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Designing Dry Multicomponent Fruit And Vegetable Products For Children With Micronutrients And Minerals.

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ABSTRACT

Massive studies conducted by the Institute of Nutrition of the Russian Academy of Medical Sciences indicate a deep shortage of micronutrients in the diet of most people, including children and schoolchildren. Lack of vitamins, especially carotene, causes an increase in the body's sensitivity to the effects of radiation background, an increase in the risk of cancer. Insufficient intake of vitamins in the body leads to the development of a deficit of these essential micronutrients, so the task of producing children's products in accordance with the requirements of the Commission of the International FAO / WHO Code and the medical and biological standards of the Russian Federation is currently extremely relevant and timely.

Keywords: technology, baby food, product, compounding, whey, grits, complementary foods, drying, granules, "boiling" layer.

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INTRODUCTION

Rational feeding of children in the first year of life is one of the most important conditions that ensure adequate maturation of various organs and tissues, optimal parameters of physical, psychomotor, intellectual development, the stability of the infant to the effects of infections and other adverse external factors. The nature of feeding in the first year of life largely determines the state of health of the child, not only at an early age, but also in subsequent periods of his life. Metabolic disorders arising from irrational feeding of infants are a risk factor for the onset and development of many diseases.

In recent years there have been significant changes in the scientific ideas and practice of feeding children in Russia. These changes affect both breastfeeding ("free" feeding instead of feeding "by the hour") and artificial feeding (the emergence of a new generation of breast milk substitutes, as well as "subsequent" mixes).

Significant shifts have also occurred in the organization of complementary foods - changing the timing of the introduction of various types of complementary foods, widespread use in nutrition of a diverse range of products of complementary food of industrial output, etc. In this connection, the Research Institute of Nutrition of the Russian Academy of Medical Sciences has developed new guidelines for organizing feeding children in the first year of life. which, in particular, contains the basic principles of the organization of complementary foods for natural (breast), artificial and mixed feeding, corresponding to the content of this article.

MATERIAL AND METHODS

Dry milk and cereal mixtures with fruit and vegetable fillers enriched with vitamin and mineral substances for young children were chosen as the main objects of research.

The following conventional and special methods for analyzing the composition and properties of raw materials, semi-finished products and finished products were used in the experiments: determination of moisture according to GOST 15113.4-77, acidity according to GOST 15113.5-77, sucrose content according to GOST 15113.677, mass fraction of fat according to GOST 15113.977, mass fraction carotenoids according to GOST R 51181-98, total protein according to GOST 30648.2-99, mass fraction of total nitrogen according to Kjeldahl and determination of the mass fraction of protein, carbohydrates - according to the methods of biochemical studies of plants, ed. Ermakova A.I., water-soluble vitamins (ascorbic acid) according to GOST 24556-95, liposoluble vitamins (α-tocopherols) using a Chromos-ZhH-301 chromatograph with a spectrophotometric detector, wavelength λ = 292 nm. Microbiological studies according to GOST 31746-2012, GOST 10444.8, GOST 10444.12, GOST 10444.15.

As a control, permissible levels were used according to the Technical Regulations or data on the composition of breast milk, which is sought in the design of complementary foods for young children. The quality of the finished samples was evaluated by a set of indicators of the quality of baby food products, which takes into account organoleptic, physico-chemical and microbiological indicators.

RESULTS AND DISCUSSION

An analysis of the nutritional status of young children was carried out, the micronutrient status of children was studied, the needs of children for vitamins were studied, and a multivitamin deficiency, combined with iron, iodine and some other micronutrient deficiencies (selenium, fluorine) was detected. Based on domestic and international experience to improve the provision of micronutrients to the population, it was concluded that they would further enrich food products for young children.

At the experimental stand, 4 batches of dry fruit and vegetable mixtures based on whey and cereals were developed: 1) A mixture of carrot and apple on buckwheat; 2) A mixture of carrot and apple on corn grits; 3) A mixture of pumpkin and apple rice flour; 4) A mixture of pumpkin and apple semolina. The scheme of the experimental stand is shown in Figure 1.

