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A STUDY OF INCORPORATION OF THERAPEUTIC VALUES OF WOOD APPLE (*FERONIA LIMONIA* SWINGLE) IN FRUIT BAR

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Keywords:

Wood apple, *Feronia limonia*, therapeutic value, Bar, Nutritional composition, Sensory quality, Storage.

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ABSTRACT: The wood apple (*Feronia limonia*), called as elephant apple, has several medicinal properties. It is antiscorbic (prevent scurvy), a disease caused by lack of vitamin C (ascorbic acid). It is an antidote for poison and also helps in curing sore throat. The objective of the study was to incorporate medicinal properties of wood apple in fruit bar, a well accepted food product. The fruit bar was prepared by using different proportions of wood apple and mango. Fruit bars were analyzed for chemical composition at monthly interval of one month storage at room temperature (16-35°C). Increasing trend in carbohydrate, acidity, TSS and reducing sugar was observed where as decrease in ascorbic acid, pH and total sugar was noted throughout the storage period. Organoleptic qualities of wood apple mango blended bar (50:50) were evaluated in comparison with control sample (wood apple fruit bar). The results on sensory parameters indicated that blended bar was superior in most of the quality attributes. Storage upto six months could be possible with wood apple mango bar and the results showed that the product remained safe microbiologically during storage and acceptable after 6 months of storage and no appreciable change was observed. It was found that the medicinal properties of wood apple can be consumed by the consumer by consuming fruit bar.

INTRODUCTION: The wood apple (*Feronia limonia*) is the only species of its genus, in the family Rutaceae. It is also called as elephant apple, monkey fruit, curd fruit, *Kath bel* and other dialectal names in India. Wood apple is erect and slow- growing tree bearing round to oval, 5-12.5 cm wide fruit, with a hard, woody, grayish-white, scurfy rind about 0.5 cm thick. The pulp is brown, mealy, odorous, resinous, astringent, acid or sweetish, with numerous small, white seeds scattered through it. It has several medicinal properties. It is antiscorbic (prevent scurvy), a disease caused by lack of Vitamin C (ascorbic acid). It is an antidote for poison and also helps in curing sore throat.

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The fruit is traditionally a poor man's food and with no known product developed yet remains unutilized. The aromatic pulp from the apple-fruits with a woody shell is eaten as raw and processed *chutney* and the fruit juice by the tribal [1]. The quality of the fruit required exploration of new products with increased shelf life so that it will be available round the year as fresh fruits are having low self life. This paper reports development of wood apple mango mix fruit bar, its quality evaluation and storage life.

MATERIAL AND METHODS:

Ripe 'Wood Apple' fruits, procured from local market and adjoining villages of Jhansi, were washed in running water to remove adhered dust, dirt and mucilaginous substances. Flesh was obtained by breaking the fruit shell and removing the peels. Flesh–water blends were prepared separately by manual mixing of flesh and water in the ratio of 1:2. Blend was heated at 100°C cooled and passed through the muslin cloth.

For the preparation of wood apple mango bar, mango pulp (13° Brix) was mixed with extracted wood apple pulp (6° Brix) in four percentages 10, 30, 50 and 70 percent (**Table 1**). Wood Apple pulp and Mango pulp were blended properly and heated for 10-15 minutes. At this stage, sugar (30 per cent) was added and heated at 80°C for dissolving the sugar. Heating is continued with co current stirring and scraping with the help of a scraper to avoid the burning till desired consistency was obtained and when most of the water gets evaporated. The product became thick in consistency and turned dark brown in colour. The whole mass was poured in tray and dried in the oven at 65-70°C for 24 hr allowed to cool and cutted into smaller pieces were packaged into aluminium foil and polythene and stored at room temperature (16-35°C) (**Fig 1**). Sensory quality of fruit bar was evaluated.

