AN ATTEMPT TO EXTEND the BLOOD PLASMA STORAGE PERIOD at CHILLING ENVIRONMENTAL TEMPERATURE

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INTRODUCTION

The use of plasma in manufacturing of edible meat products as well as evaluation of the functional properties of its proteins and indication of the factors influencing their behaviour and technological effectiveness when incorporated in receipes of meat products, mainly fine comminuted - emulsified ones were described by many autors./1,2,4,5,6,7,8,10,11,12,13, 17, 18/.

Blood plasma being extremely perishable by-product requires effective methods of preservation and for short storage period say 1-2 days quick chilling to 0-4°C is considered sufficient, while fast so called contact freezing and/or spray-drying for long period of storage /3 - 12 months/ is required. Both techniques of preservation above mentioned are high energy consuming and therefore very expensive.

Due to the fact that the use of daily and/or during one shift collected quantity of the blood plasma for appropriate manufactured products is commonly impossible and could not be synchronized, plasma must be preserved by applying any of the available and/or locally applicable method. Cooling protects the blood plasma against mainly bacterial deterioration for not sufficiently long time and from technological and economical points of view the necessity of extention of the keeping storage period for 2-4 days longer at chilling environmental temperature than at present before the stock could be used for processed meat products manufacturing, mainly considering economics of the use of such by-product as a meat tissue protein substitute, seems obvious and does not require any special justification.

Therefore, the aim of this research was to elaborate and to evaluate the comparatively low-energy consuming technology of lengthening of the chilling storage period of this source of protein.

MATERIAL and METHODS

Three experiments were performed using four batches of the experimental material each time. A batch consisted of 3.0 litres of freshly obtained, in commercial condition, swine blood plasma and the experiment was designed as shown in Table 1 using sodium nitrite /$NaNO_2$/ and sodium ascorbate as preservatives whose effectiveness against deterioration of the blood plasma kept in glass containers under chilling condition of storage at 0-4°C was assessed.

TABLE 1 LAYOUT of EXPERIMENT

B A T C H No.	Amount of preservatives added /ppm/	
	Sodium nitrite	Sodium ascorbate
0 = control	0.00	0.00
I = experimental	50.00	150.00
II = "	100.00	300.00
III = "	150.00	450.00

The proteolytic direction and dynamics of the protein content in the control batch /stored without addition of any preservatives/ and the batches of the blood plasma with the mixture of preservatives added were assessed, each 24 hours of refrigerated storage, on the basis of determination of the following physical and chemical putrefaction indicators: density, dry matter and pH, crude protein by Kjehldal method /N x 6.25/, ammonia /3/ and amino /16/ nitrogens and hydrogen sulphide /14/. The level of residual nitrite and protein precipitation was also determined./9/. As could be seen from the data presented in Table 1 the amount of the preservatives used are matching those contemporary most commonly used for curing of meat which allows direct incorporation of the preserved plasma as a component of any sort of comminuted sausage batter preparation and/or canned meat product manufactured such as for example patties.

RESULTS and DISCUSSION

The density and the dry matter content of either the control or the experimental batches of blood plasma did not change significantly /P = 0.05/ during 8 days of the storage period./Data not provided/.
The preservatives used did not influence the dynamics of pH changes of plasma, which dropped after 24 h. of storage and during the following days, up to the 8th, the alkalization, though not statistically significant, was observed, most probably as a result of ammonia accumulation. TABLE 2, Fig. 1. It should be, stressed however that pH of the plasma could not be considered as an indicator of the deteriorative processes because supposingly strong buffering sistem existed in plasma, which does not allow, using pH to determine the degree of the alkalization which should have correlated with accumulation of ammonia. After 48 h. the pH of plasma is practically stable up to the end of storage, while amount of NH_3 increases significantly. Fig. 3

