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EFFECT OF TWO VARIETIES OF TOMATO SKIN ADDITION ON OXIDATIVE STABILITY OF GHEE: A COMPARATIVE STUDY

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ABSTRACT

Tomato (*Lycopersiconesculentum*) has plethora of health benefit due to high antioxidant substances are rich in this vegetable. The red colour of tomato is due to high content of lycopene. Lycopene is a very potent natural antioxidant and quantity of lycopene of tomato depends on time of harvesting of tomato plant, agriculture practice, size and shape of tomato. Here two local varieties of tomato available in ANAND (viz- Ruby and Shaktiman) area were evaluated for antioxidative stability in ghee during storage. Our study suggested that addition of tomato skin increase the oxidative stability of ghee during accelerated storage,various oxidative parameters(FFA,TBA,PV) were lower for tomato added ghee samples as comare to control sample. Ruby variety tomato skin content more lycopene and it gave better oxidative stability in ghee during storage as compare to Shaktiman variety tomato. So tomato skins which are the waste of food industry would be a very good substitute of synthetic antioxidant.

Keywords: Ghee, Tomato, Antioxidant, FFA, TBA, PV..

INTRODUCTION

Tomato (*Lycopersiconesculentum*) among antioxidant - rich vegetable, has achieved a spectacular status because of its widespread consumption. It is one of the major vegetable crops, grown in almost every country of the world. Studies found that regular intake of cooked tomato as a part of the vegetable regimen appears to be the major nutritional factor accounting for lower risk of prostate cancer, digestive tract cancer and coronary heart diseases (Giovannucci *et.al.,* 1995). Epidemiological studies also suggested that, tomato is very effective against major lifestyle diseases such as cardiovascular diseases and cancer, and it is said to protect cells from DNA damage (Sesso *et.al*., 2003).Tomatoes have been ranked first as a source of lycopene (71.6%), second as a source of vitamin C (12.0%), pro-vitamin A carotenoids (14.6%) and other carotenoids (17.2%), and third as a source of vitamin E (6.0%) (Kargl *et.al.,* 1960). The composition of tomato changes from agriculture practice, maturity of fruits and species of fruits (Cano *et al*., 2003).The visible red color of the tomato fruit is due to its major carotenoid, lycopene, making 90% to 98% of the total carotenoids (Shi *et.al.,* 1999). It also contains colorless carotenoid precursors such as phytoene and phytofluene (15-30%), xanthophylls (free and esterifies, 6%) and minor tomato hydrocarbon carotenes such as β-carotene, γ-carotene, z-carotene, (Gross, 1991). In ripened tomato lycopene (major), β-carotene, γ-carotene are the maincarotenoids (99.6%).The distribution of carotenoids in tomato fruit is not uniform. The outer pericarp constitutes the largest amount of total carotenoids and lycopene. Tomato skin is a rich source of lycopene, indicating that lycopene is attached to the insoluble fiber portion of tomatoes (Shi *et al*., 1999). Health benefit of tomato is due to presence of its high anti oxidative components present in it. In various literatures health effect of tomato and its various parts are successfully demonstrated but very few literatures found where tomato as a whole or different part of tomato being used as natural antioxidant in food product especially fat rich dairy product like ghee.

Guleria *et.al*., (1983) reported that tomato seed powder added at 5.0 per cent level in ghee inhibited oxidation and ensured its stability practically to the same extent as 0.01 per cent of BHT or BHA.No literature found where fresh tomatoes have been evaluated for preventing oxidative rancidity in oil or ghee. So current research was targeted to check the antioxidative activity of two local varieties of tomato available in local area of Anand in two different season.

MATERIALS AND METHODS

CULTIVAR OF TOMATO

Two cultivars of tomato *viz*, Ruby and Shaktiman, were procured from AAU farm and evaluated for their skin for antioxidant activity in ghee and to check that whether these two cultivar would have same result for

oxidative stability in ghee or not.Ruby variety of tomatoes were globe in shape and harvested in summer on other hand Shaktiman tomato were oblong in shape and harvested in autumn.

PREPARATION OF GHEE

Butter was obtained from AMUL dairy, first butter was divided into three parts. In two part Ruby and Shaktiman tomato skin were added @0.6% respectively and one part left as control sample. Ghee was prepared by creamery butter methods described by De (2005).

DETERMINATION OF LYCOPENE IN DIFFERENT CULTIVAR OF TOMATO

Lycopene of tomato skin samples were determined by the method as described by Fish et al.,(2002)

DETERMINATION OF PEROXIDE VALUE

The peroxide value of ghee was determined by the method (iodometric method) as described by the Indian Standards Institution (IS, 1966).It is the evaluation of primary oxidative product during lipid oxidation.

