Research Article

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TOMATO PUREE PREPARATION WITH INCORPORATION OF TURMERIC-LIME MIXTURE

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Abstract

New types of tomato puree products were developed by blanching matured tomatoes (*Lycopersicon esculentum*) for 1 min, 2 min and 3 min individually with or without addition of the mixture of turmeric and lime during the blanching time. Soluble solid content and pH of the puree products were in the range of 11.1 - 12.7 Brix and 4.34 - 4.67 respectively. Total Hunter Lab colour difference (ΔE) of treated sample following 2 min and 3 min blanching significantly ($P < 0.05$) higher than corresponding control samples. Again, 2 min- and 3 min-blanched treated samples did not have significantly different ($P > 0.05$) Lab values (L, brightness; a, redness and b, yellowness). Also, yield stress (measure of flow behavior) of 2 min- blanched samples (both treated and control) were the maximum among other corresponding puree samples. Thus, 2 min blanching time may be preferred for the preparation of this new type of turmeric-lime treated tomato puree product.

Keywords: Turmeric-lime, *Lycopersicon esculentum,* Tomato puree.

Introduction

Tomato (*Lycopersicon esculentum*) is cultivated in different countries for its edible red fruit. Lycopene is a phytochemical nutrient element found in many fruits and vegetables, but excessively found in tomato that imparts natural red colour.[1] Lycopene is the predominant carotenoid in tomatoes.[2] Supplementation of tomato products, containing lycopene, has been shown to lower biomarkers of oxidative stress and carcinogenesis.[3] Many factors affect the lycopene concentration in raw tomatoes, such as genetics, soil, and plant nutrition, handling, maturity and seasonal variations. The green raw tomato turns into red when it ripens, as the cis-form of lycopene present in tomato gradually changes into transform of lycopene with the maturity.[4] The redness of tomato depends upon the majority concentration of trans-form. Retention of natural pigment is one of the symbols of livelihood. Thermal treatment is one of the most important methods of preservation of vegetables.[5] Thermal processing inactivates pathogens and other microorganisms and also improves the bioavailability of lycopenes since it breaks down the cellulose structure and plant cell. However, unfortunately thermal processing is also responsible for the degradation of red coloured lycopene pigment present in tomatoes. Therefore discolouration during thermal processing

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(blanching) renders tomato puree unmarketable and leads to poor consumption.

To compensate the reduction of red colour of tomato puree during its preparation, an attempt is made by adding equal proportion of turmeric and lime at the time of blanching of tomatoes. The objective of this paper is to intensify the colour of tomato puree for its better use and consumption. Another objective of this research work is to measure the rheological characteristics of fortified tomato puree as fortification of turmeric-lime mixture might be responsible for the appetizing characteristics of tomato puree such as colour and consistency (rheology).

Materials and methods

Preparation of tomato puree

Matured red coloured fresh tomatoes were purchased from the local market in Trichy, Tamilnadu, India. The tomatoes were sorted and washed with clean water. Then it was blanched in hot water at 100 C for 1, 2, and 3 min, separately. In case of pretreated tomato puree preparation, 4 mg of each of turmeric and lime were added in the blanching water during blanching. After blanching, the tomatoes were taken out of cooking water and deskined by keeping it under running water. Then it was cut into two halves, with the seeds kept out, and ground the pulp in a Food Processor (Inalsa Appliances Ltd., India). The excess water was discarded by a strainer to obtain tomato puree. The puree was stored in a sterile container at 0ºC. Puree prepared by adding no turmeric and lime was considered to be as control sample.

Soluble solid content

Soluble solid content of the samples were determined by using a Bellingham-Stanley digital refractometer (Model RFM 110) and were expressed in terms of °Brix

pH

pH of both treated and control tomato puree samples were determined by using a pH-meter (Model no. 355, Systronics, India).

Determination of colour

Visual colour was measured by using a Hunter Lab Colour Measurement System Model Color Flex 45/0 (Hunter Associates Laboratory, Inc., USA) in terms of universally accepted Hunter Lab colour scale. The intensity of the colour of both the treated and control tomato puree samples were expressed in L, a and b (brightness, redness and yellowness, respectively). The instrument (10 observer, Illuminant D-65) was calibrated against a standard white reference tile.

