

Estimation of Phytochemicals and Antioxidant Property of Tamarillo (*Solanum betaceum*) and A Value Added Product Tamarillo Sauce

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Abstract-Wild fruits available in plenty with rich sources of various vitamins, minerals, fibers, polyphenols provide various health benefits that reduce the risk of several diseases like diabetes, cancer, coronary heart disease, neurodegenerative ailment, were not properly utilized by the people. The design of the study titled "Estimation of Antioxidant property of Tamarillo - (*Solanum betaceum*) and A Value Added Product Tamarillo Sauce" is made to assess the phytochemical and antioxidant properties of Tamarillo and effective utilization of the fruit through a value added product. This study showed that the antioxidant activity for both the tamarillo and the tamarillo sauce was reported as 208 and 211 mg AA eq /100g and the other proximate analysis showed that the fruit is also rich in nutritive property, which can provide all the nutrients need for the body. The development of value added product which is also rich in antioxidant and nutritive properties will be a good source to gain nutrient as well as antioxidant property, which could also generate an additional income to the farming community.

Keywords: Tamarillo, Phytochemicals and Antioxidant property, Tamarillo sauce, Nutritive analysis.

I. INTRODUCTION

Tamarillo (*Solanum betaceum*) which is also termed as tree tomato, a sub tropical fruit, which are native to South America, Chile, Ecuador, and Peru. In India, tree tomatoes grow in the hilly regions of West Bengal and Maharashtra, including Assam, Uttaranchal, Nagaland and Himachal Pradesh and in South India, it was grown in the Nilgiri hills because of the cool climatic condition in which the crop can sustain. They appear sporadically when in season between May through October. The fruit is a rich source of vitamins

and minerals Viz., Vitamins A, C and provitamin A and an excellent source of Calcium, Iron, Potassium, Phosphorus and Magnesium respectively.

II. DESIGN OF THE STUDY

The design of the study was collection of Tamarillo from the wild areas; assess the phytochemical and antioxidant properties of the fruit and development of value added product from the tamarillo. The study was carried out in different areas of Tamil Nadu such as Kodaikanal, Ooty, Sirumalai hills, Kutralam, Thadiyankudisai, and Oothu. The analysis of phytochemical and antioxidant properties and other chemical constituents such as moisture, protein, fat, ash, crude fibre, Total Soluble Solids (TSS), pH, Acidity, Ascorbic acid, etc were carried out in this study.

III. PREVIOUS WORK

Christian Mertz et al., (2009) reported that tamarillo has higher carotenoid content. According to Bobbio et al., (1983); Wrolstad and Heatherbell, (1974) Anthocyanins were detected in the tree tomato. Rodriguez Amaya et al., (1983), observed the presence of Carotenoids in tree tomato. Olson,(1996) revealed that, except for the well-known provitamin A activity of some carotenoids, they could be involved in protective effects against degenerative or cardiovascular diseases and are known for having antioxidant capacity. From the results of the study conducted by Hassan el al., (2013), it can be concluded that *C. betacea* has a significant amount of phenolics, flavonoids, anthocyanin, and carotenoid which contribute to the antioxidant activity of the fruit extracts. The acceptable amount of phytochemicals in the fruits showed that *C. betacea* is one of the richest sources

of antioxidant phytonutrients and has anti-cholinesterase properties that can enhance human health.

IV. METHODOLOGY

Collection of wild fruits

Tamarillo fruit (*Solanum betaceum*) was collected from Kodaikanal, Ooty, Sirumalai hills, Thadiyankudisai, and Oothu.

Chemicals

The chemicals and reagents used for the study were Analytical Reagent, Laboratory Reagent and also Guaranteed Reagent (GR) grade. Chemicals used for the analysis were obtained from Madurai chemical laboratory. All the chemicals used were of analytical grade.

Assessment of Chemical constituents

The chemical constituents such as Phytochemical, antioxidant, moisture, protein, fat, ash, crude fibre, calcium, phosphorus, pH and TSS etc., were assessed using standard methods.

Proximate analysis

The fruit was sliced into small portions, and arranged on an aluminum foil, and then the samples were placed inside the oven at 63°C for 48 hours. After 48 hours, dried samples were blended into a powder form using a blender (Multipro, Kenwood, Japan). The powder was used for ash, fat, protein and fiber analysis. The moisture content was measured using an oven method according to Association of Official Analytical Chemists (AOAC International) standard. The Kjeldahl method was used for protein determination and the Soxhlet method was used for the fat content. The determination of fiber was based on the method by Lees (1968). For ash content, the sample were weighed and transferred to a muffle furnace at 550°C until a white or light grey ash is obtained. Three replications of all of these measurements were carried out.

