INFLUENCE OF WAYS OF PRODUCTION OF BLOOD PLASMA PREPARATIONS ON THEIR TECHNOLOGICAL USEABILITY

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INTRODUCTION

The application of blood plasma for the manufacture of sausages and canned Meat is nowadays the major way of blood protein application to food products. Blood plasma proteins demonstrate, among others, very good emulsifying capacity and a capacity of on first and a capacity (1.2,

gelated structure formation(1,2,3). On the other hand, liquid blood plasma exhibts an important negative feature, and this is a high water content combined with low protein content combined with row process the store. This feature decreases the storage-life of this raw material and limits its applicability to food products (4).

To expand the use of blood plasma this is recommended to employ: low temperatures, various drying techniques, chemical additives etc (1). The initial concentration of plasma Weine technique No experimentation of the sperimentation of the sperimentation technique the sperimentation technique the sperimentation technique techn has been reported (5). The experimental results confirm also the possibility of sufficient blood plasma preservation using UV-light (6) or

ionizing irradiation (7). Since most of the above mentioned The thods are energy consuming and it would be relatively expensive, it would be r_{easonable} to produce also plasma preparations partially dehydrated e.g. by coagulation technique. Up to Now by coagulation technique. Op lities method offers some possibilities for blood utilization for feed

Manufacture only (8). The Purpose of the present study Was to characterize certain principal ^{nutr}itional and functional properties of blood plasma preparations obtained through plasma preparations and/or through thermal coagulation and/or sprayed to check ^{spray-drying} technique and to check the possibility of their use for Manufacture of some meat products.

MATERIALS AND METHODS

Fresh, liquid, bovine blood plasma was prepared in a slaughterhouse by well known method of blood centrifugation and was used in this study as initial experimental material (protein content : 5.6%).

Thermal coagulation of plasma was conducted using the hot steam and direct heating system (Figure 1), however in the preliminary experiments also indirect heating of plasma in glass containers, using a water bath, was examined.



Fig. 1. The instalation for plasma coagulation by direct heating method

Part of the coagulum obtained, after removal of "free" water and granulation, was dried using a fluidisation bath $(T=40^{\circ}C)$.

Investigations were carried out also with dry samples prepared from fresh blood plasma using an ANHYDRO--spray-drier (Danish made). Plasma was dried at inlet and outlet temperature 200°C and 80°C, respectively. The speed of the spray-disc 7500 r.p.m. was used.

The procedures for characterization of obtained blood plasma preparations, as well as for fresh, liquid plasma have been described elsewhere (6,9, 10).

The following characteristics of plasma preparations were taken into consideration and discussed:

- protein content and its nutritional characterization: amino acids content (EAA-and CS-values), protein digestibility "in vitro";
- functional properties: emulsifying capacity, gel forming ability,

solubility, swelling and fat absorption.

In the last stage of experiment, two kinds of meat products ("Bologna" sausage as typical comminuted sausage and "Luncheon meat" as a model canned product) were made and meat protein was substituted by vaious amount (O--25%) of examined plasma proteins. Sensory evaluation of final consumer quality for all products using 5-point scale (11) was performed.

RESULTS

In preliminary experiments fresh plasma samples were coagulated using a water bath with controlled variable temperature (indirect heating) or with hot steam (direct heating).

There are few reasons why direct heating of blood plasma may be of particular interest, namely:

- continuous mixing of the solution,
 uniform coagulation of the whole volume
- easy separation of coagulum from water (in the indirect heating
- gelation tendency was observed),low energy consumption due to the direct input of energy into the system.

For the above reasons, a great attention was paid to this coagulation technique and to the quality of the plasma coagulum obtained.

As this was expected, direct thermal coagulation of plasma was found succesful since the process efficiency was correlated with plasma protein concentration in heated solution (3.9 to 5.6%) and varied between 41.6 and 68.6% respectively.

The highest coagulation efficiency at 5.58% protein concentration (non dilluted plasma) was combined with increasing of temperature in the experimental coagulation tank and the time required to equilibrate the "top" and "bottom" temperature was about 6 min. The "wet" plasma coagulum obtained under those conditions (approx 14.0% protein content, with desirable pink color and texture) as well as dried coagulum (using fluidisation bath) were subjected to futher investigations. The dried coagulum demonstrated similar protein content as found for spray-dried preparation and it W^{24} 72.3% and 70.3% respectively.

Table

Amino acids analysis of blood plasma preparations

Amino	Amino acid conten (% of protein)				
	FAO- stan- dard	1	2	3	_
Ile	3.7	3.2	2.6	3.1.	1
Leu	5.6	9.2	8.6	8.5	,
Lys	7.5	9.4	7.0	7.7	
Met+ Cys	3.4	3.2	1.5	4.9	
Ph + Ty	3.4	9.2	9.2	11.2	
Tre	4.4	8.5	5.8	5.2	
Try	1.5	1.3	1.3	1.9	
Val	4.1	7.0	7.0	5.0	/
EAA -					
value	1.00	0.96	0.93	0.98	/
CS - value		0.86 (Ile)	0.44 (Met+	0.84 (I1e)	(]

1 - fresh plasma

2 - spray-dried plasma

3 - non-dried coagulum

4 - dried coagulum

The essential amino acids content of all examined plasma proteins is given in Table 1. The results indicate that each of plasma preparations should be considered as a good source of anime acids important for human nutrition. The obtained EAA values are relatively high, in spite of plasma processing conditions, and comparable to milk protein or protein concentrates of plant origin.

It is well known that the nutrition nal value of proteins depends on digestibility (12).

