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ANALYSIS OF INFORMATION RELATED TO CONSUMPTION BY STUDENTS OF FOODS WITH A HIGH VITAMIN C CONTENT

An important role in shaping the body is played by nutrition, in particular, the consumption of foods with high vitamins content. Providing the diet of young people with vitamin C is one of the modern problems.

To analyze the consumption of food products with a high content of vitamin C by students, we surveyed students in grades 9–11. The questionnaire also included an analysis of awareness of students with regard to of ascorbic acid content in the most common foods.

Our research results confirm the current trend in consumption by students of foods with high vitamin C content. A survey of schoolchildren confirms that respondents most often consume fresh vegetables and fruits, most respondents said that it is required to advertise the consumption of vitamin C.

Based on the results of the survey, it was found that consumption by students of high vitamin C foods is at a fairly high level. A significant number of students who participated in the survey are sufficiently informed about the range and content of ascorbic acid in food.

Keywords: vitamins; ascorbic acid; nutrition; diet; questionnaires.

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АНАЛІЗ ВІДОМОСТЕЙ ПРО СПОЖИВАННЯ ШКОЛЯРАМИ ХАРЧОВИХ ПРОДУКТІВ З ВИСОКИМ ВМІСТОМ ВІТАМІНУ С

Харчування школярів – це важлива складова збереження здоров'я. Серед компонентів харчового раціону молоді особливе місце посідають вітаміни, складові обмінних процесів. Нестача вітамінів, як біологічно активних речовин, у добовому раціоні школяра може гальмувати психічний та фізичний розвиток дитини. Щоденне споживання вітамінів та мікроелементів, насамперед аскорбінової кислоти, має важливе значення для формування здорової особистості.

З метою з'ясування аналізу споживання харчових продуктів з високим вмістом вітаміну С було проведено анкетування школярів 9–11 класів. Результати анкетування засвідчили, що учні 9–11 класів поінформовані про вітамінний склад продуктів харчування та наявність у них аскорбінової кислоти. Встановлено, що харчовий раціон у 96 % школярів включав достатню кількість продуктів з підвищеним вмістом вітаміну С. Відомості анкетування підтвердили регулярне споживання учнями свіжих овочів та фруктів.

Виявлено, що респонденти володіють знаннями про важливу функцію аскорбінової кислоти для організму. При цьому школярі обізнані про доцільність споживання вітаміну С не лише у складі харчових продуктів, а і його синтетичного аналога.

Ключові слова: вітаміни; аскорбінова кислота; харчування; раціон; анкетування.

Introduction. The health of the younger generation, including students, is formed by many factors, such as genetic, social, family, economic, environmental, moral and psychological, behavioral, etc. One of the modern problems is to provide the human diet with the necessary vitamins. It occurs as an inevitable consequence of reduced

energy consumption and a corresponding reduction in the total amount of food consumed by humans. Therefore, the need to increase the content of vitamins in the diet, for example, by vitaminizing food for mass consumption, is becoming increasingly important [2].

An important role in forming the body is played

by nutrition, in particular, the consumption of high vitamin C foods. The real situation and problems in the field of nutrition of the Ukrainian population are that there has been a persistent disruption in nutrition in recent years: a sharp decline in biologically valuable foods containing vitamins. Vitamins have high biological activity and participate in metabolism, regulating certain biochemical and physiological processes. In particular, vitamin C – ascorbic acid – is one of the main nutrients – antioxidants, which independently destroy free radicals and microbial infections, as well as prolong the life of free antioxidants [13].

The supply of ascorbic acid to the human body is of particular concern. In 50 ...80 % of the population has a deficiency, which has an extremely negative impact on human health. Vitamin C can be attributed to miracle vitamins, which are recognized as an ingenious invention of nature. It is the most famous and most studied vitamin [8]. The World Health Organization recommends consuming 5 to 9 portions of fruits and vegetables daily. The main problem is the very rapid consumption of ascorbic acid, and its excess is eliminated from the body after four hours [1].

Analysis of the recent research and publications. In the course of evolution, man, unlike many living things, has lost the ability to synthesize vitamin C. At the same time, it is vital and therefore must come daily with food. Vitamin C belongs to the group of water-soluble vitamins, it can not be accumulated in the body and even a slight deficiency causes numerous health disorders [5].

Vitamin C is a colorless crystal, sour in taste, soluble in water and alcohol, but insoluble in gasoline, chloroform, ether, and other fat solvents. In an oxygen-free environment, ascorbic acid crystals can be stored for years, however, the vitamin is rapidly destroyed in the presence of oxygen or solution, especially alkaline C [9].

