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THE EFFECT OF FREEZE STORAGE ON THE WATER BINDING CAPACITY OF THE RAW MATERIALS OF COOKED SAUSAGE

E. PUOLANNE and P. TURKKI

University of Helsinki, Institute of Meat Technology
Viikki, SF-7100 Helsinki, Finland

INTRODUCTION

Freezing of meat is the best way to keep it for a longer period of times thus preserving the flexibility of use after thawing. Major problems that may arise are freeze burn, fat oxidation and a partial loss of water binding capacity if meat is kept longer in storage. All these defects have a more or less profound impact on the sensory quality of meat or meat products made of frozen meats.

Miller et al. (1980) noted that the water binding capacity of beef and pork decreases and the solubility of proteins and the emulsifying capacity decrease when the storage time is increased from 1 to 37 weeks. The thaw loss increased and simultaneously the dry matter content and the amount of solubilized nitrogen increased during that time. The water binding capacity of cooked sausage decreased when the freeze storage time of the meat raw materials increased.

The aim of this project was to study the effect of freeze storage of meats on the water binding capacity (WBC) of cooked sausage.

MATERIALS AND METHODS

Coarsely chopped lean beef (i, 7.7 % fat), lean pork (ii, 9.9 % fat) 50/50 pork trimmings (iii, 50.7 % fat), and pork back fat (79.4 % fat) were stored at -18 °C for 12 months in the type of cartons normally used for freeze storage of meat. Samples were taken each month, and six different kinds of sausages were made using a laboratory sausage method. Variables were: lean beef (i) + pork back fat; lean pork (ii) + pork back fat; pork trimmings (iii). Each variable was made with and without added phosphate.

The sausages were made according to the following formulations:

		fat %	with phosphate	without phosphate
I	lean beef (g) or	7.7	50	50
I	lean pork (g)	9.9	50	50
I	pork back fat	79.4	55	55
II	or pork trimmings	50.7	105	105
	water (g)		120	100
	NaCl (g)		4.1	3.7
	polyphosphate (g)		0.6	-
			229.7	208.7

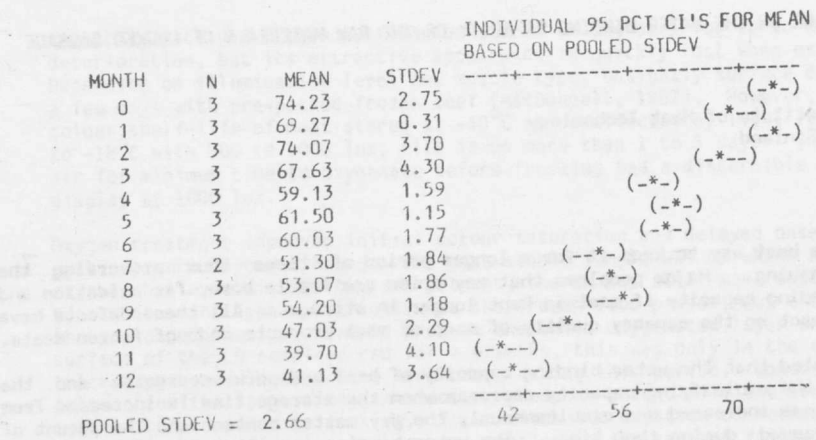
In the variables marked I the meat mass was a mixture of lean and pork back fat but in variables II the lean and fat were derived from pork trimmings. A large water addition was used in order to gain measurable amounts of released water in each test.

The WBC was measured using the laboratory sausage method of Puolanne and Ruusunen (1978). Each test was run in triplicate. The sausage mass was chopped in a Moulinex homogenizer, stuffed into a casing and cooked for 40 min at 75 °C up to an internal temperature of 72 °C. After cooking, the sausage was peeled and the excess water released was removed.

WBC was determined as the difference between the weight of the stuffed sausages (weight of casing excluded) and the weight of the cooked and peeled sausages after the removal of released water and jelly. No fat was released. These weight differences were subtracted from the 120 (or 100) grams of water added to the original recipe and represent the weight of water retained by the sausage after cooking and chilling. The results were expressed as g water/100 g meat.

