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Effect of Storage on Quality Parameters of Wood Apple (*Feronia Limonia L.*)-Lemon (Citrus Limon) Squash

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ABSTRACT

In spite of richness in nutritional and medicinal values wood apple (feronia limonia) among the several fruits, in India, is still underutilized because of lack of knowledge of processing technologies. The developing of processing technologies of wood apple is, therefore, very important to popularize its utilization and to harvest its medicinal values. This study, thus, deals with the development of technologies for juice extraction and for preparation of squash. Three squash, consequently, samples were prepared using extracted juice of wood apple and lemon in 100:0, 90:10 and 80:20 proportions. Squash with 80% wood apple and 20% lemon among these was found best during the sensory evaluation. Quality characteristics of developed squash were evaluated in terms of titratable acidity, ascorbic acid, total soluble solids, browning index, pectin content and sensory characteristics in terms of color, flavor and taste that are very considerable for the soft drinks. This study is, therefore, very useful in the view of processing and preservation of wood apple and could be the win-win process for both producer and consumer among the soft drinks in terms of money (for producer) and medicinal values (for consumer).

Keywords: *Wood apple, Squash, Storage, Quality, Development.*

INTRODUCTION

Feronia limonia L. (wood apple), is a tropical fruit plant of Rutaceae family has vast array of health benefits mainly due to their nutrients, vitamins, and organic compounds, including their tannins, calcium, phosphorous, fiber, protein, iron, etc [1]. Wood apple considered good natural source of anti-oxidants due to its potential radical scavenging activity of various phytochemicals [2]. Wood apples also known as elephant apple, monkey fruit, crud fruit, kath bel and other dialectal terms across India. In Malaya it is called gelinggai or belinggai; in Thailand ma-khwit; in Cambodia kramsang; and in Laos ma-fit. In French, it is known as pomme d' elephant, pomme de bois or citron des mois [3]. Wood apple is a highly under-utilized fruit. Its utilization, thus, can be increased by developing different products such as jam, jelly, pickles, fruit bar, squash, etc. using preservation technologies. Such processed food product from wood apple can also be utilized during the off-season. Jam, jellies, fruit bar and other preserves are some very important by product of fruits manufactured in the industries and are commonly based upon the high solids-high acid principle. These important methods of preservation are not only preserving the fruit concentrates, but also it is an important way of utilization of fruits. In addition to the pleasing taste of such preserved fruits, they possess substantial nutritive value also. Wood apple has got high medicinal value. Every part of the fruit has got its medicinal property. Wood apple is used in India as a liver and cardiac tonic, and when unripe, as a means of halting diarrhea and dysentery and for effective treatment for hiccough, sore throat and disease of the gums [4]. The pulp of wood apple has anti-inflammatory, antipyretic and analgesic activity [5] and anti-diabetic and antioxidant potential by reducing the level of blood glucose and malondialdehyde [6]. Wood apples also have hypoglycemic activity, antitumor, larvicidal and antimicrobial activity and hepato protective activity [4] and can be eaten raw, but it is popularly scooped out and frozen, or made into jam. It can also be mixed with coconut milk for a delicious, health beverage, or frozen into ice

cream. In addition, the pulp is made into a poultice to be placed onto bites and stings of venomous insects, as is the powdered rind. The leaves, bark, roots and fruit pulp are all used against snakebite [3] and for the treatment of anti-tumor and antimicrobial activity [7]. The wood apple, therefore, has been realized as a significant contributor to human well being and found cheaper and better source of protective foods. However, their perishable nature and seasonality in production implies for preservation of them to be supplied throughout the year for human consumption.

In spite of high medicinal values, various products such as chutney, jam, jelly [8], fruit bar wine, sherbet/squash, powder [9], etc are prepared from wood apple and every parts of wood apple has medicinal property. Wood apple products are now getting popularity and much attraction for consumers because of its high nutritious values. Further, Lemon is rich in vitamin C and has some antimicrobial activity and contains sugar, organic acid, carotenoids, flavonoids and pectin. In addition to this, lemon like citrus fruits contains a variety of vitamins, minerals, fiber, and phytochemicals and limonoids, which appear to have biological activities and health benefits. There is considerable evidence that citrus fruit have antioxidant and antimutagenic properties and positive associations with bone, cardiovascular, and immune system health [10].

Considering the above traditional facts about the wood apple, the goal of this study is to develop preservation technology for wood apple to harvest its nutritional and medicinal value. In this context, the wood pulp and juice were extracted and wood apple–lemon based squash has been developed. Finally, its physicho-biochemical quality, sensory characteristics, and shelf life of developed squash samples have been investigated in this research.

