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Comparison of lycopene, β-carotene and phenolic contents in fresh, boiled and stored tomatoes

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Abstract : *The present investigation aimed at comparison of lycopene, β-carotene and phenolic contents in fresh, boiled and stored tomatoes showed that maximum lycopene was found in the tomato powder (5.9 µg/ml) followed by tomato ketchup (5.8 µg/ml), fresh tomato (5.6 µg/ml), boiled tomato (5.4 µg/ml) and stored tomato (5.2 µg/ml), respectively. It was found that maximum β-carotene was found in fresh tomato (3.2 µg/ml) followed by tomato ketchup (3.1 µg/ml), boiled tomato (2.5 µg/ml), tomato powder (2.1 µg/ml) and stored tomato (0.1 µg/ml), respectively. Phenolic content was found to be more or less same in all the samples of tomato (348 µg/ml) except boiled tomato which contained 264 µg/ml. It was concluded that all the forms of tomatoes can be consumed, as the specified nutrients are not much affected by boiling or storing.*

Keywords: *Tomato, lycopene, β-carotene and phenolic contents.*

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Introduction :

Tomato (*Lycopersium esculentum*), belonging to Solanaceae family, is the vegetable crop which is very healthy to eat as it contains few calories and has high nutritional value. 100 grams of tomatoes can give us an average of 81KJ of energy. Our body gets this energy from the proteins and carbohydrates present in tomatoes. Tomatoes do not have saturated fats, making them low in calories (Bergougnoux, 2014). Lycopene, one of the nutrient content present in tomatoes, is a fat soluble carotenoid and a precursor of β-carotene (Sandmann, 1994); has at least twice the antioxidant capacity of β-carotene (Di Mascio et al, 1989). Epidemiological studies have indicated positive health benefits in consumption of diets in lycopene. Those benefits include anti-carcinogenic and anti-atherogenic (heart related diseases) effects. Lycopene is useful in coloring because of its strong colour and non-toxicity. β-carotene, another nutrient present in tomatoes, is principle vitamin A active carotenoid. β-carotene constitute only 5% of total carotenes present in tomatoes. All of the remaining 95% is lycopene. Despite of relatively low content of β-carotene content in red fruit, tomatoes are said to be good source of Vitamin A for human diet (Heinz, 1942). In addition to this there is also a nutrient present in tomatoes that is phenolic compounds. It contains antioxidant quality and acts as a defense mechanism in thermal stress of plants.

The overarching aim of the present study is to compare the lycopene, β-carotene and phenolic content in different forms of tomatoes such as fresh, boiled and stored tomato products etc. in order to determine which form of tomato should be consumed to get maximum benefits.

Materials and Methods :

Preparation of samples for determination of lycopene and β-carotene: The samples of fresh, boiled and stored tomatoes (preserved, ketchup, tomato powder) were prepared as described by Angela et al (2002).

Tomato samples were homogenized in blender until chunks were less than 4 cubic mm. The canned products were used in total and pureed without cutting. The pureed samples were diluted 1:1 (w: v) in deionised water so that consistency of the samples were homogenized.

Determination of lycopene: For determination of lycopene, 5 g of the homogenized samples were weighed and kept into 125 ml flasks. The flasks were wrapped with alumunium foil to exclude light. 50 ml of a mixture of hexane: acetone: ethanol (2: 1: 1 v/ v/ v) was added to each of the flasks containing the samples to solubilise the carotenoids (Sadler et.al., 1990). The samples were shaken for 30 min and then 10 ml of distilied water was added. The solution was left to separate into a distinct polar and non polar layer containing lycopene. The polar layer solution is used as sample.

The content of total lycopene in each of the samples was obtained by measuring the absorbance at 472 nm. The total lycopene content was calculated by comparing with the standard curve of lycopene.

Determination of β-carotene: For the determination of β-carotene, the process was repeated as described in the previous section to get a distinct polar and non polar layer of the solution of the homogenized samples and mixture of hexane: acetone: ethanol (2: 1: 1 v/ v/ v). The content of β-carotene was measured with slight changes in lycopene detection method. Here, the absorbance of the samples was measured at 750 nm and was subtracted from absorbance of the samples measured at 520 nm for analysis (Angela et al, 2002). The total β-Carotene content was calculated by comparing with the standard curve of β-carotene.

