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MICROBIAL CHANGES ON THE SURFACE OF PORK CARCASSES DUE LACTIC AND ACETIC ACIDS DECONTAMINATION

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Abstract. We studied the microbial changes on warm pork carcasses immediately after applying of lactic acid solutions and during chilled storage. The research material was represented by 10 pork samples collected in November 2006 – may 2007 period, from a slaughterhouse in Cluj County. Lactic acid decontamination (LAD) included aspersion of solutions of 3%-5% lactic and acetic acid. The bactericidal activity of lactic acid killed mainly Gram-negative bacteria. Reductions in total psychrotrophic Gram-negative and *Enterobacteriaceae* counts were found reliable indicators for the efficacy of LAD. 3% LAD treatments achieved overall reductions in total psychrotrophic count of 1.42 log ufc/cm^2 in case of acetic acid and 1.74 log ufc/cm^2 in case of lactic acid. Overall reductions in psihtrotrophic *Enterobacteriaceae* counts ranged from 0.25 log ufc/cm^2 in case of lactic acid and 0.90 log ufc/cm^2 in case of acetic acid.

INTRODUCTION

In the last years numerous techniques of microbial reduction for carcasses were tested, immediatly after obtaining them and hygienisation. The most efficient and practical methods for the hygienisation of limmited surfaces, in the case of obvious contamination, were proved to be – from the technical point of view, those which implied the application of organic acid solutions or hot water to the carcass surface, exposure to preassured steam (steam pasteurization), and using steam or hot water combine with vacuum packaging. From the organic acids, the most frequently used ones to reduce the germ load on the carcass surface are acetic and lactic acid in variable concentrations, between 1.5-5%. By using acetic and lactic acid on the carcasses a reduction of the microbial up to 1.5 log. Some studies revealed that some pathogens in meat are particullary sensitive to organic acids (*Yersinia enterocolitica*) and others more resistant (*E. coli* O_{157}:H_7). A possible advantage of organic acid treatments compared to other treatments, is that of the residual activity of them after application. On the other side, some researches proved that reduction of the microbian lkoad on the carcass surface wasn't correlated to a better hygiene due to recontamination and development thru the procession line and depositing.

The use of acidulation agents on the pork carcasses before processing, was proved to reduce but not totally eliminate the germs on the carcass surface. Kotula and Rough, cited by M.R. Strivarius and col. (2002), sugested the fact that every time when the carcasses are chopped in small pieces, the germs from their surface are inoculated on the newly created surfaces.

Van der Marrel et al (1998) studied the effect of broiler carcasses imersation in different solutions of 1 – 2 % acetic acid (pH=2,2 at 19ºC) for 15 seconds at different stages of the technological process with the purpose of determining the inhibition of bacterial development from the psychrophilic members *Enterobacteriaceae* family and *Staphylococcus aureus*. They immediately after the treatment observed that colonization per skin gram, in generally, was

reduced by 1 log and pH with values between 3,2 and 4. The treatment with 2 % lactic acid stopped the post-decontamination bacterial development, more efficiently than the 1 % concentration solution, the effect being more obvious if it was followed by immediate carcass freezing.

As following of the presented aspects, in our research we tried to appreciate the microbial psychrotrophe load and configuration after the application of 3 and 5 % lactic and acetic acid solutions for the pork carcasses, processed in a slaughterhouse from Cluj County.

MATERIAL AND METHOD

The studied material was represented by 10 pork samples, collected between November 2006 – May 2007, from a slaughterhouse from Cluj County. The samples were collected from the surface of refrigerated carcasses at 48 hours, from the chilling spaces of the abattoir in accordance with the methodical norms recommended by Veterinary National Agency and Food Safety. From the surface there were collected slices of superficial muscle tissue of a thickness of 2 – 3mm, square shaped with the side of 10 cm (100 cm^2 each), collected from different anatomic regions: leg, the chest, the flank, back.

The samples obtained from bovine and pork carcasses were treated with solutions of acetic and lactic acid, through surface aspersion of the meat pieces (2,5 – 3 ml/100 cm^2). Each collected sample was portioned in other 3 samples, from which 2 were treated with organic acids and one was the control sample, to compare the results regarding the germ number of the organic acid treated samples. The samples were cut small (200 cm^2) with scissors and homogenized with 200 ml sterile 0,9% NaCl solution, for 5 minutes, with the mechanic homogenizer, obtaining the base solution (10^{-1}) in which 1 ml liquid represents 1 cm^2 from the controlled surface, than successive dilutions were obtained: 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7} (when it was considered necessary).

