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Effect of sodium acetate and citric acid on growth of *L. monocytogenes* and sensory properties of pork sausage

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The aim of this study was to determine if sodium acetate and/or a combination of sodium acetate and citric acid could inhibit the growth of *L. monocytogenes* in a heat treated meat product without affecting the organoleptic quality of the product.

Materials and Methods.

Cured pork sausage with varyring contents of sodium acetate and citric acid was manufactured, sliced and vacuum packed in 75-80 g packages. Four recipies were used for the manufacturing of (1) Standard recipe, (2) Standard recipe added 0.125 % sodium acetate, (3) Standard recipe added 0.125 % sodium acetate and 0.125 % citric acid and (4) Standard recipe added 0.250 % sodium acetate. The 4 groups were stored for 35 days at 5°C and 10°C.

The storage experiment:
Moisture, nitrite and NaCl concentrations were determined at the beginning of the storage period. pH was measured and total bacterial counts were made after storage for 0, 7, 13, 20, 27 and 35 days respectively, one package from each recipe.
Sensory analyses were made after the 4 products had been stored for 0, 7, 14, 21, 28 and 35 days,respectively,at 5°C and 10°C. The panel comprised 7 persons. Flavour, odour and appearance were judged on a scale from 1 to 5 (1=minimum, 3=rejection limit). Each product was judged twice. Statistical analysis was made, using SAS.

The inoculation experiment:
Samples from the 4 recipies were inoculated with 1.0 ml of a suspension of *L. monocytogenes* 4b (10^2 cells/ml). All packages were vacuum sealed again after inoculation. Storage temperatures were 5°C and 10°C.

L. monocytogenes counts were made on Listeria Selective Agar Base with Listeria Selective Supplement (Oxoid) after storage for 0, 7, 14, 21, 28 and 35 days. Incubation at 37°C for 2 days. Total bacterial counts were made on PCA after incubation at 25°C for 3 days.

Results and Discussion.

The storage experiment:
pH was measured once a week during the storage period, i.e. during 5 weeks at 5 and 10°C. pH only dropped in the standard recipe(1) after 3 weeks at 10°C, from originally pH 6.5 to 6.1 and finally pH 5.7, whereas pH remained unchanged in the other samples.

An inhibition of the microflora was observed in alle products added sodium acetate and citric acid, stored at 5°C and 10°C (Fig.1). The microflora seems to be most strongly inhibited by addition of 0.125 % sodium acetate and 0.125 % citric acid when kept at 5°C.

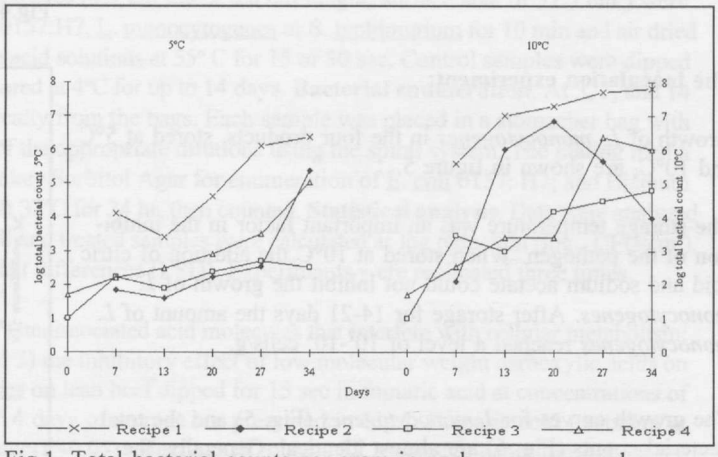

Fig.1. Total bacterial counts per gram in pork sausage samples.

