SECTION 6. FOOD TECHNOLOGY

6.1 Development of complete school nutrition with the use of catering approach

Adequate nutrition of schoolchildren is a mandatory element of the educational process and the basis of the health of the younger generation. According to the World Health Organization, only 15% of human health depends on genetic predisposition, as much on the organization of health, while 70% - on lifestyle and nutrition [288]. The state of health of schoolchildren has significantly deteriorated in recent years [289, 290]. In school-age children, the functional capabilities of the body are reduced, the level of disorders of autonomic regulation and morbidity increases. Extremely low is the extremely low physical activity of schoolchildren, the prevalence of bad habits, increasing the incidence of obesity, which forms low tolerance to physical activity, reduced adaptability and reserves of the circulatory system, deteriorating quality of life in general [291]. Every seventh child in Ukraine (twice as often in boys) is overweight or obese [292].

Rational nutrition of school-age children is of particular importance due to the peculiarities of growth and development in this period and the intensive workload. Adequate needs and balanced food consumption are a source of energy and a key factor in ensuring optimal mental development, formation of immune competence and health of the adult population [293, 294].

To date, the acute problem of providing vitamins and trace elements has not been sufficiently solved [295]. Deficiency of vitamins, macro- and microelements in the diet of schoolchildren leads to metabolic disorders, reduced physical and mental performance, negatively affects the growth and development of children, provokes the development of chronic pathology, allergic conditions [296]. Today, the diet of schoolchildren is dominated by anomalous stereotypes, which are characterized by unbalanced diet and deficiency of many essential nutrients necessary for the harmonious development and health of children [297].

There are a number of problems in the organization of quality school nutrition, which has led to a significant spread of elementary pathology. During 2000-2013, the incidence of endocrine diseases, eating disorders and metabolic disorders in young people doubled. There is also a tendency to gain weight, obesity, cardiovascular disease and cancer.

To date, there are insufficient studies in Ukraine to generalize the nutritional status of school-age children with physical disabilities, the main trends in eating behavior, depending on body weight and habitat, the prevalence of nutritional deficiencies or excessive consumption of basic macro - and micronutrients in school-age children.

The problem of the nutritional status of the child population of Ukraine is extremely relevant, so in modern socio-economic conditions there are new norms and requirements for the nutrition of schoolchildren, which must be met to organize a full meal in educational institutions [298].

An unhealthy diet is a growing concern in almost all European countries. It can lead to obesity in school-age children and increase the risk of cardiovascular and other systemic diseases in later life. The growing obesity epidemic is a growing health risk factor in many European countries [299-301].

The analysis of the experience of the advanced countries of the world shows that the successful solution of the problem of healthy nutrition of children at school and other general educational institutions should be based on the use of products of increased readiness of industrial production. Creation of structures that provide completeness of rations on their basis, taking into account the age, health and habits of children, as well as the use of modern technologies, equipment and packaging to bring industrial products to readiness and use in educational institutions.

In order to create a safe, healthy educational environment, the organization of nutrition in schools should be in accordance with the Resolution of the Cabinet of Ministers of Ukraine № 305 of March 24, 2021. This document defines the principles of planning and the mechanism of nutrition of students [302].

According to the school nutrition reform, the amount of salt and sugar, vegetable and animal fats, and juices in the diet of schoolchildren is limited. Sausages, sausages, fish, canned meat and fruits and vegetables, and confectionery are not included in the school diet because they are high in salt, sugar, and some of them are preservatives and trans fatty acids, which is against the principles of healthy eating. Reduced consumption of bread and potatoes. Instead, the consumption of milk and dairy products, meat, fish, cereals and legumes has increased. The table of food substitutions related to the principles of rational nutrition has been removed.

The daily diet should be varied and include foods that belong to different groups. Meals (breakfast, brunch, lunch, dinner, supper) include foods of the following groups: cereals and / or potatoes, fruits and / or vegetables, milk and / or dairy products, meat, fish, eggs, nuts , legumes, seeds and fats. At least one hot meal should be provided. The frequency of meals is set by the educational institution depending on the age of students, the type of educational institution and the peculiarities of the organization of the educational process in the educational institution.

Caloric content of breakfast is about 25-30%, lunch about 30-35% of daily energy needs, according to dietary norms, the average rate is calculated taking into account the requirements of the age group of students. Culinary dishes and products are sold on the day of preparation in compliance with the requirements for storage conditions and terms of sale.

