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Dipesh Kumar
Research Scholar, Department of Vegetable Science, Pt. K.L.S. College of Horticulture and Research Station, Rajnandgaon, IGKV, Raipur, Chhattisgarh, India

SP Sharma
Assistant Professor, Department of Horticulture, Pt. K.L.S. College of Horticulture and Research Station, Rajnandgaon, IGKV, Raipur, Chhattisgarh, India

Leena Thakur
Research Scholar, Department of Vegetable Science, Pt. K.L.S. College of Horticulture and Research Station, Rajnandgaon, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Dipesh Kumar
Research Scholar, Department of Vegetable Science, Pt. K.L.S. College of Horticulture and Research Station, Rajnandgaon, IGKV, Raipur, Chhattisgarh, India

Studies on recipe standardization and physico-chemical properties of blended beverage of bottle gourd along with lime and mint

Dipesh Kumar, SP Sharma and Leena Thakur

Abstract
The blended juice of bottle gourd was prepared by using mint and lime. To standardize the best recipe, 6 combinations were prepared and evaluated through organoleptic test. The physico-chemical changes were also studied under ambient condition up to 3 month of storage period. According to the organoleptic evaluation treatment T_5 containing pulp 60% (bottle gourd 50% + lime 5% + mint 5%), TSS 15 ºBrix and acidity 0.3% was scored highest for colour, appearance and overall acceptability, whereas for flavour and taste, treatments T_3 and T_2 scored highest respectively. In case of physico-chemical characteristics treatment T_6 had highest TSS, TSS/acid ratio, pH, ascorbic acid, reducing sugar and total sugar. Whereas for acidity and non-reducing sugar T_1 was highest. During the storage period the TSS, acidity, reducing sugar, total sugar increased and pH, TSS/acid ratio, ascorbic acid, non reducing sugar decreased with passage of storage period.

Keywords: Bottle gourd, blended, beverage

Introduction
Bottle gourd is one of the most significant summer cucurbitaceous vegetable crops in tropical and subtropical parts of the world, although it is farmed practically all year in India. The bottle gourd (*Lagenaria siceraria*) is a Cucurbitaceae family annual climbing vine with large leaves. Calabash, Doodhi, Lauki, Ghiya, and White flowered gourd are some of its names (Axtell and Fairman, 1992; Deore *et al*., 2009) [2, 5]. Bottle gourd fruits are yellowish green with a white flesh and have bottle shape. The fruit's length ranges from 150 to 1000 mm, and the fruit may be long, oblong or round in shape depending upon its variety (Chadha, 2006) [3].
It is reported to have originated in Africa and widely cultivated throughout the tropics, especially in India, Sri Lanka, Indonesia, Malaysia, Philippines, China, Tropical Africa and South America. It seems that bottle gourd originated from India because its wild races are still found in Dehradun (high humid area) and Malabar costal area (reported of Parle Milind, 2011)
Bottle gourd has long been an important component of indigenous herbal medicine, particularly in Asia and is underutilized fruit in spite of being one of the cheapest source of nutrients and potential source of natural antioxidants.
It is one of the excellent fruits gifted by nature to human beings having composition of all the essential constituents that are required for good health and quality human life. Bottle gourd fruit contains about 96% moisture and is rich in vitamins, minerals, antioxidants and dietary fibers and is available at a cheaper rate. Bottle gourds contain 1.6% choline on a dry weight basis (Thomas, 2008) [12]. A 100 g of edible portion of the bottle gourd contains 87.0 mg potassium, 37.0 mg phosphorus, 12.0 mg calcium, 1.7 mg Sodium, 0.8 mg Iron, 12.0 mg ascorbic acid and 0.3 mg niacin (Rumeza *et al*., 2006) [11].
The fruit is also well known for its anti – stress, adaptogenic, aphrodisiac, analgesic, anti-inflammatory, antidote to certain poisons, alternative purgative, cardio protective, cardio tonic, and cooling, diuretic, hepatoprotective and immunomodulatory properties. The bottle gourd juice has been used to treat acidity, indigestion and ulcers. It cures pain, fever and is used for pectoral-cough, asthma and other bronchial disorders (Deore *et al*., 2009) [5]. It is also considered to be beneficial in insanity, epilepsy and other nervous diseases. It has antihyperlipidemic activity (Mohale *et al*., 2008). A glass of bottle gourd juice taken daily is also considered to prevent premature graying of hair and (Hemeda and Khattab, 2010) [8] can serve as an effective thirst quencher.

In the form of vegetable it is difficult to consume fresh bottle gourd to meet daily recommended requirement, for convenience it needs to be converted into RTS, nectar, beverages so as to make it available as and when required. Bottle gourd fruit has higher edible index and lower waste index, which proves its importance for processing.

The importance of bottle gourd increases in India and abroad after the discloser of "Baba Ramdev" that bottle gourd juice is health supportive, nutritious, restorative juice and now it is very common among the peoples. The bottle gourd juice is not so pleasant but after appropriate blending with lime and mint the beverage may be acceptable and well preferred due to its higher nutritional and health supportive values.

