

Comparison of Physicochemical, Antioxidant Properties and Sensory Acceptance of Puree from Tamarillo and Tomato

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Received 11 March 2018; accepted 2 November 2018; available online 12 November 2018

DOI: <https://10.30880/jst.2018.10.03.005>

Abstract: Puree is well known as the best food ingredient to enhance flavour in cooking. Tamarillo (*Cyphomandra betacea*) is an underutilized fruit in Malaysia due to their bland and strong sour taste. Tomato (*Lycopersicon esculentum*) is a well-known fruit that grows throughout the tropical and commonly consumed vegetable fruit. The purpose of this study are to determine and do a comparison on the physicochemical properties (pH, total soluble solid (TSS), moisture content, ash, protein, fat and carbohydrates) in tamarillo and tomato puree. In addition, this study was conducted to evaluate the antioxidant properties of tamarillo and tomato puree by using TPC and FRAP assay and lastly to evaluate the consumers acceptance on the new product (tamarillo puree) using sensory evaluation by 9 point hedonic test. Based on the results, tamarillo puree has lower pH value (4.12 ± 0.11), moisture content ($89.24 \pm 0.004\%$), and fat content (0.2% wt/wt) as compared to tomato puree (pH: 4.48 ± 0.08 , moisture: $95.76 \pm 0.006\%$, fat: 0.3% wt/wt). Meanwhile, TSS value ($9.30 \pm 0.20^\circ$ Brix), carbohydrate (7.584% wt/wt), protein (1.0% wt/wt) and ash content (1.976%) of tamarillo puree was higher as compared to tomato puree (TSS: $3.30 \pm 0.10^\circ$ Brix, carbohydrate: 3.064% wt/wt, protein: 0.09% wt/wt, ash: 0.786%). The TPC and FRAP value for tomato puree was 102.111 ± 0.778 mg of GAE/L and 1.786 ± 0.013 g of FSE/ml respectively, which were higher than tamarillo puree with value of 79.815 ± 0.39 mg of GAE/L and 1.344 ± 0.016 g of FSE/ml respectively. Likewise for TFC value, tomato puree was higher (9.389 ± 0.394 RE/L) as compared to tamarillo puree (18.111 ± 2.577 RE/L). Results showed the comparison of physicochemical properties, antioxidant properties as well as consumer acceptability.

Keywords: Tamarillo; physicochemical properties; antioxidant properties; TPC; TFC; FRAP; sensory.

1. Introduction

Fruit puree is a thick liquid made by cooking and straining the fruits. It was stated by European Commission Regulation (EC) that puree contained about 3% more water than sauce. While Prohens and Nuez defined tomato puree as tomato concentrate that contains no less than 7% but less than 24% of natural total soluble solids [1]. Fruit puree was an important ingredient that being used in many food products such as jams, marmalades, spread, filling and topping (UN Comtrade Database, 2009). The physicochemical properties of fruit puree were the important quality indicators that influences food acceptance [2] [3]. Malaysians loved to use puree especially tomato puree as an ingredient to enhance the taste of local cuisine. If the community in Malaysia concerned and aware on the importance of antioxidant and nutritional value of food, the development and evaluation of tamarillo puree is crucial to

compare the properties against the well-known tomato purees.

Tamarillo also known as *Cyphomandra betacea* scientifically, is a subtropical fruit native to the Ecuadorian-Peruvian Andes. The types of tamarillo are distinguished by their colour which is red, yellow and purple [4] The fruit has 4-10 cm long and 3-5 cm in diameter [5]. Their red colour pigment of ripe tamarillo is due to the anthocyanins and the yellow-orange colour due to carotenoids. The ripe tamarillo is normally eaten raw by the local community in Kundasang. Tamarillo is remain underutilized in Malaysia, but in Colombia, it is a promising product for export due to its colour; the red variety has been most accepted internationally [5] [6].

Tomato (*Lycopersicon esculentum*) commonly referred as a vegetable that grown throughout the tropical and temperate regions of the world [7]. It is one of the most commonly cultivated and consumed vegetable fruit [8]. This

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e-ISSN: 2600-7924/penerbit.uthm.edu.my/ojs/index.php/jst

fruits are typically grows about 1 to 3 meters in height, have a weak stem and perennial in its native habitat. It is commonly used as raw materials in food production such as purees and ketchup.