Meals in educational institutions should be provided subject to the requirements for the main food groups. Thus, cereals and / or potatoes (processed) must contain no more than 10 g of sugars per 100 g of finished product; have a low sodium / salt content; contain no more than 10 g of fat per 100 g of finished product; breakfast, lunch and dinner should include at least one serving of this category; during the week the diet should include three or more varieties of dishes from this category; provide no more than one serving of fried food from this category of food per week; frying should be carried out using refined oil containing more than 50% monounsaturated fats and less than 40% polyunsaturated fats.

Vegetables should be fresh or processed, without added sugars and sweeteners. Breakfast, lunch and dinner should include at least one serving of vegetables daily, and three or more servings of fresh vegetables per week. Fruits and berries must be fresh or processed, without added sugars and sweeteners, dried fruits and berries without added sugars and sweeteners, and salt and fat.

Meat is allowed (except waterfowl) chilled, sea fish. With a single meal, the diet should include at least two servings of meat, one serving of eggs and fish per week.

Edible fats in the form of vegetable oil and butter.

Milk and dairy products (yogurt, kefir, acidophilus milk, hard cheese, soft cheese and cottage cheese, sour cream, and dishes from them should contain no more than 10 g of sugar per 100 g / ml of finished product. At a single meal should be at least one serving of milk or dairy products or dairy food.

Non-carbonated drinking water is allowed, as well as drinks based on soy, rice, oats, corn, buckwheat, nuts or almonds, which contain no more than 10 g of sugar per 100 ml of finished product, without added sweeteners, low in sodium / salt . There should also be fruit, vegetable and fruit-vegetable pasteurized juices. Beverages made on site without added sugars or sweeteners are recommended: tea, fruit tea, compote, compote, drinks based on roasted grains (barley, rye) and chicory, cocoa with milk, cocoa with drinks based on soy, rice, oats, corn , buckwheat, nuts or almonds. Beverages without added sugars and sweeteners, as well as without energy stimulants such as taurine, guarana and caffeine are used.

Iodized salt should be used during cooking.

Bakery products, flour culinary products made of baked dough, based on rye and / or whole grain rye, wheat and mixed or gluten-free flour. These products can be with hard cheese, except processed cheese, cottage cheese, eggs, greens, fresh or dried spices, processed legumes, nuts, seeds without added salt, as well as vegetables and / or fruits.

Soups, sauces, dishes prepared exclusively from ingredients of plant or animal origin without the use of food concentrates.

Modern models of school nutrition include catering. Catering belongs to one of the areas of production and trade activities of enterprises and consists in outbound (outside the location of the institution) restaurant service of consumers, as well as the provision of services of outbound event and sale of finished products, goods to consumers.

Catering in school nutrition is a way of organizing the nutrition of students, which involves the delivery and sale of ready meals made without the use of material and technical base of the educational institution by the food market operator that provides food services.

The term "catering" (translated from English means "catering"), formed from the English word "cater", which means "customer service", "supply of provisions", "desire to bring pleasure" [303].

It is possible to implement a catering approach to the organization of school meals thanks to kitchen factories. In this case, you need to think carefully about the whole city or district, choose one "central" school with a large food unit, equip it so that its capacity is enough to prepare hot meals at several neighboring institutions. This will be a "kitchen factory" with a full technological cycle of production of finished products. Another option is to organize such a centralized production outside the school, and then its capacity may not be enough for one district or one city. But the delivery of ready meals to school with the appropriate services in school dining halls and is called catering. This method of catering, according to experts, gives significant savings not only on the equipment of food units, but also in the use of resources: water - by 53%, electricity - by 48%, cleaning products - by 40%, payroll - by 50 % [303, 304].

State (municipal) institutions and educational structures are very inert. In most cases, they cannot provide complete and quality nutrition for children due to bloated bureaucracy and many time-consuming operations. Starting with the need for a large number of purchases and ending with employees of food units who receive the minimum wage and are not interested in improving the quality of food. Since the salaries of employees of the food unit, accounting and other expenses are not taken into

account in the case of cooking by the staff of the institution, the new models of catering are particularly cost-effective and generally do not increase food costs. Therefore, the food system according to modern models of food organization - catering - is the most promising, in a competitive environment.

