The effect of different starter cultures in spreadable raw sausage

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SUMMARY: Spreadable raw sausages were prepared using different starter cultures including **Staphylococcus carnosus** and **Lactobacillus plantarum** (batch 2), **Lactobacillus curvatus + Micrococcus varians** (batch 3) and **Lactobacillus sake + Staphylococcus xylosus** (batch 4). Ripening was followed by measuring parameters including pH, firmness, colour, weight loss, a_w, density, composition of the microflora and organoleptic quality. - The results confirm the practical experiences, that when using starter cultures, there will be a better and qualitativly higher spreadable sausages: Without starter, the pH remained above 5,5. This resulted in unsatisfactory colour and flavour. Sausages prepared with starter cultures containing Lactobacillus differed only moderately in pH, spreadability, weight loss, density and microbial composition. Batch 2, inoculated with **Staphylococcus carnosus** and **Lactobacillus plantarum**, ranked best with respect to aroma and flavour, while pH drop was fastest in batch 4 containing **Lactobacillus sake**, and spreadability was best and weight loss lowest in batch 3 containing **Lactobacillus curvatus**. In no batch, undesirable microorganisms did reach levels of concern.

INTRODUCTION: Spreadable raw sausages are a popular meat product in Germany and account for about 30 % of the total production of fermented sausages. While the beneficial effect of starter cultures in the manufacture of dry sausages has been demonstrated in various studies, little information is available on the effect if different starter cultures in quality and safety of spreadable raw sausages.

MATERIAL and METHODS: The recipe was as follows: 50 % pork back fat, 30 % lean pork, 20 % beef. For each kilogram of product, the following ingredients were added: 24 g of nitrite curing salt (Corresponding to 96 mg sodium nitrite/kg), 3 g glucose, 5 g spices and 0,5 g sodium ascorbate.

After grinding, the chilled meat and fat was chopped in a Müller Cutter (Saarbrücken, Germany). Glucose, ascorbate, spices and the starter culture were then added. When the temperature reached 15°C, curing salt was added. The final temperature of the mixture in the cutter was 20°C. Batch 1 = without starter cultures; batch 2 = culture A containing 90 % **Staphylococcus carnosus** + 10 % **Lactobacillus plantarum**; batch 3 = culture B containing **Lactobacillus curvatus + Micrococcus varians** and batch 4 = culture C containing **Lactobacillus sake + Staphylococcus xylosus**.

The cutter was disinfected with an aldehyde-containing disinfectant after each batch. The mixture was filled in cellophane casings with 45 mm diameter. All sausages were placed into a

ripening room (H. Maurer and Söhne KG, Germany) and fermented at 22°C for one day and at 20°C for one more day. The relative humidity during fermentation was 86 %. On the second day, friction smoke was applied for 4 hours. Subsequently, the sausages were aged at 15°C and 80 % relative humitity for four weeks.

The following tests were carried out: The pH measured with digital pH-meter (Knick, Berlin). Firmness was measured with SUR Penetrometer PNR 8, Berlin (twenty measurements in the edge and core zone of the sausage, plunger 47,5 g, taper-tipped needles 2,5 g; temperature 20°C). The percentage weight loss was monitored throughout the experimental period. Water activity was determined using an a_w-meter produced by the ISO Company, Basel, Switzerland. Specific gravity was measured by weighing the sausage in air and in water. Flavour was assessed by a panel of four persons.

RESULTS and DISCUSSION: Fig. 1 shows the time course of pH in batches 1-4.

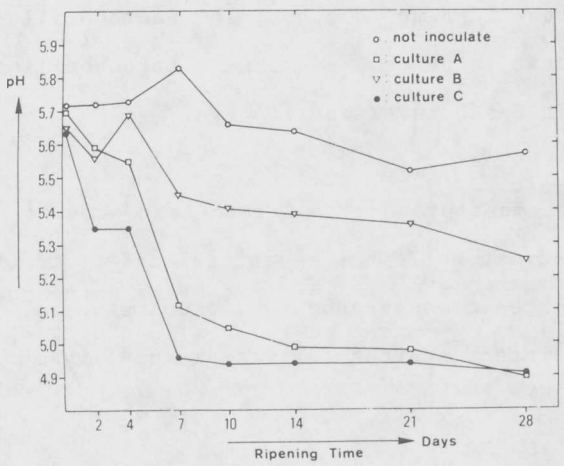

Fig. 1. The influence of different starter cultures on pH value

The uninoculated batch of spreadable sausage ha the highest pH-values: After four weeks ripeni the pH was about 5.6. Culture B lowered the pH value slowly: Only after 28 days, pH reached 5.3. With culture A, the pH value dropped to 5 within 7 days and to 4.9 after 4 weeks. With culture C the rate of pH decrease was even fa ster than that of culture A, pH 5.35 being reached within 2 days. All batches had seen pr pared with the same addition of sugar.

