EFFECT OF LACTIC ACID SPRAYS ON BEEF CARCASS CONTAMINATION

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INTRODUCTION

Under normal commercial conditions maximum shelflife for chilled beef carcasses is estimated at approximately 3 weeks. From this moment deteriorative changes of the surface occur as a result of an excessive development of psychrotrophic micro-organisms. Apart of the use of vacuum packing which controls this flora, other possibilities are available. One of these possibilities is arousing more and more attention and exists in spraying the dressed carcasses with a solution of organic, natural acids. These solutions are said to have an inhibitory effect on the normal taint flora of beef (1, 2, 3, 5, 6).

In the following report the effect of the surface treatment with lactic acid sprays on the shelflife of beef carcasses stored for 2 weeks in a commercial refrigerating room, is discussed.

MATERIAL AND METHODS

1. Material

Immediately after slaughter 5 beef carcasses were prechilled at 12°C after the right halves had been sprayed. The left halves were used for control.
As spray fluid a solution on the basis of organic acids (E 270, E 330), sugars and an antioxidant (E 300) was used (CHROMA B - N.V. DERA & VANCO FOODCHEMICALS - Belgium).
Sugars were added to delay proteolytic activity. Indeed, spoilage bacteria will metabolise carbohydrates before proteins are used as substrate for microbial growth. The antioxidant was added as color stabilizer (4).
The spraying was done with a Wagner spray gun under a constant pressure of 120 bar. The distance between the spray gun and the carcass was approximately 15 cm.
Each of the 5 carcass halves was equally sprayed over the whole surface with a total volume of 2 litre solution (0.15 meq. H^+/cm^2).

2. Sampling

30 Minutes after spraying surface samples were aseptically taken (10 cm^2) of each carcass half (treated and control halves) at 4 different areas, i.e. on the brisket, the diaphragm, the top and bottom round. The samples were transferred into 10 ml buffered peptone water.

After the sampling all carcasses were immediately cold stored at a temperature ranging from 0° to +2°C, except for day 2 and 9 where the temperature raised upto 9°C because of the replenishing of the room with hot carcasses. The relative humidity constantly balanced between 92 and 98%.

The samples were transported under cooling to the laboratory, where they were kept for 1 hour at room temperature. After homogenisation during 1 minute with a Stomacher 400 (Colworth), bacteriological examinations were performed.

After 5 days preservation the same areas of all carcass halves were sampled again.

Finally the hindquarters (diaphragm, top and bottom round) were sampled once again after 9 and 14 days of cold storage.

3. Bacteriological determinations

On all samples the follwing bacteriological determinations were performed:
- aerobic mesophiles/cm^2 on P.C.A. (OXOID CM325), 72 hrs at 30°C
- psychrotrophes/cm^2 on P.C.A. (OXOID CM325), 8d. at 8°C
- pseudomonas/cm^2 on G.S.P.-Agar (MERCK 10230), 72 hrs at 25°C
- enterobacteriaceae/cm^2 on V.R.B.G. (OXOID CM323), 24 hrs at 30°C
- lactobacilli/cm^2 on Rogosa-Agar (Inst. Pasteur 52151), 5d. at 28°C
- Microbacterium thermosphactum/cm^2 on S.T.A.A. according to GARDNER, 72 hrs at 22°C
- yeasts and moulds/cm^2 on Glucose Yeast Extract Agar, 72 hrs at 22°C

All counts are expressed in log N per cm^2.

4. Preliminary test

In a first test at the experimental-Abattoir of the Ghent State University in Melle, 1 carcass was treated and sampled in the intended way. As the results obtained were favorable, a more detailed research followed in an industrial abattoir, as described hereafter.

5. Statistical evaluation of the results

For the calculation of possible significant differences in contamination between the treated and the non-treated samples the Wilcoxon test was performed.

RESULTS AND DISCUSSION

The results shown in the figures I to IV are the average (n=5) counts (respectively mesophiles, psychrotrophes, pseudomonas, yeasts and moulds) with standard deviation (SEM) of the non-treated carcass halves related to the preservation time. Also the average decreases (-) respectively increases (+) of the counts on the treated carcass halves for the different preservation times are shown in these figures as Δ expressed in log N/cm^2 with standard deviation.
The influence of the treatment on the percentage of samples with enterobacteriaceae, lactobacilli and Microbacterium thermosphactum is given in table I.

The initial contamination of the different localisations on the control carcass halves varied considerably. Thus the total counts for aerobic mesophiles of the bottom round (outside of the carcass) were more than 1 log. unit higher than those of the diaphragm (4.19 vs. 2.80). This was also the case for the initial number of psychrotrophes (3.35 vs. 2.09) and pseudomonas (2.27 vs. 1.26).

30 Minutes after the spraying already a very significant decrease of the number of aerobic mesophiles per cm^2 could be shown over the total sampling areas of the treated carcass halves. As a result of the treatment a significant decrease of the number of psychrotrophes and pseudomonas could also be noticed. The decrease in counts was most evident on the most contaminated areas (bottom round) and amounted from 1 to 1.5 log. units for the bacterial species mentioned.