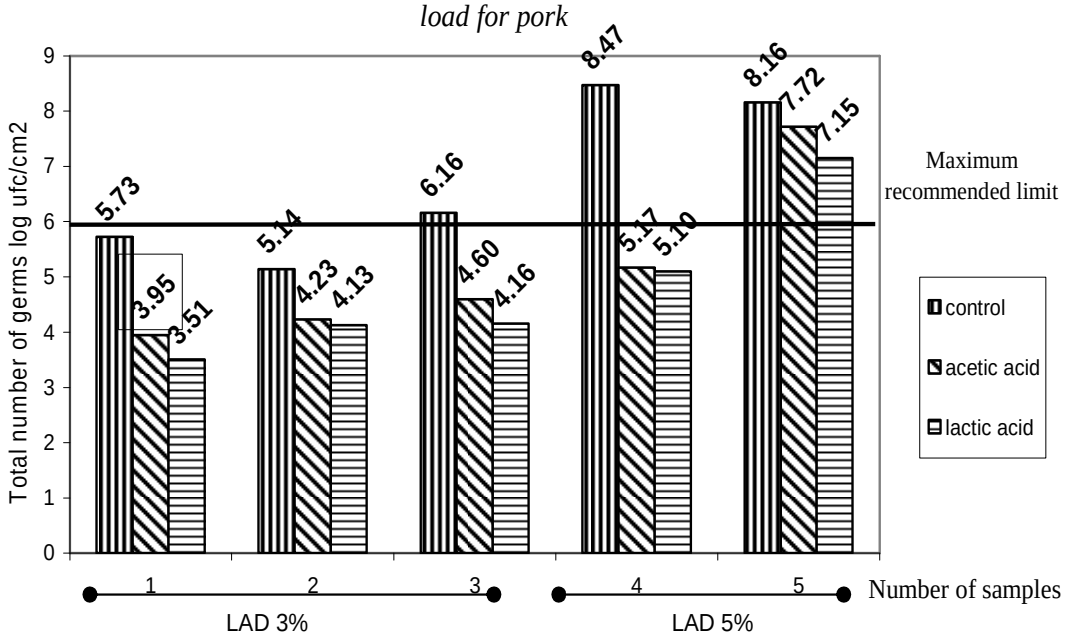
Identifying the psychrotrophic bacteria was made on a basis of morphological confirmation tests (colony aspect, Gram stained smears, the 3% KOH test to differentiate the Gram negative from Gram positive bacteria) and biochemical confirmation tests using API 20NE and 20E commercial kits. The obtained data was systematized and graphically expressed, average values being established, which were compared with the literature. The microbial load was estimated as log mean value.

