THE EFFECT OF ANIMAL TISSUE HOMOGENATES ADDITION ON THE GELATION OF BLOOD PLASMA USED IN WHITE LIVEX MANUFACTURING

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INTRODUCTION

White livex is structurized protein substitute produced from pig blood plasma. Technological process of livex manufacturing is based on destabilization of plasma (at room temperature) obtained from pig blood stabilized with sodium citrate and supplemented with some substances promoting plasma pre-gelation. Next, pre-gelled plasma is pasteurized and this heat treatment creates the final structure of the gel (6). White livex produced as above is a product whose texture and structure resemble egg white denaturated upon heat treatment. It is used as protein substitute in numerous foods, especially meat products. Gel-like structure, low initial microbiological contamination and extended to 14 days shelflife (under refrigeration) markedly increase the usability of white livex as compared to liquid plasma (6,8).However, an undeniable disanvantage of the manufacturing proces of livex, especially in the aspect of mechanization, is relatively long,sometimes above 60 minutes and inreproducible time of pre-gelation (7).The purpose of our studies was to modify the patented technology of white livex manufacturing in order to shorten and to standardize the time of fibrin network formation at the stage of blood plasma gelation.

MATERIAL AND METHODS

The studies were performed on commercially manufactured pig blood plasma stabilized with sodium citrate.Five-liter portions of plasma,whose protein content was found within the range from 5.0 to 6.0%, were used for the studies.The protein content of plasma was determined by densimetric method during colection of the raw material (1).Moreover, the pH, fibrinogen content by weight method (2) and sodium citrate by pentabromoacetone method (5) were determined. Pre-gelation of plasma was activated by the addition of frozen pig and beef offals i.e. lung, brain, kidney spinal cord, heart, spleen, liver and udder. These offals (after thawing) were added to the plasma in form of homogenate in plasma (1:9 ratio).The amount of animal tissue homogenates, added to the plasma in order to accelarate its pre-gelation, ranged from 0.01 to 10.0% (4).Parallely,pre-gellation was performed by standard, patented technology i.e. without addition of the animal tissue activators of plasma pre-gelation and this was a control sample (3). The criterion used to measure the activating efficiency of pre-gelation of the above animal tissues,was the time needed to form a relatively stable gel,measured from the moment of introducing the activators into plasma.We considered the gel to be relatively stable when its structure did not show any deflections on the surface of plasma in a beaker being characteristic of flowing liquids.The data obtained in our study were analysed statistically,using programme - "Statgraphics 2.1" and and IBM computer.The discussion of the results was based on the analysis of variance,determination of the basic statistic characteristics and correl.coeff..

RESULTS

The protein content of blood plasma used for the production of experimental livex was found within the range of 5.06 to 6.19% and averaged 5.65 $\pm$ 0.23% The fibrinogen content of plasma ranged from 0.62 $\pm$ 0.07%.Sodium citrate concentration of blood plasma averaged 0.70 $\pm$ 0.16% and was found within the range from 0.47 to 1.0%. A correlation interdependance between sodium citrate and fibrinogen content was found for 30 individual portions (n=30) of plasma (Fig.1).

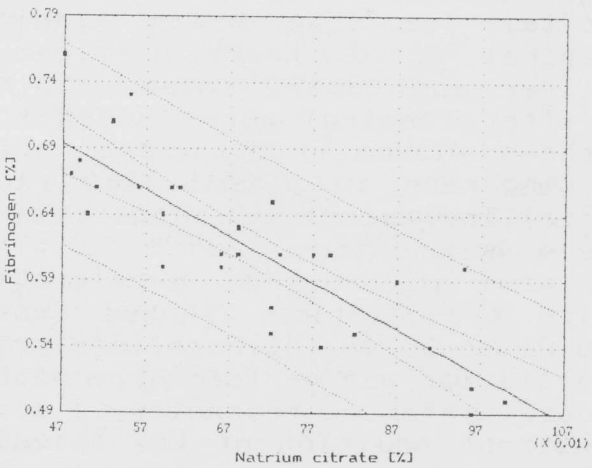

Fig.1. Regresion curve showing the effect of sodium citrate content in plasma on fibrinogen content

The calculated correlation coefficient was -0.841 for R = 71.6% . The regression equation had the following form:

$$Y = 0.857 - 0.348x$$

where: Y = fibrinogen content,
x = sodium citrate content (both in %)

The value of this interdependance indicates greatly diversified amount of sodium citrate being added during commercial stabilization of blood. Sodium citrate is introduced to the blood as 10% solution, but under industrial conditions,precise addition is difficult to achieve.Generally,the dosage of the above stabilizer exceeds the technologically required amount.which consequently,results in the dillution of blood and reduction in fibrinogen content of plasma used for livex manufacturing.It is worth noting that the decreased fibrinogen content and increased sodium citrate content of plasma generally retarded plasma gelation, both in those samples which were supplemented with the animal tissue homogenates activating the process of fibrin net formation and in those produced without such a supplementation as well (Figs. 2,3,4,5).

