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Preparation and assessment of physico-chemical and sensory qualities of pumpkin tomato vegetable squash

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Abstract

In the present world, a trend towards development and consumption of fruits and vegetables based beverages has gained attention among people to ensure their healthy life. Focusing this concept as objective, a study was conducted to develop composite vegetable squash by incorporating fundamental properties (nutritional and organoleptic properties) and functional properties (medicinal properties) of two major vegetables cultivated in Sri Lanka; tomato and pumpkin. Taking into account the decisions of several preliminary studies, five formulations with different combinations of tomato and pumpkin were prepared and analyzed for physico-chemical parameters inclusive of TSS, pH, titrable acidity, ascorbic acid content, total sugar, reducing and non-reducing sugar content and organoleptic parameters such as colour, aroma, taste, nature, and overall acceptability. Repercussions of chemical analysis declared that with the decrease in concentration of pumpkin in composite veggi squash formulations mean values for pH (6.3-4.8), total sugar (31.3–25.8), reducing sugar (7.8 –6.2) and non-reducing sugar (23.4–19.6) significantly decreased while mean values for titrable acidity (0.1-0.4) and ascorbic acid (270.2-310.4) increased at 5% significant level. In addition, scores for sensorial attributes were significantly different among composite veggi squash formulations, in which formulation T4 prepared with 50% pumpkin and 50% tomato scored high for all the sensorial attributes in sensory evaluation. With the findings derived from experimental analysis of freshly made composite pumpkin tomato vegetable squash, formulation T4 was considered as superior squash formulation in terms of physico-chemical and sensorial properties squash formulation for further storage and nutritional improvement studies.

Keywords: Composite veggi squash, physico-chemical, pumpkin, and sensorial attributes, tomato.

Introduction

Consumption of vegetables either raw or processed provide several health as well as nutritional benefits such as stimulation of immunity[1-5], prevention of chronic diseases[6], bioavailability of essential minerals; Na, k, Mg, Ca, Se[7] reduction of incidence of cancer[8] and strengthening of nervous system. The more common vegetables namely Tomato (*Lycopersicon esculentum*) and Pumpkin (*Cucurbita maxima*) widely cultivated in larger respective extents of 6729 ha and 7066 ha have great importance in human because of their nutritional and phytochemical compositions. Tomato is rich in minerals; iron and phosphorus, vitamins; vitamin B and C, amino acids, sugars and dietary fibers although a ripe tomato contains as much as 93 to 94 percent water[9]. In Sri Lanka 42,470t and 12,063t tomato and pumpkin respectively are produced annually[10].

However, continual consumption of these vegetables become problematic with the fluctuation in prices. Excess and scarce production resulting from seasonal variation leads to lower and higher prices respectively for the produce. As the demand increases price of the vegetable increases and procurement of theses vegetable by an average human is somewhat difficult. Also, surplus production of vegetables subjected to post harvest losses. Post-harvest loss of vegetables ranges from 16%-40% of total production after harvesting[11]. Development of value added products could be a suitable solution in order to reduce the post-harvest loss of vegetables and to assure the continuous consumption of vegetables regardless price and demand. Beverages prepared from juices of fruits and vegetables are kind of value added products. Nowadays considering modern life style people have higher tendency towards instant fruits and vegetable based juices. Squashes are one of the beverage among the types of beverage such as nectar, RTS, cordial and functional drink. So that, the present study was undertaken to formulate a composite vegetable squash by incorporating pumpkin and tomato pulps which have more functional properties towards healthy lifestyle.

Materials and methods

The study was undertaken at Food Science Laboratory, Food Research Unit, Gannoruwa for a period of three months from December to February 2016.

Procurement of materials: Sound, fresh, good quality, pest and disease-free vegetables; tomato and pumpkin which attained their maturity indices were procured from Cargills food city in Kandy, Sri Lanka. 200ml glass bottles were collected from Gannoruwa food research unit.