RESULTS AND DISSCUSSIONS

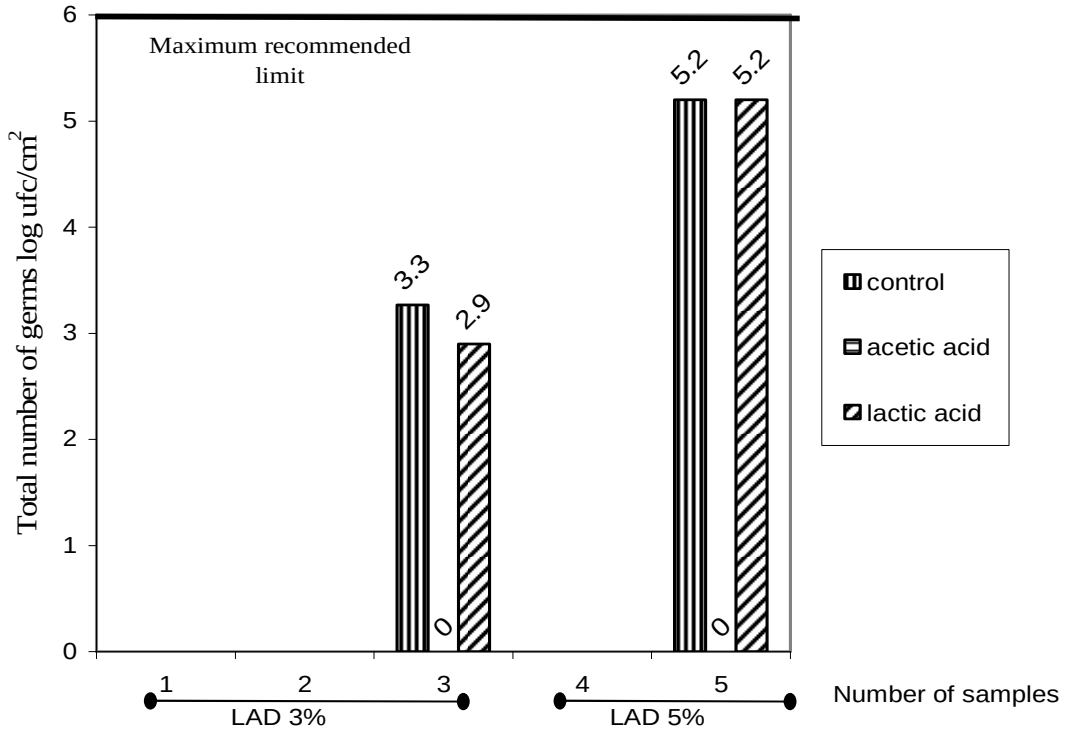
Regarding the effect of organic acid solutions on the total bacterial load, in the case of pork carcasses we observed a decrease of the TGN of average 1.42 log_{10}/cm^2 CFU in the case of 3% acetic acid, 1.74 log_{10}/cm^2 in that of 3% lactic acid, and for the acetic acid, but 5% concentration, a decrease with 1,87 log_{10}/cm^2 CFU, for the same concentration lactic acid we obtained a decrease with 2.19 log_{10}/cm^2 UFC (graph. 1).

From the 5 treated samples, 3 presented initially values of the germ load higher than the limit of 10^6 ufc/cm^2, and after the application of organic acids, the germ load was situated inside the acceptable limits in the case of 2 samples, meaning 66,66% of samples, both for acetic and lactic acids. From the data presented in graphic 1, we can notice that lactic acid in both concentrations has a more distinguished effect of diminishing the germ number. This effect is correlated also with a more intense effect of decreasing the pH value, comparing to the acetic acid. Studies made by Prasai R. K. *et al.* (1992), revealed that in the case of pork carcasses 1% lactic acid solutions decrease the germ number with over 1 log_{10}/cm^2 CFU.

Graphic 1 The effect of lactic and acetic acid treatments to the microbial load for pork



Graphic 2 The effect of organic acid solutionstreatments to development o germs from Aeromonas genus on pork carcases



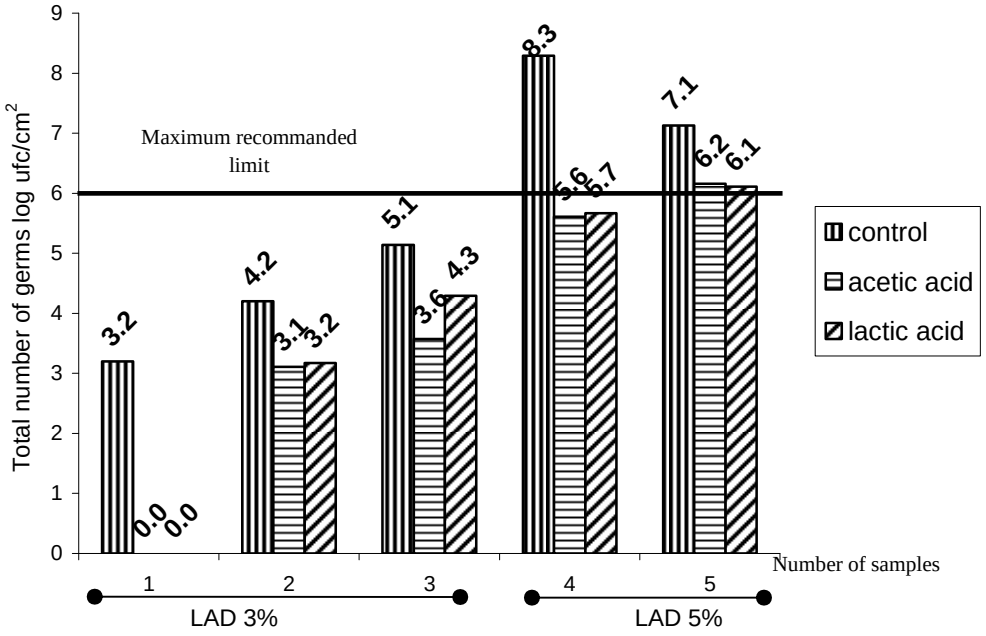
In the case of germs from *Aeromonas* gn., a decrease can be observed, of average 3.30 log_{10}/cm^2 CFU for the 3% acetic acid solution and 0.40 log_{10}/cm^2 CFU for 3% lactic acid, and for the 5% acetic acid solution the decrease is 5.20 log_{10}/cm^2 and none for the 5% lactic acid solution. Acetic acid has a very obvious effect in diminishing the number of *Aeromonas*