Materials And Methods

Fresh harvested and of different size of wood apples were procured from the local market of Hardoi districts of Utter Pradesh (India). It was ensured that the fruits were free from external defects, dirt and diseases during the procurement. However, fruits maturity was not ensured during the procurement. Hence, to confirm their maturity/immaturity, the fruit's were dropped onto the solid surface from a height of 30 cm (1 foot) at ambient temperature. Immature fruits were bounced while the mature fruits do not. After confirmation of their maturity, selected fruits were kept in the open sunlight for the period of 10-14 days for the fully ripen of the fruits [11]. After fully ripening, the pulp from fruit was removed and utilized further for extraction of wood apple juice.

Juice Extraction Technique from Wood Apple Pulp

Mature ripe wood apples were selected and cracked with the help of wooden hammer. Peels were separated and pulps were collected using domestic sharp knife very carefully. This method, however, is useful only for very small scale pulp and peel production/separation of wood apple. As, this method (removing of pulps with the help of domestic sharp knife) is needed extra care to avoid any accident during pulp separation/production. Thus, obtained wood apple pulps were added with water in the ratio of 1:2 and finally this mixture was heated at temperature 88-99^{0}C in an open pan. Wood apple juice was extracted in the water during the heating. Before start of the boiling of mixture, wood apple juice strained using muslin cloth along with water. Such collected wood apple juice was then cooled down at ambient temperature (28±2^{0}C), packed in glass bottles and stored at refrigerated condition (5^{0}C) for further use (Fig. 1).

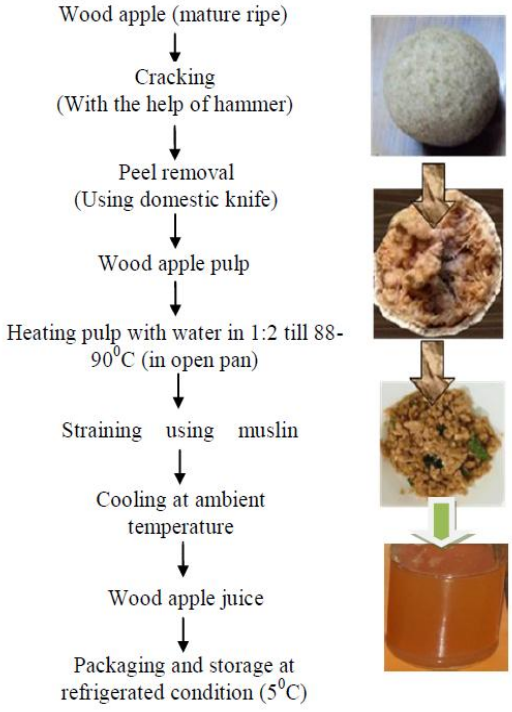

Figure1. *Standardized technique for extraction juice from wood apple pulp*

Preparation of Wood Apple Squash

This type of fruit beverage commercially contains at least 25% fruit juice or pulp and 40-50% total soluble solids, besides about 1% acid [12]. It is diluted before serving with normal potable solution containing sugar, water and citric acid.

Using extracted wood apple juice, three samples of wood apple squash were prepared following the method described by Srivastava and Kumar [12].

The TSS was adjusted and then it was filled in sterilized bottles, crowned and pasteurized for 30 min at 85°C. Followed by cooling and wax sealing to ensure air tightness. Bottled samples were stored at refrigerated storage conditions for further storage studies. Three types of wood apple squash were prepared using the wood apple and lemon blend in proportion 100:0, 90:10 and 80:20, respectively.

First type of squash (S_1) has 100% wood apple juice or of pure wood apple juice, second type of squash (S_2) has 90% and third (S_3) type of squash has only 80% wood apple juice, respectively. Squash samples were packed in glass bottles. Quality evaluation based on physico-chemical parameters and sensory characteristics (colour, flavor and taste) were carried out for fresh sample and during the storage at every interval of 15 days (i.e. 15, 30, 45, 60, 75, 90 days) under refrigerated storage conditions.

Quality Evaluations

Quality characteristics of developed squash were analyzed in terms of TSS, titratable acidity, ascorbic acidity, browning index (optical density) and pectin content. Sample was thoroughly mixed before analysis and filtered using a muslin cloth. A few drops of sample were taken on prism of digital Refractometer (model NR151 EXTECH instruments) and direct reading studied on the scale as described in AOAC [13] at room temperature (range from 32 °C). Similarly, the titratable acidity of the sample was determined using method described in AOAC [13].

