FOOD POLLUTION AS A RESULT OF VEGETABLE NITRIC OVERLOAD

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Abstract *The study shows that the most important nitrate sources of agriculture origin which can pollute vegetal food stuffs are leaf vegetables well known as nitrate accumulators. In areas with intensive nitrate fertilization crops become overloaded with nitrates. Therefore spinach, lettuce, cabbage, carrots and parsley, to be ingested by the consumer, were experimentally fertilized with various doses of nitrogen and than the nitrate content was measured at their harvest. The nitrate content in leafs was determined by using standard methods, as atomic absorption spectrometry (AAS), approved by Romanian STAS 784/2-2009.Field experiments took place by fertilizing soil with six doses of nitrogen applied as mineral and organic fertilizer. The obtained results indicate a direct correlation between the nitrogen amount used as fertilizer and the nitrate content of vegetables. Nitrogen given as organic fertilizer (manure) establish at harvest time low nitrate content in vegetables, unlike the treatment with mineral fertilizer. Therefore the organic fertilizer is to be chosen instead mineral fertilization if the agricultural technology admits it. The nitrate content in vegetables is variable, depending also on the analyzed vegetable species and plant parts. The importance of the established results lies in informing the consumers about the nitrate accumulation in several leaf vegetables when intensive mineral fertilization is used. In order to prevent high nitrate content in leaf vegetable, the chosen nitrogen fertilizer dose depends also on several factors like soil features, climatic conditions, vegetation period of the crop and harvest time. The climatic conditions, the vegetation period of the vegetables and the harvest time are relevant for the nitrate content, since they influence the reduction process of nitrates. The usefulness of the paper lies in preventing the ingestion of high nitrate amounts by the consumer through leaf vegetables consumption, knowing that leaf vegetables are an important source of vitamins and minerals. To prevent the toxic nitrate impact on the consumer's health, the daily intake of nitrates by food consumption should not exceed the acceptable level established by FAO and WHO representing 3,65 mg nitrate/ kg body mass.*

Keywords**:** *nitrogen dose, nitrogen fertilizer, leaf vegetables, nitrate content, nitric overload.*

INTRODUCTION

Due to the high content of vitamins and minerals, vegetables provide a healthy nutrition to the consumers. Because of the health benefits, in all age categories of consumers the daily food diet contains vegetables, recommended by nutritionists. Therefore the composition and vegetable quality is very important and must be checked due to possible toxic compounds like nitrates which can be found in vegetables because intensive mineral nitrogen fertilization (1,2,4). It was estimated that especially leaf vegetables and some root vegetables are known as important nitrate accumulators (5, 8, 10). As a result, vegetables can represent the main source of nitric overload for the human body by daily intake of nitrates through food (7, 10,11). In order to find the causes of nitric overload in vegetables, the influence of the nitrogen type and dose as well as vegetation period and harvest time were investigated (6,8,9). The main objective of this study is to establish the nitrate content variation as a result of the selected nitrogen fertilizer type and doses, in the vegetative organs of some vegetables and to prevent

nitric overload in those vegetative plant organs which are used in the consumers' daily food diet (13,14).

MATERIAL AND METHODS

Field experiments were taken place by treating soil with six nitrogen doses (50, 100, 150, 200, 250, 300kg/ha) as mineral fertilizer (ammonium nitrate) or organic fertilizer (manure, compost) and having also a control alternative consisting of untreated soil. The nitrate content of lettuce, spinach, cabbage, parsley and carrot harvested from those plots was determined by analyzing the parts to be ingested by the consumers' (leaf and/or root).The nitrogen fertilizer type(organic / mineral) and the vegetation period/ harvest time (spring / autumn) were taken into account. The nitrate content was determined by spectrophotometry at 538 nm using the GRIESS method (SR EN 12014-7:2001). The obtained results are discussed regarding the highest level of nitrates in food (Rules-CE nb.1881/2006) in order not to exceed by daily intake the acceptable level of nitrates in human body.

RESULTS AND DISCUSSION

The increase of the nitrogen dose leads to a growth of the nitrogen content in lettuce.. However, the increase is much lower in lettuce leaves when organic fertilizer is used. Therefore the nitrate content in lettuce, for all the nitrogen doses, lies between 154-272 ppm by using manure as fertilizer and 170-404 ppm for compost(table 1).

Table 1

Nitrate content of lettuce fertilized with organic and mineral nitrogen fertilizer

Nitrogen dose (kg/ha)	**Nitrate content (ppm) Fertilizer - Manure**	**Nitrate content (ppm) Fertilizer - Compost**	**Nitrate content (ppm) Ammonium nitrate**
0	154	170	190
50	180	207	213
100	183	212	241
150	208	223	359
200	246	228	519
250	262	303	748
300	272	404	795

The climatic conditions during the vegetation period are very important because of their influence on the reduction reaction of nitrate. Light and solar radiation increase the speed of nitrate reduction. Therefore in autumn and winter month, the shorter day time increase the nitrate concentration in lettuce leaves of greenhouse crops or autumn crops (table 2).

