VARIATION OF THE AMINO ACID CONTENT IN MINERAL PROTEIN CONCENTRATES AT ELECTROPHYSICAL PROCESSING OF WHEY

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Abstract: The main objective is the investigation of the content of the total, essential and non-essential amino acids in the protein-mineral concentrates in different processing regimes with variations of electric parameters at electrophysical processing of whey.

Keywords: electrophysical processing, whey, essential amino acids, non-essential amino acids, free amino acids, protein-mineral concentrates

Introduction

High biological or nutritional value of whey proteins is due to an elevated content of essential amino acids and conditionally essential or functional amino acids.

It is known that whey proteins make up about 20% of the milk proteins. The remaining 80% is casein.

All proteinogenic amino acids are classified into essential and non-essential ones. But comparing the amino acid profile of these two milk protein fractions shows that whey proteins contain a higher amount of essential amino acids (EAAs) and branched- chain amino acids (BCAAs) that are physiologically extremely important and confer whey proteins an important biological value [1].

Ten proteinogenic amino acids, called "essential" because they cannot be created from other compounds by the human body and so must be taken in as food, were identified in whey during electrophysical processing. The universal EAAs are: Val, Leu, Ile, Thr, Met, Lys, Phe, Trp, His and Arg. In some cases Arg and another proteinogenic amino acid Tyr can be considered partially essential, in dependence on the age and medical conditions. Other amino acids are non-essential (NEAA) ones.

More than 50% of the amino acids in whey proteins are either essential or conditionally EAAs.

The biological value of whey proteins is greater than that of other important proteins food sources. For example, it exceeds that of egg proteins by about 15%. Whey proteins are also leaders in the content of EAAs among other important sources of EAAs and are also rich in the BCAAs that are thought to play a role as metabolic regulations in protein and glucose homeostasis and in lipid metabolism [2]. In particular, β-lactoglobulin (β- Lg), which represent one of the main whey protein fractions, is rich in cysteine residues, an amino acid bearing a key role in stimulating the synthesis of glutathione. Another main protein fraction of whey proteins, α-lactalbumin (α-La), is commercially used in food supplements for babies because of its similarity in structure and composition to human milk proteins – coupled with its higher content of Cys, Trp,

Ile, Leu and Val residues, which makes it also an ingredient of choice in supplements for sportsmen [3,4].

Whey protein contains components such as β-Lg (~50-55%), α-La (~20-25%), glycomacropeptide (~10-15%), immunoglobulins (~10-15%), serum albumin (~5-10%), lactoferrin (~1%), lactoperoxidase (<1%), and other minor proteins such as β-microglobulin, lysozyme, insulin-like growth factors and γ-globulins [5-7].

Bovine serum albumin is another source of EAAs, but its therapeutic potential is largely unexplored.

Alfa-lactalbumin of whey is a protein source particularly rich in tryptophan, which modulates neurological and immunological functions through multiple metabolites, including serotonin and melatonin. Anevening intake of α-La by human volunteers increased plasma tryptophan availability and improved morning alertness and brain measures of attention [8, 9]. Recent studies have shown that tryptophan and its metabolites, e.g., serotonin (5-hydroxytryptamine, 5-HT) and melatonin can regulate the feed intake, reproduction, immunity, neurological function, and anti-stress responses [10]. Tryptophan may also modulate gene expression and nutrient metabolism to impact whole-body homeostasis in organisms.

Whey protein is also an excellent source of the key amino acids for glutathione production (cysteine, glycine and glutamate). Glutathione is your body's most powerful antioxidant that fights oxidative stress caused by free radicals in our body and is different from other antioxidants in that it is intracellular [11]. While glutathione can be found in supplement form, foods like whey are the best alternative.

Thus, an optimal balance among amino acids in the diet and circulation is crucial for whole body homeostasis and whey, from this point of view, is one of the best sources of EAAs, NEAAs and total free amino acids (FAAs).

Whey proteins, as a kind of amino acid cocktail, are important for sports training programs, not only for best athletes, and for recovery of health after severe illness, this is why an adequate dose of them is crucial for growth, development, and health of animals and humans.