Estimation of moisture

The moisture content of the sample was estimated by hot air oven method as per the procedure given by AOAC (1995). The sample was dried at 110° and the drying was continued till a constant reading was obtained. The moisture content was expressed as percentage.

Estimation of Protein

Protein was analyzed by the amount of nitrogen available in the sample by Micro Kjeldhal, Method Hart and Fisher (1971). Hundred gram of sample was transferred into 250ml of digestion flash along with three grams of catalyst mixer and 10 ml of concentrated sulphuric acid. The catalyst mixer consists of sodium or potassium sulphate and copper sulphate (5:1 ratio). The sample was digested until the solution become colourless. The digested sample was placed in the distillation unit for ammonia recovery. The solution was distilled and the ammonia was collected in the receiver solution. The solution was titrated against the 0.1N hydrochloric acid for the end point, until the colour changes. The same procedure was repeated to get the blank titre value and the nitrogen content of the sample can be calculated. The nitrogen value multiplied by factor 6.25 gives the crude protein content of the sample in per cent.

Estimation of Fat

The fat content of the sample was estimated by the method described by Hart and Fisher (1971). The lipid in the sample was extracted with petroleum ether (60-80°) in soxhlet apparatus for two hours. Then the solvent was evaporated and the remaining residue was weighed. The fat content was expressed as percentage.

Estimation of crude fibre

The crude fibre content was determined by the method described by Sadasivam and Manickam (1996). The dried sample was taken in a beaker and 200 ml of 1.25 percent H₂SO₄ was added and boiled for 30 minutes. The contents were filtered through muslin cloth and washed with distilled water until washings are no longer acidic. The residue was transferred into the same beaker and boiled with 1.25 per cent NaOH for 30 minutes and filtered through a muslin cloth, washed with 50 ml of distilled water and 25 ml of alcohol. The residue was transferred into a preweighed silica crucible, dried for 2-4 hours at 130°C and cooled and weighed. The residue was ignited and ashed for 30 minutes at 600° C and cooled and weighed. The loss in weight due to the fibre content was expressed in percentage.

Estimation of ash content

The ash of the sample was determined by the method described by Hart and Fisher (1971). A sample of five gram was ashed in an electronic muffle furnace at 500° to 600°C. The ash content was expressed as percentage.

Estimation of Acidity

Acidity of the sample was estimated by the following procedure. About 5 gram of the sample was weighed and discolored in a known quantity of water and made up to 50

ml and filtered. From the filtrate an aliquot of sample was taken and titrated against 0.01 N NaOH, using phenolphthalein as indicator till the appearance of pale pink colour. The titration was repeated to obtain concordant values. The result was expressed as percentage.

Total soluble solid (TSS)

The total soluble solid (TSS) of fruit juice (oBrix) was determined by AOAC (1995), using a Digital refractometer (AR 2008, Kruss, Germany) at 25°C. All experiments were conducted at room temperature.

Estimation of pH

The pH of the sample was estimated by the method of described by Hart and Fisher (1971). Ten grams of the 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.

Estimation of Ascorbic acid

Pipette out 5 ml of the working standard solution into a 100ml conical flask. Add 10ml of 4% oxalic acid and titrate against the dye (V1M1). End point is the appearance of pink colour which persists for a few minutes. The amount of dye consumed is equivalent to the amount of ascorbic acid. Extract the sample (0.50 – 5g depending on the sample) in 4% oxalic acid and make up to known volume (100ml) and centrifuge. Pipette out 5 ml of this supernatant and 10 ml of 4% oxalic acid and titrate against the dye (V2M1).

Estimation of total phenols

The amount of total phenols in the plant tissues was estimated by the method proposed by Mallick and Singh (1980). The sample (0.5g) was homogenized in 10% volume of 80% ethanol. The homogenate was centrifuged at 10000 rpm for 20 minutes. The extraction was repeated with 80% ethanol. The supernatant were pooled and evaporated to dryness. The residue was dissolved in a known volume of distilled water. Different aliquot were pipette out and the volume in each tube was made upto 3.0ml with distilled water. Folin – reagent (0.5 ml) was added and the tubes were placed in a boiling water bath for exactly one minute. The tubes were cooled and the absorbance was read at 650 nm in a spectrophotometer against a reagent blank. Standard catechol solution 0.2 – 1ml) corresponding to 2.0 to 10µg concentrations were also treated as above. The concentration of phenols is expressed as mg/g of sample.

