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Qualitative Changes in Blended Radish Juice Stored Under Refrigeration Condition

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ABSTRACT: The juice was extracted from winter season crops of radish, carrot, tomato and beet root. Different blends were prepared by altering the ratio of mixing. The blended samples and control were stored under refrigeration condition for storage study for 45 days at interval of 15 days. The samples were analyzed for the effect on physico-chemical properties of different samples. The recovery of juice was maximum from the carrot because of their high water content followed by radish, tomato and beet root. Beet root juice blended sample contain highest content of total solid, pH and viscosity. Ascorbic acid content was highest in control sample and decreased with the formation of blend of juice with other samples. Ascorbic acid content was lowest in case of samples blended with the carrot juice. The tannin content was very high in control sample and decreased with blending of carrot juice and tomato juice but increased with blending of beet root juice because the content of tannins was high in case of beet root. Total sugar content, reducing sugar and non- reducing sugar content was highest in samples blended with beet root juice and carrot juice. The control had lowest level of total sugar, reducing sugar and non- reducing sugar. Colour of control juice sample was very dull. The colour was best in beet root juice blended samples. These samples scored maximum score in organoleptic evaluation also. During storage period the color of juice became dull but sample blended with beet root juice were best. Tannins content, reducing sugar showed increase in their concentration. Total sugar, non- reducing sugar and ascorbic acid content showed gradual decrease in their concentration.

KEYWORDS: Juice, radish, blend, ascorbic acid, carrot, sugar, viscosity, acceptance

I.INTRODUCTION

Radish (*Raphanus sativus*) commonly known as muli, mula or mullagni in India, is a native root crop of Europe and Asia. It is grown in many states of India i.e. Uttar Pradesh, Bihar, Punjab, Haryana etc. This crop is seasonal in nature and the storage life is very limited. It is mainly consumed as salad in Northern India and also used in pickles preparation. The leaves of radish are edible and consumed as green leafy vegetables which contain valuable nutrients like calcium, riboflavin and carotene. Juice from radish sprouts is beneficial for our health as they are rich in potassium, magnesium, Vitamin C, iron, sulphur and amylase content. This crop is known for certain medicinal values and has been used for treating skin diseases, asthma and sinus problems, jaundice, piles and other health problems related to liver and spleen (Brar *et al.*1972, Leech 1997).

The use of radish juice is not common due to the dull colour and as well the astringency in the taste of juice. This astringency in radish juice is due to the presence of the compound 4-methylthio-3-transbutenylisothiocynate (MTBITC). The compound is formed during the growth of radish. Levels of this compound vary in varieties It is high in autumn and spring than in winter and summer. Radish juice could not be consumed without blending due to its unacceptable taste. Radishes can vary in flavour from mild to fiery hot and we can use this flavour to give a twist to other juice types that could do with a bit more flavour (Joshi *et al.*, 1996). In India area under the production of radish is 67345 hectares and production of radish is 802529 tones and productivity of radish is 12.77 t/ hac (International Society for Horticulture Science). The aim of present study was to standardize and determine the various levels of blending of radish juice with carrot, tomato and beet root juices and evaluation of their storage life under refrigeration condition with physicochemical components present in radish juice.

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II.LITERATURE SURVEY

Radishes can be beneficial to our health as they are sources of potassium, magnesium, vitamin C, iron, sulphur and amylase. Radish juice has been used for treating skin conditions, asthma and sinus problems. It has many medicinal values. It is used in cure of jaundice, piles and health problems related to of liver and spleen disorders. The use of radish juice is not so common. It is due to the dull colour of the juice and as well the astringency in the taste of juice. This astringency/ pungency in radish juice is due to the presence of the compound 4-methylthio-3-transbutenylisothiocynate (MTBITC). Study by Raffatullah *et. Al* (2008), showed the curative effect of radish juice against CCl_4 –induced hepatocellular injury in rats and that might be due the presence of terpenoid, phenolic and sulphanated compounds in radish juice. Aggarwal and Ichikawa, (2005) reported heptoprotective effect of radish against different carcinogenic factors.

