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# Development and Characterization of Low Caloric Papaya (*Carica papaya L.*) drink

**Muhammad Sameem Javed[1], Adnan Amjad[1*], Muhammad Riaz[1], Faiz-ul-Hassan Shah[2], Muhammad Aurangzaib[3], Ammar Ahmad Khan[2], Muhammad Amir[1], Muhammad Jawad[1], Ahmed Saad[1]**

[1]*Institute of Food Science and Nutrition, Bahauddin Zakariya University, Multan, Pakistan*

[2]*University Institute of Diet and Nutritional Sciences, The University of Lahore, Lahore, Pakistan*

[3]*Department of Agronomy, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, Pakistan*

**Key words:** Papaya Juice, low caloric, reducing sugar, antioxidant activity, Total Phenolic content.

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## Abstract

Type II diabetes risk and indigestibility problems due to carbonated beverages among the young community people of developing countries are increasing so to manage these health-associated complications, low caloric papaya drink was developed using stevia leaves as a sweetening agent and different flavours. The prepared papaya drink was subjected to different physicochemical analysis i.e. DPPH scavenging activity, total phenolic contents, TSS, vitamin C, reducing, non-reducing sugars and sensory evaluation. The result obtained indicated that the total phenolic content and DPPH scavenging activity in $T_0$ samples were 131.8 and 34.00 at initiation which decreased to 81.21 and 18 at the termination of storage period respectively. DPPH scavenging activity, Total phenolic contents, TSS and ascorbic acid of $T_2$ ranged from 35-22, 137.1-79.36, 3.4-2.7, 11.3-8.1 and 3.23-2.72 for 60 storage days. In $T_2$ total plate count was reported more i.e. 2.62 and increased to 3.50 for the same period. Different sensory parameters like colour, flavour, taste, mouthfeel and overall acceptability showed that the treatment $T_2$ and $T_3$ were of good quality and can be recommended. Papaya drink can be replaced with carbonated beverages which not only helps to decrease the consumption of the carbonated beverage but also help to lower the diabetes risk.

* **Corresponding Author:** Adnan Amjad ✉ adnanft01@gmail.com

## Introduction

High caloric carbonated beverages are not only the cause of obesity in the world but also posing serious health issues like type II diabetes, hypertension risk having BMI ≥ 25 kg/m² and dental caries (Striegel, 2006; Kitchens & Owens, 2007; Kwak *et al.*, 2019; Schulze *et al.*, 2004). Low caloric fruit juices are recommended to avoid these risks and to promote healthy life (Rivera *et al.*, 2008). For type II diabetic patients there is a need to supplement with low caloric nutrient-rich and healthy juice to avoid carbonated beverages. The study aimed to promote people's health by recommending healthy fruit juices and excluding the beverages which are associated with many health risks.

Papaya (*Carica papaya* L.) grows in equatorial temperature zones, plant is rapidly growing, short-termed and constituents present in papaya fruit reported by Niklas and Marler, (2007) was papain enzyme, pectin, phenolics, chymopapain and bactericidal components. These health-promoting factors are vital in the management of digestive and gastrointestinal.

Papaya among tropical farmed plants is ranked third and the major exporter of fruit is Mexico even though larger amounts are being produced by India and Brazil (FAO, 2019; Evans and Ballen, 2012). Sindhi and Bombay are two major varieties of papaya grown in in nearby regions of Karachi a city of Pakistan and plants have fruit-bearing capacity around the year (Nadeem *et al.*, 1997; Zhou *et al.*, 2000; Singh *et al.*, 2014).

Papaya fruit contains total vitamins 68.1186mg in which total ascorbic acid is 60.9mg, vitamin A is 47µg and β-carotene is 274µg. Papaya contains a wide variety of phenolic compounds including Total phenolic contents, p-coumaric acid, caffeic acid, protocatechuic at the concentration of 76mg, 33mg, 25mg and 11mg respectively. Enzymes in papaya fruit are present at the concentration of 26.630mg having 10% papain, 26-30% chymopapain and glycyl endopeptidase 23-28% (USDA, 2016; Werner *et al.*, 2015; Kairunnisa *et al.*, 2016).

Even though papaya contains several health-promoting constituents like anthraquinones, flavonoids and anthocyanosides there some antinutritional constituents are also present such as alkaloids, saponins (Imaga *et al.*, 2010). Immature papaya contains enzyme papain which is present in large amounts and is known as vegetable pepsin involved in the breakdown of proteins. Dyspeptic patients are unable to digest wheat protein gliadin which is broken down by papain enzyme present in papaya fruit and have a tenderizing ability so used in meat to soften the texture of meat and to make it digestible after cooking operations (Kadiri *et al.*, 2016). Chymopapain and Papain can decrease the toxic impacts of artificial medicines (Hitesh *et al.*, 2012). Pectin can enhance the viscosity of the intestines thus reducing cholesterol absorption from the food hence reducing blood cholesterol level and also have a prebiotic impact (Srivastava and Malviya, 2011) and have a very good antioxidant, anti-hypertensive, wound healing and hepato-protective potential (Vij and Prashar, 2015). 1:1 from leaf and fruit mixture of papaya is very important in weight reduction and diabetes management (Ramachandran and Nagarajan, 2014). Papaya reduces bloating, enhances digestion and increases the platelet count (Mehdipour *et al.*, 2006). Papaya fermented juice have the ability to reduce the level of blood glucose in people of older ages by reducing oxidative stress and papain present have anti-inflammatory properties thus reducing swelling of intestinal walls, helps in wound healing, ease the sting and is associated with recovery of Alzheimer's disease (Mehdipour *et al.*, 2006; Zhao and Zhao, 2013).