Analysis of ascorbic acid, pectin content, browning index and ascorbic acid was carried out by the analytical method as recommended by Ranganna [14]. The sensory quality attributes viz. color, flavor, and taste of the samples were also evaluated. Hedonic rating test as recommended by Ranganna [14] was used for the purpose of sensory evaluation. Homogenous sample was prepared by blending the required amount of wood apple pulp and juice of wood apple in a mortar-pastor as per required TSS level. New piece of cloth was used for filtering each sample.

Data Analyses

All experiments were carried out in triplicate. Experimental data obtained were statistically analyzed using SPSS software (version 16) to test significance by ANOVA. The maximum, minimum and coefficient of variation (CV) were obtained using Microsoft Excel (2007) software.

Results and Discussion

Present study was carried out for development, quality evaluation and storage behavior of wood apple based squash (WAS). Three level of lemon (0%, 10% and 20%) were used for the preparation of wood apple squash. Three samples of squash based on wood apple, thus, were prepared. The results of study have been represented in different tables and graphs

Quality of Fresh Wood Apple Squash and Effect of Lemon Juice Blend

Physico-chemical properties of wood apple squash samples evaluated just after the preparation (fresh) are given in the Table 1. Acidity, vitamin C, TSS and browning index were found to be higher for the sample S_3 as 0.71, 30.36±0.21, 49.3±0.2 and 0.145, respectively than the S_1 and S_2. But, the pectin content of sample S_1 was found to be 0.874 which is higher as compared to other samples prepared from 10% and 20% concentration of lemon.

The acidity, Vitamin C, TSS and browning index of all squash sample were varied between 0.49 and 0.719%, 25.36 and 30.36, 47.8 and 49.3, and 0.137 and 0.145, respectively (Table 1).

The sample S_3 with 20% lemon concentration has highest TSS value while sample S_1 without (0%) lemon concentration has the lowest TSS content. The sensory score of all attributes (color, flavor and taste) of all samples in fresh condition were found between like very much and like extremely in the 9-point Hedonic Scale.

This scale is most widely used for measuring food acceptability. Thus, the developed squash

at fresh condition is acceptable in between like very much and like extremely.

Table1. *Quality parameters of wood apple-lemon based squash just after preparation*

Samples	Quality parameters							
	Acidity, %	Vitamin C (AA) ,mg/100ml	TSS, ^{0}brix	Browning index	Pectin, %	Sensory quality		
						Color	Flavor	Taste
S_1	0.49(±0.00)	25.36(±0.03)	47.8(±0.30)	0.137(±0.00)	0.874(±0.00)	8.5(±0.53)	8.1(±0.34)	7.9(±0.32)
S_2	0.53(±0.00)	29.44(±0.02)	48.5(±0.10)	0.143(±0.00)	0.793(±0.00)	8.7(±0.48)	8.5(±0.53)	8.5(±0.53)
S_3	0.71(±0.00)	30.36(±0.21)	49.3(±0.20)	0.145(±0.00)	0.541(±0.00)	8.6(±0.52)	8.7(±0.48)	8.7(±0.48)

**Each values is mean ± standard deviation of 3 replicate, S_1: 100%wood apple juice and 0%lemon juice; S_2: 90% wood apple juice and 10% lemon juice; S_3:80%wood apple juice and 20% lemon juice*

The selected concentration of lemon and wood apple juice were 0%-100%, 10%-90% and 20% -80%. Table 2 shows the effect of lemon blend on quality parameters wood apple (WA) based squash. Acidity, vitamin C, TSS and browning index of squash were found to be increased significantly ($p<0.05$) as the proportion of lemon blend increased from 0% to 10% and then 20%. In contrast, pectin content of wood apple squash decreased significantly ($p<0.05$) with the increment of lemon proportion. All parameters differs significantly among the all three samples S_1 (100% WA), S_1 (90% WA+ 10% Lemon) and S_1 (80% WA+ 20% Lemon) (Table 2).