III.METHODS AND MATERIALS

The fresh and mature radishes for the study were purchased from the local vegetable market in a single lot. Washing of the Radish and other vegetables was done to remove dust and the vegetable were sliced into pieces to extract the juice. Juice was extracted by placing pieces into the juicer. Juice was extracted and evaluated for changes in the physico-chemical and organoleptic characteristics during storage period of 45 days. The juice was filtered through simple sieve to remove scum. The radish juice was blended with carrot juice in the ratio of 1:1 and 3:2 .And same ratio was maintained with tomato juice. The beet root juice was added to radish juice in the ratio of 2:3 and 1:4.Bottled Juice was stored in glass bottles under refrigeration condition at 4°C. And storage study was carried out at interval of 15 days for a period of 45 days. pH of radish juice and blended samples was measured by digital pH meter. Titratable acidity was determined by the method described by Ranganna (1977). Total soluble solid content was measured at ambient temperature by hand refractometer (0-50°Brix).

Total sugar was estimated by Yemm and Will's method (1954). The method based on development of blue-green color, the color developed due to reaction of hexose sugar and their polymer with anthrone reagent. Analysis of reducing sugar was done by Somogyi modified method (Somogyi 1945).The method is based on the reaction of cuprous oxide with arsenomolybdate and sodium arsenate. Oxidation of Cupric to Cuprous by reducing of arsenomolybdate complex, produce an intense blue coloured solution that is very stable. Ascorbic acid content was determined by redox titration method of AOAC (1990).Tannin content in sample was measured by colorimetric method AOAC (1990) using phenol reagent. It is based on measurement of blue colour formed by the reduction of phosphotungstomolybdic acid by tannin like compounds in alkaline solution. Viscosity of samples was calculated using Brookfield viscometer. It was expressed as centipoises or mega pascal. Color of samples was determined using Lovibond tintometer. The prepared juice samples were subjected to sensory evaluation using hedonic scale for evaluation of color, taste, appearance, aroma and overall acceptability. Nine point hedonic scale was followed and attributed with a mean score of 6 or more out of 9 were considered acceptable.

Statistical analysis: The samples were taken in 3 replicates and data was analyzed using two factor completely randomly design (CRD) by OP STAT computer program for statistical analysis

IV.RESULTS AND DISCUSSION

Data pertaining to the physical characteristics of fresh radish and recovery of juice from fresh radish are given in the table 1. Colour of fresh radish was white and length of the vegetable varies from 21 cm to 29 cm depending on the growth of root. Diameter of the vegetable (sample) varies from 3.2 to 4.67 cm. The recovery of juice from the sample ranges from 62.45% to 67.23% according to their growth condition and season of growth.

A) Effect of storage on composition of the blended juices: Chemical properties of samples varied according to the type of sample used for the blend. The blend of carrot juice has more concentration of total sugar as compared to the other samples of tomato and beet root. But the concentration of ascorbic acid was more in case of juice blended with the tomato juice. Tannin content was observed more in case of samples blended with the beet root juice

B) Total soluble solid: The data pertaining to changes in total soluble solids (TSS) content during storage in different blended samples are presented in the table 2.Concentration of total soluble solid varies form 3.95° Brix in sample RT2 to 9.16 ° Brix in sample RB1.The maximum TSS was observed in case of blends of radish juice with beet root juice. Lowest TSS was observed in blend of radish juice with tomato juice. There was gradual decrease in the TSS content in case of blended samples with carrot juice and tomato juice but in blend with beet root there was slight increase in TSS content. The results were in agreement with

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the work of Dhaliwal and Hira (2004) that showed slight increase in TSS content of carrot juice blended with spinach juice and pineapple juice. Results were in contrary to the finding of Shrestha and Bhatia (1982), there was significant increase in the TSS of blends. The decrease in TSS was probably due to the utilization of total sugar in biochemical reaction during storage. But in beet root juice the increase was probably due to degradation of polysaccharides to soluble sugar.