Determination of rheology

Approximately 17 ml of tomato puree was placed in a concentric cylindrical cup in a rotational Rheometer (Anton Paar, Model Physical MCR 51, Germany). Rheological measurements (shear stress and shear rate) of the samples were done and the yield stress (in Pascal unit) readings were obtained directly from the instrument.

Flow model

The power law model with or without yield term describes the flow behavior of viscous food over wide ranges of shear rate.[6] The rheological model that has been generally used for non-Newtonian fluids, especially puree/paste is the Herschel - Bulkley model, as shown in Equation 1 below:

$$y^p = a + b.x \;\ldots\ldots\ldots\ldots\; (1)$$

Where,

a, b and p are regression parameters; p is the flow behavior index.

Statistical analysis

All the tests were done in triplicate and the samples were subjected to F-test for significant difference ($P < 0.05$) using Microsoft Excel software.

Results and discussions

Soluble solid content of tomato puree samples were observed to be in the range of 11.1 – 12.7 (Table 1), which followed the conventional rule of tomato puree preparation.[7] pH of the treated and control puree were in the range of 4.34 – 4.67 (Table 2). It was observed from Table 2 that the treatment of lime (alkali) along with turmeric during tomato puree preparation did not change significantly ($P < 0.05$) the acidic pH of the puree sample compared to the control sample without any turmeric-lime treatment. This observation indicated non-significant ($P < 0.05$) change in sourness of the puree product from the control sample and the acceptability of the treated puree product was comparable to the traditional control product.

Colour and rheology of tomato puree are important appetizing properties of tomato puree. It was observed from Figures 1 and 2 that the colour parameters; L-and a-values of both the control and treated samples increased with the time of blanching and a-value of the treated samples were significantly ($P < 0.05$) higher than the corresponding control samples. However, b (i.e. yellowness of the samples) of the treated samples decreased with increasing of blanching time and was significantly ($P < 0.05$) lower than the corresponding control samples (Figure 3). This finding indicated that the treatment with turmeric and lime increased the redness of the tomato puree. In alkaline medium (due to presence of lime), the yellow coloured curcumin pigment of turmeric turns into red and the addition of turmeric-lime mixture in the blanching water of tomato puree preparation minimizes the conversion of trans-form of lycopene (red coloured tomato pigment) into cis-form of lycopene (yellow coloured pigment in tomato) and minimizes the cause of discolouration.

The total colour difference (Δ E) of the tomato puree a product (as shown in Equation 2) was determined and was shown in Figure 4:

Where,

$$\Delta E = ((\Delta a)^2 + (\Delta b)^2 + (\Delta L)^2)^{1/2} \quad .....(2)$$

It was observed from Figure 4 that the total colour difference ΔE of treated sample following 2 min and 3 min blanching significantly ($P < 0.05$) higher than corresponding control samples. The colour differences were measured with respect to the colour parameters of 0 min blanched tomatoes. a, b and L values were 21.63, 11.62 and 22.31 Hunter Lab colour unit, respectively).

However, as b-value of purees increased with blanching time, combination of Hunter Lab parameters (La/b) was found to be increased exponentially with increasing of blanching time up to 2 min and then decreased when the tomatoes were blanched for 3 min (Figure 5). La/b has also been expressed to colour change of puree products.[8, 9] 2 min-and 3 min-blanched treated samples showed insignificant ($P < 0.05$) La/b values. Rheology of tomato puree products can be measured in terms of yield stress (in Pascal unit) and data were fitted by Herschel Bulkley model. The yield stress, regression coefficients and corresponding R (percentage of model fitness) of different tomato puree samples were shown in Table 3. It was observed that the yield stress of both the treated and control samples decreased with blanching time. However, of 2 min-blanched puree showed no significant ($P < 0.05$) difference of yield stress value from 1 min-blanched tomato puree products. Tomato puree exhibited yield stress, which decreased with the blanching time, due to the reason that the rapture of tomato skin occurred and the food structure becomes weak resulting in the lowering of yield stress.[10,11] The flow behavior index (p) was less than unity. This indicated that the puree behaved its pseudoplastic (shear thinning) nature. Treated samples had significantly ($P < 0.05$) higher yield stress value than corresponding control sample irrespective of blanching time.