Sensory analysis.
Flavour:
Results from the sensory analysis of the flavour, odour and appearance of the four products are shown in Fig. 2, 3 and 4 respectively.
The statistical analysis showed that the two groups of pork sausage added 0.125 % (2) and 0.250 % (4) acetate respectively were judged better in flavour than pork sausage added citric acid (3) and pork sausage manufactured according to the standard recipe (1).
At both storage temperatures samples added citric acid were given the remark "oldish taste" by most panel members, and one of the panel members gave the remark "strange aftertaste" once. Samples from the rest of the groups were not noted as "oldish taste" until after storage for 28 to 35 days.

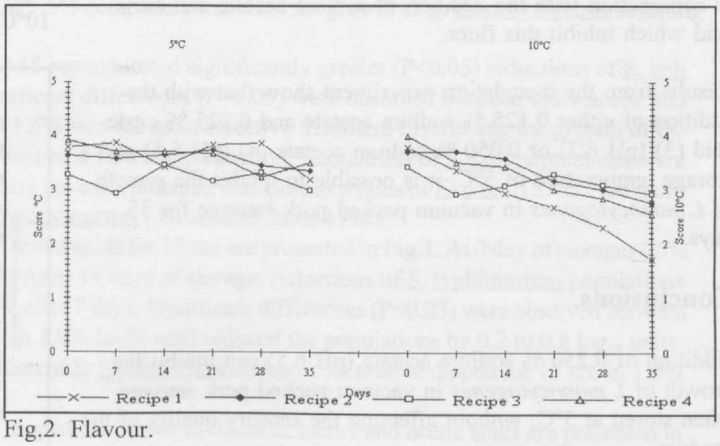

Fig.2. Flavour.

Odour:
The statistical analysis showed that pork sausage added citric acid (3) were judged lower in scores than the standard sausage (1) or sausages added 0.125 % or 0.250 % acetate.

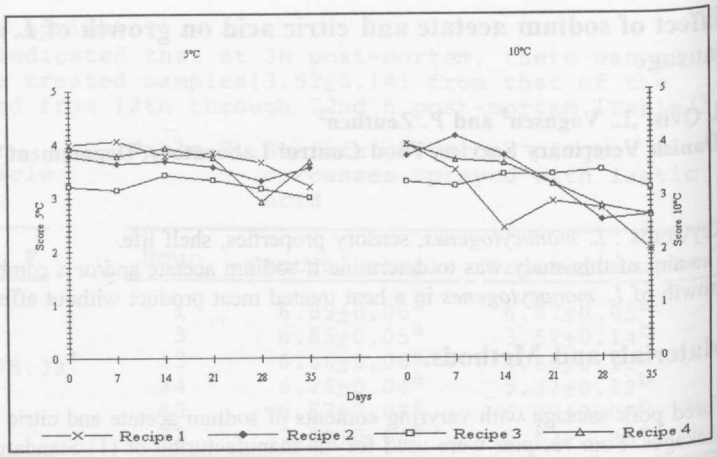

Fig.3. Odour.

Appearance:
Statistically, no difference was found in appearance, regardless of ingredient combinations. Overall, sausages stored at 10°C were given lower scores than if they were stored at 5°C.

Overall, addition of 0.125 % citric acid to pork sausage seems to reduce the sensory quality of the product. On the contrary the addition of sodium acetate increases the scores for flavour, odour and appearance and at the same time inhibits the microflora. The sensory quality of the products depends on the storage temperature. In contrast to the product stored at 10°C, the product stored at 5°C was not rejected during the storage period.

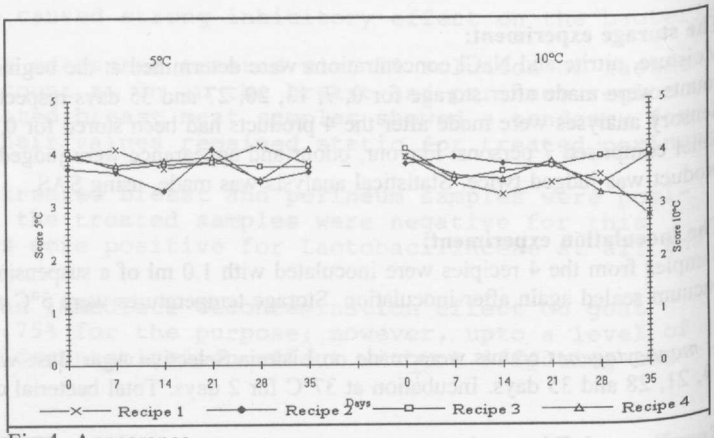

Fig.4. Appearance.

