

# Assessment and Quantification of Changes in Functional Qualities of Fortified Wood Apple Jam During Storage

## ABSTRACT

Jam is a semi-solid food product, prepared by cooking sugar with fruits or vegetables pulp, pectin, acid to a sensibly consistency. The present investigation was conducted in the Department of Post Harvest Technology, College of Horticulture, Banda University of Agriculture and Technology, Banda. The main objective of the experiment was to assess and quantify the changes in functional qualities of fortified wood apple jam during storage up to six months at room temperature (.....). Different types of products were made produced from the wood apple fruit to consume during off-seasons due to the health promoting benefits. Beetroot fortified product was prepared from wood apple pulp + lotus root powder + beetroot juice in different combinations. Different combination includes WLB<sub>0</sub> (100% WL<sub>5</sub> + 0% Beetroot juice with 68°Brix), WLB<sub>1</sub> (99% WL<sub>5</sub> + 1% beetroot juice with 68°Brix), WLB<sub>2</sub> (98% WL<sub>5</sub> + 2 % beetroot juice with 68°Brix), WLB<sub>3</sub> (97% WL<sub>5</sub> + 3 % beetroot juice with 68°Brix), WLB<sub>4</sub> (96% WL<sub>5</sub> + 4 % beetroot juice with 68°Brix), WLB<sub>5</sub> (95% WL<sub>5</sub> + 5 % beetroot juice with 68°Brix), WLB<sub>6</sub> (94% WL<sub>5</sub> + 6 % beetroot juice with 68°Brix), WLB<sub>7</sub> (93% WL<sub>5</sub> + 7 % beetroot juice with 68°Brix), WLB<sub>8</sub> (92% WL<sub>5</sub> + 8 % beetroot juice with 68°Brix), WLB<sub>9</sub> (91% WL<sub>5</sub> + 9 % beetroot juice with 68°Brix), WLB<sub>10</sub> (90% WL<sub>5</sub> + 10 % beetroot juice with 68°Brix). Fortified jam stored in glass bottle at room temperature for a storage period of 180 days. Among different treatment combinations of beetroot fortified wood apple-lotus root jam treatment WL<sub>5</sub>B<sub>5</sub> (95% WL<sub>5</sub> + 5 % beetroot juice) shown better had good amount of functional qualities like for total antioxidants activity a round (51.516%), Ascorbic acid to (40.858 mg/100g), Crude fiber of (12.449%) and g-crude and crude protein (3.959%) and overall acceptability score during six month of storage.

**Keywords:** Wood apple, functional qualities, jam, crude fibre, potential storage.

## 1. INTRODUCTION

Jam is a semi-solid food product, prepared by cooking sugar with fruits or vegetables pulp, pectin, acid to a sensibly consistency. Jam should contain 68% or more TSS and at least 45% pulp. According to Kumar *et al.* (2018), one of the Indian subcontinent's healthiest fruits is the wood apple. Numerous vitamins, including A, C, thiamine, riboflavin, and niacin, as well as minerals like calcium and phosphorus, are present in it (Bag *et al.*, 2011). Ripe fruit has

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70% pulp, 2.2% protein, 22% carbohydrates, and 3.3% fat, each of which contributes 127 kcal of energy per 100g of ~~pulp.~~pulp. In a study conducted in the nutritive range of wood-apple pulp, Goshet *et al.* (2011) discovered that the fruit's contents of ~~vitamin-Vit~~vitamin-C, Ca, Fe, P, Zn, Cu, and Mn are 16, 3.5, 8.5, 46.6, 386.3, 0.8, and 0.7 mg/100g pulp, respectively.

On a dry weight basis, pulp includes 3-8% pectin and 6% seed. 60.0% moisture, 1.69 mg riboflavin, 1.0 mg niacin, 1.6 g protein, 0.2 g fat, 1.9 g minerals, 80.0 mg calcium, 52.0 mg phosphorus, 0.5 mg iron, 55 g carotene, 0.12 mg thiamine, 1.19 mg riboflavin, 1.0 mg niacin, 8 mg vitamin C, 610 mg potassium, and 0.20 mg copper are all present in the edible pulp of 100 g of wood apple fruit (Singh *et al.*, 2014).