Table2. *Effect of treatment (lemon blend) on biochemical properties of wood apple squash*

Sample type	Bio-chemical parameters				
	Acidity, %	Vitamin C, %	TSS, ^{0}brix	Browning Index	Pectin, %
S_1 (100% WA)	0.413^c	21.790^c	49.167^c	0.1731^c	0.874^a
S_2 (90%WA+10%L)	0.446^b	23.949^b	49.662^b	0.187^b	0.793^b
S_3 (80%WA+20%L)	0.518^a	26.666^a	50.381^a	0.205^a	0.541^c
Std Error (±)	0.001	0.002	0.084	0.003	0.001
Grand mean value	0.459	24.135	49.737	0.188	0.736
Significance level	***	***	***	***	***

Effect of Storage Period on Quality of Wood Apple Squash

Effect on Acidity

Table 3 shows the values of acidity of wood apple squash samples determined during the storage at refrigerated temperature. The storage study revealed that the acidity of wood apple squash decreased significantly ($p<0.05$) with respect to the storage period (Table 4). The decrease in acidity was observed during storage attributed might be due to the chemical interaction between the organic constituents of the juice induced by the temperature and action of enzymes. Figure 2 represents the equation of linear regression and value of correlation coefficient (R^2), between 0.878 and 0.990. The negative sign in the regression equation shows that there was continuous decrease in acidity of wood apple squash samples during 90 days of refrigerated storage. Acidity of wood apple squash was found 0.579 and 0.374 at 90 days of storage, respectively. The correlation was found to be almost perfect as the value of R^2 of wood apple squash sample was found to approach 1. The present findings are in close conformity with the previous finding of Alaka et al. [15] who observed that the total titratable acidity declined during storage for both fortified and unfortified samples of guava juice stored in different packaging treatments due to the breakdown of ascorbic acid and citric acid. However, this study was differed from the findings of Kumar and Deen [16] that the acidity increased slightly during the storage of for wood apple squash.

Table3. *Effect of 90 days refrigerated storage on quality parameters of wood apple-lemon based squash*

Squash samples	Refrigerated Storage periods (days)						
	0	15	30	45	60	75	90
Acidity (%)							
S_1	0.49	0.457	0.434	0.412	0.386	0.359	0.349
S_2	0.53	0.523	0.462	0.436	0.416	0.386	0.364
S_3	0.71	0.637	0.503	0.488	0.451	0.425	0.408
Vitamin C (mg/100ml)							

S_1	25.36	24.24	23.14	22.05	20.93	19.46	17.3
S_2	29.44	27.76	26.08	24.44	22.89	19.48	17.5
S_3	30.36	29.16	28.04	26.47	25.75	23.86	22.7
Total soluble solids (^{0}brix)							
S_1	47.8	48.17	48.57	49.3	49.5	50.27	50.56
S_2	48.5	48.73	49.1	49.66	50.3	50.63	50.6
S_3	49.3	49.4	49.83	50.53	50.5	51.4	51.5
Browning Index (O.D)							
S_1	0.137	0.153	0.175	0.187	0.196	0.215	0.229
S_2	0.143	0.157	0.179	0.186	0.204	0.219	0.231
S_3	0.145	0.166	0.193	0.202	0.221	0.242	0.263
Pectin, %							
S_1	0.874	0.874	0.874	0.874	0.874	0.874	0.874
S_2	0.793	0.793	0.793	0.793	0.793	0.793	0.793
S_3	0.541	0.541	0.541	0.541	0.541	0.541	0.541

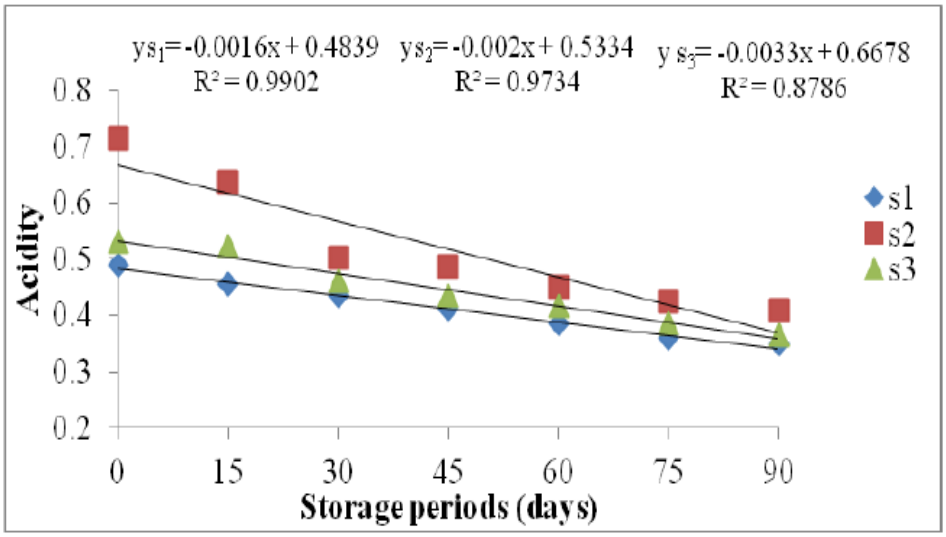

Figure2. *Effect of 90 days refrigerated storage on acidity of wood apple-lemon based squash*

