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NITRATE CONCENTRATION IN PLANT PRODUCTS OF ALBANIAN MARKET

Marsida Klemo
Applied and Natural Sciences Department, Professional Studies Faculty, "Aleksander Moisiu" University, Durres, Albania, marsi_82h@yahoo.com
Bledar Biti
Applied and Natural Sciences Department, Professional Studies Faculty, "Aleksander Moisiu" University, Durres, Albania,avbiti@hotmail.com

Abstract: This study presents a research done for nitrate concentration in fruits and vegetables purchased in Albanian markets and department stores.
Recently media and television, investigative programs, newspapers, social networks and Association for the Albanian consumer have denounced the problem of the high nitrate content found in plant products.
In this study, nitrate concentration available in vegetables and fruits, was determined and compared with standard limits.
Thirty-seven fruits and vegetables were purchased in summer and autumn and tested with *Green Test Eco 5* supply, a simple and portable apparatus that performs quick measurements with margin error about 10%. Photos of the checked products were made and each value was registered and calculated referring the margin error of the supply. Excel was used to draw diagrams and make statistical analysis.
From the results obtained it was noticed a very high concentration of nitrate in vegetables and fruits like watermelon, melon, beetroot, marrow, cherry radish, red potato. These products tested accounted around 40% of the total quantity and were dangerous to eat.
For other products it was noticed a lower nitrate content comparing with the dangerous one but again above allowed standard limit like white potatoes, eggplants, cherry radish. These products tested accounted around 20% of the total quantity and were still ok to eat.
Of course, the products with nitrate levels below the permitted standard such as bananas, carrots, broccoli, apple, orange, green lettuce, cucumber, kiwi, pineapple, persimmon, onion, cauliflower were also found in the analyzed products. So about 40% of total quantity were safe to eat.
The conclusions extracted from this study are such as to highlight the risk to the Albanian consumers and the lack of control of the responsible institutions.
Keywords: Nitrate concentration, vegetables, fruits, Green test eco 5

INTRODUCTION

Nitrate is found in nature as part of nitrogen cycle and it is important during nutrition and development of plants. Green leafy vegetables are foods that contain huge amounts of nitrate, which can have positive and negative effects on human body (Brkić1 D et.al, 2017), (Tzu-Hsien Yu. et.al, 2018). Apart of leafy vegetables, studies have indicated that other types of vegetables such as grains, tubers, nuts also contain nitrate (Gundimeda U. et.al1993).
It is common that vegetables contain levels of nitrate, especially from fertilizers (Tzu-Hsien Yu. et.al, 2018). Today the role of nitrogen fertilizer on growth, performance and quality of products as well as demand for available products at agriculture is increased to achieve more productivity and this leads to overuse or abuse of nitrogen fertilizers (Fakhreddin Afzali S & Elahi R, 2014).
Concentration of nitrates and nitrites in vegetables and other food products is an important quality indicator due to its influence on the human health (Susin J. et.al, 2006).
Nitrates itself is very low in toxicity, but it is degraded into much more toxic nitrites within the human body (Gangolli SD et.al, 1994).
Industrial revolution has caused an increase in concentration of nitrates and nitrites in foodstuffs, which now has become a global concern due to its harmful effects on environment and human health (Ziarati P & Arbabi-Bidgoli S, 2014), (Ranasinghe R & Moropana R, 2018).
Most of the nitrate accumulates in the mesophyll cells of the leaves; fruits and seeds have low nitrate levels, because nitrate is exclusively transported by the xylem (Pate, J.S et.al, 1980), (Santamaria P, et.al, 1999), (Gorenjak A. H & Cencič A, 2013). Vegetable organs can be listed in the decreasing order of the nitrate content as follows:
Petiole › Leaf › stem › root › inflorescence › tuber › bulb › fruit › seed (Jana J.C & Moktan P, 2013).

