THE STUDIES ON THE DYNAMICS CONTENT OF NITRATES AND NITRITES FROM TOMATOES AND PRODUCTS RESULTING FROM TECHNOLOGICAL FLOW OF OBTAINING TOMATO JUICE

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Abstract

The purpose of this study was to monitor the level of nitrates and nitrites in raw tomatoes for industrialization in the S.C. Contec FOODS S.R.L.Tecuci. The analyses carried out to assess the dynamics of the level of nitrates and nitrites in the raw material, the technological flow samples and finished product.
Concentrations of nitrates and nitrites have been quantified by molecular absorption spectrometry method. The level of nitrates tomatoes varied between 7.14-8.11 mg/kg and in tomato juice between 5.04-5.27 mg/kg, these values are under safety limit set by legislation. The level of nitrites in all cases (tomatoes, chopped tomatoes thermal treated, residue of skin and seed, tomato juice) are less than 1 mg/kg. The highest concentrations of nitrates and nitrites after processing tomatoes have been found in the skin and seed, obtained as residue from the processing of tomatoes.
The values obtained were below the maximum permissible concentrations of legislation in force.

Key words: (nitrates, nitrites, tomato, tomato juice)

In recent years, an increasing interest concerning determination of nitrate levels in food products has been observed, essentially due to the potential reduction of nitrate to nitrite, which is known to cause adverse effects on human and animal health. Therefore, the monitoring and surveillance of the quality of vegetal products need to be enhanced.

Nitrates and nitrites may accumulate in plants tissues and are very dangerous substances for human health, leading health disturbances (methemoglobinemia). Some epidemiological studies linking intake of nitrate and nitrite with gastric cancer in humans indicated a positive correlation.

Nitrogen is absorbed by plants in the form of either ammonium (NH^{4+}) or nitrate (NO^{3-}), and its accumulation is influenced by a series of factors that are depending on the species, cultivar, age and soil conditions. Once nitrate is absorbed by plants, it has to be reduced by the enzyme nitrate reductase to ammonium and assimilated via glutamate. The concentration and amount of nitrates levels in plants will vary depending on the type of vegetable, the temperature that it is grown at, the sunlight exposure, soil moisture levels and the level of natural nitrogen in the soil.

In relation to age, preferential tomatoes absorb at the beginning of vegetation form ammonia NH^{+} after using nitric form [Vasilica, Simion, Câmpeanu, Gh., Gina, Vasile, Mihaela, Artimon, Luminița, Catană, Mioara, Negoiță, 2008; Davidescu, D., Davidescu, Velicica, 1987].

Vegetables tend to concentrate nitrate ions, especially if they are grown by using a high application of nitrogen fertilisers. If nitrate levels in vegetal products are too high, farmers must reduce the amount of nitrogen fertilizers they use, though the problem from the farmer point of view is that by reducing nitrogen applications is likely to obtain lower yields.

Also, it is known that molybdenum is a component of nitrate reductase enzyme, which has an important role in plant nitrate metabolism.

Lower concentrations of molybdenum in plants lead to nitrate accumulation in tissues and sometimes, a higher level of nitrate is a consequence of this wait.

The major contribution of the intake of nitrates in food comes from vegetables. Nitrates are natural components of plants and are present in large quantities in many vegetables.

As a result of many factors that influence the process of accumulation of nitrates in vegetables, data from the literature usually indicates a large variation of content of nitrates. Concentrations of nitrates in tomatoes varies between 10-100 mg/kg.

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The amount of nitrates in general decreases as plant, green maturing have higher levels of nitrates than mature.

Accumulation of nitrites in the fresh products of vegetable origin is reduced, they represent a transitional stage in the processing of nitrates by endogenous reductases. As the nitrites is formed by the action of the enzyme nitrate reductase, they shall be reduced further with the same speed of nitrite reductase, oxides of nitrogen ammoniacal nitrogen up to. The process takes place in the leuchoplasts of the root or in the chloroplasts of leaf. The degree of reduction depends on genetic factors and the role of electrons from $NADPH+H^+$. So it explains why different quantities of nitrates in vegetables are much higher than the amounts of nitrites.