Preparation of squash: Firstly, tomato and pumpkin pieces were steamed and blended using colloid mill to make pulps. Sugar at half amount of pulp was mixed with water (1:1; sugar: water) and heated well to dissolve. Then tomato and pumpkin pulps at different concentrations selected from several preliminary studies were added into the sugar syrup. pH was balanced at 3.8 using citric acid and at a rate of 0.1g/l preservative potassium meta bisulfite was added. Then it was pasteurized at 70°C for 20minutes. Prepared squash formulations were filled into sterilized 200ml glass bottles and sealed leaving 1" head space. Finally squash bottles were sterilized at 80°C for 30minutes in hot water bath and 30 minutes later allowed for cooling.

Sensory evaluation: On day of preparation a sensory evaluation was conducted to evaluate organoleptic attributes such as colour, aroma, taste, nature and overall acceptability by a panel of 20semi trained and trained panelists. 5-point hedonic scale in which 1 indicates extremely dislike and 5 denotes like extremely was used to evaluate organoleptic parameters. Sensory evaluation was conducted between 9.00a.m. to 12.00pm. Each panelist was asked to evaluate every samples arranged randomly.

Physico-chemical analysis: Freshly made squash formulations were analyzed for the chemical quality parameters such as total soluble solids (TSS), titrable acidity, pH, ascorbic acid, total sugar, reducing sugar and non-reducing sugar following the standard AOAC methods[12].

Statistical Analysis: Results of the sensory evaluation and chemical analysis were analyzed statistically by ANOVA using computer aided SAS statistical analysis package to evaluate the significance at P<0.05. Standard errors were calculated using MINITAB 14 statistical package. Comparison of means of sensory evaluation and chemical analysis were done by Tukey's Standardized Range Test (TSRT) and Duncan Multiple Range Test (DMRT) respectively.

Results and discussion

Sensory evaluation: Statistical data regarding sensory evaluation of freshly made composite vegetable squash of Tomato and Pumpkin on day of preparation is shown in Table-1. It reveals that there were significant differences found among the formulations for all the sensorial attributes of colour, aroma, taste, nature and overall acceptability. The composite squash formulation T3 was ranked at least score (1.9) for colour followed by T1 and unattractive colour leads to less demand. The least score for aroma was obtained by formulation T3 which is not significant to T1. Least score of 2.62 was recorded for taste in formulation T3 which showed significant difference only from formulation T4.

Diluted forms of composite squash had good drinking quality and the formulation T3 had lowest value for nature. Even though, the formulation T3 showed lowest scores for most of the sensory parameters overall acceptability of that particular formulation was comparably high compare to others and least score for overall acceptability was observed in T1 followed by T2 in which only pumpkin and tomato juices were used respectively. When the juices were mixed for the preparation of composite vegetable squash overall acceptability was found to be more than the formulations used single juice. Furthermore, the highest scores for all the sensory parameters; colour, taste, aroma, nature and overall acceptability were obtained by formulation T4 prepared with 50% pumpkin juice and 50% tomato juice.

T1- 100 % pumpkin, T2- 100% tomato, T3- 25% tomato + 75% pumpkin, T4- 50% tomato + 50% pumpkin, T5- 75% tomato +25% pumpkin.

Table-1: Sensory Evaluation Scores of Composite Squash Formulations.

Formulations	Color	Aroma	Taste	Nature	Overall acceptability
T1	2.7692 ± 0.303^{c}	2.9231 ± 0.329^{c}	3.0769 ± 0.265^{ab}	2.3077 ± 0.175^{c}	3.1538 ± 0.274^{c}
T2	3.3077 ± 0.208^{bc}	3.9231 ± 0.239^{b}	3.3077 ± 0.237^{ab}	3.6923 ± 0.365^{b}	3.4615 ± 0.268^{bc}
T3	1.6923 ± 0.308^{d}	2.6154 ± 0.213^{c}	2.6154 ± 0.266^{b}	2.1538 ± 0.154^{c}	3.6154 ± 0.213^{bc}
T4	4.6154 ± 0.18^{a}	4.6923 ± 0.133^{a}	3.9231 ± 0.239^{a}	4.4615 ± 0.215^{a}	4.4615 ± 0.243^{a}
T5	4.0 ± 0.277^{ab}	3.8462 ± 0.274^{b}	3.3077 ± 0.365^{ab}	3.6923 ± 0.208^{b}	4.077 ± 0.211^{ab}

Values are means of 20 replicates ± standard error. Values followed by different superscripts are significantly different at p<0.05.