The first stage in the organization of school meals was the development of technological maps. The technological documentation for food and products takes into account the requirements of the "About the statement of norms and the Order of the organization of food in educational institutions and children's establishments of improvement and rest", as well as the requirements set by the Ministry of Health for catering in general secondary education. The research was also guided by the norms on the daily needs of schoolchildren in proteins, fats, carbohydrates and energy, according to the order of the Ministry of Health of Ukraine № 1073 from 03.09.2017 "About the statement of Norms of physiological needs of the population of Ukraine in the basic nutrients and energy" [305].

The main components of technological maps are presented in Fig.1.

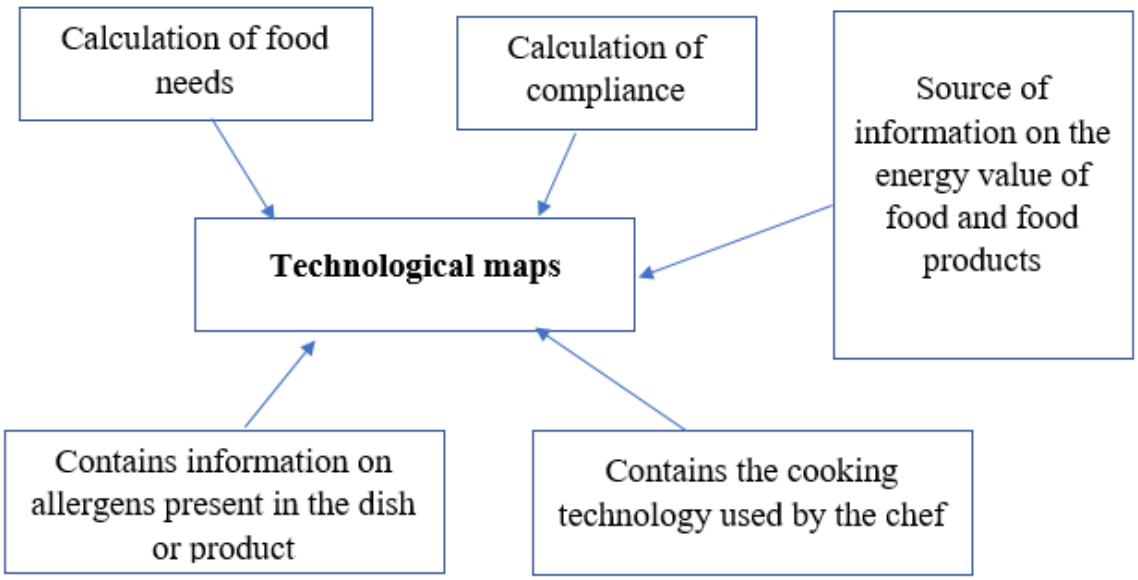

Figure 1. The main components of technological maps.

All technological maps are examined at the State Institution "Institute of Public Health. OHM. Marzeyev National Academy of Medical Sciences of Ukraine ", and the

State Food and Consumer Service issues the conclusion of the state sanitary-epidemiological examination.

Dishes and products from the technological documentation can be included in any seasonal menu, including winter. The technological maps show all the necessary calculations (gross / net, energy value, etc.), cooking processes and temperature regimes.

There are also technological maps for gluten-free meals and instructions on how to cook such food.

The technological maps indicate the expiration date and storage conditions.

In order to compile the menu of breakfasts for students of grades 1-4 of secondary schools, technological maps of salads have been developed. Salads should be present in the daily breakfast menu of students.

Developing a breakfast menu is the next step in organizing school meals.

In order to ensure a variety of food, a sufficient cycle of changes in the dishes offered to students, there is an approximate four-week seasonal menu.

In the case of catering services for the organization of food, the menu is the provider of food services (technologist, production manager).

The procedure for compiling the menu includes the stages presented in Fig. 2.

The inclusion of certain dishes in the daily diet, the caloric content of certain meals, the minimum requirements for the regime (multiplicity) of eating vegetables, fruits, meat, fish, eggs, nuts, legumes and other foods meet the standards of nutrition [305].

The development of an approximate four-week seasonal menu is provided by the founder of the educational institution for a group of educational institutions.

The menu-schedule is made on the basis of an approximate four-week seasonal menu taking into account technological documentation for dishes and products.

There is a single menu-schedule for the respective institution, but with a different number of products in accordance with the norms of nutrition for each age group of students. The menu must indicate the name of the dishes and their theoretical output for each age group, the number of servings for different age categories of students, the

amount of food needed to complete the menu (gross / net weight): in the numerator - per student. , in the denominator - for all students.

