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Development and Storage Study of Mixed Fruit Jams from Papaya and Pineapple Incorporated with *Aloe vera*

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ABSTRACT

Background: Jams are typically created from fruit pulp and juice, a combination of fruits, or a combination of fruits and vegetables. The research was conducted using papaya (*Carica papaya*), pineapple (*Ananas comusus*) pulps incorporated with *Aloe vera* gel to prepare blended jam in order to determine the acceptability of *Aloe vera* gel in fruit jam and select the best combination for jam preparation in terms of chemical constituents as well as sensory attributes with ten weeks of storage.

Methods: The pulps were mixed in proportions according to the treatments and processed into jams with five repetitions in CRD (completely randomized design). The physico-chemical and organoleptic properties of jams have been evaluated. The most favored formulations on the day of preparation were T_2, (Papaya: Pineapple: *Aloe vera*, 150:150:05), T_4 (150:150:15) and T_5 (150:150:20), based on sensory consistency characteristics, which were studied at 10 weeks of storage time.

Result: Total jam results in T_5 and T_4 ratios were similarly best for higher levels of chemical constituents, *i.e.*, total soluble solids, titratable acidity, moisture, ascorbic acid, pH and a lower percentage of total sugar. All chemical components were found to increase by up to 10 weeks with the exception of pH, moisture and ascorbic acid, which decreased with storage time. T_4 was better found to have higher aroma, texture, taste and overall acceptability score with respect to sensory characters. During storage, all sensorial characters were found to decrease. In view of the above chemical constituents and the sensory characteristics of the substance, the 150:150:15 (T_4) ratio was found to be better than the remainder of the jam ratio during storage.

Key words: *Aloe vera* gel, Jam, Papaya, Pineapple, Storage.

INTRODUCTION

Papaya is a natural tropical product (*Carica papaya*) that is universally devoured for its value and recognition. This is an economically fundamental harvest for tropical and subtropical regions (Sri and Radhai, 2017). It has greatly increased in recent years due to its ease of cultivation, quick returns and adaptability to a wide range of climatic and soil conditions (Patil *et al*., 2018). The pineapple (*Ananas comosus*) is one of the tropical biosphere's marketable fruit crops, available during the year as well. It has the usual features such as unique flavor, wonderful deliciousness, distinctive fragrance, eye-catching color, pleasant taste of sugar acid mixture and free of seeds. Comprehensive Ca, K, fiber and vitamin C are included (Rahman *et al*., 2015). Above everything, it succeeds as one of the world's preferred fruits. Eating *Aloe vera* gel improves the mixed fruit production's extra nourishment. *Aloe vera* is a long-lasting juicy xerophyte that strengthens the tissue in the leaves to store water. It is a familiar herbal houseplant, because it is well-known to provide shelter from oxidative strain, it may be the central point for the yield of the practical drink (El-Shemy *et al*., 2009). Nowadays, *Aloe vera* is also commonly used in the health sector, other than the uses in beautifying companies. Because of its biological activities and functional properties, it can be used as a valuable ingredient in food applications (Sasikumar, 2015). The processing of *Aloe vera* gel obtained from the plant's leaf pulp has become a large industry worldwide because of its application in the food industry (Rani and Rao, 2014).

Jam is one of the common constant food preservation bioactive rich shelf that could be easily produced in an emerging economy at both small and middle scale. Jam is used for breakfast with bread. Mixed foods with sole products rather than two or more fruits are considered to be more preferred by consumers than single fruit products. Mixed jams undoubtedly improve the qualitative, sensory and nutritional value of the advanced value added.

In view of all the reasons immediately above, an attempt was made to distribute the preparation of the mixed fruit jam to perceive the variations in chemical and sensory qualities, to standardize the proportion and shelf life of mixed fruit jam of papaya, pineapple and *Aloe vera* during storage.

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MATERIALS AND METHODS

An experiment was performed at the Food Science Laboratory of the Agricultural Chemistry Department, Agriculture Faculty and Eastern University to produce a mixed fruit jam.

Pineapple, papaya fruits, citric acid, pectin and Sugar were purchased from the supermarket in Baticaloa, Sri Lanka and mature *Aloe vera* leaves from my home garden were gathered and taken to the lab for conducting tests.

