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# STANDARDIZATION OF PROTOCOL FOR PREPARATION OF WOOD APPLE SQUASH

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**ABSTRACT**

Wood apple squash was prepared by using 8 recipes which consisted of two levels of sugar (40 and 45$^o$B) and wood apple pulp (25 and 30%), with or without addition of spice mixture. Analyzing the wood apple squash for specific chemical parameters, it was found to be signified significant differences between the treatments. The chemical constituents *viz.,* TSS, titrable acidity, non-enzymatic browning, total sugars, and reducing sugars, were found to increased whereas, ascorbic acid and non-reducing sugar content decreased from in a storage period of 3 months. During storage the organoleptic scores decreased significantly from an initial value of 8.46 to 8.01 for colour and appearance, 8.36 to 7.86 for flavour, 8.38 to 7.89 for taste, 7.79 to 7.54 for mouth feel and 8.25 to 7.83 for overall acceptability. Considering the performance with respect to organoleptic quality parameters. the treatment $T_7$ (30% pulp + 45$^0$B TSS) and $T_8$ (30% pulp + 45$^0$B TSS + 1 % Spice mixture) stood superior among the treatments.
***Keywords*****:** Wood apple, squash, TSS, titrable acidity, non-enzymatic browning, total sugars, and reducing sugars.

## Introduction

The most popular underutilized fruits that are becoming more and more popular include tamarind, karonda, chironji, wood apple, jamun, ber, aonla, bael *etc.* Most of these fruits are cheap, highly nutritious, known for medicinal and therapeutic properties and are used by the local tribes to cure various diseases. Many of these fruits including seeds, leaves of the plants are used as curative foods in the traditional Indian medicine and ayurveda. Among underutilized indigenous fruit species, wood apple (*Feronia limonia* Swingle) is one, known by several names like elephant apple, curd apple, monkey fruit, kavat, kathbel, Kotha, kottamda, Vilanga, Kapith and Vela marum (Mazumder *et al.,* 2006). In northern parts of Karnataka, it is called as balolakai whereas, bellada hannu in southern parts (Gorabal *et al.,* 2020). Due to its high religious, cultural, nutritional and medicinal values, this is one of the fruits awarded with “Shree” title. In Sanskrit language, its name is “Shree Phalam” or “Amrit Phal”. It is native to the dry plains of India, Pakistan and Sri Lanka, where it grows in the wild and is also planted along roads, the edges of fields and occasionally in orchards (Jayakumar and Geetha, 2012).

Traditionally, all parts of the wood apple plants are prescribed as natural medicine as a cure for various ailments (Morton, 1987), hence, has great demand in the native system of Ayurvedic medicine. The fruit is used in India as a liver and cardiac tonic, when unripe, as an astringent means of halting diarrhea and dysentery (Singh, 2001), effective treatment for hiccups, sore throat and diseases of the gums. The pulp is poultice onto bites and stings of venomous insects (Kirtikar and Basu, 1935). Wood apple has hypoglycemic, antitumor, larvicidal, antimicrobial and hepatoprotective activity (Vidhya and Narain, 2011). Also has anti-diabetic and antioxidant potential as it reduces the levels of blood glucose and malondialdehyde (Patel *et al.,* 2012). This fruit is considered to be one of the natural sources of anti-oxidants due to its potential radical scavenging activity of various phytochemicals (Nithya and Saraswathi, 2010).

People consume the raw fruit pulp as such with or without sugar or jaggery, or as a beverage after blending it with other ingredients (cardamom, salt, ginger *etc.*). Because of its excellent flavour and nutritive value, this fruit has a great potential for value addition especially in beverage industry. The principal ingredients used for preparation of RTS, nectar, squash and syrup from many fruits like oranges, mango, pineapple, grapes *etc.,* are sugar, acid and water. A proper sugar and acid blend is required to improve the taste of the juice. As the wood apple pulp is highly acidic in taste, it was thought necessary to blend with pinch of salt and spices (cardamom, black pepper and dry ginger powder). Blending of beverages with spices could improve taste, aroma and nutritional value of the final product (Deka and Bidyut, 2000). Therefore, in the present investigation different recipes containing different levels of wood apple pulp, sugar, water and with or without spice were tried in order to produce a good quality wood apple squash which has ready acceptability by the consumer.

