CERTAIN FEATURES OF ELECTROPHYSICAL PROCESSING OF WHEY

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Abstract: The objects of study were three types of whey electrophysically processed under various regimes. The protein content of each type of whey influences the obtaining of protein-mineral concentrates with different solid shear, protein and mineral composition.

Keywords: electrophysical processing, energy consumption, level of protein isolation, whey,

Nowadays, the issues of developing wasteless technologies and approaches for their implementation have received a wide-spread significance in several areas. One of them, of a primary importance for humans, is food industry, in the first place the processing one which often generates problems for the environment. At present, in the area of production, there is an intensive process of revision of environmental requirements concerning wastes. Production of dairy food is one of such areas, first of all, concerning dairy by-products. Development of wasteless technologies and processing of whey in a closed cycle is one of the major global challenges [1].

The nutritional value of milk owes its nutritive values to the milk sugar (lactose), nitrogen from protein fractions, and to an impressive content of calcium that is extremely important for cell signaling mechanisms [2] and is also beneficial for the human metabolism and skeletal system, all those and other milk ingredients making up a vital biologically active base for a human body. Important is the fact that these vital for men substances are in the dairy by-products extracted after the primary milk processing [3].

Skim milk, buttermilk, and whey are main lactic by-products that should be rationally and entirely consumed [4, 5]. The mode of the primary milk processing results in two types of whey:

- sweet (pH 5.5-6.0, manufactured during the making of several types of hard cheese), and
- acid/sour (pH 4.5-5.1) produced during the making of acid types of dairy products, such as cottage cheese or curd products).

Skim milk and buttermilk are obtained in the production of butter from milk and caseinate is produced when making casein. When using non-standard high technologies for isolation of proteins from milk, an ultra-filtrate is formed, also considered a dairy by-product [6]. The solid shear of whey is 6-8%, which makes about 50-70% of that of whole milk [7]. Still, in the respective literature, the solid shear of whey is different depending of the mode of the primary milk processing [8].

There are different techniques to process dairy by-products for obtaining protein concentrates that are used in various beneficial (dietary) supplements and in

pharmaceutical products as biologically active substances. Of special interest is the usage of proteins isolated from whey. Still, the usage of whey proteins for the mentioned purposes requires working under certain specific strict conditions – special technological regimes to ensure a high degree of purity and maintenance of natural qualities [9].

Current situation, on both national and international scale**,** related to the development of ecologically friendly technologie**s** for processing dairy by-products requires elaboration of new high-tech and efficient methods, including electro-physical processing; establishment of the parameters for the process functioning; energy-saving techniques for the process in question [10].

Results and discussion

Whey, as one of dairy by-products, is an excellence source of proteins, but also it is an aggressive ecologically non-friendly product because of organic substances present in it in large quantities.

If we want to manufacture healthy and environmentally safe products of whey, then it is necessary to upgrade methods and techniques for whey processing. The electrophysical whey processing applied in the experiments of the authors is a wasteless method that allows the valorification of all whey components. Besides, this type of processing makes it possible to control the content of whey proteins in the obtained concentrates, depending on the processing regime. Extraction of whey proteins and obtaining protein-mineral concentrates (PMCs) of a high value under the action of an electric current and avoiding the direct usage of chemicals is an advantageous process based on modern principles, which assures the finite cycle of the simultaneous processing of whey sugars (isomerization of lactose into lactulose), too, through separating them from the deproteinized whey. Concentrates of proteins from whey are of value on the global level: they can be used as biologically active additives, food supplements, and dietary products. Electrophysical processing allows for the control of the content of whey proteins in the obtained concentrates, depending on the processing mode.

All investigations and the electrophysical whey processing were carried out with three types of whey provided by the "JLC" Joint Stock Company, Chisinau, RM, after the manufacture of the: granulated cottage cheese „Grăuncior" (1); "Cottage cheese", 2% fat content (2); and „Curd product", 18% fat content (3). As a result, the following can be stated:

The isolation of the casein powder does not influence the degree of protein isolation, still, in this case, from each type of whey, a lower quantity of proteins is isolated.

Quantitatively, the modifications of the initial protein content before (I) and after (II) the isolation of casein powder are depicted in Fig. 1.

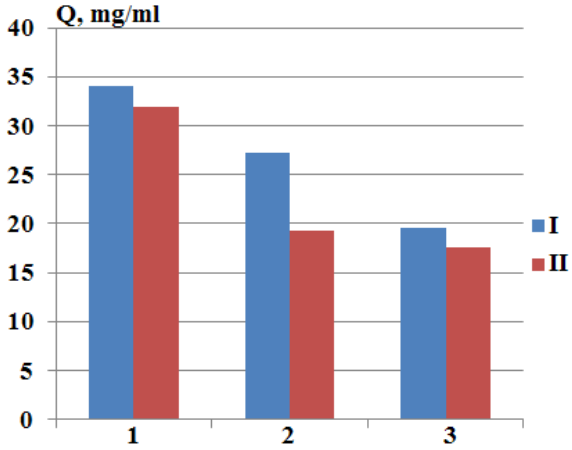

Fig.1. Initial protein content: I - without isolation of casein powder;
II - with isolation of casein powder:1- granulated cottage cheese „Grăuncior"; 2- "Cottage cheese", 2% fat content; and 3- „Curd product", 18% fat content .

