

Tomato-Processing and Consumption: Emerging Health Benefits

D. Shashikalabai^{1*}, K. Amaresh Kumar¹, Narayan S. Mavarkar¹, T. Basavarajnaik¹ and S. Pradeep¹

Abstract: Tomato belongs to the Solanaceae family. Tomato (*Solanum lycopersicum* L) is one of the most important vegetables worldwide and it is produced throughout the year in Karnataka. The major tomato growing areas of Karnataka are Bangalore, Tumkur, Kolar, Hassan, Haveri, Davangere. There is great scope for processing of tomatoes to curtail the post harvest losses. The various products such as tomato chutney, tomato soup, tomato sauce, tomato paste, tomato puree and tomato pickles can prepared from tomato processing. A fresh tomato provides 4 times lesser the amount of bio-available lycopene, while the juice or sauce or other processed product is a source of lycopene easier to use. Beside tomatoes, there are other red fruits and vegetables rich in lycopene, such as watermelon, but the content is lower over 80 per cent of the lycopene in our diet comes from tomatoes and tomato-derived products and combination with olive oil increases its absorption. Lycopene is a natural antioxidant that works effectively to slow the growth of cancerous cells. The result presented in the study has shown that lycopene content varied widely among tomato based products, fruits and vegetables indicating the need of different servings of these foods. Among the food samples tomato and tomato derived products had the highest content of lycopene.

INTRODUCTION

Horticultural crops being high value crops are important in raising the incomes of the farmers besides creating employment opportunities. India bestowed with wide range of agro-climatic and bio-diversity is ideal for growing a variety of agricultural crops, which includes large number of horticultural crops. Horticulture in India has gained its credibility for providing sustainable income, nutritional security and for providing employment opportunities both in rural and urban areas.

India has been bestowed with wide range of climate and physico-geographical conditions and as such is most suitable for growing various kinds of horticultural crops such as fruits, vegetables, flowers, nuts, spices and plantation crops. As per National Horticulture Database during 2013-14, India's contribution in the world production of fruits and vegetables was 13.6% and 14% respectively. Total production of fruits during

2013-14 was about 89 million tonnes while that of vegetables was 163 million tones.

Tomato belongs to the *Solanaceae* family. Tomato (*Solanum lycopersicum* L) is one of the most important vegetables worldwide. As it is a relatively short duration crop and gives a high yield, it is economically attractive. Tomatoes constitute an important short duration crop and are an integral part of the human diet.

They are the second most consumed vegetable after potato (FAOSTAT 2007). Although tomatoes are commonly consumed fresh, over 80 per cent of tomato consumption comes from processed products such as tomato juice, tomato paste, tomato puree, ketchup and sauces (Shi and Le Mguer 2000). Tomatoes have been traditionally credited as rich sources of carotenoids and vitamins, particularly β -carotene, provitamin A and ascorbic acid (Hanson *et al* 2004). Lycopene is a phytonutrient and a potent antioxidant; it is also a naturally occurring

¹ University of Agricultural and Horticultural Sciences, Shivamogga-577225, Karnataka, India.

* Corresponding author. Ph: 09844380742, E-mail: shashikala.bai@gmail.com

carotenoid responsible for the red colour in tomatoes, watermelons and pink grapefruits (Rao and Agarwal 1999; 2000).

One way to increase vegetable consumption may be to leverage the familiarity with, and emerging health benefits of tomatoes. Tomatoes and tomato products are well known by adults and children alike and have the unique advantage of meeting consumer demands on cost, convenience, availability, and taste, while delivering a healthful food option with flexibility for inclusion in a variety of culturally diverse dishes. Igniting interest in tomatoes may increase vegetable consumption directly as well as improve vegetable consumption in general by prompting individuals to explore other vegetables for improved health. Tomato is being produced throughout the year in Karnataka. The major tomato growing areas of Karnataka viz. Bangalore, Tumkur, Kolar, Hassan, Haveri, Davangere.