The empirical name of the vitamin (ascorbic acid) indicates its prophylactic effect on the manifestation of scurvy. This is a specific pathological process developing in the human body with exogenous vitamin deficiency. In terms of chemical structure, vitamin C is a X-lactone of 2,3-dihydro-L-gulonic acid. Fe and Cu ions contribute to its destruction. Ascorbic acid easily gives 2 H atoms, turning into dehydroascorbic acid, and vice versa. This most important reaction underlies the mechanism of its biological molecule action. It participates in redox systems and ensures the normal course of vital processes in tissues [3].

The biological role of ascorbic acid is often associated with participation in redox processes. However, enzymes in which the acid plays the role

of a coenzyme have not yet been identified. The compound was found to serve as a hydrogen donor for the reduction of various biological substrates. In particular, it is known that ascorbic acid can reduce disulfide bonds to sulfide groups, thereby activating several enzymes. In turn, dehydroascorbic acid can be enzymatically reduced in body tissues with the participation of glutathione. The presence of ascorbic acid is closely related to the metabolism of proteins, carbohydrates, and minerals. Hydroxylation processes take place with the formation of several biologically active substances in the presence of ascorbic acid. Thus, due to hydroxylation, tryptophan is converted into 5-hydroxytryptophan, which is the basis for the formation of the mediator serotonin [4].

Ascorbic acid is necessary for the processes of hydroxylation for the conversion of cholesterol on the way to steroid hormones, for the conversion of 3,4 dihydroxyphenylethylamine to norepinephrine. This compound promotes the release of iron from ferritin and transferrin, which ensures its penetration into tissues. The reduction of Fe^{3+} to Fe^{2+} necessary for its absorption takes place in the intestine with the participation of ascorbic acid. The reduction of folic acid to the coenzyme form of tetrahydrofolic acid also occurs with the participation of ascorbic acid. There is no process of hydroxylation of proline and lysine without ascorbic acid, and hence the conversion of procollagen into collagen, which is the main extracellular component of connective tissue [8].

Vitamin C or ascorbic acid is synthesized by most organisms from glucose, but humans and warm-blooded animals cannot do it and should receive it with food. Daily human need is 52... 322 mg of vitamin C, in particular, (children (1–3 years) – 15 mg, children (4–8 years) – 25 mg, adolescents (9–13 years) – 45 mg, adolescents (14–18 years) – 65–75 mg, adult women (aged 19 years) – 75 mg, adult men (aged 19 years) – 90 mg) [14].

Ascorbic acid helps the body synthesize the protein collagen, which is the basis of muscles, bones, cartilage, blood vessels, skin, and all body tissues. It is a special framework providing tissue strength (protects tissues from tearing/stretching during exercise), prolongs youth (provides skin elasticity, and together with hyaluronic acid – hydration and turgor, and therefore protect the skin from wrinkles and dehydration). Essential amino acids, vitamin C, a certain level of sex hormones, and the absence of long-term ultraviolet light are necessary for the skin or other organs to always have collagen.

Vitamin C is an anti-stress vitamin. Its reserves are quickly depleted under the stress of any nature. This is especially true for people who smoke, drink alcohol, and struggle against obesity. The level of

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vitamin C in the blood is a marker (indicator) of the health level. It protects against viral and bacterial infections [6].

Vitamin C stimulates the formation of immune cells, interferon, and antibodies (the use of sufficient amounts of vitamin reduces the duration of SARS by 23%). Conversely, vitamin C deficiency leads to suppression of immunity. The required concentration of vitamin C in the body can prevent the risk of complications such as pneumonia and other lung diseases [10].

Protects the body from the harmful effects of toxic substances. Vitamin C enhances the ability of the liver to detoxify and helps cleanse it of harmful substances such as radionuclides, heavy metals, nitrates. It has been scientifically proven that in 2–3 days after the exclusion of vitamin C from the diet, the concentration of enzymes cleansing the body of toxins in liver cells decreases by 20 % [15].

Ascorbic acid is a necessary component in the diet of people with anemia, girls, and women with excessive or unstable menstruation. Vitamin C and an acidic environment improve iron absorption. Animal foods and seafood improve the absorption of iron from plant foods. It positively affects the comprehensive treatment of diphtheria, pneumonia, and influenza: improves well-being, appetite, sleep, reduces intoxication [12].