After 5 days of cold storage both the number of mesophilic and psychrotrophic organisms and pseudomonas obviously increased on the control brisket (1.5 to 2.5 log. units), whereas the decrease caused by the treatment was almost as high as 1 log. unit. On the top and bottom round of the control halves these species did not show an increase after 5 days storage at 0° to +2°C.

After 9 days of preservation the number of aerobic mesophiles, psychrotrophes and pseudomonas increased 2 to 3 log. units on the control diaphragms. They were 1.75 to 2.5 log. units lower on the treated carcass halves. On the top round (slow increase of the contamination with increasing preservation time) the difference in bacterial growth as a result of the spraying was only noticeable after a longer preservation time (2 weeks).

After 14 days of cold storage the number of aerobic mesophiles, psychrotrophes and pseudomonas of all control samples increased 1.5 to 2.5 log. units averagely. The decrease of the number of aerobic mesophiles, respectively psychrotrophes, caused by the treatment was highly significant for the total of sampled areas (diaphragm, top and bottom round).

The treatment also resulted in a decrease of the number of sampling sites contaminated with enterobacteriaceae. This number, however, was only slightly influenced by the preservation time.

The total number of samples contaminated with lactobacilli increased as a result of the treatment.

The application of a lactic acid solution had no tangible effect on the increase of the number of sampled surfaces contaminated with Microbacterium thermosphactum.

Yeasts and moulds obviously increased on the treated areas. After 9 days of cold storage a significant increase of the number of yeasts and moulds occured as a result of the spray.

Finally it should be stated that the treatment may induce an unfavorable influence on the external aspect of the carcasses. Due to the decrease in pH a browning of the carcass surface occurs. Especially the areas with remainders of blood got a dark red-brownish color. Also the fatty tissue areas and the dorsal vertebrae showed discoloration. In the course of the preservation the color differences between the treated and non-treated carcasses diminished, but could still be noticed with the unaided eye at the end of the experimental period (14 days).

CONCLUSIONS

From the results it can provisionally be concluded that the treatment with a lactic acid solution results in a decrease of the number of surface micro-organisms. This effect persists during consecutive preservation. Hence the preservation time is extended. At the same time the presence of lactic acid exerts a selection on the bacterial flora and fungi, whereby the acidophilic psychrotrophic flora (lactobacilli, yeasts and moulds) becomes more predominant. Due to the decrease of pH resulting from the treatment with organic acids a brownish surface discoloration appeared. This browning diminished, however, did not completely disappear during further preservation. Improvements in the field of color stabilisation would therefore be desirable.
The treatment with organic acids could thus become a technique to be applied in the future to improve the shelflife of chilled meat.

LITERATURE

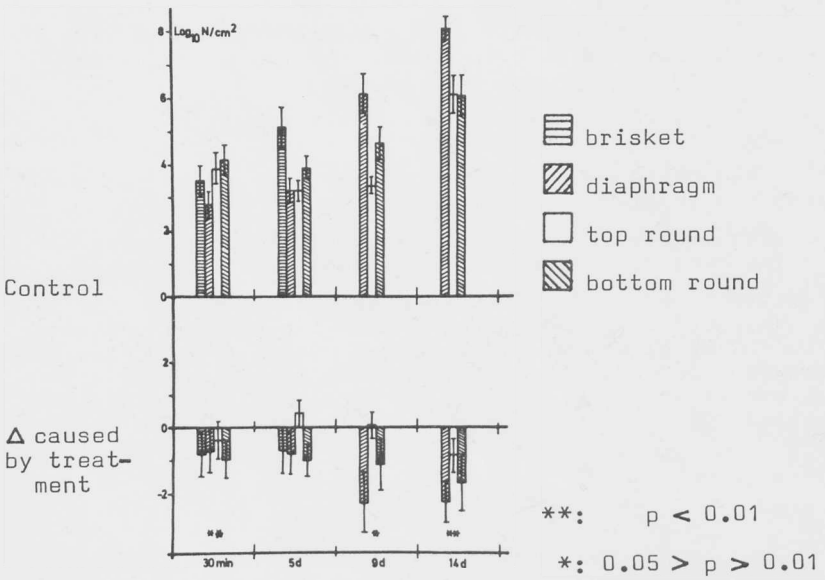
1. ANDERSON, M., e.a.: J. Food Sci., 42, 326, 1977.- 2. BALA, K., e.a.: J. Food Sci., 42, 743, 1977.- 3. BIEMULLER, G., e.a.: J. Food Sci., 38, 261, 1973.- 4. GILL, C.: J. Appl. Bacteriol., 41, 401, 1976.- 5. MOUNTNEY, G. and O'MALLEY, J.: Poult., Sci., 44, 582, 1965.- 6. REYNOLDS, A. and CARPENTER, J.: J. Anim. Sci., 38, 515, 1974.-6. SNIJDERS, J. e.a.: Fleischw.,59,658,1979

	storage	brisket		diaphragm		top round		bottom round	
		N	T	N	T	N	T	N	T
entero-	30 min.	20	0	0	0	60	40	20	20
	5d	80	80	60	20	0	0	0	20
bacteriaceae	9d	n.d.	n.d.	60	20	20	0	20	40
	14d	n.d.	n.d.	40	0	40	40	20	20
lacto-	30 min.	20	60	20	20	40	80	60	20
	5d	80	80	60	80	100	80	60	100
bacilli	9d	n.d.	n.d.	20	40	60	60	20	40
	14d	n.d.	n.d.	20	40	60	40	60	80
Microbacte-	30 min.	60	60	20	0	80	80	60	40
	5d	80	100	80	20	0	20	0	20
rium ther-	9d	n.d.	n.d.	100	60	60	60	60	60
mosphactum	14d	n.d.	n.d.	100	80	80	80	100	100