TOMATO PROCESSING

There is great scope for processing of tomatoes to curtail the post harvest losses. The excess productions of tomatoes leads to glut in the market which result in reduce the price of the tomatoes and demand will reduce. Hence, to create a good market demand for tomato and tomato based products it is necessary to develop and prepare value added products and may increase foreign exchange through tomato value added products there by farmers will get good profit from tomatoes. The various products such as tomato chutney, tomato soup, tomato sauce, tomato paste, tomato puree and tomato pickles and many other product can prepare from tomato processing.

The knowledge of cost and its profitability will be useful for the farmers, who want to substitute this crop for the traditional crop grown in the area. Keeping in view above aspects, the present study has been undertaken to prepare value added products from tomato and it health importance. This, to some extent, can be achieved through developing and popularizing suitable processing and marketing strategies for these glut season tomatoes.

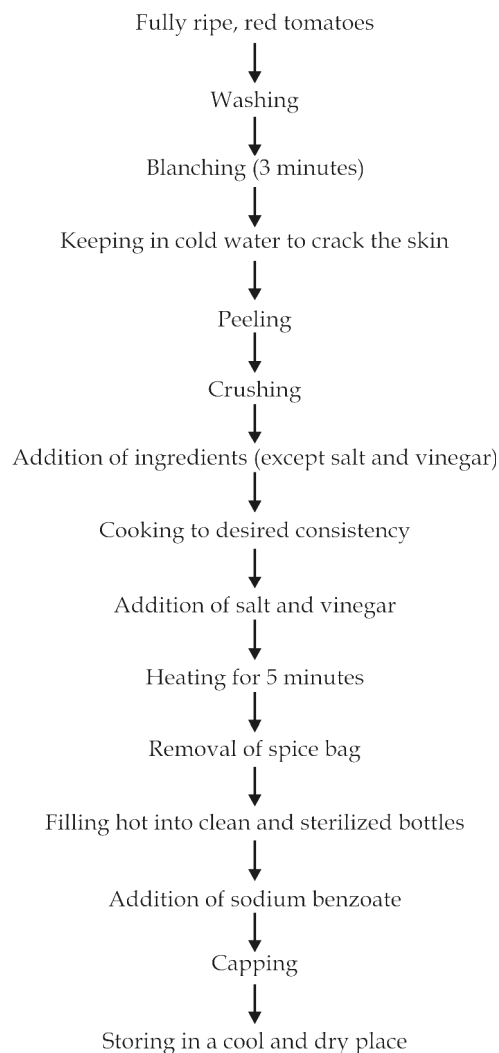


Figure 1: Process flow chart for the preparation of Tomato Chutney

Recipe: Tomato 1 Kg, Sugar 500g, onion 100g, ginger 10g, garlic 5g (grinded), red chillies 10g, hot spices 20g (cinnamon, black pepper, cardamom, aniseed, cumin powder), vinegar 100 ml, sodium benzoate 0.5g/kg of finished product.

The tomatoes are collected from the selected market places during the glut season within the Chitradurga and nearby districts. The collected tomatoes were immediately brought to the Post Harvest Engineering laboratory, College of Horticulture, Hiriya of Chitradurga district for preparation of value products and the above mentioned products have been prepared. The sensory evaluations have been made on nine point hedonic scale.