Table 2

Influence of vegetation period and harvest time on nitrate content of lettuce

Nitrogen dose (kg/ha)	**Nitrate content (ppm) Spring harvest**	**Nitrate content (ppm) Autumn harvest**
0	198	660
50	213	808
100	241	939
150	359	1197
200	519	1205
250	748	1330
300	795	1765

Comparative, fertilizing spinach with manure (0,5% N) and ammonium nitrate (33,5% N) higher nitrate content in spinach leaves were found for mineral fertilization. Nitrogen in manure is mostly in organic form which is not immediately accessible for the plant generating lower contents of nitrate than mineral fertilization (table 3).

Table 3

Nitrate content of spinach fertilized with organic and mineral nitrogen fertilizer

manure dose (t/ha) fertilizer - Manure	**Nitrate content (ppm)**	**Nitrogen dose (kg/ha) fertilizer -Ammonium nitrate**	**Nitrate content (ppm)**
0	550	0	600
20	620	100	1076
30	700	150	1100
40	825	200	1250
60	980	300	1708

Table 4 shows the importance of the climatic conditions on the nitrate reduction, a different day light between spring and autumn, which increase the nitrate content in autumn spinach (600 -1706 ppm).

Table 4

Influence of vegetation period and harvest time on nitrate content of spinach

Nitrogen dose (kg/ha)	**Nitrate content (ppm) Spring harvest**	**Nitrate content (ppm) Autumn harvest**
0	50	600
50	153	950
100	168	1076
150	250	1100
200	315	1250
250	481	1467
300	789	1708

It is well known that in the early stages of plant development the nitrogen need is much higher than at harvest time. Therefore analyzing the nitrate content in cabbage during the vegetation periods a decrease of the nitrate content was established till the harvest time. In August, for the applied 6 fertilization doses, the nitrate content lies between 760-1411ppm, in September the nitrate content alters between 368-1122 ppm and at harvest time the lowest nitrate content was established 190-750 ppm(table 5).

Table 5

Influence of vegetation stage and nitrogen fertilization on nitrate content of cabbage

Nitrogen dose (kg/ha)	**Nitrate content (ppm) August**	**Nitrate content (ppm) September**	**Nitrate content (ppm) October-harvest**
0	396	224	113
50	760	368	190
100	780	398	343
150	920	461	353
200	1174	724	410
250	1382	905	693
300	1411	1122	750

All the above studied vegetables are well known as leaf vegetables. As part of the daily diet it is very important to known also the nitrate distribution in the vegetative organs of root vegetables like carrot and parsley.

The enhance of the nitrogen dose provides a proportional increase of the nitrate content in carrot. The increase has higher values for the carrot leaves (574-1090 ppm) than for the roots (178-482 ppm), which is important because only the roots are consumed from carrots in a daily diet. The developing of leaves in early vegetative stages with high nitrogen needs leads to their higher nitrogen content (table 6).

Table 6

Nitrate content distribution in the vegetative organs of carrot

Nitrogen dose (kg/ha)	**Nitrate content (ppm)** **root**	**Nitrate content (ppm)** **leaf**
0	63	285
50	178	574
100	228	685
150	261	823
200	313	900
250	360	988
300	482	1090

Table 7

Nitrate content distribution in the vegetative organs of parsley

Nitrogen dose (kg/ha)	**Nitrate content (ppm)** **root**	**Nitrate content (ppm)** **leaf**
0	317	670
50	368	820
100	503	869
150	589	870
200	630	886
250	689	1145
300	966	1179

The importance of parsley used as a root vegetable and for its flavored leaves, requires the study of nitrate distribution in both vegetative organs. As a result of fertilizing parsley with the above mention nitrogen doses, an increase of the nitrogen content in both organs was established. However the nitrate content values were higher in leaves. The increase lies between 820-1179 ppm in leaves and only between 368-966 ppm in roots (table 7).

CONCLUSIONS

The obtained results show that the increase of the nitrogen dose administered as fertilizer rises proportional the nitrogen content of all studied vegetables. Nitrogen applied as organic fertilizer (manure, compost) generates a lower nitrate content in vegetables than mineral nitrogen (ammonium nitrate). Therefore the organic fertilizer should be preferred to mineral fertilization, if the agricultural technology admits it.

The highest accepted nitrate level for lettuce, spinach, cabbage, carrot are 2000ppm, 2000ppm, 900 ppm and 400ppm (14). Considering these requirements, the critical nitrogen dose of fertilizer for carrot root is 300 kg N. The obtained values of nitrate content for lettuce, spinach, cabbage and parsley do not exceed the maximum acceptable ones for either of the experimental doses.

Vegetables cultivated in greenhouse or as autumn crop contain higher nitrate contents than spring crops and should be consumed in lower quantities in order to avoid exceeding the

daily acceptable nitrate intake. The leaves of root vegetables have the higher nitrate content comparative with the root, which is important when also leaves (parsley) are consumed.

In order to avoid high nitrate levels in vegetables, the fertilizer nitrogen dose to be applied should be calculated on the basis of specific consumption of the species and also soil features and fertility. The climatic conditions, the vegetation period of the crop and the harvest time are also important, since they influence the nitrate reduction.

To prevent the nitric impact on the consumers' health, the daily nitrate intake through food / vegetables should not exceed the acceptable level established by FAO and WHO representing 3,65 mg nitrate/ kg body mass.

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