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Studies concerning food safety of vegetables existing on markets and hypermarkets from Timisoara

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Abstract The purpose of this paper is to analyze food safety of vegetables (onion) existing food markets and hypermarkets in Timisoara. It has a special significance which is due to the diversified use in food, consumer opportunities throughout the year, and its use in food and pharmaceutical industries. In accordance with the ORDER No. 293/640/2001-1/2002 regarding security and quality conditions for vegetables and fresh fruits for human consumption maximum limit allowed (LMA) for nitrates in onions is 80 ppm [17]. Nitrite levels in vegetables and fruit are not established by any Law, but according to Dennis M.J. and Wilson L.A. [5] are usually below 2 ppm and according to another authors, Alexa E., [1-2] and Trif A. [13] nitrite level in vegetables should be between 1-5 ppm. In order to determine the incidence of nitrates and nitrites in imported onion, were sampled 11 red, white and yellow onions, from Timisoara hypermarkets (Metro, Profi, Kaufland, Danevi, Auchan and Real) that are pursued from some U.E. countries, such as: Holland, Austria, Germany, Greece, Egypt and Bulgaria. Were also sampled onion samples from Timisoara food markets, which come from private producers in several regions of Timis County, in order to achieve correlation between the level of contamination with nitrogen compounds of imported and local vegetables. The nitrate and nitrite content determination in onions was done according to ISO 6635 [15] in the Laboratory for the Measurement of Residues of the Department of Agro-techniques of the U.S.A-V.M.B in Timisoara. The nitrogen compounds values were read to Spectrophotometer SQ 118 at wavelengths of 515 for nitrate and 525 nm nitrites. Most contaminated with nitrate was the onion sample imported from Egypt (162.5 ppm), and most secure in terms of food safety was a white onion sample coming from Germany (15.92 ppm) (table 1). Values of nitrite content determined in imported samples were according to literature studies, ranging between 1-5 ppm.

Key words

onion samples, nitrate, nitrite, statistic parameters

The presence of nitrates and nitrites in agricultural products has been of concern for some time. Abundant uses of compost, manure, and chemical fertilizers are considered to be some of the primary causes of high levels of nitrates in produce. Nitrate may also be present as a natural metabolite of nitrogen intake by green plants. Although it is generally accepted that nitrate itself is not toxic, it can act as a reservoir for the production of nitrite by bacterial action on food during storage or within the body during digestion. There are several dangers associated with nitrites: they can form carcinogenic *N*-nitroso compounds by reaction with secondary and tertiary amines present in the body [8].

Nitrosation can occur mainly in two situations: (1) during storage and ripening of the food product and (2) in the stomach from the action of salivary nitrite produced through enzymatic reduction of endogenous or exogenous nitrate [6]. Nitrate is found as a naturally occurring compound in foods such as vegetables, fruit, cereals, fish, milk, and dairy products, and is also found in water as a consequence of agricultural practices such as the use of nitrogen-containing fertilizers and from animal waste. Low levels are generally found from these sources, except in the case of some vegetables. Nitrate and nitrite are also permitted as food additives in some foods, primarily as protection against botulism. [5]

Can be mention that nitrate is not dangerous as itself (NO^-_3), but nitrite (NO^-_2) which derives from it, as well salts of nitric acid. This conversion reaction occurs in

the digestive tract of man and animals, as well as storage prolonged by products of vegetable origin. In addition to nitrite, a deleterious influence on the body exerts secondary amines and nitro amines. All these combinations being in higher amounts than the dose allowed in drinking water or fresh products (especially in vegetable crops), lead to destruction of haemoglobin in the blood, forming also meta haemoglobin. The last is particularly dangerous for children ("baby blue" syndrome or cyanosis) and young animals too. Nitro amines and nitro amides have a carcinogenic, mutagenic and toxic effect over the embryo. The maximum dose of nitrate accepted as safe for humans is about 5 ml of 1 kg of body weight [14].