Physico-chemical analysis: Total soluble solids: Results pertaining to TSS of freshly made veggi squash formulations is presented in the Table-2. The TSS is the sum of sugar (sucrose and hexoses), acids (citrate and malate) and other minor components (ascorbic acid, amino acid and mineral). According to Table-2, formulations had non-significant TSS values. Low TSS content with respect to low pumpkin pulp concentration complemented with higher tomato pulp concentration resulted in minor change in TSS among veggi squash formulations and it was found to be non-significant. However, T3 formulation had highest value and T4 formulation had lowest value. When squash was diluted with three parts of water, brix value was changed and significant. Non-significant TSS was reported in palmyrah RTS also[13].

Table-2: TSS of Composite Squash Formulations.

Formulations	Brix in squash	Brix in drink
T1	31.00 ± 0.50^{a}	5.35 ± 0.15^{a}
T2	29.25 ± 0.25^{a}	4.20 ± 0.25^{b}
T3	33.25 ± 1.25^{a}	5.05 ± 0.05^{a}
T4	28.25 ± 0.25^{a}	5.35 ± 0.15^{a}
T5	31.60 ± 3.40^{a}	4.20 ± 0.25^{b}

The values are means of 3 replicates ± standard error. Scores of the different superscripts in the same column are significant different at $p<0.05$.

pH: Data with respect to pH of freshly made pumpkin-tomato veggi squash is given in Table-3. It explains that pH of veggi squash reduced significantly ($p<0.05$) with an increase in the concentration of tomato juice. It is might be due to higher acidity of tomato juice attributed by citric acid as well as ascorbic acid as titrable acidity and pH are inversely proportional to each other. Highest score for pH was recorded in T1 in which pumpkin juice only used for veggi squash preparation. Similar results for decrease in pH was found in palmyrah RTS[13].

Table-3: pH of Composite Squash Formulations.

Formulations	pH
T1	6.30 ± 0.01^{a}
T2	4.55 ± 0.04^{d}
T3	5.36 ± 0.20^{b}
T4	5.03 ± 0.19^{bc}
T5	4.86 ± 0.01^{cd}

Values are means of 3 replicates ± standard error. Values followed by different superscripts are significantly different at $p<0.05$.

Titrable acidity: Acidity value is a practical magnitude in determination of stability and mean life of the product[14]. Statistical results regarding titrable acidity of freshly prepared pumpkin-tomato veggi squash is shown in the Figure-1 and it depicts that treatment T1 had lowest score of 0.13% because of its higher concentration of pumpkin juice only and acidity of prepared veggi squash was within the limit (0.3-1%) specified by Sri Lanka Standard Institution (SLS 729: 1985). With the decrease in concentration of pumpkin juice from 100% to 25% as well as with the substitution of tomato juice mean values of titrable acidity increased from 0.13-0.40. This might be due to higher percentage of citric acid available in tomato. In addition, oxidation of aldehydes and alcohols to acids during processing also contributed to the increase in acidity of processed tomato juice[15]. Increase in titrable acidity among treatments was noted in the palmyrah RTS with the intensification of pulp concentration from 8-16%[13].

