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DETERMINING THE AMOUNTS OF NITRITES AND NITRATES FROM FIVE VARIETIES OF TOMATOES GROWN IN A CLASIC AND ECOLOGICAL SYSTEM

Mihaela Ileana Oprea[1], Daniela Giosanu[1], Ion Gabriel Bratu[1], MădălinaVulpe[1*]

[1]University of Pitesti, Târgu din Vale Street, no 1, Pitesti, România

Abstract
Vegetables are the most important source of nitrate in the human diet. The nitrate content is not the same in the plant. Depending on the amount of nitrites, plant organs can be classified as follows: leaf (the largest amount) stem, inflorescence root, tuber, fruit. One of the most important factors in determining the quality of vegetable products is the content of nitrates and nitrites and the maximum permitted limits play an important role in human health.
It is well known that a high dietary intake of nitrates and nitrites may increase the risk of gastrointestinal cancer due to the formation of carcinogenic chemicals known as N-nitroso compounds and the appearance in newborns of blue child syndrome. This study assessed the concentrations of nitrates and nitrates in 5 varieties of tomatoes from organic and the same 5 varieties from classical crops. The study showed that the amount of nitrates and nitrites in the tomato varieties taken in the studio was within the limits according to the legislation in force.

Keywords: tomato fruit, nitrate, nitrites.

1. INTRODUCTION

Vegetables are essential for human health because they are true sources of vitamins, minerals and biologically active substances (Petersen and Stoltze, 1999).
However, vegetables also contain nitrates and nitrites. Nitrate itself is relatively nontoxic, but its metabolites - nitrites, are associated with methemoglobinemia. The nitrite can react with the amines, resulting carcinogenic nitrosamines. Dietary exposure to nitrates and nitrites is becoming a serious public health problem (Santamaria, 2006; Roila et al., 2018), due to the formation of nitrosamines, leading to some acute and chronic toxicities.
Nitrate concentrations in vegetables depend on: light intensity, soil type, temperature, humidity, frequency of plants in the field, vegetation period, harvest time, storage time and nitrogen source (Tamme et al., 2006). The nitrogen fertilization and the light intensity are major factors that influence the nitrate and nitrite content in vegetables (Gruda, 2005; Santamaria, 2006).
Both nitrates and nitrites are found naturally in the environment, being important nutrients for plants. They are used as preservatives in some food products.
Due to the increased use of nitrogen fertilizers and manure in intensive agriculture, vegetables and drinking water can contain high concentrations of nitrate (Reinink, 1991).
Vegetables represent approximately 70-90% of the total estimated dietary intake of nitrates.
The tomato crop is of particular importance throughout the world and has been recognized for a long time as a dominant crop worldwide. After potato, the tomato is the second most popular consumed vegetable (Petersen and Stoltze, 1999; Gruda, 2005).

*Corresponding author, E-mail address: tudorradumadalina@yahoo.com

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The tomato is a good source of folic acid, potassium and vitamins A, C and E, as well as lycopene and phenolic compounds. There is ample evidence that the consumption of tomato fruits and related foods plays a positive role in the prevention of diseases such as cardiovascular and chronic degenerative diseases and age-related macular degeneration. Despite these valuable characteristics, it is well known that the accumulation of nitrate in tomatoes varies depending on the harvest period and exposure to the sun, on the level of natural nitrogen in the soil. Tomato is a climacteric fruit, so the nitrite content may increase during storage, leading to some negative health problems after human consumption (Santamaria, 2006). Compared to leafy vegetables, the NO_2- concentration in tomato is usually lower (Begum, 2019).
Therefore, the aim of this study was to develop a precise assessment, through a simple and cost-effective method of quantifying the content of nitrites and nitrates in commonly consumed vegetables.

