

INFLUENCE OF DEHYDRATION TECHNOLOGIES ON DRIED TOMATO BIOLOGICAL QUALITY AND VALUE

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ABSTRACT - This paper focused upon the influence of drying technologies on contents and changes of bio-active compounds (lycopene, β -carotene, vitamin C), antioxidant properties, colour and content of HMF. As research demonstrated, lycopene was hardly destroyed during drying. Heat treatment of fresh produces, containing lycopene, has increased its bioassimilation. Acid ascorbic is one of the most thermosensitive components. Its losses have increased at the same time with temperature increase. Browning of tomatoes during drying was proportional to accumulation of HMF. The antioxidant activity of dried tomatoes depended on heat treatment, ascorbic acid destruction and antioxidant (melanoidins, flavonols) formation.

Key Words: dried tomatoes, lycopene, foods with health claims

REZUMAT – *Influența tehnologiilor de deshidratare asupra calității și valorii biologice ale tomadelor uscate.* Scopul lucrării îl reprezintă influența tehnologiilor de uscare asupra conținutului și modificărilor compușilor bioactivi (licopina, β -caroten, vitamina C), a proprietăților antioxidante, culorii și conținutului de HMF. Așa cum au arătat experiențele, licopina a fost distrusă în timpul uscării tomadelor. Tratatamentul termic al produselor în stare proaspătă, ce conțin licopină, a crescut bioasimilarea sa. Acidul ascorbic este cea mai sensibilă componentă la factorul termic. Pierderile acestui acid au fost mai mari odată cu creșterea temperaturii. Schimbarea culorii în nuanță brună a tomadelor în timpul uscării a fost proporțională cu acumularea de HMF. Activitatea antioxidantă a tomadelor uscate depinde de tratamentul termic, ducând la distrugerea acidului ascorbic și formarea de antioxidanți (melanoidine, flavonoli).

Cuvinte cheie: tomate uscate, licopena, alimente de protecție

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INTRODUCTION

In the latest years, tomatoes and the obtained products became interest subjects for researchers, due to their high biological value, antioxidant activity and functional characteristics. At a certain degree, all the products obtained from tomatoes present antioxidant characteristics, determined by the bioactive compounds, like lycopene, β -carotene, vitamin C, polyphenols and flavonoids. Dried tomatoes present a special interest, because some bioactive antioxidants are found in their composition at concentrated state. Lycopene has the highest value, with antioxidant and curative specific features on some diseases, and consequently, the lycopene-rich products may be used for obtaining foods and bioactive food supplements (BFS) (George, 2004). The efficiency of using dried tomatoes as foods with health claims or BFS is conditioned by the degree of maintaining the bioactive components.

Nowadays, there are technical opportunities (modern technologies and equipments) for using drying in order to develop the production of foods with health claims and BFS, because modern technologies for drying farming raw material allow us to take into account the requirements of these products, such as the preservation of bioactive nutrients, at rates with pharmacological effect on human body.

The aim of our work was to study the influence of drying process on tomatoes quality and biological value.

RESULTS AND DISCUSSION

I. The nutritive value of dried tomatoes. Functional characteristics

Dried tomatoes are a rich source of vitamins and mineral substances. *Table 1* presents the nutritive value of dried tomatoes, according to the Product Specifications of the "Culinary Farms" from USA. Data from Table 1 show that 100 g of dried tomatoes meet the human daily requirements of β -carotene and potassium, 2/3 of vitamin C and iron need, 3/4 of copper, half of daily magnesium and nicianine and 1/3 of phosphorus need.

The lycopene content from dried tomatoes with standard humidity may reach 50-70 mg per 100 g product.

Lycopene, the pigment of red tomatoes, determines the biological and curative value of dried tomatoes. It is a carotenoid belonging to the same group of β -carotene and gives the red colour to tomatoes, rosé grapefruits, apricots, red oranges and water melons. This compound is not only a pigment but also a strong antioxidant, which neutralizes the free radicals, and, especially, the oxygen derived ones. Its ability to inhibit the oxidative activity of the active oxygen is twice higher than in case of β -carotene and 10 times higher than in case of α -tocopherol (Shi et al., 2000).