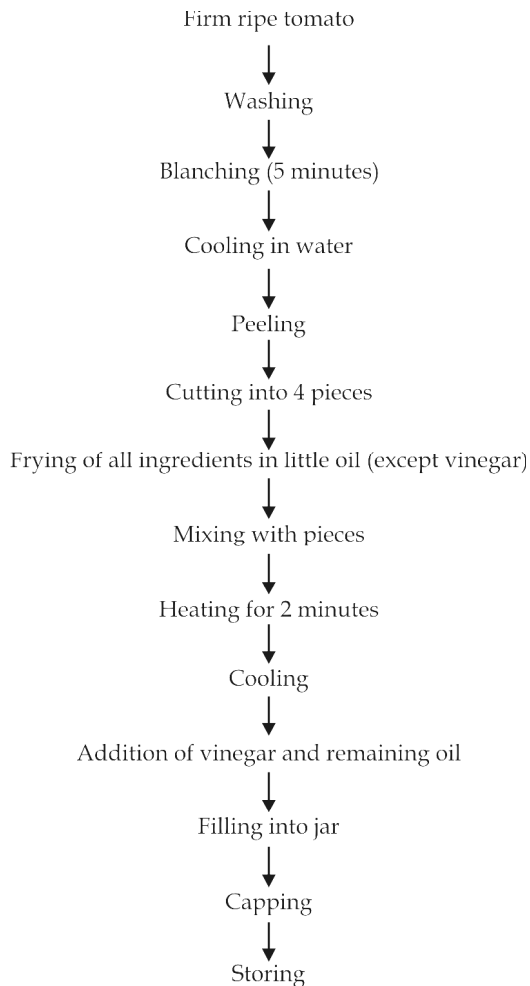


Figure 2: Process flow chart for the preparation of Tomato Pickle

Recipe: Ripe tomato 1kg, ginger chopped 50g, garlic chopped 10g, salt 75g, red chilies, mustered (rye) powder and cinnamon 10g each, vinegar 250 ml, mustered oil 300 ml.

Tomato Processing: Does it Increases the Nutritional Benefits?

Raw fruits and vegetables are typically touted as superior to their processed counterparts. However in the case of tomatoes, processing adds value by increasing the availability of lycopene for absorption. Several studies have shown that a higher serum lycopene concentration is correlated with lower cancer risk, and osteoporosis. Processing assists with lycopene’s bio-availability by softening cell walls, making lycopene in tomato tissue more accessible, and by converting some of the trans-isomers of lycopene to cis-isomers. Cis-lycopene stereo-isomers are more bio-available than the trans-isomers, which is primarily found in raw, ripe tomatoes. Cis-isomers are more readily absorbed

