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Identification of the Phytochemicals in *Passiflora edulis* f. *edulis* and *Passiflora edulis* f. *flavicarpa*

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Abstract

Phytochemicals are found abundantly in plants which are non-nutritive and bio active compounds that prevents the onset of degenerative diseases and protects the body by maintaining the health. The chemical constituents of food have the ability to protect and prevent the humans from degenerative diseases. The objective of this study is to identify the chemical components of two varieties of passion fruits *Passiflora edulis* f. *edulis* with *Passiflora edulis* f. *flavicarpa* available wildly in the Thandikudi hills, Tamil Nadu, India and compare the sensory attributes between the two varieties of the prepared squashes. High tech instrument the JASCO FTIR spectrophotometer (FTIR-4600) was used to identify the chemical constituents in the fruits. The results showed the presence alkane, primary alcohol, aldehyde and aromatic compounds in the fruit pulp. The inferential statistical analysis of the sensory evaluation revealed that the panel members categorized the *Passiflora edulis* f. *edulis* squash to be more acceptable when compared to the *Passiflora edulis* f. *flavicarpa* squash in the 9 - point hedonic scale. Further this study can be extended on comparing the other varieties of passion fruits and make them a commercial product for marketing.

Keywords

Phytochemicals, Passion fruit, Organoleptic evaluation

Introduction

Fruits are consumed as such or processed in human diet which are known for the sources of phytochemicals. About 20,000 of them have been identified as originating from fruits, vegetables and grains (Patra, 2012). Various fruits have been used as traditional or folk medicine in the early civilization period (Scartezzini and Speroni 2007).

Sugars, acids and polysaccharides are the important source of phytochemicals which has medicinal properties (Escobedo-Avellaneda et al. 2014). Phytochemicals or bioactive compounds has several health effects as antioxidants, antibacterial, antifungal, antiviral,

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cholesterol-lowering, antithrombotic, or anti-inflammatory effects (Schreiner and Huyskens-Keil, 2006).
Apart from the fruit, bark, leaves, seed, stem, root, twig, and sap have been used as ingredients for folk medicines to treat several diseases like cough, fever, asthma, diarrhoea, indigestion, and skin diseases (Muthu et al. 2006).

Passion fruits are less striking than the commercially available other fruits. This makes them not cultivated in a large-scale plantation or as cash crops. On the other hand, indigenous tropical fruits that are possible for commercialisation have lesser fame, and they are available only in the part of tropical regions. Passion fruits have high nutritive values but their medicinal benefits remain unknown (Khoo et al. 2010). The dietary phytochemicals can be classified as phenolics, alkaloids, nitrogen-containing compounds, organosulfur compounds, phytosterols, and carotenoids (Liu, 2004).

The 2010 review of the Dietary Guidelines for Americans endorse that most people, based on a 2000-kcal diet, should eat at least 8-9 servings of fruits and vegetables a day, at least 4 servings of fruits and 5 servings of vegetables. (USDA, 2010). The gap between the reference and consumption is massive. The achievement of at least 9 servings of fruits and vegetables per day, should be done by creating awareness about the health benefits of fruits and vegetables in a balanced diet (Liu, 2004).

Few clinical trials explored the effects of fruit and vegetable intake on CVD have been conducted in humans, including known CVD contributing factors as a randomized, controlled trial conducted by Watzl et al. (2005). The vegetable and fruit intake and pancreatic cancer in a population-based case-control study in the San Francisco Bay area, fruit and vegetable consumption found to be associated with the reduced risk of pancreatic cancer (Chan et al. 2005).

Various studies have recommended that a high intake of polyphenol-rich foods may have cardiovascular benefits and provides some cancer chemo preventive activities, urinary bladder dysfunctions and Alzheimer's disease (De Pascual-Teresa, 2010).

Phenolics in the form of flavonoids have an important effect such as antiallergic, anticancer, anticonvulsant antidiabetic, antihypertensive, anti-inflammatory, antimicrobial, antioxidant, antiplasmodial, antiviral, antiulcer, and reduce risks for severe human diseases (De Conti Lourenço, 2013).

Materials and Methods

The purple and yellow passion fruits were harvested in the Thandikudi hills,Western ghats (Lower Pulney Hills), Tamil Nadu, India. The collected fruit samples were taken to the central instrumentation laboratory (ACCIC) for the functional component analysis using Fourier transform infrared spectroscopy (FTIR).

