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Superficial Bacterial Contamination of Goats Carcasses

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Meat of goats can also be a source of pathogenic bacteria. In meat of healthy goats, the bacteria may enter the surface of the carcass in the abattoir, at slaughter and during processing of the hull. The aim of our study was to determine microbial contamination of carcasses of goats at the slaughter, before and after chilling, by determination of the total count of aerobic mesophylic bacteria (aerobic colony count), bacteria of family *Enterobacteriaceae* and *Salmonella spp*. Wet swabs were taken at slaughtering, immediately after the primary treatment, by non-destructive method, from a total of 95 goat carcasses. At the same time, the samples were taken for *Salmonella* testing. The total count of aerobic mesophyilic bacteria (log $_{10}$cfu/cm^2) by method ISO 4833:2003, the number of *Enterobacteriaceae* ($\log_{10}$cfu/cm^2) by method ISO21528-2:2004 and the presence of *Salmonella spp.* by method ISO6579:2002 were determined in swabs. The obtained results were interpreted according to the European regulation EC1441/2007. Test results showed that the average values of the total count of aerobic mesophylic bacteria and *Enterobacteriaceae* were with in the satisfactory range (≤ 3.5 $\log_{10}$cfu/cm^2 and ≤ 1.5 log cfu/cm^2 respectively). *Salmonella spp*. was not isolated.

Key words: Goats, Slaughterhouse, Process hygiene, Criteria.

Worldwide, goat meat, especially meat of kids, is readily consumed for its characteristic taste and desired chemical composition. As a food of animal origin it is rich in proteins, vitamins and minerals, while fat content, especially cholesterol, is low.

Breeding of goats and goat meat consumption, despite its qualitative composition, are determined by religion, traditions and customs, as well as by market and consumer habits[1].

Like all other types of meat, meat of goats can be a source of pathogenic bacteria. In meat of healthy goats or goats that have noclinical symptoms, the bacteria may enter the surface of the carcass in the abattoir, at slaughter and during processing of the hull. Skinning and evisceration are operations identified as high-risk when microbial contamination is concerned[2]. During skinning, cuts are done at the ankle, hams, in the *linea alba* area, chest, shank and front legs. Each of these sections can cause the transfer of microorganisms from the skin to the carcass, i.e. the flesh. During evisceration, the area around the anus, i.e. rectum, is cut and further processing may cause rectal contents leakage or rupture the intestines and colon, which is a further possibility of contamination of ribs, shank and chest. By conventional veterinary examination the presence of these bacteria on the surface of healthy carcasses was notdetected[3].

By its composition meat is an excellent substrate for the growth and development of bacteria which can cause, both in humans and in animals, a variety of diseases[4]. On the slaughter of

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goats, the most common is contamination of carcasses by pathogens belonging to enterobacteria. Family enterobacteria (*Enterobacteriaceae*) includes 25 genera with more than 80 different species. On the basis of pathogenicity for animals, enterobacteria are divided into three groups:

a) bacteria which pathogenicity has not been proven and are generally saprophytic commensal bacteria,
b) pathogens which include *Salmonella* species, *Escherichia coli* and *Yersinia* species,
c) opportunistic pathogens which in certain circumstances cause infections, including these genera and species: *Klebsiella, Enterobacter, Proteus, Serratia, Edwardsiella, Citrobacter, Morganella, Shigella*[5]. Some of these bacteria are zoonotic bacteria.

With in *Enterobacteriaceae* most importance is given to the genus *Salmonella.* In slaughterhouses, *Salmonella* is usually transmitted to carcasses of goats from skin or equipment for slaughtering. The degree of contamination depends on the carrier state of livestock and hygiene during the slaughter process. It is assumed that the prevalence increases as a result of stress during transport of animals for slaughter and reduced rest before slaughter[6-9].

According to the latest regulations[10,11], determination of the total count of aerobic mesophyilic bacteria, the number of enterobacteria and certain pathogenic bacteria-*Salmonella spp.* are used for monitoring the hygiene of facilities and hygienic principles at the slaughter. In addition to pathogenic species of the family *Enterobacteriaceae*, there are species that are not pathogenic and are constantly present in the environment, so that this family of bacteria can be used for routine monitoring. If their number is greater than allowed, examination for the presence of certain pathogenic bacteria should start.