The inoculation experiment:

Growth of *L. monocytogenes* in the four products, stored at 5°C and 10°C, are shown in figure 5.

The storage temperature was an important factor in the inhibition of the pathogen. When stored at 10°C the addition of citric acid and sodium acetate could not inhibit the growth of *L. monocytogenes*. After storage for 14-21 days the amount of *L. monocytogenes* reached a level of 10^7-10^8 cells/g.

The growth curves for *L.monocytogenes* (Fig. 5) and the total bacterial counts (Fig. 6) are almost identical. Generally, the other flora had no inhibitory effect against *L.monocytogenes*. This could be caused by the low initial levels of the other flora in conjunction with the addition of sodium acetate and citric acid which inhibit this flora.

Results from the inoculation experiment show that with the addition of either 0.125 % sodium acetate and 0.125 % citric acid (3) (pH 6,2) or 0.250 % sodium acetate (4) (pH 6,5) and a storage temperature of 5°C, it is possible to inhibit the growth of *L.monocytogenes* in vacuum packed pork sausage for 35 days.

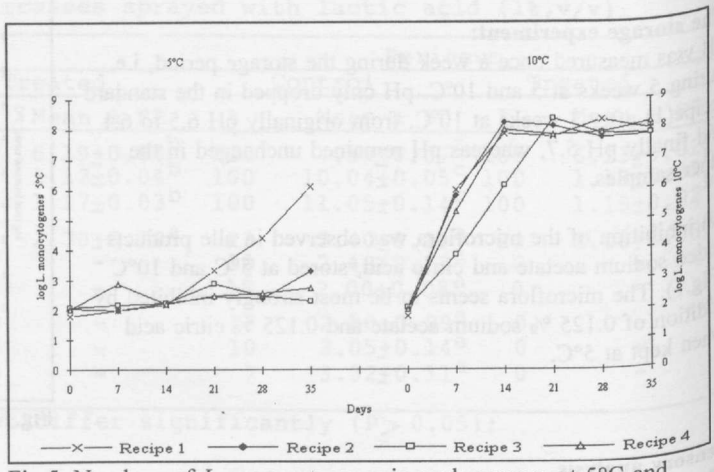

Fig.5. Numbers of *L. monocytogenes* in pork sausage at 5°C and 10°C.

Conclusions.

Addition of 0.250 % sodium acetate (pH 6,5) can inhibit the growth of *L.monocytogenes* in vacuum packed pork sausage, when stored at 5°C, without affecting the sensory quality of the product.

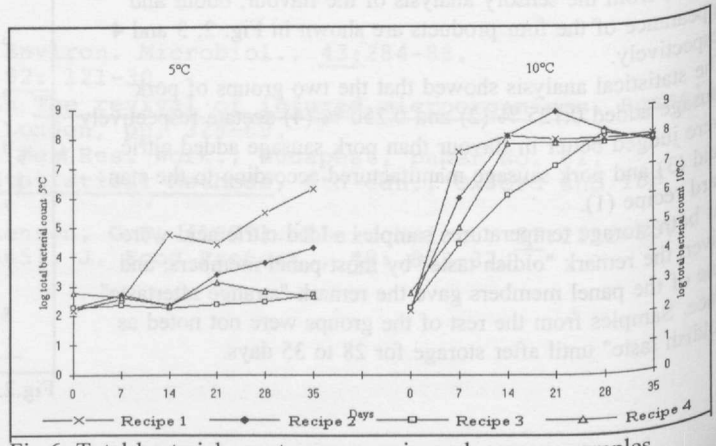

Fig.6. Total bacterial counts per gram in pork sausage samples.