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Table 1

Nutritive value of 100 g of dried tomatoes

Carbon hydrates	55.8 g	Vitamins		Mineral substances	
Glucide	34.7 g	β-carotene	12.0 mg	Potassium	3427 mg
Other carbon hydrates	8.8 g	Vitamin C	39.2 mg	Sodium	115 mg
Food fibers	12.3 g	Folacine	68.0 mg	Phosphorus	356 mg
Proteins	14.1 g	Vitamin E	3.0 mg	Magnesium	194 mg
Fats	3.0 g	Riboflavine (B2)	0.53 mg	Calcium	110 mg
Humidity	14.6 g	Thiamine (B1)	0.49 mg	Iron	9.09 mg
Energetic value	258 kcal	Niacine (B3)	9.0 mg	Zinc	2.0 mg
		Vitamin B6	0.33 mg	Copper	1.42 mg
		Panthotenic acid	2.1 mg		
According to <i>Fresh dried tomatoes</i> . Product specifications. Culinary Farms™. USA, 2004. West Sacramento, CA					

Lycopene is an important carotenoid from human plasma, but unlike β-carotene it does not have the activity of vitamin A. The biological role of lycopene in human body also consists in its capacity of preventing the oxidative reactions. It neutralizes the toxic compounds that are formed as a result of oxidative processes of the cell metabolism, thus protecting certain biomolecules (lipids, proteins and DNA). According to Shi et al. and Hadley, lycopene has anticancer properties, protecting against certain cancer types (prostate, breast and skin), vascular diseases (atherosclerosis) and diminishes the level of cholesterol in blood.

II. Influence of drying regimes on biological value and quality of tomatoes

The main critical quality parameters of tomatoes at drying are the indices that ensure at the highest degree their high biological value (maximum value of bioactive compounds), hygiene safety and consumption characteristics (especially, colour).

Lycopene. Fruit and vegetable processing, especially the thermal one, is negatively reflected on the content of bioactive substances, but many carotenoids (lycopene, α- and β-carotene) are quite thermostable (Hadley et al., 2002).

The base phenomena, which result in changing lycopene during tomato processing, are isomerisation and oxidation. While oxidation is a process leading to lycopene decomposition, isomerisation has a positive effect. Lycopene is found in tomatoes in the trans steric form. Thermal processes, including drying, lead to lycopene isomerisation and its change from trans steric to cis form. The quantity of cis isomers grows once with the increase in temperature and duration of heat treatment. The bioassimilation of lycopene cis isomers is greater than of trans

isomers. Drying increases the lycopene bioassimilation by destructing the tomato cells and breaking the connection between lycopene and matrix, damaging the lycopene-protein complex and releasing free lycopene by cis isomerisation (Hadley, 2002; Shi, 2000).

According to data given by Zanotti et al., cutting tomatoes into halves and their drying until 10% humidity with the air speed of 1.5 m/s result in losing maximum 10% of lycopene at temperature of 110°C (during 4h), which does not decompose at temperature of 80°C (during 7h).

Lavelli et al (1999) have obtained analogical data for half tomatoes, demonstrating the insignificant difference between lycopene concentration in fresh (850 mg/kg DM) and dried tomatoes at temperature of 80°C (830 mg/kg DM). We have noticed the results of Toor and Savage (Toor et al., 2006) on drying the quarter-cut tomatoes, from 5.1-6.2 to 18.9-21.8% dry matter, at low temperatures (42°C, 18h), which lead to lycopene losses from 10 to 20%. These can be explained by a great drying period.