Kaneyasu *et al.* ~~(2019)~~(2019) reported that the lotus root has been found to be rich in protein, starch, phosphorus, copper, potassium, manganese, vitamin-C, B<sub>1</sub> and B<sub>2</sub> while very low in saturated fat. Because of their possible health benefits, lotus root extracts raise the nutritional value of food (Joshi and Devender 2005; Marica *et al.*, 2007). Therefore, including root extract in a regular diet can improve the food products' medicinal and nutritional worth.

Beetroot contains the nitrogen pigment betalain, beetroot offers antioxidant properties that benefit consumers' health and wellness. Its many therapeutic qualities have a beneficial impact on human health. You can consume beetroot raw, boiling, steamed, or roasted. Minerals like magnesium, manganese, salt, potassium, iron, and copper are abundant in red beetroot (Mathangi and Balasaraswathi, 2014).

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## 2. MATERIALS AND METHODS

The experimental ~~work-study~~work-study of **“Fortification and quantification of wood apple jam for enhanced functional properties”** was conducted at Department of ~~Post-Post~~Post-Harvest Technology, College of Horticulture, Banda University of Agriculture and Technology, District Banda (U.P.) India.

The wood apple fruits were collected from paillani and Jaspura village of district Banda. The fruits were collected in monsoon season (2023) and Lotus roots and beetroot vegetables were collected from “Fruit and vegetable mandi” Banda (U.P.) and used for experimentation.

Wood apple - Lotus root jam ~~will be~~were standardized for the fortification with beetroot which includes 60% wood apple pulp and 40% lotus root powder and represents by the code WL.

The experiment was comprised of 11 treatments of fortified wood apple jam shown at table 1. The details of various treatments are presented below:

**Table 1: Formulations of fortified wood apple jam.**

Treatments	Treatment detail	TSS (°Brix)	Acidity (%)
WLB <sub>0</sub>	100% WL+ 0% B	68	1
WLB <sub>1</sub>	99% WL + 1% B	68	1
WLB <sub>2</sub>	98% WL + 2% B	68	1
WLB <sub>3</sub>	97% WL + 3% B	68	1
WLB <sub>4</sub>	96% WL + 4% B	68	1
WLB <sub>5</sub>	95% WL + 5% B	68	1
WLB <sub>6</sub>	94% WL + 6% B	68	1
WLB <sub>7</sub>	93% WL + 7% B	68	1
WLB <sub>8</sub>	92% WL + 8% B	68	1
WLB <sub>9</sub>	91% WL + 9% B	68	1
WLB <sub>10</sub>	90% WL + 10% B	68	1

Where, W= wood apple pulp, L= lotus root powder, B= beetroot juice

The Jam stored at room temperature (.....) and the parameters will be was taken at each 45 days interval a round i.e. 0, 45, 90, 135 and 180 days for storage studies.

## EXPERIMENTAL DESIGN

Analysis was carried out by ANOVA (Analysis of Variance) determinations and expressed as mean value. All the data obtained for the experiment were subjected to OPSTAT (Developed by C.C.S.H.A.U, Hishar) Statistical Software for statistical analysis. Data pertaining to the functional qualities of jam were carried out by using factorial experiment in Completely Randomized Design.

The following functional qualities were assessed during the course of investigation:

### pH

The pH was taken with ELTOP-3030 pHmeter prior to pH measurement (Model: pH, 815); the instrument was standardized with the buffer solutions of pH 4, 7 and 9. The pH of the samples was estimated directly (Ranganna, S. 1986).

### Crude protein (%)

Protein content was determined using (AOAC, 2005) method. Percentage of nitrogen and protein calculated by the following equation 1:

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### Wood apple fruit

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$$(\%) \text{Nitrogen} = \frac{Ts - Tb \times \text{Normality of acid} \times 0.014}{\text{Weight of sample taken}} \times 100$$

Where,

Ts = Titre volume of the sample (ml);

Tb = Titre volume of Blank (ml);

0.014 = M eq. of N<sub>2</sub>;

% Protein = Nitrogen × 6.25.