Table No. 01: Soluble solid content of different tomato puree samples.

Sample	Blanching time		
	1 min	2 min	3 min
Control	11.1^{ax*}	11.3^{ax}	11.5^{ax}
Treated	12.7^{by**}	12.1^{bx}	12.0^{ax}

$^{a-b}$ Different letters corresponds to the samples of a particular blanching time differ significantly ($P < 0.05$).
$^{x-y}$ Different letters corresponds to the same type of samples differ significantly ($P < 0.05$).

Table No. 02: pH of different tomato puree samples.

Sample	Blanching time		
	1 min	2 min	3 min
Control	4.34^{ax}	4.47^{ax}	4.37^{ax}
Treated	4.81^{by}	4.58^{bx}	4.67^{ax}

$^{a-b}$ Different letters corresponds to the samples of a particular blanching time differ significantly ($P < 0.05$).
$^{x-y}$ Different letters corresponds to the same type of samples differ significantly ($P < 0.05$).

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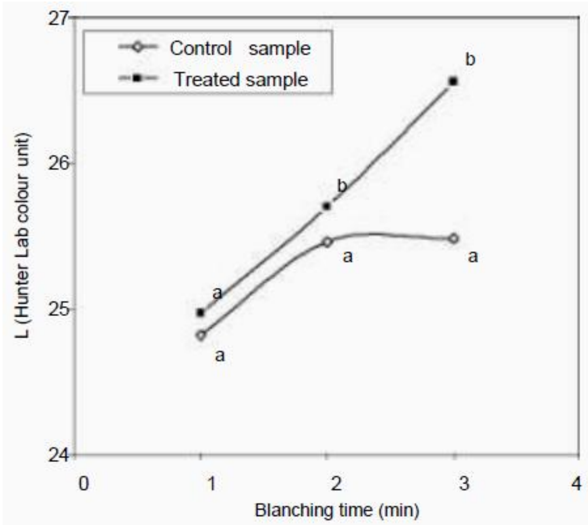

Fig. No. 01: L-value colour parameter of tomato puree samples.
[a – b] Different letters corresponds to the samples of a particular blanching time differ significantly (P < 0.05).

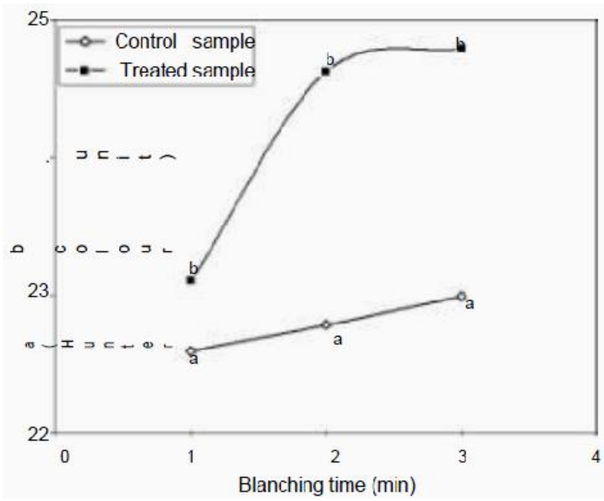

Fig. No. 02: a-value colour parameters of tomato puree samples.
[a – b] Different letters corresponds to the samples of a particular blanching time differ significantly (P < 0.05).

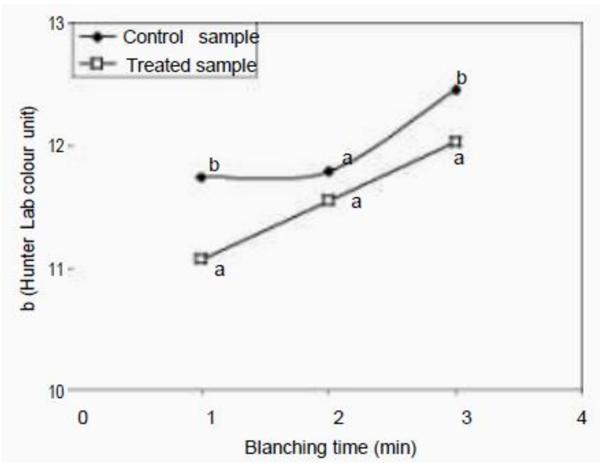

Fig. No. 03: b-value colour parameter of tomato puree samples.
[a – b] Different letters corresponds to the samples of a particular blanching time differ significantly (P < 0.05).