As it was predicted the content of ammonia nitrogen after slight drop between 24-48th h. of storage increased along with storage period passing and the quantitative accumulation, both daily and between the experimental batches of plasma, were statistically significant./P = 0.05/ Table 2 and 3 and Fig.3. The gratest accumulation of NH_3 was observed in plasma preserved with addition of the highest level of the preservative used, which is difficult to explain.
The level of amino nitrogen content in plasma stored at 0-4 °C showed slight daily increase up to the 5th day of storage inclusive and then proteolysis proceeded very fast, most probably as a result of the microbial metabolism. Table 2. Fig.4.
Results of the qualitative determination of H_2S shown in Table 2 confirm preservative effecti veness of the nitrite + natrium ascorbate especially when the doses used were 100 + 300 ppm and 150 + 450 ppm, respectively. In the control batch of the plasma hydrogen sulphide was quantitavely determined after 5 days of storage, while in batch No.II and III only after 7 -8th days.
As far as nitrite is conserned it seems that $NaNO_2$ reacts with plasma components similarly as with meat tissuebecause the initialy added amounts are decreasing relatively very fast. Data presented in Table 2 and in Fig.2 show that the amount of the residual nitrite after 8 days of storage was 12.8, 7.8 and 4.1 fold smaller than the initially added to the plasma of batches No.I, II and III, respectively. It could be therefore concluded that refrigerated plasma preserved additionaly by the dose of nitrite and natrium ascorbate used and considering usual level of the meat tissue protein substitution by this sort of proteine i.e. approx. 5-10% can not influence the amount of residual nitrite in the products manufactured.

CONCLUSIONS

1. By addition of 150 ppm nitrite + 450 ppm natrium ascorbate to the blood plasma the storage period at chilling environmental temperature i.e. 0-4 °C could be extended 2 - 3 times i.e. from 2-3 days to 6-8 days.

2. The pH could not be considered as an indicator of the advancement of deteriorative processes in plasma stored at chilling environmental temperature, while determination of accumulated amount of $N\text{-}NH_3$, $N\text{-}NH_2$ and H_2S are useful indices for the assessment of plasma freshness and are recommended to be correlated with organoleptic evaluation of the aroma.

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TABLE 2. CHANGES OF SELECTED INDICES OF BLOOD PLASMA STORED AT 0-4°C

INDICES / BATCHES	Days of Storage								
	0	1	2	3	4	5	6	7	8
pH, $\bar{x}\pm Sd$									
Control batch	7.57 0.12	7.09 0.13	7.21 0.26	7.21 0.29	7.13 0.30	7.13 0.32	7.14 0.22	7.14 0.27	7.14 0.15
Experimental batch No.I	7.55 0.11	7.10 0.14	7.22 0.22	7.19 0.22	7.12 0.21	7.05 0.23	7.13 0.15	7.07 0.14	7.09 0.16
Experimental batch No.II	7.53 0.10	7.08 0.16	7.24 0.24	7.24 0.26	7.20 0.24	7.33 0.10	7.27 0.10	7.27 0.11	7.24 0.10
Experimental batch No.III	7.51 0.10	7.08 0.16	7.21 0.26	7.21 0.24	7.12 0.16	7.16 0.34	7.25 0.17	7.43 0.23	7.42 0.16
Crude protein, %, $\bar{x}\pm Sd$									
Contral batch	6.47 0.29	6.46 0.24	6.43 0.27	6.60 0.43	6.50 0.35	6.34 0.33	6.32 0.28	6.44 0.30	6.31 0.26
Experimental batch No.I	6.47 0.32	6.48 0.27	6.27 0.33	6.43 0.29	6.44 0.27	6.41 0.30	6.46 0.37	6.44 0.29	6.34 0.33
Experimental batch No.II	6.54 0.30	6.52 0.31	6.46 0.30	6.44 0.35	6.45 0.30	6.44 0.30	6.44 0.30	6.55 0.27	6.41 0.31
Experimental batch No.III	6.55 0.31	6.52 0.31	6.45 0.44	6.37 0.44	6.39 0.38	6.40 0.35	6.43 0.32	6.47 0.28	6.40 0.35
Ammonia-N, $\%^{10^{-3}}$ $\bar{x}\pm Sd$									
Contral batch	6.79 0.74	7.30 0.42	5.79 1.46	6.53 1.51	8.04 1.67	7.95 1.23	8.37 1.16	8.19 1.74	8.59 1.85
Experimental batch No.I	6.64 0.99	7.56 0.56	6.41 1.28	7.18 1.14	8.10 1.21	7.98 1.42	8.88 1.20	9.56 1.89	8.98 1.66
Experimental batch No.II	6.73 0.69	7.02 0.82	6.55 1.19	7.56 0.71	8.89 2.31	8.32 0.84	9.28 1.24	9.94 1.78	9.01 1.59
Experimental batch No.III	6.84 0.64	7.77 0.64	7.19 1.14	7.89 1.17	9.29 2.00	9.65 1.75	9.52 1.67	10.67 1.96	10.41 1.88