The best-known effect of nitrite is its ability to regret with hemoglobin (oxy Hb) to form meth globin (met Hb) and nitrate:

$$NO^{2-} + \text{oxy Hg b } (Fe^{2+}) \rightarrow \text{met Hgb } (Fe^{3+}) + NO^{3-}$$

As a consequence of the formation of met Hb, the oxygen delivery to tissue is impaired (Knobelock L et.al, 2000), (Speijers GJA & Van den Brandt PA, 2003).

Nitrate as we mentioned above is relatively non-toxic but its metabolites, nitrite, is associated with methemoglobinemia. Nitrite might also react with amines to form carcinogenic nitrosamines in the stomach.

The concentration of nitrate in vegetables depends on species variation, season, light, temperature, method of growth and fertilizer used (https://www.cfs.gov.hk/english/programme/programme_rafs/files/Nitrate_and_Nitrite_Vegetables_Available_HK_e.pdf)

MATERIAL AND METHOD

In this study we have used the nitrate testing supply called *Green test Eco 5* (Photo 1) to test thirty-seven fruits and vegetables purchased in Albanian market and department stores.

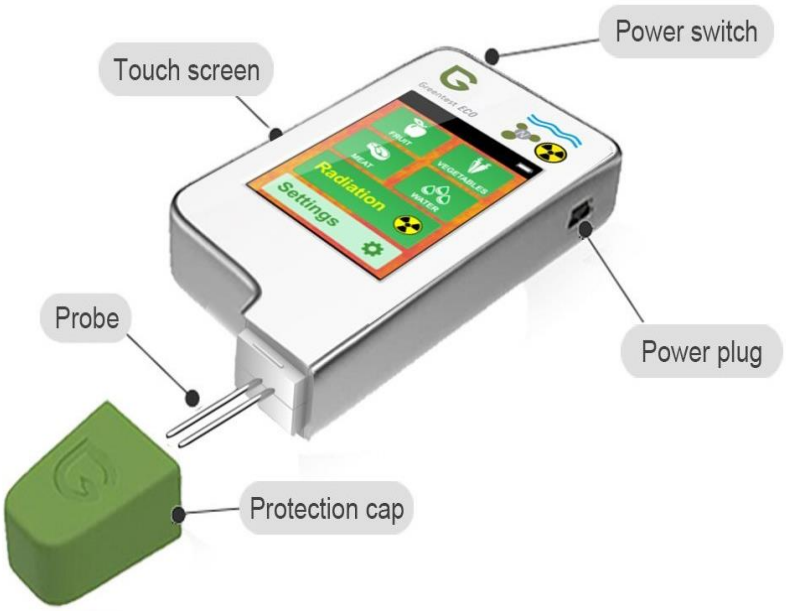

Photo 1. Green test Eco 5

Supply characteristics are found in:
https://www.amazon.com/gp/product/B0769C6SKS/ref=as_li_qf_sp_asin_il_tl?ie=UTF8&tag=myorganicssit-20&camp=1789&creative=9325&linkCode=as2&creativeASIN=B0769C6SKS&linkId=cecd5275cabda7da4d67829d9c7a434f

Vegetables tested were: cauliflower (2 pieces), red potato, white potato (2 pieces), cherry radish (10 pieces), eggplant, beetroot (3 pieces), marrow (2 pieces), onion, green lettuce, broccoli, carrot, cucumber.

Fruits tested were: pineapple, melon (4 pieces), watermelon, apple, persimmon, kiwi, banana, orange.

Vegetables and fruits were collected and tested during summer and autumn of the year 2018.

RESULTS

The nitrate content measurements of selected vegetables and fruits are presented in table 1 and table 2.

Based on the data obtained and margin error of the Green test Eco5 supply (10%) was calculated the nitrate content of the vegetables and fruits and compared it with the standard limit for each product.