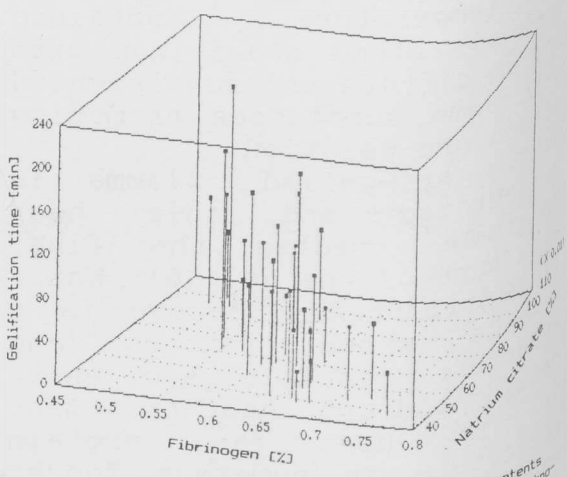

Fig.2. The effect of fibrinogen and sodium citrate contents on plasma gelation time according to standard technology used in livex manufacturing

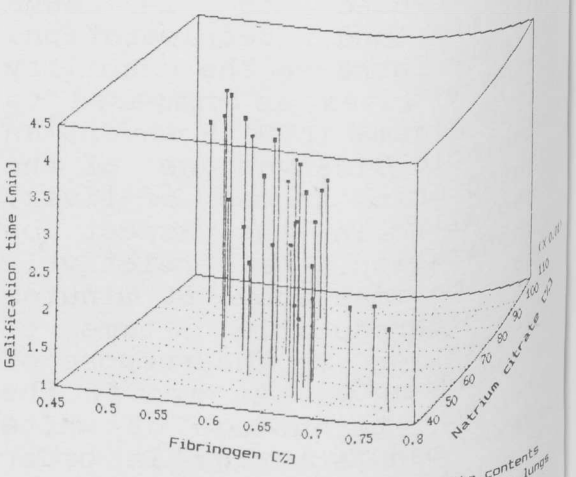

Fig.3. The effect of fibrinogen and sodium citrate contents on gelation time of plasma activated by pig lungs homogenate

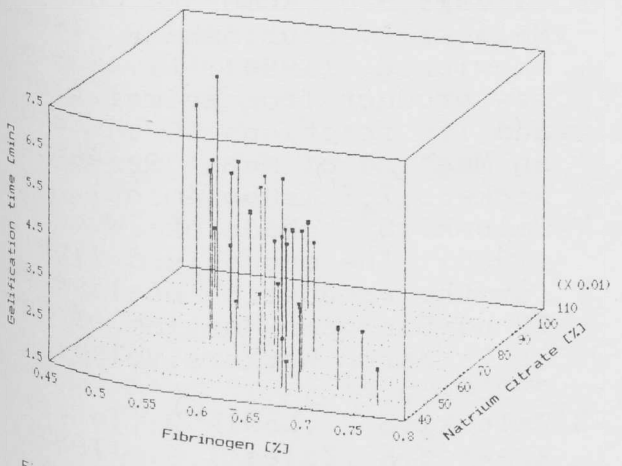

Fig.4. The effect of fibrinogen and sodium citrate contents on gelation time of plasma activated by pig brain homogenate