## Material and methods

*Raw material Procurement*

The raw material of papaya (*Carica papaya*, var. Sunrise Solo) was purchased from the nearby town market of Multan, Pakistan. Fruits were washed and trimmed properly by tap water then cleaned and dried. After peeling papaya fruit cutting was done into cubes.

*Preparation of Papaya Juice*

The Papaya cubes were transformed into fine pulp by blending. The extracted pulp finally was used to make the drink by adding ingredients (water, papaya pulp, Stevia Powder, CMC and sodium benzoate). Different flavours were used for the final juice as given in the treatment plan.

*Determination of antioxidant activity*

*1, 1-diphenyl-2-picrylhdrazyl (DPPH) scavenging activity*

Papaya juice antioxidant activity was determined using 1, 1-diphenyl-2-picrylhdrazyl method (Ghorab *et al.*, 2007). Absorbance was measured by spectrophotometer at 517nm and for assay validation BHT used as a standard solution.

Absorbance reduction (%) = [(AB - AA) / AB] × 100

AB = Blank sample absorbance at t = 0 minute;

AA = Extract solution absorbance at t = 15 minutes

*Total Phenolic Contents (TPC)*

Total phenolic contents of papaya juice were measured by Folin Ciocalteu procedure as described by (Singleton *et al.,* 1999). The stock solution of 125ml was taken with 500µL distilled water and Folin-Ciocalteu reagent in the test tube and sodium carbonate 1.25 ml was added into the sample and absorbance of the sample was taken at 725nm by using a spectrophotometer and Gallic acid used as standard.

*Total soluble solids*

Papaya juice TSS contents were determined by using a handheld refractometer (Model BS eclipse 3-45) at room temperature by following the method as explained in AOAC (1984).

*Sugars*

Lane and Eynon method was used to measure the sugar content of papaya juice described Rangana (1977).

*Reducing sugars*

The following mathematical expression is used for the calculation of reducing sugars of the sample.

$$\%\text{Reducing Sugars} = \frac{\text{Fehling's Solution Factor} \times \text{Dilution}}{\text{Volume of Sample used} \times 1000}$$

*Non-Reducing sugar*

Non-reducing sugars of the sample were calculated by the given mathematical expression. % Non-reducing sugars as (sucrose) = (%Total Sugar-%reducing sugar) × 0.95

*Total Sugars*

$$\%\text{Total Sugars} = \frac{\text{Fehling's Solution Factor} \times 100 \times \text{Dilution}}{\text{Volume of Sample used} \times 1000}$$

*pH determination*

The pH of papaya juice was determined by the use of a digital pH meter (Model lino-Lab720 Germany). 50ml of papaya juice was taken in 100ml graduated beaker and the value was recorded from the screen by electrode dipping in the papaya juice sample (Fisk *et al.,* 2008).

*Titratable Acidity (TA)*

The titratable acidity of papaya juice was calculated by using the method as described in AOAC (1984). Dilution of the 5ml sample was done by 10ml distilled water and after dilution, 2-3 drops of indicator (phenolphthalein) were added into the sample and was titrated against 0.1N sodium hydroxide until light pink colour persists. The calculation was done by the given mathematical expression.

$$\%\text{ Acidity} = \frac{\frac{1}{10} \times \text{eq. wt of acid} \times \text{Normality of base} \times \text{titre}}{\text{wt. of sample}}$$

*Determination of total plate count*

A sterile test tube containing 9ml normal saline was taken in which 1ml from the sample was added and diluted till 6 dilutions. After adding nutrient agar into Petri plates allowed it to solidify and aliquots were spread by using a sterile pipette. Petri-plates were incubated for 72 hours at 25°C and counting of the colonies was done by colony counter and no of the cell was measured by multiplying obtained count by the dilution factor.

*Ascorbic acid*

Ascorbic acid contents of the sample were determined according to AOAC (1984) by sample titration with 2, 6-dichlorophenol indophenols sodium salt solution.

*Sensory evaluation*

9-point hedonic scale sensory evaluation of papaya juice was conducted by the method of (Meilgaard *et al.*, 1999).

*Statistical analysis*

Results were subjected to two-factor factorials under Complete Randomized Design were used (Steel *et al.*, 1997).

**Result and discussion**

*Effect of storage on antioxidants of papaya drink*

Mean values of antioxidants are given in Table 2 which showed a decrease with the storage days. At 0 day of storage highest value of antioxidants i.e. 38 was found in $T_3$ and at 60$^{th}$ storage day lowest antioxidants value was 18 in $T_0$. This decrease was also observed in $T_0$ and the value of antioxidants was 34 at the start than at 45$^{th}$ day and 60$^{th}$ storage day it was decreased to 26 and 18 respectively.

This decrease was linked with storage conditions and acids added to drink. In $T_1$ at 0 storage day value of antioxidants was 36, reduced to 34 at 15$^{th}$ storage day and further at 45$^{th}$ and 60$^{th}$ storage day antioxidant value decreased to 33 and 24 respectively. Denaturation of the protein contents and at ambient temperature and weaker peptide bonds may cause a decrease in antioxidant content.

**Table 1.**

| Treatment | Flavour |
|---|---|
| $T_0$ | Control |
| $T_1$ | Mint |
| $T_2$ | Cardamom |
| $T_3$ | Lemon |

**Table 2.** DPPH scavenging activity of *Carica* papaya juice.

| Treatments | Storage Days | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | 60 |
| $T_0$ | 34±1.1ab | 30±1.1 c | 32±0.9 bc | 26±0.9 d | 18±1.1 g |
| $T_1$ | 36±1.6 ab | 34±1.1 ab | 35±0.9 ab | 33±0.9 b | 24±1.9 de |
| $T_2$ | 35±2.1 ab | 32±1.1 bc | 33±1.1 b | 30±1.1 c | 22±1.1 f |
| $T_3$ | 38±1.1 a | 35±1.1 ab | 36±1.1 ab | 34±1.1 ab | 20±0.9 fg |

a Different superscript letter shows significant difference ($P<0.05$) among the treatments.

