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SOME PROBLEMS ROUND THE PRESERVATION AND STORAGE OF "HOUSEHOLD LIVER SAUSAGE".

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1. Introduction.

The term "household liver sausage" includes a large number of rather cheap products. These products contain, besides liver and fat, cooked offals and rather much cooked connective tissue. The broth, obtained by the cooking of the offals and the connective tissue, is added to the sausage-paste too.

Usually these liver sausages are filled in natural casings (runner).

The casings are kept white by cooling the sausages after cooking in cold water during several heures.

Very different qualities of these household liver sausages are manufactured on large numbers by the butchers in the Netherlands.

In our institute research is done on this kind of sausage. For the greater part the investigations have reference to the storage of liver sausage. In this paper some results of these investigations, which are obtained till now, are mentioned.

2. The storage of liver sausage.

To keep this liver sausage fresh, longer than some days, without decrease of quality, is a problem in our country, especially during the summer season. For this reason the following storage methods are tested in our institute:

- the storage under refrigeration ($+4^{\circ}\text{C}$);
- the storage in a brine;
- the storage when frozen (-18°C) .

The first method has appeared to be not well usable. Under conditions with a low relative humidity, the casing darkened and the sausages lost weight (up to 20% in a week). Under conditions with a high relative humidity, a heavy growth of psychrophilic micro-organisms appeared on the casings.

Therefor, impermeable plastic casings (Saran and Rilsan) are studied now. The growth of sporeforming anaerobic bacteria is a special point of investigation (1).

The other two methods have appeared to be of much better use, so they are tested more in detail.

3. The storage of liver sausage in a brine.

Liver sausages can be stored in a salt solution (2-4%). The advantage of this method is: the casings keep white and there is no loss of weight. The brine, however, extracts the soluble parts of the sausage through the casing. So the brine forms a good medium for micro-organisms.

For this reason the brine gets spoiled very quickly, even at low temperatures. The spoilage can be prevented, during sometime, by the use of a preservative. The use of boric acid is still allowed in the Netherlands (2). As there are in general objections against the use of boric acid in food-stuffs (3 and 4), the possibilities of preservatives which can replace boric acid, are checked. The results of some experiments with benzoic acid and sorbic acid are communicated.

4. Activity of boric acid, benzoic acid and sorbic acid.

The preserving activities of these acids have been compared in a 4% salt-solution at 10°C. Some fresh liver sausages, filled in natural casings (runner), were placed in these brines. The brines and the sausages were examined at several times.

4.1 First experiment.

Four brines were prepared with the following composition:

- I 4% NaCl + 0,1 % benzoic acid (pH = 4,9),
- II 4% NaCl + 0,1 % sorbic acid (pH = 4,8),
- III 4% NaCl + 0,1 % boric acid (pH = 7,0),
- IV 4% NaCl (control) (pH = 7,1).

After 6 days the brines and the sausages were examined. The results are mentioned in tabel I.

Tabel I.

Examination of brine and liver sausage after storage during 6 days at 10°C.

Brine	Condition of the brine	Condition of the casing	Taste of the sausage.
I	clear with a good smell	good	little sourish (benzoic acid).
II	clear with a good smell	a trace of bacterial growth	good
III	troubled with a off-odour	heavy bacterial-growth	off-taste
IV	troubled and spoiled	spoiled and partly wasted	spoiled

Conclusion: Benzoic acid and sorbic acid are better suited for the preservation of liver sausages in brine than boric acid, when used in the same concentration (0,1 %).

4.2. Second experiment.

In the second experiment the concentrations of benzoic acid and sorbic acid are reduced to 0,02 % and the concentration of boric acid is raised to 0,50 %. The liver sausages are stored in the following solutions:

- V 4% NaCl + 0,02 % benzoic acid (pH = 5,4),
- VI 4% NaCl + 0,02 % sorbic acid (pH = 5,5),
- VII 4% NaCl + 0,50 % boric acid (pH = 6,6),
- VIII 4% NaCl (control) (pH = 7,6).

During the storage the following qualities were examined:

- the odour of the brine (tabel II, A) ;
- the condition of the casings (tabel II, B) ;
- the clearness (optical transmission) of the brine, the optical transmission was measured with a photo-electrical colorimeter (tabel III) ;
- the amount of bacterial growth in the brine, the number of bacteria was counted on nutrient-agar after incubating during 5 days at 37°C (tabel IV).

At the end of the experiment the taste of the sausages was examined (tabel II, C).

Tabel II.

Odour of the brine (A) and condition of the casings (B) during the storage of liver sausages in brines and the taste of the liver sausages (C) after the storage.