2. MATERIALS AND METHODS

The nitrite levels in vegetables can increase during storage through the action of some bacteria and/or the presence of nitrate reductase (Sanchez-Echaniz et al., 2001). When the samples are left at room temperature or higher temperatures, the amounts of nitrites and nitrates can increase (Ziarati and Mohammad-Makki, 2015). Therefore, in order to obtain the most conclusive results, the vegetable samples were analyzed immediately after harvesting.
The fresh vegetable samples were harvested in July and September 2021. The number of treatments performed on the two crops was relatively similar. In the ecological culture, five treatments were applied (maceration and extract plants), while for the conventional culture, five treatments were used with specific fungicide.
All chemicals used in this study were of analytical grade. Deionized water was used for the preparation of all reagents and standard solutions and for sample extraction. The method used in the research is the Griess method, widely used in the determination of nitrites and nitrates (Arabin et al., 1999).
Ther vegetable samples are taken from classical culture and ecological culture, all tomato samples being analyzed fresh. 5 g of the sample was weighed, over which 50 ml of 2% acetic acid was added to extract nitrates and nitrites. For each variant studied, 3 determinations were made that were analyzed statistic with the help of the Duncan test.
The dosage of nitrates was done by the spectrophotometric method using phenol 2,4 disulfonic acid in a basic medium. Nitroderivatives have absorption maxima at 420 nm.
Nitrites were also determined spectrophotometrically, using the Griess reagent (from Redox). After 30 minutes, the measurements of the formed complex were performed, at 520 nm, using a spectrophotometer.

3. RESULTS AND DISCUSSIONS

Vegetables are an important part of the diet of infants and children in general, so it is important to know the amount of nitrites ingested through diets, because an excessive amount can cause various diseases. In Romania, the maximum allowed level of nitrates from tomatoes grown in the field is up to 150 mg/kg, while for crops grown in greenhouses and solariums, it is a maximum of 300 mg/kg. (***Order no.1/3, 2002).
The results showed a significant difference in the influence of the culture system on the nitrate content for the 5 tomato varieties studied. The synthesis of the experimental data is shown in figure 1. The highest amount of nitrates was recorded in variety B, both in the case of conventional culture

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(63.73 mg/kg) and in the case of organic culture (60.47 mg/kg). The lowest content of nitrates was obtained by variety D, being 49.40 mg/kg in the conventional culture and 46.07 mg/kg in the organic culture. Regarding the influence of varieties on nitrate content, depending on the type of culture, the results show significant differences in the case of varieties B, C and D and insignificant in varieties A and E. As can be seen from figure 2, in ecological system were obtained the lowest values of nitrate content in all 5 tomato varieties, between 46.07 mg/kg and 60.47 mg/kg, the differences being significant for all 5 varieties. In the conventional culture, the highest amount of nitrates was recorded in variety B (63.73 mg/kg), and the lowest amount was obtained in variety D (49.40 mg/kg).

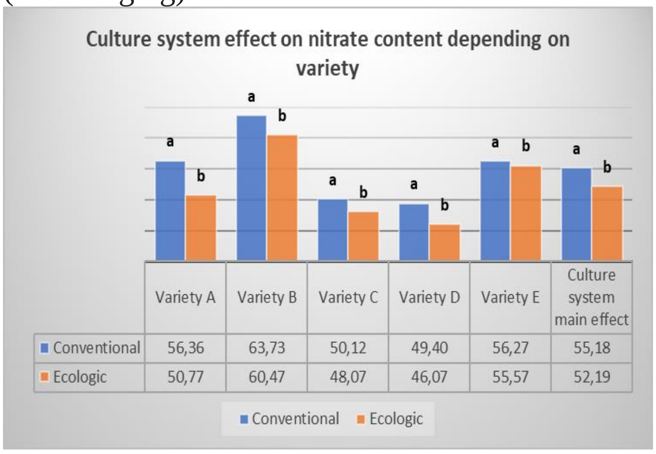

Figure 1. The influence of culture system on the nitrate content, depending on variety