$T_0$ = Control

$T_1$= Mint flavored papaya drink

$T_2$= Cardamom flavored papaya drink

$T_3$= Lemon flavored papaya drink.

In $T_2$ the antioxidants value was 35 at 0 storage day and decreased to 32 at 15$^{th}$ storage day. Furthermore, in $T_2$ antioxidants value was decreased to 30 at 45$^{th}$and 22 at 60$^{th}$ storage day. The value of antioxidants in $T_3$ was 35 which was reduced to 34 and 20 at the 45$^{th}$ and 60$^{th}$ storage day respectively. Reduction in antioxidants may be associated with an increase in total plate count and temperature fluctuations during storage. The findings of the study were linked to the findings of (Galang *et al.*, 2016).

*Storage effects on total phenolic contents of papaya drink*

Total phenolics mean values are given in Table 3. The maximum value of total phenolic contents was 137.1 in $T_2$ at 0 storage day and the minimum amount of total phenolics at 60$^{th}$ day of storage in $T_1$ was 79.35.

There observed a gradual reduction in total phenolic contents with the progression of storage. Total phenolics in $T_0$ were 131.8 at 0 storage day which decreased to 95.43 on the 45th day and 81.21 on the 60th storage day. TPC content decline may be due to temperature fluctuation, storage conditions and different levels of flavors added during the development of the drink. Total phenolic contents were 129.4 in $T_1$ at 0 storage day which declined to 124.8 on the 15th day and further decreased to 97.65 and 79.35at 45th and 60th storage day respectively.

**Table 3.** TPC (Total phenolic contents) of *Carica* papaya juice.

| Treatments | Storage Days | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | 60 |
| $T_0$ | 131.8±10.5a | 125.4±7.1ab | 128.7±9.5ab | 95.43±2.1def | 81.21±3.1f |
| $T_1$ | 129.4±10.1a | 124.8±6.5ab | 125.7±6.9ab | 97.65±4.1cdef | 79.35±3.9f |
| $T_2$ | 137.1±20.7a | 120.4±9.9abc | 114.3±1.9abcd | 105.5±2.1bcde | 79.36±4.9f |
| $T_3$ | 135.1±06.1a | 127.3±2.9ab | 124.4±6.1ab | 117.1±2.1abcd | 88.97±3.5ef |

[a-f] Different superscript letters show significant difference ($P<0.05$) among the treatments.

T0= Control

$T_1$= Mint flavored papaya drink

$T_2$= Cardamom flavored papaya drink

$T_3$= Lemon flavored papaya drink.

**Table 4.** TSS (Total soluble solids) of *Carica* papaya juice.

| Treatments | Storage Days | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | 60 |
| $T_0$ | 3.8±0.8a | 3.5±0.1a | 3.6±1.2ab | 3.1±0.01b | 2.8±0.25bc |
| $T_1$ | 3.6±0.1ab | 3.4±1.1ab | 3.5±0.1ab | 3.2±0.05b | 2.9±0.26bc |
| $T_2$ | 3.4±0.1ab | 3.3±1.1ab | 3.2±0.05b | 2.9±0.2bc | 2.7±0.9c |
| $T_3$ | 3.1±1b | 3.2±0.05b | 2.9±0.2bc | 2.8±1.8bc | 2.6±0.2d |

[a] Different superscript letter shows significant difference ($P<0.05$) among the treatments.

To = Control

$T_1$= Mint flavored papaya drink

$T_2$= Cardamom flavored papaya drink

$T_3$= Lemon flavored papaya drink.

In $T_2$ the quantity was 137.1at the start of storage and then at the 15th storage day decreased to 120.4. Furthermore, in $T_2$ value of total phenolic contents was decreased to 114.3 on the 30th day and 79.36 on the 60th storage day respectively. In $T_3$ on the 15th storage day the value of total phenolic contents was 127.3 and declined to 117.1at 45th and 88.97 on 60th storage days. The decreasing level of total phenolic contents denotes that temperature may have increased during the storage that's why the microbial changes also occurred in the drink that made total phenolics low.

**Table 5.** Reducing sugar of *Carica* papaya juice.

| Treatments | Storage Days | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | 60 |
| $T_0$ | 2.18±0.20$^{a}$ | 2.14±0.29$^{ab}$ | 2.03±0.18$^{abc}$ | 1.91±033$^{abc}$ | 1.85±0.16$^{abc}$ |
| $T_1$ | 2.15±0.15$^{ab}$ | 2.13±0.24$^{ab}$ | 1.99±0.21$^{abc}$ | 1.87±0.17$^{abc}$ | 1.84±0.11$^{abc}$ |
| $T_2$ | 2.14±0.22$^{ab}$ | 2.10±0.12$^{abc}$ | 1.94±0.33$^{abc}$ | 1.89±0.18$^{abc}$ | 1.81±0.15$^{bc}$ |
| $T_3$ | 2.15±0.17$^{ab}$ | 2.08±0.16$^{abc}$ | 1.82±0.29$^{abc}$ | 1.86±0.33$^{abc}$ | 1.75±0.26$^{c}$ |

[a] Different superscript letter shows significant difference ($P<0.05$) among the treatments.