Preparation of samples for determination of phenolic content: The tomato samples were prepared as described by Kahkonen et al (1999) with slight modification. The purees of fresh, boiled and stored tomato were prepared in blender. 50 mg of each of the samples was weighed to which 10 ml of solvent (80% aqueous acetone) was added and the sample was homogenized for 1 min. The samples were centrifuged at 10,000 rpm for 15 min and the clear supernatant was collected.

Determination of phenolic content: The amount of total phenolic contents in the tomato samples was determined according to the Folin-ciocalteu procedure (Singleton and Rossi, 1988). 2 ml of each of the tomato samples was taken in test tubes to which 1 ml of Folin-ciocalteu's reagent and 0.8 ml of sodium carbonate (7.5%) was added. The tubes were mixed and allowed to stand for 30 min. The absorbance was measured spectrophotometrically at 765 nm. The total phenolic content was calculated by comparing with the standard curve of phenol.

Results and Discussion :

Preparation of samples for determination of lycopene and β-carotene: The samples of fresh, boiled and stored tomatoes (preserved, ketchup, tomato powder) were prepared as described in the previous section.

Determination of lycopene: The content of total lycopene in each of the samples was obtained by measuring the absorbance at 472 nm. The data is tabulated in Table 1.

The lycopene content was calculated by comparing with the standard curve of lycopene and maximum lycopene was found in tomato powder (5.9 μg/ml) followed by tomato ketchup (5.8 μg/ml), fresh tomato (5.6 μg/ml), boiled tomato (5.4 μg/ml) and stored tomato (5.2 μg/ml), respectively. The data are shown in Figure 1.

Determination of β-carotene: For the determination of β-carotene, the process was repeated as that of lycopene with slight changes in lycopene detection method. The absorbance of the final samples was taken spectrophotometrically at 750 nm and was subtracted from absorbance of the samples measured at 520 nm. The data is tabulated in Table 2.

The readings were compared with the standard curve of β-carotene and maximum β-Carotene was found in fresh tomato (3.2 μg/ml) followed by tomato ketchup (3.1 μg/ml), boiled tomato (2.5 μg/ml), tomato powder (2.1 μg/ml) and stored tomato (0.1 μg/ml), respectively. The data are shown in Figure 2.

Preparation of samples for determination of phenolic content: The tomato samples were prepared as described in the previous section and the absorbance was measured spectrophotometrically at 765 nm. The data is tabulated in Table 3.

The readings were compared with the standard curve of phenolic content and it was found that the phenolic content in all samples of tomato was 348 μg/ml except boiled tomato which contained 264 μg/ml. The data are shown in Figure 3.

Tomato (*Lycopersicum esculentum*) is the edible red fruit. These tomatoes are consumed in diverse ways, raw or cooked, as an ingredient in many dishes, sauces, salads and drinks. There are various kinds of nutrients present in tomatoes. These nutrients help us prevent various kinds of diseases. The concentration of individual nutrients in tomatoes is determined by many agronomic, geographical and seasonal factors in addition to the variety. For understanding the relationship between these factors and the content compounds with antioxidant potential it is necessary to be exploited to know the benefits of consumption of tomatoes and tomato products to human health.

In this study, the nutrient contents in tomatoes and its products were estimated. Lycopene constitutes 60-74% of the carotenoids present in tomatoes and its products. From the present studies, it was found that lycopene content is highest in tomato powder and lowest in the stored tomato. This study helped us in evaluating that processing of tomatoes increases the bioavailability of lycopene (Veronica et al., 2002). From analyzing the result obtained, it was concluded that the lycopene content of tomatoes remained raised during the multistep processing operations for the productions of tomato products.

β-carotene is the principle vitamin A active carotenoid found in tomatoes. From the study, it was observed that β-carotene is highest in fresh tomato and lowest in refrigerated tomatoes stored for four days. It was also observed that tomato ketchup contains more β-carotene than tomato powder and boiled tomato.