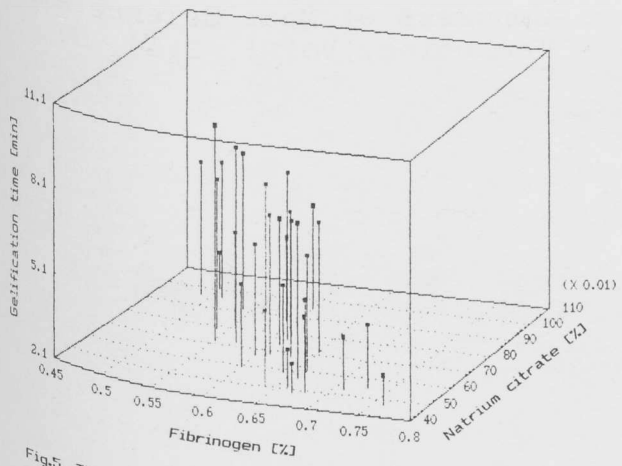

Fig.5. The effect of fibrinogen and sodium citrate contents on gelation time of plasma activated by pig kidneys homogenate

No statistically significant interdependance was found for the contents of total protein, fibrinogen and sodium citrate vs.plasma gelation time.

Pre-gelation time of plasma samples without addition of animal tissue activators i.e. time required for gel-like structure formation ranged from 19 to 200 minutes and averaged 91 $\pm$ 43.5 minutes.The measurements of plasma pre- gelation time show that the addition of all sorts of activators in form of animal tissue homogenates experimentally added to the plasma used in livex manufacturing, markedly reduce the time needed to the occurrence of interphase changes in the experimental systems However, it is worth noting that the most efective time reducers in this investigation proved to be the homogenates of pig lung, brain, and kindney. With optimal and equal amounts of the homogenates made from the above three offals added the gelation time of plasma used for livex manufacturing did not exceed 10 minutes (4). On the other hand , the best activator for pre-gelation proved to be the homogenate of pig lung, the addition of which reduced the time of fibrin net formation to the range 2-4 minutes, which on average was 3 $\pm$ 0.7 minutes (Fig.3). The brain tissue stimulated fibrinogen changes less effectively, and plasma gelation time with the use of this activator averaged 4 $\pm$ 1.2 minutes (Fig.4). The average gelation time for plasma supplemented with a kidney homogenate ranged from 3 to 10 minutes and averaged 6 $\pm$ 1.7 minutes (Fig.5). Thus, the gelation time of plasma supplemented with the homogenates of lung, brain, and kidney was 30,23, and 15 times lower, respectively than that observed using standard technologies (3,6). Such a considerable reduction and standardization of fibrin net formation, constituting one of the integral stages in livex manufacturing process seems to be specially useful in mechanization and automation of technological operations in this process. This in turn enables increased yield and production capacity of a technological line (7).

CONCLUSIONS

1.Sodium citrate content in plasma use for livex manufacturing should not exceed 0.5% because higher amount of sodium citrate in blood plasma markedly reduce the content of fibrinogen, i.e. the major protein affecting structural stability of the gel formed as a result of fibrin net formation.

2.Optimal addition of gelling activators in form of animal tissue homogenates to the plasma used in livex manufacturing can result in 30-fold reduction in time of plasma destabilization, i.e.the formation of the gel-like structure of the plasma,as compared to standard technology.

3.Reduced plasma pre-gelation time during livex manufacturing enables complex mechanization and automation of technological operations during white livex manufacturing.

REFERENCES

1.Duda,Z.,Szot,M. (1986):A comparison of several methods of protein determination in pig blood plasma. 32 nd European Meeting of Meat Research Workers,Vol II,9:7,447.

2.Kłyszejko-Stefanowicz,L. (1982): Ćwiczenia z biochemii PWN,Warszawa.

3.Polish Patent-141083, Method of transformation of animal blood and its fraction.

4.Polish Patent Application, P-266158,Manufacturing method of structured form of animal blood and its fractions.

5.Stern,J.R. (1957): Assay of tricarboxylic acids. Estimation of citric acid. in Methods in Enzymol.,Vol III,edited by S.P.Colowick, N.O.Kaplan, Acad.. Press Inc. Publishers New York, 426.

6.Zaleski,S.J.,Kumor,L.,Ławik,B Malicki,A.,Szubińska,R.,Terekiewicz,R. (1984): Livex - a new product from animal blood and its fractions.30 th European Meeting of Meeat Research Workers,7:3,(supplement).

7.Zaleski,S.J.,Nadolski,W. (1986): The mechanized line for the production of livexes 32 nd European Meeting of Meat Research Workers,Vol I, 2:20,135.

8.Zaleski,S.J.,Ławik,B.,Tereszkiewicz,R.,Zaleski,G. (1987): Survival of Salmonella in process of livex production and its behaviour on the livex surface.33 nd International Congress of Meat Science and Technology,Vol I, 2:14, 91.