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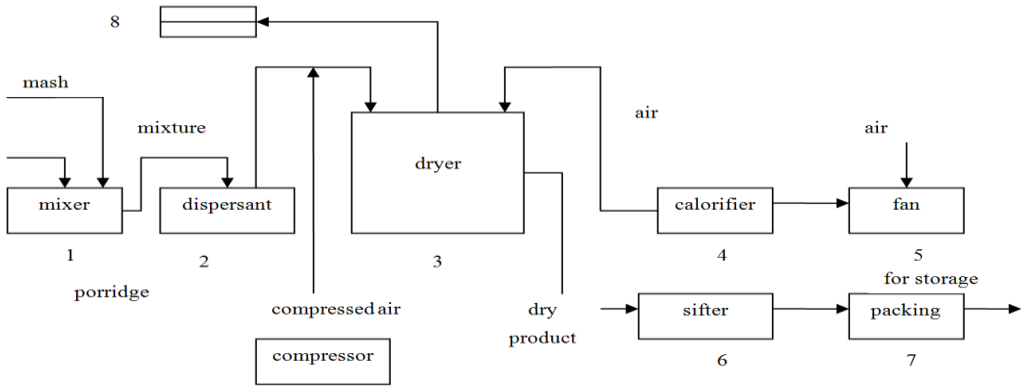

Figure 1: Diagram of the experimental stand

The main element of the stand is an experimental spraying drying installation of a spouting type (pos. 3), representing a smaller copy of the A1-FMU industrial unit. The working element is the particles of inert material - food fluoroplast in the form of cubes with a face size of 4 mm. The working agent is air, which simultaneously performs the functions of a drying and liquefying agent. The temperature mode in the drying chamber is provided by the heater (pos. 4), which is paired with an air fan (pos. 5).

Measurements and recording of the temperature in the drying zone were carried out using a KSP-4 electronic potentiometer (pos. 8).

At the first stage of the process, the preparation and processing of raw materials — milk (whey), cereal (cereals according to the recipe) and fruit and vegetable (apples, pumpkin, carrots) were carried out. Figure 2 shows the technological scheme of production of fruit and vegetable milk mixture (porridge).

All raw materials - vegetable and dairy were subjected to inspection (external examination), then physicochemical parameters were determined and metered according to the recipe. Groat porridge was cooked in whey in the ratio: cereal 1 h and 8 h of whey. Cooked porridge for 10-15 minutes in a closed boiler, at a temperature of 100 ± 5 °C. Whey was preliminarily cleared of casein dust, and whey proteins (albumin and globulin) remaining in it were converted into porridge during cooking, enriching it with valuable milk proteins and increasing the biological value of porridge due to the whole complex: carbohydrates, vitamins and minerals.

Fruits and vegetables (apples, carrots and pumpkins), after careful inspection and external processing, were ground and boiled in a kettle at a temperature of 100 ± 5 °C for 10 minutes (apples) and 20 minutes (pumpkin and carrots). The obtained puree of each type was rubbed through sieves with a diameter of 1.2 and 0.8 mm, and then finished through sieves with a diameter of 0.4 mm. Milk porridge was mixed with puree according to the recipe given in table 1.

Table 1: Recipes milk cereals with fruit and vegetable fillings in%

Components	Name porridge			
	Carrot and apple on buckwheat	Carrot and apple on cornmeal	Pumpkin and apple rice flour	Pumpkin and apple semolina
Apple mash	5	4,9	5	5
Carrot mash	29	30	-	-
Pumpkin mash	-	-	30	29
Buckwheat	7,3	-	-	-
Corn grits	-	7,4	-	-
Rice flour	-	-	7,2	-
Semolina	-	-	-	7
Whey	58,7	58,7	57,8	59
Total	100	100	100	100

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The mixture of milk porridge and fruit and vegetable puree with a 15.5% solids content was heated to a temperature of 70 ± 5 ° and crushed on a dispersant (pos. 2) to a homogeneous mass with a particle size of not more than 300 µm. Grinding was carried out at a pressure of 15-17 MPa. The homogeneous mixture was introduced into the drying chamber with a stream of compressed air and sprayed through the nozzles onto the "boiling" layer of fluoroplastic granules. The air temperature at the inlet to the drying chamber is (125 ± 5) °C, in the "boiling" zone - (115 ± 5) °C. Enveloping the "boiling" fluoroplastic particles with a thin layer, the mixture is instantly dried in the stream and when the "boiling" granules collide, the dry product is cleaved from the granules in the form of thin flake films and carried to the cyclone by waste air. The final moisture content of the powder is 2-4%. The powders are cooled to room temperature (20 ± 2) °C and packaged in sterile glass jars. Store dry mixtures at room temperature for 6 months, during the entire storage time, microbiological studies were performed on safety measures.