No significant effect of the processing conditions on plasma protein digestibility as measured "in vitro", was found. Fresh blood plasma as well as all examined plasma preparations demonstrated high succeptibility to proteolitic enzymes action

(pepsin+tripsin) and it varied from 94.5% dried coagulum to 96.5% (fresh plasma).

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Desirable functional properties of b_{lood} plasma protein were reported by (2, 42, 14)different authors (2,13,14). Our experiments confirm very good Belation ability of fresh plasma by 55°C a weak gel structure of plasma solution was observed) and its excellent emusifying capacity 8500 of oil phase). The temperature of 850°C was required to form a firm ^{gel} from non-dried plasma coagulum. Its emulsifying capacity was comparable with that of spray-dried preparation.

On the other hand, results of our experiments indicated also that dried not for dr_{ied} plasma coagulum did not form a 801 Structure upon heating even to 950C, however, it demonstrated good sorptional properties, namely water b_{0lding} capacity (>600%) and fat $ab_{sorption}$ (> 600%) and bsorption (> 300%). Table 2 illustrates tes the influence of investigated processing procedure of plasma preparations on their functional proper-

> Table 2

Influence of production method onto functional properties of plasma preparations

10.					
teristic	fresh liqu- id plasma	spray- dried plasma	non- dried pla- sma	dired plasma coa- qulum	
			cua-		
olub.			quium		
at absor-	nd	+ 1	nd	+	
wellips	nd	++	lack	++	
Mulsifu:	nd	lack	nd	++	
apacity selation	+++	++	++	+	
-ron	+++	++	++	lack	

ery 11 good

boog

poor

In the final stage of research conducted, the examined plasma preparations were used as substitutes of meat proteins for the manufacture of model "bologna" and "Luncheon meat". In this part of experiment a special attention was paid to the sensory quality of meat products containing thermal coagulated plasma. Technological usseability of fresh plasma and spray-dried plasma is well known and have been discussed in details by the same authors elsewhere (4,6,15).

The obtained results indicate that a substitution up to 10% of meat protein by non-dried plasma coagulum have not changed deterimentally their sensoric properties, however, this plasma preparation was more suitable for "Bologna" sausages manufacture. In the production of canned meat ("Luncheon meat") the application of the dried plasma coagulum gives batter effects (Figure 2). Flavor was found to be the most critical factor limiting the range of application of thermal coagulated blood plasma.





Sensory test of meat products can not be the only basis for ultimate conclusions but this may be seen from the results, that the limited substitution of meat proteins by non-dried plasma coagulum as well as by thermal coagulated and dried plasma could be possible in practice.

CONCLUSION

The results of this experiment have confirmed that production methods of blood plasma preparations affected their principal physicio-chemical properties in different way. Thermal coagulated plasma (directly with hot steam) demonstrated desirable nutritional and functional properties as well in non-dried as in dried form. The eyamined coagula were suitable as substitutes for the manufacture of some meat products.

REFFERENCES

- 1 Stiebing A., Wirth F. (1986):
 "Blutplasma: I. Literaturübersicht"
 Fleischwirtschaft, 66, 838-852
- 2 Poulsen H. (1978): "En undersgelse of blodplasma-proteiners funktionelle egenskaber", Ph.O. thesis, Royal Vet. and Agr. University, Copenhagen
- 3 Peters H., Sielaff H., Thiemig F. (1987): "Eigenschaften, Gewinnung, und Verarbeitung von Blutproteinen", Fleisch, 41, 5, 84-87
- 4 Uchman at al. (1978): "Krew zwierząt rzeźnych i jej wykorzystanie", PWRiL, Poznań (in polish)
- 5 Hager O. (1984): "Ultrafiltration von Schewineblutplasma unter besonderer Berücksichtigung mikrobiologischer Aspekte", Ph.D. thesis, Tierarztliche Hochschule Hannover, (FRG)
- 6 Uchman at al. (1984): "Investigations of the influence of various concentrations of bovine blood plasma on some meat products", Project P1-ARS-108, Final report
- 7 Konieczny P. (1987): "Technological aspects of gamma-irradiation of fresh blood plasma", Ph.D.thesis, University of Agriculture, Poznań

- 8 Uchman W., Chalcarz W., Pezacki W. (1980): "Die Vorverarbeitung von Schlachttierblut zur menschli chen Ernährung", Fleischwirtschaft, 60, 273-277
- 9 Uchman W. at al. (1977): "Estimation of the digestibility of the products containing additivies by means of enzymes", Journal of Food Science, 42, 5
- 10 Uchman at al. (1987): "Radiation pasteurization of bovine blood plasma II. Effect of dose on functional properties of spray -dried preparation", Acta Alimentaria Polonica, 2, 115-122
- 11 Baryłko-Pikielna N. (1975): "Zarys" analizy sensorycznej" (in Polish), Warsaw
- 12 Maga J.A. at all. (1973): "Diger stive acceptability of protein as measured by the initial rate of "in vitro" proteolysis" Journal of Food Science, 38, 173
- 13 Howell N., Lawrie R.A. (1981): "Functional aspects of blood plasma fractions", Proceedings the European Meeting of Meat Research Workers, Vol. 2, D: 4, Vienna
- 14 Hermansson A.M., Tornberg E. of (1976): "Functional properties some protein preparations from blood", Proceedings of the European Meeting of Meat Research Workers, Malmo, 1:3
- 15 Uchman W., Konieczny P., Krys^{zto} fiak K. (1985): "Influence of the use of different dried plasma preparations onto sensoric properties of some meat products" 31th European Meeting of Meat Research Workers, Albena, Bulgaria, Vol. 2, 748-752