TABLE 2. Cont.

Amino-N, ug/100g, $\bar{x}\pm Sd$									
Control batch	11.70	12.10	12.00	12.20	12.50	12.60	13.60	15.50	17.30
	1.39	1.15	1.25	0.84	1.07	1.44	0.95	1.01	1.00
Experimental batch No.I	12.10	12.30	12.60	12.50	12.70	13.20	13.80	14.50	15.50
	1.05	1.13	1.20	1.21	1.10	0.98	1.01	0.81	0.63
Experimental batch No.II	11.60	11.80	11.60	11.70	12.20	12.00	12.70	13.20	13.80
	1.55	1.42	1.28	1.12	1.03	1.39	1.12	0.83	0.76
Experimental batch No.III	11.80	12.20	12.10	12.30	12.40	12.50	12.40	12.60	12.90
	1.45	1.00	1.28	1.11	1.12	0.91	0.83	0.58	0.71
Hydrogen sulphide /-//+/[1]									
Control batch	/-/	/-/	/-/	/-/	/-/+/+/	/+/	/+/	/+/	/+/
Experimental batch No.I	/-/	/-/	/-/	/-/	/-/	/+/+/-/	/+/	/+/	/+/
Experimental batch No.II	/-/	/-/	/-/	/-/	/-/	/-/	/-/	/+/	/+/
Experimental batch No.III	/-/	/-/	/-/	/-/	/-/	/-/	/-/	/-/	/-/+/+/
1=/-/ not present qualitatively, /+/ present qualitatively									
Free-$NaNO_2$, ppm, $\bar{x}\pm Sd$									
Control batch	4.02	2.63	2.65	2.51	1.95	1.70	1.89	2.01	1.83
	0.07	0.05	0.07	0.06	0.04	0.02	0.04	0.07	0.03
Experimental batch No.I	46.04	37.09	30.01	27.30	19.97	12.27	4.83	3.64	3.62
	4.70	5.25	8.10	7.14	2.68	5.57	1.74	0.65	0.85
Experimental batch No.II	93.83	89.18	82.03	76.38	65.56	56.31	39.44	19.02	12.22
	4.93	1.28	5.60	4.44	6.34	11.69	21.27	7.63	7.17
Experimental batch No.III	156.65	151.80	134.20	127.03	109.53	95.23	63.56	48.23	38.02
	4.25	4.92	7.18	6.00	13.71	20.30	5.34	9.22	13.62

TABLE 3. STATISTICAL DATA

INDICES	F emp	F theor	P=0.05
1. pH batches	0.565	3.01	
daily	1.582	2.36	
2. Free nitrite batches	49.105	3.01[x]	
daily	5.543	2.36[x]	
3. Crude protein batches	9.142	3.01[x]	
daily	15.107	2.36[x]	
4. Ammonia-N batches	17.600	3.01[x]	
daily	36.700	2.36[x]	
5. Amino-N batches	4.268	3.01[x]	
daily	6.178	2.36[x]	

