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Разработка рецептур продуктов с концентратом хлореллы

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Аннотация. В статье представлен материал для разработки холодного сладкого блюда — рисового пудинга. В качестве источника ингредиентов, повышающих пищевую и биологическую ценность блюд, используется концентрат хлореллы. Клеточная стенка хлореллы твердая и неперевариваемая, но в концентрате целлюлозная мембрана разрушена, что не препятствует усвоению питательных веществ. Варианты соотношения ингредиентов в разработанных рецептурах определены методом линейного программирования с использованием программы Excel «Поиск решений». Соотношение концентрата хлореллы на 100 г сырья для вариантов рецептуры составило 20% в образцах № 1 и № 4, 5% в образце № 2, 40% в образце № 3. В ходе исследования был сделан вывод, что рисовый пудинг с концентратом хлореллы имеет более высокую оценку по сравнению с розовым рисовым пудингом. Содержание микроэлементов почти во всех разработанных образцах выше, чем аналогичные показатели в прототипе, а содержание железа, витамина В2, β-каротина удовлетворяет суточную потребность более чем на 15%, что свидетельствует о функциональных свойствах разработанного продукта. По органолептическим показателям рекомендуется следовать рецептам №1 и №4 с 20% хлореллового концентрата.

Ключевые слова: рисовый пудинг, хлорелловый концентрат.

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Working up of formulations of products with chlorella concentrate

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Abstract. The article presents the material to develop a cold sweet dish - rice pudding. Chlorella concentrate is used as a source of ingredients raising the food and biological values of the dishes. The cell wall of chlorella is hard and indigestible, but in the concentrate the cellulose membrane is destroyed, which will not interfere with the absorption of nutrients. Options for the ratio of ingredients in the developed formulations are defined by the design using the linear programming method using the Excel program «Search for solutions». The ratio of chlorella concentrate per 100 g of raw materials for the formulation options was 20% in samples No. 1 and №4, 5% in sample No. 2, 40% in sample No. 3. During the research, it was concluded that the rice pudding with chlorella concentrate has a higher score in comparison with rice pudding pink. The content of micronutrients in almost all the developed samples is higher, than the same indexes in the prototype, and the content of iron, vitamin B2, β-carotene satisfies the daily need by more than 15%, which indicates the functional properties of the developed product. According to organoleptic indexes, it is recommended to follow recipes №1 and №4 with 20% of chlorella concentrate.

Keywords: rice pudding, chlorella concentrate.

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Introduction

Chlorella is a single-celled green alga belonging to the Chlorophytes. Nicoletty M at his article «Microalgae Nutraceuticals» [1] suggests that some new products, including algae, are not concerned to be food or medicine (according to Zeisel's S.H. scientific work [2] and research conducted by EAS [3]). Various changes and new interpretations take place although that they are considered full members of the Nutritional Supplements sector. As a justification, the author cites works, including the work of Kalra E.K. [4], a Dictionary of Nutraceuticals and Functional Products [5], and one of the earlier works of Nicoletti M himself [6].

Chlorella is mainly used as a biological active supplement and not an ingredient for culinary products and dishes at Russian Federation. One of the reasons for this is the lack of knowledge about chlorella and its qualities in Russia in comparison with other countries such as Japan where it's used on an industrial scale in producing foods. Chlorella is almost not used in public catering, except for a small number of developments [7,8,9,10,11].

There is a patent [8] for developing a confectionery functional mixture for sugar cookies. The suggested mixture reduce time spent on making cookies and allows cookies to take convenient nutritional form.

Prashant Sahni and Rajiv Kumar Aneja use chlorella concentrate for developing burfi, a traditional Indian sweet at their research [9].

The patent [10] includes chlorella freshwater microalgae in the composition for the production of chocolate. Chlorella is supposed to be a powder biological active supplement. There are results of a research of using spirulina pigment as a dye for chocolate in the article [11].

The development of food products with reduced energy value and increased food value based on the use of various types of non-traditional and local raw materials is a progressive direction in the development of mass nutrition [12].

Pudding is a widely distributed sweet dish served chilled which contains of eggs, sugar, milk and flour. This group of dishes also includes rice puddings. Sweet dishes contain a large amount of easily digestible carbohydrates, so many of them are high-calorie products. It should be noted that some sweet foods could be served hot or cold. The temperature is

individual for each specific dish and depends on the regulatory documents adopted at the enterprise.

Some facts confirming that the developing of rice puddings is expedient for the Russian market:

- rice puddings are unique because they are appropriate for all groups of population including school-age children, as well as the elderly population;
- rice puddings are recommended for various diets which are not excluded sugar or allow a small amount of sugar;
- rice puddings can be sold not only in public catering establishments, but also through culinary stores, in network trade enterprises.

The purpose of the study. The purpose of the research is to develop a cold sweet dish – rice pudding with chlorella concentrate – which can be produced at public meals. It is necessary to identify the best percentage of chlorella concentrate in rice pudding, determine the nutritional and biological value and justify the use of chlorella concentrate at pudding production.

