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

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Authors' contributions

This work was carried out in collaboration among all authors.All authors read and approved the final manuscript.

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ABSTRACT

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Jam is a semi-solid food product, prepared by cooking sugar with fruits or vegetables pulp, pectin, acid to a sensibly consistency. 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 (25-30 degree centigrade). Different types of products were 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. 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_5B_5 (95% WL_5 + 5 % beetroot juice) shown better amount of functional qualities for total antioxidants activity (51.516%), Ascorbic acid (40.858 mg/100g), Crude fiber (12.449%) and crude protein (3.959%) and good overall acceptability score during six month of storage.

Keywords: Wood apple; functional qualities; jam; 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 [1]. Ripe fruit has 70% pulp, 2.2% protein, 22% carbohydrates, and 3.3% fat, each of which contributes 127 kcal of energy per 100g of pulp. In a study conducted in the nutritive range of wood-apple pulp, Goshet al. [2] discovered that the fruit's contents of 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 [3].

Kaneyasuet al.[4] reported that the lotus root has been found to be rich in protein, starch, phosphorus, copper, potassium, manganese, vitamin-C, B_1 and B_2 while very low in saturated fat. Because of their possible health benefits, lotus root extracts raise the nutritional value of food [5,6]. 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 [7].

Both wood apple and lotus roots are underexploited crops for processing purpose and yet only a few products of these crops are available in the market. By conducting the present research, their potential can be explored for processed products as both are nutritionally rich

2. MATERIALS AND METHODS

The experimental study was conducted at Department of 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 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.

Table 1. Formulations of fortified wood apple jam

Treatments	Treatment detail	TSS (ºBrix)	Acidity (%)
WLB_0	100% WL+ 0% B	68	1
WLB_1	99% WL + 1% B	68	1
WLB_2	98%WL + 2% B	68	1
WLB_3	97%WL + 3% B	68	1
WLB_4	96%WL + 4% B	68	1
WLB_5	95%WL + 5% B	68	1
WLB_6	94%WL + 6% B	68	1
WLB_7	93%WL + 7% B	68	1
WLB_8	92%WL + 8% B	68	1
WLB_9	91%WL + 9% B	68	1
WLB_{10}	90%WL + 10% B	68	1

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

The Jam stored at room temperature (25-30 degree centigrade)and the parameters was taken at each 45 days interval .ie. 0, 45, 90, 135 and 180 days for storage studies.

3. 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 pH meter 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 [8].

Crude protein (%): Protein content was determined using [9] method. Percentage of nitrogen and protein calculated by the following equation 1:

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

Where:
Ts = Titre volume of the sample (ml);
Tb = Titre volume of Blank (ml);
0.014= M eq. of N_2;
% Protein = Nitrogen × 6.25.

Crude fat: The crude fat was determined using the method of…AOAC, [9]. 2g of sample was taken into the thimble and the whole weight was recorded (W_1). 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 the 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 got condensed followed by the reclamation all the solvent in beaker was evaporated the value of fat recorded with following formula and expressed in percent 2.

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

Crude Fiber (%): Crude fibre contents were estimated by the method given by [9] by using the following formula 3:

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

Free radical scavenging activity (%): Free radical scavenging activity was measured as per the method of Brand-Williams et al., [10]. 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 4.

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

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. [11].

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

Ascorbic acid (mg/100g): Ascorbic acid was determined by using 2,6-Dichlorophenol-indophenols visual titration method [12].

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

Overall acceptability evaluation: For, the nine-point Hedonic rating scale approach, as suggested by Ranganna, [8], was applied. The appearance, texture, taste, mouth-feel were assessed as sensory quality for overall acceptability calculation.

4. RESULTS AND DISCUSSION

Data depicted in Table 2 shownthat fortified jam pH was significantly affected from storage period, indicate that 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_5B_3 (4.056) at 180 days followed by WL_5B_3 (3.982) at 135 days, WL_5B_3 (3.930) at 90 days, WL_5B_3 (3.865) at 45 days and WL_5B_3 (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 [13].

Table 2. Effect of storage period on pH of fortified jam

Treatment/storage (days)	0	45	90	135	180	Mean
WLB_0	3.693	3.718	3.779	3.837	3.905	3.786
WLB_1	3.715	3.738	3.800	3.857	3.919	3.806
WLB_2	3.689	3.715	3.780	3.835	3.899	3.784
WLB_3	3.839	3.865	3.930	3.982	4.056	3.934
WLB_4	3.700	3.731	3.793	3.854	3.919	3.799
WLB_5	3.720	3.747	3.810	3.869	3.948	3.819
WLB_6	3.810	3.830	3.893	3.950	4.017	3.900
WLB_7	3.613	3.639	3.703	3.759	3.838	3.710
WLB_8	3.749	3.777	3.840	3.895	3.969	3.846
WLB_9	3.015	3.100	3.168	3.223	3.287	3.159
WLB_{10}	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 3 that protein value, in general, shown 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_5B_7 (4.038) then WL_5B_8 (4.036) and WL_5B_9 (4.030) lowest in WL_5B_0 (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_5B_7 (5.421) at 0 day while at least protein value in WL_5B_0 (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 [14].