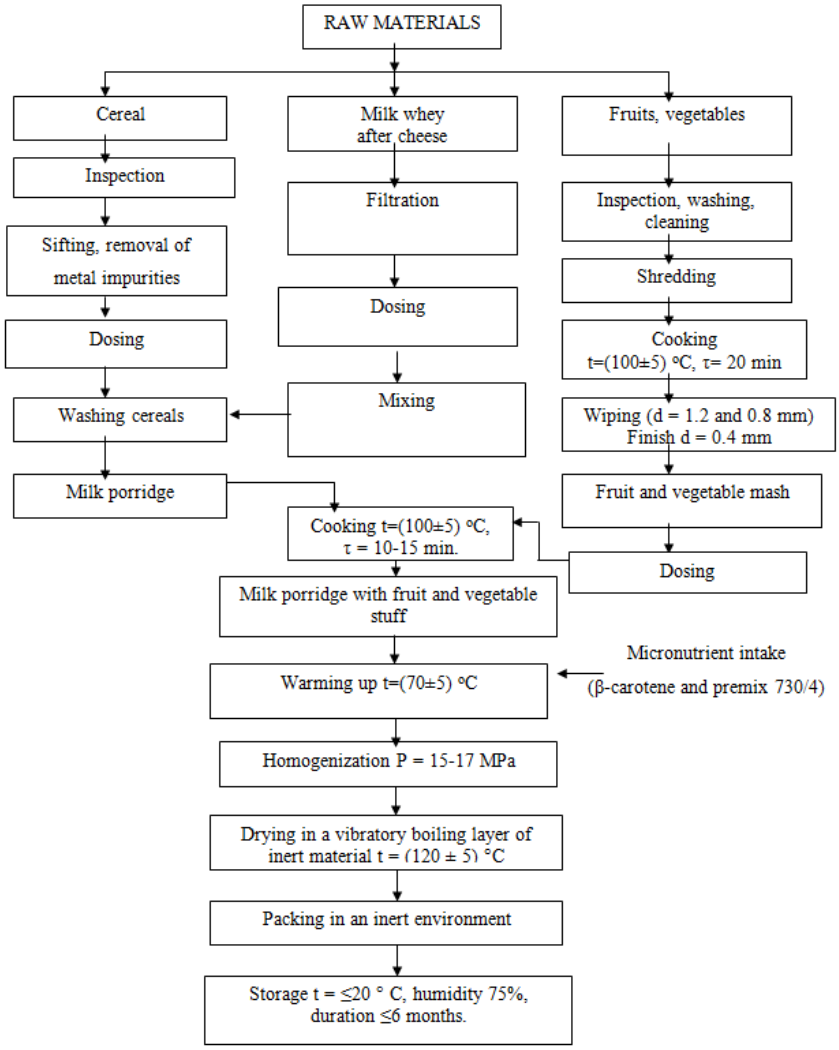

Figure 2: Technological scheme of the production of milk and cereal cereals with fruits and vegetables

Four experimental batches of milk-cereal mixtures (porridges) with fruit and vegetable filling were developed: buckwheat with apple and carrot; corn mixture with apple and carrot; rice mix with apple and pumpkin; a mixture of semolina with apple and pumpkin.

The developed batches of dry mixes (porridge) have been studied in biochemical and physico-chemical composition, in microbiological indicators (Tables 2, 3).

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Table 2: Physico-chemical and biochemical indicators of the quality of milk and cereal mixtures with fruit and vegetable fillers

Indicator	A mixture of carrot and apple on buckwheat (sample number 1)	A mixture of carrot and apple on corn grits (sample number 2)	A mixture of pumpkin and apple rice flour (sample number 3)	A mixture of pumpkin and apple semolina (sample No. 4)
Humidity,%	2,04	1,85	2,13	2,27
Proteins,%	14,5	8,75	12,0	12,5
Fat%	0,9	0,32	0,88	1,38
Carbohydrates:				
General	31,18	29,45	25,89	27,07
including reducing	22,82	20,82	17,72	18,18
Starch	22,77	37,17	39,17	33,25
Amount of sugars	53,95	66,62	65,06	60,32
Cellulose, %	4,15	1,75	4,70	1,55
α-tocopherol, mg / 100 g	4,87	6,66	4,07	5,92
β-carotene, mg / 100 g	3,75	4,06	0,9	1,0
Ascorbic acid, mg / 100 g	17,6	22,9	26,4	16,7
Titratable acidity in terms of malic acid,%	1,39	1,05	1,09	1,30

Milk-cereal-based mixtures of fruit and vegetables are fine powder in the form of small scales, easily dosed, have good flowability, do not crumple and do not cake during storage. The final moisture content of the powder is 2 - 4%.