## Material and Methods

Wood apple pulp was extracted from the ripe fruits by using pectinase enzyme. The extracted pulp was pasteurized at 75°C for 5 minutes to inactivate the enzymes and used for preparation of squash. For the preparation of squash, pulp was mixed with sugar, spice mixture (salt, pepper powder, dry ginger powder and cardamom powder) and water as per recipes mentioned in the treatment details (Table 1). The TSS of the beverage was adjusted by adding cane sugar as specified in the treatment details using hand refractometer (Erma make). Further 0.1 per cent citric acid was added to maintain the required acidity percentage and chemical preservative in the form of potassium metabisulphite was added @ 350 ppm. This beverage was filled in clean, sterile bottles and sealed with crown corks and pasteurized at 85°C for 25 minutes and stored at ambient condition for further studies.

## Result and Discussion

Quality of a product is determined by evaluation of chemical composition and consumer acceptability. In the present study also, it was observed that the various physico-chemical parameters of the wood apple squash were found to be influenced by different treatments (recipes) involved.

The treatments $T_1$, $T_2$, $T_5$ and $T_6$ exhibited minimum values for TSS and total sugars throughout the storage period it may be attributed to initial low TSS (40°B) adjusted whereas, the treatments $T_3$, $T_4$, $T_7$ and $T_8$ exhibited maximum as initial high TSS of 45°B adjusted. Irrespective of the treatments, a slight increase in total soluble solids with the advancement in storage period was observed (Table 2). An increase in TSS content in squash during storage period might be due to the conversion of polysaccharides (starch and cellulose substances) into sugars in the presence of organic acids. The inversion of added sucrose into simpler soluble substances during the storage period may be another factor responsible for increase in TSS content. This indicates that during storage there was change in composition of pulp/juice used in the products. The increase in reducing sugars, total sugars and decrease in non-reducing sugar content of squash could be due to inversion of non-reducing sugar into reducing sugars as decreases in non-reducing sugar corresponded to increase in reducing sugars content (Table 3). Hydrolysis of polysaccharides like pectin and starch could also be one of the reasons for increase in the sugars content. The results of present study are in close conformity to the findings of Pattar, (2012) in tamarind squash and syrup; Chandana, (2016) and Kumar and Deen (2018) in wood apple squash.

The mean values for titratable acidity at different months of storage of wood apple squash indicated that titratable acidity increased with the progress in storage period (Table 1). It comes into view that, increase in acidity observed in the wood apple squash beverage was gradual and consistent. The slight increase in titratable acidity might be due to formation of organic acids by the degradation of the ascorbic acid as it decreased with storage period of the beverage. Conn and Stumf, 1976 reported degradation of pectin substances of pulp in to soluble solids which might have contributed towards an increase in titratable acidity of squash. This is in consonance with the findings of Kumar and Deen (2017) in wood apple RTS and Kumar and Deen (2018) in wood apple squash.

Irrespective of treatments ascorbic acid content in the wood apple squash reduced considerably during storage as the time moved on (Table 1). This fact is evident from the mean ascorbic acid level 1.99 mg/100 mL, 1.89 mg/100 mL, 1.82 mg/100 mL and 1.76 mg/100 mL observed at 0, 1, 2 and 3 MAS respectively. The decline in ascorbic acid concentration could be due to thermal degradation during processing and subsequent oxidation in storage as it is very sensitive to heat, oxidation and light [Yeom *et al.* (2000)]. Another reason for reduction in ascorbic acid concentration might be due to conversion of ascorbic acid to di-hydroxy ascorbic acid and both ascorbic acid and dehydro ascorbic acid are highly volatile and unstable forms of vitamin C. Kumar and Deen, (2018) reported that, reduction in ascorbic acid content of the drink could be due to oxidation by trapped oxygen in glass bottles which results a formation of highly volatile and unstable dehydro ascorbic acid followed by further degradation to 2, 3- di-ketogulonic acid and finally to furfural compounds.