On the basis of published data, vegetables can be divided into three groups according to their nitrate content: low nitrate (< 100 mg/kg), medium nitrate (100–1000 mg/kg) and high nitrate (> 1000 mg/kg) [16]**.** Onions are included in the first category of vegetables with low nitrate content (<100 mg / kg). It has a special significance which is due to the diversified use in food, consumer opportunities throughout the year, and its use in food and pharmaceutical industries.

Food value is given by the carbohydrate content (7-11%); protides (1.2 to 1.9%), vitamin C (8-16 mg/100 g sp), B1 (0.05 mg/100 g sp), B2 (0.03 mg/100 g sp) and mineral salts of P (45 mg), K (230 mg) to 100 g sp, resulting a calorific value of 35-48 g sp kcal/100. Besides food value, onions ensure good hygiene and nutrition, due to antibiotic action. It is effective in treatment of some disease such as: fatigue, gallstones, respiratory disease, influenza, atherosclerosis, and diabetes, wound healing.

Due to its food importance and hygiene value, it is recommended that a grown man to consume 30 g onion, and 11 kg/ year, 6 kg during the winter [18].

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Material and Methods

In order to determine the incidence of nitrates and nitrites in imported onion, were sampled 11 red, white and yellow onions, from Timisoara hypermarkets (Metro, Profi, Kaufland, Danevi, Auchan and Real) that are pursued from some U.E. countries, such as: Holland, Austria, Germany, Greece, Egypt and Bulgaria. Were also sampled onion samples from Timisoara food markets, which come from private producers in several regions of Timis County, in order to achieve correlation between the level of contamination with nitrogen compounds of imported and local vegetables.

The nitrate and nitrite content determination in onions was done according to ISO 6635 [15] in the Laboratory for the Measurement of Residues of the Department of Agro-techniques of the U.S.A-V.M.B in Timisoara. The nitrogen compounds values were read to Spectrophotometer SQ 118 at wavelengths of 515 for nitrate and 525 nm nitrites.

Minimum detection limits according to work method are: 1 mg/l for nitrates, 0.02 mg/l for nitrites. Spectrophotometer measures the reflectance or relative transmittance of light to a sample of the one colour, to more points of the visible spectrum. The result is known as spectrophotometer curve and represents the most accurate way to measure colour [19].

Samples of onions were washed and than have been finely chopped and put in 500 ml distillation water.

After an hour the onion extract was filtrated and than was took 1.5 ml of onion matrices and put it over the Aqua Merk nitrate solution. After 10 minutes we read the value of nitrate to Spectrophotometer SQ 118. Regarding the nitrite determination we took 10 ml of the same onion extract and put it over the nitrite Aqua Merk solution, and after 10 minutes we read the value of nitrite to the same Spectrophotometer SQ 118, but to another wavelength [9].

The conclusions will be express after the interpretation of some statistics parameters. Beside the classic parameters of position and variation (mean, standard deviation, variation coefficient), we will analyze a few aspects concerning the symmetry or obliquity (skewness) and flattening or vaulting (kurtosis). „Normality" of static distribution is given by the approaching of normal curve form (Gauss). In the case of normal distribution, a perfect symmetric distribution, arithmetic average, median line and modulus coincide [20]. Asymmetric coefficient (skewness) returns the skewness of a distribution. Skewness characterizes the degree of asymmetry of a distribution, around its mean. Positive skewness indicates a distribution with an asymmetric tail extending toward more positive values. Negative skewness indicates a distribution with an asymmetric tail extending toward to more negative values [7].

Fig. 1. The NO^-_3 and NO^-_2 determination in onions in the Laboratory for the Measurement of Residues

Results and Discussions

The obtained experimental results are shown in tables 1-3 and figures 2-3.

Table 1

Nitrate content determined in imported onion samples (red, yellow and white), pursued from Timisoara hypermarkets (Metro, Profi, Kaufland, Danevi, Auchan, Real).