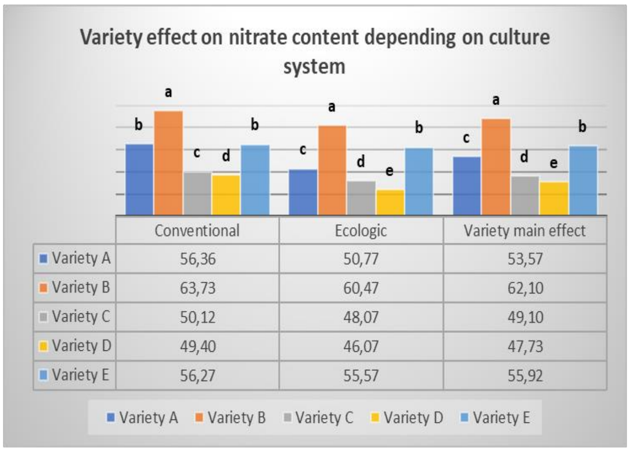

Figure 2. The influence of the variety on the nitrate content, depending on the culture system

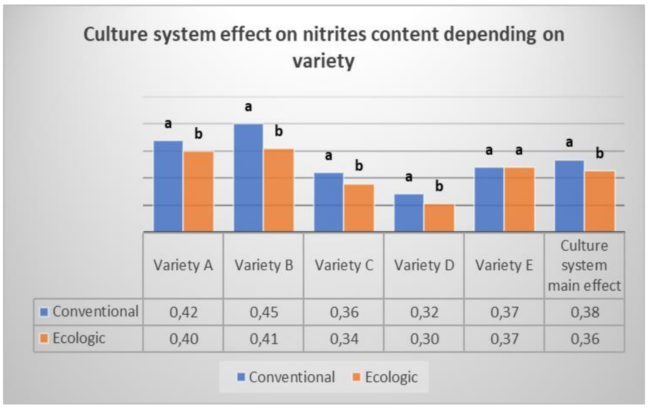

Figure 3. The influence of culture system on the nitrites content, depending on variety

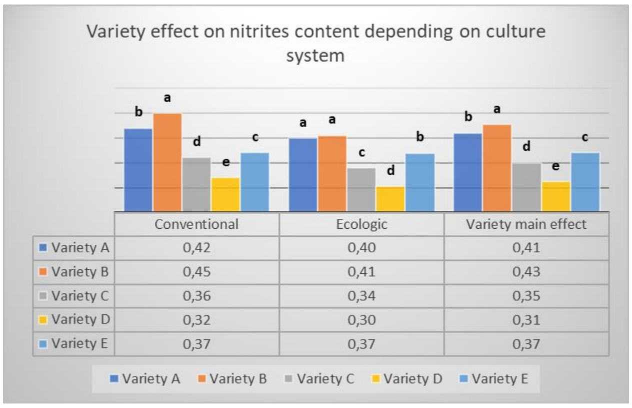

Figure 4. The influence of the variety on the nitrites content, depending on the culture system

Regarding the nitrite content, the culture system had a significant influence on varieties A, B, C and D and insignificant for variety E (Figure 3). The lowest nitrite content was obtained by variety D, of 0.30 mg/ kg, in ecological system, and the highest nitrite content was obtained by variety B (0.45 mg/kg), in conventional culture. Varieties influenced the nitrite content depending on the culture system. In conventional culture, significant differences appear in the amount of nitrite in all studied varieties. The highest amount was recorded in variety B (0.45 mg/kg), and the lowest in variety D (0.32 mg/kg). In organic culture, significant differences appear only in varieties C, D and E and

*Corresponding author, E-mail address: tudorradumadalina@yahoo.com

insignificant in cultivars A and B (Figure 4). The lowest amount of nitrites was recorded by variety D (0.30 mg/kg).

4. CONCLUSIONS

The results showed significant differences regarding the influence of the culture system on the nitrate content for the 5 tomato varieties studied.

Regarding the influence of varieties on nitrate content, depending on the type of culture, the results show significant differences in the case of varieties B, C, D and insignificant in varieties A and E.

Regarding the nitrite content, the conventional culture had a significant influence on only varieties C, D and E and insignificant for variety A and B. The influence of the variety on the nitrite content was significant only in the conventional culture.