Non-enzymatic browning of the product is one of the undesirable colour changes during storage. Usually, a juice having clear transparent colour will have a good appeal. In the present investigation, the changes due to non-enzymatic browning as measured by optical density (OD) values showed that progressive increase in browning of squash was observed with the storage period (Table 4). This could be mainly due to the non-enzymatic reaction such as reaction of organic acids with sugars or oxidation of phenol which leads to the formation of brown pigments. The present investigation also support the contention that reduction in ascorbic acid content during storage of squash corresponding an increase in browning. The browning of beverages during storage is a general phenomenon as witnessed by many workers (Deen and Singh, (2012) in karonda squash; Kumar and Deen, (2018) in wood apple squash).

Evaluation of organoleptic qualities of a product is an important tool for deciding the consumer acceptability. Human element plays an important role in evaluation of organoleptic characters of a product. For new product, the consumer acceptability needs to be first evaluated at the laboratory level. Hence, in the present investigation, trained and semi-trained panelists were involved in the evaluation process.

The mean score for overall acceptability of wood apple squash varied from 8.25 in fresh squash to 7.83 at the end of 3 months of storage indicating decrease in performance over the time (Table 5). Loss in organoleptic quality of squash after certain period is obvious because of undesirable changes in the product. Temperature plays an important role in inducing certain undesirable biochemical changes in the beverage which leads to development of off flavour as well as discoloration (browning) and there by masking the original colour and flavour of the beverage. Similarly, reduction in organoleptic quality has also been reported by several workers in beverages prepared by different fruits [Kotecha and Kadam, (2003); Pattar, (2012); Akhtar *et al.* (2013); Deen and Kumar, (2014); Chandana, (2016) and Hamid *et al.* (2017)].

Microbial population (total bacterial count) of wood apple squash showed a marginal increase in their number during storage period of three months (Table 6). Increase in microbial load during storage may be attributed to the slow rate of chemical and enzymatic reactions and slow rate of microbial growth. Similar results were observed by Manikanta (2005) in guava beverages; Upale (2005) in jamun beverages; Chandana, (2016) in wood apple squash. In present findings the microbial count had not exceeded this limit up till the squash remained acceptable organoleptically.

**Table 1 :** The treatments used for for preparation of wood apple squash

| | | |
|---|---|---|
| $T_1$ | : | 25% pulp + $40^{o}$B TSS |
| $T_2$ | : | 25% pulp + $40^{o}$B TSS + 1% Spice mixture |
| $T_3$ | : | 25% pulp + $45^{o}$B TSS |
| $T_4$ | : | 25% pulp + $45^{o}$B TSS + 1% Spice mixture |
| $T_5$ | : | 30% pulp + $40^{o}$B TSS |
| $T_6$ | : | 30% pulp + $40^{o}$B TSS + 1% Spice mixture |
| $T_7$ | : | 30% pulp + $45^{o}$B TSS |
| $T_8$ | : | 30% pulp + $45^{0}$B TSS + 1% Spice mixture |

**Table 2 :** Changes in total soluble solids, titratable acidity and ascorbic acid of wood apple squash as influenced by treatments and storage period

| Treatments | Total soluble solids ($^{o}$B) | | | | Titratable acidity (%) | | | | Ascorbic acid (mg/100 g) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Initial | 1MAS | 2 MAS | 3 MAS | Initial | 1 MAS | 2 MAS | 3 MAS | Initial | 1 MAS | 2 MAS | 3 MAS |
| $T_1$ | 40.05 | 40.65 | 41.01 | 41.57 | 1.08 | 1.14 | 1.18 | 1.21 | 1.85 | 1.76 | 1.69 | 1.61 |
| $T_2$ | 40.08 | 40.81 | 41.30 | 42.01 | 1.10 | 1.15 | 1.19 | 1.23 | 1.87 | 1.77 | 1.70 | 1.65 |
| $T_3$ | 45.07 | 45.65 | 46.37 | 47.13 | 1.17 | 1.23 | 1.27 | 1.30 | 2.03 | 1.93 | 1.86 | 1.82 |
| $T_4$ | 45.05 | 45.68 | 46.45 | 47.22 | 1.19 | 1.26 | 1.28 | 1.31 | 2.09 | 1.98 | 1.91 | 1.85 |
| $T_5$ | 40.11 | 40.75 | 41.15 | 41.65 | 1.12 | 1.18 | 1.20 | 1.22 | 1.89 | 1.78 | 1.69 | 1.64 |
| $T_6$ | 40.15 | 40.91 | 41.34 | 42.13 | 1.11 | 1.13 | 1.19 | 1.23 | 1.91 | 1.83 | 1.78 | 1.73 |
| $T_7$ | 45.15 | 45.83 | 46.58 | 46.48 | 1.23 | 1.28 | 1.32 | 1.35 | 2.12 | 2.06 | 1.97 | 1.90 |
| $T_8$ | 45.11 | 45.90 | 46.63 | 46.57 | 1.21 | 1.27 | 1.30 | 1.32 | 2.15 | 2.03 | 1.93 | 1.89 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | **42.60** | **43.27** | **43.85** | **44.35** | **1.15** | **1.21** | **1.24** | **1.27** | **1.99** | **1.89** | **1.82** | **1.76** |
| **SE ±** | 0.029 | 0.029 | 0.026 | 0.021 | 0.012 | 0.019 | 0.011 | 0.010 | 0.016 | 0.016 | 0.015 | 0.015 |
| **CD at 1%** | 0.120 | 0.119 | 0.107 | 0.088 | 0.048 | 0.045 | 0.044 | 0.040 | 0.065 | 0.068 | 0.060 | 0.061 |