Table 1. Physical characteristics of fresh radish

Physical characteristics	
Length	23 ±0.5 (cm)
Diameter	4.0 ±0.2 (cm)
Colour	White
Recovery of juice	63.25 %

Table 2. Changes in the total soluble solid (TSS) content (°Brix) of radish and blended juice samples during storage

Storage period (days)	**Treatment**							
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**	**MEAN**
0	5.700	7.167	6.833	5.067	4.867	9.167	7.500	6.614
	± 0.10	± 0.5	± 0.15	±0.11	±0.11	±0.35	±0.3	
15	5.333	6.767	6.400	4.783	4.417	8.500	6.833	6.148
	± 0.15	± 0.25	± 0.10	±0.10	±0.07	±0.30	±0.15	
30	4.900	6.367	6.183	4.550	4.117	7.833	6.383	5.762
	± 0.10	± 0.05	± 0.02	±0.05	0 ±0.1	±0.15	±0.10	
45	4.667	6.117	5.000	4.450	3.950	8.300	6.767	5.607
	± 0.20	± 0.07	± 0.1	±0.08	±0.15	±0.17	±0.25	
MEAN	5.150	6.604	6.104	4.713	4.338	8.450	6.871	-

CD at 5%	
Interval	0.2214
Treatment	0.2929
Interval X Treatment	NS

Each figure under particular interval for a sample is mean ± SD of three observations
Treatment R = radish juice as control,RC1= radish juice + carrot juice (1:1), RC2= radish juice + carrot juice (3:2), RT1= radish juice + tomato juice (1:1), RT2= radish juice + tomato juice (3:2), RB1= radish juice + beet root juice (3:2), RB2= radish juice + beet root juice (4:1)

C) pH: The observed data, showing changes in the pH of different blended samples during storage are expressed in the table 3. The pH of blended sample varied from 4.757 in RT1 to 6.697 in RB2 according to concentration on different blends and types of blended juices. The pH of the juice blended with tomato juice showed more increase as compared to the radish juice.

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Table 3. Changes in the pH content of radish and blended juice samples during storage

Storage period(days)	Treatment							
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**	**MEAN**
0	6.417±0.00	6.677± 0.01	6.820± 0.02	4.910±0.02	5.127±0.06	6.697±0.02	6.873±0.02	6.217
15	6.407±0.01	6.677± 0.00	6.810± 0.01	4.843±0.01	5.017±0.01	6.693±0.00	6.853±0.02	6.186
30	6.377±0.01	6.630± 0.03	6.753± 0.03	4.817±0.02	4.947±0.04	6.643±0.04	6.813±0.01	6.140
45	6.210±0.02	6.280± 0.02	6.490± 0.03	4.757 ±0.04	4.937±0.02	6.610±0.03	6.717±0.03	6.000
MEAN	6.353	6.566	6.718	4.832	5.007	6.661	6.814	-

CD at 5%
Interval 0.0174
Treatment 0.0230
Interval X Treatment 0.046
Each figure under particular interval for a sample is mean ± SD of three observations

D) Acidity: The data pertaining to change in acidity during storage in different blended samples are presented in the table 4.Acidity of blended samples ranged from 0.153 of R to 0.690 of RB1. Acidity is expressed as lactic acid in study of different blends during storage of 45 days. The acidity was maximum in samples blended with beet root juice that was probably due the less disruption of cell wall during extraction of juice.