The data to respect to change in fat during room temperature storage are presented in Table 4 shown that the fat was found non-significant by treatment. The highest mean value of fat was recorded in WL_5B_{10} (1.797) while lowest in WL_5B_0 (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_5B_{10} (2.485) at 0 day while minimum in WL_5B_0 (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, [15] on developed functional jam from African locust bean fruit.

The data in respect to change in fibre at room temperature during storage are presented in Table 5 shown that the fibre was non-significant by treatment and greatest mean was notice in WL_5B_1 (12.663) followed by WL_5B_4 (12.659) then WL_5B_3 (12.626), WL_5B_0 (12.580), WL_5B_8 (12.566), WL_5B_7 (12.547), WL_5B_{10} (12.484), WL_5B_9 (12.472), WL_5B_5 (12.449), WL_5B_6 (12.446) and WL_5B_2 (12.444). The interaction of treatment and storage period was also found non-significant on fibre. The maximum value in WL_5B_1 (14.218) at 0 day while minimum value in WL_5B_5 (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. [16] in rosehip jam and plum jam.

The data in Table 6 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_5B_{10} (51.927) then WL_5B_9 (51.828) and WL_5B_8 (51.580) however lowest value in WL_5B_0 (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_5B_{10} (60.530) at 0 day and minimum in WL_5B_0 (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. [17] in strawberries sweet cherries and sour cherries mix jam.

Data in Table 7reveal the changes in the total phenol of jam during room temperature storage and shown that the total phenol was significantly affected by treatment. The minimum mean in WL_5B_6 (10.477) but maximum in WL_5B_1 (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_5B_1 (12.865) at 0 day while lowest in WL_5B_1 (10.990) at 180 days of storage period was recorded. The result of study was also in accordance with Kannan and Thirumaran [18] 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 (27-36ºC).

Table 3. Effect of storage period on Crude protein (%) of fortified jam

Treatment/storage (days)	0	45	90	135	180	Mean
WLB_0	5.016	4.279	3.465	2.861	2.563	3.637
WLB_1	5.220	4.482	3.663	3.062	2.766	3.839
WLB_2	5.223	4.481	3.663	3.056	2.752	3.835
WLB_3	5.317	4.583	3.761	3.156	2.714	3.906
WLB_4	5.330	4.590	3.770	3.163	2.853	3.941
WLB_5	5.346	4.607	3.783	3.182	2.875	3.959
WLB_6	5.405	4.667	3.843	3.241	2.936	4.018
WLB_7	5.421	4.680	3.863	3.265	2.961	4.038
WLB_8	5.418	4.679	3.866	3.263	2.953	4.036
WLB_9	5.415	4.676	3.861	3.256	2.943	4.030
WLB_{10}	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	-	-	-

Table 4. Effect of storage period on Crude fat (%) of fortified jam

Treatment/storage (days)	0	45	90	135	180	Mean
WLB_0	2.431	2.133	1.725	1.358	1.000	1.729
WLB_1	2.437	2.138	1.736	1.369	1.006	1.737
WLB_2	2.445	2.145	1.739	1.371	1.063	1.753
WLB_3	2.450	2.147	1.738	1.368	1.038	1.748
WLB_4	2.456	2.153	1.741	1.376	1.110	1.767
WLB_5	2.463	2.163	1.750	1.386	1.026	1.758
WLB_6	2.466	2.163	1.743	1.380	1.117	1.774
WLB_7	2.470	2.167	1.760	1.393	1.124	1.783
WLB_8	2.473	2.170	1.763	1.396	1.127	1.786
WLB_9	2.480	2.173	1.767	1.386	1.119	1.785
WLB_{10}	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	-	-	-

Table 5. Effect of storage period on Crude fibre (%) of fortified jam

Treatment/storage (days)	0	45	90	135	180	Mean
WLB_0	14.135	13.069	12.242	11.936	11.519	12.580
WLB_1	14.218	13.152	12.325	12.018	11.601	12.663
WLB_2	13.986	12.921	12.115	11.813	11.386	12.444
WLB_3	14.180	13.114	12.287	11.987	11.562	12.626
WLB_4	14.208	13.143	12.319	12.020	11.605	12.659
WLB_5	13.992	12.926	12.125	11.827	11.375	12.449
WLB_6	13.985	12.919	12.118	11.817	11.392	12.446
WLB_7	14.110	13.044	12.217	11.916	11.446	12.547
WLB_8	13.978	12.912	12.318	12.023	11.601	12.566
WLB_9	13.968	12.900	12.180	11.873	11.437	12.472
WLB_{10}	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	-	-	-