All studied tomato varieties obtained the lowest values of nitrate and nitrite content in the organical culture system.

The amounts of nitrites and nitrates found fall within the ranges allowed by the legislation of our country.

The quantities obtained are close to the minimum limits allowed by Romanian legislation. Similar data to those obtained in our study regarding the content of nitrates and nitrates in tomato fruits were also obtained by other researchers (Chan, 2015; Ali, Muhammad and Qadir, 2021).

The small amounts of nitrites and nitrates in tomatoes do not seem to cause problems for health, the larger amount of nitrites being found in the water table, as other researchers have shown.

5. REFERENCES

Ali, R. A., Muhammad, K. A., Qadir, O. K. (2021). A survey of Nitrate and Nitrite Contents in Vegetables to Assess the Potential Health Risks in Kurdistan, Iraq. *IOP Conference Series: Earth and Environmental Science*, 910(1). doi: 10.1088/1755-1315/910/1/012065.

Arabin, B., Laurini, R. N., Van Eyck, J. (1999). Early prenatal diagnosis of cord entanglement in monoamniotic multiple pregnancies. *Ultrasound in Obstetrics and Gynecology*, 13(3), 181–186. doi: 10.1046/j.1469-0705.1999.13030181.x.

Begum, A. (2019). Evaluation of municipal sewage sludge vermicompost on two cultivars of tomato (*Lycopersicon esculentum)* plants. *Int. J. ChemTech Res*. 3, 1184–1188.

Chan, M. (2015). Language Learner Autonomy and Learning Contract: A Case Study of Language Majors of a University in Hong Kong. *Open Journal of Modern Linguistics*, 05(02), 147–180. doi: 10.4236/ojml.2015.52013.

Gruda, N. (2005). Impact of environmental factors on product quality of greenhouse vegetables for fresh consumption. *Critical Reviews in Plant Sciences*, 24(3), 227–247. doi: 10.1080/07352680591008628.

Petersen, A., Stoltze, S. (1999). Nitrate and nitrite in vegetables on the Danish market: Content and intake', *Food Additives and Contaminants*, 16(7), 291–299. doi: 10.1080/026520399283957.

Reinink, K. 1991. Genotype × Environment Interaction for Nitrate Concentration in Lettuce. *Plant Breeding*, 107(1), 39–49. doi: 10.1111/j.1439-0523.1991.tb00526.x.

Roila, R., Branciari, R., Staccini, B., Ranucci, D., Miraglia D., Altissimi, M.S., Mercuri, M.L., Haouet N. M. (2018). Contribution of vegetables and cured meat to dietary nitrate and nitrite intake in italian population: Safe level for cured meat and controversial role of vegetables. *Italian Journal of Food Safety*, 7(3), 168–173. doi: 10.4081/ijfs.2018.7692.

Sanchez-Echaniz, J., Benito-Fernández, J., Mintegui-Raso, S. (2001). Methemoglobinemia and consumption of vegetables in infants. *Pediatrics*, 107(5), 1024–1028. doi: 10.1542/peds.107.5.1024.

Santamaria, P. (2006). Nitrate in vegetables: Toxicity, content, intake and EC regulation. *Journal of the Science of Food and Agriculture*, 86(1), 10–17. doi: 10.1002/jsfa.2351.

Tamme, T., Reinik, M., Roasto M., Juhkam K., Tenno T., Kiis, A. (2006). Nitrates and nitrites in vegetables and vegetable-based products and their intakes by the Estonian population. *Food Additives and Contaminants*, 23(4), 355–361. doi: 10.1080/02652030500482363.

Ziarati, P., Mohammad-Makki, F. M. (2015). Removal of nitrate and nitrite from tomato derived products by lemon juice. *Biosciences Biotechnology Research Asia*, 12, 767–772. doi: 10.13005/bbra/2258.

*** 2002. *Order no.1/3 january 2002*. Available at: httpslegislatie.just.roPublicDetaliiDocumentAfis33091.

*Corresponding author, E-mail address: tudorradumadalina@yahoo.com