Table 1. Nitrate content measurement results of vegetables in mg/kg

Nr.	Kind of vegetable	Nitrate (average measured value) (mg/kg)	Nitrate content scale	Nitrate (calculated value) (mg/kg)	Standard limit (mg/kg)	Product safety
1.	Cauliflower	10	Low	10±1	2000	Safe to consume
2.	Cauliflower	610	Low	610±61	2000	Safe to consume
3.	Red potato	510	High	510±51	250	Dangerous
4.	Cherry radish	2200	Elevated	2200±220	1500	High levels but still ok to eat
5.	Cherry radish	2500	Elevated	2500±250	1500	High levels but still ok to eat
6.	Cherry radish	1600	Elevated	1600±160	1500	High levels but still ok to eat
7.	Cherry radish	2100	Elevated	2100±210	1500	High levels but still ok to eat
8.	Cherry radish	4700	High	4700±470	1500	Dangerous
9.	Cherry radish	2800	Elevated	2800±280	1500	High level but still ok to eat
10.	Cherry radish	5100	High	5100±510	1500	Dangerous
11.	Cherry radish	4300	High	4300±430	1500	Dangerous
12.	Cherry radish	4100	High	4100±410	1500	Dangerous
13.	Cherry radish	3800	High	3800±380	1500	Dangerous
14.	eggplant	570	Elevated	570±57	300	High levels but still ok to eat
15.	beetroot	4600	High	4600±460	1400	Dangerous
16.	beetroot	7800	High	7800±780	1400	Dangerous
17.	beetroot	3000	High	3000±300	1400	Dangerous
18.	Marrow	970	High	970±97	400	Dangerous
19.	Marrow	320	Low	320±32	400	Safe to consume
20.	White potato	380	Elevated	380±38	250	High levels but still ok to eat
21.	White potato	390	Elevated	390±39	250	High levels but still ok to eat
22.	Onion	25	Low	25±2.5	80	Safe to consume
23.	Green lettuce	20	Low	20±2	2000	Safe to consume
24.	Broccoli	530	Low	530±53	2000	Safe to consume
25.	Carrot	50	Low	50±5	400	Safe to consume
26.	Cucumber	190	Low	190±19	400	Safe to consume

Table 2. Nitrate content measurement results of fruits in mg/kg

Nr.	Kind of fruit	Nitrate (average measured value) (mg/kg)	Nitrate content scale	Nitrate (calculated value) (mg/kg)	Standard limit (mg/kg)	Product safety
1.	Pineapple	15	Low	15±1.5	30	Safe to consume
2.	Melon	540	High	540±54	90	Dangerous
3.	Melon	380	High	380±38	90	Dangerous
4.	Melon	490	High	490±49	90	Dangerous
5.	Melon	370	High	370±37	90	Dangerous
6.	Watermelon	130	High	130±13	60	Dangerous
7.	Apple	0	Low	0	60	Safe to consume
8.	Persimmon	0	Low	0	60	Safe to consume
9.	Kiwi	10	Low	10±1	60	Safe to consume
10.	Banana	0	Low	0	200	Safe to consume
11.	Orange	10	Low	10±1	30	Safe to consume

The data from table 1 and 2 are represented in graphic 1 and 2.

