# The Effect of Marinading with Organic Acids on Composition and Sensory Properties of Beef

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## SUMMARY

Studies about the effect of organic acids on the composition and sensory properties of beef were carried out in order to compare theoretical knowledge with the application in practice. M. mastoideus from youg bulls were cut into pieces of 200 g and marinaded 2 resp. 10 days at 4°C with solutions of acetic and lactic acid varied in concentration (0.05 to 0.25 mol/l). After marinading the meat was heated for 2 h at 90°C. The pH of meat homogenates decreased with increasing marinade strength before and after cooking. Marinade with lactic acid was more effective in lowering pH than acetic acid of the same concentration. The penetration of organic acid solutions was not complete. The measurement of pH-values showed that in the centre of all marinaded and heated meat pieces the values differed only slightly whereas the surface showed changes comparable to the marinade. Marinading resulted in a marked increase of weight. Assessment of shear force indicated that cooked meat was slightly more tender after marinading with higher acid concentration. But the taste panel assessment of the overall acceptability of cooked meat showed that marinading with acid concentrations above 0,15 mol/l resulted in an undesirable sour taste accompanied with higher (worse!) taste panel scores. Therefore pH values below 5.0 in cooked meat are not unrestrictedly acceptable. After 10 days marinading the shear force values were conspicuously low with all meat pieces. Therefore the increase in tenderness with longer marinading time is not caused by acid but ageing.

## INTRODUCTION

Marinading is a method for tenderizing meat with a long tradition. In former times marinading was made with wine or vinegar. Furthermore with venison there exist recipes using butter milk for marinading. In literature the effect of marinading of meat is discussed controversially. The described effects of marinading are on the one hand due to the influence of organic acids on the connective tissue proteins and on the other hand due to the effect on the water-holding capacity of the myofibrils of the muscle. WENHAM and LOCKER (1976) and GAULT (1988) stated that marinading was only effective in tenderizing thin strips of meat. The marination of thick pieces of beef resulted in incomplete penetration of marinade into the meat. Our studies about the effect of organic acids on the composition and sensory properties of beef were carried out in order to compare theoretical knowledge with the application in practice.

## MATERIALS and METHODS

For the experiments M. mastoideus from young bulls (four days post mortem) were cut in pieces of 200 g. The marinades of acetic and lactic acid varied in concentration (0,05, 0,1, 0,175 and 0,25 mol/l). The meat pieces were placed in polystyrene bags and covered with 200 ml of marinade and stored 2 resp. 10 days at 4°C. After marinading the meat was separated from marinade and heated in polystyrene bags for 2h at 90°C in water bath. Cooking juice was collected.

The change of weight of meat pieces were determined after marination and after heat treatment. Concentration of total protein (N x 6.25) and collagen were analyzed in the marinade, in the cooking juice and in the meat. pH-values were measured in meat (surface and centre), meat homogenates, marinade and cooking juice. The change of sarcomere lengths of myofibrils was estimated by the method of VOYLE (1971) with laser diffraction and shear force values were assessed with an Instron Instrument fitted with a Warner-Bratzler shear device in centre parts of the cooked meat.