No.	The source and type of analyzed onion sample	NO^-_3 (ppm)	NO^-_2 (ppm)
1	Egypt – yellow onion	162.05	2.52
2	Austria 1 Ergofruct - yellow onion	148.9	1.43
3	Austria 2 - yellow onion	82.54	1.71
4	Bulgaria - yellow onion	72.10	1.59
5	Greece - yellow onion	98.02	1.78
6	Holland – yellow onion	52.00	0.81
7	Holland – white onion	29.23	0.92
8	Germany – white onion	15.92	0.53
9	Holland - red onion	41.66	0.78
10	Austria - red onion	146.85	1.94
11	Germany - red onion	35.86	1.63

Regarding nitrogen compounds contamination of imported onion samples, were registered values that exceed the maximum admitted limit of 80 ppm in 45% of imported onion samples, the values were ranging between 82.54 ppm (yellow onion, Austria) and 162.05 ppm (yellow onion - Egypt). Nitrite content determined in studied samples was framed in the admitted range of 1-5 ppm, the highest concentration was determined in yellow onions samples from Egypt 2.52 ppm, and the lowest in samples from Germany 0.53 ppm (table 1).

The transformations that nitrates it supports in plants, in the first stage, consist in two successive reductions, catalyzed by nitrate-reduction and nitrite-reduction enzymes. These enzymes contain minor elements (nitrate-reduction enzymes contain molybdenum, and nitrite-reduction enzymes contain lead and cooper. The nitrates reduction is influenced by the light intensity and by the presence of molybdenum, which provide the needed electrons for the reduction reaction. The less molybdenum quantity, the more is the accumulation of nitrate in plants [11].

Transformation of nitrate to nitrite during storage, especially in home-prepared food, is known to occur. Evidence from studies on methaemoglobinaemia support the contention that the nitrate contained in vegetables is converted to nitrite before consumption [3]. Levels of nitrite up to 400 mg/kg have been reported in vegetables that have been damaged, poorly stored or stored for extended periods and in pickled or fermented vegetables In contrast, levels of nitrite in cured meat appear to decrease during storage as it is converted into nitric oxide. The decrease is mainly due to its reactivity, and may average 70% [14].

The most important cause of nitrate contamination of vegetable products is excessive fertilization with nitrogen doses which exceeding the needs of the plant during the period of maximum consumption. Other causes may be: soil characteristics (pH, anion and cation content present in the soil solution, soil retention capacity and its buffer capacity), the genetic potential of plants, climatic conditions (temperature, precipitation, light intensity) determines the level of nitrates in plants, as a result of the conditions in which the reduction reaction takes place.

Among these, lighting system has an important role, because interferes as a source which provides energy in the of nitrate reduction process in the plant (nitrate - nitrite - ammonia - amino acid). Thus in the months May-September, when light intensity tends to maximum, allows obtaining low nitrate content in vegetables because is favourised reduction process, while in winter months - winter nitrate content in plants increases [1].

Most contaminated with nitrate was the onion sample imported from Egypt (162.5 ppm), and most secure in terms of food safety was a white onion sample coming from Germany (15.92 ppm) (table 1). Values of nitrite content determined in imported

samples were according to literature studies, ranging between 1-5 ppm [1,13] (table 1).

Table 2

Statistical analysis of data on nitrate and nitrite content determined in imported onion samples (red, yellow and white), pursued from Timisoara hypermarkets

Parameter	Total No.	Mean	Standard deviation	Variation coefficient %	Minimum value	Maximum value	Skewness coefficient	Kurtosis coefficient
NO^-_3	11	80.46	±52.18	0.64845	15.92	162.05	0.5052	-1.2757
NO^-_2	11	1.42	±0.599	0.42146	0.53	2.52	0.1239	-0.52935

The average of nitrate content values in imported onions samples was 80.46 ppm, the minimum value was 15.92 ppm (white onions - Germany) and the maximum value was 162.05 ppm (yellow onion - Egypt). The coefficient of variation was 0.64845% and standard deviation ±52.18, (table 2).

Skewness coefficient, of nitrate values, was positive (0.5052) higher than *0*, which determine asymmetry to right, so most of the values of nitrate content in imported onion samples were below the average of 80.46 ppm.

Kurtosis coefficient was negative -1.2757, so the distribution of nitrate content values, is relatively flattened (platikurtic) were not observed values to occur in many numbers, the values of nitrate content, are similar in all analyzed samples. In the case of nitrite content regarding the symmetry, (table 2) the *skewness* coefficient had positive value (0.1239), asymmetry to right, so the most data obtained are under the mean of 1.42 ppm. Nitrite content values had a negative *kurtosis* coefficient -0.52935 indicating a relatively flattened (platikurtic) distribution, haven't been registered values which appeared in many number (table 2).