Protein fractions from the seric proteins in whey have different behavior after the isolation in the PMCs during electrophysical processing; in addition, different content remaining in the cathode cell (CC) has been registered.

Proteins from whey after the manufacture of the granulated cottage cheese „Grăuncior" are isolated in a maximal quantity during first 5-10 min. (~ 52-57%); also they have the lowest quantity of proteins that remained in CC, while proteins from whey after the manufacture of the "Cottage cheese" (2% fat content) have the maximal isolation degree of 62-63% after 25-30 minuts of processing, they also have a quite high quantity of proteins that remained in the CC. Proteins from whey after the manufacture of the „Curd product" (18% fat content) are isolated at 20-25 min. maximum, and they allow for the isolation of about 42-43% of seric proteins in the PMCs.

As is clear from the Figures above, the degree of isolation of proteins in the PMCs is different for the three types of whey investigated. It can be accounted for by the following factors: primary processing of milk, initial solid shear of whey, as well as that of proteins and minerals. For the whey after manufacture of the granulated cottage cheese „Grăuncior", under all processing regimes, we have registered the maximal isolation during first 10 minutes, which tells us of a different content of initial protein fractions in this type of whey, which is different from other two types (Fig. 2).

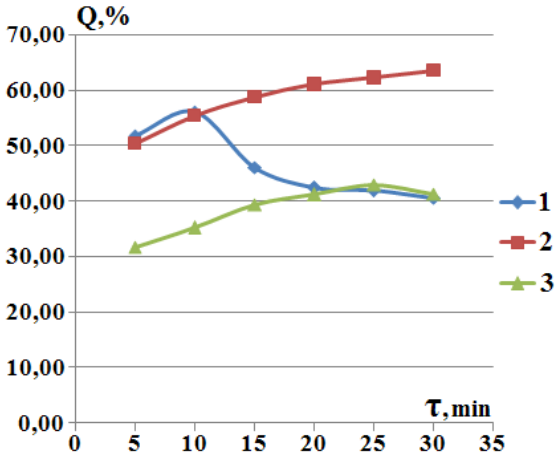

Fig. 2. Variations of degree of recovery (Q, %) of protein fractions from whey in PMCs (stationary regime) without isolation of caseine powder, at processing of three types of whey: 1 - after manufacture of granulated cottage cheese „Grăuncior"; 2 - after manufacture of "Cottage cheese", 2% fat content; 3 - manufacture of „Curd product", 18% fat content.

The protein content of the whey after the manufacture of the „Curd product", 18% fat content, is much lower in comparison with that of the other two types of whey; still it keeps the isolation nature in the PMCs as is also the case for the whey after the manufacture of the "Cottage cheese", 2% fat content (Fig. 3).

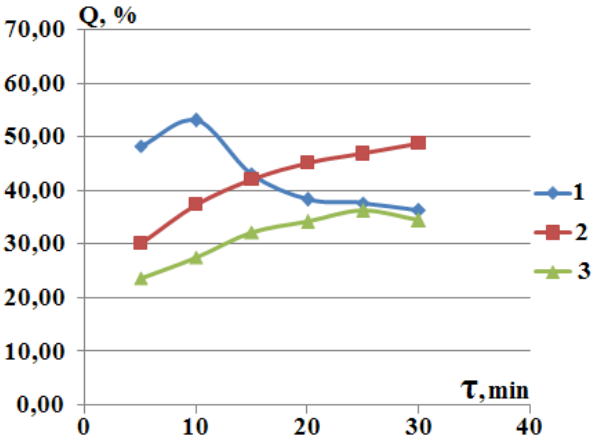

Fig. 3. Variations of degree of recovery (Q, %) of protein fractions from whey in PMCs (stationary regime) with isolation of caseine powder, at electrophysical processing of three types of whey: 1 - after manufacture of granulated cottage cheese „Grăuncior"; 2 - after manufacture of "Cottage cheese", 2% fat content; 3 - after manufacture of „Curd product", 18% fat content.

Of a special interest is the fact that at the higher the current density, the higher is the temperatute of the processed whey, which leads to the denaturation of whey proteins in the PMCs. However, there is no rise of the quantity of the isolated proteins because

for the electrolyzors used in our experiments the optimal processing values are: j= 20 mA/cm^2, at15-25 min. of processing, which makes it possible to isolate 61-64% of protein fractions from whey in the PMCs in the temperature range of 28-34 ^{o}C.

Conclusions

Using three types of *whey* provided by the "JLC" Joint Stock Company, Chisinau, RM, after the manufacture of the: granulated cottage cheese „Grăuncior", „Cottage Cheese", 02% fat content, and „Curd product", 18% fat content the following was carried out:

- The deproteinized whey in a metastable state is a non-equillibrated system that after some time enters into a period of a latent relaxation;
- Certain physical-chemical transformations that occur in the reactions with the participation of electroactivated substances are irreversible, which sets conditions for a maximal isolation of protein fractions in the PMCs.

The results achieved, although further investigations are necessary, still will make up a solid base for electrophysical processing of various types of secondary dairy products with various solid and protein content; they will allow creation of technologies that are environmentally safe and beneficial for health.

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