ANALYSIS OF THE CONTENT OF TOXIC SUBSTANCES IN CARROT SUBJECTED TO HEAT TREATMENT

ANALIZA CONȚINUTULUI DE SUBSTANȚE TOXICE ÎN MORCOVUL SUPUS TRATAMENTULUI TERMIC

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Abstract: *Obiectivul acestui studiu a fost determinarea efectului tratării termice (fierberea la 100 °C) asupra conținutului de toxine în morcov (Daucus Carrota) cu scopul stabilirii modalităţilor de reducere a cantităţilor de toxine în alimente. A fost analizat conținutul de nitrați în morcovul de import și cel autohton (soi Cadril) înainte și după tratare termică. De asemenea, a fost determinat conţinutul de substanţe radioactive în legumele date. În urma analizei s-a observat o diferență mică dintre conținutul de nitrați în cele două tipuri de morcov studiate, cel de import având o concentrație mai mică. Fonul radioactiv a acestor legume a prezentat valori stabile incluse în limitele normalului.*
Key words: *morcov, nitrați, nitriți, tratare termică, substanţe radioactive, nitratometru*

Abstract: *The aim of this study was to determine the effect of heat treatment (boiling at 100 ° C) on the content of toxins in carrots (Daucus Carrota) in order to establish ways to reduce the amount of toxins in food. The nitrate content of imported and domestic carrots (Cadril variety) was analyzed before and after heat treatment. The content of radioactive substances in carrots was also determined. Following the analysis, a small difference was observed between the nitrate content in the two types of carrots studied, the imported one having a lower concentration. The radioactive background of these vegetables showed stable values within normal limits*.
Key words: *carrot, nitrates, nitrites, heat treatment, radioactive substances, nitratometer*

Introduction

Carrot is one of the root vegetables rich in bioactive compounds such as carotenoids and dietary fiber with important health-maintaining properties [1]. Consumption of carrots and its products is constantly increasing, due to its recognition as an important source of natural antioxidants with anticancer activity [2,3]. In addition to the carrot roots that are traditionally used in salads, it can also be used in the manufacture of other nutrient-rich products, such as juice, dry powder, preserves, candies, pickles [4].

In addition to the beneficial composition of this root, in case of non-compliance with the conditions and rules of cultivation, it can accumulate substances toxic to the human body, such as nitrates and nitrites [5,6].

It should be noted that it are dangerous not nitrates such as NO_3, but nitrites NO_2 derived from nitrates, as well as nitric acid salts. This transformation reaction takes place in the human and animal digestive tract, as well as in the case of long-term storage of vegetable products [7,8]. In addition to nitrites, a harmful influence on the body is exerted by secondary amines and nitroamines. All these combinations, being in quantities higher than the allowed doses in fresh products (especially in vegetable crops), cause the destruction of hemoglobin in the blood, forming, at the same time, metahemoglobin. The latter is particularly dangerous for children (children's "blue" disease or cyanosis). Nitrosamines and nitrosamides exert a carcinogenic, mutagenic and toxic action on the embryo [9]. The maximum harmless dose of nitrate

for humans is 5 ml per 1 kg of body weight [10].

Research Methodology

The Ecotester-2 nitratometer was used for the express method. Nitrate tester and dosimeter Ecotester Soecs is a universal 2-in-1 device that combines two important functions - dosimeter and nitrate tester. With this simple and fast ecotester you can check the level of nitrates in food, fruits and vegetables, but also accurately measure the radioactive background. When used as a dosimeter, objects with large sources of environmental radiation can be detected. However, the disadvantage of the tester is that it measures the dose of nitrates in the product only at the point where the nitratometer probe was inserted, but not in the whole product, which leads to errors (about 15%).

The ionometric method is much more accurate which consists in extracting nitrate ions with a solution of aluminum and potassium alum - $AlK(SO4)_2 \cdot 12 \cdot H_2O$ and subsequently determining the logarithm of nitrate ion concentration using an ionoselective electrode. The method is not accepted if the chloride content in the analyzed material exceeds more than 25 times the nitrate content. The lower limit of nitrate identification is 6 mg in 1 dm^3 of solution analyzed. The safe limit of determination of nitrates in the analyzed sample is 30 mg / kg. The method is used to determine nitrates in agricultural products.

To study the influence of the heat treatment duration on the nitrate content, the portioned carrot of 20 g each was placed in boiling water and boiled for 10, 15, 20, 25, 30, 40 min. After boiling, the samples were cooled to room temperature and the amount of nitrates and the amount of radiation were measured..

Findings

Following the study, the factors on which the degree of nitrates in carrots depends were established. The manufacturer, who will decide the amount of nitrates used to increase them; 2. types of fertilizers used; 3. cultivation period (in summer the nitrate content is much lower than in winter); 4. the action of the sun's rays (the lower the concentration of nitrates); 5. core (here is the largest amount of nitrates in the whole vegetable).

