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NITRITE AND NITRATE POISONING

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Abstract: Nitrates and nitrites are widely used in modern agriculture and the food industry. They are mainly used as fertilizers and as preservatives in the preservation of meat products. However, excessive consumption of these substances is dangerous to health and leads to various degrees of poisoning. From this point of view, their monitoring, control and analysis based on artificial intelligence are one of the urgent problems today.

The main sources of nitrate in the body are vegetables, melons, fruits and berries. Among them, the highest levels of nitrate are found in leafy greens, beets and savoy cabbage (summer varieties). A significant amount of nitrite enters the body with sausage products. Increased intake of nitrites leads to significant health problems (primarily in children and the elderly).

Keywords: methemoglobin, nitrate, nitrite, hypoxia, enzyme, physiological changes, preservative, liver cells, healthy.

Аннотация: Нитраты и нитриты широко используются в современном сельском хозяйстве и пищевой промышленности. Они используются преимущественно в качестве удобрений и консервантов при консервировании мясных продуктов. Однако чрезмерное потребление этих веществ опасно для здоровья и приводит к отравлениям различной степени тяжести. С этой точки зрения, их мониторинг, контроль и анализ на основе искусственного интеллекта являются одной из актуальных задач современности.

Основными источниками нитратов в организме являются овощи, бахчевые, фрукты и ягоды. Наибольшее их количество содержится в листовой зелени, свекле и савойской капусте (летних сортов). Значительное количество нитритов поступает в организм с колбасными изделиями. Повышенное потребление нитритов приводит к серьёзным проблемам со здоровьем (в первую очередь, у детей и пожилых людей).

Ключевые слова: метгемоглобин, нитрат, нитрит, гипоксия, фермент, физиологические изменения, консервант, клетки печени, здоровые.

Introduction.

Food poisoning is an acute (rarely chronic) disease caused by eating food that has been contaminated with a significant number of opportunistic pathogens or that contains substances toxic to both microbial and non-microbial organisms.

Food poisoning is divided into two groups: microbial and non-microbial.

Table 1.

Microbial			
Toxicoinfections	**Toxicosis**		**Mixed etiology (mixtures)**
Bacterial	Bacterial	Mycotoxicose	Bacterial

		s	
Germ-free			
Poisonings from naturally toxic products		**Poisoning from products that are toxic under certain conditions**	**Poisoning by chemicals (xenobiotics)**
Extracted from plants	**Animal-derived**	**Extracted from plants**	**Animal-derived**	**Chemical**
Poisonous mushrooms (pale toadstool, moss, strochok) Wild plants (banded nightshade, devil's broom, belladonna, white nightshade) Wild plants with poisonous seeds growing among sedges (blueberry, camphor, violaceae, cakra, thermopsis)	Caviar and milk of some fish (marinka, usach, ninakorin), some mollusks and non-traditional seafood	Bitter pits of peaches, apricots, cherries, and almonds, which contain amygdalin. Conditionally edible mushrooms that have not been properly cooked (morel, white mushroom, champignon, etc.)	Liver, caviar, and milk of some fish (salmon, flounder, mackerel, etc.)	Nitrates, nitrites

Note: The information in the table above is taken from the textbook “Food Hygiene” by Prof. G. Shaikhova, some information has been shortened.

As can be seen from the table above, poisoning by nitrites and nitrates is a type of non-microbial poisoning. The main factor is chemicals, which are caused by their improper use.

When the rules, restrictions and technology for the use of various agrochemicals, primarily nitrogenous, complex and organic fertilizers, are not observed, as well as when agricultural crops are grown on irrigated fields, nitrates and other nitrogenous compounds (nitrites, nitrosamines) can accumulate in agricultural products in quantities exceeding the ADI. Excessive accumulation of nitrate in feed reduces its nutritional value: vitamins, carbohydrates, amino acids decrease, and the mineral composition of the product changes.

Literature analysis and method. According to the sources cited in the literature, nitrate absorption occurs mainly in the stomach, with up to 90% of nitrate excreted in the urine within 8 hours. Clinical signs of nitrate poisoning appear 1-6 hours after ingestion and are characterized by an enlarged liver and tenderness, dyspeptic disorders mixed with subicteric sclera. Changes in the nervous system can also be observed - symptoms of general weakness, severe headaches in the temporal region, drowsiness, dizziness, darkening of the vision, impaired coordination of movements. The vasodilating effect of nitrate leads to a decrease in arterial blood pressure, sinus arrhythmia, chest pain, shortness of breath. Nitrate itself does not become a methemoglobin generator. However, depending on the storage conditions and microflora of the product (food), under certain conditions, some of the nitrates are converted to nitrite, which is relatively more toxic, in food products or in the digestive tract (especially in dyspepsia in children).

Table 2.

T/r	Substance	Chemical formula	Where is it found?	Permitted rate (in Uzbekistan)
1.	Nitrate	NO_3^-	Vegetables, water, fertilizer	50 mg/l (in drinking water)
2.	Nitrite	NO_2^-	Meat products	Very rare (0–3 mg/kg)

(Sources: SSV, FAO, WHO data)

Discussion and results. The above data indicate that the correct and appropriate use of any chemical substances does not pose a serious threat to human health. Since it is known that their use in excess of the established norm has a negative impact on the quality of food products, as well as human health.

Currently, in many rural areas or small production facilities, the level of nitrates and nitrites is not regularly monitored. Vegetables, especially onions, carrots, cabbage, spinach, are high in nitrates.

The conversion of nitrates to nitrites (biotransformation) occurs as follows:

- When nitrates (NO_3^-) enter the body (usually through food or water), they are converted to nitrites (NO_2^-) by the microflora of the gastrointestinal tract.
- This process occurs especially quickly in children and people with weak digestive systems.
- Under normal conditions, the hemoglobin molecule in the blood binds an oxygen molecule and delivers it to the tissues.
- However, nitrites convert the Fe^{2+} (iron 2+) ions in hemoglobin to Fe^{3+} (iron 3+).
- As a result, methemoglobin is formed - this substance is unsuitable for oxygen transport.
- Due to increased methemoglobinemia, oxygen transport in the body decreases sharply.
- This leads to oxygen deficiency in tissues and organs - hypoxia.

Depending on the degree of poisoning by nitrites and nitrates, the amount of methemoglobin and symptoms in a person

Methemoglobin %	Characters
0–10%	There may be no symptoms.
10–20%	Headache, weakness
20–40%	Bruising, dizziness, heart palpitations
40–60%	Severe shortness of breath, dilated pupils
Above 60%	Fainting, coma, risk of death

The body uses the enzyme NADH-methhemoglobin reductase to neutralize nitrites. However, in severe poisoning, this enzyme is not enough.

Conclusion. Nitrate and nitrite poisoning remains a serious threat to health. There are opportunities to solve this problem through modern technologies, in particular, artificial intelligence. At the same time, social and human sciences also play an important role in this process - by disseminating information, raising public awareness, and increasing digital literacy, we can take steps towards a healthy society.

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