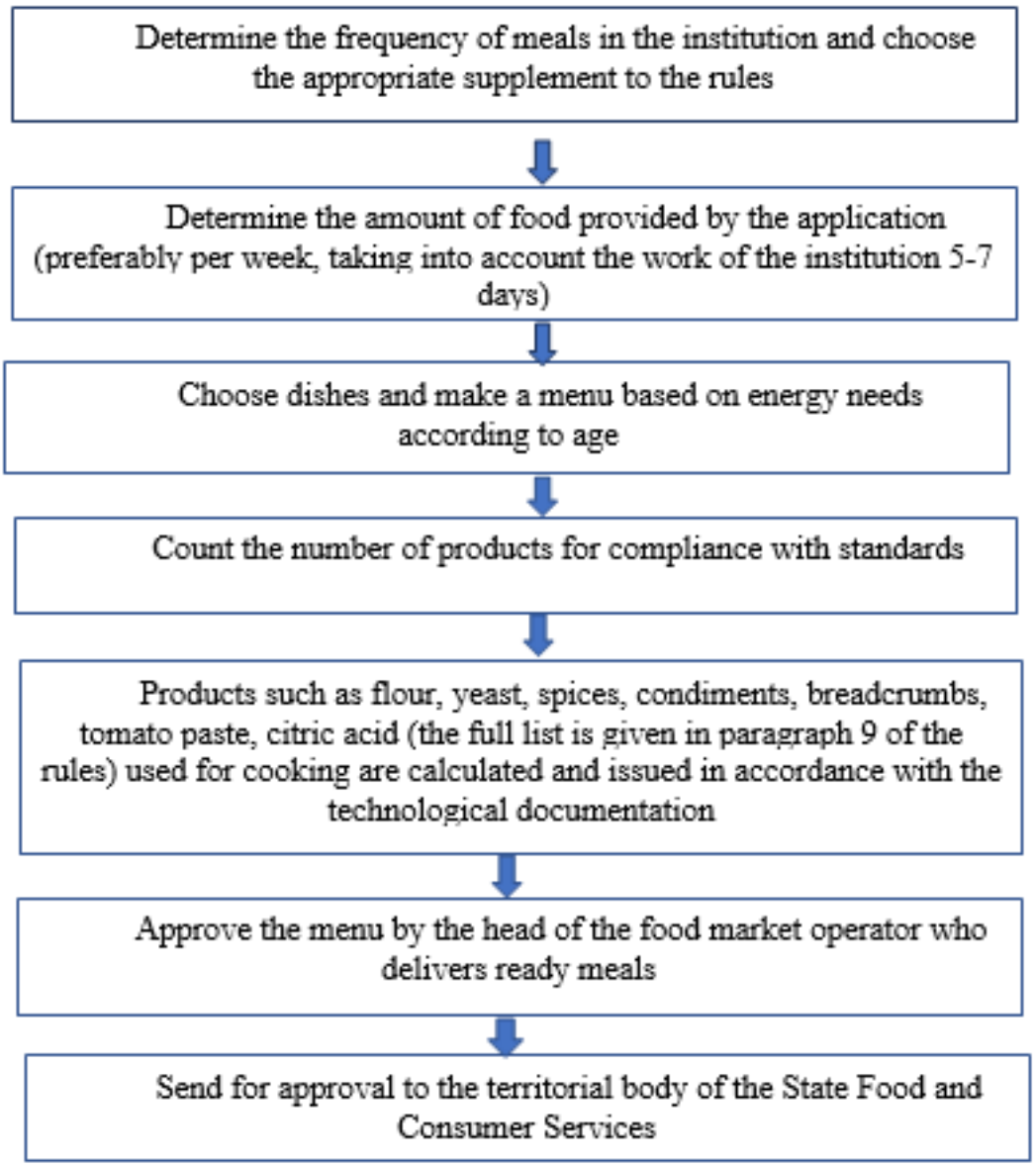

Figure 2. The procedure for compiling a menu for catering

If there is a medical certificate issued by a general practitioner - family doctor or pediatrician, certifying the special dietary needs of students with a diagnosis, for such categories of students organized nutrition in accordance with the recommendations of a general practitioner - family doctor or pediatrician in the certificate on restriction / exclusion of relevant foodstuffs, beverages and meals and their replacement with foodstuffs of similar energy and nutritional value.