$T_0$= Control

$T_1$= Mint flavored papaya drink

$T_2$= Cardamom flavored papaya drink

$T_3$= Lemon flavored papaya drink.

The results of my investigations are in corroboration with the earlier findings of (Maisarah *et al.*, 2013).

*Storage effect on papaya drink total soluble solids*

Mean values of TSS of papaya drink are depicted in Table 4. Maximum and minimum values of total soluble solids were recorded in $T_0$ and $T_3$ i.e. 3.8 and 2.6 at 0 and 60$^{th}$ storage day respectively. The results indicated a lowering in TSS of papaya drink with time. In $T_0$ TSS value was 3.8 at 0 storage day and decreased to 3.1and 2.8 at 45$^{th}$ and 60$^{th}$ day of storage respectively.

**Table 6.** Non-reducing sugar of *Carica* papaya juice.

| Treatments | Storage Days | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | 60 |
| $T_0$ | 1.10±0.12$^a$ | 1.05±0.15$^a$ | 1.00±0.15$^a$ | 0.96±0.10$^a$ | 0.93±0.10$^a$ |
| $T_1$ | 1.09±0.17$^a$ | 1.04±0.08$^a$ | 0.97±0.11$^a$ | 0.95±0.15$^a$ | 0.90±0.08$^a$ |
| $T_2$ | 1.07±0.09$^a$ | 1.05±0.12$^a$ | 1.01±0.09$^a$ | 0.91±0.16$^a$ | 0.91±0.19$^a$ |
| $T_3$ | 1.08±0.16$^a$ | 0.99±0.16$^a$ | 0.95±0.16$^a$ | 0.93±0.14$^a$ | 0.88±0.21$^a$ |

[a] Different superscript letter shows significant difference (P<0.05) among the treatments

$T_0$ = Control

$T_1$= Mint flavored papaya drink

$T_2$= Cardamom flavored papaya drink

$T_3$= Lemon flavored papaya drink.

The value of total soluble solids in $T_1$ was 3.6 at initial storage which on the 15$^{th}$ day reduced to 3.4 and this reducing pattern continued till the 45$^{th}$ and 60$^{th}$ day of storage i.e. 3.2 and 2.9. In $T_2$ the TSS value was 3.4 on the initial day of storage which decreased to 3.3 on the 15$^{th}$ day of storage. Moreover, in $T_2$ TSS value was decreased to 3.2 and 2.7 on the 30$^{th}$ and 60$^{th}$ day of storage respectively.

**Table 7.** Total sugar of Carica papaya juice.

| Treatments | Storage period (Days) | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | 60 |
| $T_0$ | 3.28±0.32$^{a}$ | 3.19±0.45$^{abcd}$ | 3.03±0.26$^{abcdef}$ | 2.87±0.32$^{abcdef}$ | 2.78±0.17$^{def}$ |
| $T_1$ | 3.25±0.22$^{ab}$ | 3.18±0.19$^{abcd}$ | 2.97±0.32$^{abcdef}$ | 2.82±0.18$^{bcdef}$ | 2.75±0.27$^{def}$ |
| $T_2$ | 3.23±0.31$^{abc}$ | 3.16±0.17$^{abcde}$ | 2.95±0.49$^{abcdef}$ | 2.82±0.14$^{bcdef}$ | 2.72±0.36$^{ef}$ |
| $T_3$ | 3.23±0.29$^{abc}$ | 3.08±0.19$^{abcdef}$ | 2.78±0.21$^{def}$ | 2.79±0.31$^{cdef}$ | 2.65±0.23$^{f}$ |

[a-d] Different superscript letters show significant difference (P<0.05) among the treatments

$T_0$ = Control

$T_1$= Mint flavored papaya drink

$T_2$= Cardamom flavored papaya drink

$T_3$= Lemon flavored papaya drink.

The value of total soluble solids on the 15$^{th}$ day in $T_3$ was 3.2 and reduced to 2.8 at the 45$^{th}$ and 2.6 on the 60$^{th}$ day of storage. A decrease in total soluble solids of papaya drink was might be due to increased microbial growth and environmental fluctuations. The results were linked with earlier investigations (Vishal *et al.*, 2015). Differences in results with (Vishal *et al.*, 2015) were due to the effect of storage conditions.

*Effect of storage on reducing sugar of papaya drink*

Reducing-sugar contents of the drink are given in Table 5. A decreasing trend was observed in all treatments showing a maximum value of 2.18 and a minimum of 1.75 in $T_0$ and $T_3$ at 0 and 60th storage day respectively. At the initial level in $T_0$, the value of reducing sugars was 2.18 and, in this value, the decrease observed at the 15th and 60th day of storage was 2.14 and 1.85. In $T_1$ contents of reducing sugars at 0 day were 2.15 which decreased to 1.99 and 1.87 at 30th and 45th storage day. The decrees in reducing sugars of the drink were associated with storage conditions as the progression of time influenced the reducing sugars and the lowering trend observed in $T_3$ at 0 and 60th day was 2.15 and 1.75 respectively.

This decreasing pattern in the reducing sugars was might be due to temperature fluctuations and storage conditions which enhanced the total plate count and lowered reducing sugars. The study results were linked with Vishal *et al.*, (2015) findings who reported the same results.