After harvesting the vegetables kept in inadequate conditions favouring the development of microorganisms, leading to the accumulation of large amounts of nitrites by reducing nitrates. This fact is explained by the decrease of nitrite and nitrate reductase increase in activity of endogenous or microbial origin. In this case the concentration of nitrites can reach very high values (approximately 360 mg/kg dry matter) (Clemensa, Tofan, 2001].

In tomatoes intended for processing are specific sources of pollution and contamination.

Stagnation in manufacturing technological flow derivatives are also causes of conversion of nitrates into nitrites (Andrei, Corina, 2011).

During the processing necessary to select those processes to ensure reduction of nitrates. So, wash with plenty of water and boiling hot moulding or short-lived, with removal of water, nitrates can reduce up to 30% of the initial quantity (carrots, spinach, potatoes, but not in red beets).

The presence of nitrates/nitrites in large quantities in food can create a number of technological problems in the preservation industry: corrosion of metallic tin packaging, or the opportunity of formation of nitrogen oxide during sterilisation, which causes the camber boxes and even their explosion (Watson, D., H., 2002; Clemensa, Tofan, 2001).

Because of the potential hazards to health as a result of high intake of nitrates and nitrites, determination of the content of these ions in the tomato was considered and measured in many countries (Vasilica, Simion, Câmpeanu, Gh., Gina, Vasile, Mihaela, Artimon, Luminița, Catană, Mioara, Negoiță, 2008).

MATERIALS AND METHODS

Biological material used for the analyses was the tomatoes harvested at maturity, in Tulcea County, and for recovery within S.C. Contec Foods S.R.L Tecuci.

Figure 1 **Tomatoes and tomato juice**

Samples were collected in October 2011.

This study analyzed the levels of nitrates and nitrites in raw tomatoes, chopped tomatoes thermal treated, residue of skin and seed, and tomato juice of finished product.

The obtained results were correlated with the limits laid down by the legislation in force (*Figure 1).*

Defining stages of processing regarded as critical points of sampling in the analysis of the dynamics of the nitrates and nitrites content are presented in *Figure 2*.

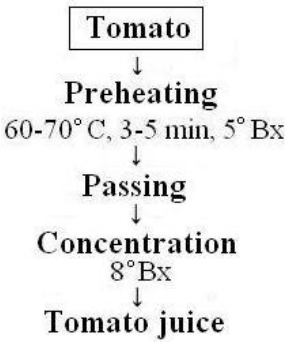

Figure 2 **Stages of processing tomatoes for tomato juice**

Determination of the content of nitrates and nitrites were carried out by molecular absorption spectrometry method.

Determination of nitrites is based on their reaction to the pH 1.9 with reagent 4-amino benzene sulphonamide in the presence of orthophosphoric acid, to form a salt of diazonium forming a complex with red color with N (1-naphthyl reagent) – ethylene - diamine, which measure the absorbance at 540 nm.

Trace the calibration curve was made into a series of nine volumetric flasks of 50 ml, where volumes have been introduced by a standard solution of nitrite nitrogen concentration of 1 mg/l, indicated in the table below (*table 1*).

It was carried out and a blank, but replacing the sample with ultrapure water.

Determination of the content of nitrates is performed in a series of bottles of evaporation, where they added 1 ml, 2 ml, 3 ml, 4 ml and 5 ml nitrate and 0.5 ml solution of sodium azide and 0,2 ml of acetic

acid. After 5 minutes added 1 ml of sulphuric acid, to dissolve the residue in the flask. Added 10 ml of distilled water and 10 ml of the alkaline solution.

Table 1

Trace the calibration curve

Volume of standard nitrite (ml)	Mass of nitrite nitrogen, expressed in m_N (µg)	The optical path of the cells (mm)
0.00	0.00	10 and 50
0.50	0.50	50
1.00	1.00	10 and 50
1.50	1.50	50
2.00	2.00	50
2.50	2.50	10 and 50
5.00	5.00	10
7.50	7.50	10
10.00	10.00	10

The mixture obtained has been into a volumetric flask at 25 ml and put in water bath at a temperature of 25°C, for 10 minutes, and then it was brought up to the mark with water. The absorbance measured at wavelength of 415 nm in cells with optical path 40 mm or 50 mm, with reference to distilled water.

RESULTS AND DISCUSSION

The results obtained from samples allow us to state that they are much smaller than the maximum permissible concentrations (CMA) by the legislation in force.

