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MONITORING OF THE CONTENT OF NITRATES IN THE MOST COMMON VEGETABLES OF THE ODESSA'S COMMERCIAL NETWORK

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The article presents the results of the research on the content of nitrates in the most common vegetables of the Odesa retail network. It has been established that certain types of vegetables have a nitrate content that significantly exceeds the permissible values, and their consumption without proper pretreatment can lead to poisoning. In particular, the content of nitrates in table beets was in the range of 4000.0±254.0-9999.0±457.7 mg/kg. The content of nitrates in the head of white cabbage turned out to be high (1600.0±69.3-2200.0±98.6 mg/kg) and in potatoes (330.0±25.5-850.0±64.2 mg/kg

No excess of nitrate content was found in onions and carrots, and it was 30.0±2.5 and 50.0±3.7-190.0±16.3 mg/kg, respectively.

Key words*: nitrates, nitrites, poisoning, safety, vegetables.*

PROBLEM STATEMENT, ANALYSIS OF RESEARCH AND PUBLICATIONS

The modern attitude to nutrition involves a reasoned choice by the consumer of such food products that are useful for health and are able to provide the body with physiologically necessary nutrients. Fresh vegetables can be attributed to the category of natural functional food products, because with their regular consumption, it is possible to ensure the improvement and strengthening of human health, the improvement of the functioning of individual organs and systems of the body due to the presence in such raw materials of a high content of certain physiologically functional ingredients [18].

Accumulation of nitrates and nitrites in plants poses a serious threat to human health. Nitrates and nitrites, interacting with hemoglobin, turn it into methemoglobin, which does not tolerate oxygen. A sick person feels a lack of oxygen, and the development of the disease can end in death. In addition, nitrates are carcinogens, cause diseases of the digestive tract, hypertension and other diseases [2, 6]. Nitrites, which are formed from nitrates, are the most dangerous form of nitrogen compounds for humans. The destructive effect of nitrites and nitrates on the body is due to the initiation of free radical processes and peroxidic oxidation of lipids, which leads to damage to cell membranes, a decrease in the activity of the immune system, changes in the antioxidant system, activation of oxidative modification of proteins [20]. An increase in reactive nitrogen species can lead to nitrosative stress, a deleterious process that can be an important mediator of damage to cellular structures, including lipids, membranes, proteins, and DNA [9].

Recently, there has been a great interest in the nitrate content of food products and in those disorders in human health that can be caused by nitrate pollution. Nitrates and nitrites accumulate in products of plant origin under conditions of excess nitrogen nutrition. The toxicity of nitrates for humans and animals is caused mainly by their transformation into nitrites, which can form with secondary amines carcinogenic compounds - nitrosoamines. In the alimentary canal, under the influence of microflora, nitrates are converted into nitrites, which cause nitrate methemoglobinemia [1, 13, 21].

Plants of different species accumulate nitrates differently [19]. Literary data show that, according to the Ministry of Health of Ukraine, the nitrate content in 10% of plant products constantly exceeds the maximum permissible levels, therefore the nitrate content in vegetables and their products is regulated. Domestic scientists found that vegetables from the supermarket contain more nitrates, compared to vegetables from home plots [4]. There are also reports that about 45% of experimental samples of plant products contain elevated nitrate content [15]. The most nitrates accumulate in root crops and leafy vegetables, the least in grains [5, 6]. The factors that cause the accumulation of nitrates in vegetable agricultural products include: lack of light, heat and cold during the growing season of plants, drought and constant moisture, large and small amounts of such elements as nitrogen, potassium, phosphorus in the soil, biological activity and acidity of the soil, diseases soil and others. In addition, research results indicate that all winter vegetables are characterized by an acceptable nitrate content [8]. At the same time, there are reports of excess nitrate content in table beets, carrots, cabbage, zucchini, cucumbers [3, 10, 17]. Relatively few nitrates are concentrated in potatoes, tomatoes, sweet peppers, onions, garlic, peas, beans [12].

Nitrates constantly circulate in the atmosphere, terrestrial and aquatic ecosystems. Their transformation and migration are carried out in biogenic and abiogenic ways through air, water, soil, microorganisms, plants, animals and humans. Based on many years of research in many countries of the world, WHO and FAO established that the maximum permissible dose of nitrates, which is harmless to human health, is 3.6 mg per 1 kg of body weight [6, 14]. The toxic dose for adults is 600-650 mg per day, and for infants - only 10 mg [11, 16].

