

A study of the process of Ca^{++} ion structurization in "blood plasma - cow udder" systems

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It is theoretically and experimentally confirmed that there exists Ca^{++} donor function in the cow udder. It has been found that the quantity of Ca ions in cow udders comes to the level of crucial concentration of gelatinization that can provide initiation of the de-stabilization process of blood plasma. It is shown that the quantity of Ca^{++} varies in relationship to: pH of the environment; existence of Sodium chloride; preliminary thermal treatment. The results of this study are the basics for creating a set of fundamentally new technologies, where the natural biopotential of animal stuff is used. This allows for a significant increase in the level of protein processing, direct regulation of technological processes and forecasting of the quality of finished production.

Introduction

Usage of butchers blood plasma in recipes for some kinds of meat products, capable of forming gel systems and protein matrix at the expense of destabilization of fibrinogen and converting it into fibrin polymer over Ca ions allows to adjust both the technological process of structurization and the extent of clarity of some quality characteristics in finished products.

It is shown {1-8} that the extent of detachment of Ca ions from different sorts of animal stuffs mainly depends on: nature of the object; initial concentration; level of homogenization; physical-chemical factors: pH, ionic power and the temperature of the environment.

Chemical empirical results confirm that the existence of general Ca in the cow udder is from 45mg% to 65mg%. At this concentration part of it, apparently, exists in the ionic form, i.e. in some conditions an udder can bear an initiator function of the structurization process of blood plasma.

With the aim of checking this assumption, there has been research directed at the evaluation of Ca^{++} donor function of the cow udder by means of studying an influence of physical-chemical factors on the extent of detachment of Ca ions from raw materials and research of the dynamic of the gelatinization process in the binary system "udder - blood plasma" during the process of spontaneous re-calcination in it.

Materials and methods. Carrying out the experiment

In our research we used stabilized plasma derived from the blood of cattle as well as a defatted cow udder. Concentration of Ca ions in an udder was determined by means of chelatometric titration. Maintenance of ionized Calcium was carried out by a Calcium ion selective electrode. While surveying the influence of the environment's pH and of the ionic force on the extent of detachment of Calcium ions the necessary conditions were set up by adding to the water, which was used for preparing the extract, fixed amounts of 0.1n HCl or 0-4% of NaCl. During studying of binary systems "udder - blood plasma", continuance of the period that preceded commencement of the gelatinization process was registered by using a monitoring device "Reotest-2" and by sight.

Yield of acquired clot was determined after thermal treatment the gels using the water bath (temperature $90 \pm 5^\circ\text{C}$, duration 30 minutes).

Results and discussion

Assessment of Ca^{++} donor capability of both raw and thermal treated udder was carried out under various environmental conditions. In so doing, the pH value of the water extract from an udder was varied within a range from 4.3 to 9.7, while the ionic force was changed by injecting Sodium chloride from 0 to 4%. It is shown that displacement of pH to alkaline side (Fig. 1) is accompanied by monotonous reduction of Ca^{++} concentration in the system that is well correlated with the data of other surveys {2,5}.

Studying the influence of Sodium chloride concentration (when the value of the environment's pH is fixed and equal 6.5(0.1) on the level of quantity of calcium-ion in a raw udder (Figure 2) allowed us to find the existence of the inhibiting effect of Sodium chloride on the detachment process of Ca ions from the object. Moreover, the most distinctive effect was when there was 1% and more of NaCl.

Taking into account the capability of Calcium to relatively easily turn from one form to another (including ionic form), as well as the existence in an udder of considerable amounts of easily melted fats and phospholipins, that in our opinion block ions of Calcium, it was expedient to fulfill an extra (simultaneous) set of research on a preliminary thermal treated udder. In this case, the thermal treatment theoretically could provide an increase of Ca ion share in the partly defatted system. In the whole studied range of pH values in the thermal treated udder there was a marked increase in the quantity of Calcium in the system.