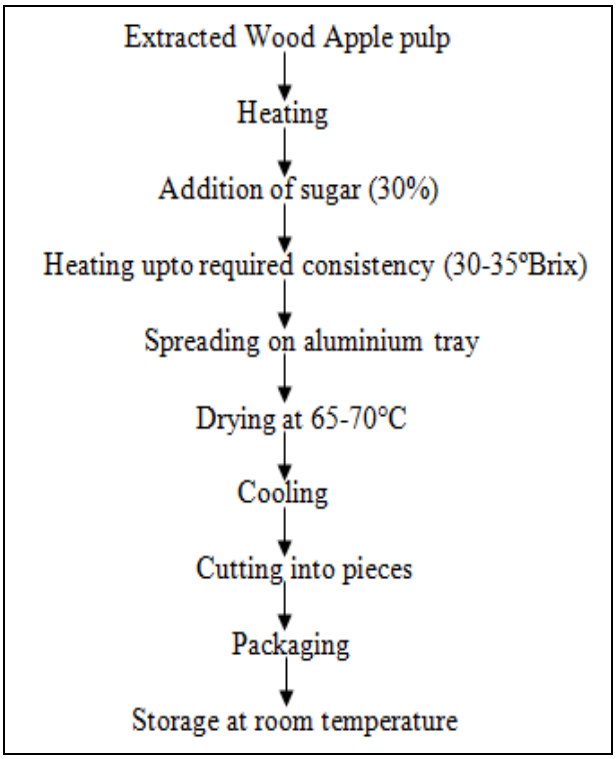

FIG. 1: PREPARATION OF WOOD APPLE FRUIT BAR

Standardization of pulp percentage: Wood apple and mango pulp were blended in the proportion of 90:10, 70:30, 50:50 and 30:70 respectively. The sensory scores were 6.25, 6.30, 7.85 and 6.08 for 90:10, 70:30, 50:50 and 30:70 ratio (Wood Apple pulp: Mango pulp) respectively. The highest sensory score of 7.85 was found for 50:50 ratio of Wood Apple pulp and Mango pulp (**Table 1**). The sensory score of 50:50 ratio was significantly different ($P \leq 0.05$) in comparison to other combinations (CD = 0.508).

TABLE 1: STANDARDIZATION OF THE RATIO OF WOOD APPLE PULP WITH MANGO PULP

Treatment	Colour	Flavour	Taste	Body & Texture	Chewness	Overall Acceptability
WAP:MP(90:10)	6.30	6.05	6.55	6.40	5.95	6.25
WAP:MP(70:30)	6.55	6.00	6.25	6.55	6.15	6.30
WAP:MP(50:50)	8.05	7.65	7.95	7.85	7.75	7.85
WAP:MP(30:70)	6.15	6.00	6.05	5.90	6.30	6.08
CD (5%)	0.558	0.511	0.592	0.575	0.606	0.508
P value	0.01	0.01	0.02	0.02	0.04	0.01

Standardization of sugar percentage: Sugar content was standardized by incorporation of 20, 30 and 40 per cent sugar (**Table 2**). The sensory score for 30 per cent sugar was found highest (7.75) and this was significantly different ($P \leq 0.05$) in comparison to other combinations (CD = 0.365).

TABLE 2: STANDARDIZATION OF THE PERCENTAGE OF SUGAR IN WOOD APPLE BAR

Treatment	Colour	Flavour	Taste	Body & Texture	Chewness	Overall Acceptability
Sugar (20%)	6.80	6.65	5.80	6.60	6.85	6.54
Sugar (30%)	7.80	7.70	7.80	8.00	7.45	7.75
Sugar (40%)	6.65	6.85	6.10	6.10	5.95	6.33
CD (5%)	0.488	0.241	0.857	0.660	0.576	0.365
P value	0.03	0.00	0.04	0.01	0.03	0.00

Storage study:
The prepared wood apple mango bar was wrapped in aluminium foil and packed in air tight polythene and stored at room temperature for six months. Physico-chemical characteristics were evaluated intermittently at the intervals of 0, 1, 2, 3, 4, 5 and 6 months during storage at room temperature (16-35°C) and physico-chemical, organoleptic, textural and microbiological changes were observed.

Physico-chemical characteristics:
The chemical constituents present in wood apple fruit influence the nutritional and storage qualities of the product. The wood apple bar (control) and wood apple mango bar were analysed for proximate composition as per the approved methods. Moisture content was analysed by oven drying method, ascorbic acid content by titration method by using 2, 6, dichlorophenol indophenol dye, total ash, total acidity (as anhydrous citric acid), carbohydrate, sugars [2], TSS [3], protein by micro-kjeldahl method, fat by soxhlet extraction method, calcium and phosphorus were determined by the procedures described by Ranganna [3]. The pH of the bar was determined after blending it with 15 volumes of boiled distilled water. All constituents were analysed at the end of 0, 1, 2, 3, 4, 5 and 6 months of storage at room temperature (16-35°C).