Ready meals contain a limited amount of salt, sugar and fat in accordance with the requirements set by the Ministry of Health for the organization of nutrition in general secondary education.

In different seasons, fresh, frozen, dried and pickled vegetables, fruits and berries with salt, sugar and fat content can be offered in accordance with the requirements set by the Ministry of Health for the organization of nutrition in general secondary education.

Porridge and pasta are offered as stand-alone dishes or as side dishes. Preference is given to products with a higher content of dietary fiber (in particular, buckwheat compared to rice).

It is not allowed to boil vegetables for salads the next day.

Salads are seasoned immediately before delivery.

The salt content of bread meets the requirements set by the Ministry of Health for nutrition in general secondary education. Preference is given to whole-grain bakery products with a high fiber content, with the addition of bran and seeds.

Legumes (green peas, beans, peas, lentils) and dishes with their contents are offered as side dishes or stand-alone dishes.

The milk and milk products offered in terms of sugar content meet the requirements set by the Ministry of Health for nutrition in general secondary education institutions. There are dishes with milk and dairy products, to which vitamin D is added. Milk and kefir with a mass fraction of fat from 2.5 to 3.2 percent, yogurt - from 1.5 to 2.5 percent, cottage cheese - at least 5 percent, sour cream - not less than 15 percent.

Poultry (chicken, turkey), skinned, lean pork, veal, beef were used to prepare meat dishes.

Pasteurized juice without added sugars and sweeteners is offered in limited quantities in accordance with the diet - once a week in the amount of 200 g

Educational establishments do not use technologically processed meat and fish products, meat and eggs of waterfowl, river fish, food products (including snacks) with a salt content of more than 0.12 grams of sodium or the equivalent amount of salt per

100 grams finished product, food products with sugar content over 10 grams per 100 grams of finished product, food products containing synthetic dyes and flavors (except vanillin, ethylvanillin and vanilla extract), sweeteners, flavor enhancers, preservatives, unpasteurized milk and dairy products, made from unpasteurized milk, mushrooms, coffee and coffee beverages, fish, meat, fruit and vegetables and other preserves of industrial production, except pasteurized juices of industrial production without added sugars and sweeteners, carbonated beverages, including sweet carbonated and energy drinks, unpasteurized juices home-made products.

Do not use pasteurized bottled milk without boiling, cottage cheese (in the absence of primary packaging) and sour cream without cooking.

There are no such dishes as sour milk "samovasva", jellies, meat and fish salads, cold cuts, pâtés, zeltsy, forshmak, deep-fried products, pasta "navy" with soft cheese, cottage cheese or m ' ash, pancakes with soft cheese, cottage cheese or meat, creams, fruit drinks, drinks with artificial colors, flavors and sweeteners.

Vegetable oil (sunflower, corn, olive) is recommended for salads, and is a priority when cooking other dishes that require fat.

Saturated fats, including butter, make up no more than 10 percent of total calories.

One of the most useful components of complex dishes, including salads, are peeled nuts and seeds, without icing, without the addition of salt or sugar.

Information on the content of nuts and other common food allergens in ready meals is provided in the menu in accordance with the diet, clearly and easily provided to students with allergic reactions, their parents and other legal representatives. Next to the menu there is information on the interpretation of food allergen indices according to dietary norms.

Drinking water should be available at all times during meals and at any other time.

The founder (founders) and heads of relevant institutions provide students with clean and safe drinking water that meets the requirements set by the Ministry of Health.

The salt content is one of the main criteria for the selection of products and dishes offered in educational institutions and meets the standards of nutrition, as well as the requirements set by the Ministry of Health for the organization of nutrition in general secondary education.

Iodized salt is used in cooking.

The amount of added sugars in products and meals offered in educational institutions is limited in accordance with nutrition standards and the requirements set by the Ministry of Health for the organization of nutrition in general secondary education institutions. The content of sugars, which is naturally contained in dairy products, fruits, berries and vegetables, is not limited.

When choosing suppliers of seasonal vegetables, fruits, berries, cereals, legumes, nuts and seeds, preference is given to local agro-industrial enterprises in terms of supplying quality and safe products.

Procurement of food products is carried out in accordance with the Law of Ukraine "On Public Procurement".

The founder (s) and heads of educational institutions ensure the change of dishes, their preparation and taking into account the feedback and suggestions of students, their parents or other legal representatives and staff of institutions to meet food quality in order to limit food waste.

The developed 14-day menu for students in grades 1-4 is presented in tables 1 and 2.

