DEVELOPING MILK-FRUIT DRINKS FOR SCHOOL NUTRITION

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Abstract

Expanding the range of dairy products of high biological value with therapeutic and prophylactic properties is the current direction. In this article the recipe and evaluation of the nutritional value of milk-fruit drink with the addition of banana puree, apple and carrot juice is presented. The chemical composition of the product contains 3.7% protein, 9.2% carbohydrates and 0.88% fat. Designed drink with low fat content is recommended to include in the diet of school meals.

Key words: milk-fruit drink, banana, juice, school nutrition, recipe, carrot

Introduction

The most important strategic task of the food industry is to satisfy all categories of the population in high-quality, biologically high-grade and safe food products[1-4]. The unfavorable ecological situation in cities leads to the need of developing the milk-protein functional products enriched with proteins, minerals, vitamins [5, 6]. In recent years, the diet of the population of the Republic of Kazakhstan and Russian Federation is deficient in proteins of animal origin. Considering this, about 20-25% of the milk produced is used for the production of protein products [7, 8].

Analysis of the situation in the milk industry shows that the scientific research on the complex waste-free using of milk and development of new methods and formulations of the wide range multi-component milk-based functional products are most relevant [9-12].

Milk products play an important role in daily human nutrition, as milk contains a balanced composition of amino acids, vitamins, and minerals [13-15]. Milk products are more valuable when it additionally contains herbal supplements, cereal grains, which enrich it with fiber, minerals, and vitamins [16].

One of the objectives of the research work was the development of the technology of milk and vegetable drink using fruit and vegetable purées. For this purpose, milk of 1% fat content, banana puree, carrot and apple juice with pulp were chosen as ingredients. Benefits and health properties are determined by the choice of the vegetable supplements.

Eating fresh carrot juice mitigates fatigue, increases appetite, restores healthy complexion, reduces the toxic effect of antibiotics on the body, strengthens hair and nails, improves eyesight, prevents from colds, improves the activity of the digestive system [17]. Bananas help with liver and kidney diseases, anemia, hypertension, atherosclerosis and depression.

Eating bananas contributes to the removal of toxins from the body, reduces the level of "bad" cholesterol, stimulates the immune system, normalizes sleep and calms the nervous system. Banana is also useful for the digestive system. Catecholamines contained in its pulp help with...
enteritis, inflammation of the mucous membranes of the mouth and stomach, as well as ulcers of the stomach and duodenum [18, 19].

Fresh apple juice is useful in diseases of the cardiovascular, digestive and urogenital systems, in hepatocholecystitis, atherosclerosis, infections and colds. It also intensifies the activity of the kidneys and counteracts the formation of kidney stones, has a pronounced choleretic and diuretic action, tones the body and quenches thirst [20].

Honey has a complex chemical composition. It contains about 20% of water and 80% of dry matter, which includes 35% of grape sugar 40% of fruit sugar - 40%. In addition, honey contains sucrose 1.3% - 5%, maltose 5 - 10%, dextrins 3 - 4%. The amount of protein in the flower honey is 0.04 - 0.29%. Honey contains 20 amino acids. It contains malic, lactic, tartaric, oxalic, citric, succinic and other acids. Honey contains enzymes such as invertase, diastasis, catalase, lipase, etc. The vitamin composition represents predominately with thiamine (B1), riboflavin (B2), pyridoxine (B6), pantothenic, nicotinic (PP), ascorbic acid (C) [21, 22].

The nutritional value of milk describes the fullness of its beneficial qualities. Milk is the most complete and balanced by essential nutrients food, which recommended for nutrition of people of all age groups. The high nutritional value of milk is due to its optimal content of proteins, fats, carbohydrates, mineral and vitamins necessary for human nutrition, as well as a favorableratio of them, at which these nutrients are mostly completely digested [23]. In the human body, milk proteins have the role of plastic material necessary for the construction of new cells and tissues, the formation of biologically active substances, enzymes, hormones. Among the 18 amino acids of milk 8 of them are essentials, which are not synthesized in the body [24].

Good digestibility of milk fat is explained by its low melting point. The presence of saturated and unsaturated fatty acids and phospholipids in milk fat along with its high digestibility determine the nutritional value of milk [25]. Milk contains quite a lot of carbohydrate components, of which 90% comes from lactose. Lactose is a source of energy. The milk that enters the human body serves as a source of minerals that maintain acid-base balance in the tissues and osmotic pressure in the blood. Milk consumption is contributing the normal physiological activity of the body.

The goal of this work to evaluate the chemical, vitamin composition and sensory properties of milk drink enriched with fruit supplements.

**MATERIALS AND METHODS**

Various combinations of milk and vegetable ingredients were selected for producing drink.

Table 1 – Recipe of milk-vegetable drink

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Sample 3</th>
<th>Sample 4</th>
<th>Sample 5</th>
<th>Sample 6</th>
<th>Sample 7</th>
<th>Sample 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pureed banana</td>
<td>123</td>
<td>136</td>
<td>73</td>
<td>-</td>
<td>73</td>
<td>60</td>
<td>120</td>
<td>130</td>
</tr>
<tr>
<td>Apple juice with pulp</td>
<td>41</td>
<td>68</td>
<td>-</td>
<td>73</td>
<td>182</td>
<td>60</td>
<td>180</td>
<td>130</td>
</tr>
<tr>
<td>Carrot juice with pulp</td>
<td>41</td>
<td>170</td>
<td>182</td>
<td>182</td>
<td>-</td>
<td>60</td>
<td>180</td>
<td>120</td>
</tr>
<tr>
<td>Milk with 1% of fat</td>
<td>816</td>
<td>677</td>
<td>727</td>
<td>727</td>
<td>727</td>
<td>800</td>
<td>500</td>
<td>600</td>
</tr>
<tr>
<td>Honey</td>
<td>20</td>
<td>17</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
</tbody>
</table>