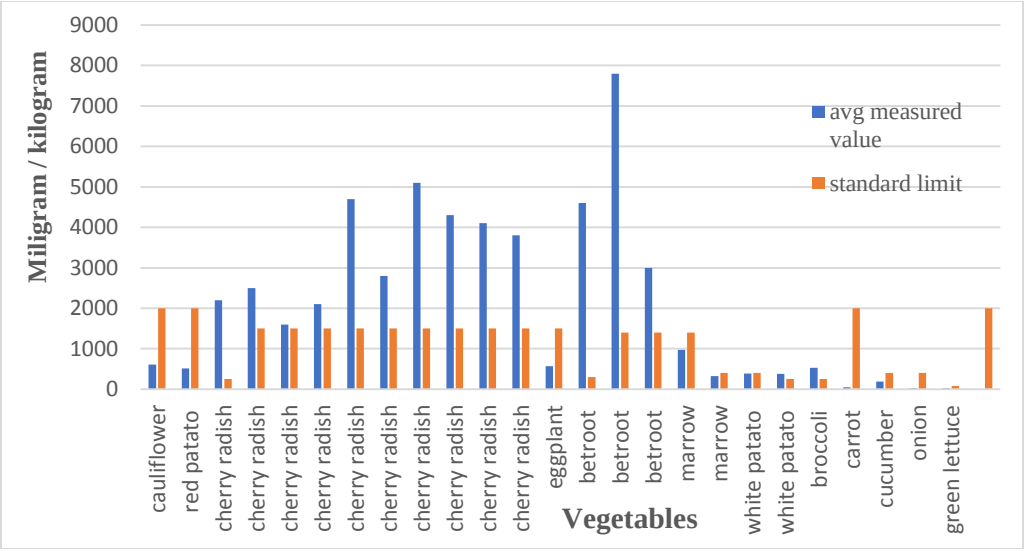

Figure 1. Comparison of avg nitrate measured value with standard limit for different kind of vegetables

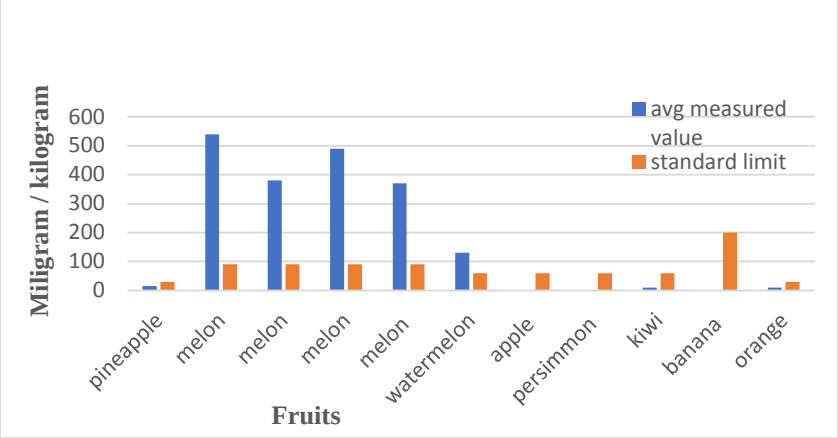

Figure 2. Comparison of avg nitrate measured value with standard limit for different kind of fruits

As we notice in the graph of fig 1, nitrate concentration is higher than standard limit in vegetables like cherry radish, marrow, beetroot, red potato.
In the graph of fig 2 nitrate concentration is noticed to be higher than standard limit in fruits like melon, watermelon.
As a conclusion we must say that about 40% of all the vegetables and fruits have a very high nitrate content comparing to the standard limit.
For other products it was noticed a lower nitrate content but again above permitted standard limit. These products were white potatoes, eggplant, cherry radish, that count nearly 20% of all the products tested.
Of course, the products with nitrate levels below the permitted standard such as bananas, carrots, broccoli, apple, orange, green lettuce, cucumber, kiwi, pineapple, persimmon, onion, cauliflower were also found in the analyzed products, nearly 40% of total quantity.

CONCLUSIONS AND RECOMMENDATIONS

- The biggest part of nitrate content was found in root vegetables (red potato, cherry radish, beetroot), marrow and in fruits like melon and watermelon.
- The highest values were: for beetroots from 3000 to 7800 mg/kg (standard limit 1400 mg/kg), cherry radish from 3800 to 5100 mg/kg (standard limit 1500 mg/kg), red potato with 510 mg/kg (standard limit 250 mg/kg), marrow with 970 mg/kg (standard limit 400 mg/kg), melon from 370 to 540 mg/kg (standard limit 90 mg/kg), watermelon 130 mg/kg (standard limit 60 mg/kg). These products are not recommended to consume because of the very high nitrate content that is considered hazardous for the population.
- Elevated values of nitrate content were also found in white potato, eggplant, cherry radish samples. For white potato was 380-390 mg/kg (standard limit 250 mg/kg), for eggplant was 570 mg/kg (standard limit 300 mg/kg) and for cherry radish was from 1600 to 2800 mg/kg (standard limit 1500 mg/kg). These vegetables are recommended to be consumed moderately.
- The conclusions extracted from this study indicate that Albanian consumers are at a high risk because of the lack of control of the responsible institutions.

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