THE EFFECT OF LACTIC AND ACETIC ACIDS ON THE SHELF-LIFE OF FRESH SAUSAGE

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Background

In recent years there has been a new tendency for the food industry to use organic acids in meat products, this having been brought about because both the industry and consumers are increasingly concerned about producing foodstuffs which are microbiologically and chemically safe. Although organic acids have been used as food preservatives for millennia it is only relatively recently that their effects and mode of action have been investigated in detail, and in the meat industry the use of organic acids is only just beginning because of lack of information on when and how to use these naturally occurring preservatives.

The use of naturally occurring organic acids has been studied by some authors (Holzapfel, Geisen & Shillinger, 1995; Smulders & Greer, 1998; Nieto-Lozano, et al., 2002 with the intention of providing greater microbiological and chemical safety for meat products.

According to Frazier & Westhoff (1993) acetic acid is more effective in inhibiting yeasts and bacteria than filamentous fungi, the efficiency of inhibition increasing with decreasing pH which favors the presence of non-dissociated acid. Lactic acid is one of the principle organic acids formed during natural fermentations and is widely distributed in nature (Silveira, Fries & Terra, 2002) and considered a substance Generally Regarded As Safe (GRAS), whose anti-microbial action is mainly due to the destruction of the cell membrane which results in increased permeability, accumulation of ions and reduced cellular pH cause by the dissociation of hydrogen ions from the organic acid (Jay, 2000).

The use of organic acids in meat products is a new option for the production of microbiologically and chemically safe foodstuffs, because of which it is important to scientifically evaluate these substances for their ability to extend the shelf-life of meat products.

Objectives

Our objective was to evaluate the use of lactic and acetic acids as preservatives and shelf-life extenders of refrigerated fresh sausage.

Methods

The ingredients %w/w of the sausages were: commercially produced refrigerated pork (83.01); pork fat (9.23); cold water and ice (4.62); antioxidant (0.92); sodium chloride (0.47); sodium nitrate curing agent (0.46) and spices (1.2).

The sausages were made by mincing the pork using an 8 mm disk, adding the other ingredients, homogenizing and packing the meat mixer into natural sausage skins made from sheep intestine, the finished sausages being refrigerated at 4°C.

To compare lactic and acetic acids as preservatives we prepared batches of sausages containing 0 (control), 2, 3.5 or 5% (w/v) lactic or acetic acid, the sausages being stored at 4°C. Duplicate samples were taken twice a week for three weeks for microbiological an physico-chemical tests and the results analyzed using the student's t-test.

The number of mesophiles and lactic acid bacteria were counted according to the methods of Silva, Junqueira & Silveira (1997), coagulase positive Staphylococcus by the American Public Health Association (ASM, 1984) method and psychrophiles by the method described by Silva, Junqueira & Silveira, (1987) of 25 grams, sausage samples being serially diluted 10^{-1} to 10^{-5} in 0.1% saline.

The physico-chemical parameters investigated were pH using a DM-20 pH-meter (DIGIMED, São Paulo, Brazil) with a probe-type electrode, peroxide index according to the methods of the Brazilian National Animal Reference Laboratory (Laboratório Nacional de Referência Animal (LANARA), 1981) and acidity (Terra & Brum, 1988).

Results and discussion

For sausages with added acetic acid the mesophile count remained constant from the first count and for sausage with added lactic acid the count showed a one-log increase only in the third week of storage, while control samples without added organic acids showed a two-log increase in the second week.

The lactic acid bacteria count for samples from sausages with added acetic acid showed a one-log increase at the beginning of the second week (sample 5) and remained constant until the end of the shelf-life (three weeks). The count for samples with added lactic acid also showed a one-log increase at the beginning of the second week (sample 5) but also a one-log increase for each subsequent sample, while the control (no added organic acids) increased by two-logs starting at the end of the first week (Sample 2) The psychrophile and coagulase positive staphylococcus counts for the control sausages were similar, showing a two-log increase from the end of the first week (sample 2), while samples containing added organic acids showed a one-log decrease in the numbers of both these types of bacteria, with acetic acid producing the most pronounced effects.

These results agree with those of Brul & Coote (1999), who showed that because organic acids in solution exist in a state of pH-dependent equilibrium between the associated and disassociated acid they can inhibit microbial growth by destruction of the cell membrane, inhibition of metabolic reactions, accumulation of ions and the production of intracellular stress through the alteration of homeostasis and pH.

The results of the physical-chemical analyses are given in Tables 1 and 2. There was no significant difference in acidity when higher concentrations of acetic acid were used (Table 1). For pH, we found that some of the comparisons were without significant differences, especially for the comparison between 2% lactic and acetic acids, the same being true for peroxide index (Table 1).

Conclusions

Lactic and acetic acids inhibited the growth of bacteria under the conditions used, while the physical-chemical factors measured changed in relation to the concentration and type of acid used. These results indicate that there is a need for further studies in this area.

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Table 1. Comparison between peroxide index and acidity means for sausages with and without the addition of lactic or acetic acid. The control contained no added lactic or acetic acid. The numbers in each cell represent Student's t-test values, those in boldface referring to acidity, those in normal text to peroxide index.

	Acidity						
Peroxide index	Control	Lactic acid (%)			Acetic acid (%)		
		2.0	3.5	5.0	2.0	3.5	5.0
Control	—	8.352*	15.216*	12.563*	**37.645***	**20.742***	**16.549***
Lactic acid (%) 2.0	5.176*	—	**10.789***	**9.602***	35.031*	19.261*	15.478*
3.5	3.749*	2.648*	—	**2.924***	17.834*	15.706*	13,144*
5.0	3.463*	4.703*	0.860ns	—	**9.156***	**13.211***	**11.63***
Acetic acid (%) 2.0	3.966*	1.321ns	0.651ns	1.434ns	—	**9.385***	**8.688***
3.5	3.083*	7.885*	1.966ns	1.283ns	2.353*	—	**1.749ns**
5.0	2.053ns	5.923*	2.838*	2.394*	3.113*	1.696ns	—

*significant at the 5% level; nsnot significant

Table 2. Student's t-test values for the comparison between pH means for sausages with and without the addition of lactic or acetic acid.

	Control	Lactic acid (%)			Acetic acid (%)		
		2.0	3.5	5.0	2.0	3.5	5.0
Control	—	7.494*	20.465*	22.615*	18.313*	20.2185*	20.094*
Lactic acid (%) 2.0		—	2.082ns	3.052*	0.736ns	1.653ns	1.887ns
3.5			—	5.520*	9.172*	3.099*	1.036ns
5.0				—	18.276*	11.595*	6.6881*
Acetic acid (%) 2.0					—	11.675*	7.918*
3.5						—	1.746ns
5.0							—

*significant at the 5% level; nsnot significant