Results and discussion

The degree of amino acids isolation in the PMCs during electrophysical processing of whey depends on the: current density, duration (time) of processing, and the type of whey. Varying these parameters, the content of essential and functional amino acids in the PMCs during electrophysical processing can be modeled.

In the framework of the experiments of electrophysical processing, three types of whey were used provided by the “JLC” Joint Stock Company, Chisinau, RM, after the manufacture of the: granulated cottage cheese „Grăuncior”; “Cottage cheese”, 2% fat content with the membrane electrolyzer EDP-4.

The determination of the content of amino acids in the studied samples was done by the ion-exchange chromatography [12], with the help of amino acid analyzer AAA-339M.

In our experiments, 18 proteinogenic amino acids out of 20 were detected: Asparate that includes both Aspartate and Asparagine and Glutamate that includes both Glutamate and Glutamine (in the process of detection Asparagine is combined with Aspartate and Glutamine with Glutamate and they have the identical picks that reflect the

quantity of extraction). In addition, we described the peculiarities of amino acids content and their spectrum changes, according to the mentioned groups during whey electrophysical processing at different current densities.

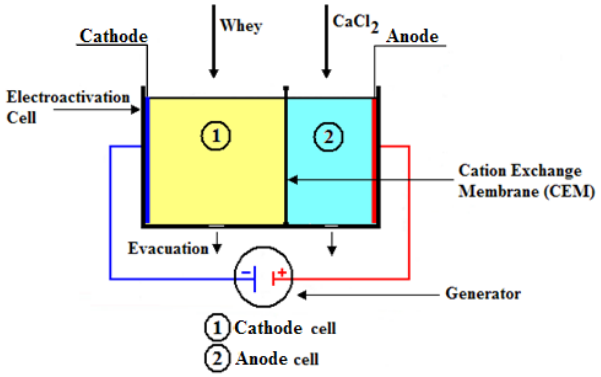

Fig. 1. *Layout of membrane electrolyzer EDP-4.*

Variations of the total FAAs, NEAAs and EAAs content during electrophysical processing with electrolyzer EDP-4 of the whey after the manufacture of the granulated cottage cheese „Grauncior" and that after the manufacture of the "Cottage cheese", 2% fat content, at current density j=10 mA/cm^2 are presented in Figures 2 and 3.

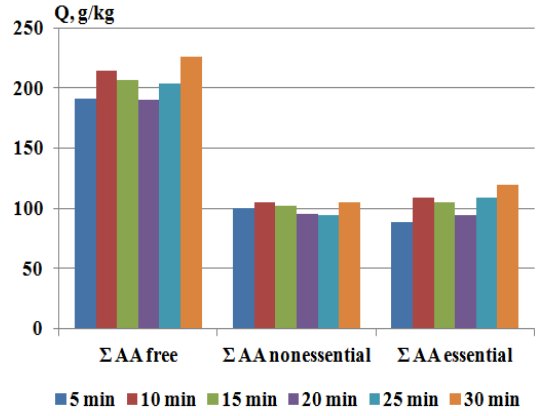

Fig.2. *Variations of total FAAs, NEAAs and EAAs content during electrophysical processing with electrolyzer EDP-4 of whey after manufacture of granulated cottage cheese „Grauncior" in stationary regime, at current density j=10 mA/cm^2*

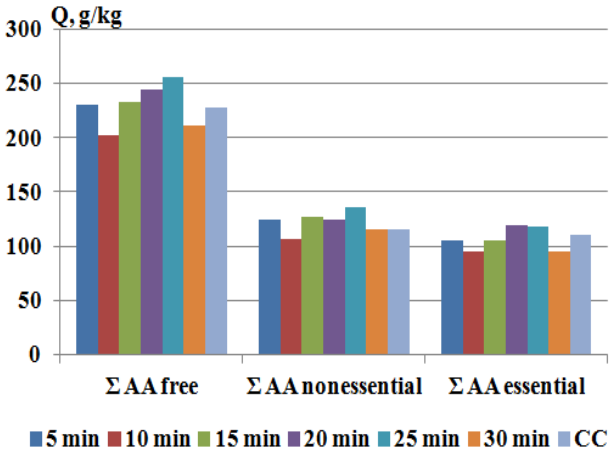

Fig.3. *Variations of total FAAs, NEAAs and EAAs content during electrophysical processing with electrolyzer EDP-4 of whey after manufacture of "Cottage cheese", 2% fat content, in stationary regime, at current density j=10 mA/cm²*