These data show that national culinary traditions are taken into account when planning and preparing meals. At the same time, we offer a variety of modern dishes that meet international culinary trends - macaque, vegetable risotto.

Vegetables, fruits and berries are presented in the maximum variety, different forms and composition of ready meals.

Porridge and pasta are offered as stand-alone dishes. Preference is given to buckwheat with a higher content of dietary fiber.

The number of meat, poultry and fish dishes offered during the week corresponds to the diet. Meat dishes are combined with vegetable garnishes or salads.

Table 1.

Menu and nutritional value of breakfasts for students of grades 1-4, 1st week

№	The name of the dish	Output	Proteins	Fats	Carbohydrates	Energy value, kKal
Monday						
1	Vegetable salad with seeds	100,00	1,81	2,02	16,30	87,36
2	Mac and Cheese	150,00	11,11	14,41	24,11	265,75
3	Sour cream	20,00	0,70	2,12	1,42	27,28
4	Pancakes with apples	100,00	3,50	3,30	31,20	162,26
5	Fruit orange	100,00	0,90	0,20	8,10	36,18
6	Green / herbal tea	200,00	0,20	0,00	4,00	16,00
	Total		18,22	22,05	85,13	594,82
Tuesday						
1	Cucumber salad with parsley and garlic	100,00	1,59	3,23	4,02	50,71
2	Chicken thigh in mustard sauce	100,00	13,90	8,10	4,10	144,08
3	Buckwheat porridge with butter	120,00	4,10	3,10	32,08	166,20
4	Masala tea	200,00	3,75	3,05	6,36	66,62
5	Mandarin fruits	50,00	0,45	0,11	4,05	18,18
	Total		23,79	17,59	50,61	445,79
Wednesday						
1	Salad with cabbage and carrots and flax seeds	100,00	1,51	3,45	5,83	59,24
2	Fish fried in egg	100,00	12,30	6,20	10,00	143,00
3	Vegetable risotto	120,00	2,40	3,61	36,60	181,17
4	Yogurt	200,00	4,40	4,20	17,00	120,00
5	Grape fruits	100,00	0,84	0,40	18,00	75,36
	Total		21,45	17,86	87,43	578,77

Continuation of Table 1

Thursday						
№	The name of the dish	Output	Proteins	Fats	Carbohydrates	Energy value, kKal
1	Beet salad a	100,00	1,55	3,19	9,20	69,87
2	Roast at home with chicken	180,00	12,50	7,10	33,60	241,58
3	Cocoa with milk	200,00	2,80	3,90	24,80	140,54
4	Oatmeal cookies	60/2шт	1,80	6,00	14,20	115,16
5	Mandarin fruits	100,00	0,80	0,20	7,50	33,50
	Total		19,45	20,39	89,30	600,65
Friday						
1	Tomato and bread salad	100,00	1,75	2,43	6,98	55,39
2	Barley porridge with butter	120,00	2,40	3,12	30,40	153,20
3	Chicken schnitzel / Fish sticks	100,00	12,50	9,85	16,19	200,17
4	Masala tea	200,00	3,75	3,05	6,36	66,62
5	Banana fruit	100,00	1,51	0,52	21,15	91,09
	Total		21,91	18,97	81,08	566,47
Recommended rate			**18-21**	**17-21**	**73-88**	**525-630**

Potatoes as a separate dish (potatoes baked with turmeric) are offered no more than twice a week.

Among the most useful components of salads are nuts and seeds, in particular, the menu includes a salad with cabbage, carrots and flax seeds, as well as a vegetable salad with seeds. The amount of nuts and seeds should be 25 g twice a week.

The menu includes sea fish, which is a source of complete proteins and unique fatty acids, the menu of the first week presents fish fried in egg, and the second week includes fish under vegetables.

Analysis of the data in Table 1 showed that the nutritional value of breakfasts for students in grades 1-4 in the 1st week of nutrition meets the recommended standards for protein, fat and carbohydrates.

A slight excess of the recommended protein content (18-21 g) was noted in the menu on Tuesday (23.79 g), Wednesday (21.45 g) and Friday (21.91 g), but this is not a disadvantage, as the protein is necessary for the growth and development of the child's body. At the same time, the average protein content per week is 20.96 g, which is within the recommended norm.