#### Crude Fat:

The crude fat was determined using the method of ..... 2g of sample was taken into the thimble and the whole weight was recorded (W<sub>1</sub>). About 50-60 ml of solvent was taken in the beaker and thimble was placed in the beaker. The temperature of the system maintained near boiling temperature of the solvent taken. It was left undisturbed for half an hour. At the end of the boiling temperature was increased to 150-200 °C. The condensation was allowed till the solvent in beaker condensed followed by the reclamation all the solvent in beaker was evaporated the value of fat recorded with following formula and expressed in percent.

$$\text{Crude fat (\%)} = \frac{\text{Weight of ash with thimble} - \text{Weighing the thimble with sample}}{\text{Weight of sample}} \times 100$$

#### Crude Fiber (%)

Crude fibre contents were estimated by the method given by (AOAC, 2005) by using the following formula:

$$\text{Crude fibres (\%)} = \frac{\text{Loss in weight}}{\text{Weight of sample taken}} \times 100$$

#### Free radical scavenging activity (%)

Free radical scavenging activity was measured as per the method of Brand-Williams *et al.*, (1995). DPPH (2, 2-diphenyl-1-picrylhydrazyl) was used as a source of free radical. DPPH solutions were prepared by 3mg DPPH and add 51 ml of methanol. In 0.2g sample and add 2ml methanol were centrifuge in 4000-6000 RPM for 15 minute. In 3ml of freshly prepared DPPH solution, 1 ml of sample was added in test tubes and after 30 minutes absorbance was recorded at 520 nm by UV- photo colorimeter using methanol as blank. The free radical scavenging activity was recorded as per the following equation and expressed in percent.

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$$\text{Antioxidant activity (\%)} = \frac{\text{Ab (B)} - \text{Ab (S)}}{\text{Ab (B)}} \times 100$$

Where:-

Ab (B) = Absorbance of blank;

Ab (S) = Absorbance of sample.

### Total phenols

The amount of total phenolics in jam was determined with the Folin-Ciocalteu Reagent method according to the method of A.O.A.C. (1970).

$$\text{Phenols (mg/100 g)} = \frac{\text{mg of catechol} \times \text{dilution} \times 100}{\text{ml of sample taken for} \times \text{weight of sample} \times 1000}$$

### Ascorbic acid (mg/100g)

Ascorbic acid was determined by using 2,6-Dichlorophenol-indophenols [visual titration](#) method (Johnson and Dana 1948).

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titre} \times \text{Dye Factor} \times \text{Volume made up} \times 100}{\text{Vol. of Aliquot for estimation volume of sample} \times \text{wt. of sample}}$$

### Overall acceptability evaluation

For, the nine-point Hedonic rating scale approach, as suggested by Ranganna, (2001), was applied. The appearance, texture, taste, mouth-feel were assessed as sensory quality for overall acceptability calculation.

## 3. RESULTS AND DISCUSSION

Data depicted in Table.1-2 ~~showed~~ [shown](#) that fortified jam pH was significantly affected from storage period, indicate that ~~the~~ pH was increase during 180 days of storage period. The maximum pH was recorded (3.835) at 180 days, followed by (3.766) at 135 days, (3.709) at 90 days, (3.645) at 45 days and (3.614) at zero day of storage period. The interaction of treatment and storage period was found non significant on pH. The highest value of pH was recorded in WL<sub>5</sub>B<sub>3</sub> (4.056) at 180 days followed by WL<sub>5</sub>B<sub>3</sub> (3.982) at 135 days, WL<sub>5</sub>B<sub>3</sub> (3.930) at 90 days, WL<sub>5</sub>B<sub>3</sub> (3.865) at 45 days and WL<sub>5</sub>B<sub>3</sub> (3.839) at zero day of

storage period. A slight increase in pH during storage might occur due to degradation of ascorbic acid, degradation of polyphenols and conversion of proteins to amino acids (Yadav, 2004).