germs, these vanish totally, while lactic acid has a very reduced effect, for the 3% concentration solution. (fig. 2).

For the germs from the *Pseudomonas* gn., we observed a decrease of average 1.93 log_{10}/cm^2 CFU in the case of 3% acetic acid, 1.70 log_{10}/cm^2 CFU for the 3% lactic acid, 1.80 log_{10}/cm^2 CFU for the 5% acetic acid and 1.80 log_{10}/cm^2 CFU for the same concentration lactic acid solution. (fig. 3.). It seems that for this category of bacteria, there are no significant differences regarding the effect in diminishing the microorganism numbers. Also, it can be observed that for the 2 samples in which the Pseudomonas germ numbers crossed the acceptable limits, after 24 hours from acid application, their values were normal.

Studies conducted by Cutter and Siragusa (1994), using acetic and lactic acid solutions of 1, 3 and 5% concentrations, observed a decrease in *Pseudomonas fluorescens* number of 1 to 2 log_{10}/cm^2 UFC.

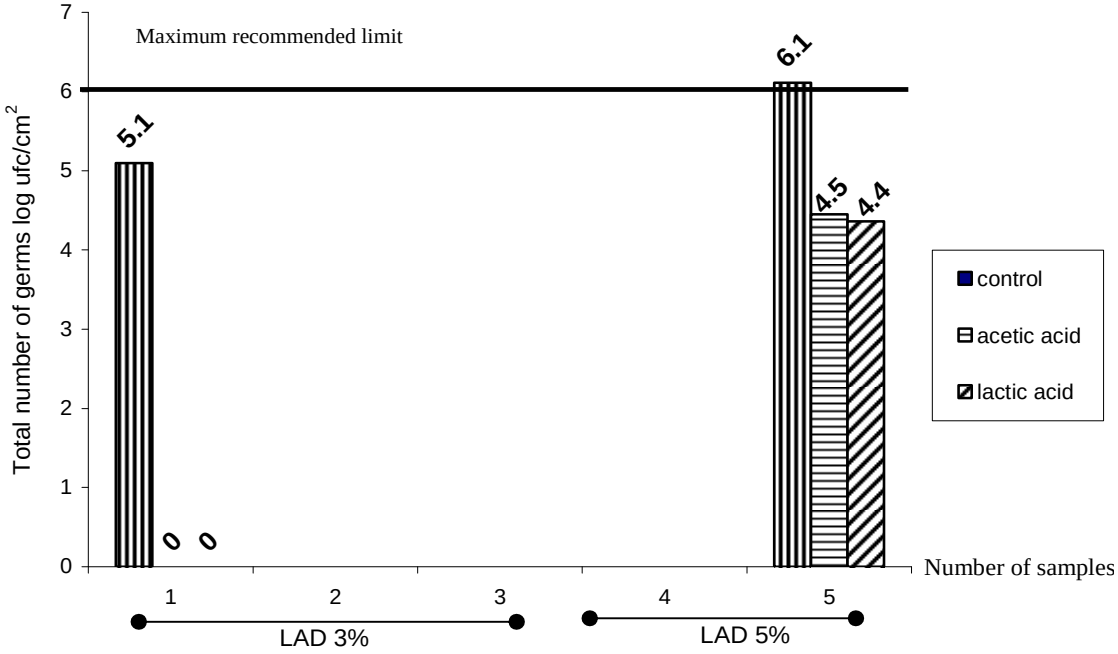
Graphic 3 The effect of organic acid solutionstreatments to development of germs from Pseudomonas genus on pork carcasses



In the case of germs from *Yersinia* gn., we observed that these were totally destroyed at 24 hours after applying the organic acid solutions of 3% concentration, a numeric decrease of 5.1 log_{10}/cm^2 CFU. In the case of 5% concentration acid solutions a decrease of 1.60 log_{10}/cm^2 CFU for the acetic acid was observed and 1.70 log_{10}/cm^2 CFU for the lactic acid. (fig. 4). We note that for the samples 2, 3 and 4 there were no *Yersinia* germ isolates.