RESULTS AND DISCUSSION

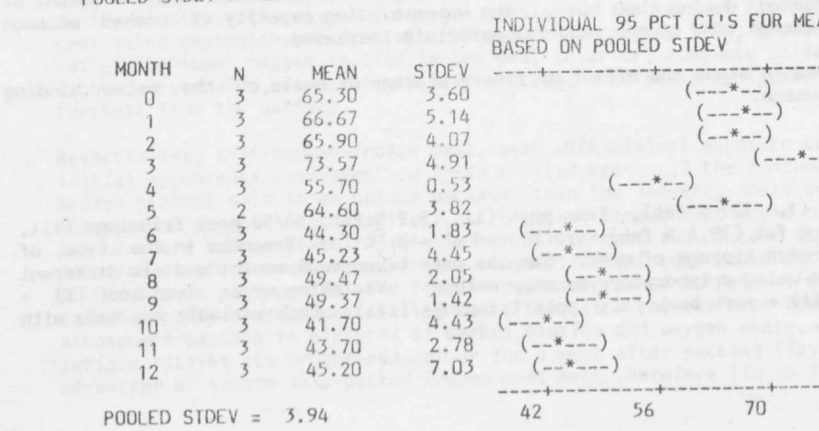
With added phosphate the water binding decreased with lean beef (i) linearly (r= -0.947) 45% in 12 months (figure 1). With lean pork there were no linear decrease during the first 5 months. After that came a steep decrease to a level at which the WBC stayed during the rest of the test period



MONTH	N	MEAN	STDEV
0	3	74.23	2.75
1	3	69.27	0.31
2	3	74.07	3.70
3	3	67.63	4.30
4	3	59.13	1.59
5	3	61.50	1.15
6	3	60.03	1.77
7	2	51.30	1.84
8	3	53.07	1.86
9	3	54.20	1.18
10	3	47.03	2.29
11	3	39.70	4.10
12	3	41.13	3.64

POOLED STDEV = 2.66

Figure 1.
The water binding capacity (WBC, g water/100 g meat) of lean beef after 0-12 months of freeze storage. Cooked sausage with phosphate.



MONTH	N	MEAN	STDEV
0	3	65.30	3.60
1	3	66.67	5.14
2	3	65.90	4.07
3	3	73.57	4.91
4	3	55.70	0.53
5	2	64.60	3.82
6	3	44.30	1.83
7	3	45.23	4.45
8	3	49.47	2.05
9	3	49.37	1.42
10	3	41.70	4.43
11	3	43.70	2.78
12	3	45.20	7.03

POOLED STDEV = 3.94

Figure 2.
The water binding capacity (WBC, g water/100 g meat) of lean pork after 0-12 months of freeze storage. Cooked sausage with phosphate.

MONTH	N	MEAN	STDEV
0	2	63.40	0.85
1	3	51.73	6.54
2	3	50.07	10.81
3	3	48.97	13.37
4	3	48.33	1.10
5	3	39.00	2.46
6	3	32.10	3.44
7	3	23.90	2.25
8	3	36.13	1.71
9	3	36.70	1.55
10	3	26.90	4.04
11	3	29.20	2.91
12	3	35.50	2.71

POOLED STDEV = 5.66

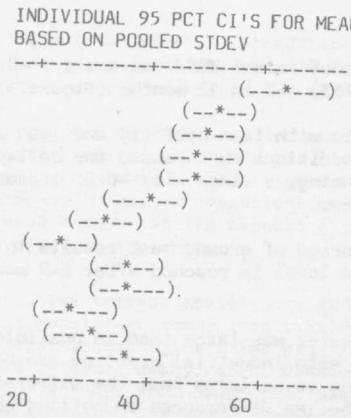


Figure 3.
The water binding capacity (WBC, g water/100 g meat) of pork trimmings after 0-12 months of freeze storage. Cooked sausage with phosphate.