The aim of our study was to determine microbial contamination of carcasses of goats at slaughter, before and after cooling, by determination of the total count of aerobic mesophyilic bacteria, bacteria of family *Enterobacteriaceae* and *Salmonella spp.*

MATERIALS AND METHODS

The material used in this study was slaughtered goats with average body weight at slaughter of about 50 kg. Goats were reared in the stable-pasture system and slaughtered[13] in a slaughterhouse with the implemented HACCP system. Smear samples were collected and processed during the three years period. Regulation EC[11] requires that samples for microbiological testing of carcasses should be taken after treatment and before cooling. As this investigation is part of a larger study, it was decided for this paper to examine effects of cooling temperature (24 hours) on the sustainability of microorganisms.

Wet swabs were taken at the slaughtering, immediately after the primary treatment, by non-destructive method[12], from a total of 95 goat carcasses. Sampling for microbiological testing of carcasses of goats was carried out as shown in Scheme. The scheme was taken from the Guide to the implementation of microbiological criteria for food, published by the Ministry of Agriculture, Trade, Forestry and Water Management of the Republic of Serbia[13], which complies with EC[11].

Swabs were taken from four locations on the body (flank, chest on the lateral side, perineal area and the top of the chest from the lateral side), with a total area of 100cm^2 per carcass. Swabs were transferred to the laboratory in liquid transport medium.

Samples collected by the swab method after processing, before chilling, were taken from the right carcass sides, while the swab samples after chilling were taken from the left sides. At the sametime, sampling for the *Salmonella* testing was carried out by the swab method, using an abrasive sponge in accordance with EU Regulation[11] which was replaced by EURegulation[10].

Possible sampling points at the carcasses of goats with areas that are usually contaminated with a large number of microorganisms:

Flank (3); Chest, lateral (4); Perineal area (6); Top of the chest, lateral (7).

The total count of aerobic mesophyilic bacteria ($\log_{10}$cfu/cm^2), the number of *Enterobacteriaceae* ($\log_{10}$cfu/cm^2) and the presence of *Salmonella* spp. were determined in

the swabs. The total count of aerobic mesophyilic bacteria was detected by the ISO method[14]. Number of *Enterobacteriaceae* was determined by the ISO method[15]. Presence of *Salmonella* spp. was tested by ISO method[16].

The obtained results were interpreted according to the table given in the European regulation[10,11] (Table 1).

RESULTS

Test results of the total count of aerobic mesophyilic and *Enterobacteriaceae* bacteria are shown in Tables 2, 3, 4, 5 and 6.

Tables 2 and 3 show the results of total aerobic mesophilic bacteria on carcasses of slaughtered goats before and after chilling.

The distribution of the swab samples according to the criteria for the total count of bacteria on carcasses of goats before chilling is shown in the Table 2. From the total number of samples (n=95) a satisfying number of bacteria was from 78 (perineal region) to 83 (from the top of the chest). Between the number of samples in the criteria "satisfactory" statistically significant difference was not found, although the number of samples that meet the "satisfactory" criteria was minimal for the swabs taken from the perineal region. Number of acceptable swabs was from 7 (perineal region) to 11 (chest from the lateral side). Between the numbers of samples in the criteria "acceptable" there were no statistically significant differences. As with the criterion "satisfactory", in the criterion "acceptable" there was numerically smallest number of samples in the smears from the perineal region. Regarding the criterion "unsatisfactory" number of samples taken from the perineal region was significantly higher ($p<0.05$) compared to the number of samples taken from the

Table 1. Microbiological criteria of hygiene in the production process

Microbiological profile of samples	Total count of aerobic mesophyilic bacteria (log_{10}cfu/cm^2)	*Enterobacteriaceae* (log_{10}cfu/cm^2)	*Salmonella* spp.
Acceptable	≤3,5 log cfu/cm^2	≤ 1,5 log cfu/cm^2	It must not be present on the tested carcass area
Limit value	3,5 - 5,0 log cfu/cm^2	1,5-2,5 log cfu/cm^2	
Unacceptable	> 5,0 log cfu/cm^2	> 2,5 log cfu/cm^2	