Codex Standard (1981) defined that tomato puree is considered as tomato concentrate that contains no less than 7% but less than 24% of natural total soluble solids, meanwhile tomato paste is defined as tomato concentrate that contains at least 24% of natural total soluble solids. There is stated in Food Regulations 1985 that tomato puree shall be the heat processed product made from whole, sound, ripe tomatoes, with the skin and seeds removed, concentrated to yield product with a specific gravity of not less than 1.050 (20°C/20°C). It shall be packed in hermetically sealed packages and processed by heat to prevent spoilage. It shall contain not less than 8% of soluble salt-free solids. It is also stated that tomato puree may contain permitted preservative.

The purpose of this study are to determine and do a comparison on the physicochemical properties (pH, total soluble solid (TSS), moisture content, ash, protein, fat and carbohydrates) in tamarillo and tomato puree. In addition, this study was conducted to evaluate the antioxidant properties of tamarillo and tomato puree by using TPC and FRAP assay and lastly to evaluate the consumers acceptance on the new product (tamarillo puree) using sensory evaluation by 9 point hedonic test. Hence, this study is to evaluate whether tamarillo can be an alternative for tomato puree as they possess similar physicochemical, antioxidant properties as well as the acceptance by consumers.

2. Materials and Methods

Materials. Tamarillo was purchased from fresh market at Cameron Highlands and tomato was purchased at Pasar Mini Kim Seng at Pagoh, Muar, Johor.

Puree preparation. The fruits were washed and blanched for 2 minutes at 85°C and cooled using cold water. After that, it was peeled and the peeled-flesh was blended. The prepared puree was pasteurized at 60-75°C for 30 minutes. The end yield was the pasteurized puree.

Physicochemical analysis pH. The pH of both purees were measured using standard method with minor modification described by Horita *et al.*, (2016) [9]. 10 g of sample was mixed well by stirring with 50 ml of distilled

water using glass rod and the pH of the suspension was determined in the pH meter.

Total Soluble Solid (TSS). TSS content of purees was determined by using Digital refractometer. All the experiments were conducted at room temperature [10].

Moisture content. The moisture content was determined using AOAC method 934.01. The samples were dried at 120°C and drying was continued till a constant reading was obtained. The moisture content was expressed as percentage [11].

Carbohydrates. Total carbohydrates content of the purees was obtained by using the method described by Mohammed Abdus Satter *et al.*, (2016) [12], and was calculated as shown in Equation 1 [13]. The total carbohydrate was expressed in percentage.

$$\text{Total carbohydrates} = 100 - (\text{protein} + \text{fat} + \text{ash} + \text{moisture content}) \quad (1)$$

Protein. The protein content was estimated using Kjeldhal method according to AOAC method 934.01, which analyzed the amount of nitrogen available in the sample [14]. 100g of sample was transferred into digestion and 3g of catalyst mixer and 10ml of concentrated sulfuric acid were added. It consisted of sodium or potassium sulfate and copper sulfate with ratio 5:1 respectively. The sample was digested until the solution became colourless. The digested sample was placed in the distillation unit for ammonia recovery. The sample was distilled and ammonia was collected in the receiver solution. The solution was titrated against the 0.1N hydrochloric the colour changes (end point). The nitrogen value multiply by factor 6.25 gives the crude protein content of the sample in percentage.

Fat. The fat content of the sample was estimated by method according to AOAC method 945.18A. The lipid in the sample was extracted with petroleum ether (110°C) in soxhlet apparatus for three hours. Then the solvent was dried overnight and the remaining residue was weighed. The fat content was expressed as percentage [11] [13].

Ash. Total ash was determined using muffle furnace as described by AOAC method 978.04 [11] [13]. The crucible was heated on the hot plate till it gave no fumes and then ignited in a muffle furnace at 550° C till greyish white residue were obtained. The ash content was expressed in percentage.

Antioxidant properties

Total phenolic content (TPC). The total phenolic content of puree was determined by using Folin-Ciocalteu method with minor modification by Nallakurumban *et al.*, (2015) and few references by Miliauskas *et al.*, (2004) [14] [15]. 100 μ l of sample was mixed with 2ml sodium carbonate and left for 2 minutes at room temperature. Then, mixed with the same Folin-Ciocalteu reagent and left for 30 minutes. The absorbance reading was taken at 725nm. The phenolic content is expressed as mg of GAE/L.