Sensory analysis:
The acceptability of blended Wood Apple bar was evaluated by using ten members panel as per the standard procedure. The product was stored at room temperature (16-35°C). The panelists were asked to judge the samples for colour, flavour, body, texture, chewiness and overall acceptability using a 9-point hedonic scale rating [4].

Microbial analysis:
The microbial quality of the wood apple bar (control) and wood apple mango bar were observed periodically. Microbiological changes were evaluated at the interval of 0, 1, 2, 3, 4, 5 and 6 during storage at room temperature (16-35°C). Total plate count, yeast and mould and coliform count in wood apple mango bar were determined as per the standard method given in [5].

Rheological analysis:
The texture analyzer (model TAXT2i) was calibrated at the beginning of each testing session using a 25 kg load cell. A compression plate (P 75, 75 mm diameter) and cutting probe (HDP/LKB light knife blade perspex) were used in conjunction with a texture analyzer [6] for the determination of sticking characteristics and cutting strength. A 25 kg maximum load cell was used and the pre test speed was set at 2.0 mm for a total travel of 10 mm. Data acquisition was initiated using a trigger force. Cutting strength was measured the pre test speed at 2.0 mm for a total travel of 3.0 mm for bar samples by keeping the bar horizontally and cutting with vertical blade. The force required was noted.

Statistical analysis:
Various physico-chemical characteristics and sensory analysis of wood apple bar (control) and wood apple mango bar were subjected to statistical analysis using ANOVA with statistical software (Systat 11 software).

RESULTS AND DISCUSSION:
Chemical changes during storage: The changes in the chemical constituents were analyzed once in 30 days for 6 months and are given in **Table 3** and **4**.

The moisture content of wood apple bar (control) and wood apple mango bar decreased significantly ($P \leq 0.05$) from 17.40 and 14.80 percent to 13.52 and 10.95 percent respectively on storage. This may be due to the evaporation of water from bar during storage. Earlier researchers observed [7] that the moisture content of papaya bar decreased significantly from 19.62 to 17.40 per cent during 9 month storage. The fat content of wood apple bar

(control) and wood apple mango bar was non significantly decreased from 0.48 and 0.46 to 0.45 and 0.43 percent respectively during 6 months of storage. The initial protein content of wood apple bar (control) and wood apple mango bar was 2.20 and 1.98 percent which had decreased significantly (P≤ 0.05) to 1.92 and 1.84 percent respectively after 6 months of storage. It was observed [8] that the initial protein content of protein enriched sapota bar was 9.60 g percent which had decreased to 9.31 g percent after six months storage while others [7] observed no significant changes in protein content (from 7.39 to 7.33 g percent) in cereal based papaya powder during storage for 9 months.

A remarkable increase in the carbohydrate content of the wood apple bar (control) and wood apple mango bar was noted throughout the storage period. The initial carbohydrate content of wood apple bar (control) and wood apple mango bar was 78.70 and 81.64 percent and increased to 82.86 and 85.62 percent respectively after the 6 months of storage.

The initial ascorbic acid content of wood apple bar (control) and wood apple mango bar was 64.34 and 62.20 mg/100g which had decreased to 50.18 and 46.78 mg/100g respectively after 6 months of storage at room temperature. The ascorbic acid content decreased in control and Mango bar during storage at room temperature [9]. Similar pattern of decreasing trend of ascorbic acid in Papaya bar during 9 month storage was reported by [7]. The jack fruit bar samples showed reduction in ascorbic acid content from 7.30 to 4.75 mg mg/100g after 180 days of storage [10]. It was observed [11] that the initial ascorbic acid content in mixed fruit bar (50:50 ratio of Mango pulp: Banana pulp) was 6.6 mg/100g, which had reduced to 5.0 mg/100g after 5 months of storage.