Table 6. Effect of storage period on Antioxidant activity (%) of fortified jam

Treatment/storage (days)	0	45	90	135	180	Mean
WLB_0	59.035	55.893	50.510	45.673	41.053	50.433
WLB_1	60.100	56.960	51.590	46.750	42.130	51.506
WLB_2	60.150	57.010	51.647	46.810	42.180	51.559
WLB_3	60.230	57.080	51.710	46.870	42.540	51.686
WLB_4	60.260	57.100	51.720	46.860	42.238	51.636
WLB_5	60.300	57.140	51.500	46.630	42.012	51.516
WLB_6	60.320	57.160	51.700	46.830	42.210	51.644
WLB_7	60.360	57.200	51.600	46.740	42.117	51.603
WLB_8	60.400	57.240	51.860	47.010	41.390	51.580
WLB_9	60.460	57.300	51.900	47.050	42.428	51.828
WLB_{10}	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	-	-	-

Table 7. Effect of storage period on Total phenol content (%) of fortified jam

Treatment/storage(days)	0	45	90	135	180	Mean
WLB_0	12.863	12.176	11.617	11.249	10.982	11.777
WLB_1	12.865	12.178	11.619	11.258	10.990	11.782
WLB_2	12.860	12.173	11.612	11.241	10.973	11.772
WLB_3	12.620	11.933	11.374	11.083	10.857	11.573
WLB_4	11.986	11.299	10.737	10.393	10.120	10.907
WLB_5	12.316	11.629	11.267	10.893	10.629	11.347
WLB_6	11.386	10.699	10.325	10.117	9.859	10.477
WLB_7	11.778	11.091	10.786	10.535	10.325	10.903
WLB_8	11.325	10.638	10.385	10.180	9.927	10.491
WLB_9	12.415	11.728	11.365	10.997	10.735	11.448
WLB_{10}	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	-	-	-

Table 8. Effect of storage period on Ascorbic acid (mg/100g) of fortified jam

Treatment/storage (days)	0	45	90	135	180	Mean
WLB_0	46.350	42.788	40.221	38.307	36.643	40.862
WLB_1	46.327	42.769	40.202	38.287	36.623	40.842
WLB_2	46.347	42.790	40.225	38.315	36.650	40.865
WLB_3	46.349	42.790	40.223	38.314	36.642	40.864
WLB_4	46.351	42.793	40.226	38.317	36.651	40.868
WLB_5	46.342	42.783	40.215	38.309	36.643	40.858
WLB_6	46.346	42.777	40.210	38.292	36.623	40.850
WLB_7	46.339	42.780	40.215	38.307	36.640	40.856
WLB_8	46.348	42.788	40.220	38.310	36.646	40.862
WLB_9	46.351	42.790	40.218	38.309	36.647	40.863
WLB_{10}	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	-	-	-

Table 9. Effect of storage period on overall acceptability of fortified jam.

Treatment/storage(days)	0	45	90	135	180	Mean
WLB_0	6.100	5.550	4.700	4.000	3.225	4.715
WLB_1	6.650	6.050	5.325	4.500	3.850	5.275
WLB_2	6.425	5.900	5.350	4.475	3.800	5.190
WLB_3	7.650	7.000	6.175	5.275	4.350	6.090
WLB_4	6.900	6.350	5.650	4.900	4.300	5.620
WLB_5	8.400	7.775	6.875	6.025	5.525	6.920
WLB_6	8.150	7.600	6.650	5.825	5.275	6.700
WLB_7	7.550	6.925	6.150	5.275	4.700	6.120
WLB_8	7.700	7.100	6.225	5.250	4.325	6.120
WLB_9	7.225	6.650	5.675	4.750	4.100	5.680
WLB_{10}	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	-	-	-

It can be conjectured from the data in Table 8 showed that the ascorbic acid value, in general, 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_5B_{10} (40.878) then WL_5B_4 (40.868) and WL_5B_2 (40.865) while lowest in WL_5B_1 (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. [19] suggested decrease of ascorbic acid might be due to oxidation taking place within the sample as well as enzymatic catalytic reaction taking place within the jam during storage.

The data regarding to overall acceptability of jam given in Table 9 during room temperature storage and indicate reading of overall acceptability significantly affected by treatment. The highest score of treatment was recorded in WL_5B_5 (6.920) then WL_5B_6 (6.700), WL_5B_7& WL_5B_8 (6.120), WL_5B_3 (6.090) but lowest score WL_5B_0 (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_5B_5 (8.400) at 0 day while lowest score of overall acceptability in WL_5B_0 (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, [20] in bael jam; Prasad and Mali, [20] in ber jam; Mulla [21] in mixed fruit jam.

5. CONCLUSION

Realized the study was concluded that treatment WLB_5 (95% WL_5 + 5 % beetroot juice) shown better amount of functional qualities for total antioxidants activity (%), Ascorbic acid (mg/100g), Crude fiber (%), crude protein (%), crude fat (%) and phenol content during 6 months of storage. These functional qualities provide many therapeutic, health and functional benefits. This treatment also possesses highest overall acceptability at room temperature as well as safe for consumption up to 6 months of storage.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (Chat GPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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