Vitamin C activates folic acid (vitamin B₉), so this vitamin can have its effect. Folic acid is necessary for the prevention of fetal malformations, and for the prevention of heart attacks and strokes in combination with vitamins B₆ and B₁₂. It protects “good” cholesterol from oxidation, helps reduce “bad” levels, and prevents the development of atherosclerosis. People with high vitamin C diets had a 42 % lower risk of stroke than people with a vitamin C-poor diet. It protects the body from the harmful effects of the environment: enhances the detoxification function of the liver and promotes cleansing of toxic substances, radionuclides, heavy metals, nitrates. It has been proven that the content of enzymes in liver cells, which cleanse the body of toxins, decreases by 20 % 2 days after the exclusion of vitamin C from the diet. It improves the delivery of oxygen to cells: penetrating erythrocytes (blood cells that carry oxygen), protects them from destruction by free radicals. It provides the transport of vitamin D to cells, preventing the development of rickets. Vitamin D is ineffective with vitamin C deficiency [7].

Vitamin C is required for the synthesis of one of the most important neurotransmitters norepinephrine and anti-stress hormones corticosteroids. Vitamin C restores the structure of the endothelium (inner wall of blood vessels) in people with coronary heart disease, hypertension, diabetes, and smokers [16].

It reduces the risk of blood clots in the blood vessels by reducing aggregation (sticking) of platelets (blood cells). This effect, especially in combination with vitamin E, slows the development of neurodegenerative diseases, such as Alzheimer disease.

It is a strong antioxidant: a molecule of vitamin C gives 1 or 2 electrons to a free radical and makes it inactive. Free radicals are known to cause almost 100 diseases, such as inflammation, heart disease, blood vessels diseases, eyes diseases, type 2 diabetes, cancer, and premature aging. It protects DNA from free radical damage, blocks the formation of carcinogenic nitrosamines from nitrates (nitrates are abundant in sausages and smoked products, as well as in cigarette smoke), reduces the risk of tumors. It reduces the risk of cancer, especially gastric cancer in people with atrophic gastritis and bowel cancer, as well as – by neutralizing nitrates – substances abundant in sausages (make the product pink and are preservatives), vegetables, and fruits, grown on soils rich in ammonia fertilizers.

Vitamin C deficiency can also occur during a lack of protein in the diet, exposure to adverse climatic factors, hard physical labor, mental stress, pain, etc. Vitamin C is prescribed for toxidermia, allergic dermatitis, eczema, neurodermatitis, chronic urticaria, herpes zoster, photodermatitis, vesicles, chronic pyoderma, acne, long-term use of corticosteroids. In diseases manifested by vascular pathology of the skin, vitamin C is combined with routine [11].

However, long-term use of the vitamin daily in the amount of 1000 mg can cause a tendency to the formation of kidney stones and elevated iron levels, to various allergic manifestations, as well as during pregnancy can contribute to miscarriage. Vitamin C is contraindicated in severe forms of diabetes, caution should be exercised in prescribing its maximum (intravenous) doses to patients with increased blood clotting, thrombophlebitis, the propensity to thrombosis [16].

Vitamin C is an important vital substance that must be constantly supplied to the body with food. Every day the human body should receive 70–90 mg of ascorbic acid with food [14].

The source of vitamin C is, above all, plants. It is known that fresh fruits, berries, and vegetables are high in vitamin C. Ascorbic acid is found in many fruits and vegetables, including oranges, strawberries, kiwis, bell peppers, broccoli, cabbage, and spinach.

Black currants are characterized by the highest content of vitamin C among berries. Black currants are a source of vitamin C. Two tablespoons of black currants contain the daily norm of vitamin C. 100 g of currants contain as much vitamin C as two lemons

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or four oranges. It contains also vitamins A, E, B₁, B₅ and B₆. Fat-soluble vitamins A and E are contained in currant seeds. Fruits and leaves of black currant have anti-inflammatory, diaphoretic, and diuretic properties. Black currants are used to strengthen the immune system, to increase appetite. Black currant leaves in the form of a decoction are used to treat rheumatism, gout, tuberculosis [7].

Sweet pepper, parsley and dill, cauliflower and white cabbage, green onions, horseradish are among the vegetables high in ascorbic acid. A slightly lower content of vitamin C is in strawberries and citrus fruits (oranges, tangerines, lemon, grapefruit), and sorbier domestique. Apples, carrots, and eggplants are characterized by a low content of vitamin C. The distribution of vitamin C in the components of fruits and vegetables is different – as a rule, it is higher in the integumentary tissues than in the parenchymal.

