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SPORT DRINKS WITH DIFFERENT OSMOLALITY

In this article the assortment sport drinks' extending possibility is represented. The juice component compositions for sport drinks with different osmolality were designed. The feasibility of adding into the drink calcium lactate as a source of quick body energy renovation and as calcium deficiency's reducer were proved.

Keywords: *juice drinks, drinks for athletes, energy drinks, osmolality, calcium lactate.*

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СПОРТИВНІ НАПОЇ З РІЗНОЮ ОСМОЛЯЛЬНІСТЮ

У статті розглянута можливість розширення асортименту спортивних напоїв. Розроблені рецептурні композиції соковмісної складової для спортивних напоїв різної осмоляльності. Доведена доцільність введення у напій лактату кальцію як джерела швидкого поновлення організмом енергії та зниження дефіциту кальцію.

Ключеві слова: *соковмісні напої, напої для спортсменів, енергетичні напої, осмоляльність, лактат кальцію.*



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I. INTRODUCTION

Specialized sports food is represented on the market very well. However, the domestic production's volume of such products is very small - only 5 % [1, 2]. For many people in the present conditions physical activity becomes a main element of an active lifestyle. More and more people after work or study are directed at health clubs and gyms. Over time, they begin to invest in their new way of life more and more by buying different sport goods, including specialized sports drinks. In addition, considerable attention to these drinks is given by professional athletes, they have to use every legal opportunity to improve athletic achievements [3].

II. ANALYSIS OF RECENT RESEARCH

It is known that the lack of water in 2 ... 4 % can reduce the strength training athlete's effectiveness at 28 %, and its physical capabilities – 48 % [3]. In ordinary the lack of water manifests itself in the fatigue's growth.

Dehydration not only reduces athletic performance, but also prolongs the time required for the further athlete body recovery. If you do not fill in fluids immediately after a workout, athletic performance in the next few days will fall, and the long-term health can be in a danger. It is necessary to

pay attention to another important aspect. With each sweat liter we loose from 1 to 4 g of sodium and amounts of certain other mineral components such as calcium, magnesium, iron [3].

According to the recommendations of the Scientific Committee on Nutrition of the European Commission from 2001 all foods for athletes are divided into four categories: A, B, C and D [4]. The greatest scientific and proven effectiveness have products of the category B. These include carbohydrate-electrolyte solutions or carbohydrate-mineral drinks that allow fill in fluid in the body, maintain normal blood glucose levels and provide muscles with energy. As the carbohydrate component of these products mono-, di, oligo- and polysaccharides are used. Electrolytes are presented by salts of sodium, potassium, and magnesium in some cases. Of course, you can fill in the liquid with clean water. In this case, the thirst's sensation desist with decreasing concentrations of solutes in blood plasma, which in turn stimulates diuresis. Therefore, taking pure water you can reached only a short-term rehydration. Fully water-salt balance is restored under the joint action of carbohydrates and electrolytes. Often the base of such drinks are juices. So, sports energy drinks should provide energy to working muscles, maintain or enhance the performance of the body, to compensate fluid loss during physical exertion. At the moment the sport drinks' part in the overall functional foods'

market is 4 % [5]. Also, the category B should be attributed to the energy drinks with the use of biological stimulants. On the market such drinks are abundant. It usually consists of: Brazilian tree seeds of guarana, caffeine, etc. They are stimulants of the nervous system, energy metabolism boosters and allowed for almost unlimited use by athletes during competition. However, these stimulants have side effects: possible hyperactivity, insomnia, and other manifestations of the nervous system. In addition, these drinks have low calorie content and the energy burst just after consumption - this is a self-deception, which may have a number of negative consequences.

III. PURPOSE OF THE ARTICLE

The purpose of our work is to provide juicy drinks for athletes, which consumption won't lead to health deterioration other negative manifestations on the organs and body systems. It is necessary to select and to give a scientific base for juice drinks base's composition recipe according to the recommended solids content. It is also important to choose the energy component for drinks, which will increase their functionality and have positive physiological effects on the human body.