Table 4. Changes in the acidity (as lactic acid content) and pH of radish and blended juice samples during storage

Storage period (days)	Treatment							
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**	**Mean**
0	0.160±0.02	0.283±0.01	0.160±0.02	0.273±0.02	0.170±0.02	0.317±0.04	0.290±0.01	0.235
15	0.170±0.02	0.327±0.03	0.190±0.01	0.323±0.03	0.190±0.01	0.407±0.04	0.317±0.04	0.273
30	0.183±0.01	0.387±0.04	0.210±0.02	0.437±0.07	0.280±0.05	0.563±0.01	0.319±0.04	0.318
45	0.210±0.05	0.430±0.04	0.260±0.02	0.543±0.07	0.357±0.03	0.690±0.05	0.327±0.03	0.385
Mean	0.171	0.309	0.168	0.419	0.247	0.494	0.313	__

CD at 5%
Interval 0.0234
Treatment 0.0310
Interval X Treatment 0.062
pH

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E) Viscosity: The changes in viscosity during storage in various blended samples are expressed in the table 5. Viscosity ranged from 56.66 centipoises in sample R to 490 centipoises in sample RB1 according to different their concentration of blending with radish juice. The viscosity of samples showed increases during the storage period. The maximum increase was there in beet root juice blended samples

Table 5. Changes in the viscosity (centipoise) of radish and blended juice samples during storage

Storage period (days)	Treatment							
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**	**Mean**
0	56.66±5.7	86.66±11.5	82.66 ±6.4	76.66±5.7	66.66±5.7	293.33±11.5	103.33±5.7	109.42
15	83.33±5.7	103.33±5.7	102.66±2.30	93.33±5.7	76.66±5.7	380.00 ±5.6	111.66±7.6	135.85
30	96.66±5.7	150.00	110.00	116.66	96.66	440.00	123.33	161.90
45	98.00±7.2	163.33±3.0	120.00±10.0	126.66±5.7	100.00±10.0	490.00±5.7	126.66±5.7	174.95
Mean	83.66	125.83	103.83	103.33	85.00	400.83	116.25	__

CD at 5%
Interval 5.480
Treatment 7.250
Interval X Treatment 14.5
Each figure under particular interval for a sample is mean ± SD of three observations

F) Ascorbic acid*:* Effect of storage on ascorbic acid content during storage in different blended juice samples is presented in the table 6. The concentration of ascorbic acid ranged in different samples from 1.577 in sample RC1 to 15.493 in sample R (mg/100g) during storage. The maximum concentration of ascorbic acid was present in the control sample and it decreased by blending and also during storage

Table 6. Changes in the ascorbic acid content (mg/100gm) of radish and blended juice samples during storage

Storage period (days)	Treatment							
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**	**Mean**
0	15.70±0.47	4.70±0.47	1.85±0.08	8.85±0.95.	8.03±0.46	11.33±1.25	9.96±0.83	7.23
15	14.38±0.47	2.90±0.41	1.65±0.09	7.45±0.85	6.39±0.21	9.13±0.83	8.24±0.83	6.167
30	13.55±0.47	2.29±0.20	1.41±0.08	5.67 ±0.86	5.57±0.27	7.29±0.18	6.39±0.21	4.318
45	11.62±0.8	1.57±0.08	.94±0.17	3.65±0.43	4.78±0.2	5.56±0.21	4.81±0.1	3.78

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	3				0		5	0
Mean	4.764	2.871	1.583	6.410	6.198	8.330	7.353	__

CD at 5%	
Interval	0.344
Treatment	0.455
Interval X Treatment	0.910

Each figure under particular interval for a sample is mean ± SD of three observations

F) Tannin content*:* The data pertaining change in the content of tannins during storage of different blended samples of juices are presented in the table 7.The tannins content ranged from 212.6 in sample RT1 to 767 in sample RB1 (mg /100ml) in different samples during storage. The maximum content of tannin was found in the samples blended with beet root juice. This content was responsible for the astringency in the juices samples. The level decreased in case of samples blended with carrot juice and tomato juice as compared to the control radish juice

Table 7. Changes in the tannin content (mg/100ml) of radish and blended juice samples during storage