MONTH	N	MEAN	STDEV
0	2	26.50	3.39
1	3	19.70	3.08
2	3	23.00	3.76
3	3	23.37	3.25
4	3	20.10	3.36
5	3	26.87	3.19
6	3	27.07	0.95
7	2	18.10	0.99
8	2	26.70	2.40
9	3	19.80	3.47

POOLED STDEV = 3.02

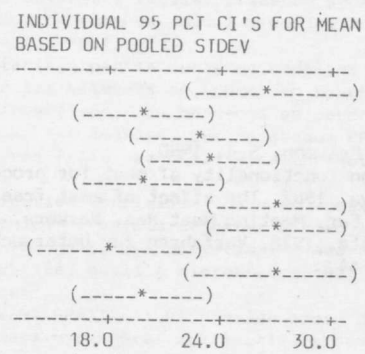


Figure 4.
The water binding capacity (WBC, g water/100 g meat) of lean beef after 0-9 months of freeze storage. Cooked sausage without phosphate.

MONTH	N	MEAN	STDEV
0	1	36.50	*
1	3	27.67	1.78
2	3	28.80	0.75
3	3	36.10	4.68
4	3	30.63	1.89
5	2	31.80	2.55
6	3	31.93	3.09
7	3	26.33	4.65
8	3	26.90	2.19
9	3	33.27	2.93

POOLED STDEV = 3.01

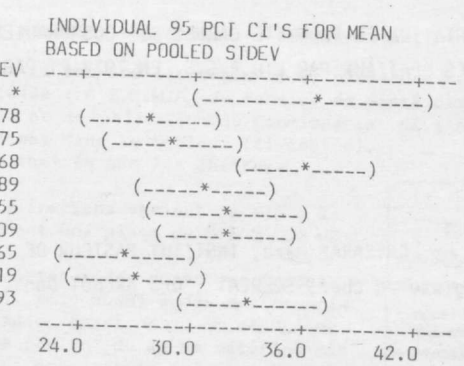


Figure 5.
The water binding capacity (WBC, g water/100 g meat) of lean pork after 0-9 months of freeze storage. Cooked sausage without phosphate.

MONTH	N	MEAN	STDEV
0	3	51.53	2.20
1	3	41.57	2.84
2	3	36.93	8.55
3	3	40.77	2.40
4	2	38.05	6.29
5	3	38.07	3.07
6	3	22.73	1.43
7	2	23.80	2.83
8	3	22.53	4.53
9	2	23.00	3.11

POOLED STDEV = 4.24

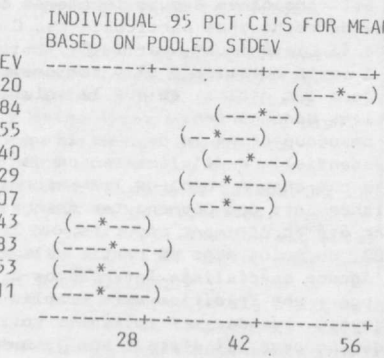


Figure 6.
The water binding capacity (WBC, g water/100 g meat) of pork trimmings after 0-9 months of freeze storage. Cooked sausage without phosphate.

(figure 2). The correlation coefficient WBC/time was r = -0.813. With pork trimmings the WBC decreased quite linearly (r= -0.753) 44% in 12 months (figure 3).

Without added phosphate the tests with lean beef (i) and lean pork (ii) gave inconsistent results, maybe due to too large water additions that caused the collapse of the sausages during cooking (figures 4 and 5). With pork trimmings a linear (r= -0.869) decrease (55%) took place over 9 months, after which the test was terminated.

It was concluded that freeze storage of ground meat results in a strong decrease in water binding capacity. With pork the minimum level is reached after 6-9 months, but with beef the decrease is linear during at least 12 months.

Because the amount of added water was large than is possible in the industrial preparation of sausages, no direct comparisons with industrial practice can be made. In industrial production the safety margin of the water binding is so large that the differences in WBC caused by freeze storage are not shown as released water but as differences in gelling ability and consistency. Later tests will show whether these effects of freeze storage can be noticed as quality deterioration in sausages made according to normal industrial formulation.

LITERATURE

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