Along with vegetables, berries, and fruits, wild plants are a valuable raw material of vitamin C. Among wild species, some representatives are characterized by a high content of ascorbic acid. Such plants are represented by groups: grasses, shrubs, and trees. The vitamin C content in different parts of plants is not the same. Vitamin C, or rather its form L-ascorbic acid – is common in wild berries. Most of them, with regular consumption, replenish the daily requirement of ascorbic acid (200 mg per day) [14].

Rosehip is a natural concentrate of vitamin C. The content of vitamin C in rose hips varies sharply in its various species. The following types of dog rose differ in the high content of ascorbic acid: *Rosa cinnamomea*, *Rosa acicularis*; *Rosa canina*. 100 g of dried rose hips contain up to 1500 mg of ascorbic acid.

Information about the healing properties of linden has a long history. For centuries and modern times, this plant is widely used in folk medicine and is part of some medicines. All parts of this plant show medicinal value. Regarding the vitamin C content, most of it is concentrated in flowers.

Horseradish is used as a spicy flavoring not only increasing appetite. Horseradish has always been valued as an important vegetable, which contains up to 60 mg of vitamin C. Nettle leaves are a well-known phytotherapeutic agent. In terms of vitamin C, it is equivalent to sweet pepper. The leaves of field penny-cress contain a large amount of vitamin C. The plant has disinfectant and anti-zinc properties [15].

Alfalfa is a well-known fodder plant. As a medicinal raw material, alfalfa is an unofficial plant. However, alfalfa herbal tea is a source of vitamins for humans. At the same time, alfalfa is used for medicinal purposes. Alfalfa contains a large amount of vitamin C. All nutrients are contained in the flowers

(purple or yellow), in the green part of the plant, and even in the seeds. Alfalfa improves vision.

Rowan berries are rich in vitamin C (up to 160 mg %) and β-carotene (up to 5.6 mg %). Preparations from rowan fruit reduce the amount of fat in the liver and cholesterol in the blood, powder from rowan fruit increases the resistance of blood vessels. In scientific medicine, the fruits of rowan are used as a multivitamin, diuretic, hemostatic agent [13].

Thus, a significant number of plant species contain high levels of ascorbic acid, which defines them as a valuable food and phytotherapeutic product.

Material and methods. To analyze the consumption of food products with a high content of vitamin C by students, we surveyed students in grades 9–11. The survey was attended by 120 students, of which 44 % were boys and 56 % were girls. To do this, we developed a questionnaire, which consisted of 10 questions. In particular, the questions were whether and how often respondents consume high vitamin C foods, which foods high in vitamin C they eat most often, whether they know about the consumption of foods high in vitamin C by friends, whether they use ascorbic acid medications, whether they use vitamin herbal teas and juices in their diet, whether they believe that vitamin C is good for the body, and its consumption needs advertising.

Some questions concerned awareness of students with regard to of the list of the most common foods high in vitamin C, in particular, which fruits and vegetables high in ascorbic acid they know.

Results and discussion. The results of the survey showed a fairly high level of consumption by students (95 %) of foods high in vitamin C. It should be noted that all students in 10th grade (100 %) reported the use of foods high in ascorbic acid in their diet, 11th graders (90 %) and 9th graders (95 %) also consume a sufficient amount of foods high in vitamin C.

In recent years, more and more attention is paid to the nutrition of schoolchildren and its impact on the formation of health. It is proved that an insufficient amount of vitamins during school years can inhibit the physical and mental development of the child. Daily intake of vitamins and trace elements, including ascorbic acid, is important for the formation of a healthy personality.

To the question “How often do you consume foods high in vitamin C?” the majority of respondents (52,5 %) answered that they consume 1–2 times a week, 25,8 % of respondents consume sporadically, 17,6 % consume every day and 4,1 % of schoolchildren said that they do not use foods high in vitamin C in their diet.

Given the relatively low, in our opinion, level of

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food consumption high in vitamin C among schoolchildren, it should be noted that our body does not produce ascorbic acid, it is obtained only from food, including fruits and vegetables, citrus fruits, kiwi, black currant, raspberry, cranberry, bell pepper, sorrel, etc.

The results of the survey showed that only 15 % of respondents were not sufficiently informed about the content of ascorbic acid in food and could not correctly name vegetables and fruits with high vitamin C content. However, all respondents (100 %) believe that vitamin C intake is good for the body.

In addition to fresh vegetables and fruits, a significant source of vitamin C for the young body is the presence of juices in their daily diet. Juices are one of the most common drinks not only among adults but also among children. Fruit and vegetable juices contain flavoring and nutrients, have a positive effect on the physiological process. They saturate the body with a large number of essential vitamins, micro-, and macronutrients, polysaccharides, sugars, organic acids, some essential acids, without overloading the digestive system.