A gradual increase in the acidity of wood apple bar (control) and wood apple mango bar from 2.35 and 2.44 percent to 2.48 and 2.55 percent respectively was observed throughout the storage period. Earlier researchers reported [7] that protein enriched Sapota bar had acidity of 0.306 percent initially, which increased to 0.398 percent on 6 months of storage. Aruna *et al*. in their experiments on Papaya fruit bar had reported initial acidity of 1.20 percent (as citric acid), which increased to 1.39 percent on 9 month of storage. Doreyappa Gowda *et al*. noted an increase in acidity of Mango bar from 1.4 to 1.5 g percent after 6 months of storage. Similarly, Gayathri and Uthira prepared blended bars (Mango pulp: Papaya pulp), standard-I (75:25) and standard-II (50:50). The acidity content of the standard fruit bars (standard-I and standard-II) increased from 0.5 and 0.55 per cent to 0.80 to 0.76 percent, respectively during 90 days of storage.

The pH declined significantly (P≤ 0.05) from 3.90 and 4.32 percent to 3.63 and 4.07 percent respectively in wood apple bar (control) and wood apple mango bar during storage period. The protein enriched Sapota bar [7] had initial pH of 3.92, which decreased to 3.64 during storage period. Gayathri and Uthira also showed the declining trend of pH in blended fruit bars (Mango pulp: Papaya pulp) from 4.5 to 4.0. The TSS in wood apple bar (control) and wood apple mango bar significantly (P≤ 0.05) increase from 78.90 and 78.1ºBrix to 79.16 and 78.90ºBrix respectively after the 6 months of storage period. A gradual increase in the TSS of the protein enriched Sapota bar from 68.0 to 68.9ºBrix during the storage period [8] of 180 days. Total ash, calcium and phosphorus in wood apple bar (control) and wood apple mango bar were changed non significantly. The Mango and banana fruit bar prepared by Mathur *et al.* contained 0.52 to 0.66g percent ash content.

A remarkable decrease in the total sugar and non reducing sugar of the bar samples were noted throughout the storage period. The initial and final total sugar content of the wood apple bar (control) and wood apple mango bar was noted as 14.25 to 12.18 percent and 14.72 to 10.78 percent respectively. The decline in the total sugar may be due to the utilization by bacteria or conversion of sugar to other products during storage. Saravana and Manimegalai observed that the protein enriched sapota bar had total sugar 53.40 percent initially, which decreased to 52.12 percent during 6 months of storage.

The total sugar in papaya fruit bar decreased significantly on storage [7]. The non reducing sugar ranged from 9.30 and 9.62 percent to 5.26 and 3.88 percent respectively in wood apple bar (control)

and wood apple mango bar during the storage period. The decline in the non-reducing sugar may be due to the conversion of non-reducing sugar to reducing sugar during storage. Aruna *et al.* observed that the non reducing sugar in papaya fruit bar decreased significantly on storage. Significant (P≤ 0.05) decrease in total and non reducing sugars in bar samples might be due to the significant increase in reducing sugars.

The reducing sugar content of the wood apple bar (control) and wood apple mango bar was increased significantly (P≤ 0.05) from 4.95 and 5.10 percent to 5.26 and 3.88 percent respectively. This is might be due to the conversion of non-reducing sugar to reducing sugar during storage. The reducing sugar content of the protein enriched Sapota bar increased from 7.25 to 8.30g per cent [8]. A gradual increase in the reducing sugar content of the Mango bars from 12.73 to 14.92 per cent during 3 months of storage was reported [15]. Chauhan *et. al.* observed that the reducing sugar in mango bar and mango-soy fruit bar after six months of storage changed from 33.00 to 38.80 and 29.60 to 33.40g per cent, respectively.

During storage significant changes were not observed for fat, total ash, calcium and phosphorus, whereas significant changes were noticed in moisture, protein, carbohydrate, Vitamin C, acidity, pH, TSS, total sugars, reducing sugar and non reducing sugar during six months of storage.