Preparation of mixed fruit jam

The fruits were washed, peeled, sliced into small portions and homogenized in blender separately. Fresh *Aloe vera* leaves were washed and external coatings were peeled off and the pure gel was taken out by spoon. Each fruit pulps were squeezed through muslin fabric. The certain sum of sugar was added with water and warmed well to dissolve. Different mixtures of *Aloe vera* pulp, constant quantity of fruit pulps selected from numerous preliminary readings were added into the sugar syrup and mildly heated for 15 minutes till temperature become 105°C, in the meantime pectin and citric acid were added and cooked by stirring continuously until the finish point, TSS (total soluble solid) of 68°Brix value. The sauce pan was detached from the fire and cooled for 5 minutes and the jam was filled in to disinfected plastic cups and wrapped with caps. The treatments were analyzed for chemical as well as organoleptic valuation. Based on sensory analysis the most preferred three jam formulations (T_2, T_4 and T_5) with the different amount *Aloe vera* gel were selected for storage studies. They were stored at ambient conditions 30±1°C for ten weeks. The treatments are given below in Table 1.

Sensory evaluation

Mixed fruit jam samples were performed on the preparation day and at the end of storage for a sensory evaluation aimed at assessing organoleptic taste, texture, color, aroma and overall acceptability characteristics by 20 semi-qualified judges. “The hedonic scale of seven points, ranging from “dislike highly” to “like extremely. For the tactile test, a survey was used.

Chemical analysis

For the selected mixed fruit jam samples, chemical parameters including TSS, titrable acidity, ascorbic acid, total sugars, pH and moisture content were measured for ten weeks at two-week intervals. The physico-chemical properties of the jam samples were tested using AOAC-recommended standard procedures (Horwits and Latime, 2005). Total soluble solids (TSS) were measured using a hand-held refractometer (Model ATAGO-S-28E). The pH was measured using a digital pH meter (Model HANNA HI 98130). By titrating the juices with standard NaOH and reporting the results in percent citric acid, the titratable acidity of the juices was determined. In all jam formulations, the indophenol dye method was applied to determine vitamin C content, whereas the Lane-Eynon method was utilized to determine total sugar. Using the air oven method, the moisture content was determined. Each variable was replicated three times during the experiment.

Table 1: Proportion of papaya, pineapple and *Aloe vera* mixed fruit jam.

Treatments	*Aloe vera* pulp (g)	Pineapple pulp (g)	Papaya pulp (g)
T_1	00	150	150
T_2	05	150	150
T_3	10	150	150
T_4	15	150	150
T_5	20	150	150

Statistical analysis

Each formulation has been repeated and treatments have been in complete random design (CRD). Analysis of Variance (ANOVA) was used to analyze the Physico-chemical review data and to do the mean separation, Duncan’s multiple range test (DMRT) was utilised. Data from the Organoleptic Assessment was analyzed by the Turky’s examination.

RESULTS AND DISCUSSION

Physico-chemical analysis of papaya, pineapple and *aloe vera* mixed fruit jam during storage

Titrable acidity

Over the storage period, mixed fruit jam titratable acidity increased ($p<0.05$) significantly (Table 2). This might be due to oxidation of sugar and polysaccharide hydrolysis and the addition of citric acid to the mixed fruit jam as well. These findings were similar to the results of pineapple juice blend with carrot and orange juice (Jan and Masih, 2012).

pH

The pH of all treatments was declined significantly by means of rise of storing duration as indicated in Table 2. Raise of acidity for the period of storage may be the reason for this (Hirdyani, 2015). In ready to serve (RTS) cabbage and key lime blended drinks through storage, similar results were perceived (Inthuja *et al*., 2019).

Ascorbic acid

The ascorbic acid content of the mixed fruit jam in Table 2 was decreased as the storage time increased. According to DMRT, the amount of ascorbic acid in all treatments revealed an important decreasing trend in storage ($p<0.05$). Due to the oxidation of ascorbic acid by oxygen in the containers into dehydro-ascorbic acid and non-enzymatic browning reactions, the cause for ascorbic acid reduction during storage is probable(Patel *et al*., 2015). These kind of results were recorded in RTS from medicinal plants (Hirdyani, 2015) and mulberry squash (Thakur and Hamid, 2017).