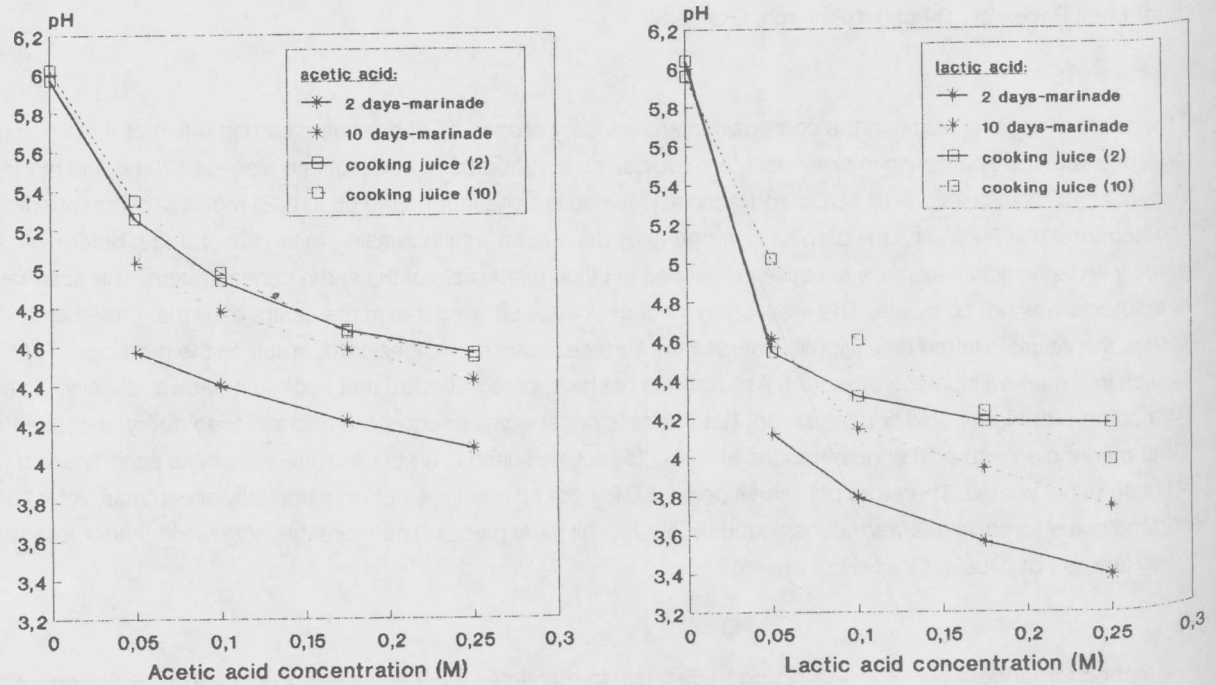
Tenderness and overall acceptability of the meat were evaluated by a sensory panel of 5 persons (evaluation on a hedonic scale "6 to 1", "none to much").

## RESULTS and DISCUSSION

Before marinading the solutions had pH-values between 3.0 and 2.6 (0.05M to 0.25M acetic acid) resp. 2.2 and 1.8 (0.05M to 0.25M lactic acid). After 2 days of marinading the solutions showed higher pH-values than at the beginning and after 10 days a further increase was noticed (fig. 1). These increases were caused by the buffering capacity of dissolved meat proteins extracted from meat during marinading. pH-values of cooking juices decreased with increasing concentrations of organic acids in the marinades but they were higher than those in marinades.

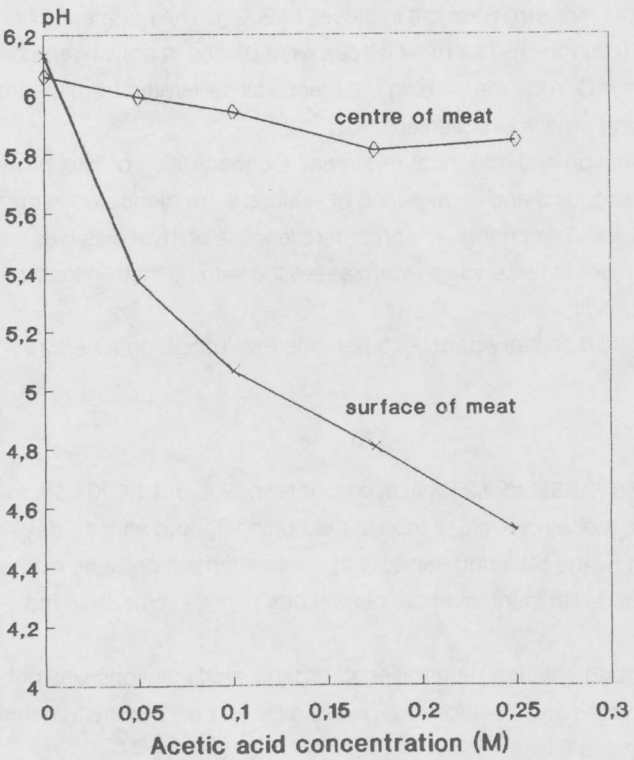
According to the results of WENHAM and LOCKER (1976), we found, that the penetration of organic acid solutions was not complete. Fig. 2 shows that the pH-values in the centre of all marinaded and heated meat pieces differed only slightly. Whereas the surface showed changes comparable to those we found in cooking juices.

