The development of the sports nutrition drink formula with low allergenic capacity

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Abstract. The key trend of sports nutrition market growth in Russian Federation is the development of new products, in particular, which may have specific effect on the human body. Proteins are of the highest value in sports nutrition, and more especially, whey proteins. However, their application in food products manufacturing requires carrying out technical operations, which provide the decrease of their allergenic capacity. The purpose of the research was the development of sports nutrition drink formula with low allergenic capacity. The objects of the study were whey protein hydrolysate, obtained from cheese whey ultrafiltration concentrate with the usage of proteolytic enzyme preparations Promod 439L and Flavorpro 766MDP; sports nutrition drink on the basis of hydrolysate, produced by adding banana, peach and squash juices. The whey protein hydrolysate was used as the main formula ingredient, and fruit juices were used as an additional source of biologically active elements. The microstructure differences of the investigated mixtures were defined. The protein conglomerate size varied from 50 up to 80 μm in diameter, lactose was in form of crystals up to 5-7 μm by size. It was proved, that polysaccharides, presented in fruit juices, were involved with the structure formation of drinks. Considering high content of starch among complex carbohydrates of banana in comparison with squash and peach, the sample with squash juice was chosen as the working formula of sports nutrition drink. The usage of whey protein hydrolysate allowed getting the final product with high biological value, digestibility and low allergenic capacity.

1. Introduction

Nowadays, it is impossible to achieve good sports results without hard physical and neuro-psychic exercise, which sportsmen have during training and at the competitions [1]. To compensate the power input and anabolic processes activation as well as working efficiency reconstruction of sportsmen it is necessary to provide the body with an adequate number of energy and nutrients [2]. In this regard, sports nutrition products are enriched with proteins, carbohydrates, minerals and vitamins [3 – 5]. The priority area in the sphere of nutrition is the development of functional products containing essential nutrients.

Proteins are of the highest value in sports nutrition [6]. They are the structural components of the cells. Besides, whey proteins are characterized by the high biological value and digestibility. The main weak point of their application in food technology is the presence of antigenic regions in molecules, in β-lactoglobulin molecule, particularly, which results in high allergenic capacity of proteins [7]. In this regard, whey proteins application in sports nutrition food production requires carrying out technical operations, which decrease this allergenic capacity.
2. The purpose of the study
The purpose of the study is the development of sports nutrition drink formula with low allergenic capacity on the basis of whey protein hydrolysate, obtained with usage of enzyme preparations Promod 439L and Flavorpro 766MDP. It was defined that whey proteins proteolysis in cheese whey UF-concentrate with these enzyme preparations promoted obtaining peptides with antioxidant characteristics, which may positively affect metabolic processes in human body [8].

To reach this purpose the following tasks were determined:

- to choose and ground the application of the components of the sports nutrition drink formula;
- to study the properties of the final product.

3. The object of the study
The objects of the study were whey protein hydrolysate, obtained from cheese whey ultrafiltration concentrate with usage of proteolytic enzyme preparations Promod 439L and Flavorpro 766MDP; sports nutrition drink on the basis of whey protein hydrolysate, produced by adding banana, peach and squash juices.

4. Materials and methods
The experimental researches were carried out at the Department of Technology of Animal Origin Products and Research Equipment Sharing Center “Monitoring and Control of Power-Efficient Projects”, FSBEI of Higher Education, Voronezh State University of Engineering Technologies.

Amino-acid composition of whey protein hydrolysate was determined with the help of ion exchange chromatographic method with post-column derivatization, using ninhydrin, on liquid chromatograph Shimadzu LC-20 Prominence (GOST 32195-2013 and GOST 32201-2013).

The microstructure of the samples was defined by means of microscopy (a 600-power microscope “Altami Bio 1”, camera adapter Canon). The drop of the tested sample was placed on the slide, then covered with cover glass and fixed on the object table of microscope. The microstructure image was obtained in digital form with the help of camera adapter.

To analyze the chemical composition, physical and chemical characteristics of the primary material and the final product we used standard methods as well as modern information technologies and equipment. The experimental researches were carried out at a triple sequence, each of which provided the determination of different parameters at least 5-10 times. The collected data store was processed with the help of mathematical statistics methods.

5. Results
Whey protein hydrolysate obtained with usage of enzyme preparations Promod 439L and Flavorpro 766MDP is suggested to be used as the main formula ingredient of the sports nutrition drink. Its chemical composition (table 1, figure 1) and presence of biologically active peptides allows enriching the final product with the essential elements.

Table 1. The chemical composition of whey protein hydrolysate.

| Indicator description | Value  |
|-----------------------|--------|
| Dry matter, %         | 8.58   |
| Total protein, %      | 3.18   |
| Lactose, %            | 4.57   |
| Fat, %                | 0.18   |
| Ash, %                | 0.62   |
| Active acidity        | 6.61   |
It is suggested to add fruit juices to whey protein hydrolysate as an additional source of biologically active elements, which also allowed hiding whey flavor of the final product (table 2). The fruit juices selected for the experiment contain mono-, di-, and polysaccharides, proteins, minerals and vitamins [9, 10]. As the body demands considerable amount of energy during long time physical loads (more than 90 minutes) the carbohydrates, presented in fruit juices, appear to be the main source of it energy deficiency supplementing. The choice of formula components was made based on microscopy results of the final products (figure 2).