Storage period (days)	**Treatment**							
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**	**Mean**
0	471.66	311.00	323.33	212.66 .		9.960	8.601	0.235
	±1.5	±1.0	±4.7	±2.5	±0.46	±1.25	±0.83	
15	14.387	2.907	1.653	7.457	6.393	9.130	8.243	7.167
	±0.47	±0.41	±0.09	±0.85	±0.21	±0.83	±0.83	
30	13.557	2.297	1.413	5.577	7.290	6.393	6.029	0.318
	±0.47	±0.20	±0.08	±0.86	±0.27	±0.18	±0.21	
45	11.620	1.577	1.440	3.657	4.787	5.563	4.817	4.780
	±0.83	±0.08	±0.17	±0.43	±0.20	±0.21	±0.15	
Mean	13.764	2.871	1.583	6.410	6.198	8.330	7.353	__

CD at 5%	
Interval	1.432
Treatment	1.895
Interval X Treatment	NS

Each figure under particular interval for a sample is mean ± SD of three observations

G) Total sugar: Effect of storage on total sugar content during storage in different blended juice samples are presented in the table 8.The data presented in table shows a gradual decrease in concentration of total sugar in some samples. Concentration of total sugar ranged from 2.077 in sample R to 9.767 in sample RB1 (mg %) during storage. The total sugar content was maximum in case of radish juices sample blended with the beet root juice followed by carrot juice and concentration of sugar increase with ratio of blend of these juice

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Table 8. Changes in the total sugar content (mg %) content of radish and blended juice samples during storage

Storage period (days)	Treatment							
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**	**Mean**
0	2.45±0.05	5.75±0.04	5.15±0.05	3.46±0.03	3.08±0.02	9.76±0.25	7.60±0.26	5.324
15	2.34±0.05	5.65±0.05	4.91±0.15	3.25±0.05	2.97±0.02	9.66±0.15	7.38±0.10	5.169
30	2.16±0.03	5.30±0.30	4.65±0.05	2.93±0.05	2.85±0.05	9.21±0.07	7.21±0.07	4.904
45	2.07±0.05	5.35±0.10	4.40±0.05	2.85±0.05	2.65±0.25	8.73±0.40	7.283	4.763
Mean	2.257	5.514	4.779	3.123	2.889	9.346	7.371	__

CD at 5%	
Interval	0.0872
Treatment	0.1153
Interval X Treatment	0.231

Each figure under particular interval for a sample is mean ± SD of three observations

H) Reducing sugar*:* The amount of reducing sugar expressed as mg %, in different samples during storage is presented in form of data in table 9.The amount of reducing sugar varied from 1.077 in sample R to 2.500 in sample RB1 (mg %) in different samples during storage. The concentration was maximum in case of radish juice blended with beet root juice followed with carrot juice. During storage there was gradual increase in level of reducing sugar

Table 9. Changes in the reducing sugar content (mg %) of radish and blended juice samples during storage

Storage period (days)	Treatment						
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**
0	1.077±0.02	1.923± 0.02	1.817±0.01	1.227±0.02	1.110±0.05	2.283±0.05	2.077±0.02
15	1.203±0.04	2.033±0.01	1.913±0.02	1.317±0.02	1.177±0.03	2.377±0.03	2.110±0.03
30	1.25±0.02	2.11±0.03	1.92±0.02	1.42±0.02	1.26±0.01	2.42±0.02	2.22±0.02
45	1.340±0.05	2.327±0.02	2.120±0.10	1.527±0.02	1.327±0.02	2.500±0.05	2.330±0.02
Mean	1.218	2.099	1.944	1.374	1.219	2.397	2.186

CD at 5%	
Interval	0.0226
Treatment	0.0299
Interval X Treatment	0.060

Each figure under particular interval for a sample is mean ± SD of three observations

