

## Nitrates and nitrites as source of n-nitroso compounds

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### Abstract

*Studies referring to the presence of nitrates and nitrites in food and drinking water suggested that these compounds are precursors in the formation of N-nitroso compounds, which are genotoxic compounds consisting of nitrosamines and nitrosamide. N-nitroso compounds are known to cause birth defects in animals and humans. Nitrate and nitrite are present in vegetables because the use of chemical and organic fertilizers, rich in nitrogen. Another source of nitrates and nitrites is watering with high concentrations of nitrogen leaching. The presence of nitrates and nitrites in foodstuffs is restricted by a directive of the World Health Organization, all over the world. In Romania this is regulated for vegetables by no.1/2002 Order of the Ministry of Health. The aim of the research was to establish the level of load setting these nitrates and nitrites in several species of commonly consumed vegetables. Analyses carried out for many kind of vegetables sold in Bucharest market highlights that the contents of nitrate and nitrite were in legal limits. The variation of nitrate and nitrite contents of vegetables requires a periodic review.*

**Keywords:** nitrates, nitrites, vegetables

### 1. Introduction

Nitrates and nitrites are compounds that pose a risk factor for human health if consumed in quantities exceeding certain limits [11], [7], [8]. Their presence in the environment and plant material due to uncontrolled application of fertilizers or organic nitrogen or by the use of irrigation water loaded with these compounds [1]. The research [2] showed that the utilization on daily diet of some noncertified vegetables determined illness at population.

Nitrates and nitrites are more frequently present in natural waters in our country due to prolonged droughts due to global warming [11]. By growing vegetables and impose a high productivity factor is always given fertilizer and irrigation water which may lead to increased absorption of nitrogen compounds in plants [3]. Toxicological implications of these substances, nitrates, nitrites became more complex after reporting the cumulative effect of nitrates. Reduce nitrate to nitrite in saliva leads to the body of nitrosamines, carcinogens in the intestinal tract [6], [7], [9] and then blocking iron from hemoglobin to methemoglobin occurrence that causes disease "baby blue" to children. Nitrate accumulation in some vegetables (especially leafy ones) occurs for amino acid biosynthesis. Being less reactive nitrate ion, nitrite ion transformation in the action of nitrate reductase is achieved with energy consumption. In the acid, nitrate ion is transformed into nitric acid ions in the presence of halogens (chlorine, bromine, etc.) form nitrosyl halide that combining an amine leads to the formation of nitrosamines. Depending on the genetic and biological characteristics of each species of plant origin absorbed quantities of nitrates and nitrites in the edible parts are different.

Walters C.L. [10] presents the average concentrations of nitrate and nitrite in vegetables and shows that, with some exceptions fruits contain a small amount of nitrite, typically less than 10 ppm.

Nitrate content in various vegetables varies according to species, growing season, temperature and brightness, and especially fertilization system. Nitrogen compounds such cannot be fully absorbed and thus remain metabolized in plants and are consumed by humans.

Vegetables contain 54% of the total dietary nitrate in food (Royal Commission on Environmental Pollution) but the percentage may increase by water consumption [5]. Nitrate ingestion of food and water can reach different levels depending on the composition of each food nitrates.

Due to different contents of nitrate and nitrite in vegetables World Health Organization has limited the concentration of these compounds in the so-called Maximum Allowable Concentrations (MAC).

In our country, the Order no. 1/2002 of Ministry of Health [12] regulated the conditions for security and quality fresh fruit and vegetables consumption and imposed concentration limits admitted to nitrates and nitrites. A research made in 2012, regarding the marketing of vegetables and products from vegetables showed that the Order is not applied [4]. **The aim of the research** was to establish the level of load setting these nitrates and nitrites in several species of commonly consumed vegetables, which are a risk factor for human health.

## 2. Material and methods

Vegetable food quality was monitored in various markets of Bucharest in some varieties of lettuce, tomato and carrot marketed population. For a correct estimate of the quantities of nitrates and nitrites were analysed 10 replicates for each sample and interpreted by the average value of nitrates and nitrites. Method for determination of nitrites and nitrates in vegetables is Griess method, standardized by STAS 9058/2002. Determination of nitrate and nitrite thus obtained is at  $\lambda = 515$  nm spectrophotometric.

## 3. Results and Discussion

Results on nitrate content highlight different results depending on the species and type of crop.