In Ukraine and the European Union, the content of nitrates in plant products is regulated at the legislative level. However, the EU only sets nitrate limits for green leafy vegetables (lettuce, spinach and arugula) and for processed grain-based foods and other foods for babies and young children [7].

Technological processing of agricultural products is of great importance for reducing nitrates [11]. Environmentally controlled facilities, such as greenhouses and closed plants, provide great convenience for controlling nitrate concentrations in vegetables [2].

Thus, the problem of the content of nitrates in products of vegetable origin is relevant not only for our country and requires the constant attention of scientists.

THE GOAL OF THE WORK

The purpose of the work was to monitor the content of nitrates in the most common and available vegetables, which are sold in the commercial network of Odessa during December 2023-February 2024.

MATERIALS AND METHODS

Samples of such vegetables as potatoes, carrots, table beets, white onions, white cabbage were selected for the research. Every month (during December 2023 - February 2024), 5 samples of each type of vegetable were taken from different trading places (agricultural markets, supermarket chains). Samples were taken randomly. A total of 75 samples of vegetables (15 samples of each species) were examined during the monitoring period. Each measurement was performed in triplicate.

Determination of the content of nitrates in vegetables was carried out using the express method, using the "Green EKO" device. The device was used according to the instructions attached to it.

All obtained measurement results were processed statistically according to generally accepted classical mathematical methods.

RESEARCH RESULTS

Research on the content of nitrates in vegetables was conducted during the winter of 2023-2024. The obtained measurement results are shown in Table 1.

Table 1. **Fluctuations in the content of nitrates in vegetables of the commercial network Odessa (M±m, n=225)**

№ in order	Kind of vegetables	Fluctuations in nitrate content, mg/kg
1	Potato	330.0±25.5-850.0±64.2
2	Carrot	50.0±3.7-190.0±16.3
3	Table beet	4000.0±254.0-9999.0±457.7
4	White onion	30.0±2.5
5	White cabbage (leaves)	30.0±2.1-260.0±17.5
6	White cabbage (cob)	1600.0±69.3-2200.0±98.6

Table 1 shows that the content of nitrates in potatoes in all samples was elevated and was in the range of 330.0±25.5-850.0±64.2 mg/kg. The average value for potatoes was 548.0±52.5 mg/kg, which exceeds the permissible value by 119.2%. No increase in nitrate content was detected in any carrot sample during the experimental period. Thus, their content in carrots was in the range of 50.0±3.7-190.0±16.3 mg/kg.

The content of nitrates in table beets turned out to be the highest. Table beet samples were found to exceed the permissible content by 528.5%, because the average content for the samples was 8799.2±125.5 mg/kg. In general, in table beets, the nitrate content fluctuated between 4000.0±254.0-9999.0±457.7 mg/kg.

In onion samples, as well as in carrot samples, not a single sample with an excess of nitrates was detected. Thus, all onion samples had the same value of nitrate content – 30.0±2.5 mg/kg.

As for white cabbage, the content of nitrates in leaves and heads differed significantly. An excess of nitrate content was not detected in any sample of white cabbage in the leaves. Their content was in the range of 30.0±2.1-260.0±17.5 mg/kg. The average value was 98.0±8.5 mg/kg. As for the content of nitrates in the heads of white cabbage, it significantly exceeded the permissible value in all samples by approximately 117.7% and was in the range of 1600.0±69.3-2200.0±98.6 mg/kg, based on the average value of 1960 ,0±112.5 mg/kg. The deviation of the nitrate content from the permissible values in vegetables sold in the Odesa retail network is shown in Fig. 1.