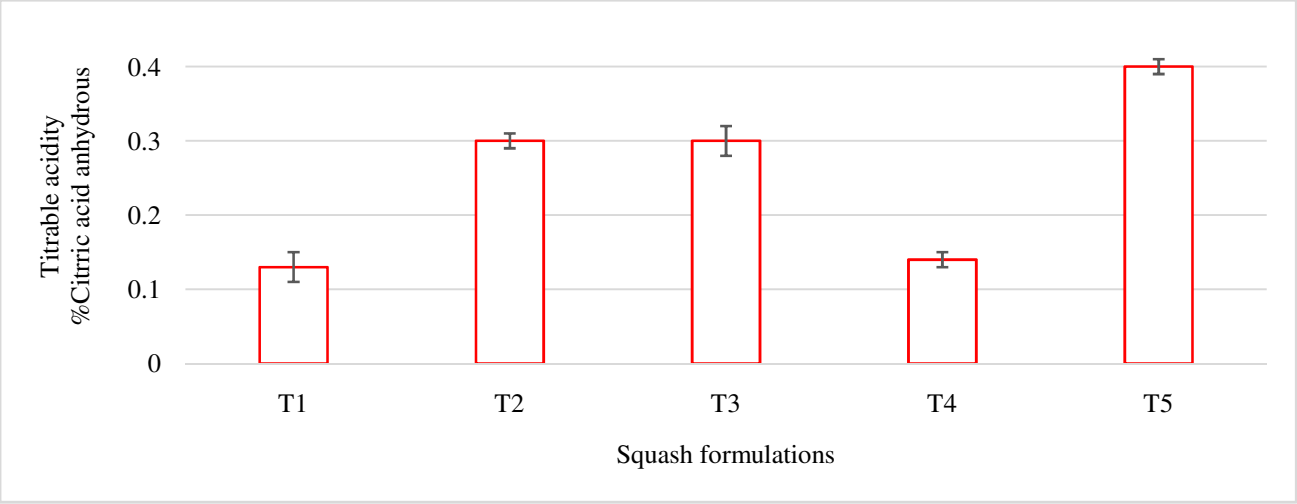

Figure-1: Titrable Acidity of Composite Squash Formulation. Values are means of 3 replicates.

Ascorbic acid: Ascorbic acid content of freshly prepared veggi squash formulations is shown in Figure-2. It depicts that mean values of ascorbic acid content increased from 270.22mg/100 ml to 310.44mg/100ml when tomato juice percentage increased from 0-75%. This is because of higher ascorbic acid content of tomato (13.7mg/100g) than pumpkin (9mg/100g)[16,17]. On day of preparation T5 (75% tomato +25% pumpkin) had shown highest amount of ascorbic acid and T3 (25% tomato + 75% pumpkin) had shown lowest amount of ascorbic acid. Similar findings of increase in ascorbic acid content were reported in bael-guava blended beverage and palmyrah RTS[13,18].

Sugar: Mean values for total sugar, reducing sugar and non-reducing sugar contents of freshly prepared veggi squash formulations are presented in Figure-3. The formulation T1 had highest values for total sugar as it is expressed as percentage invert sugar (fructose + glucose). Mean values for total sugar decreased with the decrease in percentage of pumpkin juice. It's because of 87% of total free sugar present in flesh are fructose and glucose[19]. However, the formulation T4 had higher total sugar content than the formulations T3 and T5 which were not significant to each other. Decrease in pumpkin juice percentage substituted with increase in tomato juice percentage resulted in comparably higher total sugar content in the formulation. Same as total sugar higher reducing sugar and non-reducing sugar contents were recorded in formulation T1. Lowest reducing sugar content was obtained in the formulation T2 which has only tomato juice. Results related to decrease in total sugar was reported in cucumber-melon functional drink[20].

