STUDIES ON THE DYNAMICS OF HEAVY METALS CONTENT DURING THE PROCESS FLOW FOR OBTAINING TOMATO JUICE AT SC CONTEC FOODS SRL TECUCI

STUDII ASUPRA DINAMICII CONȚINUTULUI ÎN METALE GRELE PE PARCURSUL FLUXULUI TEHNOLOGIC DE OBȚINERE A SUCULUI DE TOMATE LA SC CONTEC FOODS SRL TECUCI

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Abstract. *The purpose of this study was to monitor the concentrations of Pb, Cd, Cu, Zn, Fe and Mn (essential elements) by physico-chemical determinations on raw material samples within the technological and the finished product to assess the dynamics the levels of metals. Analyses were performed by atomic absorption spectrophotometry with flame (SAAF), in the mineralized sample by dry with nitric acid. The results of this study showed that the average concentrations detected ranged from 0.41 ± 0.74, 0.01 ± 0.09, 16.6 ± 20.15, 19.15 ± 25.07, 88.87 ± 98.37 and 82.15 ± 103.07 mg/kg for Pb, Cd, Cu, Zn, Fe and Mn. The highest average levels of essential elements and/or potentially toxic samples were detected in seed and skin and tomato juice finished product. Processing of raw tomatoes has increased the level of these elements in the finished product without exceeding the maximum allowed by applicable law.*
Key words: heavy metals, tomatoes, tomato juice

Rezumat. *Scopul acestui studiu a fost monitorizarea concentrațiilor de Pb, Cd, Cu, Zn, Fe şi Mn (elemente esențiale) prin determinări fizico-chimice asupra materiei prime, probelor prelevate pe fluxul tehnologic şi produsului finit, în vederea evaluării dinamicii nivelului de metale. Analizele au fost efectuate prin spectrofotometrie de absorbție atomică prin flacără (SAAF), din proba mineralizată pe cale uscată cu acid azotic. Rezultatele acestui studiu au arătat că, concentrațiile medii detectate au variat între 0,41± 0,74, 0.01 ± 0.09, 16,6 ± 20.15, 19,15 ± 25.07, 88,87 ± 98,37 şi 103,07 ± 82.15 mg/kg pentru Pb, Cd, Cu, Zn, Fe şi Mn. Cele mai ridicate niveluri medii de elemente esențiale şi/sau potențial toxice au fost detectate în probele de sămânță şi pieliță şi în sucul de tomate produs finit. Procesul de prelucrare al tomatelor materie primă a dus la creşterea nivelului acestor elemente în produsul finit, fără a depăşi însă nivelul maxim admis de legislația în vigoare.*
Cuvinte cheie: metale grele, tomate, suc de tomate

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INTRODUCTION

Absorption and accumulation of heavy metals in vegetables and fruits is conditioned by the reaction of the soil, organic matter content, in particular by organic compounds, not so strong to the humificare, the quantity and nature of the mineral colloids, soil moisture conditions and intensity of the activity of micro-organisms.

Organic matter has important role in the collapse of metals chelated by complex formation, from which they have varying degrees of access to plants. Essential heavy metals (Fe, Mn, Zn and Cu), are essential for growth and development bodies, being toxic in case of their accumulation in large concentrations. Other heavy metals (Cd and Pb) are toxic to plants, affects a large number of biochemical and physiological processes, such as nutrition, photosynthesis, breath, growth, development and yield per harvest.

However, you can add other sources of agricultural technologies, such as: irrigation with waste water, organic fertilizer management and mineral impurities of heavy metals, or the application of pesticides containing chemical elements in their structure (fungicides containing mercury, copper, arsenic, zinc etc) (Gergenet al., 2000).

Lead used in petroleum and additive enter into the composition of pesticides that have been banned; main anthropogenic sources of Cd are fertilizers (Cd is found in many products and is used as a fungicides), and zinc originates from the use of insecticides and fungicides based organic compounds of Zn, leading to contamination of tomatoes (Hussam, 2009).

Copper is a normal nutrient with a representation in soils of our country, but in smaller concentrations of Fe and Mn, close to or higher than that of Zn. Tomatoes contain copper, level 3-20 mg/kg of normal levels and s.u. in plant tissues are less than those of Fe and Mn (Rusu et al., 2005).

Processing, preservation and packaging, food can enrich toxic metals. Potentially toxic metals (Pb, Cd, Zn, Cu) chemical elements are very stable, not heat or chemically degrade, but depending on how they can link to migrate.

Stages of technological process of processing tomatoes which can be changed in composition in micro-nutrients (and heavy metals) are: washing, cleaning, shelling, hot moulding, pasteurization and sterilization. Also, washing vegetables and allow diffusion of ions in the apoplast (Andrei, 2011).