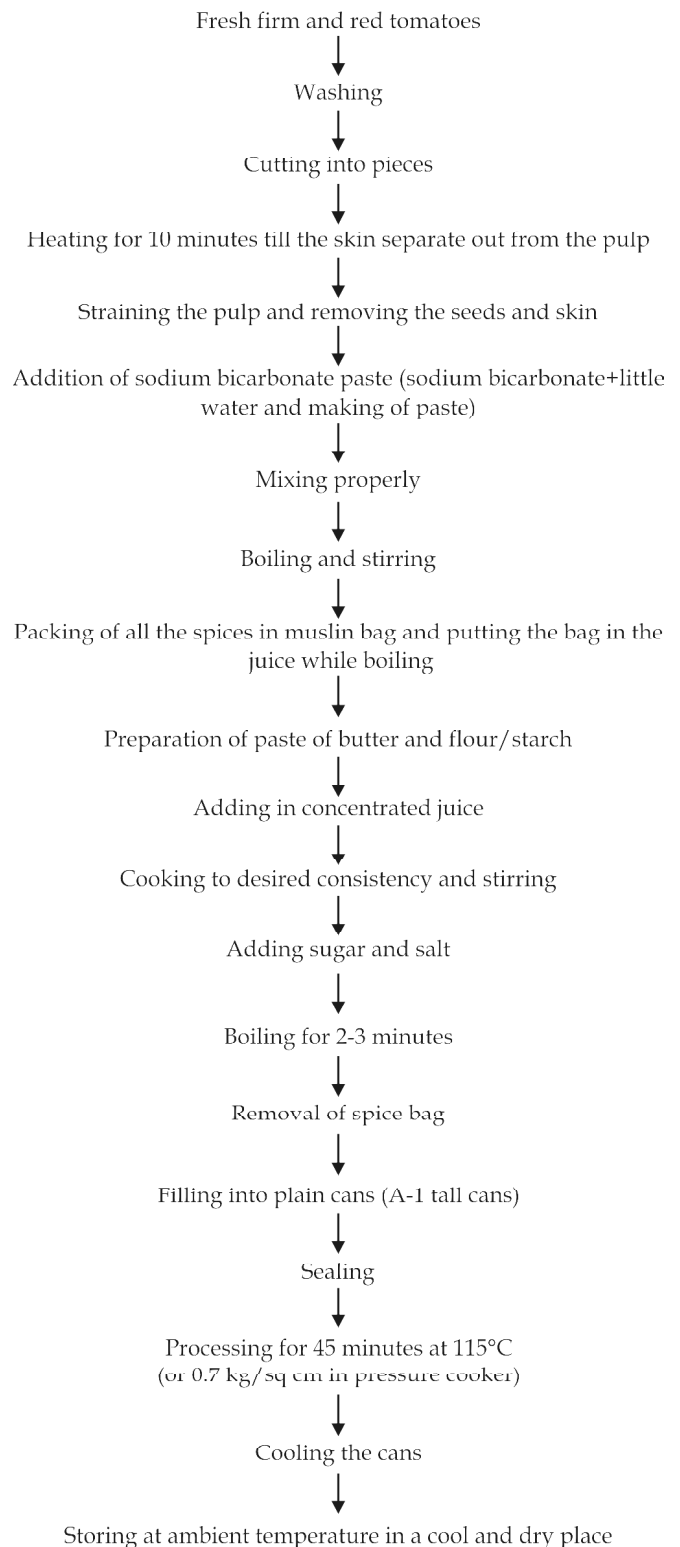


Figure 3: Process flow chart for the preparation of Tomato Soup

Recipe: Tomato juice/pulp 1 kg, salt 10g, sugar 15g, flour/starch 5g, garlic chopped 5g, cinnamon, headless clove, dry ginger, cardamom, black pepper, cumin (all spices in powder form) 0.5g each, sodium bicarbonate 1g, cream/butter 10g.