TABLE 3a: CHANGES IN CHEMICAL CONSTITUENTS OF WOOD APPLE FRUIT BAR (CONTROL) DURING STORAGE

Storage Period (Month)	Moisture %	Fat %	Protein %	Carbohydrate %	Ascorbic Acid (mg/100g)	Acidity %	PH %	TSS (ºBrix)
0 Day	17.40	0.48	2.20	78.70	64.34	2.35	3.90	78.90
1 Month	17.20	0.48	2.18	78.92	62.98	2.36	3.86	78.92
2 Month	16.80	0.47	2.16	79.34	60.12	2.38	3.85	78.98
3 Month	16.35	0.46	2.12	79.83	58.86	2.42	3.76	79.02
4 Month	15.76	0.46	2.10	80.44	54.44	2.43	3.70	79.08
5 Month	14.64	0.45	1.98	81.68	52.62	2.45	3.67	79.12
6 Month	13.52	0.45	1.92	82.86	50.18	2.48	3.63	79.16
CD (5%)	0.043	NS	0.006	0.045	0.006	0.006	0.006	0.006
P Value	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 3b: CHANGES IN CHEMICAL CONSTITUENTS OF WOOD APPLE FRUIT BAR (CONTROL) DURING STORAGE

Storage Period (Month)	Total Ash %	Calcium (mg/100gm)	Phosphorus (mg/100gm)	Total Sugar %	Reducing Sugar %	Non-Reducing Sugar %
0 Day	1.22	169.60	78.00	14.25	4.95	9.30
1 Month	1.22	169.60	78.00	14.16	5.08	9.08
2 Month	1.23	169.70	78.01	13.92	5.44	8.48
3 Month	1.23	169.70	78.01	13.45	5.86	7.59
4 Month	1.24	169.80	78.02	12.86	6.08	6.78
5 Month	1.24	169.80	78.02	12.68	6.53	6.15
6 Month	1.24	169.80	78.02	12.18	6.92	5.26
CD (5%)	NS	NS	NS	0.005	0.006	0.004
P Value	0.08	0.08	0.08	0.00	0.00	0.00

TABLE 4a: CHANGES IN CHEMICAL CONSTITUENTS OF WOOD APPLE MANGO BAR DURING STORAGE

Storage Period (Month)	Moisture %	Fat %	Protein %	Carbohydrate %	Ascorbic Acid (mg/100g)	Acidity %	PH %	TSS (ºBrix)
0 Day	14.80	0.46	1.98	81.64	62.20	2.44	4.32	78.1
1 Month	14.02	0.46	1.96	82.44	60.00	2.45	4.30	78.2
2 Month	13.78	0.45	1.95	82.68	58.72	2.48	4.27	78.4
3 Month	12.88	0.45	1.92	83.61	56.14	2.50	4.23	78.6
4 Month	11.60	0.44	1.90	85.25	52.62	2.51	4.19	78.8
5 Month	11.15	0.44	1.88	85.37	48.06	2.53	4.13	78.8
6 Month	10.95	0.43	1.84	85.62	46.78	2.55	4.07	78.9
CD (5%)	0.035	NS	0.006	0.123	0.025	0.025	0.025	0.061
P Value	0.00	0.13	0.00	0.00	0.00	0.02	0.00	0.00

TABLE 4b: CHANGES IN CHEMICAL CONSTITUENTS OF WOOD APPLE MANGO BAR DURING STORAGE

Storage Period (Month)	Total Ash %	Calcium (mg/100gm)	Phosphorus (mg/100gm)	Total Sugar %	Reducing Sugar %	Non-Reducing Sugar %
0 Day	1.12	156.70	72.40	14.72	5.10	9.62
1 Month	1.12	156.70	72.40	13.35	5.28	8.07
2 Month	1.13	156.70	72.40	13.30	5.40	7.90
3 Month	1.13	156.80	72.50	12.56	6.20	6.36
4 Month	1.13	156.80	72.50	11.90	6.60	5.30
5 Month	1.14	156.90	72.60	11.20	6.68	4.52
6 Month	1.14	156.90	72.60	10.78	6.90	3.88
CD (5%)	NS	NS	NS	0.035	0.050	0.034
P Value	0.13	0.08	0.08	0.00	0.00	0.00

Organoleptic changes during storage:

According to Kalia and Sood quality is the ultimate criterion of the desirability of any food products. Among various factors which influence quality of products, sensory attributes may be considered as a major factor and these are liable to change during storage. Effect of storage of the organoleptic qualiies of fruit bar samples was assessed during a storage period of six months (**Table 5** and **6**). The initial score for colour of wood apple fruit bar and wood apple mango bar was 7.85 and 8.35 which was decreased to 6.6 and 7.2 after 6 months of storage period. The flavour scores of wood apple fruit bar and wood apple mango bar decreased significantly on storage, had scores (7.75 and 8.25) initially and changed to (6.35 and 7.35). The score of taste showed a declining trend on storage in wood apple fruit bar and wood apple mango bar. The initial score of the fruit bars was 7.65 and 8.3, which had decreased to 6.05 and 7.1 after six months of storage. The texture of wood apple fruit bar and wood apple mango bar was 7.95 and 8.43 and ranged from 6.43 to 7.3. The chewness of wood apple fruit bar and wood apple mango bar was analyzed during the storage period. It had 7.75 and 8.40 score initially and had changed to 5.80 and 7.40 respectively after six months of storage. A significant decrease in overall acceptability scores of wood apple fruit bar and wood apple mango bar was (7.79 and 8.29) initially and decreased to (6.25 and 7.27) during the storage period. During storage changes in the sensory attributed of bar samples were significant but the product was acceptable after six months of storage.

TABLE 5: CHANGES IN SENSORY ATTRIBUTES IN WOOD APPLE FRUIT BAR (CONTROL) DURING STORAGE

Treatment	Colour	Flavour	Taste	Body & Texture	Chewness	Overall Acceptability
0 Day	7.85	7.75	7.65	7.95	7.75	7.79
1 Month	7.70	7.55	7.55	7.65	7.50	7.59
2 Month	7.20	7.10	7.15	7.15	7.15	7.15
3 Month	6.95	7.00	7.00	6.90	7.00	6.97
4 Month	6.85	6.90	6.90	6.85	6.85	6.87
5 Month	6.65	6.65	6.55	6.60	6.45	6.58
6 Month	6.60	6.35	6.05	6.45	5.80	6.25
CD (5%)	0.255	0.242	0.279	0.238	0.225	0.209
P Value	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 6: CHANGES IN SENSORY ATTRIBUTES IN WOOD APPLE MANGO BAR DURING STORAGE

Treatment	Colour	Flavour	Taste	Body & Texture	Chewness	Overall Acceptability
0 Day	8.35	8.25	8.30	8.43	8.40	8.29
1 Month	8.25	7.65	7.99	7.75	8.00	7.92
2 Month	8.05	7.55	7.75	7.65	7.65	7.73
3 Month	7.75	7.55	7.35	7.50	7.60	7.55
4 Month	7.75	7.50	7.30	7.35	7.50	7.48
5 Month	7.35	7.35	7.15	7.30	7.50	7.33
6 Month	7.20	7.35	7.10	7.30	7.40	7.27
CD (5%)	0.223	0.188	0.213	0.185	0.190	0.156
P Value	0.00	0.03	0.00	0.00	0.00	0.00

Microbial changes during storage:
Microbial food safety is an essential component of food quality. Quality is a combination of characteristics that have significance in determining the degree of acceptability of the product to the consumer.

Microbial count was not observed upto three months of storage but after six months of storage microbial counts were noticed, which were negligible in number and safe to consume.

Rheological changes during storage:
Adhesiveness and cuttingness will give an idea about the chewing characteristics of the bar. Initially the adhesiveness of wood apple fruit bar and wood apple mango bar was -0.108 and -0.110 kg, which had increased 0.114 and -0.116 kg respectively further on months storage with the storage period **(Table 7**). The cutting strength of wood apple fruit bar and wood apple mango bar was 2.80 and 3.04, which had decreased to 2.16 and 2.12 respectively after six months of storage.

TABLE 7: CHANGES IN TEXTURE OF BAR SAMPLES DURING STORAGE

	Adhesiveness (kg)		Cuttingness (kg)	
Treatments	Wood Apple Fruit bar(Control)	Wood Apple Mango Bar	Wood Apple Fruit bar(Control)	Wood Apple Mango Bar
0 Days	-0.108	-0.110	2.80	3.04
1 Month	-0.108	-0.112	2.57	2.80
2 Month	-0.109	-0.112	2.52	2.68
3 Month	-0.110	-0.113	2.47	2.36
4 Month	-0.110	-0.114	2.43	2.33
5 Month	-0.112	-0.114	2.36	2.16
6 Month	-0.114	-0.116	2.16	2.12
CD (5%)	0.001	0.001	0.11	0.113
P Value	0.01	0.00	0.01	0.00

When the adhesiveness of bar samples were increased, cutting strength of bar samples were declined with the storage period. These changes in bar samples occurred might be due to the presence of sugar and increase in the concentration of invert sugar and reducing sugar during storage.