**Table 8.** Total plate count of *Carica* papaya juice.

| Treatments | Storage Days | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | 60 |
| $T_0$ | 1.36±0.12 $^{i}$ | 2.15±0.75 $^{f}$ | 2.68±1.24 $^{d}$ | 2.99±1.60 $^{bc}$ | 3.27±0.09 $^{ab}$ |
| $T_1$ | 1.97±0.14 $^{fgh}$ | 2.34±0.15 $^{ef}$ | 2.64±0.15 $^{de}$ | 2.94±0.83 $^{bc}$ | 3.55±0.19 $^{a}$ |
| $T_2$ | 1.82±0.25 $^{fgh}$ | 2.01±1.63 $^{fg}$ | 2.47±0.07 $^{e}$ | 3.15±0.20 $^{b}$ | 3.50±0.83 $^{a}$ |
| $T_3$ | 1.61±0.21 $^{h}$ | 2.26±0.75 $^{ef}$ | 2.27±0.75 $^{ef}$ | 2.58±0.30 $^{c}$ | 3.31±0.11 $^{ab}$ |

$^{a-i}$ Different superscript letters show significant difference ($P<0.05$) among the treatments

$T_0$= Control

$T_1$= Mint flavored papaya drink*

$T_2$= Cardamom flavored papaya drink*

$T_3$= Lemon flavored papaya drink.

*Effect of storage on Non-Reducing sugar of papaya drink*

Mean Table 6 show that the maximum amount of non-reducing sugars was observed at 0 day of storage in $T_2$ i.e. 1.10 and lowest found in $T_3$ at the 60th day of storage. The decreasing trend in non-reducing sugars of the papaya drink was observed at all the storage days and was positively correlated with the environmental fluctuations. The value of non-reducing sugars in $T_0$ was 1.10 which decreases to 1.00 at 30th and 0.93 at 60th storage day. Non-reducing sugar value in $T_1$ at 15th storage day was observed 1.04 which reduced to 0.90 at 60th day of storage.

**Table 9.** Ascorbic acid/Vitamin C of *Carica* papaya juice.

| Treatments | Storage Days | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | 60 |
| $T_0$ | 11.3±2.7 $^{a}$ | 9.8±1.5 $^{ab}$ | 7.2±0.1 $^{c}$ | 6.4±2.8 $^{d}$ | 5.2±2.4 $^{e}$ |
| $T_1$ | 11.5±1.9 $^{a}$ | 10.2±0.1 $^{ab}$ | 6.6±2.1 $^{cd}$ | 5.5±2.8 $^{de}$ | 4.7±2.2 $^{ef}$ |
| $T_2$ | 11.3±0.1 $^{a}$ | 9.9±2.9 $^{ab}$ | 6.6±2.9 $^{cd}$ | 5.3±1.1 $^{de}$ | 5.1±1.7 $^{e}$ |
| $T_3$ | 11.4±0.2 $^{a}$ | 8.9±1.8 $^{ab}$ | 6.5±2.3 $^{d}$ | 5.8±1.6 $^{de}$ | 5.3±1.3 $^{e}$ |

$^{a-e}$ Different superscript letter shows significant difference ($P<0.05$) among the treatments

$T_0$= Control

$T_1$= Mint flavored papaya drink

$T_2$= Cardamom flavored papaya drink

$T_3$= Lemon flavored papaya drink.

The reducing pattern continued in $T_2$ and $T_3$ and the values noted were 1.07, 1.01 and 0.91 at 0, 45th and 60th day respectively for $T_2$ and for $T_3$ the values of non-reducing sugars were 0.99 on the 15th day 0.93 on the 45th day of storage. The decreasing trend in non-reducing sugars was associated with the temperature fluctuations during storage and breakdown due to fermentation and microbial activities as plate count was increased during storage. There was a positive correlation between the study and the results of Vishal *et al.*, (2015) and some contradictions were due to the addition of different flavours and additives.

*Effect of storage on Total sugar of papaya drink*

Papaya drinks total sugar values are shown in Table 7. The mean table indicates that maximum total sugars were found in $T_0$ i.e. 3.28 and minimum values were observed in $T_3$ i.e. 2.65. The breakdown of carbohydrate contents into lower molecular weight sugars and the conversion of sugars due to temperature change during storage and microbial influence may reduce the total sugar contents of the drink. The value observed at initial storage for total sugars in $T_0$ was 3.28 which was reduced to 3.03 and 2.78 at 30$^{th}$ and 60$^{th}$ storage day. A similar reducing trend was observed in $T_1$ and values noted for 0 and 60$^{th}$ storage day were 3.25 and 2.75 respectively. Total sugars of the papaya drink reduced from 3.16 on the 15$^{th}$ day of storage to 2.82 on the 45$^{th}$ storage day in $T_2$. Reduction of total sugars in $T_3$ was also observed and this was 3.23, 2.78 and 2.65 at 0, 45$^{th}$ and 60$^{th}$ storage day. Results reported were similar to the findings of (Vishal *et al.*, 2015).