Ascorbic acid

Ascorbic acid is one of the most thermolabile components of food products, fact also confirmed at tomato drying. Zanoni et al. (1999) have discovered in the process of tomato drying at temperature of 80°C, the diminution by 90% in the content of ascorbic acid and complete decomposition at temperature of 110°C. The results obtained by Lavelli et al. (1999) have shown that the content of ascorbic acid decreased from 3300 mg/kg DM in fresh tomatoes to 400 mg/kg DM in dried tomatoes at temperature of 80°C. The results of Toor and Savage (2006) have shown that drying tomatoes in quarters at 42°C during 18 h, led to ascorbic acid losses between 17-27%, according to tomato varieties. The increase of drying temperature results in deep decomposition of ascorbic acid.

Hydroxymethylfurfural (HMF), colour. It is a complete index of the quality of foods submitted to heat treatment, which reflects the degree of developing the degradation processes in the product. HMF is an intermediary product and is the result of the so-called Maillard reaction, forming melanoidine in the process of tomato drying. Melanoidine - dark coloured compounds are the products of reactions between reducing sugars and components containing the aminic group (aminoacids, proteins, etc.).

Colour is one of the most important indices of dried tomatoes, which determines their consumption value. If colour is determined by means of colorimeter, the chromatic parameters of colour are *L* (index of light shade), *a* and *b*. *a/b* is usually used as index of red colour light shades. The more the red shade and the less the dark shade, the better the quality of dried tomatoes is. Changing the colour into dark shade is directly proportional to HMF accumulation during the drying process.

According to references (Toor, Savage, 2006), drying at temperature of 42°C during 18h led to the accumulation of 7-8mg/kg DM of HMF; the *L*

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diminution (against fresh tomatoes) represented 30-36%, and the *a/b* increase – 25-42% for different tomato varieties.

Zanoni et al. (1999) have registered an increase in HMF content in dried tomatoes once with the increase in temperature and drying duration. The increase of drying duration from 390 to 430 min led to the increase of HMF content from 10 to 36mg/kg DM at temperature of 80°C and from 18 to 512mg/kg DM at 110°C. The paper shows that if the HMF content is greater than 20 mg/kg DM, it will change the colour from red to brown.

Antioxidant activity. The antioxidant activity of hydro- and lipophilous extracts of dried tomatoes was investigated by many works (Dewanto et al., 2002; Giovanelli et al., 2002; Lavelli et al., 1999).

For the determination of the antioxidant activity of hydrophilous extract, we have used the xanthin oxidase/xanthin model system with superoxide radicals, and for the lipophilous extract –linoleic acid/CuSO₄ model system (Giovanelli et al., 2000; Hadley et al., 2002).

The antioxidant activity of hydro- and lipophilous extracts was measured by means of ABTS dye (diamonic salt of acid 2,2'-azino-bis (3-ethylbenzthiasolin-6-sulphonic) (Toor et al., 2006). These model systems simulate oxidative reactions, which have influence on the appearance and development of different diseases in humans, determining the role of tomato products on inhibiting the oxidative reactions.

The diminution in the antioxidant activity of hydrophilous extracts for semi-dry tomatoes represented 28-38% against fresh tomatoes, being determined by the destruction of ascorbic acid and phenolic compounds (Toor and Savage, 2006). The diminution in the antioxidant activity of lipophilous extracts was of 35-42%. The antioxidant activity of hydrophilous extracts has increased twice, while of lipophilous extracts remained unchanged (Giovanelli et al., 2002). The increase in the antioxidant activity of hydrophilous extracts has been also found by other authors (Dewanto et al., 2002), which could be explained by the fact that high temperature treatment (>70°C) resulted in forming antioxidant feature melanoidine. Some authors considered that heat treatment has increased the level of free flavonols, which had a high antioxidant activity (Giovanelli et al., 2000; Stewart et al., 2000).

CONCLUSIONS

Dried tomatoes represent a rich source of antioxidants and vitamins, especially lycopene and β -carotene.

Traditional drying methods may be used for obtaining foods of high biological value, inclusively foods with health claims and biologically active food supplements.

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