Heavy metals in general are not biodegradable, have long biological half life period and potential accumulation in different organs of the body that lead to undesirable side-effects (Mohamed and Ahmed, 2006).

MATERIAL AND METHOD

Biological material used for the analyses was the tomatoes harvested at maturity, in Tulcea County, and for recovery within the SC Contec Foods Ltd Tecuci.

Samples were collected in October 2011. Immediately after sampling, the samples were put polyethylene bags and stored at -20°C, and the liquid samples in glass containers, hermetically sealed and clean storage at any time up to the roasting time.

Determination of heavy metal contents in tomato, chop treated, heat the residue of hang and seed and tomato juice, the finished product was carried out by atomic absorption spectrophotometry by flame (SAAF) of dry sample digested by ($450^0 \pm 10^0$C calcination and dissolution in mineral acids). Calibration curves were made with concentration standards Merk 1000mg/kg, at different levels, depending on the concentration of metal in question. He has worked with the following wavelengths: Pb:283,3 nm, Cd:228,8 nm, Cu:327,4 nm, Zn:213,9 nm, Fe:372 nm, Mn:280,1 nm. Interpretation of the results was done in mg/kg.

For the determination of Pb, Cd, Cu, Zn, Fe and Mn in fresh and processed tomatoes applied standard SR EN 14082:2003-food. Determination of heavy metals by flame atomic absorption spectrometry (AAS) in roasting.

Defining stages of processing as a critical point of sampling in order to analyse the dynamics of content in metals are shown in fig. 1.

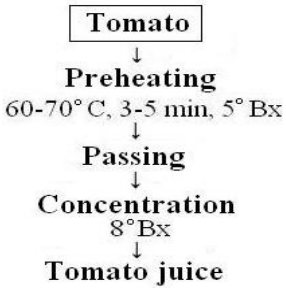

Fig. 1 - Stages of processing tomatoes for tomato juice

Following the results obtained, the correlations were calculated on the contents of elements in samples taken in the study with employment eligibility limits regulated in national legislation, in accordance with Order No. 975/1998 of the Romanian Ministry of Public Health.

RESULTS AND DISCUSSION

Comparison of the content of Pb in tomato during processing, technological operations with the maximum permissible concentration for Pb, show this through processing solutions with 2.6%, tomato juice in the finished product (fig. 2). Pb level of tomatoes have increased by up to 10% after washing and preheating at 60-70°C. The contents of Pb in the cuticle and keep seeds obtained as a residue from the processing of tomatoes.

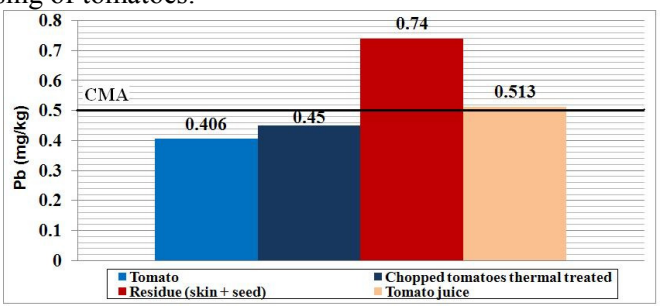

Fig. 2 - The influence of technological stages of processing tomatoes on average Pb content, compared with the maximum permissible concentration *(CMA)

*Maximum permissible concentration: 0.5 mg/kg of tomatoes

If the contents of the Cd were recorded under the maximum permitted concentration values for both raw tomatoes for industrialization took low values below 0.1 mg/kg (maximum permissible concentration for tomatoes), and tomato juice with CMA for this element is 0.2 mg/kg (fig. 3).

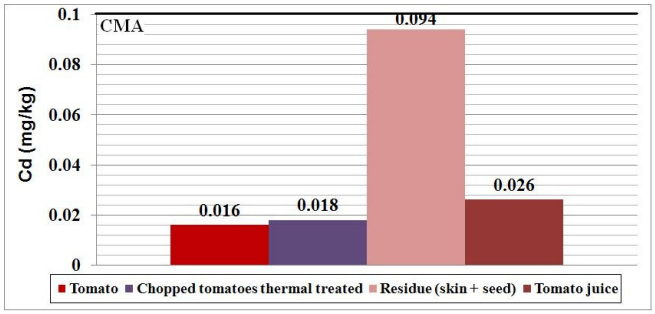

Fig. 3 - The influence of technological stages of processing tomatoes on average Cd content, compared with the maximum permissible concentration *(CMA)
*Maximum permissible concentration of 0,1 mg/kg of tomatoes

Effect of heat treatments on tomato, resulted in raising tomato juice Cd in, due to the strong absorption of plant tissues and/or low solubility in water on this category of elements. Remarkable is the fact that the contents of the Cd, and to be kept high and the seed produced cuticle as residue from the processing of tomatoes. Comparing the values obtained with the legislation in force, it is observed that tomato juice does not raise problems in relation to quality for the consumer.