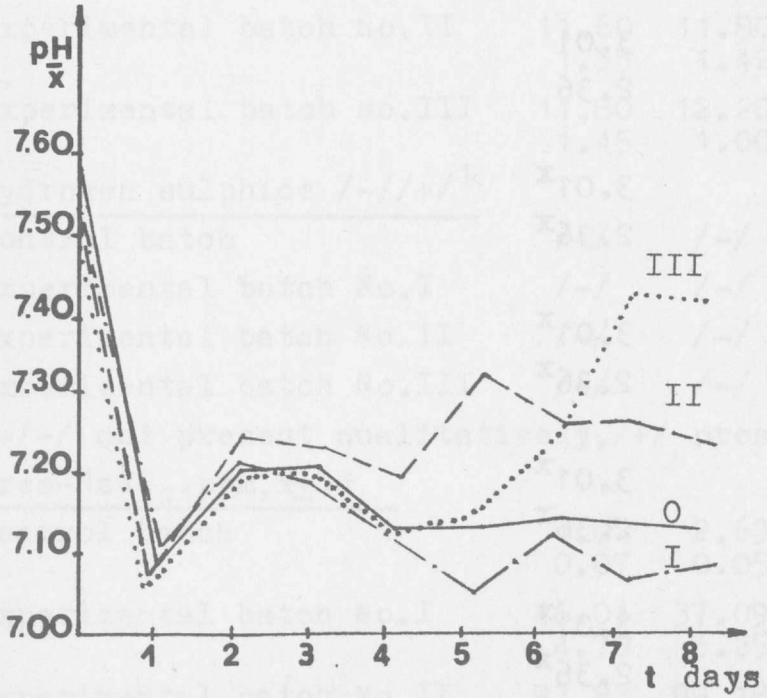

Fig.1.Changes of pH during storage of plasma

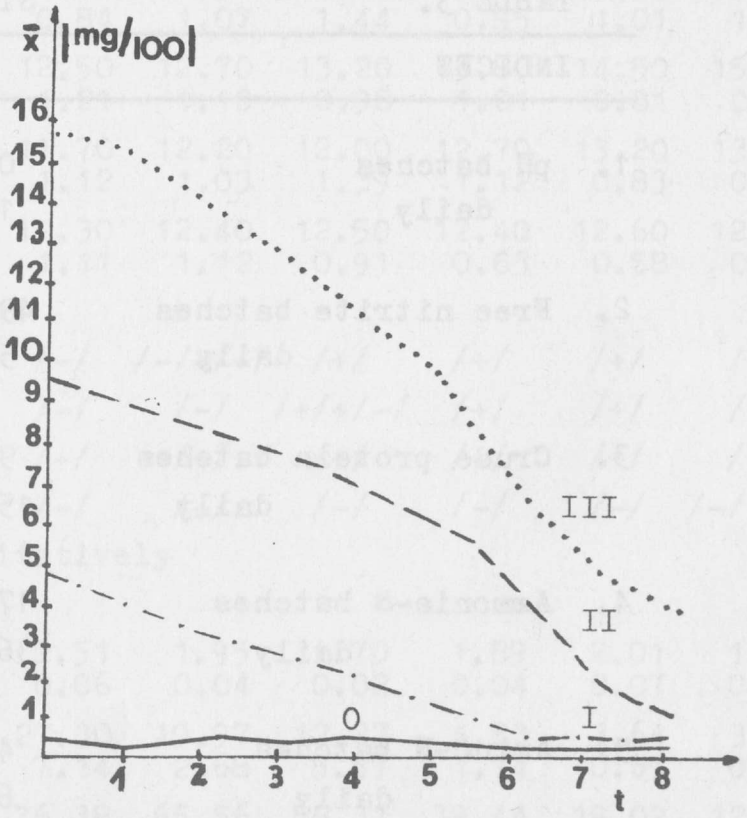

Fig.2.Contents of residual nitrite