To the question "Do you consume juices?" 91,6 % of students gave a positive answer. It should be noted that 47,5 % of students consume juices 1–2 times a week, 25 % of students consume juices sporadically and only 27,5 % of respondents consume vitamin drinks every day. It should be noted that analyzing the total consumption of juices by respondents found that students of 10th grade consume more juices (95 %) than students of 11th grade (80 %) and students of 9th grade – 85 %. However, in general, this figure is quite high.

To the question "Do your friends consume foods high in vitamin C?" 36,7 % of respondents said they were uninformed, and 63,3 % of students were aware of their friends consumption of foods high in ascorbic acid. Among them, 62,5 % of students in the 11th grade know about the consumption of foods high in vitamin C by friends, 75 % in the 10th grade, and 52,5 % in the 9th grade.

A significant number of respondents (70,8 %) said that vitamin C intake should be advertised, 25,8 % of respondents are not aware of advertising and only 3,4 % believe that vitamin C consumption does not need advertising. Thus, 62,5 % of respondents among 11th-grade students, 85 % among 10th-grade students, 65 % among 9th-grade students believe that the consumption of foods high in vitamin C needs advertising.

Today, herbal teas, which are rich in vitamins, biologically active, and aromatic substances, are also common among non-traditional drinks. They contain ascorbic acid, B vitamins, antioxidants, antibacterial

substances, carotene, rutin, trace elements, etc. Ascorbic acid in a fairly large amount (400–3000 mg/%) is synthesized in lemon balm, mint, dog rose, currant leaves, etc.

During the processing of school questionnaires, it was found that 51,6 % of students in grades 9–11 consume herbal teas with a high content of vitamin C (rose hips, currants). In particular, 62,5 % of respondents consume herbal teas among 10th-grade students, 35 % among 11th-grade students, and 57,5 % among 9th-grade students.

Fresh vegetables and fruits are the main sources of vitamins, minerals, and fiber. Complete nutrition involves the mandatory inclusion of fresh vegetables and fruits, especially foods high in vitamin C in the diet of schoolchildren. Their consumption ensures the normal functioning of all organs and systems.

The survey found that 80 % of respondents most often eat fresh vegetables and fruits. In particular, among 11th-grade students, fresh vegetables and fruits are most often used in the diet of 80 % of respondents, 70 % among 10th-grade students, 90 % among 9th-grade students.

All citrus fruits (oranges, lemons, tangerines, grapefruits) are very useful for the body because they are rich in ascorbic acid, vitamins A, B, P. In addition, they serve as a source of phytoncides helping to remove toxins, strengthen the immune system, normalize metabolic processes. Ascorbic acid helps the functioning of the immune system, helps maintain energy metabolism, along with zinc involved in protecting cells from antioxidant stress cells.

To the question "Do you consume citrus fruits?" 95 % of students gave a positive answer. In particular, citrus is consumed by 100 % of respondents among students in grades 10–11, and by 85 % of respondents among students in grades 9.

The main methodological element is to develop measures to raise awareness of students of sufficient ascorbic acid consumption. For this purpose, the following forms of work are used: conducting extracurricular activities, conversations, health days in the classroom and school, as well as the use of such tools as writing dictations on this topic, quizzes, debates in the educational process. All these forms of work should be supported by real-life examples showing a positive impact on vitamin intake.

Conclusions. Our research results confirm the current trend in the consumption of foods high in vitamin C by schoolchildren. Thus, all students in 10th grade (100 %) reported the use of foods high in ascorbic acid in their diet, 11th-grade students (90 %) and 9 classes (95 %) also consume a sufficient amount of foods high in vitamin C.

The results of the survey showed that the majority

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of respondents (52,5 %) consume foods high in vitamin C 1–2 times a week, 25,8 % of respondents consume sporadically, 17,6 % consume every day and 4 % of students said they did not use at all foods high in ascorbic acid in their diet.

The main modern foods high in ascorbic acid are juices, fresh vegetables, and fruits, pickled vegetables, herbal teas, etc. Data from a survey conducted among schoolchildren confirm that 80 % of respondents most often eat fresh vegetables and fruits. 70,8 % of respondents said that it was required to advertise the consumption of vitamin C, 25,8 % of respondents are not aware of advertising and only 3,4 % believe that vitamin C intake does not need advertising.

Based on the results of the survey, it was found that consumption by students of high vitamin C foods is at a fairly high level. A significant number of students who participated in the survey are sufficiently informed about the range and content of ascorbic acid in food.

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