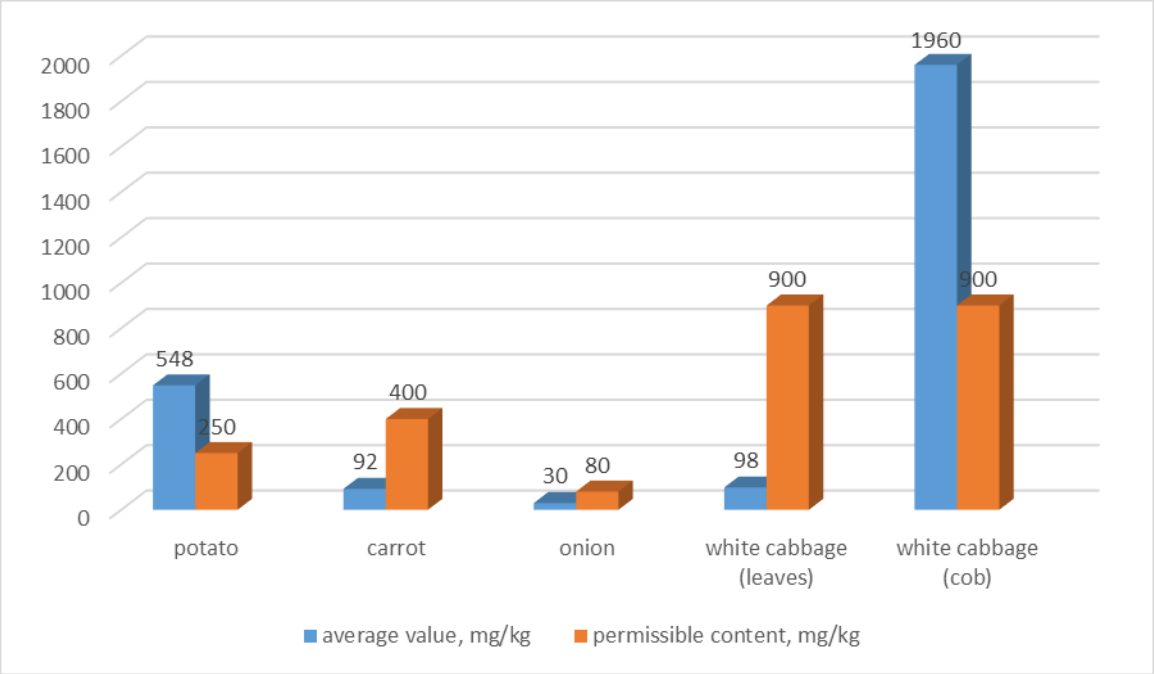

Fig. 1 Nitrate content in vegetables of the Odesa retail network (December 2023 - February 2024)

According to Fig. 1 it becomes clear that even local vegetables can pose a threat to human health due to their high nitrate content. They pose a particular danger to children and the elderly, those recovering from illnesses. As the results of our research showed, special attention should be paid to table beets and potatoes, because the heads of white cabbage are usually not used for human consumption. Nitrate content in such vegetables can be reduced by proper technological processing and preparation for use, including cooking, soaking, and removal of areas containing the largest amount of nitrates.

CONCLUSIONS

Vegetables, such as potatoes, onions, carrots, beets, white cabbage, are valuable components of human diets, as well as the diets of people who follow a healthy diet. However, despite their benefits, they can pose a threat to the health of the population due to their high nitrate content. Thus, in the winter season (December 2023-February 2024), an increased content of nitrates in table beets, which exceeds the permissible content by 528.5%, was found in the vegetables of the Odesa trade network; in potatoes - by 119.2%; in heads of white cabbage - by 117.7%. In the onion and carrot samples, no excess of the permissible nitrate content was detected during the experimental period.

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МОНІТОРИНГ ВМІСТУ НІТРАТІВ У НАЙБІЛЬШ ПОШИРЕНИХ ОВОЧАХ ТОРГІВЕЛЬНОЇ МЕРЕЖІ М. ОДЕСИ

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У статті представлені результати дослідження вмісту нітратів у найбільш поширених овочах торгівельної мережі м. Одеси. Встановлено, що окремі види овочів мають вміст нітратів, який значно перевищує допустимі значення, та вживання їх без належної попередньої обробки може призвести до отруєнь. Зокрема, у буряку столовому вміст нітратів знаходився у межах 4000,0±254,0-9999,0±457,7 мг/кг. Високим виявився вміст нітратів у качані білокачанної капусти (1600,0±69,3-2200,0±98,6 мг/кг) та у картоплі (330,0±25,5-850,0±64,2 мг/кг).
У цибулі ріпчастій та моркві не виявлено перевищення вмісту нітратів та він становив відповідно 30,0±2,5 й 50,0±3,7-190,0±16,3 мг/кг.

Ключові слова: *овочі, нітрати, нітрити, безпечність, отруєння.*