IV. THE MAIN PART

The carbohydrate content in the drinks, intended for sports and fitness, usually no more than 6 %, which is close enough to the isotonic concentration of low-molecular sugars. Such concentration better promotes the restoration of the body water balance, since this creates more favorable conditions for the liquid's rapid assimilation [3].

To characterize the athletes' drink the osmolality's concept is introduced. It shows the amount of osmotically active particles in a liquid product's unit. According to these there are three types of sport drinks: isotonic, hypertonic and hypotonic drinks [6]. Isotonic are the drinks with number of osmotically active particles in a range of 280 ... 300 milliosmoles per 1 kg, which is in correlation with the blood osmolality. These drinks do not cause an imbalance within the body, delivering carbohydrates and fluid in the quantities needed to compensate their losses during exercise. Hypertonic are drinks with the osmolality value more than 300 (typically 600 ... 700) milliosmoles per 1 kg). These drinks can play a positive role only as a component of the preparation diet, allowing the athlete to restore the spent energy reserves without consuming large quantities of carbohydrate-rich foods. Hypotonic drinks have a osmolality value in a range of 50 ... 250 milliosmoles per 1 kg. This group includes the so-called "light" drinks.

Now there is developers and sports nutritionists' growing attention to the release problem of energy drinks which could provide the athlete a wide complex of nutrients. The recipes' basis of many sports drinks are traditionally consist of carbohydrate-sodium-

chloride composition. However, sport drinks, except of sportsmen's rehydration, should have beneficial physiological effects on the body. This can be achieved by enriching the beverage with the biologically active components, the ultimate goal of using them - enhance the functionality of the human body, improve the athletic performance and health protection during sports. Range of the biologically active components' use as a sport drinks' composition is quite wide. [7] From this viewpoint, juices - ideal component for sport drinks. They contain the necessary amount of sugars, vitamins, macro- and micronutrients, have flavor's range, are refreshing and it is pleasant to quench the thirst. The juice market in Ukraine is developing at a significant rate. Annual production of juices and juice drinks is about 250 million cans. Potential capacity of juices enterprises is in a range of 600 ... 800 million dm³ per year [8].

Consumption of juices and drinks per capita has increased steadily. Under these conditions, especially important to increase the assortment, to formation the new kinds of products that meet the present needs the best. Therefore, as a base for the sport drinks' production juices and purees were selected. A leading place among the assortment of fruit and vegetable canned products in Ukraine hold apple and carrot juices. Most canning enterprises have complex equipment for this assortment, and finished products are in great demand among consumers. Recipes' selection of the developed juicy sport drinks based on the content of soluble solids, which allows to assign them to a particular group (hypertonic, isotonic, hypotonic). Prescription composition of sport drinks are given in Table 1.

During prolonged strenuous exercise, the body loses a lot of energy, so it is advisable for athletes to consume drinks containing energy in an easily digestible form. It is known that glucose is the fast energy supplier in the body. But it needs insulin to pass through the cell membrane. As a result of anaerobic glycolysis lactic acid produces, a molecule that is half of a glucose molecule, and hormonal support in this case is not needed, so it passes easily through the membrane into the cell and is an indispensable energy source. For designed sport drinks on juicy base it was proposed to add calcium lactate, which in the body breaks down into lactic acid residue (rapid recuperation) and calcium ions. Calcium lactate - a food additive E 327, which is authorized for use in the food industry in the most countries, including Ukraine, Russia and the EU. [9] According to GOST 31905-2012 "Food additives. Calcium lactate E327. Technical requirements " calcium lactate is used as acidity regulator, humectant, emulsifying salt, synergistic antioxidants. Calcium lactate is easily soluble calcium donor and generally used for enrichment, especially for fruit juices. In developed drinks calcium lactate (Table 1) correlates with the daily norm so it is possible to consume in the day of training not more than 600 cm³ of such drink. Depending on the osmolality we recommend the following use of sport drinks: hypotonic - 200 cm³

before workouts, isotonic - 200 cm³ during exercise, hypertonic - 200 cm³ after workouts.