**SENSORY EVALUATION**

Sensory evaluation of the yoghurt samples was done by 9 panellists who are familiar with sensory qualities of youghurt including the color, odor, consistency, and taste. The scores were calculated using a 100-point system where maximum score for taste and flavor was 60 points; structure and consistency was 30 points and color was 10 points.
CHEMICAL COMPOSITION
Fat content was determined using the method described by [26]. Into a butyrometer, 10 mL of $\text{H}_2\text{SO}_4$ (92% w/v), 11 mL of milk and 1 mL of isoamyl alcohol were added. Then the butyrometer was capped with rubber cap and was vigorously shaken until all particles were melted. Next the butyrometer was placed in water bath set at 60°C for 15 min and centrifuged for 5 min at 1,200 rpm. Separated milk fat was determined using divider.

Protein content was determined using Kjeldahl method in which the total nitrogen was obtained and multiplied with the factor 6.38 [27]. Total solid content was determined by drying the samples at 105°C for 2 h.

VITAMIN COMPOSITION DETERMINATION
The vitamins were determined by the method reported by Rudenko and Kartsova (2010) [28]. Liquid chromatography was used to quantify the vitamins. The instrument used was a “Shimadzu LC-20 Prominence” liquid chromatography system (Shimadzu, Japan) equipped with fluorometric and spectrophotometric detectors.

STATISTICAL ANALYSES
Statistical analysis was performed using Statistica 12.0 (STATISTICA, 2014; StatSoft Inc., Tulsa, OK, USA). The differences between samples were evaluated using ANOVA method. The differences were considered to be statistically significant at $p \leq 0.05$.

RESULTS AND DISCUSSION
On the first stage pH of milk-fruit drink was determined. It was observed that samples 4, 7 and 8 has low pH values (4.3, 4.2 and 4.1), while the highest pH values were detected in samples 3 and 5 (5.4).

![Figure 1 - pH of milk-fruit drinks](image)

Organoleptic characteristics of milk-fruit drinks are characterized by indicators determined by the senses: appearance, texture, taste, smell and color. They are closely related to the digestibility of products. The choice of organoleptic characteristics and indicators depends on the purpose of the product and is determined by the standards.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Organoleptic characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample 1</td>
<td>Taste: banana flavored milk drink; color: light pink</td>
</tr>
<tr>
<td>Sample 2</td>
<td>Taste: clean milk flavored drink; color: hot pink; homogenous consistency with fruit and vegetable pulps</td>
</tr>
</tbody>
</table>
Sample 3 | Taste: carrot flavored milk drink; color: pink; homogenous consistency predominantly with carrot pulps
---|---
Sample 4 | Taste: carrot flavored milk drink; color: hot pink; stiff homogenous consistency
Sample 5 | Taste: apple flavored milk drink; color: light pink; stiff homogenous consistency
Sample 6 | Taste: clean milk flavored drink; color: light pink; liquid consistency
Sample 7 | Taste: banana flavored milk drink; color: cream-coloured
Sample 8 | Taste: clean milk flavored drink with taste of food supplements; color: light pink; homogenous consistency

The results showed that the best taste indicators were in sample 1. This drink was examined for chemical composition, the results are presented in table 3.

**Table 3 – Chemical composition of milk-vegetable drink**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Content, g%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>3.70</td>
</tr>
<tr>
<td>Fat</td>
<td>0.88</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>9.20</td>
</tr>
<tr>
<td>Organic acid</td>
<td>0.20</td>
</tr>
<tr>
<td>Water</td>
<td>85.0</td>
</tr>
<tr>
<td>Ash</td>
<td>0.83</td>
</tr>
<tr>
<td>Saturated fatty acids</td>
<td>0.60</td>
</tr>
<tr>
<td>Unsaturated fatty acids</td>
<td>0.02</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0.002</td>
</tr>
<tr>
<td>Mono- and disaccharides</td>
<td>56.0</td>
</tr>
<tr>
<td>Starch</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Milk-fruit drinks can be widely used in public catering facilities. Also the drink can be used in school meals, as a source of essential trace elements and vitamins.

Lipatov et al. [29] developed a recipe of milk drink comprising milk, skim milk powder, lactose with a mass fraction of dry matter 50%, potassium citrate, iron sulphate, zinc sulphate, vitamin A, vitamin E, vitamin C, vitamin D2, vitamin B and water. The method of production allows to get milk drink with improved nutritional, biological and prophylactic properties for the nutrition of the elderly.

The method of milk drink production developed by Bannikova et al. (2015) [30] involves mixing the milk with the dry ingredient and homogenization. Two types of milk (low fat milk (0.09-0.12%) and 3.4-3.8% fat milk) were mixed. As a dry component, sodium caseinate is used in the amount of 3.5%, inulin in the amount of 2% of the total mass of all ingredients, sugar, cocoa powder, flavoring, coloring, stabilizer and emulsifier, which are simultaneously added to the milk, mixed for 10-12 minutes and heated with constant stirring up to 52-55 °C for 10 minutes. After the homogenization, milk drink treated with ultra-high temperatures at 138-142 ⁰C for 2 to 5 seconds, followed by packing in sterile conditions. The proposed method allows to improve the
nutritional and biological value of the milk drink with high organoleptic properties, and increase the shelf life.

CONCLUSION
The substantiation of the use of functional ingredients (pureed banana, apple juice with pulp, carrot juice with pulp) in the technology of milk-fruit drink is stated, the choice and dosage of functional ingredients from fruit berries are confirmed.

REFERENCE
scientific-practical conference of students, graduate students and young scientists “The use of modern technologies in agriculture and food industry”, 108-112, April 19-20, 2016.