**MAS:** Month After Storage

**Treatment details**

**$T_1$** - 25% pulp + $40^0$B TSS
**$T_2$** - 25% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_3$** - 25% pulp + $45^0$B TSS
**$T_4$** - 25% pulp + $45^0$B TSS + 1 % Spice mixture
**$T_5$** - 30% pulp + $40^0$B TSS
**$T_6$** - 30% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_7$** - 30% pulp + $45^0$B TSS
**$T_8$** - 30% pulp + $45^0$B TSS + 1 % Spice mixture

**Table 3 :** Changes in total sugars, reducing sugars and non-reducing sugars of wood apple squash as influenced by treatments and storage period

| Treatments | Total sugars (%) | | | | Reducing sugars (%) | | | | Non-reducing sugars (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Initial** | **1** | **2** | **3** | **Initial** | **1** | **2** | **3** | **Initial** | **1** | **2** | **3** |
| $T_1$ | 36.62 | 36.68 | 36.75 | 36.80 | 3.82 | 4.38 | 4.67 | 4.80 | 31.16 | 30.68 | 30.48 | 30.40 |
| $T_2$ | 36.71 | 36.73 | 36.79 | 36.86 | 3.89 | 4.42 | 4.73 | 4.92 | 31.18 | 30.70 | 30.46 | 30.34 |
| $T_3$ | 40.72 | 40.70 | 40.83 | 40.88 | 4.26 | 4.81 | 5.06 | 5.27 | 34.64 | 34.10 | 33.98 | 33.83 |
| $T_4$ | 40.81 | 40.84 | 40.88 | 40.91 | 4.31 | 4.87 | 5.11 | 5.38 | 34.68 | 34.17 | 33.98 | 33.75 |
| $T_5$ | 36.88 | 36.90 | 37.92 | 37.98 | 4.12 | 4.76 | 4.99 | 5.14 | 31.12 | 30.53 | 31.28 | 31.20 |
| $T_6$ | 37.06 | 37.04 | 37.10 | 37.13 | 4.18 | 4.71 | 4.95 | 5.10 | 31.24 | 30.71 | 30.54 | 30.43 |
| $T_7$ | 41.03 | 41.06 | 41.10 | 41.12 | 4.57 | 5.08 | 5.48 | 5.68 | 34.64 | 34.18 | 33.84 | 33.67 |
| $T_8$ | 41.11 | 41.14 | 41.17 | 41.22 | 4.64 | 5.11 | 5.53 | 5.71 | 34.65 | 34.23 | 33.86 | 33.73 |
| **Mean** | **38.87** | **38.89** | **39.07** | **39.11** | **4.22** | **4.77** | **5.07** | **5.25** | **32.91** | **32.41** | **32.30** | **32.17** |
| **SE ±** | 0.037 | 0.034 | 0.027 | 0.022 | 0.020 | 0.019 | 0.016 | 0.017 | 0.040 | 0.037 | 0.022 | 0.028 |
| **CD at 1%** | 0.152 | 0.142 | 0.110 | 0.090 | 0.081 | 0.080 | 0.067 | 0.071 | 0.165 | 0.154 | 0.090 | 0.117 |