Table 2. Distribution of swab samples according to the criteria for the total count of bacteria on carcasses of goats before chilling

Criteria	Sampling points (n= 95)			
	Flank (n)	Chest, lateral (n)	Perineal area (n)	Top of the chest, lateral (n)
Satisfactory	80	81	78	83
Acceptable	10	11	7	10
Unsatisfactory	5	3[a]	10[b]	2[a]

Diference letters: a, b ($p<0.05$)

Table 3. Distribution of swab samples according to the criteria for the total count of bacteria on carcasses of goats after chilling

Criteria	Sampling points (n= 95)			
	Flank (n)	Chest, lateral (n)	Perineal area (n)	Top of the chest, lateral (n)
Satisfactory	90	91	85	87
Acceptable	3	4	5	8
Unsatisfactory	2	0[a]	5b	0[a]

Diference letters: a, b ($p<0.05$)

lateral side of the chest, or on the lateral side of the top of the chest, but did not differ significantly from the number of samples in criteria "unsatisfactory" taken from the flank.

Distribution of swab samples according to the criteria for the total count of bacteria on carcasses of goats after chilling is shown in the Table 3. From the total number of samples (n= 95) satisfying the total number of bacteria was from 85 (perineal region) to 91 (swab samples from lateral side of the chest). Number of samples according to the criteria "acceptable" was from 3 (flank) to 8 (lateral side of the top of the chest). Between the numbers of samples in the criteria "satisfactory" and the criteria "acceptable" statistically significant differences were not found. The number of samples from the criteria "unsatisfactory" taken from the perineal region was significantly higher than the number of samples in this criteria taken from the outside of the chest, or on the outside of the top of the chest, but did not significantly differ from the number of samples from the criteria "unsatisfactory" taken from the flank.

Results of the number of bacteria from the family *Enterobacteriaceae* on carcasses of slaughtered goats before and after chilling are shown in the Table 4 and 5.

Distribution of the samples according to the criteria for *Enterobacteriaceae* on carcasses of goats before chilling is shown in Table 4. It was found that the number of swabs from the criterion "satisfactory" taken from the perineal region was significantly lower ($p<0.001$) than the number of swabs taken from the top of the chest. This number was also statistically lower ($p<0.01$) compared to the number of swabs from this criteria in samples

Table 4. Distribution of swab samples according to the criteria for the total number of *Entero bacteriaceae* on carcasses of goats before chilling

Criteria	Sampling points (n= 95)			
	Flank (n)	Chest, lateral (n)	Perineal area (n)	Top of the chest, lateral (n)
Satisfactory	85^{x}	83a	$70^{y b \beta}$	90^{β}
Acceptable	8^{a}	7a	$18^{b x}$	4^{y}
Unsatisfactory	2	5	7	1

Diference letters: a, b ($p<0.05$); x, y ($p<0.01$); α, β($p<0.001$)

Table 5. Distribution of swab samples according to the criteria for the total number of *Enterobacteriaceae* on carcasses of goats after chilling

Criteria	Sampling points (n= 95)			
	Flank (n)	Chest, lateral (n)	Perineal area (n)	Top of the chest, lateral (n)
Satisfactory	90^{a}	85	80^{b}	90^{a}
Acceptable	5	9	13	5
Unsatisfactory	0	1	2	0

Diference letters: a, b ($p<0.05$)

Table 6. Comparative summary (all sampling points) of the bacteriological status of goat carcasses before and after chilling according to the criteria for the total bacteria count and the total numberof *Enterobacteriaceae* (n=380)

Criteria	Total bacteria count		*Enterobacteriaceae*	
	Before chilling (n)	After chilling (n)	Before chilling (n)	After chilling (n)
Satisfactory	328^{x}	353^{y}	328	345
Acceptable	37^{a}	20^{b}	37	32
Unsatisfactory	15	7	15a	3b