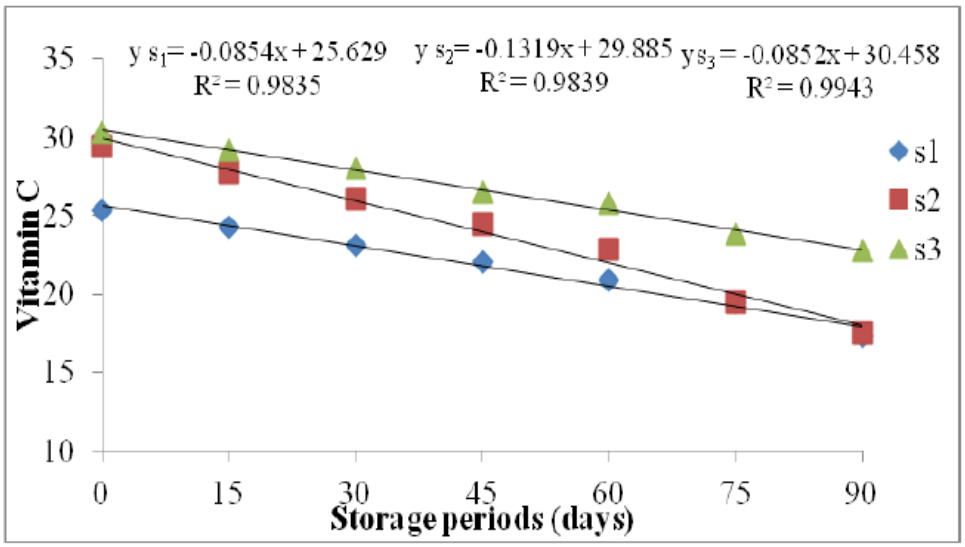

Figure3. Effect of 90 days refrigerated storage on vitamin C of wood apple-lemon based squash

Effect on Vitamin C/ascorbic acid (AA)

The Vitamin C content of wood apple squash samples were determined at every 15 days during 90 days of storage at refrigerated temperature. The obtained values of Vitamin C content, before and after storage period (15, 30, 45, 60, 75 and 90 days) are presented in Table 3. It was observed that Vitamin C content

decreased significantly ($p<0.05$) with increased in storage period (Table 4). Storage study revealed that Vitamin C content decreased progressively in all samples during storage and was observed as its lowest level after 90 days of storage. The loss in Vitamin C content during storage was attributed. Ascorbic acid is sensitive to heat and is oxidized quickly in the presence of oxygen. Hence, it might have been destroyed during processing and subsequently during the storage period due to its oxidation. A gradual loss in ascorbic acid during storage of litchi beverages was observed which may be due to the effect of storage temperature and catalytic activity of fructose in the catabolization of vitamin C.

The linear regression equation and correlation coefficient (R^2) are shown Fig (3). The R^2 values were found between 0.983 and 0.994. The negative sign in the regression equation shows that there was continuous decrease in Vitamin C contents of wood apple squash samples during 90 days of refrigerated storage. Similar results were obtained by Maria et al. [17] who observed that the ascorbic acid (vitamin C) contents were decreased with the storage period.

Effect on Total Soluble Solids (TSS)

TSS of wood apple squash samples was determined just after preparation of squash and at 15, 30, 45, 60, 75 and 90 days of refrigerated storage (Table 3). The TSS value of wood apple squash samples of was found to be increased with the storage period. The TSS of sample S_3 was found to be highest (51.5) while the TSS value of sample S_1 had lowest value (50.56) after 90 days of refrigerated storage. The storage study shows significant ($p<0.05$) increase in TSS of wood apple squash during refrigerated storage (Table 4). This phenomenon may be due to increment in total soluble solids content of juice during storage which is desirable for the preservation of good juice quality. The increment in total soluble solids contents in the squash samples with respect to the storage might be due to hydrolysis of polysaccharides into monosaccharide and increase in concentration of juice due to dehydration.

