* count, EBC)[1,3]. However, such studies on wild boars hunted in Serbia are lacking in the literature. Therefore, the main aim of this study was to investigate the microbiological status of wild boar carcass meat and determine the likely cause for its contamination. Several factors that might influence carcass meat contamination, i.e. the level of microbiological contamination of the skin, anatomical shooting location and hygienic practice during handling and evisceration of carcasses, were investigated.

2. Materials and methods

Sampling was performed during November and December in the hunting season of 2014. In total, 125 wild boars were sampled during five hunting days, in three hunting areas in Northern Serbia. All samples were collected from the animals after their arrival at the collection point, and for each tested animal data were recorded including anatomical shooting location, time elapsed between shooting and evisceration and the level of hygienic practice during handling and evisceration of carcasses. Skin samples were collected immediately before evisceration by swabbing approximately 1000 cm^2 area (lateral rump-perianal-medial rump-flank-brisket-neck). Following evisceration, carcass meat samples were taken by swabbing the same location on the corresponding dressed carcass, but covering a smaller area (400 cm^2) for practical reasons. Each swab was placed in a separate stomacher bag (Nasco, Whirl-pack, 19x30 cm; Fort Atkinson, WI, USA) and transported in a chill-bin to the laboratory within 2 h. The evisceration procedure was performed in the period 30-90 minutes after killing of the animals, and the carcass meat sampling approximately 10 minutes after evisceration.

Maximum Recovery Diluent (MRD; Oxoid; 90 ml) was added to each bag containing a sponge-swab, the bag exterior was then repeatedly squeezed manually for 1 min and further decimal dilutions were made in MRD (ISO method 6887-1:1999). Sample homogenates or their appropriate dilutions were used for microbiological analysis. For TVC and *Enterobacteriaceae* counts, the respective procedures were followed: ISO 4833:2004 and ISO 21528-2:2009.

On both skins and carcasses, TVC and EBC were calculated as $\log_{10}$ cfu/cm^2. For each appropriate group of samples, mean values and standard deviation as well as significance of differences between means (*t*-test) based on $\log_{10}$ cfu/cm^2 values of target microorganisms in individual samples were calculated using Microsoft Excel 2007.

3. Results and discussion

In Table 1 the results of the TVC and *Enterobacteriaceae* count on wild boar skin and carcass meat throughout different hunting days are presented. The mean determined TVC level on the skin was 3.5 $\log_{10}$ cfu/cm^2 and for EBC 2.1 $\log_{10}$ cfu/cm^2, ranging from 2.7-4.1 $\log_{10}$ cfu/cm^2 and 1.3-3.1 $\log_{10}$ cfu/cm^2 for different hunting days, respectively. Higher TVC and EBC levels of 4.3 and 2.9 $\log_{10}$ cfu/cm^2 respectively (ranging from 3.5-4.9 $\log_{10}$ cfu/cm^2 and 1.9-4.5 $\log_{10}$ cfu/cm^2) were determined on carcass meat than on wild boars' skin. According to other published studies, average TVC and EBC on wild boar carcass meat were either lower (3.2 and 2.1 $\log_{10}$ cfu/cm^2)[3], or higher (4.6 and 3.0 $\log_{10}$ cfu/cm^2 respectively)[1], when compared to our study.

When examining the influence of anatomical shooting location, the frequencies of animal shot in the abdomen region were similar for all hunting days, and ranged from 34-54% (Table 2). Overall, 55 animals (44%) were shot in abdomen, which was similar to another study[1]. That situation would have presumably led to higher TVC or EBC levels on carcass meat. However, that was not the case, as no significant difference was found between shots in the abdomen and elsewhere within the same hunting day and when comparing the levels of TVC or EBC (Table 2), contrary to another study[3]. This leads to the conclusion that "poor shooting" did not account for the high level of microbial contamination of carcass meat; even the animals shot in the right anatomical location had high levels of microbial contamination. On the other hand, TVC and EBC on carcass meat were notably higher than those on the

skin, implying that skin had little impact on meat contamination during dressing carcasses (Table 1). The contamination from the skin and/or from the rupturing of digestive tract are the main sources for carcass meat microbial contamination, but we found no evidence that this occurred in our study. Therefore, we conclude that workers' handling and dressing practice might have had an influence on the high level of carcass meat contamination.

Table 1. The microbiological status of wild boar skin and carcass meat.

Hunting day (area)	Number of animals	Skin		Carcass meat	
		Mean TVC $\log_{10}$ cfu/cm^2	Mean EBC $\log_{10}$ cfu/cm^2	Mean TVC $\log_{10}$ cfu/cm^2	Mean EBC $\log_{10}$ cfu/cm^2
1 (A)	27	4.1±1.5^{b}	1.7±1.0^{a}	4.6+1.7^{cde}	2.3±0.9^{a}
2 (B)	21	3.6±0.7^{b}	1.8+0.9^{a}	3.5±0.9^{a}	1.9±0.9^{a}
3 (A)	28	3.8±0.8^{b}	3.1±0.8^{c}	4.9±0.6^{c}	4.5±0.9^{c}
4 (B)	23	2.7±0.5^{a}	2.4±0.8^{b}	4.3±0.6^{bd}	3.4±0.6^{b}
5 (C)	26	3.0±1.0^{a}	1.3±1.2^{a}	3.9±0.9^{abe}	2.1±0.8^{a}
Total	125	3.5±1.1	2.1±1.2	4.3±1.2	2.9±1.3

Mean log values within a column with a common letter are not significantly different ($p > 0.05$).

