MONITORING OF NITRATE CONTENT IN POTATOUS FROM BULGARIAN MARKET

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Abstract: The potatoes are common food for people of all ages and very often are used in Bulgarian kitchen as a main component of core dishes and also separately under different types of salad. The aim of this article is to give information about the nitrate content in potatoes from the commercial chain in Bulgaria. The monitoring have been conducted during June, July and August. The measurements of NO3 ions were carried out with a Greentest appliance, Model ECO 5. The samples from the conducted monitoring were with higher NO3 content for the fresh potatoes that have been accepted and recommended from EU as healthy one. The highest content of NO3 in fresh potatoes were 645 mg/kg measured for June, 340 mg/kg for August, and 500 mg/kg for fresh potato produces from BG measured in August, at the accepted safety level 250 mg/kg. The red potatoes were with average 287 mg/kg nitrate levels. The amount of nitrates are not eliminated during cooking processes, so that results are warning that the food from the commercial chain can be not enough healthy, especially for infants.

Keywords: nitrates, food safety, potatoes

1. INTRODUCTION

For most of the 20th century, Europe was the undoubted world leader in potato production and consumption in the world, approximately 90 kg per capita per year. In Bulgaria the production of potato was 227,815 t for 2017, with consumption approximately 31.07 kg/capita/year for 2011, according to FAOSTAT. While in Belarus the consumption was about 180 kg, more than any other country, which is almost half a kilogram a day, and with potato production 6,414,760 tonnes, in 2017 [1].

The potatoes provides substances that benefit human health, for example, as fibres, B6 and C vitamins, minerals as Mg, and K, and phytochemicals [2, 3, 6], even in a created from the researchers “healthy eating pyramid” potatoes are at the top as one of the most unhealthy foods, due to their high glycemic index [4]. A medium potato, supplies about 15 % of a daily need for Mg; and about 20 % of a daily K need [2]. The consumption of potatoes help ward off diseases, reducing inflammation and constipation, preventing osteoporosis, maintaining heart health, and reducing the risk of infection [3]. Potatoes contain folate that plays a role in DNA synthesis and repair, and prevents many types of cancer [3].

According to Ware [3], a 100 g of white potato, baked with skin, contains:

- 94 calories;
- 0.15 grams of fat;
- 0 grams of cholesterol;
- 21.08 grams of carbohydrate;
- 2.1 grams of dietary fiber;
- 2.10 grams of protein;
- 10 milligrams (mg) of calcium;
• 0.64 mg of iron;
• 27 mg of magnesium;
• 75 mg of phosphorus;
• 544 mg of potassium;
• 12.6 mg of vitamin C;
• 0.211 mg of vitamin B6;
• 38 micrograms (mcg) of folate.

Potatoes also provide niacin, choline, and zinc, as different varieties provide slightly diverse nutrients [3].

Potatoes are frequently used as a components of main dishes or separately under different types of salad. The most common pollutant in vegetables and in that case in potatoes are nitrates. The aim of article is to present the results of summer monitoring of the content of nitrates in vegetables, especially in potatoes.

2. MATERIALS AND METHODS

The vegetables were purchased from the food market during June and August. The NO₃⁻ ions measurements were carried out with a Greentest appliance, Model ECO 5. The appliance is certified and calibrated based on more than 1,000 studies of leading labs using spectrometric equipment. It has certificates: SGS, CCIC-SET, EMC, LVD, and SQC. Min/max amount of measured nitrate concentration: 0-9999 mg/ kg, with permissible error: <10%.

All samples were bought from the food chain supermarkets in BG, with a permission to be sell in EU. The measurements were repeated ten times per sample, processed with Excel using ANOVA – one tail, and standard descriptive analysis. The averaged values with variables, minimum and maximum in a single sample are represented in the results.

3. RESULTS AND DISCUSSION

The results of conducted monitoring of nitrate content in potatoes are represented in Table 1.

Table 1. Content of nitrates in fresh potatoes, summer 2019 (mg/kg)

| Nitrate content          | acceptable level | average | SD  | min  | max  |
|--------------------------|------------------|---------|-----|------|------|
| Fresh potatoes (bg)      | 250              | 501*    | 96  | 320  | 640  |
| Fresh potatoes (1)       | 250              | 645*    | 160 | 390  | 900  |
| Fresh potatoes (2)       | 250              | 367*    | 126 | 230  | 560  |
| Red fresh potatoes       | 250              | 287*    | 117 | 130  | 130  |

* - exceed it the acceptable value;

All samples exceeded NO₃⁻ content from the maximum recommended levels 250 mg/kg for EU. The highest measured level of NO₃⁻ ions were 645 mg/kg with SD 160 mg/kg, and coefficient of variation 24%. The fresh potatoes samples from August also have higher NO₃⁻ content, average 367 mg/kg, 287 mg/kg, and 501 mg/kg with coefficient of variation 34%, 41%, and 19% for fresh and red potatoes respectively (table 1 and figure 1).
Potato is an important and popular food in the EU, average of 73 kg/capita/year. The highest consumption per person per year is in Latvia - 178 kg, followed by Poland - 118 kg, and Greece 103 kg [5]. Global potato consumption in 2013 was on average 35 kg/capita/year, which is about 50% of the world’s food energy needs [6]. Potatoes can be the main source of nitrate intake [5]. According to Santamaria [7], vegetables account for 97% of our nitrate intake, as 32% originates from potato consumption and 29% from lettuce consumption.