Estimation of flavonoids

The method proposed by Cameron et al.(1943) was used to extract and estimate flavonoids.

Extraction of flavonoids

The samples (0.5g) were first extracted with methanol: water mixture (2:1) and secondly with the same mixture in the ratio 1:1. The extracts were shaken well and they were allowed to stand overnight. The supernatants were pooled and the volume was measured. This supernatant was concentrated and then used for the assay. A known volume of the extract was pipette out and evaporated to dryness. Vanillian reagent (4.0ml) was added and the tubes were heated in a boiling water bath for 15 minutes. Varying concentrations of the standard were also treated in the same manner. Optimal density was read in a spectrophotometer at 340nm. A standard curve was constructed and the concentration of flavonoids in each sample was calculated. The values of flavonoids were expressed as mg/g sample.

Estimation of total carotenoids and lycopene

Total carotenoids and lycopene can be extracted in the sample using petroleum ether and estimated at 450nm and 503nm respectively. The sample (0.5g) was homogenized and saponified with 2.05ml of 12% alcoholic potassium hydroxide in a water bath at 60°C for 30 minutes. The saponified oxlate was transferred to separating funnel containing 10-15ml of petroleum ether and mixed well. The lower aqueous layer was transferred to another separating funnel and the upper petroleum ether layer containing the carotenoids was collected. The extraction was repeated until the aqueous layer become colourless. A small amount of anhydrous sulphate was added to the petroleum extract to remove excess moisture. The final volume of the petroleum ether extract was noted. The absorbance of the yellow colour was read in a spectrophotometer at 450 nm and 503 m using petroleum ether as blank.

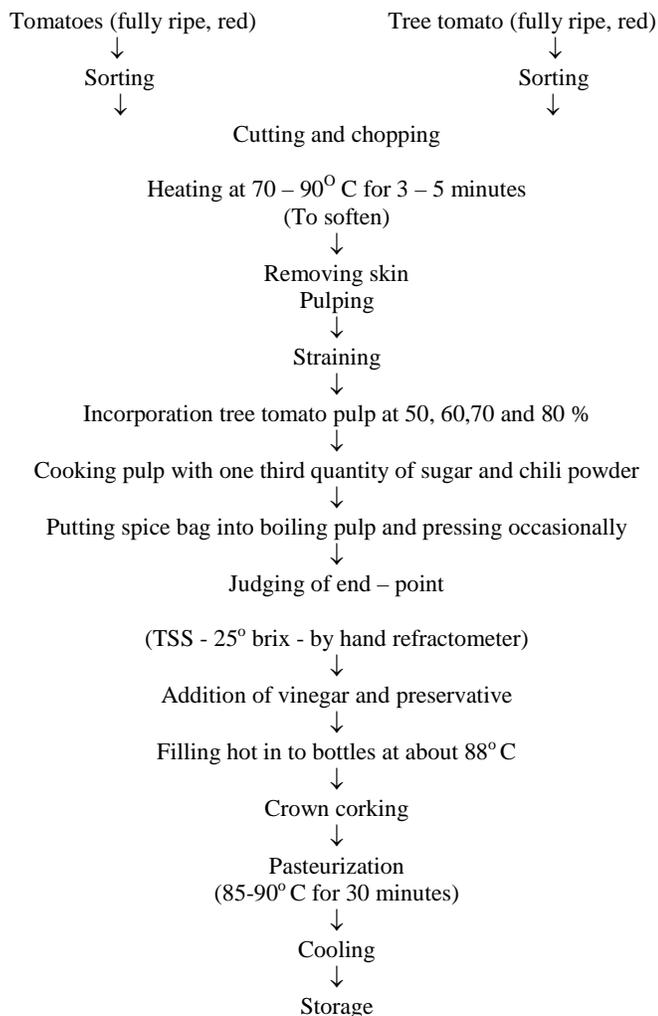
Total antioxidant activity

Total antioxidant activity is measured by ferric reducing antioxidant power (FRAP) Assay of Benzie and strain (1996). FRAP assay user antioxidants as reductants in a redox – linked colorimetric method employing an easily reduced oxidant system present stoichiometric excess. Sample (100ml) is mixed with 3 ml of working FRAP reagent and absorbance (593nm) is measured at 0 minute after vortexing. Thereafter samples are placed at 37°C in water bath and absorption is again measured after 4 minutes. Ascorbic acid standards (100µm - 1000 µm) were presented in the same way.

