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Lycopene content of tomatoes and tomato products

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Abstract

Lycopene, the predominant carotenoid in tomatoes, exhibits the highest antioxidant activity and singlet oxygen quenching ability of all dietary carotenoids. Processing of tomatoes increases the biovailability of lycopene. This study evaluates the lycopene contents of fresh tomatoes and various commonly consumed tomato products (tomato paste, tomato sauce, tomato ketchup, spaghetti sauce) from the romanian market.

For analysis of lycopene we used a fast and simple spectrophotometric method, at 472 and 502 nm, in hexane:acetone:ethanol extract. The lycopene concentration was expressed as mg/100g product. The results show that lycopene content of samples of fresh tomatoes was aproximatly 12 mg/100g. In tomato products the lycopene content had the folowing values: in tomato paste aproximatly 16 mg/100g, in tomato boild sauce aproximatly 4 mg/100g, tomato Ketchup 17 mg/100g and spaghetti sauce 16 mg/100g. Analizing the results obtained, we concluded that the lycopene content of tomatoes remained raised during the multistep processing operations for the production of juice or paste.

Keywords: lycopene, tomatoes, tomato products, spectrophotometer

1. Introduction

It is Lycopene is a bright red carotenoid pigment and phytochemical found in tomatoes and other red fruits.

Fruits and vegetables that are high in lycopene include gac, tomatoes, watermelon, pink grapefruit, pink guava, papaya, red bell pepper, seabuckhorn, wolfberry (goji, a berry relative of tomato), and rosehip. Tomato (Lycopersicum esculentum) representing *Solanaceae* family, is one of the most popular vegetable crops [9].

In plants, algae, and other photosynthetic organisms, lycopene is an important intermediate in the biosynthesis of many carotenoids, including beta carotene, responsible for yellow, orange or red pigmentation, photosynthesis, and photo-protection. Due to its strong color and non-toxicity, lycopene is a useful food coloring.

Structurally, it is a tetraterpene assembled from eight isoprene units, composed entirely of carbon and hydrogen. Lycopene, a C_{40} polyisoprenoid compound containing 13 double bonds, is the most abundant carotenoid, accounting for approximately 80–90% of the total pigment contents in ripe tomatoes.

With its 11 conjugated and two non-conjugated double bonds, it was found to be a more efficient antioxidant (singlet oxygen quencher) than β-carotene, α-carotene, and α-tocopherol [3].

Lycopene, the predominant carotenoid in tomatoes, exhibits the highest antioxidant activity and singlet oxygen quenching ability of all dietary carotenoids [4].

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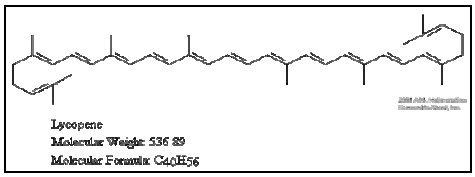

The lycopene content of tomatoes depends on species and increases as the fruit ripens[11].

Lycopene is biosynthesised in plants mainly (above 90%) as the all-*E*-isomer. Most available sources of lycopene maintain the natural isomeric distribution ratio. It was shown that during food processing lycopene undergoes geometrical isomerisation, increasing the proportion of *Z*-isomers. In particular, lycopene may isomerise to *Z*-forms with the presence of heat or oil, or during dehydration [12].

Besides, lycopene underwent further geometrical isomerisation, mainly retro-isomerisation, during storage of processed foods. Thus, an ideal source of highly bioavailable lycopene should be a tomato extract containing stable *Z*-isomers which do not undergo retro-isomerisation. Isomerisation of lycopene has been achieved by different means, *e.g.* using heat, acids, active surfaces, complexation with boron trifluoride and also light in the presence or absence of a photosensitiser [12]. These isomerisation processes not only induce the formation of various *Z*-isomers but also underline that degradation competes with isomerisation. With long heating times or at temperatures above 50 °C degradation proceeds faster than isomerisation [5]

Unlike C vitamine from fruits and vegetables, where nutritional content is diminished upon cooking, processing of tomatoes increases the biovailability of lycopene.

Processed tomato products such as pasteurized tomato juice, soup, sauce, and ketchup contain the highest concentrations of bioavailable lycopene from tomato based sources. Lycopene in tomato soup and tomato paste is more bioavailable than in fresh tomatoes [6]. Gartner Christine et al. also concluded that lycopene bioavailability is higher from tomato paste than from fresh tomatoes [10]. For this reason, tomato sauce is a preferable source as opposed to raw tomatoes. While most green leafy vegetables and other sources of lycopene are low in fats and oils, lycopene is insoluble in water and is tightly bound to vegetable fiber.