Table4. *Effect of 90 days refrigerated storage on biochemical properties of wood apple-lemon based squash*

Storage periods	Bio-chemical parameters				
	Acidity, %	Vitamin C, mg/100ml	TSS, ^{0}brix	Browning Index	Pectin, %
0 day	0.579^a	28.481^a	48.567^a	0.149^e	0.736^a
15 days	0.538^b	27.057^b	48.767^a	0.157^e	0.736^a
30 days	0.466^c	25.753^c	49.167^b	0.177^d	0.736^a
45 days	0.446^d	24.322^d	49.833^b	0.187^c	0.736^a
60 days	0.418^e	23.181^e	50.167^c	0.201^b	0.736^a
75 days	0.392^f	20.939^f	50.767^c	0.215^a	0.736^a
90 days	0.374^g	19.211^g	50.889	0.232^a	0.736^a
Std Error (±)	0.001	0.031	0.055	0.002	0.001
Significance level	***	***	***	***	NS

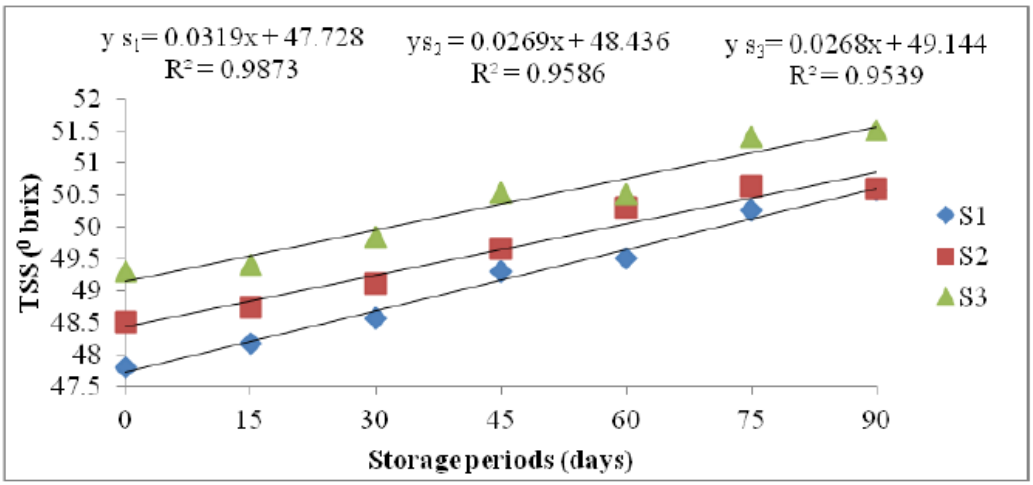

Figure4. *Effect of 90 days refrigerated storage on TSS of wood apple-lemon based squash*

Similar results have also been reported by Kumar and Dean [18] for wood apple RTS (ready to serve) beverages. The other probable reason might have been the barrier property of glass with respect to permeation of water vapour from environment. Figure 4 shows the graphical

relation between TSS and refrigerated storage periods (days) of wood apple squash samples S_1, S_2 and S_3. The equation of linear regression and correlation coefficient (R^2) has been shown in corresponding regression graph. It was found that R^2 values of wood apple Squash samples in the regression graph were between 0.953 and 0.987. The positive sign in regression equation shows there was continues increase in TSS of wood apple squash samples during 90 days of refrigerated storage. The correlation was found to almost perfect as the value of R^2 was approach 1.

Effect on Browning Index (Optical Density)

Optical density of wood apple squash samples was determined just after preparation of squash (fresh) and after 15, 30, 45, 60, 75 and 90 days of storage at refrigerated temperature (Table 3). Optical density is the physical property associated to the presence of pigments in any sample found to be increased significantly ($p<0.05$) with the storage period (Table 4). The value of optical density was 0.149 and 0.232 at 0 and 90 days of storage. This increment in optical density might be attributed due to the non-enzymatic browning during the storage. Non enzymatic maillard browning reaction takes place between nitrogenous compound and organic acids, sugar and organic acid and among organic acids themselves [12]. In case of wood apple squash samples, however, Maillard browing would have takes place due to reaction between sugar and organic acid. Since, also Potassium Meta Bisulphate (KMS) was used in the preparation; maillard browning was largely inhibited leading only to a slight increase in browning index. Figure (5) shows the graphical relation between browning index and refrigerated storage (days) of wood apple squash sample (S_1, S_2 and S_3). The linear regression has been shown in Fig (5). The equation of linear regression and correlation coefficient (R^2) has been shown in corresponding regression graph. It was found that R^2 values in the regression graph were between 0.957 and 0.992. The positive sign in the regression equation shows that there was continuous increase in browning index contents of wood apple jelly samples during 90 days of refrigerated storage. The correlation was found to be almost perfect as the value of R^2 of wood apple squash ample was found to approach 1. This study was close conformity with findings of Kumar and Deen [16] reported for wood apple squash.