Development of value added product – Tamarillo Sauce

Tamarillo sauce was developed with different levels of incorporation viz., 60%, 70% and 80%. The product was subjected to the sensory evaluation by the untrained judges, which was scored according to the hedonic scale 9-1.

Processing flow chart – Tamarillo Sauce



V. RESULTS

The Tamarillo fruit and sauce were subjected to various chemical analysis and the results were given in the table 1. The value added product tamarillo sauce was standardized with 70% incorporation of tamarillo pulp. Then the value added product was again subjected to various analysis. The results for the analysis were given in the table 1. Both the fresh and the value added product was subjected to Phytochemical and antioxidant analysis and the results were expressed in the table 2.

TABLE 1. PROXIMATE COMPOSITION ANALYSIS OF TAMARILLO

S.No.	Particulars	Fresh fruit	Sauce (70%)
1.	Moisture (g%)	83.56	50.41
2.	Protein (g%)	0.52	1.45
3.	Calcium (mg)	9.51	8.67
4.	Fat (g%)	0.81	0.12
5.	Ash (g%)	1.64	1.72
6.	Crude fiber (g%)	0.39	0.29
7.	Acidity (g%)	0.81	0.58
8.	TSS(g %)	4.8	25.4
9.	pH	6.61	3.92

TABLE 2. PHYTOCHEMICAL AND ANTIOXIDANT ANALYSIS OF TAMARILLO

S.No.	Particulars	Fresh fruit	Sauce (70%)
1.	Ascorbic acid (mg/100g)	33.6	21.00
2.	Total phenols (mg GAE/100g)	190.0	185.12
3.	Total flavonoids (µg/g)	81.22	76.79
4.	Antioxidant activity (mg AA eq /100g)	208	211
5.	Beta carotene (µg/g)	1.72	1.46

From the analysis the results obtained were the Moisture (g %), Protein (g %), Calcium (mg), Fat (g%), Ash (g%), Crude fiber (g%), Acidity (g %), TSS (g %), and pH (g %) present in fresh fruit was observed as 83.56, 0.52, 9.51, 0.81, 1.64, 0.39, 0.81, 4.8 and 6.61 respectively. Tamarillo sauce was developed with different levels of incorporation viz., 60%, 70% and 80%. The product was subjected to the sensory evaluation by the untrained judges, which was scored according to the hedonic scale 9-1. Among that 70% of tamarillo pulp incorporation was highly accepted. The nutritive value of tamarillo sauce acquired by chemical analysis revealed that the Moisture (g %), Protein (g %), Calcium (mg), Fat (g %), Ash (g %), Crude fiber (g %) content, Acidity (g %), TSS (g %), and pH (g %) was 50.41, 1.45, 8.67, 0.12, 1.72, 0.29, 0.58, 25.4 and 3.92 respectively. As mentioned in the table 2, the results of the Phytochemicals

and antioxidant analysis revealed that, the ascorbic acid content was 33.6 mg/100g for fresh fruit and 21.00 mg/100g for sauce respectively. The total phenolic contents were obtained as 190.0 and 185.12 mg GAE/100g for both the Fruit and the value added product. The results obtained for total phenolic content in the present study were similar to the study by Mertz et al. and the total flavonoids were measured as 81.22 and 76.79 µg/g for the both the products. The beta carotene content was observed as 1.72 and 1.46 µg/g respectively for both the products which is correlated with the study made by Mertz *et al.* in which it was confirmed that the major carotenoids content in tree tomato was beta carotene. The antioxidant activity for fresh fruit was observed as 208 AA eq /100g for fruit and 211 for value added product which is similar to a study by Azrina *et al.* In this the antioxidant activity was higher for sauce when compared to the fresh fruit this is because of the addition of spices to the sauce. The statistical analysis shows that there was a higher significant difference for both the product and the fresh fruit.

VI. CONCLUSION

From the results of this study, it can be concluded that (*Solanum betaceum*) has a significant amount of phenolics, flavonoids, and carotenoids which contribute to the antioxidant activity of the fruit. And the addition of spices to the sauce contributes the higher antioxidant activity when compared to the fresh fruit. The acceptable amount of phytochemicals in the fruits showed that tamarillo (*Solanum betaceum*) is one of the richest sources of antioxidant properties as well as Vitamins and minerals that can enhance human health.

VII. FUTURE SCOPES

Effective and Proper utilization of this fruit as a value added product can be a source of food material for an ever increasing population and it will also generate an additional income to the farming community.

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