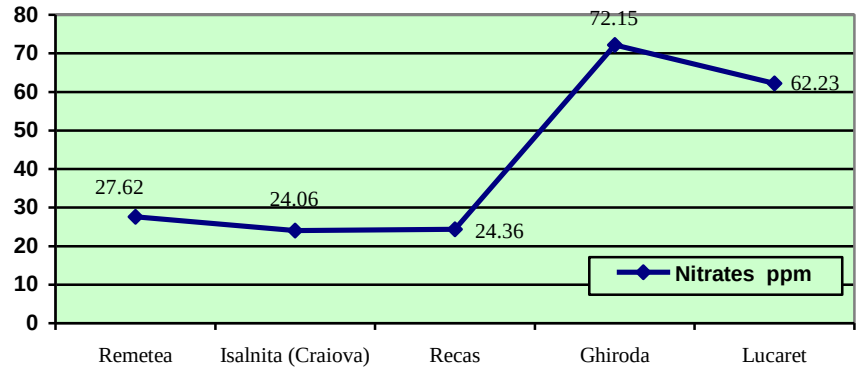

Fig. 2. Nitrates content determined in yellow onion pursued from Timisoara agro food markets.

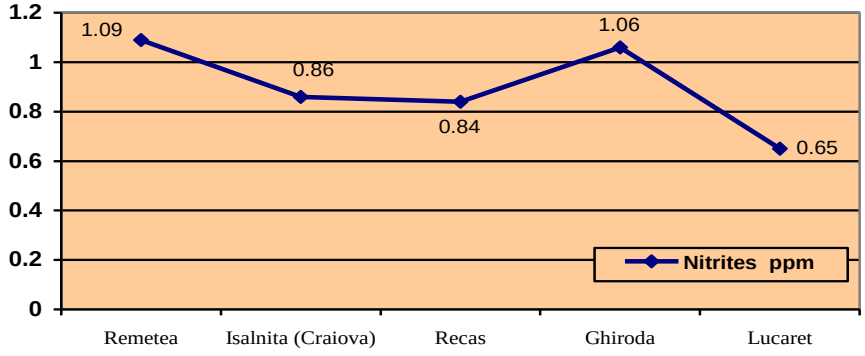

Fig. 3. Nitrites content determined in yellow onion pursued from Timisoara agro food markets

Values of nitrate content in onion taken from the Timisoara food markets are frame in the normal range, below 80 ppm in all analyzed samples, being fit for human consumption. Samples came from four localities of Timis county (Remetea Recas, Ghiroda and Lucaret) and a sample of Isalnita (locality near

Craiova) (figure 2). Nitrite content determined in local onion samples had values ranging between 0.65 - 1.09 ppm, framing in the range allowed, which according to studies is between 1-5 ppm (figure 3) [1, 13].

Data of the literature [2, 5] points out that the storage and packaging condition is a very important factor that influences the nitrates contamination, especially nitrites contamination in plant products.

In these days is practice half cooked packaging, in vacuum packaging of vegetable mixtures. In the fresh vegetables, nitrite ion is missing or is found in small traces. If the vegetables are stored in improper conditions, to temperatures above 5^0C, appears the microbial reduction of nitrates to nitrites, the nitrite content increases greatly, and the nitrate content decreases in vegetables. Considering the toxic potential of nitrites 6-12 times higher compared with nitrates, it is important to respect the conditions and storage duration of vegetables.

The measures that consumers can apply to reduce the amount of nitrates and nitrites, in fresh plant products, refers to the careful washing with water because the nitrates are water soluble and a large portion of it is removed as a result of washing process, keeping vegetables in proper conditions, at low temperatures and for short period of time and avoid consumption of vegetables grown in glass houses [1].

Table 3

Statistical analysis of data on nitrate and nitrite content determined in yellow onions, from Timisoara food markets.