Total flavonoid content (TFC). The content of flavonoids was determined by a Pharmacopeia method (1989) with few modifications which used rutin as a reference compound [16] [17]. One ml aliquot of extract puree was diluted with 4 ml deionized water in 10 ml volumetric flask. At zero time, 0.3 ml of 10% AlCl₃ was added. After 6 minutes, 2 ml of 1M NaOH was added to the mixture. Then, immediately 2.4 ml of deionized water was added to the reaction flask and mixed thoroughly and the absorption at 510 nm was read. The experiment was done in duplicate. The contents of flavonoid were calculated by comparing the absorbance value against the rutin standard.

Total antioxidant activity (FRAP). Total antioxidant activity was measure by ferric reducing antioxidant power (FRAP) assay with slight modification by Josipovic *et al.*, (2016) [18]. Reagents included 250 ml deionized distilled water, 4 ml C₂H₄O₂ glacial acetic acid and 0.78g sodium acetate were mixed in a volumetric flask as buffer; 0.31g in TPTZ ((2,4,6-tripyridyl-s-triazine) in 100 ml of HCl which 0.34 ml of 1M HCl diluted in 100 ml deionized distilled water; 0.54g FeCl₃ hexahydrate in 100 ml deionized distilled water. Working FRAP reagent was prepared by mixing 25ml acetate buffet, 2.5ml TPTZ solution and 2.5ml FeCl₃·6H₂O solution. 100 μ l of sample added with 300 μ l H₂O was put together with the FRAP reagent. Absorbance reading was taken after 4 minutes. The FRAP value is expressed as g of ferrous sulphate/ml [17].

Sensory Evaluation. The sensory acceptance was determined by method proposed by Hidalgo and Almajano (2017) [19]. 50 trained panelists were chosen for this sensory evaluation. All panelists were asked to evaluate upon its overall acceptance (flavour, appearance, colour, odour and texture). First, panellists were asked to evaluate the samples and choose the acceptability on a structured hedonic scale (9=most like, 5=

neither like nor dislike and 1= most dislike) [20] as shown in Table 1.

Table 1. 9-Point Hedonic Scale

9	Like Extremely
8	Like Very Much
7	Like Moderately
6	Like Slightly
5	Neither Like nor Dislike
4	Dislike Slightly
3	Dislike Moderately
2	Dislike Very Much
1	Dislike Extremely

3. Results and Discussion.

The results for physicochemical properties and antioxidant properties for both tamarillo and tomato purees were tabulated in Table 2 and Table 3 respectively. The tomato puree was made to compare between the overall sensory acceptance, antioxidant properties and physicochemical properties of tamarillo puree. The comparison was tabulated as indicated in Table 2.

Table 2. Physicochemical properties of tamarillo and tomato puree

Physicochemical properties	Tamarillo puree	Tomato puree
pH	4.12 \pm 0.11	4.48 \pm 0.08
TSS ($^{\circ}$ Brix)	9.30 \pm 0.20	3.30 \pm 0.10
Moisture (%)	89.24 \pm 0.004	95.76 \pm 0.006
Carbohydrate (% wt/wt)	7.584	3.064
Protein (% wt/wt)	1.0	0.09
Fat (% wt/wt)	0.2	0.3
Ash (% wt/wt)	1.976	0.786

Table 3. Antioxidant analysis of tamarillo and tomato puree

Antioxidant analysis	Tamarillo puree	Tomato puree
TPC (mg of GAE/L)	79.815 \pm 0.390	102.111 \pm 0.778
TFC (mg of RE/L)	18.111 \pm 2.577	9.389 \pm 0.394
FRAP (mg FSE/L)	1.344 \pm 0.016	1.768 \pm 0.0134

Physicochemical analysis is a method to investigate the physicochemical properties and it can also be used for the determination of

interaction between component of food which was related to the system's physical properties, composition, antioxidant properties and sensory acceptance [21].

The pH, moisture content and fat of tamarillo were lower than tomato puree. Puree was classified as acid food (pH < 4.6) [22]. Previous studies stated that the pH range of tamarillo and tomato puree were 3.09-4.75 and 4.26-4.82 respectively [23] [24] [25]. The result obtained from this study was within the range where tamarillo was 4.12 and tomato was 4.48. Moisture is important in influencing food quality, preservation and shelf-life factors [26]. Previous studies reported that the moisture content of tamarillo and tomato were 85.82% and 98.07% respectively [27] [28] [3] [29]. Both results showed similar values as previous researchers. Tomato puree has higher value of fat than tamarillo puree, 0.3 and 0.2% respectively. Previous studies claimed that the total fat content for tomato was 4.04g/100g, while for tamarillo varied from 0.2-0.5%, which mean, the values found in this study fit this range [28] [30].