Moisture content

An indication of the shelf life of the any food is moisture. In Table 3, the moisture content of all treatments decreased significantly ($p<0.05$) over the storage period. The observed variations in moisture content could be attributed to the heating process used in processing. The removal of water during jam processing resulted in a change in the concentration of food nutrients (Rana *et al*., 2021).

Total soluble solid

Per the DMRT, there were significant ($p<0.005$) increasing in total soluble solids among treatments. This may be because of the degradation during storage of complex polysaccharides into simple sugars and also increase in concentration of jam due to dehydration (Bhardwaj and Mukherjee, 2011). These results were consistent with the previous RTS from orange juice and *Aloe vera* gel (Kausar, 2020) and in seabuckthorn squash (Ali *et al*., 2011).

Total sugar

The total sugar content of mixed fruit jam during storage has increased as in Table 3. Any of the reasons for increasing the sugar content during storage may be the hydrolysis of polysaccharides such as pectin and starch and the distortion of non-reducing sugars into reducing sugars, leading to an increase in total sugars in the jam (Hariharan and Mahendran, 2016). In papaya and pineapple mixed RTS (Sindhumathi and Premalatha, 2013) and sapota squash (Relekar *et al*., 2013) the same increase in total sugars was reported.

Sensory analysis

The results in terms of sensory qualities are shown in Table 4. The color, aroma, taste, texture and overall acceptability scores of jams steadily decreased as the storage period advanced, according to the sensory evaluation results. The most important parameters used during consumption are the color of the food product. The highest mean value (5.5) observed in the T2 formulation is based on the mean value of sensory scores. The formation of off-color compounds is the result of carotenoid breakdown, which could be accelerated by reduced oxygen in the headspace via oxidation (Gliemmo *et al*., 2009). The highest mean value score for taste was 5.4 for the T4 formulation and the lowest mean value score was 3.9 for the T5 formulation at the end of storage. The decrease of jam's sugar-acid combination during storage could explain the product's drop in taste ratings (Chauhan *et al*., 2019). The T_4 treatment had the highest mean value score of 5.5 and the lowest mean value score of 3.2 for the T_2 treatment in the potential explanation for a drop in the texture score may be owing to the presence of galacturonic acids, the adverse effect of humidity and ambient temperature. In sapota squash, comparable results were perceived (Relekar *et al*., 2013). T_4 had a maximum mean aroma score (5.7) and T_2 had a minimum mean aroma score of 3.5 at the end. Mean aroma scores showed a significant decrease in the aroma of mixed fruit jam after a storage period of 10 weeks. The loss of volatile aromatic components is most likely to blame for the reduction of aroma scores after storage (Thakur and Hamid, 2017). The overall acceptability score was found to be the highest in T_4

Table 2: Changes of ascorbic acid, pH and titratable acidity in papaya, pineapple and *Aloe vera* mixed fruit jam during storage.

Storage duration (weeks)	Ascorbic acid			pH			Titratable acidity		
	T_2	T_4	T_5	T_2	T_4	T_5	T_2	T_4	T_5
2	7.45±0.02^a	10.98±0.01^c	12.54±0.01^a	4.10±0.02^b	4.21±0.01^c	4.36±0.01^a	1.54±0.05^a	1.38±0.01^b	1.27±0.02^c
4	6.12±0.02^b	9.82±0.02^c	10.13±0.02^b	4.05±0.01^a	4.10±0.01^a	4.20±0.02^b	1.65±0.02^a	1.50±0.01^b	1.47±0.01^b
6	5.29±0.02^a	7.80±0.02^a	8.59±0.01^c	4.01±0.05^c	4.00±0.02^b	4.05±0.02^c	1.99±0.03^a	1.80±0.01^b	1.60±0.04^c
8	4.87±0.03^d	6.63±0.01^a	6.85±0.01^d	3.90±0.02^b	3.95±0.15^b	3.99±0.01^b	2.50±0.01^a	2.30±0.01^a	1.90±0.02^c
10	4.65±0.02^e	5.48±0.01^b	5.69±0.01^d	3.60±0.01^c	3.78±0.22^b	3.80±0.01^a	3.40±0.01^b	3.0±0.01^a	2.50±0.08^c

Values are means of 3 replicates ± standard error.