Figure 1 Purple passion fruit

Figure 2 Yellow passion fruit

Sample analysis procedure in FTIR

Where the samples are in a liquid or solid form the intensity of the spectral features is determined by the thickness of the sample and typically this sample thickness cannot be more than a few tens of microns. The technique of Attenuated Total Reflectance (ATR) has transformed solid and liquid sample analyses because it combats the most challenging facets of infrared analyses, namely sample preparation and spectral reproducibility (James et al. 2003).

Figure 2 JASCO FTIR Spectrophotometer (FTIR- 4600).

Steps to interpret FTIR

Identification of number of absorption bands in the full IR spectrum. If the sample has a simple spectrum less than 5 absorption bands, the compounds analysed are simple organic compounds, small mass molecular weight, or inorganic compounds.

Identifying single bond area (2500-4000 cm^{-1}). There are numerous peaks in this area: A broad absorption band in the range of between 3650 and 3250 cm^{-1}, indicating hydrogen bond. This band confirms the presence of hydrate (H2O), hydroxyl (-OH), ammonium, or amino.

Identifying the triple bond region (2000-2500 cm^{-1}) that is if there is a peak at 2200 cm^{-1}, it should be absorption band of C≡C. Identifying the double bond region (1500-2000 cm^{-1}) Double bound can be as carbonyl (C = C), amino (C = N), and azo (N = N) groups. 1850 - 1650 $cm^{-1}$for carbonyl compounds. Above 1775 cm^{-1}, conforming active carbonyl groups such as anhydrides, halide acids, or halogenated carbonyl, or ring-carbonyl carbons, such as lactone, or organics carbonate.

Identifying the fingerprint region (600-1500 cm^{-1}) This area is characteristically specific and unique, but several identifications can be found between 1000 and 880 cm^{-1} for multiple band absorption, there are absorption bands at 1650, 3010, and 3040 cm^{-1} (Nandiyanto et al., 2019).

Squash preparation

Fruit beverages are prepared from fruit juices or pulp scooped and preserved by chemical preservatives or by heat application. Squash is a ready to drink product, which is prepared by mixing of measured quantity of fruit juice or pulp, with sugar, acid and other ingredients. As per FSSAI specifications, squash should contain minimum 25 per cent fruit content in the finished product and the total soluble solids content should not be less than 40^{o} Brix. The acidity of the squash should not be more than 3.5 per cent as anhydrous citric acid. Purple passion fruits are used for making squash preparation.

The washed fruits need to be cut into halves, followed by scooping up of pulp and seed. Place the mixture of pulp and seed in a pan and heat over a low heat. This is to soften the pulp and allow the seeds to be separated. Seeds are separated by filtration process which is then followed by addition of sugar. Boil the mixture for 10 minutes till the sugar dissolves completely with continuous stirring. The maximum permissible limit of preservative in squash is 350 ppm of sulphur dioxide or 600 ppm of benzoic acid. Sodium benzoate is used as a preservative. Squash contains 40 to 50 percent sugar and about 1.0 percent acid. They have to be diluted in the ratio of 1:4 before consumption.

FSSAI specifications for squash are: (i) minimum per cent of total soluble solids (TSS) is 40 and (ii) minimum per cent of fruit juice is 25. The following permissible limit of the preservative as sulphur dioxide 350 ppm or as benzoic acid 600 ppm.

Table 1. Standardised ingredients for squash making

Ingredients	**Quantity**
Pulp	600ml
Sugar	900g
Water	900ml
Citric Acid	8g
Sodium benzoate	2g

The prepared squashes were analysed for the sensory attributes using 9-Point hedonic scale. The yellow fruit squash and purple fruit squash were compared with the sensory attributes of the lemon squash evaluated by Emelike and Akusu (2019).

Results and Discussion

The following tables and graphs are the results of the yellow and purple fruit pulp analysed in FTIR spectroscopy.

Table 2. Functional Components in Yellow Passion fruit pulp

S.NO	ABSORPTION(Cm-1)	GROUP	COMPOUND
1	3303.46	C-H Stretching	Alkyne
2	2949.59	C-H Stretching	Alkane

3	1738.51	C=O Stretching	Aldehyde
4	1641.13	C=N Stretching	Imine/Oxime
5	1368.25	C-H Bending	Alkane
6	1215.9	C-O Stretching	Vinyl ether
7	1108.87	C-O Stretching	Primary alcohol

The peak values of the yellow passion fruit pulp reveal the presence of Alkyne 3303.46 cm^{-1}, alkane 2949.59 cm^{-1}, aldehyde 1738.51 cm^{-1}, vinyl ether 1215.9 cm^{-1} and primary alcohol 1108.87 cm^{-1}.