According to the fat content, an increase in their number is observed only in the menu on Monday - 22.05 g at the recommended rate of 17-21 g. The species composition of dishes indicates the diversity of lipid composition and the predominance of vegetable oil against saturated animal fats.

Unsaturated fats include essential fatty acids and fat-soluble vitamins, so their consumption is mandatory for the proper structural and functional state of the body and its organs and systems, including brain, nervous system, heart, blood vessels, endocrine system, vision, skin and hair.

Reducing the consumption of saturated fats, mainly of animal origin, is associated with a reduced risk of diseases of the circulatory system. According to the average fat content, the weekly menu corresponds to the recommended norm.

Educators should regularly consume foods and foods rich in carbohydrates. The priority products of this group are plant products with a high content of dietary fiber. The content of carbohydrates in the daily meals presented in the weekly menu varies between 50.61-89.30 g. At the same time, the total average value of carbohydrates corresponds to the recommended norm of 73-88 g.

The energy value of the presented weekly menu below the recommended norm (525-630 kKal) is noted in the Tuesday menu (445.79 kKal).

The total average number of calories per week meets the recommendations.

The results of Table 2 indicate the compliance of the dishes presented in the menu, their nutritional and energy value to the recommended standards for students in grades 1-4.

Table 2.

Menu and nutritional value of breakfasts for students of grades 1-4, 2st week

№	The name of the dish	Output	Proteins	Fats	Carbohydrates	Energy value, kKal
Monday						
1	Cucumber salad	100,00	1,13	2,14	2,95	34,99
2	Potatoes baked with turmeric	120,00	3,09	8,11	25,21	181,15
3	Cheesecake with raisins	100,00	15,00	14,00	33,40	312,92
4	Sour cream	20,00	0,70	2,12	1,42	27,28
5	Drink from dried fruits	200,00	0,60	0,00	10,00	40,40
6	Grape fruits	100,00	0,63	0,30	13,51	56,56
	Total		21,42	26,57	86,49	653,29
Tuesday						
1	Salad with vegetables and eggs	100,00	2,54	4,48	3,26	62,87
2	Pilaf with meat	200,00	16,60	13,36	33,60	314,32
3	Rye bread	30,00	1,00	0,20	15,00	62,80
4	Cocoa with milk	200,00	2,80	3,90	24,80	140,54
5	Fruit orange	100,00	0,90	0,20	8,10	36,18
	Total		23,84	22,14	84,76	616,71
Wednesday						
1	Tomato salad	50,00	0,60	3,00	1,90	36,62
2	Boiled pasta with butter	120,00	5,92	5,28	25,28	167,26
3	Fish under vegetables	100,00	14,34	5,25	15,80	164,65
4	Yogurt	150,00	3,30	3,15	12,75	90,00
5	Mandarin fruits	100,00	0,80	0,20	7,50	33,50
	Total		24,96	16,88	63,23	492,03

Continuation of Table 2

Thursday						
№	The name of the dish	Output	Proteins	Fats	Carbohydrates	Energy value, kKal
1	Salad with cabbage and carrots	100,00	1,51	3,45	5,83	59,24
2	Buckwheat with butter	120,00	4,10	3,10	32,08	166,20
3	Milanese cutlet with cheese	100,00	15,40	11,08	23,60	251,00
4	Kefir	150,00	2,90	2,50	3,80	48,54
5	Apple fruits	100,00	0,37	0,40	13,12	54,94
	Total		24,28	20,53	78,43	579,92
Friday						
1	Cheese and tomato salad	50,00	4,20	5,10	1,70	69,16
2	Vegetable stew with green peas	120,00	3,10	7,80	10,10	120,98
3	Corn pancakes with apples	150,00	8,25	10,05	50,10	313,83
4	Сметана Sour cream	20,00	0,70	2,12	1,42	27,28
5	Yogurt	150,00	3,30	3,15	12,75	90,00
	Mandarin fruits	50,00	0,45	0,11	4,05	18,18
	Total		20,00	28,33	80,12	639,43
Recommended rate			**18-21**	**17-21**	**73-88**	**525-630**

In the daily menu there are no significant deviations in the content of individual factors of nutrition, but the overall average values of protein, fat, carbohydrates and calories per week correspond to their recommended amounts.

Thus, based on the research and taking into account the requirements, recommendations for the organization of school meals on the terms of catering. Technological maps of salads and breakfast menus for schoolchildren of grades 1-4 have been developed, taking into account their preferences and in accordance with the recommended norms of nutritional and energy value of rations.