The phenolic compounds were characterized as phenolics and hydroxycinnamic acid. Quercetin is one of the 4000 naturally available plant phenolics with pharmacological effects that have been reported. In our study, it was observed that boiled tomato contains low phenol whereas the other samples have same phenolic content.

From the above study, it can be concluded that the lycopene, β-carotene and phenolic contents of tomato in its different forms like fresh, boiled, cooked and preserved are not much affected by boiling or storing. Therefore, it can be suggested that all forms of tomato can be consumed for its benefit. In fact, the processed tomato contained more lycopene due to breakdown of its cell walls.

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Table 1. Absorbance of tomato samples taken at 472 nm

S.N.	Tomato sample	Absorbance at 472 nm
1.	Fresh Tomato	1.805
2.	Boiled Tomato	1.784
3.	Stored Tomato	1.607
4.	Tomato Ketchup	1.869
5.	Tomato Powder	1.993

Table 2. Absorbance of tomato samples taken at 520 nm and 750 nm

S.N.	Tomato sample	Absorbance at 520 nm	Absorbance at 750 nm	Difference
1.	Fresh Tomato	1.018	0.696	0.322
2.	Boiled Tomato	0.558	0.313	0.245
3.	Stored Tomato	0.072	0.048	0.024
4.	Tomato Ketchup	0.849	0.539	0.310
5.	Tomato Powder	0.740	0.527	0.213

Table 3. Absorbance of tomato samples taken at 765 nm

S.N.	Tomato sample	Absorbance
1.	Fresh Tomato	2.999
2.	Boiled Tomato	2.268
3.	Stored Tomato	2.999
4.	Tomato Ketchup	2.999
5.	Tomato Powder	2.999

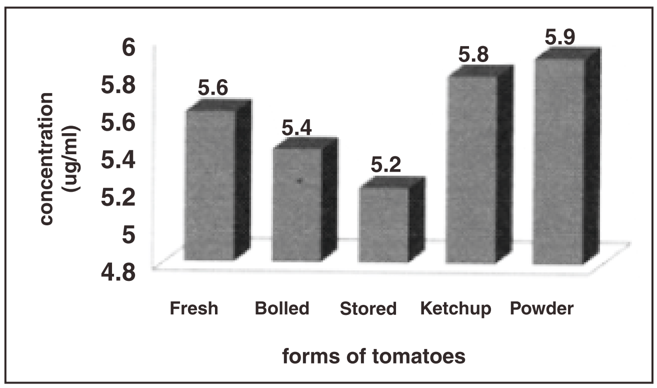

Fig. 1. Lycopene concentration in different forms of tomatoes

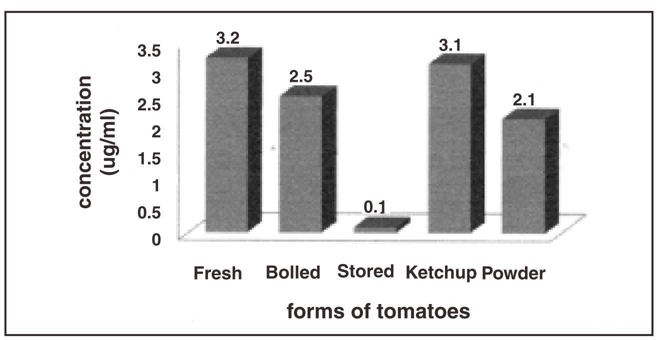

Fig. 2. -carotene concentration in different forms of tomatoes

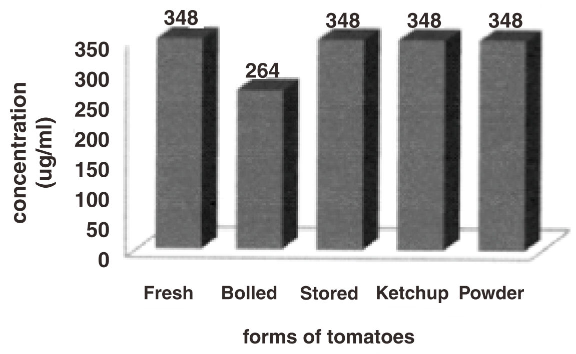

Fig. 3. Phenolic content in different forms of tomatoes

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