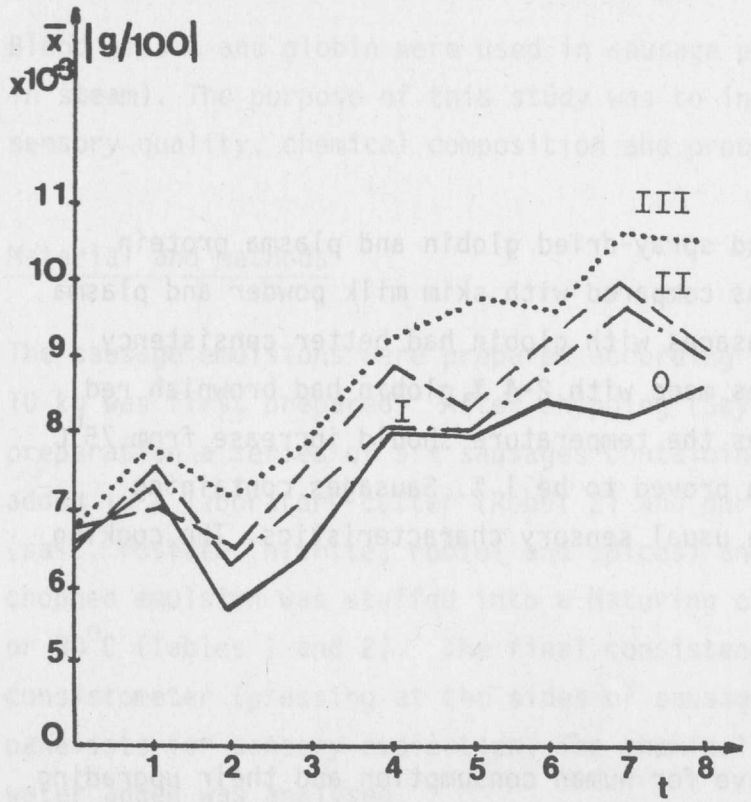

Fig.3.Dynamics of N-NH_3 accumulation

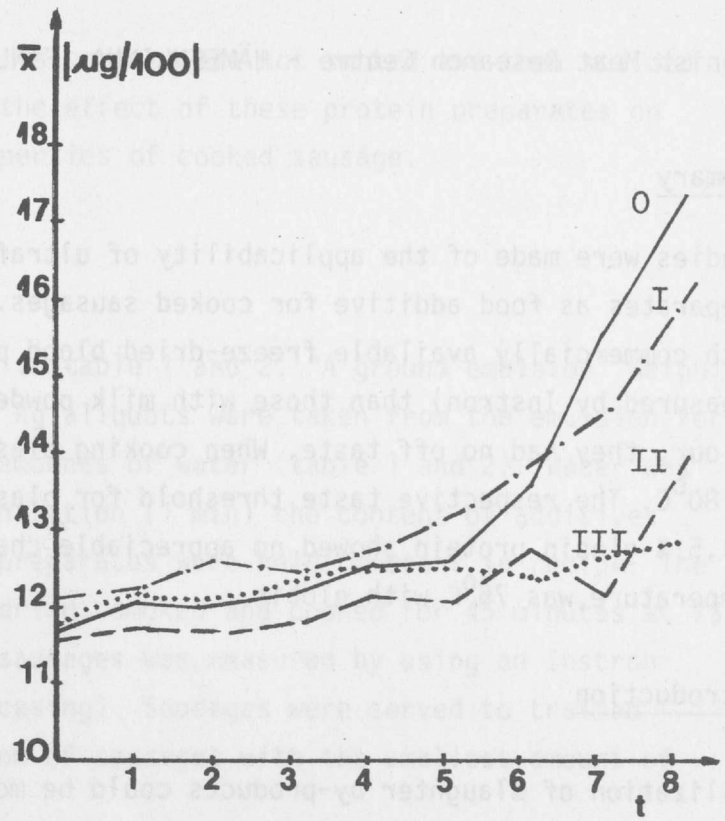

Fig.4.Dynamics of N-NH_2 accumulation