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I)Non-reducing sugar: Storage effect on non-reducing sugar content during storage in different blended juice samples are presented in the table 10.The amount of non-reducing sugar varied from 0.737 in case of R to 7.493 in case of RB1 (mg %) in different samples of blended juice during storage under refrigeration condition. There was gradual decrease in amount of non-reducing sugar during storage in all the samples and decrease was significant. The decrease was in case of radish juice blended with beet root juice followed by the carrot juice

Table10. Changes in the non-reducing sugar content (mg %) of radish and blended juice samples during storage

Storage period (days)	Treatment							
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**	**Mean**
0	1.373	3.833	3.333	2.233	1.973	7.493	5.523	3.680
	± 0.04	±0.05	±0.06	±0.05	±0.06	±0.21	±0.28	
15	1.137	3.593	3.003	1.933	1.797	7.290	5.273	3.432
	±0.06	± 0.09	±0.010	± 0.05	±0.02	±0.14	±0.12	
30	0.907	3.187	2.723	1.523	1.587	6.823	4.990	3.106
	±0.04	±0.28	±0.06	± 0.07	±0.06	±0.04	± 0.09	
45	0.737	3.023	2.313	1.323 1	1.323	6.233	4.953	2.844
	±0.06	±0.06	±0.24	±0.06	± 0.06	±0.23	±0.40	
Mean	1.038	3.409	2.843	1.753	1.670	6.960	5.185	__

CD at 5%	
Interval	0.0920
Treatment	0.1217
Interval X Treatment	0.243

Each figure under particular interval for a sample is mean ± SD of three observations

J) Organoleptic evaluation: Organoleptic evaluation of different blended samples of juice was done by a panel of 8 judges during storage interval. The scores recorded on the basis of hedonic scale are presented in the table 11. The results showed that juice sample blended with carrot juice in a ratio of 1:1 scored maximum acceptance in overall acceptability. The radish juice sample blended with beet root juice showed maximum score in for colour and consistency of final sample but taste scored least because of astringency in taste. During storage the score of acceptability decreased in case of blended juice with tomato juice due to loss of color. In case of beet root juice blend the score did not show significant change probably due to because of increase in the consistency of juice and color darkening. The scores in case of carrot juice blend were not much affected

Table 11. Changes in the organoleptic qualities of radish and blended juice samples during storage (Score is out of 9)

Storage period (days)	Treatment							
	R	**RC1**	**RC2**	**RT1**	**RT2**	**RB1**	**RB2**	**Mean**
0	4.6	6.1	5.8	5.0	4.1	6.0	5.8	5.3

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15	6.0	6.0	5.7	4.7	3.8	6.0	5.7	5.2
30	4.4	6.0	5.6	4.6	3.7	5.8	5.5	5.1
45	4.2	6.0	5.5	4.6	3.7	6.0	5.5	5.1
Mean	4.4	6.0	5.7	4.7	3.8	5.9	5.6	__

Each figure under particular interval for a sample is an average of scores given by eight panellists

V. CONCLUSIONS

The juice was extracted from winter season crops of radish, carrot, tomato and beet root. Different blends were prepared by altering in the ratio of mixing. After 45 days foul smell was observed in the juice samples. The blended samples prepared were best during storage and scored maximum scores in organoleptic evaluation of samples. Beet root juice blended sample contain highest content of total solid, pH and viscosity. The acidity content was highest in case of sample blended with tomato juice. Ascorbic acid content was highest in control sample and decreased with the formation of blend of juice with other samples. Ascorbic acid content was lowest in case of samples blended with the carrot juice. The tannin content was very high in control sample and decreased with blending of carrot juice and tomato juice but increased with blending of beet root juice because the content of tannins was high in case of beet root. The colour was best in beet root juice blended samples. The change in pH, total soluble solids and acidity was not significant. Tannins content, reducing sugar showed increase in their concentration. It can be concluded from the study that radish juice blended with carrot juice was best in acceptance and other physico- chemical properties followed by blended with beet root juice and tomato juice.

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