Quality studies have established the shelf life of the packaged product at a temperature of (18 ± 2) °C, relative air humidity not higher than 75% - 6 months for feeding young children (up to 1 year) and 12 months for dietary nutrition of adults.

Dry mixtures according to the developed technology are intended for direct consumption (without cooking) by restoring the powder in water at a temperature of 50 ± 5 °C within 2-3 minutes. The recovered product is a homogeneous puree homogeneous creamy consistency, with a pronounced taste, aroma and color of the original vegetables and fruits. Product has a gentle milky taste.

To correct the taste in the preparation of mashed potatoes, you can add sugar, butter or vegetable oil.

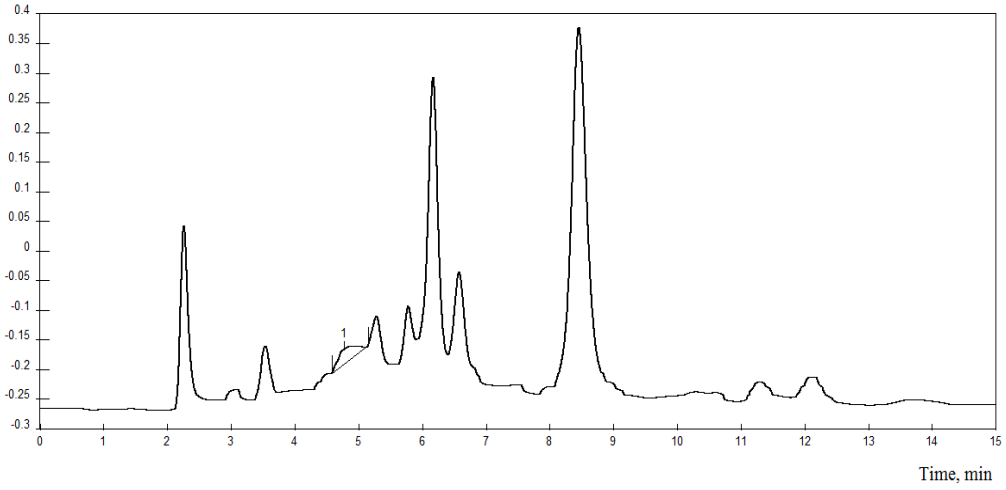

Figure 3: Chromatogram of the fat-soluble vitamins from sample 1

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The data in Table 3 indicate the microbial purity of the prepared batches of dry children's products, due to the pasteurizing effect during drying. The method of drying biological material in a “fluidized” layer of inert particles used in the work excludes from the technological process such operations as the movement of dry material, its grinding into a finely dispersed powder, and pouring in order to cool it. All these operations do not exclude additional contamination of the product with undesirable microflora.

Table 3: Microbiological indicators and safety indicators of milk-cereal mixtures with fruit and vegetable fillers

Indicators	Permissible levels, mg / kg, not more than	A mixture of carrot and apple on buckwheat (sample number 1)	A mixture of carrot and apple on corn grits (sample number 2)	A mixture of pumpkin and apple rice flour (sample number 3)	A mixture of pumpkin and apple semolina (sample No. 4)
Total microbial number, CFU / g, not more than	1.10^4	$3,2.10^2$	4.10^1	$1,5.10^3$	$1,2.10^3$
E. coli group bacteria, mass (g), which is not allowed	1,0	No growth	++	No growth	No growth
S.aureus, the same	1,0	-	-	-	-
B.cereus, CFU / g, not more	2.10^2	-	-	-	-
Mold, CFU / g, not more than	100	10	10	20	10
Yeast, the same	50	No growth	No growth	No growth	No growth

Figures 3 - 6 present the data of experiments on the analysis of the vitamin composition of the developed mixtures. All types of mixtures enriched with -carotene and multivitamin premix 730/4 and H 33053 have been studied.