Blending of juice is a way of utilization of under-utilized vegetables, fruits, and spices. This may be attributed to change in dietary habits, taste preferences, and the way of life of present-day consumers.

Mint is botanically known as *Mentha piperita* and is a member of the Lamiaceae family. Mint is high in antioxidants and phytonutrients, which can help our stomachs. The menthol present in mint (pudina) helps the enzymes necessary for digestion. Antibacterial and anti-inflammatory qualities occur in mint leaves.

Lime, botanically known as *Citrus aurantifolia*, is a member of the Rutaceae family. Lime is well-known for its ability to treat scurvy, a condition caused by a deficiency of vitamin C. When lime juice and its natural oils are eaten or applied topically, they are extremely helpful to the skin. Due to the presence of a significant amount of vitamin-C and flavonoids, it rejuvenates the skin, maintains it gleaming, protects it from infections, and eliminates body odour. Both of these antioxidants are class 1 and have antibacterial and disinfection effects.

Materials and methods

For the preparation of bottle gourd beverage, well-developed soft bottle gourd fruits, ripe lime, and fresh mint leaves were used. Hand peeler was used to peel the bottle gourd, which was then chopped into small pieces using a knife. The leaves of the mint plant were removed from the stem. To deactivate enzymes and prevent browning, bottle gourd and mint were blanched in boiling water at 75-80^{o}C for 2-3 minutes. A mixer grinder was used to grind bottle gourd pieces and mint. Lime was cut into two halves and juice was extracted by squeezing. Water, sugar, and citric acid were added to mix grinded pulp and then were boiled together. The prepared beverages were filtered through a sieve to obtain a uniform consistent product. The hot beverages were put into sterilised bottles with a volume of 200 ml, leaving a 2 to 2.5 cm headspace, and corked with a sterilised crown cork using a crown corking machine. The filled bottles were pasteurised in boiling water until the product reached the temperature of 80°C. It took about 15 minutes to attain required temperature.