Research subjects and methods

Objects of research are rice groats, granulated sugar, plum jam, chlorella concentrate according to the Unified Sanitary-Epidemiological and Hygienic Requirements for Products (Goods) Subject to Sanitary-Epidemiological Surveillance (Control) (as amended on May 10, 2018) (as of March 2, 2019), and rice pudding with chlorella concentrate. The prototype of the developed recipe is the recipe «Rice pudding pink» with rice groats, currant or raspberry syrup, granulated sugar and water. The recipe for the prototype – rice pudding pink color – is presented in table 1.

Experimental studies of rice pudding were carried out with standard methods adopted in the regulatory documentation. Variants of the ratio of ingredients in the formulations that were developed are determined by design using the linear programming method using the Excel function «Search for solutions».

The technological process for cooking the pudding provided for the preparation of raw materials by standard methods of grinding rice groats in a laboratory grinder LZM-1, boiling in water with the addition of sugar, and jam to a viscous mass, cooling to a temperature not exceeding 30 ° C, introducing chlorella concentrate, mixing, portioning into molds and cooling in a refrigerator until completely solidified.

Research results and its discussion

Chlorella's benefits for people's health as an additional source of protein, amino acids, minerals and vitamins have been studied and confirmed in the works of many scientists [1,7,9,13]. The cell wall of chlorella is hard and indigestible, but in the concentrate used, the cellulose membrane is destroyed, which will not interfere with the absorption of nutrients.

There are 4 formulations variants including

Table 1 - Rice pudding pink

Ingredient name	Gross weight, gr	Net weight, gr
Rice groats	27	27
Currant or raspberry syrup	18	18
Granulated sugar	9	9
Water	46	46
Mass of finished pudding	-	100
Product output	-	50

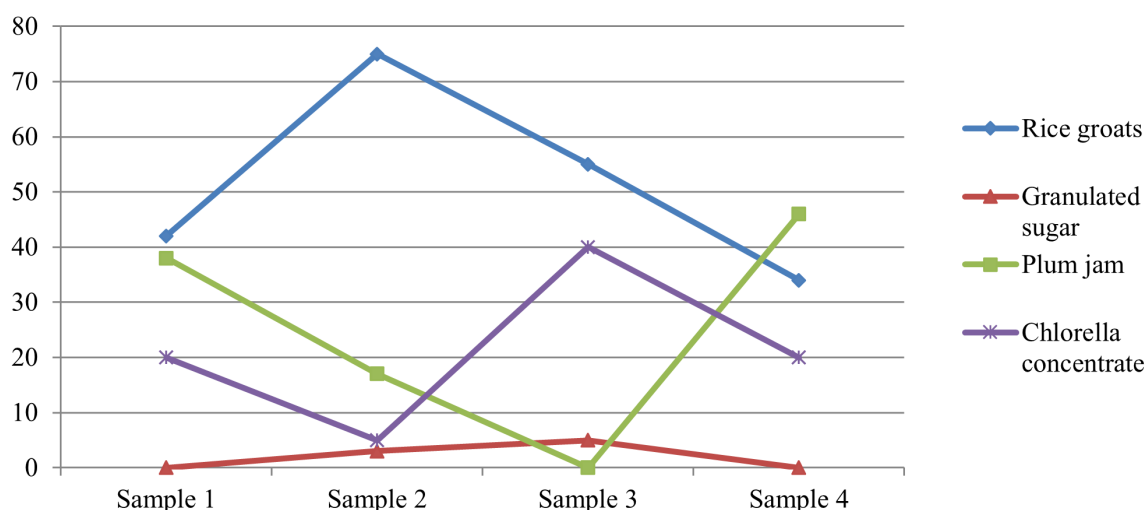


Figure 1. The ratio of components offered by the Excel function «Search for solutions»