Time (days)	Brine V	Brine VI	Brine VII	Brine VIII
2	good	good	good	good
4	good	good	good	A: a little off - odour. B: good
6	good	A: sourish B: good	good	A: off -odour B: slimy
8	good	A: off-odour B: a little slimy C: good	good	A: spoiled B: wasted C: off taste
11	good	-	A: off-odour B: good	---
13	A: off-odour B: good	-	A: off-odour B: good	---

15	A: spoiled B: good C: good	-	A: off-odour B: good C: good	-
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Tabel III

Clearness (optical transmission) of the brine during the storage of liver sausages.

Time (days)	B r i n e			
	V	VI	VII	VIII
0	100 %	100 %	100 %	100 %
4	89 %	95 %	98 %	71 %
6	82 %	72 %	97 %	65 %
8	83 %	42 %	90 %	20 %
11	85 %	-	76 %	-
13	74 %	-	68 %	-
15	51 %	-	60 %	-

Tabel IV

Number of bacteria in 1 ml of the brine during the storage of liver sausages in the brine.

Time (days)	B r i n e			
	V	VI	VII	VIII
0	50	50	50	50
4	3.000	5.000	300	100.000
6	6.500	40.000	500	200.000
8	3.000	150.000	-	1.300.000
11	20.000	-	10.000	-
13	120.000	-	260.000	-
15	2.000.000	-	630.000	-

Sorbiini happo: Keinika

Kunon suola? Ascorbiini;

Bintat, Niskin.

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4.3 Discussion and conclusions.

It has appeared, that benzoic acid and, in a less degree, sorbic acid, increase considerably the keeping qualities of liver sausages in brine. Prolonged experiments revealed that, if in addition the temperature was reduced to 4°C, a concentration of 0,05 % benzoic acid, kept the liver sausages in fresh condition up to four weeks. Details of these experiments are not mentioned here.

With this method the storage of liver sausage is not possible longer than four weeks.

A drawback of this method is the decrease of flavour and protein content of the liver sausage, as a result of the extraction of soluble substances.

5. The storage of liver sausage in frozen condition.

Just like other foodstuffs, cooked liver sausage can be stored in frozen condition at - 18°C.

The disadvantage of this method is the change in structure and the typical flavour of liver. This drawback can be prevented by freezing the liver sausage in raw condition and by cooking it after thawing. The qualities, of the liver sausage, treated in this way, are considerably better than if frozen after cooking.

6. References.

- (1) Steinke, P.K.W. and Foster, E.M., Botulinum toxin formation in liver sausage. Food Research, 16 (1951), 477 - 484.
- (2) The "Vlees- en Vleeswarenbesluit (Warenwet)" (Meat- and meatproducts decree (Foodact), permits 0,3 % boric acid in liver sausages.
- (3) Reith, J.F. and van Genderen, H., De toelaatbaarheid van boorzuur als conserveermiddel in levensmiddelen. Conserva, 4 (1955-56), 326 - 331.
- (4) Mossel, D.A.A. and Eggelaar, G., Noodzakelijkheid en vervangbaarheid van boorzuur als conserveermiddel in eiwitrijke voedingsmiddelen. Conserva, 5 (1956-57), 7 - 12.

7. Summary.

" Household liver sausage", stored without any precautions, deteriorated within several days.

A 4%-salt-solution with the addition of a preservative, made it attainable to store the liver sausage up to 4 weeks. An investigation is mentioned in which the effect as a preservative of boric acid, benzoic acid and sorbic acid has been compared. The best results were obtained with benzoic acid.

Storage longer than 4 weeks was only possible in frozen condition. It is recommended to freeze the liver sausage in raw condition and to cook it after thawing.

Resumé:

La qualité de " boudin blanc ordinaire's détériore quand le boudin est gardé, sans précautions, plus longtemps que quelques jours. Dans une saumure (4%), à laquelle une substance de preservation est additionné, c'est possible de tenir le boudin blanc jusqu' à quatre semaines. Une investigation est communiquée, comparant l'acide borique, l'acide benzoïque et l'acide sorbique.

Les resultats meilleurs étaient réalisable avec l'acide benzoïque. Pour la conservation plus longtemps que 4 semaines, seulement la congélation (-18°C) est réalisable. C'est recommandable à congeler le boudin blanc cru et le bouillir après dégeler.

Zusammenfassung:

Die Qualität gewöhnlicher Leberwurst deterioriert ohne spezielle Vor-sorge nach einigen Tagen.

Die Bewahrung bis vier Wochen ist möglich in einer 4-prozentiger Lake mit Zusatz einer Konservierungsmittel. Die folgende Konservierungs-mitteln sind untersucht worden: Borsäure, Benzoëssäure und Sorbinsäure. Die beste Ergebnisse werden erreicht mit Benzoëssäure.

Die Bewahrung langer dann 4 Wochen ist nur möglich in tiefgefrorenen Zustand. Es ist aber empfehlungswert die Würste roh ein zu frieren und erst nach das Auftauen zu brühen.