Diference letters: a, b ($p<0.05$);x,y ($p<0.01$)

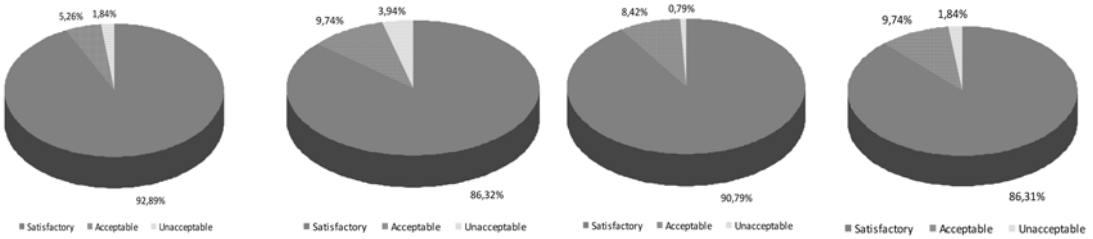

Fig. 1.

taken from the flank region, and also significantly lower ($p<0.05$) compared to the number of swabs from this criterion in samples taken from the lateral side of the chest. Test results show that the number of samples from the criteria of "acceptable" was statistically significantly higher ($p<0.01$) in the samples taken from the perineal region in relation to the number of swabs taken for this criteria from the lateral side of the top of the chest. It was determined that this number was significantly higher ($p<0.05$) compared to the number of swabs taken from the flanks or from the lateral side of the chest. Numerically the largest number of smears, but not statistically significant, from the criterion "unsatisfactory" was found in samples taken from the perineal region (7) and the lowest in the samples taken from the lateral side of the top of the chest (1).

After chilling number of swabs from the criterion "satisfactory" taken from the perineal region was significantly lower ($p <0.05$) compared to the number of swabs taken from the flank or the lateral side of the top of the chest. Number of swabs from the criteria "acceptable" was from 5 (flank or lateral side of the top of the chest) to 13 (perineal region). Between the numbers of smears from the criteria "acceptable" statistically significant difference was not found. Also it was not noted in the criterion "unsatisfactory" (Table 5).

Table 6 presents a comparative summary of the bacteriological status of goat carcasses before and after chilling according to the criteria for total bacterial count and total number of *Enterobacteriaceae* (n=380). It was found that regarding the criterion "satisfactory" number of swabs (353) related to the total count of bacteria after chilling was significantly higher($p<0.01$) than the number of these results (328) before chilling. Number of smears related to the total count of bacteria according to the criteria "acceptable" before chilling was significantly higher ($p<0.05$) compared to this criterion after chilling. There was no statistically significant difference between the number of smears by the criteria "unsatisfactory" in relation to the total count of bacteria before (15) and after chilling (7), although numerically after chilling that number was smaller

Between the numbers of "satisfactory", as well as "acceptable", smears regarding enterobacteria before and after chilling were no statistically significant differences (Table 6). However, the number of swabs for number of enterobacteria in the criteria "unsatisfactory" was significantly lower ($p <0.05$) after chilling carcasses in relation to the number of swabs from the above criteria before chilling.

Salmonella spp. was not detected at the examined area on the carcasses of slaughtered goats.

All 95 samples taken from goat carcasses were examined for the presence of *Salmonella spp.* In all samples *Salmonella spp.* was not identified. Percentage of the results for the criteria "satisfactory", "acceptable" and "unsatisfactory" for the total number of bacteria and for the total

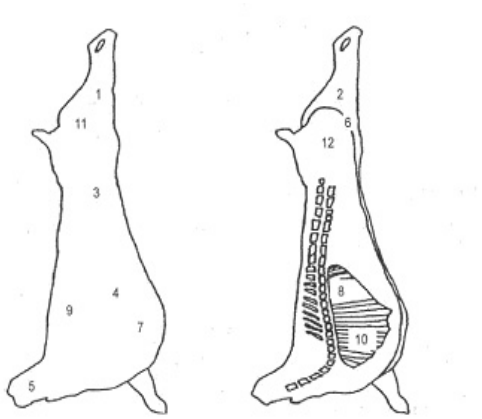

Fig. 2.