DETERMINATION OF FREE FATTY ACIDS

The free fatty acids content of ghee was determined by the method as described by Indian Standards Institution (IS, 1966).

DETERMINATION OF THIOBARBITURIC ACID (TBA) VALUE

TBA value is the evaluation of secondary oxidative product during lipid oxidation, TBA valuesof ghee samples were determined by the method as described by Patton and Kurtz (1951).

SENSORY EVALUATION FOR FLAVOR

It was carried out using 9-point Hedonic scale.

ACCELERATED STORAGE STUDY

All the samples of ghee filled in glass bottle and were stored in aincubator at elevated temperature (80 ^{0}C± 2 °C) to accelerate the oxidation. All data were analyzed by Prism 3 software and Data represented by mean value ± SEM (n=4)

RESULT AND DISCUSSION

LYCOPENE CONTENT IN DIFFERENT CULTIVAR OF TOMATO

The most common and rich source of lycopene is tomato. Therefore, the term lycopene is derived from the scientific name of tomato, *Lycopersiconesculentum* (Choksi and Joshi, 2007). From table 1 Ruby and Shaktiman tomato skin content 9.00±0.187 and 7.775±0.427 (mg/Kg) of lycopene respectively.

Table 1: Lycopene content in two cultivar of tomato skin (mg/Kg)

Sr No	Name of tomato cultivar	Lycopene content
1	Ruby	9.00 ±0.187
2	Shaktiman	7.775± 0.427
Mean ± SEM (n=4)		

According to local farmer utilization of N_2 fertilizer was higher for harvesting of Ruby tomato as compare to Shaktiman variety, using of Nitrogen fertilizers were reported to increase the lycopene and others carotenoids content in tomatoes (Grolier, 2000).Ruby variety tomato cultivated in summer so lycopene contain was higher that agreed the early finding of Heinonen *et al.,* (1989).

EFFECT OF DIFFERENT PARTS OF TOMATO ON CHANGES IN FLAVOR SCORE OF GHEE DURINGSTORAGE

The samples of ghee were subjected to sensory evaluation on 9 point Hedonic scales for flavour characteristics on first day and then at an interval of every one day for period of 15 days. The average results obtained from four different replications for changes in flavor score of the ghee samples are given in Table 2.

Results clearly showed that during first day of storage (fresh sample) there were no significant flavour difference among all the samples it clearly rectify addition of tomato skin had not produce any flavor defects or adverse effect on flavor of ghee.

Flavor value of control sample became unacceptable (below 6) within seven days of accelerated storage and for Shaktiman and Ruby variety tomato skin added samples flavour score came below (6) on 9th and 11th day of storage respectively, on the other-side flavor score of tomato added samples were always better than control samples throughout whole accelerated storage period. There were no significant flavour differences between samples of ghee added with skin oftwo varieties of tomato. At 15th days of storage flavour score was highest for Ruby tomato skin added sample and lowest for control sample.

Table 2: Effect of parts of tomato on changes in Flavor score (basis of 9pt Hidonic scale) of ghee during storage

Storage period (days)	Cultivar of tomato added in ghee		
	None (control)	Ruby tomato Skin	Shaktiman tomato skin
1	8.75± 0.11	8.77± 0.26	8.29± 0.10
3	8.100± 0.17	8.10± 0.44	8.55± 0.19
5	6.00± 0.17	7.60± 0.36	7.40± 0.53
7	4.90± 0.10	6.300± 0.44	7.20± 0.57
9	4.20± 0.07	6.10± 0.37	5.90± 0.61
11	4.10± 0.07	5.50± 0.23	5.50± 0.45
13	3.500± 0.20	5.000± 0.00	4.80± 0.47
15	2.75± 0.10	4.60± 0.07	4.40± 0.26
Mean ± SEM, n=4, (P<0.0001)			

EFFECT OF DIFFERENT PARTS OF TOMATO ON CHANGES IN PEROXIDE VALUE OF GHEE DURING STORAGE

The changes in peroxide value expressed in millie-quivalents of oxygen per kg (meq.O2/kg). The samples of ghee were also analyzed for peroxide value when fresh and at an interval of every one day. The average results obtained from four different replications for changes in peroxide value of the ghee samples are given in Table 3 Initially the peroxide values of all samples were zero and for first three days of storage differences in peroxide value among all the three samples were found non-significant. From third days onwards control sample peroxide value was significantly higher than that of different tomato variety skin added samples. At the end of 15 days of storage peroxide value of control sample, Ruby and Shaktiman tomato skin added samples were 24.23±0.58, 16.20±1.47 and 17.00±1.27 respectively. This result satisfy early agreement of Cano *et al.,* (2003) that tomato skin contain lycopene and other carotenoids that were very efficient for preventing peroxide formation during storage.