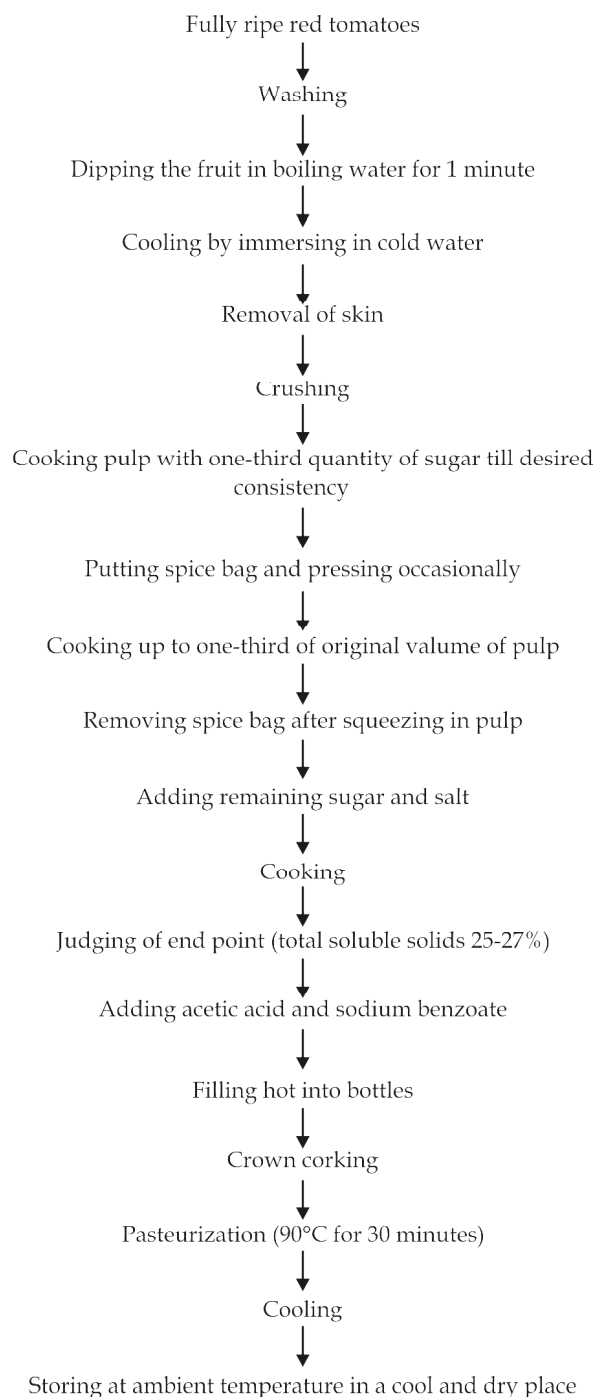


Figure 4: Process flow chart for the preparation of Tomato Sauce

Recipe: Tomato pulp 1 kg, onion paste 50g, garlic paste 10g, sugar 100 g, salt 10g, spice 10g, red chilli powder 5g, sodium benzoate 0.25g/kg of finished product, acetic acid 5ml.

through the intestinal wall into the plasma because of the greater solubility in micelles, preferential incorporation into chylomicrons, less tendency to aggregate and crystallize, more efficient volatilization in lipophilic solutions, and easier transport within cells, across plasma membranes,

and the tissue matrix. The greatest increase in cis-isomer formation occurs when tomato products are heated at very high temperatures. Likewise, lycopene bio-availability increases in the presence of oil. Whether oil needs to be present in the tomato product during thermal processing to solubilize and free the lycopene from its matrix to enhance isomerization is still uncertain. (Bratt et al, 2011)

Processed Tomato Products are More Efficient

Unlike fruits and vegetables which reduce their nutritional content when are thermally treated, such as vitamin C, thermally processed tomatoes increase the concentration of lycopene and the antioxidant properties are not lost. Moreover studies have confirmed that the body absorbs better the lycopene from tomatoes when they are thermally processed. Fresh tomatoes provides 4 times lesser the amount of bio-available lycopene, while the juice or sauce or other processed product is a source of lycopene easier to use. Beside tomatoes, there are other red fruits and vegetables rich in lycopene, such as watermelon, but the content is lower over 80 per cent of the lycopene in our diet comes from tomatoes and tomato-derived products and combination with olive oil increases its absorption. (Debjit et al 2012)

Processing Constraints

Processing of tomatoes is faced with challenges like timely inadequate raw material, high cost of processing and packaging machinery and equipment, preference of farmers and middlemen to sell to urban markets rather than sell to processors, inadequate infrastructures. These challenges result in high cost of production for industries involved in processing tomato. In addition, these industries battle with excessive imports of tomato products.

Medicinal Uses of Solanum Lycopersicum

1. Tomatoes contain a high level of lycopene, which is a substance that is used in some of the more pricy facial cleaners that are available for purchase over-the-counter.
2. Lycopene is a natural antioxidant that works effectively to slow the growth of cancerous cells. Cooked/processed tomatoes and tomato processed product produce even more lycopene

3. Tomatoes contain a considerable amount of calcium and vitamin K. Both of these nutrients are essential in strengthening and performing minor repairs on the bones as well as the bone tissue.
4. Tomatoes can reduce the amount of damaged caused by smoking cigarettes.
5. Tomatoes contain a great deal of vitamin A and vitamin C. This is primarily because these vitamins and beta carotene work as antioxidants to neutralize harmful free radicals in the blood.
6. Because of the vitamin B and potassium in tomatoes, they are effective in reducing cholesterol levels and lowering blood pressure.
7. The vitamin A in tomatoes works perfectly to keep the hair shiny and strong. In addition, it also does wonders for the eyes, skin, bones and teeth.
8. Addition of tomatoes without seeds to the diet has been proven in some studies to reduce the risk of kidney stones.
9. The vitamin A found in tomatoes is fantastic for improving the vision and to prevent the development of night blindness.
10. Chromium present in tomatoes are helpful for diabetics and keep the blood sugar levels under better control.