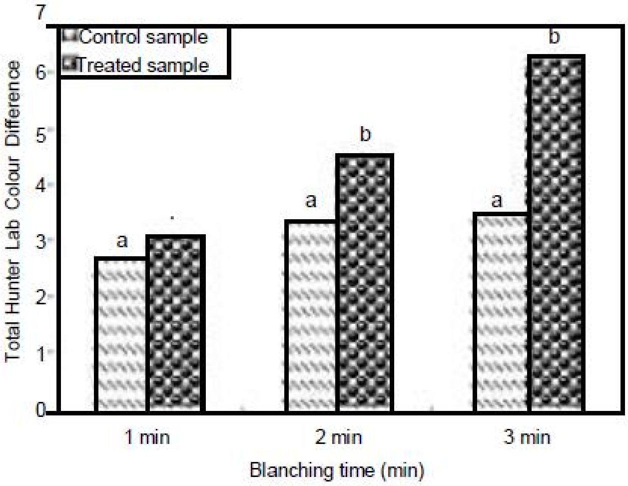

Fig. No. 04: Changes in Total colour Difference of the tomato puree samples.
[a – b] Different letters corresponds to the samples of a particular blanching time differ significantly (P < 0.05).

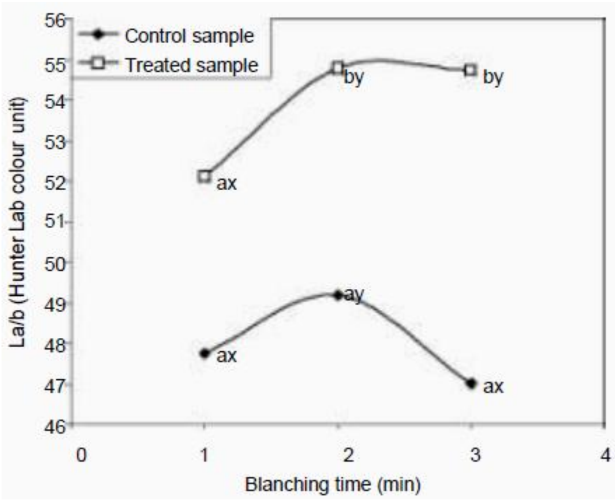

Fig. No. 05: Lab value colour Parameter of tomato puree samples.
[a – b] Different letters corresponds to the samples of a particular blanching time differ significantly (P < 0.05).
[x – y] Different letters corresponds to the same type of samples differ significantly (P < 0.05).

Table No. 03: Yield stress values and corresponding Model-fitting parameters of different tomato puree products.

Sample	Blanching Time (min)	Regression coefficients			Regression (%)	Yield stress (pa)
		a	b	p		
Control	1	102.26	-0.09	0.91	0.92	102.26[b]
	2	90.24	-18.19	0.28	0.93	90.24[ab]
	3	86.74	-2.37	0.62	0.91	86.72[a]
Treated	1	132.92	-12.20	0.42	0.94	132.92[b]
	2	126.82	-0.40	0.90	0.93	126.82[b]
	3	112.42	-2.69	0.69	0.92	112.43[a]

Conclusion

Degradation of lycopene, that is, deterioration of red colour of tomato in tomato puree preparation can be best compensated by using turmeric and lime mixture during the blanching of tomatoes. Also, yield stress of 2 min blanched samples (both treated and control) were the maximum compared to the corresponding samples of different blanching time, indicating their most acceptable flow behaviors. Thus, 2 min blanching time may be preferred for the preparation of this new type of turmeric lime treated tomato puree product.

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