**Table-12** Effect of storage period on pH of fortified jam.

Treatment/storage (days)	0	45	90	135	180	Mean
WLB <sub>0</sub>	3.693	3.718	3.779	3.837	3.905	3.786
WLB <sub>1</sub>	3.715	3.738	3.800	3.857	3.919	3.806
WLB <sub>2</sub>	3.689	3.715	3.780	3.835	3.899	3.784
WLB <sub>3</sub>	3.839	3.865	3.930	3.982	4.056	3.934
WLB <sub>4</sub>	3.700	3.731	3.793	3.854	3.919	3.799
WLB <sub>5</sub>	3.720	3.747	3.810	3.869	3.948	3.819
WLB <sub>6</sub>	3.810	3.830	3.893	3.950	4.017	3.900
WLB <sub>7</sub>	3.613	3.639	3.703	3.759	3.838	3.710
WLB <sub>8</sub>	3.749	3.777	3.840	3.895	3.969	3.846
WLB <sub>9</sub>	3.015	3.100	3.168	3.223	3.287	3.159
WLB <sub>10</sub>	3.210	3.238	3.302	3.362	3.429	3.308
Mean	3.614	3.645	3.709	3.766	3.835	-
	T	S	TxS	-	-	-
C.D. (0.05)	0.033	0.022	N/A	-	-	-
SEm ±	0.012	0.008	0.026	-	-	-

It can be conjectured from the data in Table-2-3 that protein value, in general, showed a decrease trend with the increase in storage period in jam stored under room temperature. The protein was significantly affected by treatment and the highest value of protein was observed in WL<sub>5</sub>B<sub>7</sub> (4.038) then WL<sub>5</sub>B<sub>8</sub> (4.036) and WL<sub>5</sub>B<sub>9</sub> (4.030) lowest in WL<sub>5</sub>B<sub>0</sub> (3.637). Protein was also significantly affected by storage period. The highest mean value of protein was recorded (5.320) at 0 day and lowest protein mean value (2.842) at 180 days of storage period. The interaction of treatment and storage period was reported that the

non-significant on protein. The topmost protein value was notice in WL<sub>5</sub>B<sub>7</sub> (5.421) at 0 day while at least protein value in WL<sub>5</sub>B<sub>0</sub> (2.563) at 180 days of storage period. The decline of crude protein may be due to denaturation and degradation of protein into amino acid (Paramita and Arora, 2015).

**Table-23** Effect of storage period on Crude protein (%) of fortified jam.

Treatment/storage (days)	0	45	90	135	180	Mean
WLB <sub>0</sub>	5.016	4.279	3.465	2.861	2.563	3.637
WLB <sub>1</sub>	5.220	4.482	3.663	3.062	2.766	3.839
WLB <sub>2</sub>	5.223	4.481	3.663	3.056	2.752	3.835
WLB <sub>3</sub>	5.317	4.583	3.761	3.156	2.714	3.906
WLB <sub>4</sub>	5.330	4.590	3.770	3.163	2.853	3.941
WLB <sub>5</sub>	5.346	4.607	3.783	3.182	2.875	3.959
WLB <sub>6</sub>	5.405	4.667	3.843	3.241	2.936	4.018
WLB <sub>7</sub>	5.421	4.680	3.863	3.265	2.961	4.038
WLB <sub>8</sub>	5.418	4.679	3.866	3.263	2.953	4.036
WLB <sub>9</sub>	5.415	4.676	3.861	3.256	2.943	4.030
WLB <sub>10</sub>	5.412	4.670	3.852	3.246	2.947	4.025
Mean	5.320	4.581	3.763	3.159	2.842	-
	T	S	TxS	-	-	-
C.D. (0.05)	0.104	0.070	N/A	-	-	-
SEm ±	0.037	0.025	0.083	-	-	-