Likewise, TSS, carbohydrate, protein and ash value for tamarillo were higher than tomato puree. TSS in fruit generally was used to determine the concentration of sugar. The TSS of tamarillo puree was 9.30 °Brix, higher than tomato puree which was 3.30°Brix. Since the value of TSS was referred to the total amount of soluble constituents of puree, mainly sugars with smaller amounts of organic acids, vitamins, proteins, free amino acids, essential oil and glucosides [31], it was claimed that tamarillo puree had higher total amount of soluble constituents. Carbohydrates in tamarillo puree were higher than tomato puree with 7.584 and 3.064% respectively. US Department of Agriculture, Agricultural Research Service stated that tomato was 4.2% wet weight basis for carbohydrate value [32] while tamarillo's 3.7-4.6% [33]. Hence the values claimed by previous studies showed similar value for both purees.

US Department of Agriculture, Agricultural Research Service (2009) stated that the range for protein content varied from 0.2 to 2.0 % wet weight basis while Lister *et al.*, (2005) stated for tamarillo in the range of 1.8-2.0 [33]. The value obtained varied from previous studies which showed tamarillo and tomato purees protein content of only 1.0 and 0.09% but tamarillo's value fit the range reported by US Department of Agriculture, Agricultural Research Service. Total ash content determination in foods provides a

measure of total amount of minerals since minerals are not destroyed by heating. The mineral content varies and depends on many factors, such as the variety of plant species, the terrain, the fertilization, and the climate. Moreover, it helps to estimate food quality, microbial stability and nutrition value. Lister *et al.*, (2005) stated the range for ash for tamarillo was 0.78-1.5 [33], while Bakkali *et al.*, (2009) claimed the ranged for fruit and vegetables to be between 0.2-1.0% [34]. The value of ash in this study fit the range by both group of researchers with tamarillo and tomato values of 1.976 and 0.786% of ash respectively.

The antioxidant of the purees was studied to compare both properties. As indicated in Table 3, the antioxidant analysis revealed that, TPC of tamarillo puree was 79.815±0.390mg of GAE/L which indicated lower value than tomato puree with 102.111±0.778mg of GAE/L. It contradicted to the study done previously as it claimed that tomato should have lower TPC than tamarillo [7]. The condition of harvesting, storing and treatment method were able to affect the antioxidant properties of the processed fruit [22]. TFC of tamarillo puree was higher than tomato puree, which showed values of 18.1111 and 9.3889 g of RE/ml respectively. The higher TFC value indicated higher amount of antioxidant activity in tamarillo puree. Antioxidant activity by FRAP test of tamarillo puree was lower (1.344±0.016g FSE/ml) than tomato puree (1.768±0.0134g FSE/ml). The higher of FRAP values might correlate with the tendency of polyphenols to become pro-oxidants activity. Thus, it can be concluded the highest value of FRAP means the lower the reducing power which serves as indicator of potential antioxidant activity [25] [35].

An ANOVA analysis by Microsoft Excel 10.0 for sensory evaluation on six attributes of the purees was applied. The value of "Prob>F for sensory attributes sweetness, sourness, overall flavour, texture, appearance and overall acceptance are 0.0150, 0.0351, 0.0001, 0.0004, 0.0003 and 0.0004 respectively which were less than 0.05. The judges can differentiate the puree since the results showed significance value (p<0.05) to all sensory attributes.

4. Conclusions

By comparing both purees, it can be concluded that tamarillo can be an alternative for tomato purees as they possess similar physicochemical,

antioxidant properties as well as the acceptance by consumers. From the results obtained in this study, it was shown that tamarillo puree has lower pH value, moisture content and fat content as compared to tomato puree. Meanwhile, TSS value, carbohydrate, protein and ash content of tamarillo puree were higher as compared to tomato puree. The TPC and FRAP values for tomato puree were higher than tamarillo puree, however, TFC of tamarillo puree possess higher value. For sensory evaluation, the panelists were able to differentiate the puree since the results showed significance value ($p < 0.05$) to all sensory attributes.

Acknowledgement

This study was financially supported by Research Management Centre (RMC) through the RACE grant (vote no. 1518) and RAGS grant vote no. R050 provided by the Universiti Tun Hussein Onn Malaysia (UTHM) in assistance with the government of Malaysia.

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