Table 2. The formulas of the samples of sports nutrition drink per 1000 kg of the final product.

| Component description | Component mass, kg |
|-----------------------|--------------------|
|                       | Sample 1 | Sample 2 | Sample 3 |
| Whey protein hydrolysate | 947.0   | 942.0   | 950.0   |
| Banana juice         | 55.0     | -       | -       |
| Peach juice          | -        | 60.0    | -       |
| Squash juice         | -        | -       | 52.0    |
| Stevioside           | 0.3      | 0.5     | 0.3     |

The investigated mixtures have microstructure differences and peculiarities. The whey protein hydrolysate is represented by the particles, which are evenly distributed in a volume. The protein conglomerate size is varied from 50 up to 80 μm in diameter, lactose is in form of crystals up to 5 – 7 μm by size.
Fiber and starch are involved with structure formation of the samples No 1 and No 3, contained in banana and squash. As the peach juice contains less number of the dissolved polysaccharides, the structure change of the sample No 2 as to the whey protein hydrolysate was not significant. Considering higher content of starch among the complex carbohydrates of banana in comparison with squash the sample No 3 is chosen as the working formula of sports nutrition drink. The high concentration of peptides and free amino acids in the final product allows saving glycogens with hard aerobic exercise, as well as improving muscles rehabilitation after training [12 – 14]. Isotonic characteristics of the developed drink respond to the presence of vitamins and minerals, and due to this, it is possible to keep up the preferable fluid status and replenish electrolytes in the body by its consumption.

6. Conclusion
The whey protein hydrolysate application as the main formula ingredient of the sports nutrition drink provides getting the final product of high biological value, digestibility and low allergenic capacity; it also determines import phase out in the section of sports nutrition products in Russian Federation. The future researches will be focused on the study of chemical composition of the developed drink and estimation of its physiological impact on the human body.

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References
[1] Novokshanova A L 2021 About the classification of specialized sports nutrition products IOP Conference Series: Earth and Environmental Science 677 32054
[2] Purcell L K 2013 Sport nutrition for young athletes Pediatric Child Health 18(4) 200-2
[3] Valenta R and Dorofeeva Yu A 2018 Sport nutrition: the role of macronutrients and minerals in endurance exercises Foods and Raw Materials 6(2) 403-12
[4] Walsh N P 2019 Nutrition and Athlete Immune Health: New Perspectives on an Old Paradigm Sports Medicine 49 153-68
[5] Stellingwerff T, Peeling P and Garvican-Lewis L A 2019 Nutrition and Altitude: Strategies to Enhance Adaptation, Improve Performance and Maintain Health: A Narrative Review Sports Medicine 49 169-84
[6] McKinlay B J, Theocharidis A, Adebero T, Kurgan N, Fajardo Val A, Roy B D, Josse A R, Logan-Sprenger H M, Falk B and Klentrou P 2020 Effects of post-exercise whey protein consumption on recovery indices in adolescent swimmers International Journal of Environmental Research and Public Health 17(21) 7761
[7] Korzhov R P, Ponomarev A N, Melnikova E I and Bogdanova E V 2015 Preclinical studies of kefir product with reduced allergenicity of β-lactoglobulin Foods and Raw Materials 3(2) 115-21
[8] Melnikova E I and Bogdanova E V 2021 Whey proteins as a source of biologically active peptides Dairy industry 3 55-6
[9] Bhardwaj R, Nandal U, Pal A and Jain S 2014 Bioactive compounds and medicinal properties of fruit juices Fruits 69(5) 391-412
[10] Jiménez-Sánchez C, Lozano-Sánchez J, Segura-Carretero A and Fernández-Gutiérrez A 2017 Alternatives to conventional thermal treatments in fruit-juice processing Part 2: Effect on composition, phytochemical content, and physicochemical, rheological, and organoleptic properties of fruit juices Critical Reviews in Food Science and Nutrition 57(3) 637-52
[11] Heyman M B and Abrams S A 2017 Fruit juice in infants, children, and adolescents: current recommendations Pediatrics 139(6) e20170967
[12] Zdzieblik D, Oesser S, Baumstark M W, Gollhofer A, and König D 2015 Collagen peptide supplementation in combination with resistance training improves body composition and increases muscle strength in elderly sarcopenic men: a randomised controlled trial The British Journal of Nutrition 114(8) 1237-45
[13] Jäger R, Kerksick C M and Campbell B I 2017 International society of sports nutrition position stand: protein and exercise Journal of the International Society of Sports Nutrition 14 20
[14] Phillips S 2012 Dietary protein requirements and adaptive advantages in athletes The British Journal of Nutrition 108(S2) 158-67