fig. 1: pH-values of marinades and cooking juices after 2 and 10 days of marinading followed by heating (2h 90°C) of beef




The pH of meat homogenates decreased with increasing marinade strength after 2 and 10 days before and after cooking (fig. Marinade with lactic acid was more effective in lowering pH than acetic acid of the same concentration. The pH-lowering effe 10 days of marinading on meat homogenates were remarkable higher than that of 2 days-marinading with both organic acids

fig. 2: pH-values of 2 days-marinaded and heated (2h 90°C) beef homogenates from centre and surface parts of meat.




Marinading with increasing acid concentration resulted in marked increase of weight in the uncooked state; lactic a is more effective than acetic acid. The uptake of liquid is related to the pH of the meat (fig. 4). Also with increasing marinading time the weight gain was higher. After cooking all samples showed loss of weight. Total retention of wate increased with decreasing pH of meat during cooking, caused by swelling of the myofibrils under acidic condition below the iso-electric point of its major proteins. These results are supported by the results of GAULT (1985, 198 It is known that the water-holding capacity of meat increa with changing pH above or below the iso-electric point o meat proteins (HAMM 1960).

The content of total soluble protein in the marinades changed negligibly with increasing acid concentration. Higher values, however, were measured after 10 days of marinading comparable to 2 days with both organic acids Soluble collagen was found only in traces. In cooking ju the concentration of collagen increased with strength of in the marinade, whereas in meat the values fell slightly.

fig. 3: pH-values of meat homogenates after marinading (2 resp. 10 days with different concentrations of acetic and lactic acid) followed by heating (2h 90°C)