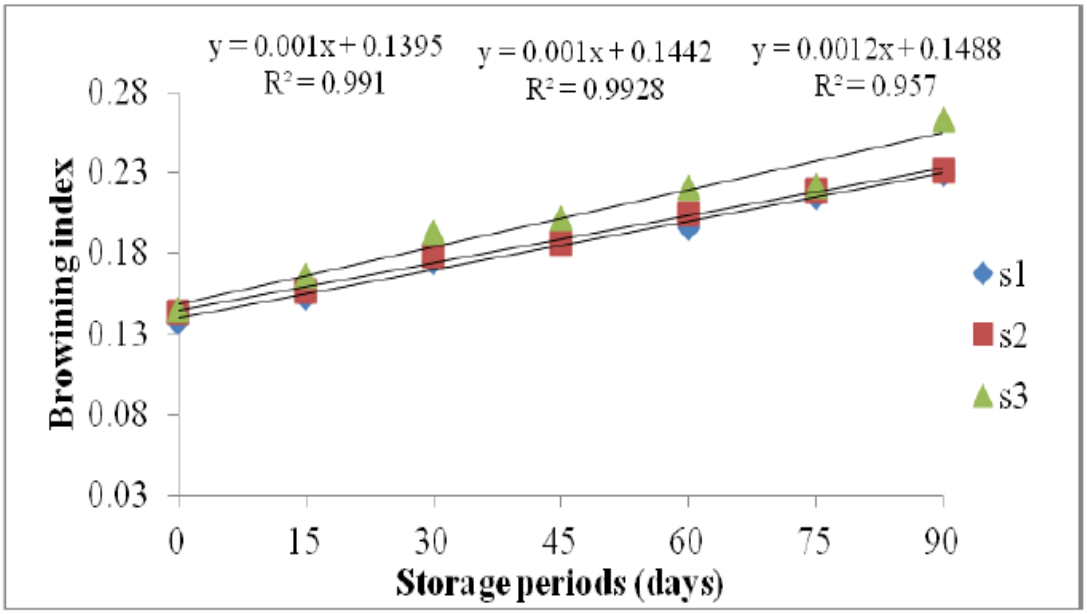

Figure5. *Effect of 90 days refrigerated storage on browning index of wood apple-lemon based squash*

Effect of Storage Period on Pectin Content

Pectin is a complex polysaccharide due to the complicated chemical composition and structure. Tables 3 and 4 showed that the pectin content of all squash samples remains constant during the 90 days of refrigerated storage (Figure 6). The regression graph show a straight line which indicate that there is no effect of storage and treatment and storage on pectin. There is no. value of R^2 (Figure 6). This was might be due to the refrigerated storage of all squash samples. As freezing destroyed only the gel-producing qualities of liquid pectin, but liquid pectin will keep for two years in a cool, dry place [19]. Similar result has also been

reported by the Porrit [20] during the effect of temperature on postharvest physiology and storage life of pears. The pectin content of wood apple-lemon based squash samples S_1, S_2 and S_3 were found to be 0.874, 0.793 and 0.541 %, respectively.

Effect on Sensory Qualities

Sensory qualities were evaluated for fresh as well as stored samples after preparation and 15, 30, 45,60,75,90 days of storage at refrigerated temperature. Samples were diluted using normal portable water before they were served to panelist. Colour, flavor and taste were selected as sensory attributes on 9 point hedonic scale. Table 5 represents the averages score awarded by all panelists for individual attributes and also the averages of all attributes. The sensory attributes found to be decreased with the advancement of storage period. Similar result has also been reported by the Kumar and Deen [16]