number of enterobacteria varies depending on whether the swabs are taken before or after chilling. Thus, the "satisfactory" criterion related to the total number of bacteria for smears taken before chilling was 86.31% and after chilling 92.89%. According to the criterion "acceptable" part of smears related to the total number of bacteria before chilling was 9.74% and after chilling 5.26%, while according to the criteria "unsatisfactory" percentage of smears related to the total number of bacteria before chilling was 3.94% and 1.84% after chilling (Figure 1).

Percentage of the smears related to the total number of enterobacteria before chilling for the criterion "satisfactory" was 86.32% and after chilling in this criterion was 90.79%. According to the criterion "acceptable" the total number of smears related to enterobacteria before chilling was 9.74% and 8.42% after chilling, while for the criterion "unsatisfactory" participation of smears related to the total number of enterobacteria before chilling was 3.94% and 0.79% after it (Fig. 2).

DISCUSSION

Test results for the total number of aerobicbacteria in our trials (Table 2) are in agreement with the results of Dragojevic[17]. During three years she examined the total number of bacteria on carcasses of cattle, on 200 samples, using swabs from four sampling points: neck, chest, leg and tail set. Daily average values of total bacterial count expressed as $\log_{10}$cfucm^{-2} on carcasses of cattle were in 2011 from 0.53±0.30 to 2.93±0.67, in 20100.80±0.33 to 2.27±0.40 and in 2009 from 0.85±0.34 to 1.84±0.20. Our results are also consistent with the results of Liliæ *et al*[18]. Authors tested swab samples taken from 100 beef carcasses before chilling. Test results of the mentioned authors showed that the average values of the total number of aerobic bacteria on beef carcasses before chilling were <2.80 $\log_{10}$ cfu/cm^2. Nouichi[3] took swabs from 120 carcasses of sheep and 90 cattle carcasses, from three anatomical regions (perineal area; lateral side of the chest and lateral side of the top of the chest), to test the number of aerobic mesophilic bacteria.

Results[3], for samples related to sheep, but not for the samples pertaining to cattle, are in accordance to the results presented in Table 2. Nouichi[3], found that the average number of bacteria isolated from the surface of sheep carcasses was 3.11±0.68 $\log_{10}$ cfu/cm^2 ± s, and from the carcasses of cattle 4.48±0.63 $\log_{10}$ cfu/cm^2 ± s. The results presented in Table 4 are consistent with the results of Dragojevic[17]. She collected the samples from carcasses of cattle for enumeration of enterobacteria in the same manner as for the total number of bacteria. Daily average values of total enterobacteria expressed as $\log_{10}$cfu/cm^2 on carcasses of cattle were in 2011 from 0.18±0.06 to 1.56±0.54, in 2010 0.50±0.02 to 0.66±0.18 and in 2009 from 0.25±0.05 to 1.35±0.40.

Our results are also consistent with the results of Liliæ *et al*[18] who tested swab samples taken from 100 beef carcasses before chilling. Those results showed that the average value of the *Enterobacteriaceae* family was <0.80 $\log_{10}$ cfu/cm^2. According to the criteria prescribed by European regulation[10,11], our results are consistent with the results of Bennadji *et al*[19]. Mentioned authors have investigated total count of *Enterobacteriaceae* on carcasses of young cattle. Their finding was 2.59±0.29 $\log_{10}$cfu/cm^2. Nouichi[3] examined the total number of enterobacteria on 90 beef carcasses and the mean value was 2.92±0.43 $\log_{10}$cfu/cm^2. These values are not consistent with the values that we have presented in Table 4.