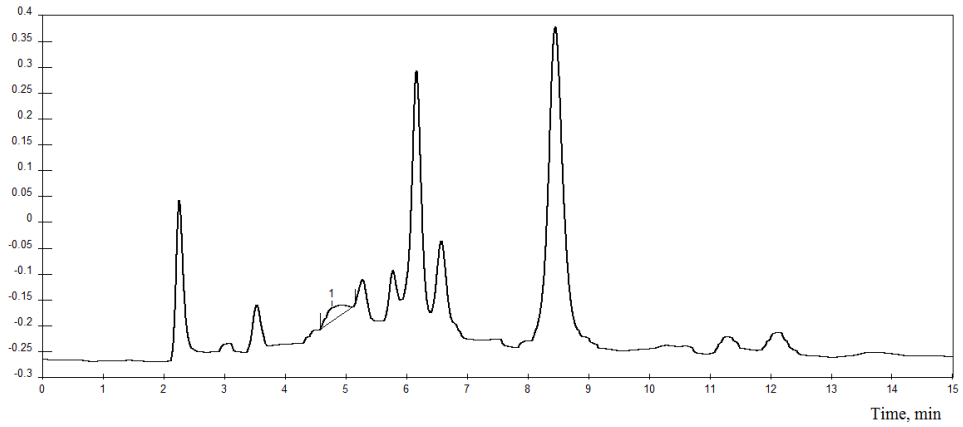

Figure 4: Chromatogram of fat-soluble vitamins from sample 2

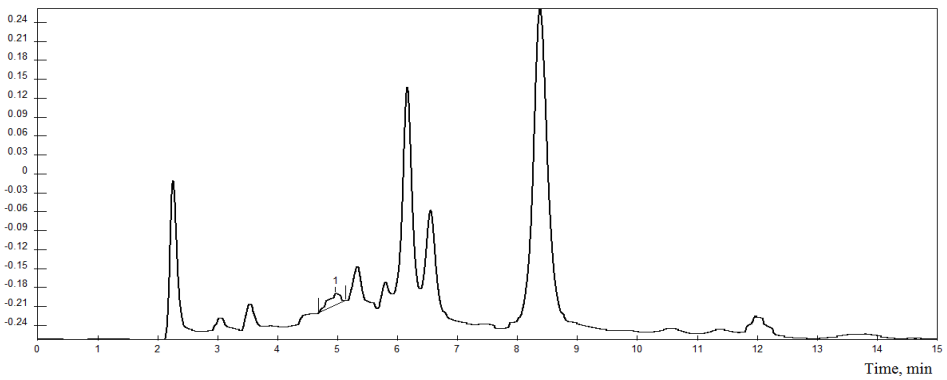

Figure 5: Chromatogram of fat-soluble vitamins from sample 3

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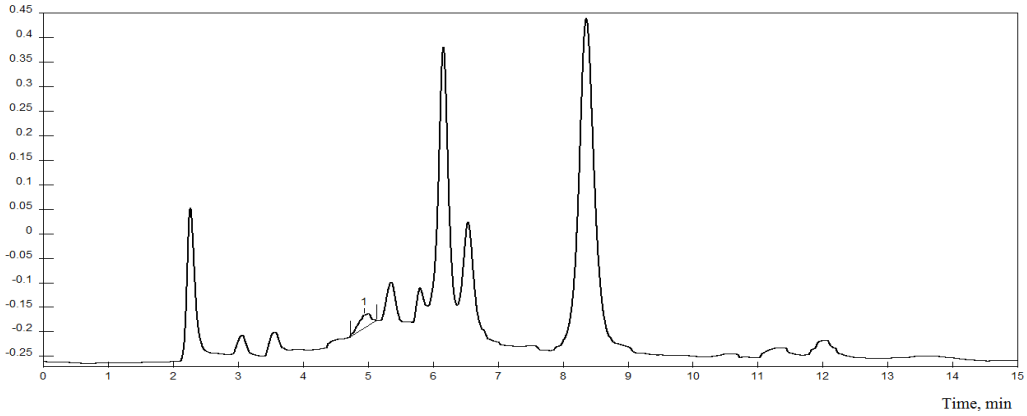

Figure 6: Chromatogram of fat-soluble vitamins from sample 4

CONCLUSION

Based on the research results, the following conclusions were made:

1. The problem of the production of domestic fast-recovery complementary food for young children (up to 1 year) remains relevant in the southern region of Russia.

2. The use of multivitamin preparations, which determine the prophylactic and therapeutic purpose of foods of young children, is used as an additional enrichment of dry infant formula.

3. A technology has been developed for the production of rapidly reconstituted dairy mixes with fruit and vegetable fillers enriched with a multivitamin premix 730/4 and β-carotene (cyclocar).

4. Experimental batches of dry milk formulas for baby food were developed
buckwheat mix with apple and carrot;
corn mixture with apple and carrot;
rice mix with apple and pumpkin;
a mixture of semolina with apple and pumpkin.

All four types of products are enriched with β-carotene in a new form - cyclocar, and 730/4 multivitamin premix, developed by specialists of the Institute of Nutrition of the Russian Academy of Medical Sciences in cooperation with «Hoffman La Roche».

5. The developed batches of dry dairy mixes with fruit and vegetable fillers underwent physical, chemical and microbiological studies.

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