The data to respect to change in fat during room temperature storage are presented in Table-34 & figure-1 show that the fat was found non-significant by treatment. The highest mean value of fat was recorded in WL<sub>5</sub>B<sub>10</sub> (1.797) while lowest in WL<sub>5</sub>B<sub>0</sub> (1.729). The fat was also found non-significant by storage period. The highest fat in (2.460) at 0 days and lowest fat in (1.079) at 180 days of storage period was observed. The interaction of both factors was founded significantly on fat. The maximum fat was notice in WL<sub>5</sub>B<sub>10</sub> (2.485) at 0 day while minimum in WL<sub>5</sub>B<sub>0</sub> (2.431) at 180 days of storage. A slight decrease of crude fat content might be due to oxidation of fat into free fatty acids during storage of jam. Similar findings were reported by Akubor, (2023) on developed functional jam from African locust bean fruit.

**Table-34** Effect of storage period on Crude fat (%) of fortified jam.

Treatment/storage (days)	0	45	90	135	180	Mean
WLB <sub>0</sub>	2.431	2.133	1.725	1.358	1.000	1.729
WLB <sub>1</sub>	2.437	2.138	1.736	1.369	1.006	1.737
WLB <sub>2</sub>	2.445	2.145	1.739	1.371	1.063	1.753
WLB <sub>3</sub>	2.450	2.147	1.738	1.368	1.038	1.748
WLB <sub>4</sub>	2.456	2.153	1.741	1.376	1.110	1.767
WLB <sub>5</sub>	2.463	2.163	1.750	1.386	1.026	1.758
WLB <sub>6</sub>	2.466	2.163	1.743	1.380	1.117	1.774
WLB <sub>7</sub>	2.470	2.167	1.760	1.393	1.124	1.783
WLB <sub>8</sub>	2.473	2.170	1.763	1.396	1.127	1.786
WLB <sub>9</sub>	2.480	2.173	1.767	1.386	1.119	1.785
WLB <sub>10</sub>	2.485	2.178	1.773	1.408	1.140	1.797
Mean	2.460	2.157	1.749	1.381	1.079	-
	T	S	TxS	-	-	-
C.D. (0.05)	N/A	0.094	N/A	-	-	-
SEm ±	0.050	0.034	0.111	-	-	-

The data in respect to change in fibre at room temperature during storage are presented in Table-45 ~~showed~~ shown that the fibre was non-significant by treatment and greatest mean was notice in WL<sub>5</sub>B<sub>1</sub> (12.663) followed by WL<sub>5</sub>B<sub>4</sub> (12.659) then WL<sub>5</sub>B<sub>3</sub> (12.626), WL<sub>5</sub>B<sub>0</sub> (12.580), WL<sub>5</sub>B<sub>8</sub> (12.566), WL<sub>5</sub>B<sub>7</sub> (12.547), WL<sub>5</sub>B<sub>10</sub> (12.484), WL<sub>5</sub>B<sub>9</sub> (12.472), WL<sub>5</sub>B<sub>5</sub> (12.449), WL<sub>5</sub>B<sub>6</sub> (12.446) and WL<sub>5</sub>B<sub>2</sub> (12.444). The interaction of treatment and storage period was also found non-significant on fibre. The maximum value in WL<sub>5</sub>B<sub>1</sub> (14.218) at 0 day while minimum value in WL<sub>5</sub>B<sub>5</sub> (11.375) at 180 days of storage period was recorded. The fibre was significantly affected by storage period. The highest value (14.066) at 0 day followed by (13.000) at 45 days, (12.222) at 90 days, (11.920) at 135 days and (11.490) at 180 days of storage period was observed. The decrease in crude fibre might be due to the degradation of hemicelluloses and other structural polysaccharides during storage. Heat and moisture solubilizes also degrade pectic substances leading to the decrease in crude fibre content as reported by Smajic *et al.* (2022) in rosehip jam and plum jam.