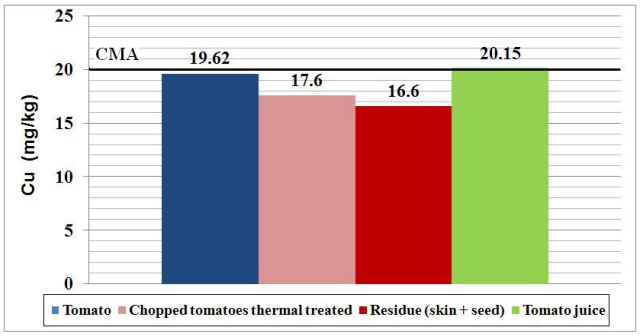

Fig. 4 - The influence of technological stages of processing tomatoes on average Cu content, compared with the maximum permissible concentration *(CMA)
*Maximum permissible concentration: 20 mg/kg of tomatoes

Analysis on strength with the tomato was employed less than 20 mg/kg, the juice of tomato product had value beyond the CMA of the legislation in force, recording 20.15 mg/kg (fig. 4). The contents of the lowest for this element is found in the residue of skin and seed. Copper is a metal that can be potentially

toxic, used as plant-protection products on the treatment of cuprice tomatoes (manna), and very stable, not degrade.

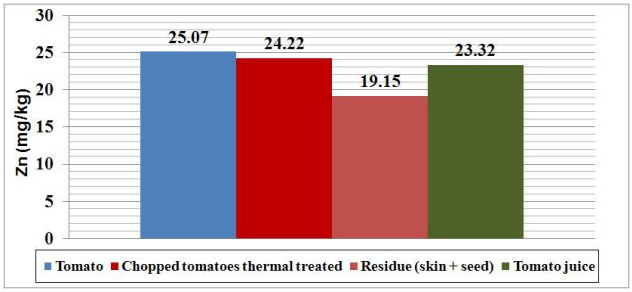

Fig. 5 - The influence of technological stages of processing tomatoes on average Zn content

Element analysis, zinc, could be considered both heavy metal and nutrient substance, depending on the physiological roles in plants and contents.

For this metal, has not been able to establish certain values for the maximum permissible limits (fig. 5). However, you may notice a decrease in Zn content during technological flow, which culminates with 23.32 mg/kg, registered in the tomato juice finished product.

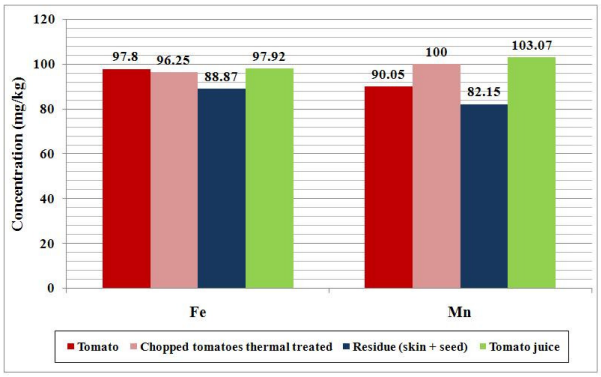

Fig. 5 - The influence of technological stages of processing tomatoes on average Fe and Mn content

Tomatoes and even their component tissues have a characteristic mineral substances (fig. 6). Soil, climate and culture technology determines them significant variations, within limits.

Iron is considered to be the element that makes switching between micro- and macroelements. Fe content of tomatoes (reckoned from the dry substance) is 100 mg/kg.

Tomatoes respond well to applying fertilizers with magnesium. For this element, it was not an average for tomatoes.

On the stages of processing, Fe and Mn content has not been altered significantly in tomato juice (Beceanu, 2010; Davidescu and Davidescu, 1992).

CONCLUSIONS

1. Analysis of Pb and Cd in the tomatoes at all stages of technological highlights an increase in the values of these elements during processing of tomatoes. During processing, the concentration of Pb only exceeded permissible maximum mass by 2.6%. The juice of the tomatoes result had values of cadmium in the value of 0.03 mg/kg, where CMA for this metal is 0.1 mg/kg;

2. The high content of Pb and Cd was retained in the skin and seed obtained as residue from processing tomatoes;

3. Tomato juice has been obtained with less than CMA values for Cu, values that do not adversely affect quality of tomato juice consumption;

4. During the stages of study in technological content in Zn recorded a decrease of the content on this item;

5. Influence of processing tomatoes did not change significantly in the Fe and Mn content.

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