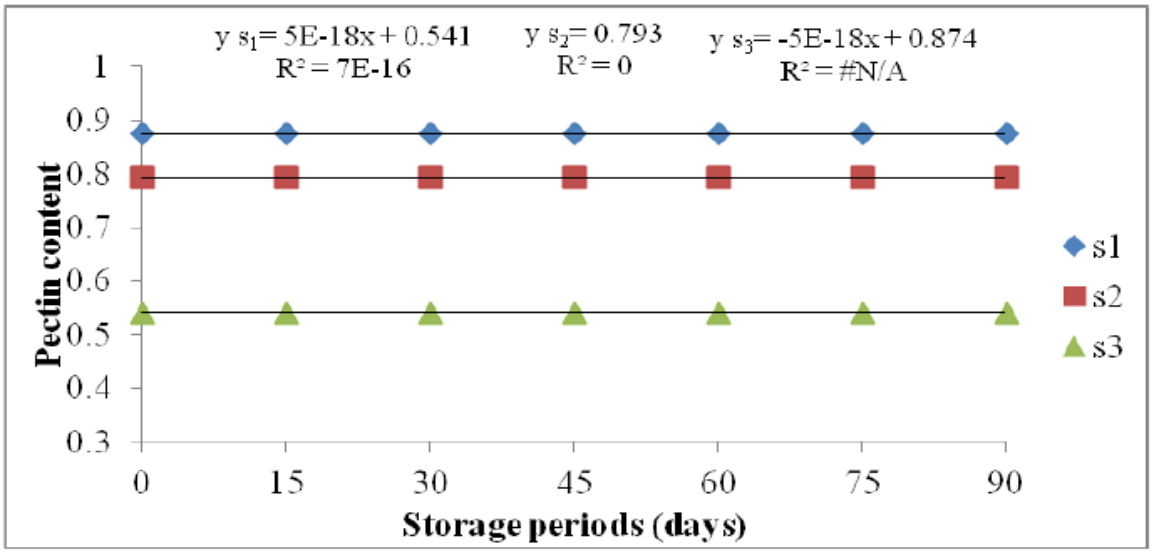

Figure6. *Effect of 90 days refrigerated storage on pectin content of wood apple-lemon based squash*

Table5. *Effect of 90 days refrigerated storage on sensory quality of wood apple squash Each value is mean ± standard deviation of 3 replicates*

Sample	Storage periods						
	0	15	30	45	60	75	90
Colour							
S_1	8.5±0.53	8.5±0.53	8.4±0.52	8.2±0.42	8.1±0.34	8.0±0.31	7.8±0.26
S_2	8.7±0.48	8.5±0.53	8.4±0.0.52	8.3±0.41	8.1±0.34	7.9±0.30	7.7±0.29
S_3	8.6±0.52	8.5±o.53	8.4±0.52	8.1±0.34	7.9±0.32	7.7±0.29	7.3±0.57
Flavor							
S_1	8.1±0.34	8.0±0.31	7.8±0.26	7.8±0.26	7.7±0.29	7.6±0.23	7.5±0.21
S_2	8.5±0.53	8.3±0.41	8.1±0.34	7.9±0.34	7.7±0.29	7.6±0.23	7.5±0.21
S_3	8.7±0.48	8.6±0.52	8.4±0.52	8.2±0.42	8.0±0.31	7.9±0.30	7.8±0.26
Taste							
S_1	7.9±0.32	7.8±0.26	7.7±0.29	7.6±0.23	7.5±0.21	7.3±0.15	7±0.37
S_2	8.5±0.53	8.4±0.52	8.2±0.42	8.1±0.43	8.0±0.44	7.8±0.26	7.7±0.20
S_3	8.7±0.48	8.6±0.52	8.5±0.53	8.3±0.67	8.1±0.43	7.9±0.32	7.7±0.29

All the samples were rated between like extremely and like very much. In general the concentration of lemon changes the colour and the colour of 10% lemon was very good score for colour is 8.7. Flavor was found to have scored best in sample containing 20% lemon concentration 8.7. On an average, sample with 20% lemon concentration was rated best. Taste in was found to have scored best value of 8.7 sample containing 20% lemon concentration. Decrease in score awarded as the lemon concentration.

CONCLUSION

The storage study revealed that the titratable acidity and ascorbic acid (vitamin C) of wood apple-lemon based squash samples (S_1, S_2 and S_2) decreased significantly ($p<0.05$) with the refrigerated storage. In contrast to above, the TSS and browning index (O.D) of all squash

samples (S_1, S_2 and S_2) were found to be increased significantly ($p<0.05$) as the refrigerated storage period prolonged. But, there was no effect of 90 days refrigerated storage on optical density (browning index) of all samples. The sensory characteristics (colour, flavor and taste) evaluated using 9 point Hedonic Scale showed that all samples were like very much at 90 days of refrigerated storage. However, the change in concentration of lemon changes the colour of wood apple squash.

The colour score of squash having 10% lemon blend was found to be more (i.e. 8.7) than wood apple squash sample containing 0% and 20% lemon. On an average, sample with 20% lemon concentration was rated best. However, the sample with 20% lemon concentration was rated best on an average. This research, therefore, revealed that by adopting the developed processing technologies the utilization of underutilized wood apple fruit can be increased and consequently losses can be minimized. Through squash development, various medicinal compounds of wood apple can be preserved and it utilization can be benefited to the patient of cancer and cardiovascular diseases. In addition, inflammatory disorders, neurological degeneration, wound healing, infectious diseases and aging, and antibacterial, antitumor, antifungal, antioxidant and other various medicinal values in wood apple can also be harvested.

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