SUMMARY AND CONCLUSION: The control sample (wood apple fruit bar) prepared by 100 percent pulp and wood apple mango bar (50:50, wood apple pulp: mango pulp) was preferred by panelists. Physico-chemical, sensory, microbial and textural changes were studied in wood apple fruit bar and wood apple mango bar at room temperature. Non-significant changes were noticed in fat, total ash, calcium and phosphorus whereas significant changes were noticed in moisture, protein, carbohydrate, Vitamin C, acidity, pH, TSS, total sugar, reducing sugar and non-reducing sugar during six months of storage. Similarly scores for all the sensory attributes a slight decrease in colour, flavour, taste, body and texture and chewiness and overall acceptability was observed with storage. However the decrease in scores was found acceptability of product even after six months of storage. There was negligible changes observed in sensory, microbial and textural analysis and the product was consumed safely after six months of storage. Hence it could be concluded that the fruit bars developed in the present experiment had good shelf life stability features with high consumer appeal. The wood apple pulp has all the essential nutrients and thus can be recommended for regular use to contribute various nutrients. It could be efficiently utilized in the form of fruit bar, which are cheap, consumer acceptable and shelf stable. The nutritional value and organoleptic features of the product could be enhanced by means of blending with other fruit pulps. The technology developed could be promoted and recommended for micro-enterprises which will good returns to entrepreneurs.

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REFERENCES:

1. Seidemann, J. The wood apple (*Feronia Limonia* [L.] Swingle). An Unknown exotic fruit. Deutsche Lebensm-Rund 2002; 98: 88-92.

2. Lane, J.H. and Eynon, L. J. Soc. Chem. Ind. 1923; 42: 32.
3. Ranganna, S. Hand book of analysis and quality control for fruit and vegetable products. 3rd edn. Tata Mc Graw-Hill Pub. Co. Ltd., New Delhi 2003.
4. Amerine, M.A.; Pangborn, R.M. and Roessler, E.B. Principles of sensory evaluation of food. Academic press, New York 1965
5. APHA: Recommended methods for the microbiological examination of foods. American Public Health Association, Inc. New York, 1992
6. Bourne, M.C.: Food texture and viscosity. Academic press, New York, 1994.
7. Aruna, K.; Vimala, N.; Dhanalakshmi, K.; Vinodini, Reddy: Physico-chemical changes during storage of papaya fruit (*Carica papaya* L.) Bar (Thandra). *J*. Food Technol. 1999; 36: 428-433.
8. Saravana, K., Manimegalai, R.G. Storage stability of Protein Enriched Sapota bar. Beverage and Food World 2002, 6: 23-24.
9. Chauhan, S.K.; Lal, B.B. and Joshi, V.K. : Preparation and evaluation of protein enriched mango fruit bar. Indian Food Packer 1997; 51: (5) 5-9.
10. Krishnaveni, A.G.; Manimegalai, Vennila and Saravana Kumar, R. Storage stability of jack fruit bar in different packing materials. Indian Food Packer 1998, 53 (6): 67-70.
11. Veeranan, V., Giridhari, A. and Malathi, D Nutritious and tasty mixed fruit bar. Processed Food Industry 2005; 4: 27-30.
12. Doreyappa, Gowoda, I.N.; Amba, Dan, Ramanjaneya, K.H.: Studies on mango fruit preparation. Indian Food Packer 1995; 49: 17-24.
13. Gayathri, S. and Uthira, D.: Preparation and evaluation of protein enriched mango-papaya blended fruit bar. Beverage and Food World 2008; 9: 56-57.
14. Mathur, V.K., Das, Anthony, S.; Jayaraman and Bhatia B.S. Preparation of fruit bars for use in combat ratios. Indian Food Packer 1972; 26 (2) 33-35.
15. Rao, V.S. and Roy, S.K. Studies on dehydration of mango pulp I. Standardization for making mango sheet/leather. Indian Food Packer 1980; 34: 64-71.
16. Kalia, M. and Sood, S. Food preservation and processing. Kalyani Publisher, New Delhi, 1996.

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