Values followed by different letters are significantly different at $p<0.05$.

Table 3: Changes of total soluble solids, moisture content and total sugar in papaya, pineapple and *Aloe vera* mixed fruit jam during storage.

Storage duration (weeks)	TSS			Moisture			Total sugar		
	T_2	T_4	T_5	T_2	T_4	T_5	T_2	T_4	T_5
2	70.47±0.01^a	74.23±0.01^c	78.34±0.01^a	53.51±0.32^a	58.33±0.24^b	60.25±0.31^b	45.43±0.31^b	40.07±0.13^c	38.07±0.21^c
4	72.65±0.02^b	74.57±0.02^c	80.62±0.02^b	54.1±0.23^a	58.98±0.45^c	61.32±0.39^a	25.00±0.11^a	20.47±0.31^b	17.58±0.05^c
6	73.96±0.02^a	76.99±0.02^a	82.14±0.01^c	55.01±0.37^a	59.45±0.42^a	61.95±0.22^a	25.9±0.08^a	21.63±0.13^b	18.63±0.14^b
8	75.10±0.05^d	77.22±0.01^a	83.38±0.01^d	55.13±0.28^a	59.78±0.32^d	62.12±0.26^c	26.8±0.14^a	21.99±0.11^c	18.99±0.24^c
10	78.15±0.02^e	78.65±0.01^b	83.98±0.01^d	55.45±0.21^a	60.38±0.35^b	62.43±0.25^c	27.6±0.18^a	22.58±0.10^b	19.65±0.11^b

Values are means of 3 replicates ± standard error.

Values followed by different letters are significantly different at $p<0.05$.

Table 4: Sensory analysis of papaya, pineapple and *Aloe vera* mixed fruit jam during storage.

Treatment	Weeks	Color	Taste	Texture	Aroma	Overall Acceptability
T_2	0	5.7±0.16^{c}	3.4±0.19^{b}	3.6±0.10^{c}	4.0±0.12^{cd}	3.5±0.08^{cd}
	10	5.5±0.06^{c}	2.01±0.15^{b}	3.2±0.09^{c}	3.5±0.01^{c}	2.2±0.08^{c}
T_4	0	5.0±0.12^{a}	6.0±0.00^{a}	5.6±0.10^{a}	6.4±0.07^{a}	6.4±0.07^{a}
	10	4.8 ±0.14^{a}	5.4±0.00^{a}	5.5±0.10^{a}	5.7±0.07^{a}	5.8±0.00^{a}
T_5	0	4.0±0.16^{b}	4.9±0.17^{b}	4.5±0.26^{b}	5.7±0.27^{b}	4.2±0.22^{cb}
	10	3.7±0.13^{b}	3.9 ±0.07^{b}	4.3±0.05^{b}	3.9±0.01^{b}	2.1±0.21^{cb}

Values are means of 20 replicates ± standard error. Values followed by different letters are significantly different at $p<0.05$. Sensory parameters were measured using seven-point hedonic scales.

(5.8) and the lowest mean value score in T_5 (2.1) considering the texture, color, aroma and taste of mixed fruit jam. Because of changes in texture, flavor components and processing variables such as temperature and storage duration, jam's overall acceptance scores may deteriorate over time (Ullah *et al*., 2015).

CONCLUSION

Titratable acidity, total soluble solid and total sugar of all formulations increased with storage periods of 10 weeks, but pH, ascorbic acid and moisture content decreased marginally, according to the compositional investigation. T_5 (150 g pineapple pulp, 150 g papaya pulp and 20 g *Aloe vera* pulp) has a greater level of TSS, titratable acidity, moisture and ascorbic acid and a lesser level of total sugar, but the formulation T4 outscored the other formulations in terms of overall acceptance during a 10-week period. Throughout the storage period, there was a minor decline in the jam's chemical composition and sensory parameters, but they were all within acceptable limits. T_4 was considered best for jam preparation in terms of chemical constituents as well as sensory attributes. It is highly appropriate to use *Aloe vera* gel in fruit jam.

Conflict of interest: None.

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