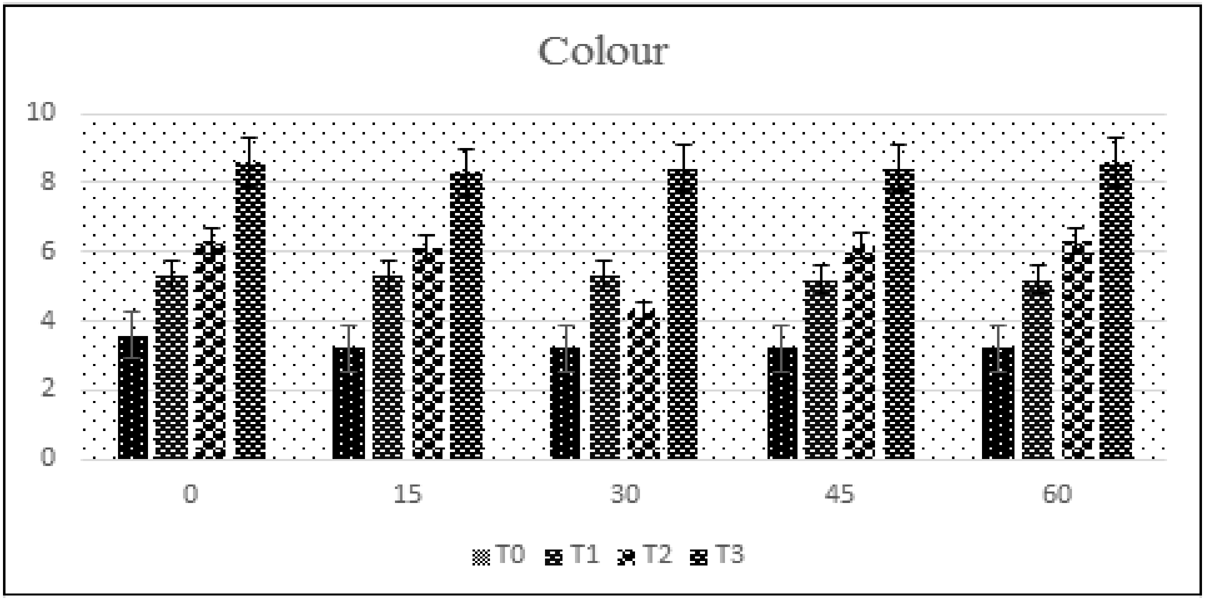


**Fig. 1.** Color of papaya drink.

*Effect of storage on Total Plate Count of papaya drink*

Total plate counts of the drink are given in Table 8. The total plate count of the papaya drink increased during storage and the maximum value was noticed at 45$^{th}$ day i.e. 3.55 in $T_1$ and minimum values were found in the control group at 0 storage day i.e. 1.36 in $T_0$. The value of total plate count in $T_0$ at initial storage day was 1.36 which increased with the progression of time and was 2.68 and 3.27 at 30$^{th}$ and 60$^{th}$ storage day. The values for $T_1$ at 0, 45$^{th}$ and 60$^{th}$ storage day were 1.97, 2.94 and 3.55 respectively. The temperature of the storage played a vital role in increasing total plate count as there were fluctuations in the environmental conditions during the storage period and sugar contents available for fermentation which also influenced all the parameters of the study. In $T_2$ total plate count at 0 storage day were 1.82 and increased to 2.47 and 3.50 at 30$^{th}$ and 60$^{th}$ storage day. The total plate count of the papaya drink observed in $T_3$ was 1.61 at initial storage which increased to 2.58 at 45$^{th}$ day storage and after that period total plate count of the drink escalated to 3.31 at the end of the storage period. The results of the study showed a positive relationship with the results of Ranganna (1991) and differences during storage with the findings of Chowdhury *et al.* (2008) were might be the effect of temperature fluctuations.

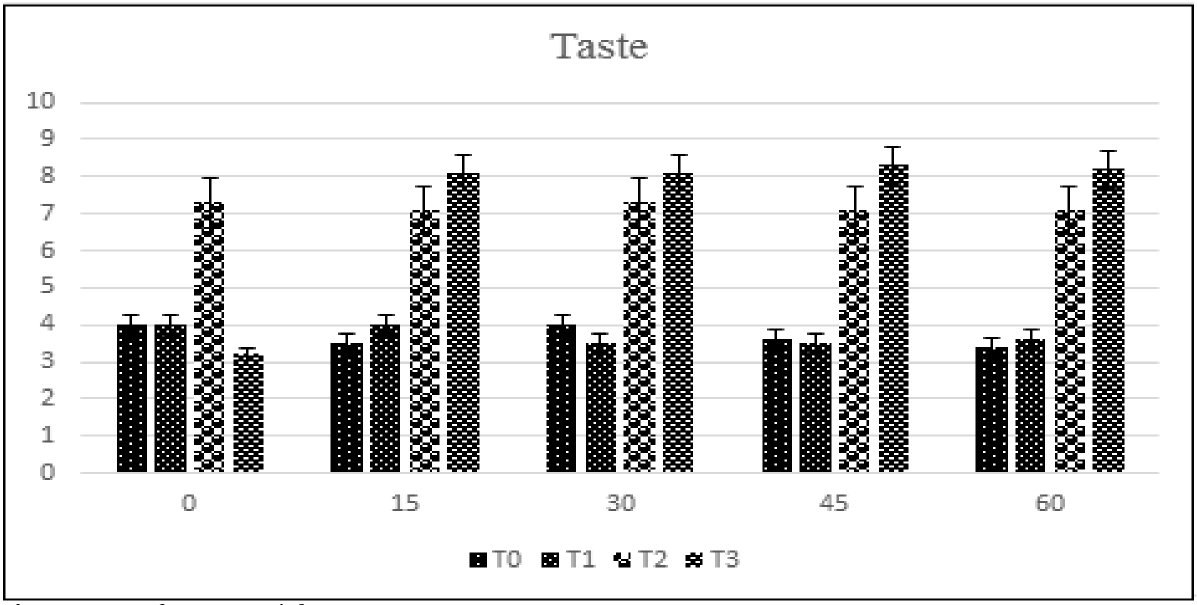


**Fig. 2.** Taste of papaya Drink.

*Effect of storage on Ascorbic acid/Vitamin C of papaya drink*

Ascorbic acid contents of the drink are given in Table 09. From which it can be divulged that the maximum value of ascorbic acid was reported in $T_3$ at 0 storage day i.e. 11.4 and lowest observed in $T_2$ at 60th storage day i.e. 5.1. In $T_1$ the ascorbic acid contents at 0 storage day were 11.3 which start decreasing till the end of storage i.e. 7.2 and 5.2 at 30th and 60th day of storage. In $T_1$ value of ascorbic acid was 11.5 at 0 storage day which decreased to 6.6 and 4.7 at 30th and 60th storage day respectively. This degradation of ascorbic acid was associated with an environment which was hydrogen ion catalyzed and furfurals formation due to anaerobic degradation in aqueous media. The reduction in ascorbic acid in $T_2$ and $T_3$ from initial values i.e. 11.30 and 11.40 was 6.6 and 5.1 at 30th and 60th storage day in $T_2$ while in $T_3$ values were 8.9 and 5.3 at 15th and 60th storage day.