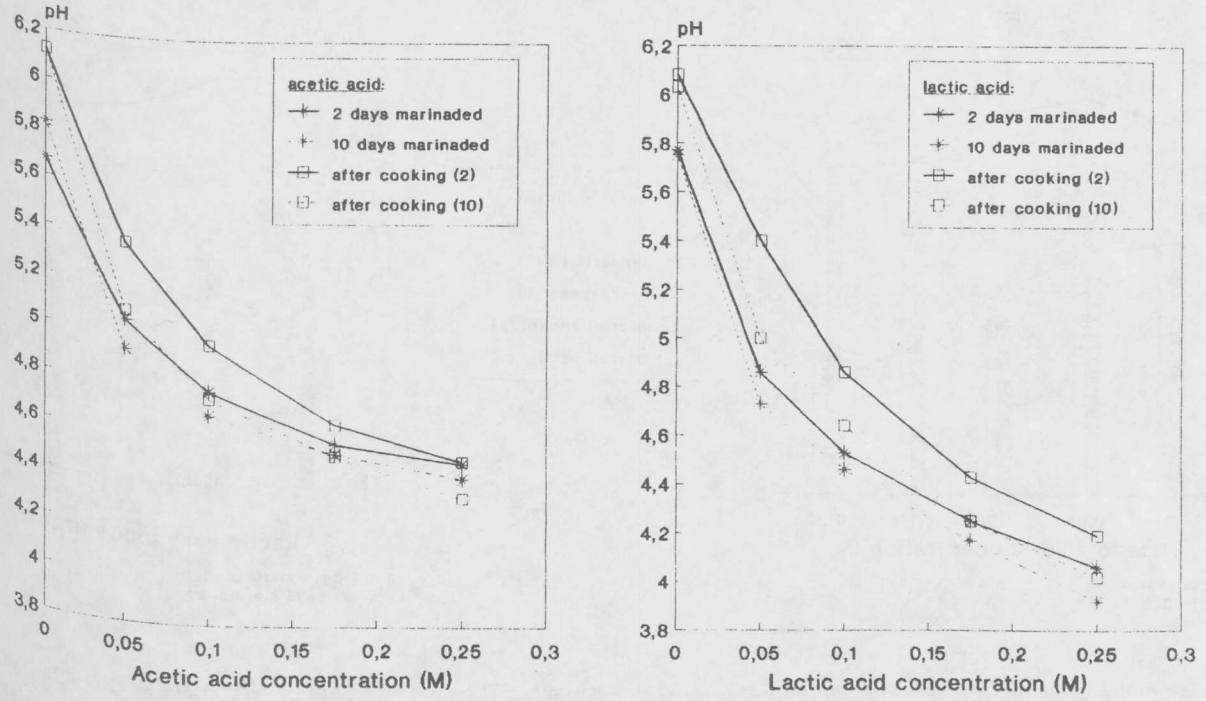



fig. 4: Weight changes of meat after marinading (2 resp. 10 days with different concentrations of acetic and lactic acid) followed by heating (2h 90°C)

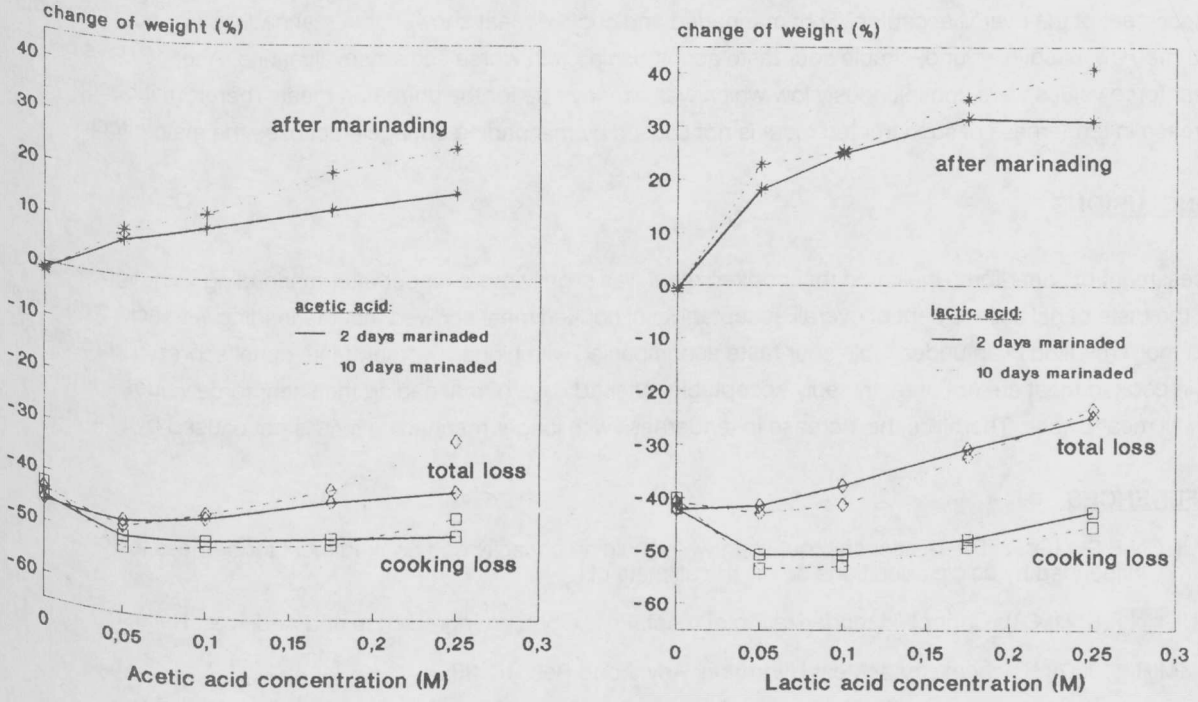
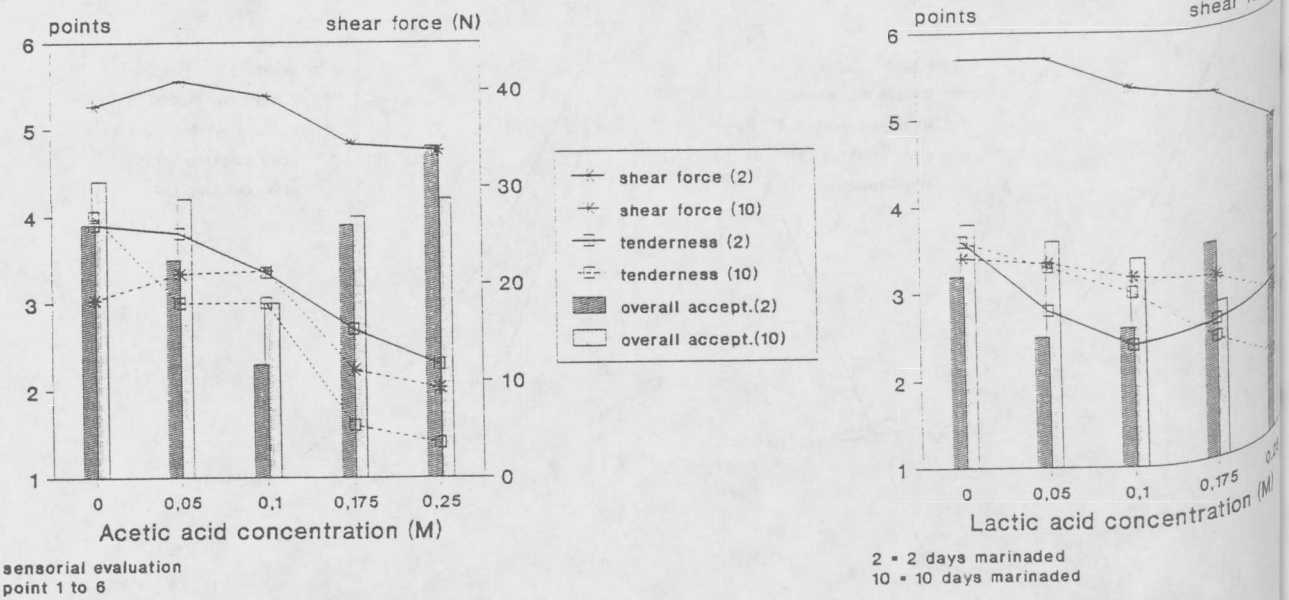