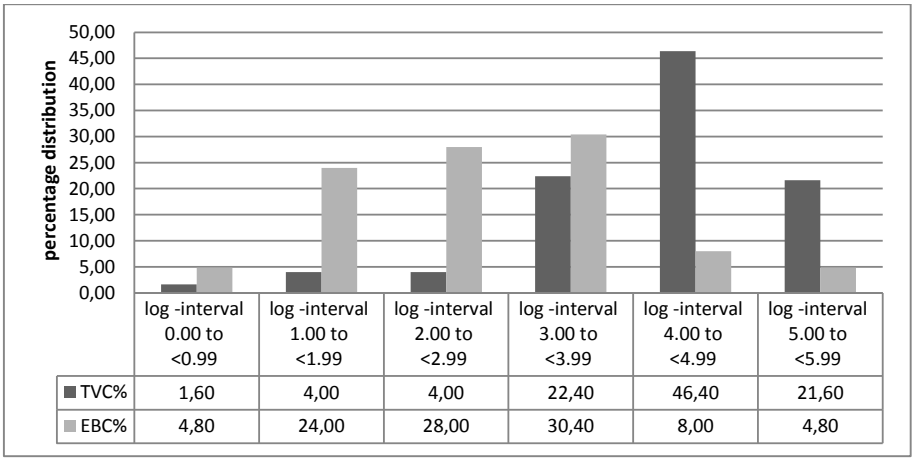
Table 2. The comparison of microbial levels between shots in abdomen and elsewhere.

Hunting day	Shot in locations other than abdomen			Shot in the abdominal region		
	Mean TVC $\log_{10}$ cfu/cm^2	Mean EBC $\log_{10}$ cfu/cm^2	Number of animals	Mean TVC $\log_{10}$ cfu/cm^2	Mean EBC $\log_{10}$ cfu/cm^2	Number of animals
1	4.6±1.8	2.4±0.9	13 (48%)	4.6±1.7	2.3±0.9	14 (52%)
2	3.3±0.9	1.6±0.7	14 (66%)	3.7±0.8	2.6±1.0	7 (34%)
3	5.1±0.6	4.7±0.9	18 (64%)	4.5±0.6	4.1±1.0	10 (36%)
4	4.2±0.6	3.3±0.5	13 (57%)	4.4±0.5	3.5±0.8	10 (43%)
5	3.7±1.2	1.8±0.9	12 (46%)	4.1±0.7	2.4±0.5	14 (54%)
Total	4.3±1.2	2.9±1.4	70 (56%)	4.3±1.0	2.9±1.1	55 (44%)

In addition, significant differences ($p < 0.05$) were observed in TVC or EBC levels between hunting days, predominantly showing that microbiological counts were significantly lower on days 2 and 5 (Table 1). That corresponded to our observation of the practice of handling and evisceration of carcasses. During five days of sampling, different workers handled carcasses at all three animal collection points. According to our observation, workers that handled carcasses on days 2 and 5 had some level of training in food hygiene and previous experience in the meat industry. As opposed to the practice observed on other sampling days, these workers were using basic hygiene rules while dressing carcasses, i.e. using a set of knives, frequently changing knives between dirty and clean operations and using water sterilisers to wash and sterilise knives whenever necessary.

To assess the microbiological status of wild boar carcass meat analysed, TVC and EBC results were compared with criteria specified by Regulation (EC) No. 1441/2007[4]. However, reference to these criteria is for guidance only, since they are provided for the carcasses of domestic pigs slaughtered in licensed premises (slaughterhouses). Also, in our study we used swabbing sampling method as opposed to the destructive method for which criteria and limits are applied. According to EU microbiological criteria for pig carcasses, the results are interpreted as satisfactory if the daily mean log for TVC is $\leqslant 4$ $\log_{10}$ cfu/cm^2 and for EBC $\leqslant 2$ $\log_{10}$ cfu/cm^2, acceptable if TVC is between 4 and 5 $\log_{10}$ cfu/cm^2 or in the case of EBC between 2 and 3 $\log_{10}$ cfu/cm^2, and unsatisfactory if the daily mean log for TVC is > 5 $\log_{10}$ cfu/cm^2 and > 3 $\log_{10}$ cfu/cm^2 for EBC (with the need for immediate improvements in process hygiene and control). The incidence of TVC above 5 log cfu/cm^2 and of EBC above 3 log cfu/cm^2 limits as set by abovementioned regulation, occurred in 21.6% and 43.2% of carcasses in our study, respectively (Fig. 1). The

comparison of our results with the EU microbiological criteria that are used to demonstrate the microbiological quality of the production process, indicate that the hygienic quality of handling and dressing procedures with wild boar carcasses in our study was low and needs urgent improvement.



	log -interval 0.00 to <0.99	log -interval 1.00 to <1.99	log -interval 2.00 to <2.99	log -interval 3.00 to <3.99	log -interval 4.00 to <4.99	log -interval 5.00 to <5.99
TVC%	1,60	4,00	4,00	22,40	46,40	21,60
EBC%	4,80	24,00	28,00	30,40	8,00	4,80

Fig. 1. Distribution of the log values of TVC and EBC of the wild boar carcass meat.

4. Conclusion

The present study investigated the microbiological status of wild boar carcass meat in three hunting areas and the likely causes for its contamination. High microbial contamination of carcass meat was determined indicating the low hygienic quality of wild boar meat and possible public health concern. No statistical difference was observed in the microbial levels between animals shot in the abdominal region and those shot elsewhere, implying that contamination was not related to the rupturing of the guts, but was probably due to improper handling practices, particularly evisceration procedures. These findings support the requirement for the implementation of good hygienic procedures for game meat during the whole chain of events from shooting to chilling operations.

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