The influence of temperature during storage was the major factor responsible for the reduction in ascorbic acid contents and this reduction was associated with the earlier findings of Nekeety *et al.* (2017).

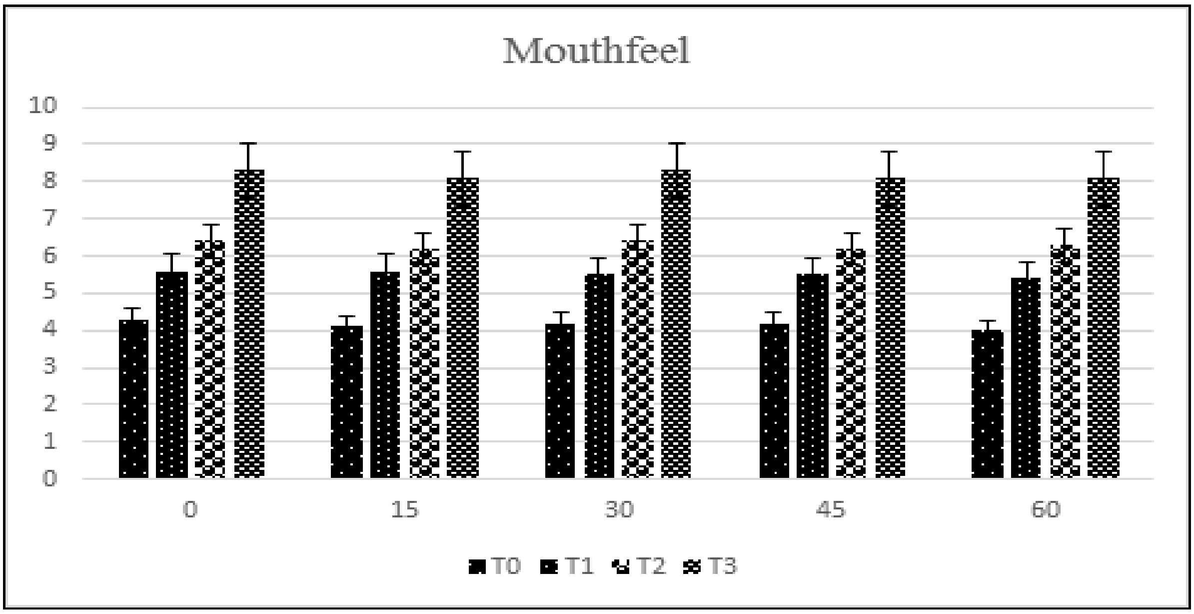


**Fig. 3.** Mouthfeel of papaya drink.

*Sensory evaluation of Carica papaya juice*

From the sensory results of C. *papaya* juice computed in Fig. 1, it can be concluded that the maximum colour score was observed in $T_3$ at all storage days but a negligible decrease in colour of juice was also observed with the progression of storage. The lowest colour value was seen in $T_0$ on the 60th day of storage. In $T_2$ & $T_3$ constant pattern of colour was observed at all storage days and there no significant change mentioned by the expert panelist. The results of the findings were aligned with previous research (Jothi *et al.*, 2014).