**MAS:** Month After Storage

**Treatment details**

**$T_1$** - 25% pulp + $40^0$B TSS
**$T_2$** - 25% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_3$** - 25% pulp + $45^0$B TSS
**$T_4$** - 25% pulp + $45^0$B TSS + 1 % Spice mixture
**$T_5$** - 30% pulp + $40^0$B TSS
**$T_6$** - 30% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_7$** - 30% pulp + $45^0$B TSS
**$T_8$** - 30% pulp + $45^0$B TSS + 1 % Spice mixture

**Table 4 :** Changes in non enzymatic browning, colour and appearance and flavour of wood apple squash as influenced by treatments and storage period

| Treatments | Non enzymatic browning | | | | Colour and appearance | | | | Flavour | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Initial** | **1** | **2** | **3** | **Initial** | **1** | **2** | **3** | **Initial** | **1** | **2** | **3** |
| $T_1$ | 0.322 | 0.327 | 0.337 | 0.351 | 8.17 | 8.08 | 7.83 | 7.50 | 8.33 | 8.33 | 8.17 | 8.00 |
| $T_2$ | 0.325 | 0.340 | 0.352 | 0.360 | 8.33 | 8.00 | 7.83 | 7.50 | 8.00 | 7.67 | 7.33 | 7.17 |
| $T_3$ | 0.324 | 0.329 | 0.341 | 0.356 | 8.33 | 8.33 | 8.08 | 7.83 | 8.42 | 8.33 | 8.17 | 8.08 |
| $T_4$ | 0.326 | 0.340 | 0.349 | 0.365 | 8.42 | 8.33 | 8.17 | 8.08 | 7.92 | 7.83 | 7.58 | 7.33 |
| $T_5$ | 0.328 | 0.336 | 0.347 | 0.359 | 8.50 | 8.42 | 8.33 | 8.17 | 8.67 | 8.50 | 8.33 | 8.17 |
| $T_6$ | 0.331 | 0.343 | 0.353 | 0.385 | 8.58 | 8.33 | 8.33 | 8.25 | 8.33 | 8.17 | 8.08 | 7.83 |
| $T_7$ | 0.329 | 0.337 | 0.349 | 0.360 | 8.67 | 8.58 | 8.50 | 8.42 | 8.83 | 8.67 | 8.42 | 8.33 |
| $T_8$ | 0.333 | 0.344 | 0.356 | 0.389 | 8.67 | 8.50 | 8.33 | 8.33 | 8.42 | 8.33 | 8.17 | 8.00 |
| **Mean** | **0.33** | **0.34** | **0.35** | **0.37** | **8.46** | **8.32** | **8.18** | **8.01** | **8.36** | **8.23** | **8.03** | **7.86** |
| **SE ±** | 0.001 | 0.001 | 0.001 | 0.001 | 0.078 | 0.088 | 0.118 | 0.110 | 0.118 | 0.128 | 0.110 | 0.102 |
| **CD at 1%** | 0.004 | 0.005 | 0.006 | 0.005 | 0.322 | 0.365 | 0.487 | 0.455 | 0.487 | 0.530 | 0.455 | 0.422 |

**MAS:** Month After Storage

**Treatment details**

**$T_1$** - 25% pulp + $40^0$B TSS
**$T_2$** - 25% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_3$** - 25% pulp + $45^0$B TSS
**$T_4$** - 25% pulp + $45^0$B TSS + 1 % Spice mixture
**$T_5$** - 30% pulp + $40^0$B TSS
**$T_6$** - 30% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_7$** - 30% pulp + $45^0$B TSS
**$T_8$** - 30% pulp + $45^0$B TSS + 1 % Spice mixture