Lycopene is not an essential nutrient for humans, but is commonly found in the diet, mainly from dishes prepared with tomato sauce. When absorbed from the stomach, lycopene is transported in the blood by various lipoproteins and accumulates in the liver, adrenal glands, and testes. Because preliminary research has shown an inverse correlation between consumption of tomatoes and cancer risk, lycopene has been considered a potential agent for prevention of some types of cancers, particularly prostate cancer[6].

Lycopene is fat-soluble, so the oil is said to help absorption. So, is important to know the lycopene content of the tomato products commonly consumed and the contribution of these products to the intake of lycopene. The recommendation for optimal daily lycopene intake is 3,35 –4,82 mg [1].

2. Materials and Method

Absorption determination for lycopene content was made by using Spectrophotometer UV-VIS SPECORD 205 by Analytic Jena.

Lycopene in the tomato and the tomato products samples was extracted with hexane:ethanol:acetone (2:1:1)(v/v) mixture following the method of Sharma and Le Maquer [7].

One gram of the homogenized samples and 25 ml of hexane:ethanol:acetone, which were than placed on the rotary mixer for 30 min., adding 10 ml distilled water and was continued agitation for another 2 min. The solution was than left to separate into distinct polar and non-polar layers. The absorbance was measured at 472 nm and 502 nm, using hexane as a blank (Figure 1). The lycopene concentration was calculated using its specific extinction coefficient (E 1%, 1 cm) of 3450 in hexane at 472 nm [8] and 3150 at 502 nm [2]. The lycopene concentration was expressed as mg/100g product.

All determinations was repeated for three times.

At λ = 472 nm:lycopene content (mg/100g) =

$$\frac{E}{3,45}\cdot\frac{20}{m}$$

at λ = 502 nm:lycopene content (mg/100g) =

$$\frac{E}{3,15}\cdot\frac{20}{m}$$

m – the weight of the product (g);
E – extinction coefficient.

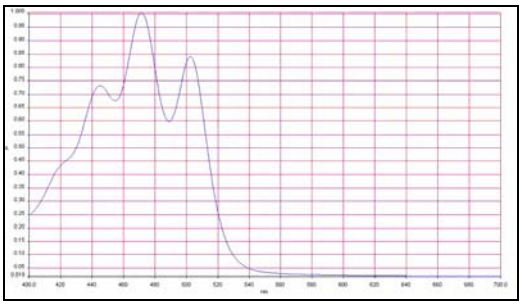

Figure 1. UV spectra of lycopene in hexane.

3.Results and Discussion

The lycopene content of tomatoes and different tomato products was determined. In the next table we prezent the content of lycopene (mg /100 g), of the products that we studied.

The results show that lycopene content of samples of fresh tomatoes was aproximatly 12 mg/100g. In tomato products the lycopene content had the folowing values: in tomato paste aproximatly 16 mg/100g, in tomato boild sauce aproximatly 4 mg/100g, tomato Ketchup 17 mg/100g and spaghetti sauce 16 mg/100g (Table 1 and Figure 2).

Table 1. Tomatoes and different tomato products lycopene content (mg/100g)

Product	Lycopene (mg /100 g)	
	472 nm	502 nm
Fresh tomatoes	12,58	12,34
Tomato paste	15,65	15,83
Tomato boild sauce	4,32	3,92
Tomato Ketchup	17,12	17,00
Spaghetti Sauce	15,92	16,15

Analizing the Fig.2 we observe that the lycopene (mg/100g) registered in Tomato paste, Tomato ketchup and Spaghetti sauce is raised comparative with lycopene content from Fresh tomatoes.

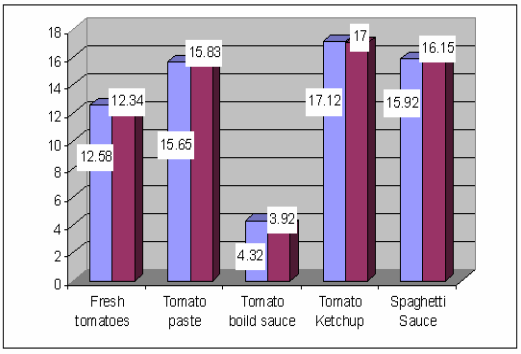

Figure 2. Lycopene content in tomatoes and tomato products

4. Conclusions

1. Lycopene content of tomatoes remained raised during the multistep processing operations for the production of juice or paste.
2. These result have implications for the evaluation of the daily intake of lycopene in Romania, for establishing a recommendation for optimal daily lycopene intake.

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