In the whole studied range of pH values in the thermal treated udder there was a marked increase in the quantity of Calcium in the system. At that, dynamic of the influence of pH value on the detachment level of Ca^{++} was constant, i.e. this dynamic was similar to the results, presented in Fig. 1. Correlation of acquired results with data from other authors {2} tells us that when creating certain conditions of the environment in the system, which has an udder, there can be achieved the level of crucial concentration (30-40 μM of Calcium ion that provides intensive re-calcination of blood plasma and its subsequent gelatinization. In doing so, from a practical point of view, using available technological facilities (boiling, blanching of raw materials, injecting of phosphates, Sodium chloride etc.) there is a possibility to regulate the extent of detachment of Ca ions from an udder and, thus, directly affect a course of structurization of fibrin blood plasma, strength and functional-technological features of formed gel. And, therefore, it can influence features of finished products. For the purpose of examining this statement, there was carried out the series of pattern tests in binary systems "udder - blood plasma", directed to the study of the gelatinization process and features of acquired clots depending on: the ration of Ca^{++} donor component and a fibrin-inclusive object; the degree of chopping of an udder; presence or absence external forces (steady-state condition, mixing), thermal treatment of various intensity (heating, boiling), presence of Sodium chloride. In particular, it was established that the process of spontaneous gelatinization is able to occur in systems, that have an udder and blood plasma in the ratio of 1:1 to 4:1. The most acceptable range is 2(3):1 - Fig. 4. It is shown, that homogenization of an udder, intensive mixing of the components and increasing the temperature (Fig. 4a) provides acceleration of the gelatinization process. Furthermore, presence of Sodium chloride (Fig. 4b) slows down structurization. The value of the outcome of clots in binary systems "udder-blood plasma" after thermal treatment fluctuates within the limit from 72.5 to 82.9%. In which connection, minimal losses of free moisture under acceptable textured characteristics exist in the solutions, which contain components in the ration of 3:1 to 2:1 (Fig. 5a). Injection into the system of Sodium chloride (Fig. 5b) slightly decreases the outcome of clots.



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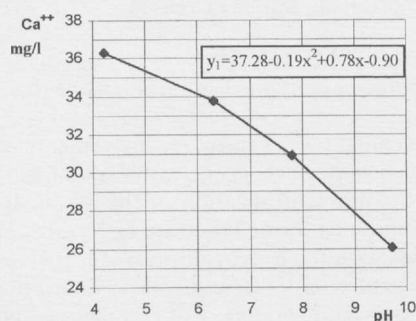


Figure 1. Influence of pH environment on concentration of Ca ions in water extract from a raw udder.

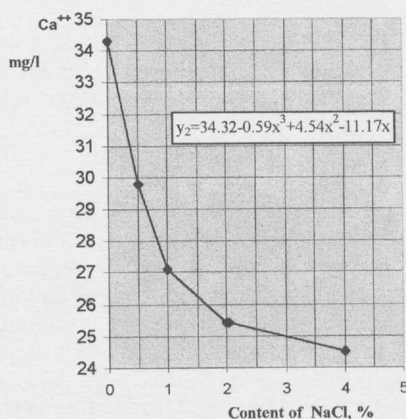


Figure 2. Influence of Sodium chloride on concentration of Ca ions in water extract from an udder (under $pH=6,5\pm 0,1$).

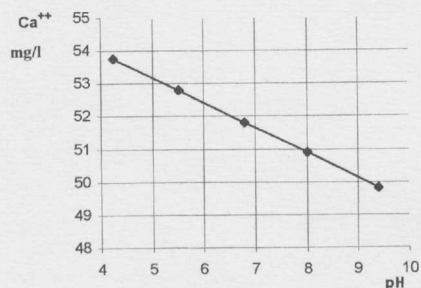


Figure 3. Influence of pH environment on concentration of Ca ions in water extract from a thermal treated udder.

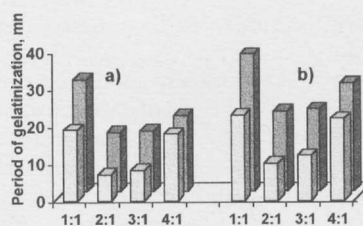


Figure 4. Diagram: Change in continuance of commencement period of gelatinization in system "udder - blood plasma" depending on the ratio of components (from 1:1 up to 4:1) under:

- a) the environment temperature $-15^{\circ}C$
- b) presence of 1% of Sodium chloride.

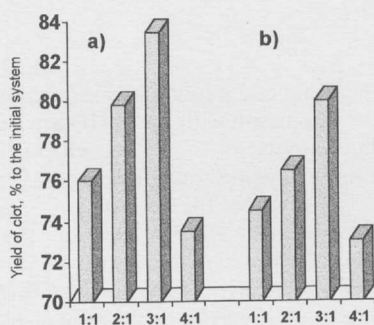


Figure 5. Diagram: Change in value of yield of clot after thermal treatment depending on the ratio of components in the system "udder - blood plasma" (a) and presence 1% of Sodium chloride (b).