Nitrate levels were influenced by the duration of heat treatment. By diffusion the nitrates in the product reach the water, thus reducing the nitrate content in the product and increasing in the water. The longer the cooking time, the lower the nitrate level in the product. The limit value for this product is 250 mg / kg. This fact is demonstrated by the results obtained (Table 1).

Table 1: The influence of cooking time on the change of nitrate content in carrots

Cooking time	***Nitrate content, X_{NO3} mg/kg***	
τ, min	***Republic of Moldova***	***Ukraine***
0	124,6	101,33
10	122,3	79,66
15	120,6	74,00
20	115,3	69,66
25	114,3	65,33
30	111,6	60,66
40	101,3	57,66

ccording to the data obtained, a dependence was found between the duration of heat treatment and the nitrate content of carrots. There is a considerable decrease in the concentration of nitrates, constituting a practical value less than twice the initial value (Fig. 1.).

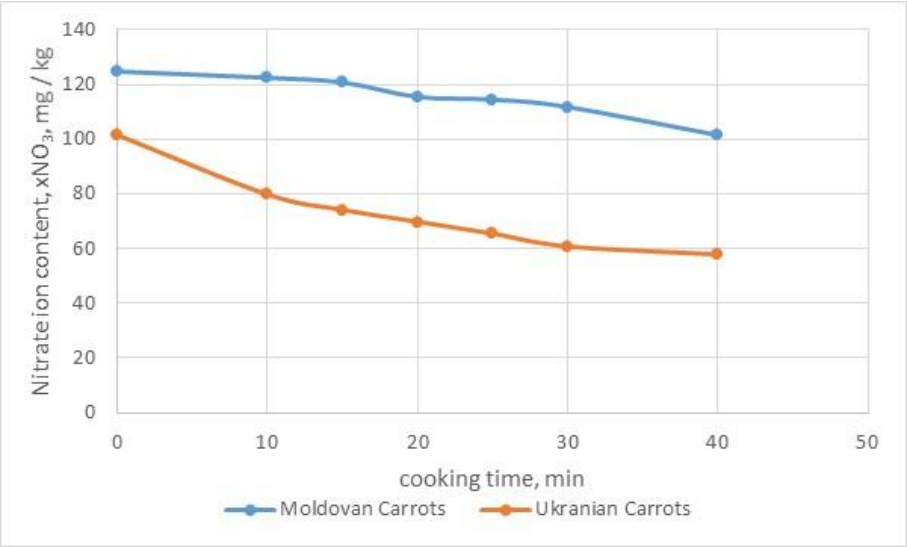

Fig. 1. Dependence of nitrate level on the duration of heat treatment in carrots

In the process of boiling, about 50% of nitrates are lost and destroyed. However, vegetable and fruit juices may contain a certain amount of nitrates. Diluting concentrated juices with boiled water and consuming them in reasonable quantities excludes the accumulation of nitrates in the body. When storing vegetables and fruits, the storage conditions must be strictly observed.

Another way to reduce the amount of nitrates can be to clean those parts of the plant where the content of those substances is maximum. In peeled fruits and vegetables, the nitrate content is reduced by 15-20%. In carrots kept in water for one hour, the nitrate content decreases by 25-30%. In the case of boiling, for 30 - 40 minutes, remove up to 70% of the carrot. The water in which the vegetables were boiled must be thrown away.

In pickled and marinated vegetables, the nitrate content is reduced by up to 50%, but in the first days of pickling, when there is an intense process of synthesis of nitrates and nitrites, it is not recommended to consume these vegetables.

According to the rules of the FAO/WHO, the maximum permissible daily dose of NO_3^- ions for one person is 220 mg and, making the appropriate transformations, the amount of 49.7 mg N-NO_3 / person / day is reached, representing the Maximum Permissible Limit / person / day for N-NO_3. Analyzing the situation of nitrate content, and N-NO3 in vegetables, fruits and water in households that produce or market these products, it can be seen whether the situation is worrying or not.

Regarding the content of radioactive substances, it can be seen that the heat treatment does not influence their concentration in the product. Regardless of the duration of the heat treatment, the radioactive background remained the same which is included within the normal limits and constitutes 9-10 Sv.

Conclusions

The experimental and theoretical research carried out led to the formulation of the following conclusions:

• Following the analysis, a small difference was observed between the nitrate content in the two types of carrots studied, the imported one having a lower concentration;

• The degree of nitrates in carrots depends on the producer, the fertilizers used, the cultivation period (in summer the nitrates do not form part of the vegetable, instead, in winter yes), the action of the sun's rays (the lower the higher the nitrate concentration) , the core (here is the largest amount of nitrates);

• The nitrate level decreased approximately twice after heat treatment, through the diffusion of nitrates from the product into water, but the content of radioactive substances remained stable at 10 Sv, being included within normal limits.

• However, it is necessary to monitor the content of toxic substances in food, especially in carrots, as more and more new foods based on or with the addition of carrots are launched on the consumer market.

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