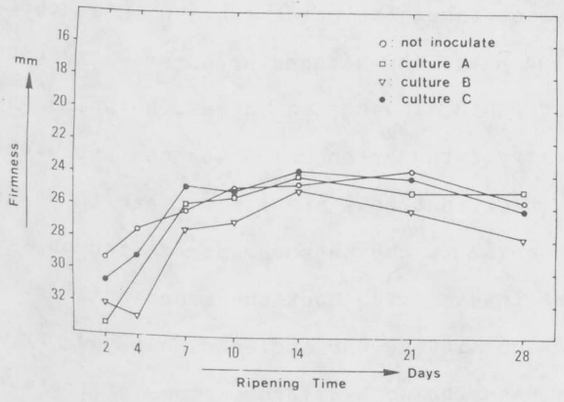

Fig. 2. The influence of different starter culture on firmness

Fig. 2 shows firmness measurement with distance penetrometer. With decreasing depth of penetration, firmness increased. Firmness increased until the 7th day. Consistency was softest with starter culture B. This batch was very well spreadable and the other batches were sufficiently spreadable. In other experiments we found that spreadability was good when the penetrometer value was 18 mm or more.

There were no great differences between the batches concerning colour. The maximum in red colour was reached after 14 days.

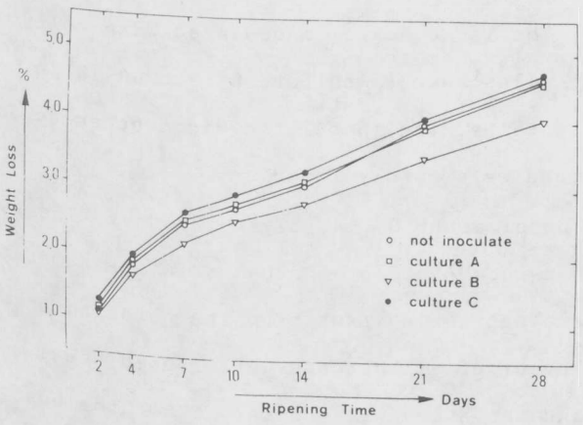

Fig. 3. The influence of different starter culture on weight loss

Fig. 3 represents the weight loss of the batches with different starter culture. The batch which was inoculated with culture C lost a little more weight loss than did the uninoculated batch and the batch inoculated with culture A. The weight loss of the batch inoculated with culture B was smallest. This corresponded to the smaller decrease in pH and the slightly better spreadability of this batch. However, the total weight loss after 28 days was as little as 4 %.

The water activity decreased from an initial value of 0.953 to 0.951 after one week, to 0.948 after two weeks and to 0.944 after four weeks, with only small differences between the batches.

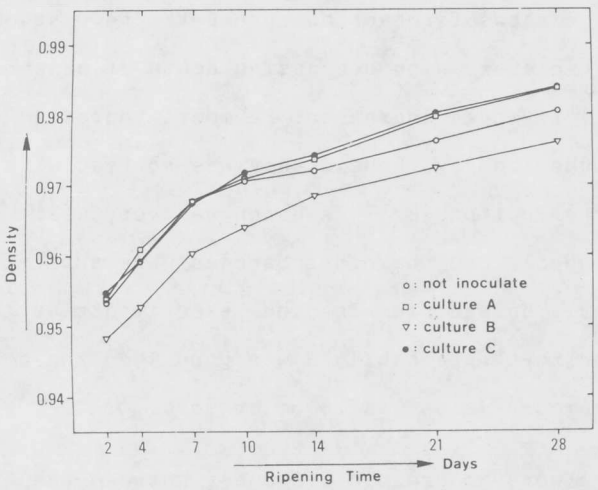

Fig. 4. The influence of different starter culture on density

Fig. 4 shows the density in relation to the ripening time. It increased with prolonged ri pening time. The batches prepared with cultur A and C had almost equal densities while the density of the batch which was not inoculated was lower, but only after more than 10 days. The density of the batch prepared with culture B was lowest throughout the ripening time. Lower density values indicate that gas may have been formed by microorganisms or that les gas had been consumed by microorganisms or lo by diffusion.

The development of the microflora during ripening of spreadable raw sausages was investigated also. In the uninoculated batch, the "spontaneous" lactic acid bacteria reached 10^7/g only af ter 7 days, and pseudomonaes decreased only slowly. The lactobacilli inoculated with culture or B reached 10^8/g after about 4 days while **Lactobacillus sake** in culture C reached 10^8/g within 2 days. This starter culture caused lowest pH value. The inoculated **Micrococcaceae** did not multiply but remained dominant. **Enterobacteriaceae** were hardly found.

Spreadable raw sausages were assessed by a sensory panel after 8, 14, 21 and 28 days. The sau sages were not packed and the storage took place in a room of 15°C and 80 % relative humidity After seven days the colour was pink, and there was a decreasing rank from the batch with cul ture A, C, B and with no inoculum. The taste and flavour of all batches were ranked equal. After 14 days, the uninoculated batch turned pale and the batch with culture B had the best colour. The batch without starters had a slightly oily taste and was not "fresh" anymore. Aft 28 days, its colour was yellow-pink while the batch with culture A was pink-red, the batch wi culture B was a little less pink and the batch with culture C was not quite as red as batch with culture A. Sausages prepared without starters were unacceptable because the taste was be The other batches had a good aroma and flavour, and the batch of culture A was judged best.

CONCLUSIONS: The results confirm the practical experience that starter cultures improve the quality of spreadable raw sausages. Also, the production risk is higher when no starter cultu res are used. There were only small differences between the starter cultures. Use of culture containing 90 % **Staphylococcus carnosus** + 10 % **Lactobacillus plantarum** resulted a little bit better sensory quality than the other cultures tested. **Lactobacillus sake** lead to the most rapid and extensive drop. Undesirable microorganism did not grow to levels of concern in any batch.