**Table-45** Effect of storage period on Crude fibre (%) of fortified jam

Treatment/storage (days)	0	45	90	135	180	Mean
WLB <sub>0</sub>	14.135	13.069	12.242	11.936	11.519	12.580
WLB <sub>1</sub>	14.218	13.152	12.325	12.018	11.601	12.663
WLB <sub>2</sub>	13.986	12.921	12.115	11.813	11.386	12.444
WLB <sub>3</sub>	14.180	13.114	12.287	11.987	11.562	12.626
WLB <sub>4</sub>	14.208	13.143	12.319	12.020	11.605	12.659
WLB <sub>5</sub>	13.992	12.926	12.125	11.827	11.375	12.449
WLB <sub>6</sub>	13.985	12.919	12.118	11.817	11.392	12.446
WLB <sub>7</sub>	14.110	13.044	12.217	11.916	11.446	12.547
WLB <sub>8</sub>	13.978	12.912	12.318	12.023	11.601	12.566
WLB <sub>9</sub>	13.968	12.900	12.180	11.873	11.437	12.472
WLB <sub>10</sub>	13.970	12.904	12.193	11.887	11.467	12.484
Mean	14.066	13.000	12.222	11.920	11.490	-
	T	S	TxS	-	-	-
C.D. (0.05)	N/A	0.187	N/A	-	-	-
SEm ±	0.099	0.067	0.221	-	-	-

The data in Table-56 deal with the effect of room temperature on antioxidant of jam during storage. The antioxidant was significantly affected by treatment. The highest value in WL<sub>5</sub>B<sub>10</sub> (51.927) then WL<sub>5</sub>B<sub>9</sub> (51.828) and WL<sub>5</sub>B<sub>8</sub> (51.580) however lowest value in WL<sub>5</sub>B<sub>0</sub> (50.433) was recorded. Antioxidant was also significantly affected by Storage period. The maximum antioxidant was observed (60.195) at 0 day followed by (57.042) at 45 days, (51.613) at 90 days, (46.763) at 135 days and (42.076) at 180 days of storage period. The interaction of treatment and storage period was observed non-significant on change in antioxidant. The maximum antioxidant was recorded in WL<sub>5</sub>B<sub>10</sub> (60.530) at 0 day and minimum in WL<sub>5</sub>B<sub>0</sub> (41.053) at 45 days of storage period. The reason might be due to the degradation of polyphenols which are responsible for the antioxidant activity. Results are in accordance with the findings of Atena *et al.* (2011) in strawberries sweet cherries and sour cherries mix jam.

**Table-56g** Effect of storage period on Antioxidant activity (%) of fortified jam

Treatment/storage	0	45	90	135	180	Mean
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(-days(days))						
WLB <sub>0</sub>	59.035	55.893	50.510	45.673	41.053	50.433
WLB <sub>1</sub>	60.100	56.960	51.590	46.750	42.130	51.506
WLB <sub>2</sub>	60.150	57.010	51.647	46.810	42.180	51.559
WLB <sub>3</sub>	60.230	57.080	51.710	46.870	42.540	51.686
WLB <sub>4</sub>	60.260	57.100	51.720	46.860	42.238	51.636
WLB <sub>5</sub>	60.300	57.140	51.500	46.630	42.012	51.516
WLB <sub>6</sub>	60.320	57.160	51.700	46.830	42.210	51.644
WLB <sub>7</sub>	60.360	57.200	51.600	46.740	42.117	51.603
WLB <sub>8</sub>	60.400	57.240	51.860	47.010	41.390	51.580
WLB <sub>9</sub>	60.460	57.300	51.900	47.050	42.428	51.828
WLB <sub>10</sub>	60.530	57.380	52.010	47.173	42.540	51.927
Mean	60.195	57.042	51.613	46.763	42.076	-
	T	S	TxS	-	-	-
C.D. (0.05)	0.396	0.267	N/A	-	-	-
SEm ±	0.141	0.095	0.316	-	-	-

Data in Table-67 reveal the changes in the total phenol of jam during room temperature storage and showed that the total phenol was significantly affected by treatment. The minimum mean in WL<sub>5</sub>B<sub>6</sub> (10.477) but maximum in WL<sub>5</sub>B<sub>1</sub> (11.782) was recorded. The total phenol was also significantly affected by storage period. The interaction of treatment and storage was found non-significant on total phenol. The highest value in WL<sub>5</sub>B<sub>1</sub> (12.865) at 0 day while lowest in WL<sub>5</sub>B<sub>1</sub> (10.990) at 180 days of storage period was recorded. The result of study was also in accordance with Kannan and Thirumaran (2004) also noticed a decrease in phenolic contents in *jamun* products like ready to serve, squash and jam during storage for 6 months at ambient temperature (27-36°C).