Table 3. Functional Components in Purple Passion fruit pulp

S.NO	ABSORPTION(Cm-1)	GROUP	COMPOUND
1	3312.53	C-H Stretching	Alkyne
2	2926.45	C-H Stretching	Alkane
3	1278.25	C-N Stretching	Aromatic amine
4	1983.52	C-H Bending	Aromatic compound
5	1385.67	C-H Bending	Alkane
6	1014.37	C- F Stretching	Fluoro compound
7	1112.5	C-O Stretching	Primary alcohol

The table exhibits the presence of functional compounds in the purple passion fruit pulp and the absorption confirms the alkyne 3312.53 cm^{-1}, alkane 2926.45 cm^{-1}, aromatic amine 1278.25 cm^{-1}, aromatic compound 1983.52 cm^{-1}, 1112.5 cm^{-1} primary alcohol and fluoro compound 1014.37 cm^{-1}.

Table 4. Comparison of sensory attributes between yellow passion fruit squash and lemon squash

Quality Parameters	Yellow Passion fruit Squash (Present study) Mean (X bar)	Yellow Passion fruit Squash (Present study) standard deviation (s)	Lemon squash (Emelike and Akusu, 2019) Mean (μ)	Lemon squash (Emelike and Akusu, 2019) standard deviation (σ)	Sample size (n)	2 tailed t test	Risk Alpha t (0.05), 24	P(t)
Colour and Appearance	7.2	0.4	7.5	0.2	25	3.54	-1.71	0.00
Flavour	7.5	0.3	8.0	0.2	25	1.10	-1.71	0.21
consistency	8.2	0.2	8.3	0.1	25	-2.18	-1.71	0.04
Taste	7.5	0.4	7.8	0.2	25	3.87	-1.71	0.00
Overall acceptability	7.1	0.3	8.1	0.2	25	2.04	-1.71	0.05

Decision: Reject null hypothesis - Yes statistically different

The colour is more impressive than the reference value. The flavour is lesser than the reference value. The consistency is better with the reference value. The taste is lesser than the reference value. The overall acceptability is lesser when compared with the lemon squash. Thus, yellow passion fruit squash has better aroma and appearance which makes it less acceptable compared to the citrus lemon squash.

Table 5. Comparison of sensory attributes between purple passion fruit squash and lemon squash

Quality Parameters	Purple Passion fruit Squash (Present study) Mean (X bar)	Purple Passion fruit Squash (Present study) standard deviation (s)	Lemon squash (Emelike and Akusu, 2019) Mean (μ)	Lemon squash (Emelike and Akusu, 2019) standard deviation (σ)	Sample size (n)	2 tailed t test	RISK ALPHA t(0.05), 24	P(t)
Colour and Appearance	8.6	0.5	7.5	0.2	25	5.50	-1.71	1.48E-05
Flavour	8.8	0.4	8.0	0.2	25	5.04	-1.71	4.77E-05
Consistency	8.1	0.4	8.3	0.1	25	3.65	-1.71	1.57E-03
Taste	8.0	0.5	7.8	0.2	25	5.10	-1.71	4.12E-05
Overall acceptability	8.3	0.5	8.1	0.2	25	4.68	-1.71	1.19E-04

Decision: Reject null hypothesis - Yes statistically different

The colour is more impressive than the reference value. The flavour is better than the reference value. The consistency is lesser with the reference value. The taste is much better than the reference value. The overall acceptability is higher when compared with the lemon squash. Thus, purple passion fruit squash has better aroma and appearance which makes it more acceptable compared to the citrus lemon squash.

Conclusions

This study confirms the presence of functional properties present in the samples and proves the medicinal property of passion fruits. Thus, they can be utilized for various pharmaceutical and nutraceutical purposes. Regular consumption of these fruits will definitely provide health benefits and act as functional foods. Though everyone knows the importance of fruits in the diet many skip them because of lack of time in peeling and cutting, also because it is seasonal one may not consume regularly. To make this ready to eat and convenient to take away to the work place the best way is to prepare a squash out of the passion fruits. The purple passion fruit squash has a better colour, flavour, taste and overall acceptability compared to the yellow passion fruit squash. More products like jam, jelly and cakes can be formulated in the future. The researcher also wishes to proceed further with advanced spectroscopic techniques which are needed to elucidate the structure and quantification of the bio active compounds. This may

make the research futuristically to identify the functional components in the peel and rind portion of the fruits which can be recommended for preventive and curative drugs.

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