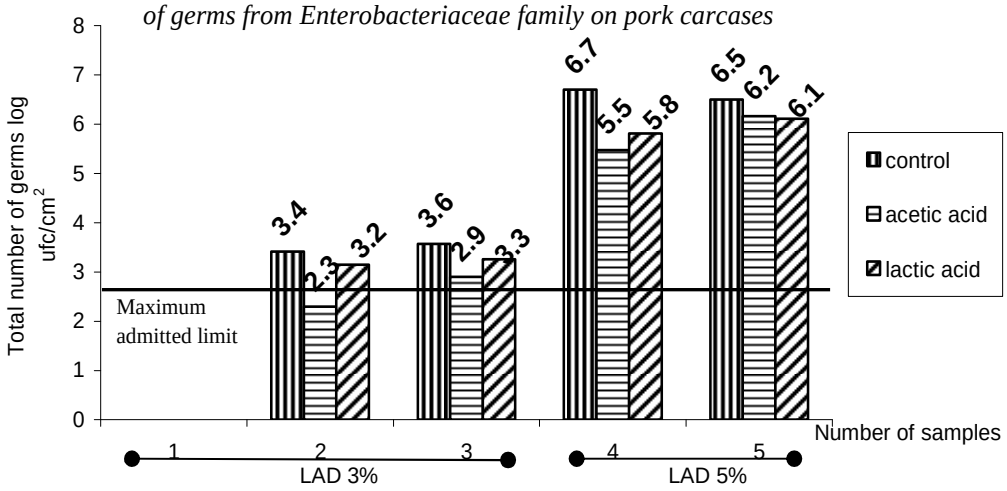
In the case of *Enterobacteriaceae* we can note a numeric reduction of the germ load of 0.90 log_{10}/cm^2 CFU in the case of 3% acetic acid and 0.25 log_{10}/cm^2 CFU in the case of 3% lactic acid solution. After the application of 5% acids concentration we can notice an average decrease of 0.75 log_{10}/cm^2 CFU in the case of acetic acid and 0.65 log_{10}/cm^2 CFU for the lactic acid (fig. 5). From the graphic analysis we can observe that the acetic acid solutions used (3, 5%) have a more obvious effect that those of lactic acid in diminishing the bacterial load. Also, we can notice that when the contamination level with *Enterobacteriaceae* is very high (6.5-6.7 log ufc/cm^2), the solutions used although reduce the germ numbers, don't make them frame into the accepted values (2.5 log uf/cm^2).

Graphic 4 The effect of organic acid solutions treatments to development of germs from Yersinia genus on pork carcases



From the obtained data analysis it can be said that regarding the total germ number, the 3 and 5% lactic acid solutions have a more obvious effect than acetic acid solutions. In the case of germs from *Aeromonas, Yersinia* gn. and *Enterobacteriaceae* fam., we can appreciate that 3 and 5% acetic acid solutions have a more pronounced reduction effect than the same concentration lactic acids. For the germs from *Pseudomonas* gn., the two organic acids hade approximately the same effect.

Graphic 5 The effect of organic acid solutions treatments to development of germs from Enterobacteriaceae family on pork carcases



CONCLUSIONS

In the case of pork, a decrease of psychrotrophe count with 0,25 $\log_{10}/cm^2$ CFU – 5.2 $\log_{10}$ CFU/cm^2 was revealed, after the application of acetic and lactic acids solutions (3 – 5%). Lactic acid is more efficient in reducing the aerobic plate count, compared to acetic acid,

which is more efficient in decreasing the germs from *Aeromonas, Yersinia* genus *and Enterobacteriaceae* family; for the germs belonging to *Pseudomonas* genus, acetic and lactic acids had a similar effect.

Based on our results, we recommend the spraying of 3% organic acid solutions to the surface of pork carcasses immediately after the final washing, before chilling in the purpose of germ load reduction. Although acetic acid has, in general, a more pronounced antimicrobial residual effect, we recommend 3% lactic acid because is a natural metabolite of the muscle tissue.

Using these methods of carcass decontamination must be considered as complementary measures of meat hygienic quality, without diminishing the importance of HACCP implementation.

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