**Table-67 Effect of storage period on Total phenol content (%) of fortified jam**

Treatment/storage (-days(days))	0	45	90	135	180	Mean
WLB <sub>0</sub>	12.863	12.176	11.617	11.249	10.982	11.777
WLB <sub>1</sub>	12.865	12.178	11.619	11.258	10.990	11.782
WLB <sub>2</sub>	12.860	12.173	11.612	11.241	10.973	11.772
WLB <sub>3</sub>	12.620	11.933	11.374	11.083	10.857	11.573

WLB <sub>4</sub>	11.986	11.299	10.737	10.393	10.120	10.907
WLB <sub>5</sub>	12.316	11.629	11.267	10.893	10.629	11.347
WLB <sub>6</sub>	11.386	10.699	10.325	10.117	9.859	10.477
WLB <sub>7</sub>	11.778	11.091	10.786	10.535	10.325	10.903
WLB <sub>8</sub>	11.325	10.638	10.385	10.180	9.927	10.491
WLB <sub>9</sub>	12.415	11.728	11.365	10.997	10.735	11.448
WLB <sub>10</sub>	12.450	11.763	11.397	10.987	10.702	11.460
Mean	12.260	11.573	11.135	10.812	10.554	-
	T	S	TxS	-	-	-
C.D. (0.05)	0.171	0.115	N/A	-	-	-
SEm ±	0.061	0.041	0.136	-	-	-

It can be conjectured from the data in Table-78 showed that the ascorbic acid value, in general, ~~showed~~ shown a decrease trend with the increase in storage period in jam stored under room temperature. The ascorbic acid was found non-significant by treatment. The highest ascorbic acid was recorded in WL<sub>5</sub>B<sub>10</sub> (40.878) then WL<sub>5</sub>B<sub>4</sub> (40.868) and WL<sub>5</sub>B<sub>2</sub> (40.865) while lowest in WL<sub>5</sub>B<sub>1</sub> (40.842). The interaction of treatment and storage period was also recorded not significant on ascorbic acid. The ascorbic acid was significantly affected by storage period. The lowest mean value (36.643) at 180 days however highest mean value (46.346) at 0 day of storage period was noticed. Souad *et al.* (2012) suggested decrease of ascorbic acid might be due to oxidation taking place within the sample as well as enzymatic ~~as~~ catalytic enzymatic ~~reaction~~ catalytic ~~taking~~ reaction ~~place~~ taking within place ~~the~~ within ~~jam~~ the ~~mass~~ jam ~~during~~ mass ~~storage~~ during storage.

**Table-78** Effect of storage period on Ascorbic acid (mg/100g) of fortified jam

Treatment/storage ( <del>days</del> (days))	0	45	90	135	180	Mean
WLB <sub>0</sub>	46.350	42.788	40.221	38.307	36.643	40.862
WLB <sub>1</sub>	46.327	42.769	40.202	38.287	36.623	40.842
WLB <sub>2</sub>	46.347	42.790	40.225	38.315	36.650	40.865
WLB <sub>3</sub>	46.349	42.790	40.223	38.314	36.642	40.864
WLB <sub>4</sub>	46.351	42.793	40.226	38.317	36.651	40.868
WLB <sub>5</sub>	46.342	42.783	40.215	38.309	36.643	40.858
WLB <sub>6</sub>	46.346	42.777	40.210	38.292	36.623	40.850