Results on the content of nitrates and nitrites in tomatoes and products from the technological flow are presented in *table 2*.

Table 2

The concentration of nitrates and nitrites ions from the samples studied

Sample	Values obtained (mg/kg)	
	NO_2^-	NO_3^-
Tomatoes	0,030	8,02
	0,051	7,14
	0,026	8,11
	0,022	7,70
Chopped tomatoes thermal treated	0,014	5,23
	0,032	5,18
	0,011	5,26
	0,013	5,28
Rezidues (skin and seed)	0,030	7,16
	0,033	7,23
	0,026	6,80
	0,031	7,12
Tomato juice	0,011	5,04
	0.016	5,13
	0,020	5,27
	0,012	5,07

Level of nitrates in tomato juice looked varied between 5.04-5.27 mg/kg, with an average of 5.12 mg/kg. The average highest nitrate was found in raw tomatoes (7.74 mg/kg), which subsequently dropped after washing (2 washing with cold water, 2 showers) and preheating 60-70°C, with a concentration of 5.25 mg/kg (*figure 3*).

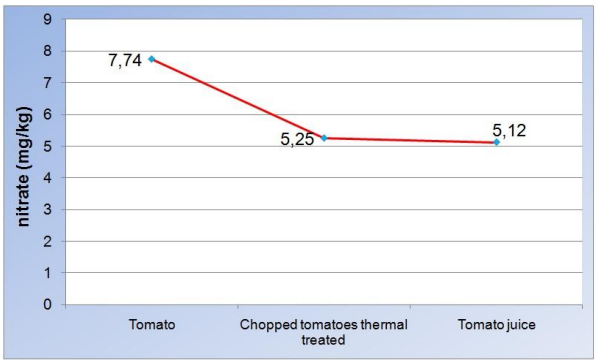

Figure 3 **The effect of processing on the content of nitrates, mg/kg**

This quantity of nitrates leachate dropped due to the composition of the heat treatment (preheating to 60-70° C for 4 minutes) after which the NaCl was added at the rate of 0.35%.

Surveys say that nitrates are stable chemical substances and which do not fall under the action of oxidants and temperature, but is characterized by a high solubility in water (Tărâță, V., 1992).

Nitrates, a dangerous compound for the quality of finished product, measured in it are well below 150 mg/kg (CMA as specified in the Ordinance the Government Romania No. 1/2002) on all samples.

The same situation is found and to nitrites, where the values of this compound are well below 3 mg/kg.

The level of nitrites in tomatoes and products resulting from technological flow are very small, less than 1 mg/kg (*figure 4*). Anyway, the content of nitrites in plant products are generally lower than those in the nitrate.

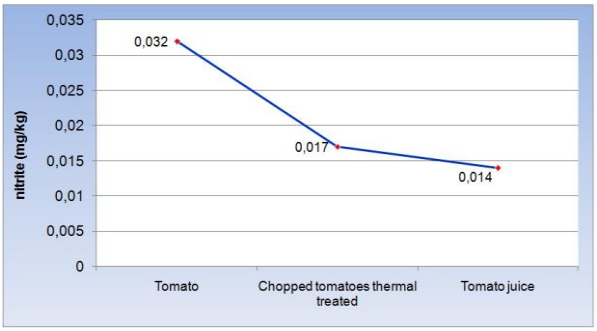

Figure 4 **The effect of processing on the content of nitrites, mg/kg**

Content of nitrites in tomatoes vary between 0.022-0.051 mg/kg, with an average of 0.032 mg/kg.

Content of nitrites in tomato juice is lower by about 50% in raw material, while the content of the highest technological steps to be taken in the

study was obtained in skins and seeds obtained as residue from the processing of tomatoes.

CONCLUSIONS

Influence of processing steps taken in the study on the nitrate content of lowering their concentrations at a level of 7.74 mg/kg in raw tomatoes, at a value of 5.12 mg/kg in the finished product.

As regards the content of nitrites in tomato juice (0.014 mg/kg) it is lower than for the corresponding content of tomatoes was 0.032 mg/kg.

High concentrations of nitrates and nitrites was recorded in skin and seed obtained as residue from the processing of tomatoes.

Analysis of nitrates and nitrites shows a tomato juice containing normal in these compounds, so a good quality for human consumption and marketing.

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