Table I. Nitrate and nitrite content of some vegetables marketed in Romania

No.	Specification	ppm NO <sub>3</sub> <sup>-</sup>	M.A.L. <sub>NO3</sub> ppm	ppmNO <sub>2</sub> <sup>-</sup>	M.A.L. <sub>NO2</sub> ppm
1	Lettuce Iceberg cultivar*	1878±79	3000	0,12 ±0,02	0,5
2	Lettuce Mona cultivar*	1567 ±56	3000	0,18 ± 0,08	0,5
3	Lettuce Marula cultivar**	789 ±92	2000	0,23 ± 0,07	0,5
4	Tomatoes Amanda*	267 ± 13	300	0,12 ± 0,05	0,5
5	Tomatoes Tovi Roca*	198 ± 34	300	0,21 ± 0,06	0,5
6	Tomatoes Lady Rosa*	258 ± 15	300	0,18 ± 0,06	0,5
7	Tomatoes Menhir*	289 ± 15	300	0,23 ± 0,04	0,5
8	Tomatoes Siriana F1**	98 ± 17	150	0,19 ± 0,06	0,5
9	Tomatoes Arletta F1**	112 ± 19	150	0,22 ± 0,08	0,5

10	Carrot De Nantes	323 ±7	400	0,25 ± 0,10	0,5
11	Carrot Narbonne	253 ±12	400	0,26 ± 0,08	0,5

\* - Crops in solar greenhouses

\*\* - Field crops

Lettuce samples consisted from several cultivars or varieties: Iceberg, Mona and Marula and two types of culture respectively culture in solarium and field. Lettuce comes from solarium accumulate more nitrate oscillating between 1576 ppm and 1957 ppm NO<sub>3</sub>. Of the two varieties most commonly grown in greenhouses in our country, Iceberg lettuce samples have accumulated high content of nitrates because of fertilizers used and quantities up to 40 t/ha manure, which also has nitrogen in composition.

The accumulation of nitrite content in lettuce is between 0.12 ppm and 0.26 ppm NO<sub>2</sub>, a low accumulation in this compound. If lettuce crop in the field accumulated nitrates between 789 ppm NO<sub>3</sub> and 881 ppm NO<sub>3</sub>, nitrite varied between 0.23 and 0.30 ppm NO<sub>2</sub>.

Between the two types of cultures the accumulations of nitrates and nitrites are lower in the case of field culture. Analysis of nitrates and nitrites to lettuce plant accumulated in the three varieties in quantities below the Maximum Admissible Limits presented from the Order no.1/2002 of Ministry of Health.

Tomatoes are one of the most consumed vegetables were also analyzed. Four cultivars were considered namely: Amanda, Tovi Roca, Lady Rosa and Menhir, varieties grown in greenhouses and which have earliness.

Nitrate content varied between the cultivars 198 ppm NO<sub>3</sub> Tovi Roca and 304 ppm NO<sub>3</sub> the Menhir. It is noted that in some cases exceeded of Maximum Admissible Limits of nitrates 300 ppm NO<sub>3</sub> shown that some varieties have a higher affinity to nitrate and the consumption of tomatoes in large quantities can cause consumer illness.

Were also analyzed two varieties of tomatoes grown in the field Siriana and Arletta. Nitrate content analysis revealed a minimum of 98 ppm NO<sub>3</sub> and maximum 131 ppm NO<sub>3</sub>. In these cases the Maximum Admissible Limits of nitrates is 150 ppm NO<sub>3</sub> and the analyzed results show that tomatoes are good for consumption.

The tomatoes nitrite accumulated amounts ranging from 0.17 ppm and 0.30 ppm NO<sub>2</sub> and comparing with Maximum Admissible Limits of 0,50 ppm NO<sub>2</sub> it can be observed that the accumulation of this compound is limited.

Analysis of nitrate to *Daucus carota* was performed in two varieties most commonly grown in our country respectively De Nantes and Norbonne. The results presented show that nitrate is between 253 ppm NO<sub>3</sub> and 330 ppm NO<sub>3</sub> to Norbonne, these contents are below Maximum Admissible Limits of 400 ppm NO<sub>3</sub>, good content for this compound respectively.

Nitrites accumulated in carrot oscillate between 0.25 ppm and 0.35 ppm NO<sub>2</sub> a low contents compared with M.A.L. of 0.50 ppm NO<sub>2</sub>.

#### 4. Conclusions

The analysis shows that:

1. Nitrate content varies greatly with plant species, variety and type of crop. Quantities of nitrates are higher in lettuce and tomatoes grown in greenhouses and solariums compared to those grown in field;

2. Nitrates in vegetable samples examined values fall below the MAL for this compound under the regulations of the Ministry of Health Order no.1/2002. Nitrite accumulated in small quantities under MAL of 0.50 ppm NO<sub>2</sub> all vegetables analyzed by failing to consumer health issues;

3. Variation of nitrate and nitrite contents of vegetables is a risk factor for the health of consumers and requires a periodic review of these products to limit their toxic action.

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