CONCLUSION

Lycopene is a very powerful antioxidant which can help prevent the development of many forms of cancer. Cooked tomatoes and tomato products are the best source of lycopene since the lycopene is released from the tomato when cooked. A raw tomato has about 20% of the lycopene content found in cooked tomatoes. However, raw or cooked tomatoes are considered the best source for this antioxidant.

The result presented in the study has shown that lycopene content varied widely among tomato based products, fruits and vegetables indicating the need of different servings of these foods. Among the food samples, tomato and tomato derived products had the highest content of lycopene. Lycopene content in the tomato based products commonly consumed in India was significantly

higher than the commonly consumed fruits and vegetables. The result also shows that the lycopene content in the selected tomato based product was significantly higher than in fresh tomato which is likely due to the higher moisture content of fresh tomatoes than the processed tomatoes paste.

References

- Agarwa, A. and Rao, A.V., (2000), Tomato lycopene and its role in human health and chronic diseases. *Can. Med. Assoc. J.* 163, 739-744.
- Agarwal and Sand Rao V.A., (2000), Tomato lycopene and its role in human health and chronic diseases. *Canadian Medical Association Journal*, 163, 739-744
- Annual Report (2013-14), Agricultural and Processed Food Products Export Development Authority (APEDA).
- Borguini, R. and Torres, E., (2009), Tomatoes and tomato products as dietary sources of antioxidants. *Food Rev. Intern.* 25, 313-325.
- Clinton, S.K., (1998), Lycopene; chemistry, biology and implications for human health and diseases. *Nutr. Rev.* 56, 35-51.
- Collins A.R., (1999), Oxidative damage, antioxidants and cancer. *BioEssays* 21, 238-256.
- Giovannucci, E., Rimm, E.B., Liu, Y., Stampfer, M.J. and Willett, W.C., 2002. A prospective study of tomato products, lycopene, and prostate cancer risk. *J. Natl. Cancer Inst.* 94, 391-398.
- Kotkov, Z., Hejtmnkov, A. and Lachman, J. (2009), Determination of the influence of variety and level of maturity of the content and development of carotenoids in tomatoes. *Czech J. Food Sci.* 27, S200-S203.
- Kotkov, Z., Lachman, J., Hejtmnkov, A. and Hejtmnkov, K. (2011), Determination of antioxidant activity and antioxidant content in tomato varieties and evaluation of mutual interactions between antioxidants. *LWT - Food Sci. and Technol.* 44, 1703-1710
- Khan N, Afaq, F and Mukhar H (2008), "Cancer chemoprevention through dietary antioxidants: progress and promise". *Antioxid.Redox Signal.* 10(3): 475-510.
- Lenucci, M.S., Cadinu, D., Taurino, M., Piro, G. and Dalessandro, G. (2006). Antioxidant composition in cherry and high-pigment tomato cultivars. *J. Agric. Food Chem.* 54, 2606-2613.
- Moco, S., Bino, R.J., Vorst, O., Verhoeven, H.A., de Groot, J., van Beek, T.A., Vervoort, J., de Vos, J.H.R. (2006), A liquid chromatography-mass spectrometry based metabolome database for tomato. *Plant Phys.* 141, 1205-1218.
- Vallverdú-Queralt, A., Medina-Remón, A., Martínez-Huélamo, M., Jáuregui O., Andres-Lacueva, C. and Lamuela-Raventos, R.M. (2011), Phenolic profile and hydrophilic antioxidant capacity as chemotaxonomic markers of tomato varieties. *J. Agric. Food Chem.* 59, 3994-4001.