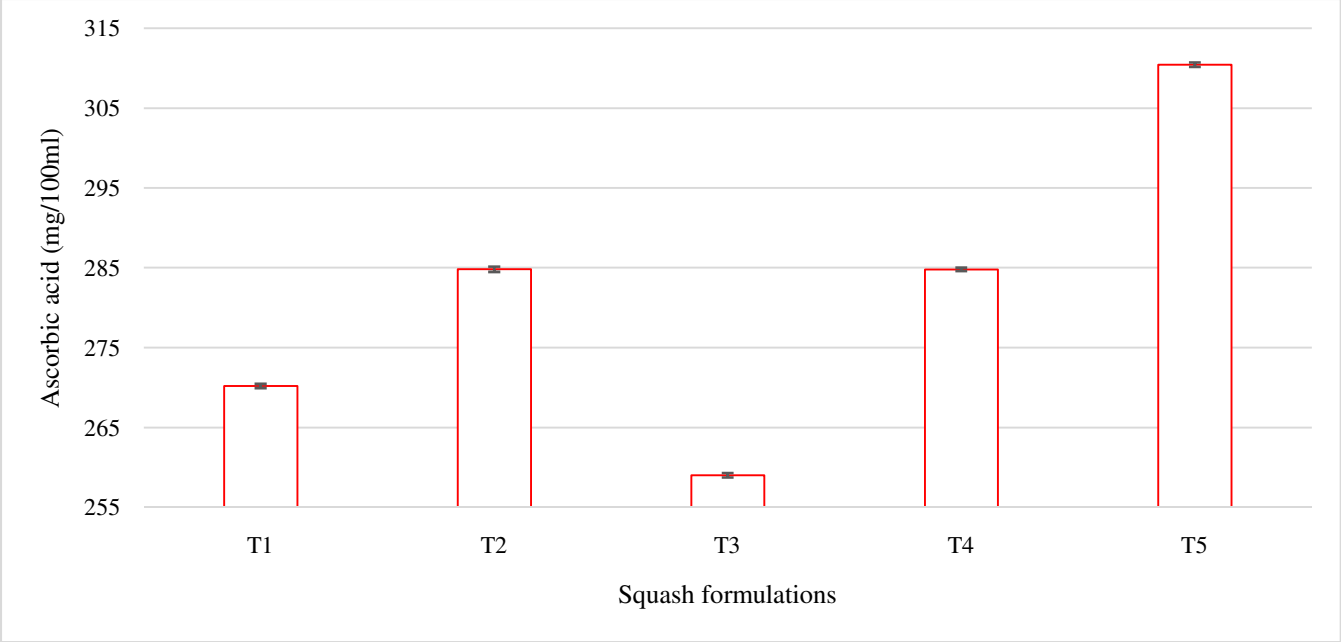

Figure-2: Ascorbic Acid Content of Composite Squash Formulations. The values are means 3 replicates.

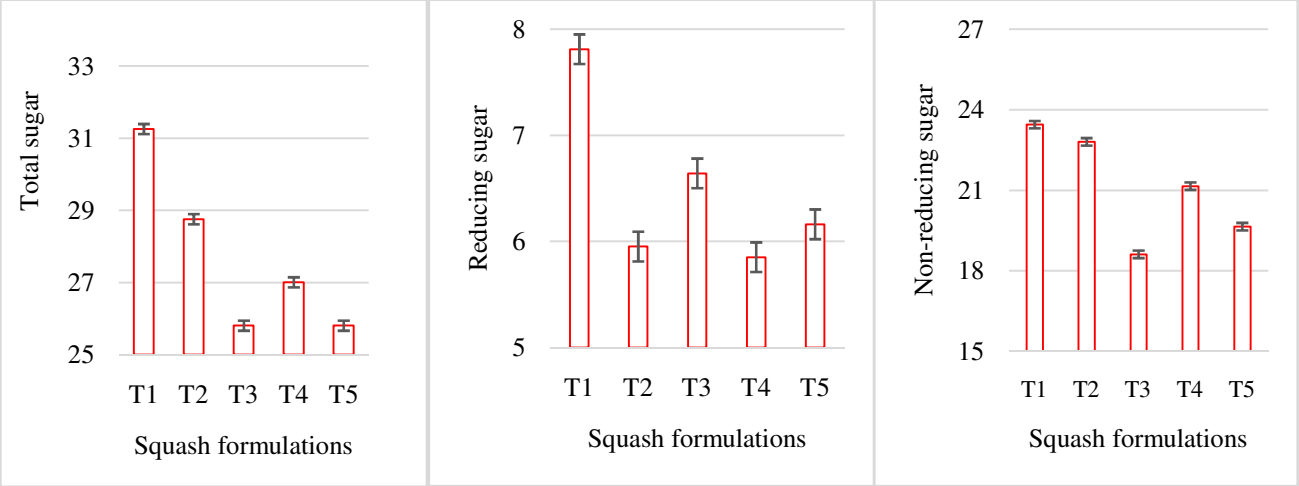

Figure-3: Total, Reducing and Non-Reducing Sugar Content Composite Squash Formulations. The values are means 3 replicates.

Conclusion

Beverage prepared from fruits and vegetables by utilizing their functional properties become more popular in the modern world in which consumers seek beverage for health as well as nutritional properties. Composite combination of pumpkin and tomato at equal concentration (50%) was the best combination for composite veggi squash development in terms of chemical and sensory qualities. However, this kind of squash may have short shelf life and become unsuitable for commercial production. So that determination of shelf life by incorporating any spices which improves the storability of squash could be studied in future.

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