As a result of developed functional sport drinks' physico-chemical studies we selected drinks that are better suited for product concept. For these the sterilization modes were found out and evidence-based (Table 2). We studied microbiological indicators of ready sport drinks before and after heat treatment (using the sterilization modes from the table 2). It was shown that prolonged temperature exposure kills a significant number of microorganisms (table 3).

V. CONCLUSIONS

As a research result the creation of sport drinks with different osmolality's necessity was shown. As a base for drinks apples and carrots juices and purees were selected. It is the most common raw material in Ukraine. It was suggested to add calcium lactate to the drinks in correlation with the allowable daily rate for calcium deficiency's removing and rapid renovation of energy body forces.

Table 1 – Prescription compositions of functional sport drinks

Product name	Recipes amount of raw materials in sport drinks per 100 g, g								
	Carrot juice	Apple juice	Sugar syrup/sugar, g				Carrot puree	Apple puree	Calcium lactate
			9 %	8,5 %	3 %	1 %			
Hypertonic 1	40	-	60 / 5,4	-	-	-	-	-	1
Hypertonic 2	-	40	-	60 / 5,1	-	-	-	-	1
Hypertonic 3	-	-	70 / 6,3	-	-	-	15	15	1
Hypertonic 4	-	-	70 / 6,3	-	-	-	30	-	1
Hypertonic 5	-	-	-	60 / 5,1	-	-	-	40	1
Isotonic 1	40	-	-	60 / 5,1	-	-	-	-	1
Isotonic 2	-	30	-	-	70 / 2,1	-	-	-	1
Isotonic 3	15	15	-	-	70 / 2,1	-	-	-	1
Isotonic 4	-	-	60 / 5,4	-	-	-	20	20	1
Isotonic 5	-	-	70 / 6,3	-	-	-	30	-	1
Isotonic 6	-	-	-	60 / 5,1	-	-	-	40	1
Hypotonic 1	30	-	-	-	-	70 / 0,7	-	-	1
Hypotonic 2	20	20	-	-	60 / 1,8	-	-	-	1
Hypotonic 3	-	30	-	-	-	70 / 0,7	-	-	1
Hypotonic 4	-	-	-	-	70 / 2,1	-	40	-	1
Hypotonic 5	-	-	-	-	75 / 2,25	-	-	25	1
Hypotonic 6	-	-	-	-	70 / 2,1	-	15	15	1

Table 2 – The sterilization modes of functional sport drinks

Product name	Active acidity (pH)	The sterilization modes in the stream
Apple juice	4,3	<u>1...2 min</u> 120 °C
Carrot juice	6,5	<u>2 min</u> 120 °C
Hypertonic 1	6,75	<u>2 min</u> 120 °C
Hypertonic 2	4,89	
Isotonic 1	6,91	
Isotonic 2	5,04	
Isotonic 3	5,57	
Hypotonic 1	7,01	
Hypotonic 3	6,87	

Table 3 – Microbiological indicators of sport drinks after heat treatment

Indicator name	Regulatory requirements	Hypertonic 1	Hypertonic 2	Isotonic 1	Isotonic 2	Isotonic 3	Hypotonic 1	Hypotonic 3
Colonies of mesophilic aerobic and facultative anaerobic bacteria, KFU/g	No more than 10^3	$1,7 \times 10^1$	$2,0 \times 10^1$	$1,9 \times 10^1$	$1,6 \times 10^1$	$1,2 \times 10^1$	$0,7 \times 10^1$	$0,6 \times 10^1$
Yeast, fungi, KFU/g	No more than 10^2	No	No	No	No	No	No	No
Pathogenic microorganism, including salmonella	Not allowed	No	No	No	No	No	No	No

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СПОРТИВНЫЕ НАПИТКИ С РАЗНОЙ ОСМОЛЯЛЬНОСТЬЮ

В статье рассмотрена возможность расширения ассортимента спортивных напитков. Разработаны рецептурные композиции сокоосодержащей составляющей для спортивных напитков различной осмоляльности. Доказана целесообразность введения в напиток лактата кальция в качестве источника быстрого обновления организмом энергии и снижение дефицита кальция.

Ключевые слова: сокоосодержащие напитки, напитки для спортсменов, энергетические напитки, осмоляльность, лактат кальция.

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