Our findings are consistent with those by Dragojevic[17] who did not isolate *Salmonella spp*. from examined samples in her studies. But, our results are not in agreement with results by Liliæ *et al*[18] that detected the presence of *Salmonella spp*. in the 100 samples taken from cattle carcasses. They pulled a total of 5 primo isolates. By subsequent serological tests they found that they belonged to *Salmonella enterica subsp. Enterica serovar Typhimurium* (3 isolates), *Salmonella enterica subsp. Enterica serovar Dublin* (1 isolate) and *Salmonella enterica subsp. Enterica serovar Infantis* (1 isolate).

Our results are also in consistent with the results obtained by Nouichi[3]. This author isolated *Salmonella* spp. from one sample of 120 samples taken from 120 carcasses of sheep, while in cattle he isolated *Salmonella spp* from 7 of the 90 samples taken from 90 cattle carcasses. By serotyping he found the presence of *S. anatum* (76.9%), *S. arizonae* (15.4%), and *S. abortus ovis* (7.7%).

Byrne *et al*[20] examined the total number

of bacteria, enterobacteria and coliform bacteria in five categories of sheep. The categories included: (A) clean and dry, (B) clean and wet, (C) dirty and dry, (D) and wet and dirty (E) with visible faecal dags. Swabs were taken after slaughter from four points: brisket, shoulder, flank and rump. The findings of these authors which refer to the total number of bacteria, according to EC 2073/2005 belong to the microbiological criteria "satisfactory" and "acceptable". Our results are not fully consistent, as part of them belong to the category "unsatisfactory" (5 flank samples, chest on lateral side 3 samples, 10 samples from perineal area, top of the chest on lateral side 2 samples), what indicates that the hygiene of our carcasses is at the lower level comparing to the hygiene of carcasses that showed Byrne *et al*[20].

According to the same EC Regulation[11], the results for enterobacteria presented by Byrne *et al*[20], for all types of samples, belong to the category "unsatisfactory". Our results are not consistent with these findings, because from the total of 380 samples only 3 are in this category. Sudhakar *et al*[21] took swabs from carcasses of sheep and goats in a slaughterhouse after different stages of processing and from the carcasses in stores. They determined the total number of bacteria and the presence of individual species of bacteria. If the values they got for the total number after evisceration (6.06±0.53) are interpreted according to the regulation EC[10], they all belong to the category "unsatisfactory". It is possible to interpret the results for enterobacteria in the same way. Our results are not consistent with these results and they suggest that hygiene in our abattoir is on a higher level.

Based on the number of aerobic bacteria, it can be concluded that the hygiene of the goats slaughtering line is at the satisfactory level in 82-87% of cases and at the acceptable level in 7-12% of cases. In 2-11% of swab samples determined number of aerobic bacteria is at unacceptable level in terms of microbiological criteria for carcasses before chilling. Also, based on the number of aerobic bacteria, it can be concluded that the hygiene of the goats slaughtering line is at the satisfactory level in 89-96% of cases and at the acceptable level in 3-8% of cases. In 2-5% of swab samples determined number of aerobic bacteria is at unacceptable level in terms of microbiological criteria for carcasses after chilling.

The number of bacteria from *Enterobacteriaceae* family was at the satisfactory level in 74-95% of samples, while in the acceptable range were 4-24% of cases. Microbiological criteria did not meet 1-7% of samples taken before chilling. The number of bacteria from this family was at the satisfactory level in 84–94% of samples, while in the acceptable range were 4–5% of cases. Microbiological criteria did not meet 1–2 % of samples taken after chilling.

Those results show that the cooling temperature affects (24 hours) the sustainability of microorganisms. On the other side, *Salmonella spp*. has not been identified in all examined samples. In conclusion, the hygiene of the goats slaughtering line presented here is at the satisfactory level.

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REFERENCES

1. Ivanoviæ, S., Pavloviæ, I., Žujoviæ, M., Tomiæ, Z., Memiši, N.: Bacteria in goat meat-biological danger. *Biotech. Anim. Husbandry*. 2011; **27** (3):pp1185-1192.
2. Bell, R.G. Distribution and sources of microbial contamination on beef carcasses. *J. Appl. Microbiol.*, 1997; **82**: 292-300.
3. Nouichi, S. Superficial Bacterial Contamination of Ovine and Bovine Carcasses at El-Harrach Slaughterhouse (Algeria). *Eur. J. Sci. Res.*,2009; **38**(3): 474-485.
4. Pointon, A., Jenson, I., Jordan, D., Vanderlinde, P., Slade,J., Sumner, J. A risk profile of the Australian red meat industry: Approach and management. *Food Control*, 2006; **17**: 712-718.
5. Ašanin, R., Krnjajiæ, D., Miliæ, N. (ed): Handbook with practical exercises in microbiology with immunology, 3rd edn.