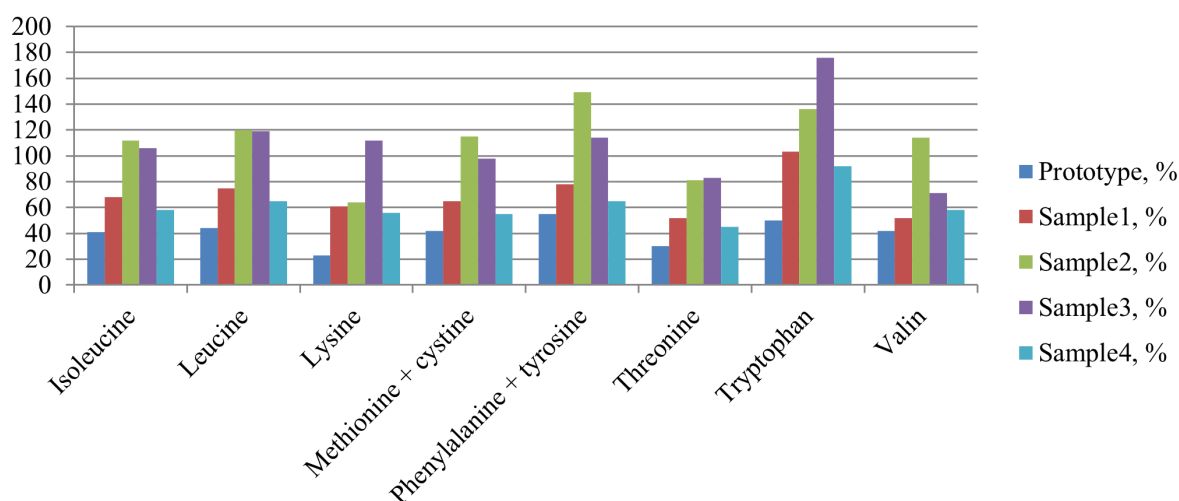


Figure 2. Values of amino acids scores of pudding with chlorella concentrate

rice groats, granulated sugar, plum jam, Chlorella concentrate and water. Variants of the ratio of ingredients in the developed formulation in accordance with the established criteria for modeling are presented on figure 1. The ratio of chlorella concentrate per 100 g of raw materials for the formulation options was 20% in sample No. 1, and No. 4, 5% in sample No. 2, 40% in sample No. 3.

Chlorella microalgae is a source of protein; chlorella concentrate used in the research contains 8.7 g of protein, it is not too high. It was found that the protein content for the sample according to recipe No. 1 is 4.8 g; according to recipe No. 2 - 6.8 g; No. 3 - 7.8 g; No. 4 - 4.3 g. The fat content in the products is 0.6 g per 100 g of pudding. The results of the study of the biological value of rice pudding with the addition of chlorella concentrate are impressive although the protein is low. Chlorella protein contains all essential amino acids [14].

Values of amino acids scores of pudding with chlorella concentrate according to recipes are on figure 2.

The ratio of amino acids at recipes exceeds the ratio of amino acids at prototype: for isoleucine by 65%, 173%, 158% and 42%; for leucine by 69%, 171%,

69% and 46%; for lysine by 160%, 172%, 374% and 138%; by the sum of methionine and cystine by 53%, 171%, 133% and 30%; by the sum of phenylalanine and tyrosine by 42%, 171%, 108% and 19%; for threonine by 74%, 171%, 178% and 51%; tryptophan by 106%, 172%, 252% and 84%; for valine by 25%, 171%, 69.7% and 38%. In that way, rice pudding with chlorella concentrate has a higher score in comparison with rice pudding pink.

According to the research of the content of micronutrients in the chlorella concentrate [14], the following results were obtained: the content of micronutrients in almost all the developed samples is higher than the same indexes in the prototype. The ratio of micronutrients at recipes exceeds the ratio of micronutrients at prototype: for iron by 112,48%, 300,19%, 1557,89% and 670,37%; for β -carotene by 3444,44%, 3233,33%, 74900,00% and 33488,89%; for B2 by 280,46%, 340,96%, 4679,56% and 2133,02%; for PP by 63,09%, 214,11%, 111,61% and 53,90%; for PP by 113,15%, 97,96%, 54,06% and 175,97%. All micronutrients indexes were compared with the prototype and also with the recommendations of Sanitary-Epidemiological Rules about the physiological need for basic nutrients and energy.

Table 2 - Organoleptic indexes of puddings with chlorella concentrate

Index	Sample 1	Sample 2	Sample 3	Sample 4
	Characteristics			
Appearance	The pudding keeps the form			
Colour	Deep, green	Pale, pink-green	Deep, dark green, close to dirty green	Deep, green
Consistency	Homogeneous, thick, rice grains are sodden	Homogeneous, thick, rice grains are sodden	Homogeneous, a bit fluid, rice grains are sodden	Homogeneous, soft, rice grains are sodden
Smell	Peculiar to a rice porridge			
Taste	Sour-sweet, peculiar to a rice porridge	Sweet, peculiar to a rice porridge	Peculiar to a rice porridge, with a bit of herb taste	Sour-sweet, peculiar to rice porridge

Comparison of organoleptic indexes of samples based on recipes 1 – 4 is in table 2.

After tasting that was decided that samples 1 and 4 are the best by some indicators.

Conclusion

After making researches it was concluded that rice pudding with chlorella concentrate is appropriate for all groups of the population, it supposed to be the source of iron since it satisfies the daily need of a human body

by 28% and the source of vitamin B2 since it satisfies the daily need of a human body by 22%, has a high content of β -carotene with the satisfaction of the daily need of a body by 100% and the low fat content (fat is not more than 3 g per 100 g for solid Food Products). According to organoleptic indexes, recipes №1 and №4 with 20% of chlorella concentrate are preferred. On the other side, chlorella concentrate increases the biological value of rice pudding in comparison with the prototype - rice pudding pink.

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