fig. 5: Assessment of shear force and sensory evaluation (6 to 1; "none to much") of tenderness and overall acceptability of after marinading (2 resp. 10 days with different concentrations of acetic and lactic acid) followed by heating (2h 90°C




sensorial evaluation
point 1 to 6

2 = 2 days marinaded
10 = 10 days marinaded

Changes of the structure are very important for the sensory evaluation. The measurement of sarcomere length after marina and heating showed no uniform trend with increasing acid concentration, only a shortening of myofibrils caused by heat trea ment occurred. This is explicable, as the samples were taken from the centre of the meat pieces, where the marinade had penetrated incompletely. Therefore no statement can be made about the structural changes in accordance to the changes sarcomere length.

Assessment of shear force indicated that cooked meat was slightly more tender after 2 days of marinading with higher acid c centration (fig. 5). The sensory evaluation of tenderness was in accordance with the estimation of shear force. But the taste assessment of the overall acceptability of marinaded and cooked meat showed that marinading with acid concentrations ab 0,15 mol/l resulted in an undesirable sour taste accompanied with worse sensory evaluations. After 10 days of marinading t shear force values were conspicuously low which was already true for the untreated meat. Therefore it becomes obvious that increase in tenderness of such treated meat is not caused by marinading but ageing causes the main effect.

## CONCLUSIONS

Assessment of shear force indicated that cooked meat was slightly more tender after marinading with higher acid concentrat But the taste panel assessment of overall acceptability of cooked meat showed that marinading with acid concentrations abo 0,15 mol/l resulted in an undesirable sour taste accompanied with higher (worse!) taste panel scores. Therefore pH values b 5.0 in cooked meat are not unrestrictedly acceptable. After 10 days of marinading the shear force values were conspicuously with all meat pieces. Therefore the increase in tenderness with longer marinading time is not caused by acid but ageing.

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