**Table 5 :** Changes in taste, mouth feel and overall acceptability of wood apple squash as influenced by treatments and storage period

| Treatments | Taste | | | | mouth feel | | | | overall acceptability | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Initial | 1 | 2 | 3 | Initial | 1 | 2 | 3 | Initial | 1 | 2 | 3 |
| $T_1$ | 7.83 | 7.67 | 7.50 | 7.17 | 8.00 | 8.00 | 7.83 | 7.67 | 8.08 | 8.02 | 7.83 | 7.58 |
| $T_2$ | 8.58 | 8.33 | 8.17 | 8.00 | 7.67 | 7.33 | 7.17 | 7.08 | 8.15 | 7.84 | 7.63 | 7.44 |
| $T_3$ | 8.00 | 7.67 | 7.58 | 7.33 | 8.08 | 8.00 | 8.00 | 7.92 | 8.21 | 8.09 | 7.96 | 7.79 |
| $T_4$ | 8.67 | 8.50 | 8.17 | 8.08 | 7.58 | 7.50 | 7.42 | 7.33 | 8.15 | 8.04 | 7.83 | 7.71 |
| $T_5$ | 8.17 | 7.83 | 7.67 | 7.58 | 8.08 | 8.08 | 8.00 | 8.00 | 8.35 | 8.21 | 8.08 | 7.98 |
| $T_6$ | 8.67 | 8.50 | 8.33 | 8.33 | 7.42 | 7.33 | 7.33 | 7.17 | 8.25 | 8.09 | 8.02 | 7.90 |
| $T_7$ | 8.25 | 8.17 | 8.08 | 8.08 | 8.17 | 8.17 | 8.08 | 8.00 | 8.48 | 8.40 | 8.27 | 8.21 |
| $T_8$ | 8.83 | 8.83 | 8.67 | 8.50 | 7.33 | 7.25 | 7.17 | 7.17 | 8.31 | 8.23 | 8.08 | 8.00 |
| **Mean** | **8.38** | **8.19** | **8.02** | **7.89** | **7.79** | **7.71** | **7.63** | **7.54** | **8.25** | **8.11** | **7.96** | **7.83** |
| **SE ±** | 0.088 | 0.102 | 0.106 | 0.144 | 0.128 | 0.106 | 0.088 | 0.102 | 0.040 | 0.055 | 0.055 | 0.059 |
| **CD at 1%** | 0.365 | 0.422 | 0.439 | 0.596 | 0.530 | 0.439 | 0.365 | 0.422 | 0.166 | 0.227 | 0.227 | 0.242 |

**MAS:** Month After Storage

**Treatment details**

**$T_1$** - 25% pulp + $40^0$B TSS
**$T_2$** - 25% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_3$** - 25% pulp + $45^0$B TSS
**$T_4$** - 25% pulp + $45^0$B TSS + 1 % Spice mixture
**$T_5$** - 30% pulp + $40^0$B TSS
**$T_6$** - 30% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_7$** - 30% pulp + $45^0$B TSS
**$T_8$** - 30% pulp + $45^0$B TSS + 1 % Spice mixture

**Table 6:** Changes in total bacterial count ($10^{-3}$cfu/ml) of wood apple squash as influenced by treatments and storage period

| Treatments | Total bacterial count ($10^{-3}$cfu/ml) | | |
|---|---|---|---|
| | 1MAS | 2 MAS | 3 MAS |
| $T_1$ | 0.26 | 0.35 | 0.52 |
| $T_2$ | 0.23 | 0.31 | 0.43 |
| $T_3$ | 0.28 | 0.37 | 0.51 |
| $T_4$ | 0.25 | 0.33 | 0.42 |
| $T_5$ | 0.23 | 0.33 | 0.45 |
| $T_6$ | 0.2 | 0.35 | 0.42 |
| $T_7$ | 0.27 | 0.35 | 0.43 |
| $T_8$ | 0.21 | 0.3 | 0.38 |
| **Mean** | **0.24** | **0.34** | **0.45** |

**Treatment details**

**$T_1$** - 25% pulp + $40^0$B TSS
**$T_2$** - 25% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_3$** - 25% pulp + $45^0$B TSS
**$T_4$** - 25% pulp + $45^0$B TSS + 1 % Spice mixture
**$T_5$** - 30% pulp + $40^0$B TSS
**$T_6$** - 30% pulp + $40^0$B TSS + 1 % Spice mixture
**$T_7$** - 30% pulp + $45^0$B TSS
**$T_8$** - 30% pulp + $45^0$B TSS + 1 % Spice mixture

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