Belgrade: Belgrade University, 2006; pp 160-166.
6. Humphrey, T.: Public-health Aspects of *Salmonella* Infection. In: *Salmonella in Domestic Animals* (C. Wray and A. Wray, ed). Eastbourne: CABI Publishing, 2000; pp245-263.
7. Borch, E., Nesbakken, T., Christensen, H. Hazard identification in swine slaughter with respect to foodborne bacteria. *Int. J. Food Microbiol.*, 1996; **30**: 9-25.
8. Botteldoorn, N., Heyndrickx, M., Rijpens, N., Grijspeerdt, K., Herman, L. *Salmonella* on pig carcasses: positive pigs and cross contamination in the slaughterhouse. *J. Appl. Microbiol.*, 2003; **95**: 891-903.
9. Zweifel, C., Baltzer, D., Stephan, R. Microbiological contamination of cattle and pig carcass at five abattoirs by swab sampling in accordance with EU Decision 2001/471/EC. *Meat Sci.*, 2005; **69**: 559-566.
10. Commission Regulation (EC), No 1441. *Official Journal of the European Union*, 2007.
11. Commission Regulation (EC), No 2073. Microbiological criteria for foodstuffs.*Official Journal of the European Union*, 2005.
12. ISO, 17604. Microbiology of food and animal feeding stuffs — Carcass sampling for Microbiological analysis. *International Organization for Standardization*, 2003.
13. RS Ministry of Agriculture, Trade, Forestry and Water Management. Guide for the application of microbiological criteria for foods.*Sl. glasnik*, 2011; 33. http://www.mpt.gov.rs/
14. ISO, 4833. Microbiology of food and animal feeding stuffs - Horizontal method for the enumeration of microorganisms — Colony-count technique at 30 degrees C.*International Organization for Standardization*, 2003.
15. ISO, 21528-2. Microbiology of food and animal feeding stuffs - Horizontal methods for the detection and enumeration of *Enterobacteriaceae* - Part 2: Colony-count method. *International Organization for Standardization*, 2004.
16. ISO, 6579. Microbiology of food and animal feeding stuffs — Horizontal method for the detection of *Salmonella* spp.*International Organization for Standardization*,2002.
17. Dragojevic, T. (ed):Bacteriological examination of the status of cattle carcasses in one export facility. Belgrade: University of Belgrade, Faculty of Veterinary Medicine, Department of Food Hygiene and Technology of animal origin, 2012.
18. Liliæ, S., Boroviæ, B., Velebit, B., Lakiæeviæ, B., Baltiæ, T., Rašeta, M., Spiriæ,D. Microbiological status of beef carcasses on the slaughter line. *Meat Technol.*, 2012; **2**: 149-153.
19. Bennadji, M.A.,Baazize-Ammi, D.,Sahraoui, N.,Brahim, E.M.,Guetarni, D. Superficial Bacterial Contamination of Bovine Carcassesat BlidaSlaughterhouse (Algeria). *J. Anim. Prod. Adv.*, 2013; **3**(2):49-56.
20. Byrne, B., Dunne, G., Lyng, J., Bolton, D.J. The development of a 'clean sheep policy' in compliance with the new Hygiene Regulation (EC) 853/2004 (Hygiene 2). *Food Microbiol.*,2007; **24**: 301-304.
21. Sudhakar, G.B., Sherikar, A.T., Paturkar, A.M., Waskar, V.S., Zende, R.J. A comparison of microbial contamination on sheep/goat carcasses in a modern Indian abattoir and traditional meat shops. *Food Control*, 2007; **18**: 854-858.