Parameter	Total no.	Mean	Standard deviation	Variation coefficient %	Minimum value	Maximum value	Skewness coefficient	Kurtosis coefficient
NO^-_3	5	42.09	±23.24	0.55	24.06	72.18	0.69566	-2.71533
NO^-_2	5	0.9	±0.18	0.20	0.65	1.09	-0.35447	-0.97633

The average of *nitrate content* values registered in local onion samples was 42.09 ppm, the minimum value was 24.06 ppm (Isalnita) and the maximum value was registered in samples coming from Ghiroda (72.18 ppm). The coefficient of variation was 0.55% and standard deviation ± 23.24. Skewness coefficient was positive (0.69566) higher than 0, which leads to right asymmetry, so most of the nitrate content values were below the average of 42.09 ppm. Kurtosis coefficient was negative -2.71533, distributions of values of nitrate content is relatively flattened, and were not observed many nitrate values to occur with differences between them, the values of nitrate content, are similar in all analyzed samples (table 3).

The *nitrite content* average was 0.9 ppm, the minimum value was 0.65 ppm (Lucaret) and the maximum value was registered in samples coming from Remetea (1.09 ppm). The coefficient of variation was 0.18% and standard deviation ± 0.20. Skewness coefficient had negative value (-0.35447) resulted to left asymmetry, so most of the nitrite content values were higher the average of 0.9 ppm. Kurtosis coefficient had negative value -0.97633, distributions of values of nitrite content were relatively flattened, and were not observed many nitrite values to occur with differences between them (table 3).

A study on food safety of vegetable products regarding nitrogen compounds contamination has been achieved in the state of Mazandaran (Iran) in 2008 by Shokrzadeh M., and all. [12].

They analysed the concentration of nitrates and nitrites in carrots and onions sampled from three central cities of Mazandaran state and was determined in 12 samples of each vegetable collected from farmlands of four geographical regions in each city. The average content of nitrates and nitrites in all of the samples was less than standard threshold limits. Babol-sampled carrot had significantly higher nitrate content than two other cities. On the other hand, onions which were sampled from Sari showed significantly higher content of nitrate than two other cities. Based upon the maximum levels that were specified by European Commission Regulation, data showed that the investigated vegetables were safe for consumption [12]. Nitrate content has different dynamics from one variety to another within the same species. Also, soil characteristics on which culture has been developed influence largely nitric oxide content available for plants. Thus, absorptive capacity depends on the intensity and direction of biochemical processes that occur in plants, the exchange reactions occurring in soil solution and also colloidal changes which appear to roots interface contact with the environmental response[6]. For these reasons the values obtained for samples analyzed from studied rural area, with soils with different characteristics have variable distribution of nitrate and nitrite content (figure 2-3).

Similar studies were made in 2006 by Cumpata Simona and Beceanu D., [4] being monitored Iasi food markets. Like the samples from food markets of Timisoara, samples that were analyzed from Iasi did not exceeded the admitted values of nitrates and nitrites in any of the onion samples analyzed.

Conclusions

- Nitrate contamination of imported onion samples, registered values that exceed the maximum admitted limit of 80 ppm in 45% of imported onion samples, the values were ranging between 82.54 ppm (yellow onion, Austria) and 162.05 ppm (yellow onion - Egypt).
- Nitrite content determined in imported onion samples framed in the range of 1-5 ppm, the highest concentration was determined in yellow onions samples from Egypt 2.52 ppm, and the lowest in samples from Germany 0.53 ppm.
- Values of nitrate content in onion taken from the Timisoara food markets are frame in the normal range, below 80 ppm in all analyzed samples, being fit for human consumption.
- Samples came from four localities of Timis county (Remetea Recas, Ghiroda and Lucaret) and a sample of Isalnita (locality near Craiova).
- Nitrite content determined in local onion samples had values ranging between 0.65 - 1.09 ppm, framing in the range allowed, which according to studies is between 1-5 ppm
- Imported onions studied, coming from hypermarkets are in a high percent safe in terms of food safety, except those coming from countries Austria and Egypt. In conclusion, we can recommend that the people should consume vegetables from local food markets, pursued from Romanian farmers, not imported coming from UE countries.

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