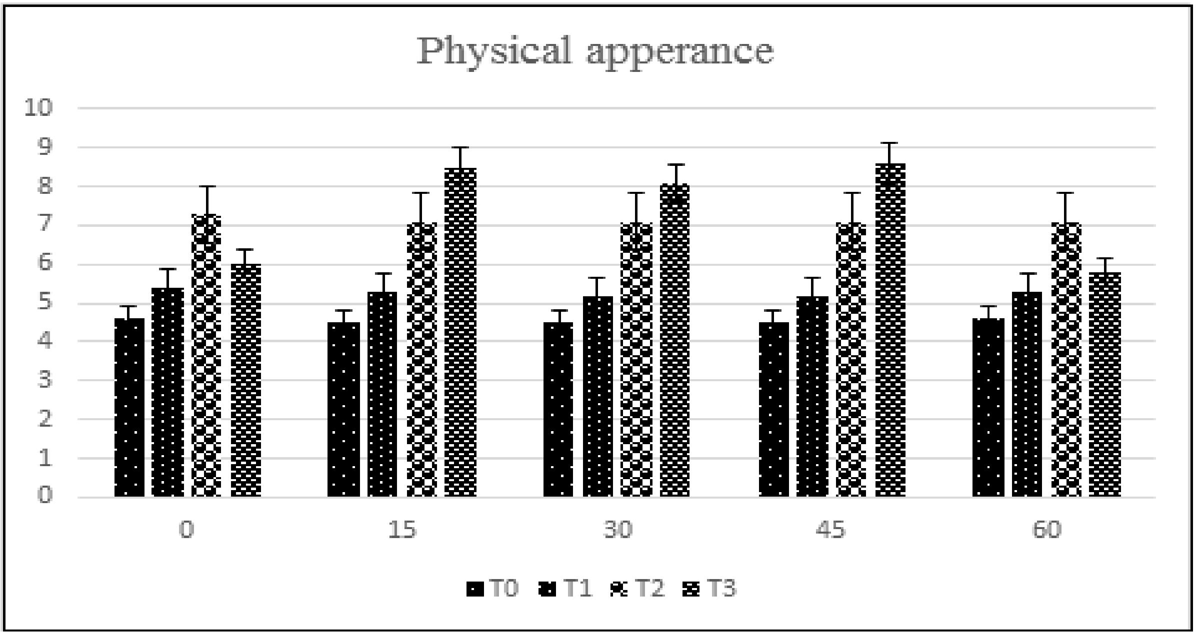


**Fig. 4. P**hysical appearance of papaya drink.

From sensory results of taste evaluated in Fig. 2, it can be concluded that maximum score of taste was observed in $T_3$ at the 45th day of storage and minimum score was observed at 0 day of storage but in $T_0$, $T_1$ and $T_2$ the value of taste remained same without any significant difference in the results. The slight decreased in taste with the progression of time was due to the storage effect on different nutritional components of juice. The results of my findings are aligned with previous research of Jothi *et al.*, 2014.

Sensorial results regarding mouth feel from Fig. 3 showed that the maximum value was observed in $T_3$ on the 30th day of storage while the minimum score was recorded in $T_0$ on the 60th storage day. The results are debatable because during the whole process the score for mouthfeel was gradually decreased in all treatments.

The change in the mouthfeel with the advancement of time was might be due to physicochemical changes i.e. sugar conversion in the juice. These findings showed coherency with the previous research of Jothi *et al.* (2014).

Results by the panelist regarding physical appearance are depicted in Fig. 4. From the values, it can be concluded that the maximum physical appearance of juice was observed in $T_3$ on the 45th day of storage and the minimum in $T_0$ on the 30th day of storage.

The changes in physical appearance in different treatments with the advancement of storage are linked with the natural colour degradation of the juice because of oxygen retention during packaging and aseptically processing. These results are aligned with previous research (Jothi *et al.*, 2014).

Overall acceptability of different treatments regarding sensory parameters in Fig. 5 showed that the highest taste score was observed in $T_3$ at 0 day of storage and minimum in $T_0$ at 45th day of storage.

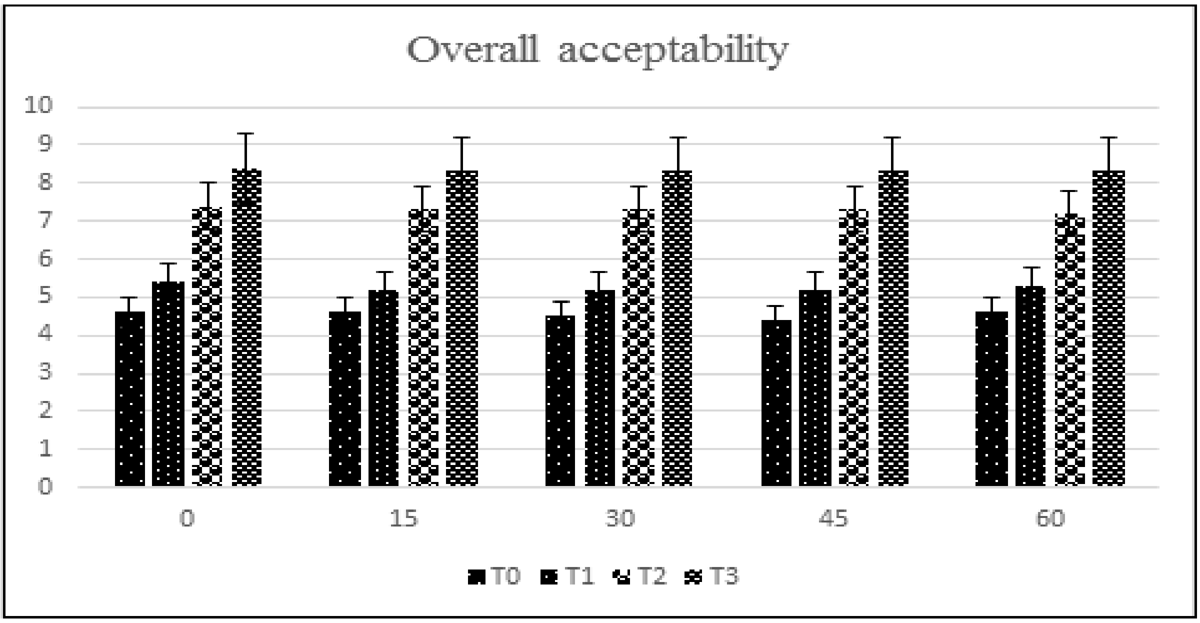


**Fig. 5.** Overall acceptability of papaya drink.

The decrease in overall acceptability with the progression of time was associated with textural and sensorial properties of juice which were might be due to enzymatic reactions responsible for changes in product consistency, colour and taste of juice associated. The study's results are linked with previous investigations (Jothi *et al.*, 2014).

## Conclusion

Drinks that are loaded with sugar are the worst choice because they provide lots of calories and virtually no other nutrients. Drinking them routinely can lead to weight gain and increase the risk of diabetes. So, the use of papaya is beneficial because this drink not only increases digestibility and quenches thirst but also provides a wide range of phytochemicals to the human body to sustain good health. The drink has good antioxidant potential and carries a higher amount of polyphenols. Morever it aids in enhancement of digestion as it contains appreciable amount of papain enzyme. It is obvious from the results obtained that lemon flavor fortified papay drink was liked more than other drinks.

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