Variations of the total FAAs, NEAAs and EAAs content during electrophysical processing with electrolyzer EDP-4 of the whey after the manufacture of the granulated cottage cheese „Grauncior" and that after the manufacture of the "Cottage cheese", 2% fat content, at current density j=20 mA/cm² are presented in Figures 4 and 5.

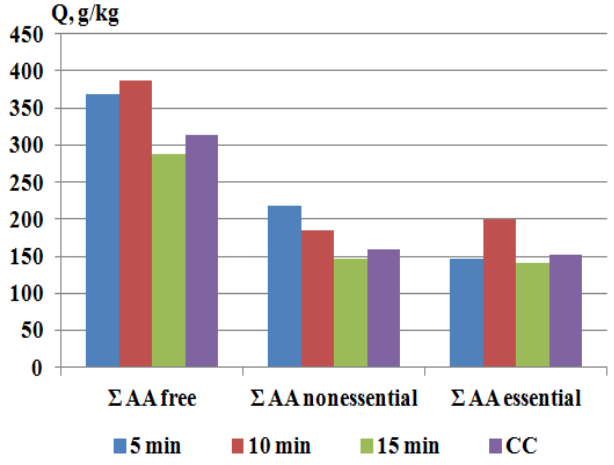

Fig.4. *Variations of total FAAs, NEAAs and EAAs content during electrophysical processing with electrolyzer EDP-4 of whey after manufacture of granulated cottage cheese „Grauncior" in stationary regime, at current density j=20 mA/cm²*

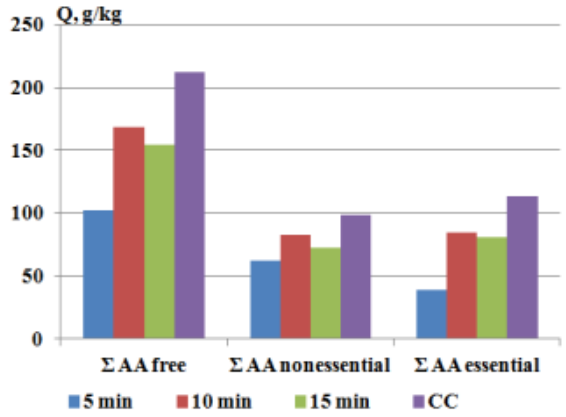

Fig.5. *Variations of total FAAs, NEAAs and EAAs content during electrophysical processing with electrolyzer EDP-4 of whey after manufacture of "Cottage cheese", 2% fat content, in stationary regime, at current density j=20 mA/cm^2*

A higher degree of total FAAs and the content of both EAAs and NEAAs isolated in the PMCs has been established during electrophysical processing of whey: after the manufacture of the "Cottage cheese", 2% fat content, at current density j=10 mA/cm^2 and after the manufacture of the granulated cottage cheese „Grauncior", at current density j=20 mA/cm^2.

The highest degree of extraction of free, especially EAAs, has been recorded in the PMCs during electrophysical processing with electrolyzer EDP-4 of whey after the manufacture of the granulated cottage cheese „Grauncior", at current density j=20 mA/cm2, at 10 min of processing, when pH=11.6 and tº C=29.5 ºC.

The content of NEAAs reached maximum values in the PMCs during electrophysical processing with electrolyzer EDP-4 of whey after the manufacture of the granulated cottage cheese „Grauncior" at current density j=20 mA/cm2, at 5 min of processing, when pH=8.5 and tº C=24.5 ºC.

Conclusions

The level of variations of each EAA and NEAA in the PMCs depends on the duration of electrophysical processing, current density, pH value and temperature (t ºC). The obtained results may be of interest for producing the PMCs with desired amino acids content and spectrum by applying various parameters (regimes) of whey electrophysical processing and can be promising for further investigations in that direction.

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