Table 3: Effect of parts of tomato on changes in peroxide value of ghee during storage

Storage period (days)	Cultivar of tomato added in ghee		
	None (control)	Ruby tomato Skin	Shaktiman tomato skin
1	0.00	0.00	0.00
3	2.40± 0.41	2.050± 0.37	2.175± 0.38
5	5.77 ± 0.27	3.20± 0.51	4.25± 0.34
7	8.57± 1.83	4.87± 0.11	5.37± 0.40
9	8.80± 1.83	6.60± 0.60	8.17± 0.55
11	13.75± 1.74	8.85± 1.02	8.62± 0.99
13	18.35± 1.84	12.15± 1.93	13.40± 0.98
15	24.23±2.11	16.20±1.47	17.000±1.27
Mean ± SEM, n=4, (P<0.0001)			

EFFECT OF DIFFERENT PARTS OF TOMATO ON CHANGES IN FREE FATTY ACID (FFA) VALUE OF GHEE DURING STORAGE

The samples of ghee were also analyzed for FFA value when fresh and at an interval of every one day. The average results obtained from four different replications for changes in FFA value of the ghee samples are given in Table 4. FFA of a product indicates extended lipolysis of a product. During first day of storage FFA were lower for skin added samples that was indication of good storage stability of ghee. During whole storage period FFA of control sample was higher as compare to different two varieties tomato skin added samples. This result also satisfy that addition of tomato skin did not increase FFA so much that cross the AGMARKstandard of ghee (De 2005), so addition of tomato skin had no adverse effect on the quality of ghee.

Table 4: Effect of parts of tomato on changes in FFA of ghee during storage

Storage period (days)	Cultivar of tomato added in ghee		
	None (control)	Ruby tomato Skin	Shaktiman tomato skin
1	0.22± 035	0.11± 0.003	0.11± 0.002
3	0.25± 0.049	0.11± 0.002	0.11± 0.004
5	0.36± 0.043	0.23± 0.042	0.23± 0.017
7	0.45± 0.0701	0.23± 0.042	0.24± 0.022
9	0.57± 0.096	0.24± 0.044	0.25± 0.023
11	0.62± 0.119	0.25± 0.045	0.26± 0.0307
13	0.65± 0.120	0.25±0.046	0.26± 0.032
15	0.77± 0.089	0.277± 0.043	0.29± 0.015
Mean ± SEM, n=4, (P<0.0001)			

EFFECT OF DIFFERENT PARTS OF TOMATO ON CHANGES IN THIOBARBITURIC ACID VALUE OF GHEE DURING STORAGE

The samples of ghee were also analyzed for TBA value at an interval of every one day over a period of fifteen days. The average results obtained from four different replications for changes in TBA value of the ghee samples are given in Table 5.

Changes in TBA value of all the samples of ghee during storage were well collaborated with changes in flavor score of the corresponding samples of ghee. The control sample having highest TBA value and corresponding lowest flavor score compare to samples of ghee added with two varieties of tomato skin added samples. The sample of ghee added with Ruby tomato skin had lowest TBA value correspondingly highest flavor score after the fifteenth days of storage.

Our result clearly-rectify a positive correlation between lycopene content and anti oxidative activity of tomato. All the oxidative parameters FFA, TBA and Peroxide value were lesser for tomato added sample as compare to control sample. Our results were also satisfied early finding of Hart and Scott, (1995) that lycopene content in tomato depends on size, shape, agriculture practice and harvesting time of tomato. So lycopene content was higher in Ruby variety tomato and oxidative stability was highest during storage in ghee sample added with skin of Ruby variety tomato. As skin of Ruby tomato was thinner as compare to Shaktiman variety mixing (availability) of lycopene might be more in Ruby tomato added ghee sample. As according to Al- Wandawi *et al.,* (1985) the skin and the pericarp of the tomato fruit are particularly rich in lycopene and this Lycopene is bound in lipid matrix of tomato and structure of different lipid matrix depends on the size and shape of tomato and in another study Hussein and El-Tohamy, (1990) reported that availability of lycopene depends on shape of matrix of tomato.

So from above discussion and from results we could say that skin of tomato was a great source of lycopene which were very efficient to prevent oxidative rancidity in ghee during storage.

CONCLUSION

On the basis of flavor score and other oxidative parameters of ghee during storage had conclusively suggested that Ruby tomato variety was best to retain the flavor of ghee by inhibiting oxidative deteoration .So in tropical country like India where lots of ghee uses to spoil for development of rancid flavor due to poor transport and storage facility. So tomato skin would be a very good substitute of synthetic antioxidant in house hold application.

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