To date, no official limits for nitrate content of potato have been set by the EU. The Commission Regulation (EU) No 563/2002 sets limits for content of nitrates in vegetables, but only for leafy green once. Hence, some countries proposed their own guidelines to set limits to maximum levels of nitrate for trade of vegetables that form the main source of total dietary intake of nitrate. For instance, for potato in Germany the content should be less than 200 mg/kg fresh matter (fm), in Poland less than 183 mg/kg fm [5, 7]. In many countries that limits of nitrates in potatoes are exceeded [5, 8]. During 2017, the quality of domestic and imported vegetables in Slovene market in Ljubljana were investigated, and values over 1000 mg NO₃⁻ kg⁻¹ were found in 30% of randomly selected samples [8].

The nitrates are considered not so harmful by themselves but conversion of nitrates to nitrite, during cooking changes in nitrate content may reach up to 75% [9]. Even it was founded that cooking process caused a significant increase in the level of nitrate [10]. The conversion of nitrates to nitrite and further formation of nitrosamines are associated with gastrointestinal cancer and methaemoglobinemia. The positive effect of nitrate on the human organism is reflected in its conversion to NO, which control of blood pressure, improving cardiovascular health, and supporting gastrointestinal and immune function [9]. The monitoring of nitrate levels, during a period of 13 years in Slovenia, showed an average of NO₃⁻ content as follow:

![Figure 1. Content of nitrates in fresh potatoes (mg/kg)](image-url)
lettuce (962 mg/kg) > cabbage (795 mg/kg) > string beans (298 mg/kg) > carrot (264 mg/kg) >
cauliflower (231 mg/kg) > potato (169 mg/kg) > cucumber (93 mg/kg) > pepper (69 mg/kg).
With those results have been calculated that the daily intake per inhabitant is close to the
acceptable DI permitted in EU just with the consumption of potato [11].

4. CONCLUSIONS
In our study the content of nitrates are significantly higher and that can lead to negative effects
especially for infants. All types’ of food pollution are undesirable and monitoring programmes
control the possible toxic substances. Nevertheless, on the food chain market in BG are still in
the trade food products with not enough quality, besides of the tough control that exist.

5. REFERENCES
[1] FAOSTAT (2019). https://www.potatopro.com/europe/potato-statistics (Retrieval Date:
January 5, 2019)
[2] Calderone J. (2018). Are Potatoes Good for You? Why these tasty tubers are not as
harmful to your waistline as you may think. https://www.consumerreports.org/healthy-
eating/are-potatoes-good-for-you/
[3] Ware M. (2017). How can potatoes benefit my health? https://www.medicalnewstoday.
com/articles/280579.php
[4] Wilett WC, Skerrett PJ. (2005). Eat, Drink and Be Healthy: the Harvard Medical School
Guide to Healthy Eating. 2005. Free Press, NY.
[5] Gorenjak A. Hm., D. Urih, T. Langerholc, J. Kristl, (2014). Nitrate Content in Potatoes
Cultivated in Contaminated Groundwater Areas. Journal of Food Research; Vol. 3, No. 1; 2014. ISSN 1927-0887 E-ISSN 1927-0895. Published by Canadian Center of Science and
Education.
[6] Ramani Wijesinha-Bettoni, Béatrice Mouillé (2019). The Contribution of Potatoes to Global
Food Security, Nutrition and Healthy Diets. January 2019American Journal of Potato
Research 96(2). DOI: 10.1007/s12230-018-09697-1
[7] Santamaria Pietro (2013). Review. Nitrate in vegetables: toxicity, content, intake and EC
regulation. J Sci Food Agirc 86:10–17 (2013). doi: 10.1002/jsfa.
[8] Kmecl V., Znidarcic Dr., M. Franić, S. Goreta, B. Smiljana, G. Ban (2019). Nitrate and
nitrite contamination of vegetables in the Slovenian market. April 2019Food Additives and
Contaminants Part B DOI: 10.1080/19393210.2019.1600589
[9] Gorenjak A. Hm., A. CenCić (2013). Nitrate in vegetables and their impact on human health.
A review. June 2013Acta Alimentaria 42 (2) (2):158-172. DOI: 10.1556/AAlim.42.2013.2.4
[10] Keshavarz Mitra, Seyed Mohammad Mazloomi, Siavash Babajafari (2015). The Effect
of Home Cooking Method and Refrigeration Processes on the Level of Nitrate and Nitrite
in Spinach. J Health Sci Surveillance Sys July 2015; Vol 3; No 3, p.88-93.
[11] Kmecl Veronika, Tea Knap, Dragan Žnidarič, (2017). Evaluation of the nitrate and nitrite
content of vegetables commonly grown in Slovenia. Italian Journal of Agronomy 2017;
volume 12:801.
