SURVEY OF COMPLEX INFLUENCE OF PHYSICO-CHEMICAL AND TECHNOLOGICAL PARAMETERS ON THE PROCESS OF MILK-EGG CO-PRECIPITATE OBTAINING

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1. Introduction

At present, there are widely known mechanisms that predetermine the natural resistance of the child's body against infections. In particular, lysozyme (muramidase), which is characterized by the high activity against gram-positive flora, plays an undoubted protective role [1].

The introduction of lysozyme into dairy products significantly increases their biological value. Most often, specially selected lysozyme enzyme preparations, lysozyme supple ments with bifidobacteria, etc., are used to enrich new baby food dairy products [2]. It is more acceptable to combine raw milk with the natural sources of lysozyme, first of all, a chicken egg. That is why it may be advisable to try to obtain a high-protein milk-egg concentrate, with a prospect of its further use in baby food technology.

It is possible to obtain milk-egg protein concentrate with high organoleptic, physicochemical, and microbiological properties by the separate pasteurization of eggs and raw milk and joint comprehensive deposition of their proteins, using sour whey as a coagulant. When co-deposited, egg proteins will act as additional centers for the coagulation of raw milk proteins, due to their significant molecular weight and a sufficient number of hydrophobic groups [3]. In addition, during heat treatment, egg proteins are denatured, turning into a gel, capable of retaining not only all the moisture of the eggs but also partially the moisture of other formulation components.

An important feature of egg proteins is their heterogeneity, which predetermines a fairly wide range of protein coagulation temperatures [4]. The temperature of egg protein coagulation (50...95 °C) differs significantly from the temperature of the latent coagulation of milk proteins, which has both positive and negative aspects. One can consider, as a positive factor, that the lower temperature of egg protein coagulation ensures the presence of ready-made coagulation centers for additional deposition of casein and whey proteins at the time of their destabilization. On the other hand, the emergence of large particles of the coagulated egg proteins long before the denaturation of globular molecules of whey proteins can yield a coagulant of inhomogeneous structure, which will reduce its qualitative characteristics.

To obtain a coagulant with high organoleptic characteristics, it is necessary, if possible, to bring the temperature of the coagulation of egg and milk proteins closer. However, since a temperature of 92±2 °C is required for the minimum heat resistance of whey proteins [5], the above temperatures can be brought closer only by increasing the coagulation temperature of egg proteins.

It is known that the introduction of some substances into the egg mass prevents the coagulation of proteins. Kitchen salt (sodium chloride) in low concentrations and sugar are used as such stabilizers. The amount of these ingredients varies depending on the technological purpose of the mixtures. Thus, sugar is added to the egg mass in an amount of 5 to 50 %, kitchen salt – up to 1.5 %. Sometimes it is practiced to add these substances in a combination. Given that obtaining a milk-egg coprecipitate could expand the range of baby food, studying the effect of sodium chloride, sucrose, and their compositions with whey on the coagulation of egg mass is a relevant scientific task.

2. Literature review and problem statement

The effect of sodium dodecyl sulfate on the egg proteins ovalbumin, conalbumin, and lysozyme was determined in [6]. The experiment was performed by heating protein systems from 25 °C to 90 °C at a rate of 1.25 °C/min. The performance during the deposition process involving heating was similar for all three proteins. It was determined that increasing the concentration of sodium dodecyl sulfate in the system shifted the deposition curves towards lower temperatures and the course of the deposition process became less abrupt.

The effect of heat on some physical and chemical properties of egg proteins was determined in [7] by using different temperature and time parameters. The obtained results indicated the evolution of sigmoid with a negative slope of transmission and the irreversible loss of solubility by the studied compositions. The coagulation and deposition of the examined proteins were observed at parameters of 74 °C/20 min.

The effect of pulsed electric fields (PEF) and heat treatment on the aggregation of the egg protein ovomucin (OvEP) at different pH values was determined [8]. It was determined that heating to 60 °C for 10 min caused a pronounced aggregation of OvEP at pH 5, 7, and 9. At a constant electric field strength (E=1.4…1.8 kV/cm), PEF treatment at high specific energy input caused some protein aggregation at pH 5 and 7, but not at pH 4 and 9. A comprehensive influence of pH, the temperature, and pulsed electric fields on the digestibility of egg protein in vitro by the creation of protein drinks was also investigated [9]. It was determined that in order to obtain products with high digestibility it is advisable to apply the following parameters: pH 4, electric field strength 690 kJ/kg, temperature 80 °C.

The effect of different concentrations of NaCl and pH values on the intermolecular interactions and properties of the dispersed gel-type systems, formed on the basis of chicken egg proteins, was analyzed in [10]. The results showed that the intermolecular forces involved in the egg gel formation can be regulated by changing the pH and NaCl concentration in food systems.

In work [11], the effect of different pH values and salt concentration on the solubility and density of egg protein at room temperature (25 °C) was investigated. The experiment was performed for three types of salt – NaCl, Na2SO4, and (NH4)2SO4. The results showed an increase in the solubility of egg proteins with an increase in pH for all these salts. When the pH shifted to the acidic side (3.0), an increase in solubility and an increase in the concentration of salt solution due to the salinity effect were observed. The density increased with an increased salt concentration.

The effect of sodium chloride, sodium sulfate, ammonium sulfate salts, and nonionic surfactants (glycerin) on the thermal properties of egg proteins was studied in [12]. It was determined that the addition of glycerin had the greatest effect on reducing turbidity and increasing the time of thermal coagulation and solubility of the egg protein while sodium chloride had the least positive effect on the physical and chemical properties of the egg protein during heat treatment.

No fundamental studies aimed at determining the comprehensive influence of sodium chloride, sucrose, and pH, on the coagulation process of egg proteins in a milk medium were found. Therefore, this issue remains unresolved.