WLB <sub>7</sub>	46.339	42.780	40.215	38.307	36.640	40.856
WLB <sub>8</sub>	46.348	42.788	40.220	38.310	36.646	40.862
WLB <sub>9</sub>	46.351	42.790	40.218	38.309	36.647	40.863
WLB <sub>10</sub>	46.358	42.800	40.240	38.329	36.665	40.878
Mean	46.346	42.786	40.220	38.309	36.643	-
	T	S	TxS	-	-	-
C.D. (0.05)	N/A	0.115	N/A	-	-	-
SEm ±	0.061	0.041	0.136	-	-	-

The data regarding to overall acceptability of jam given in Table-89 during room temperature storage and indicate reading of overall acceptability significantly affected by treatment. The highest score of treatment was recorded in WL<sub>5</sub>B<sub>5</sub> (6.920) then WL<sub>5</sub>B<sub>6</sub> (6.700), WL<sub>5</sub>B<sub>7</sub> & WL<sub>5</sub>B<sub>8</sub> (6.120), WL<sub>5</sub>B<sub>3</sub> (6.090) but lowest score WL<sub>5</sub>B<sub>0</sub> (4.715) by panel of judges on the basis 9-point scale. Overall acceptability was also significantly affected by storage period; the overall acceptability retention was highest at 0 day (7.241) and lowest at 180 days (4.275) on the basis of organoleptic organs of 7 semi trend judge on the basis of 9-point hedonic scale. The interaction of both factors (treatment and storage period) was found non-significant on overall acceptability. The highest score of overall acceptability was notice in WL<sub>5</sub>B<sub>5</sub> (8.400) at 0 day while lowest score of overall acceptability in WL<sub>5</sub>B<sub>0</sub> (3.225) at 180 days of storage period. The decrease of overall acceptability score might be due to the decline score of appearance, texture, taste and mouth-feel with increasing the storage period. Such identical findings were also revealed by Prasad and Mali, (2005) in bael jam; Prasad and Mali, (2006) in ber jam; Mulla (2007) in mixed fruit jam;

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**Table-89 Effect of storage period on overall acceptability of fortified jam.**

Treatment/storage (days)	0	45	90	135	180	Mean
WLB <sub>0</sub>	6.100	5.550	4.700	4.000	3.225	4.715
WLB <sub>1</sub>	6.650	6.050	5.325	4.500	3.850	5.275
WLB <sub>2</sub>	6.425	5.900	5.350	4.475	3.800	5.190
WLB <sub>3</sub>	7.650	7.000	6.175	5.275	4.350	6.090
WLB <sub>4</sub>	6.900	6.350	5.650	4.900	4.300	5.620
WLB <sub>5</sub>	8.400	7.775	6.875	6.025	5.525	6.920
WLB <sub>6</sub>	8.150	7.600	6.650	5.825	5.275	6.700

WLB <sub>7</sub>	7.550	6.925	6.150	5.275	4.700	6.120
WLB <sub>8</sub>	7.700	7.100	6.225	5.250	4.325	6.120
WLB <sub>9</sub>	7.225	6.650	5.675	4.750	4.100	5.680
WLB <sub>10</sub>	6.900	6.225	5.175	4.375	3.575	5.250
Mean	7.241	6.648	5.814	4.968	4.275	-
	T	S	TxS	-	-	-
C.D. (0.05)	0.282	0.190	N/A	-	-	-
SEm ±	0.100	0.068	0.224	-	-	-

#### 4. CONCLUSION

Realized the study ~~It~~ was concluded that treatment WLB<sub>5</sub> (95% WL<sub>5</sub> + 5 % beetroot juice) ~~had shown better good~~ amount of functional qualities ~~for like~~ total antioxidants ~~activity~~ activity (%), Ascorbic acid (mg/100g), Crude fiber (%), ~~crude~~, crude protein (protein (%), crude fat (%) and phenol content during 6 months of storage. These functional qualities provides many therapeutic, health and functional benefits. ~~%~~). This treatment also ~~possess~~ possesses highest overall acceptability at room temperature as well as safe for consumption up to 6 months of storage.

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