N: Non treated n.d.: not determined

T: Treated

Table I: Influence of the surface treatment of 5 beef carcass halves with a lactic acid spray on the percentage of samples (n=5) contaminated with enterobacteriaceae, respectively lactobacilli and Microbacterium thermosphactum (log N per cm^2 > 1.3).



**: p < 0.01

*: 0.05 > p > 0.01

Figure I: Influence of the surface treatment of 5 beef carcass halves with a lactic acid spray on the average number of aerobic mesophiles per cm^2 (n=5) of the different sampling surfaces during preservation at 0° to +2°C.

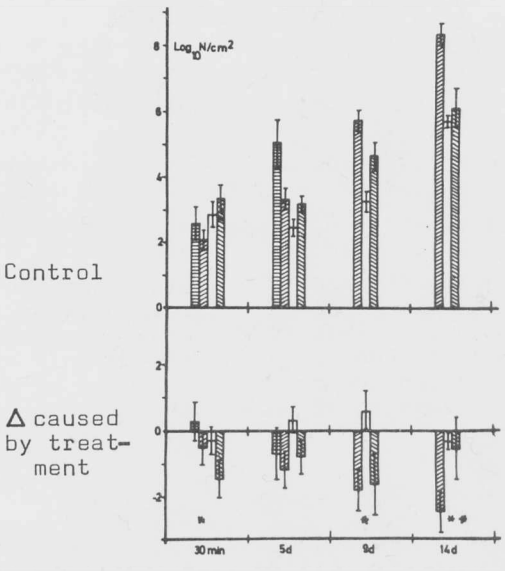


Figure II: Influence of the surface treatment of 5 beef carcass halves with a lactic acid spray on the average number of psychrotrophes per cm^2 (n=5) of the different sampling surfaces during preservation at 0° to +2°C.

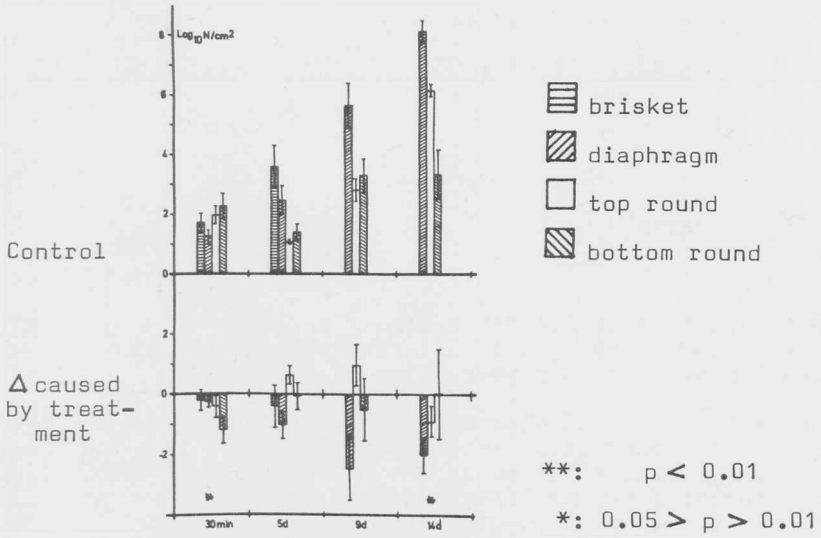


Figure III: Influence of the surface treatment of 5 beef carcass halves with a lactic acid spray on the average number of pseudomonas per cm^2 (n=5) of the different sampling surfaces during preservation at 0° to +2°C.

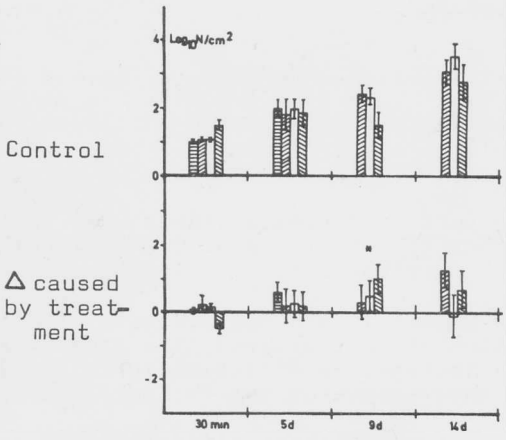


Figure IV: Influence of the surface treatment of 5 beef carcass halves with a lactic acid spray on the average number of yeasts and moulds per cm^2 (n=5) of the different sampling surfaces during preservation at 0° to +2°C.