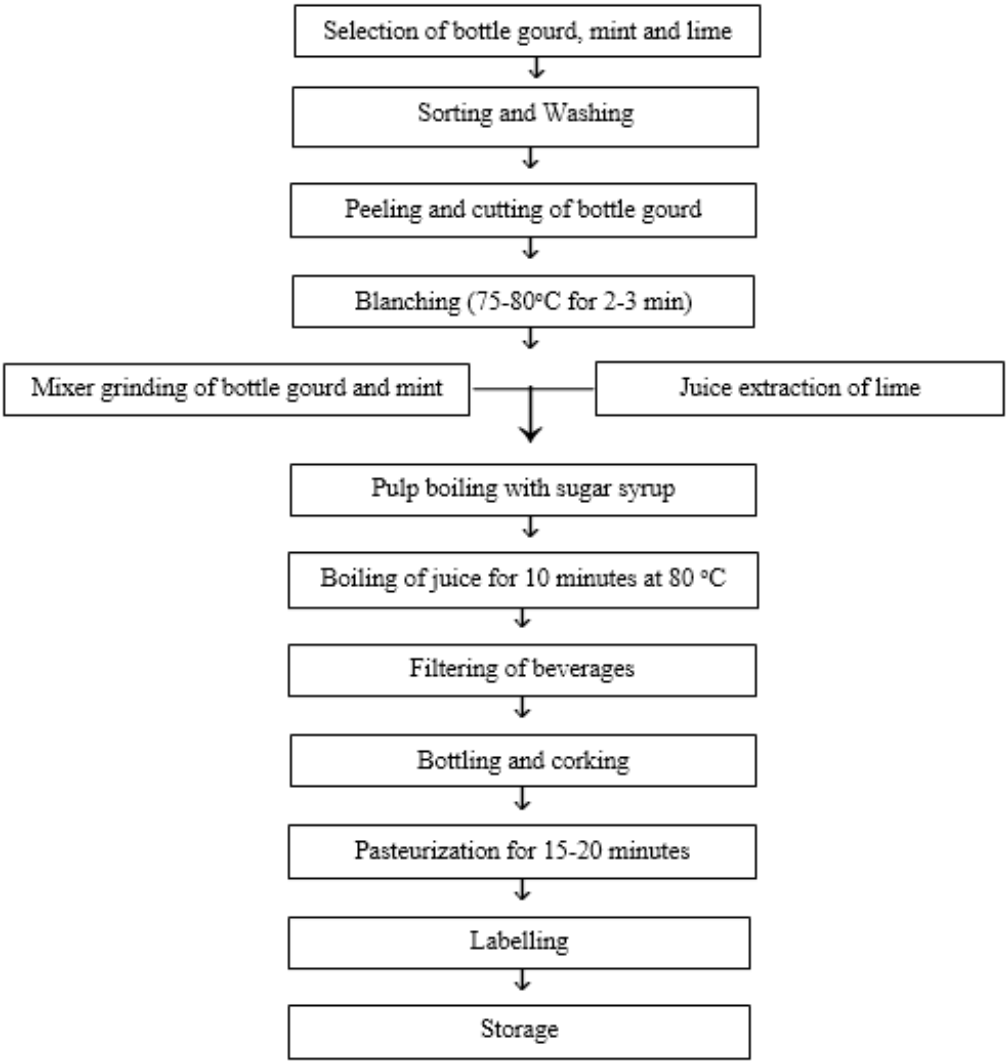

Fig 1: Sheet for preparation of bottle gourd beverage blended with lime and mint

Results and Discussion

Standardization of recipe

The panel of five judges did organoleptic evaluation of beverage prepared from different recipes using a nine-point hedonic rating test as described by Ranganna (1997) [10]. The organoleptic scores are presented in Table 1. Colour and appearance scored maximum 8.06 and 7.73 respectively by T_5. Flavour scored 8.06 by T_3 and taste 8.00 was obtained by T_2. The overall acceptability of beverage was maximum 7.65 by T_5.

Table 1: Organoleptic score of beverage

Organoleptic score (9-point hedonic rating test)					
Treatments	**Colour**	**Appearance**	**Flavour**	**Taste**	**Overall acceptability**
T_1 [pulp 20% (bottle gourd 10% + lime 5% + mint 5%), TSS 15 ºBrix, acidity 0.3%]	6.53	6.66	7.13	7.46	6.95
T_2 [pulp 30% (bottle gourd 20% + lime 5% + mint 5%), TSS 15 ºBrix, acidity 0.3%]	6.53	6.86	7.86	8.00	7.31
T_3 [pulp 40% (bottle gourd 30% + lime 5% + mint 5%), TSS 15 ºBrix, acidity 0.3%]	7.20	7.06	8.06	7.73	7.51
T_4 [pulp 50% (bottle gourd 40% + lime 5% + mint 5%), TSS 15 ºBrix, acidity 0.3%]	7.73	7.20	7.60	7.66	7.55
T_5 [pulp 60% (bottle gourd 50% + lime 5% + mint 5%), TSS 15 ºBrix, acidity 0.3%]	8.06	7.73	7.33	7.46	7.65
T_6 [pulp 70% (bottle gourd 60% + lime 5% + mint 5%), TSS 15 ºBrix, acidity 0.3%]	7.80	7.46	6.86	6.93	7.26
CD at 5%	0.268	0.24	0.19	0.24	0.122
S.Em ±	0.086	0.077	0.061	0.077	0.039
CV	2.039	1.86	1.41	1.767	0.918

TSS (ºBrix): The total soluble solids (TSS) of beverages were determined using a hand refractometer and presented in Table 2. The TSS was maximum for T_6 and ranged between 15.23 to 16.20. T_1 scored lowest for TSS and varied from 15.06 to 15.83 during the course of storage. The increasing trend of TSS in blended bottle gourd beverage was probably due to conversion of insoluble carbohydrate into soluble carbohydrate (sugars). Similar finding was reported by Verma (2009) [13] in bottle gourd beverage.

Acidity (%): To determine the acidity of the beverages, Ranganna's (1997) [10] method was used and described in Table 3. The acidity of beverage was maximum for T_1 and ranged from 0.31 to 0.42, whereas minimum value for T_6 ranged from 0.30 to 0.38. The increase in acidity of blended bottle gourd beverage during storage might be due to formation of other organic acids. Similar finding was also reported in the beverage of bottle gourd (Verma, 2009) [13].

Table 2: Changes in TSS during storage

TSS (ºBrix)				
Notation	**Storage periods (in days)**			
	0	**30**	**60**	**90**
T_1	15.06	15.26	15.53	15.83
T_2	15.10	15.30	15.63	15.90
T_3	15.13	15.33	15.70	16.06
T_4	15.16	15.33	15.73	16.10
T_5	15.20	15.36	15.70	16.10
T_6	15.23	15.53	15.86	16.20
CD at 5%	N/A	0.141	0.17	0.203
S.Em ±	0.049	0.045	0.054	0.065
CV	0.561	0.509	0.601	0.705

Table 3: Changes in acidity during storage

Acidity (%)				
Notation	**Storage periods (in days)**			
	0	**30**	**60**	**90**
T_1	0.31	0.34	0.38	0.42
T_2	0.31	0.33	0.37	0.40
T_3	0.31	0.33	0.36	0.40
T_4	0.30	0.32	0.35	0.39
T_5	0.30	0.32	0.35	0.39
T_6	0.30	0.32	0.35	0.38
CD at 5%	N/A	0.011	0.017	0.011
S.Em ±	0.005	0.004	0.006	0.004
CV	3.052	1.89	2.67	1.559

TSS/acid ratio: TSS/acid ratio of beverage was calculated by dividing TSS of the beverage by its acid. Data described in Table 4. The TSS/acid ratio was highest in T_6 and ranged 50.23 to 41.89 during the storage of 90 days. Whereas lowest TSS/acid ratio was in T_1 ranged from 47.58 to 37.39. The decrease in TSS / acid ratio of different treatments may be due to the increase in acidity of the beverage during storage was higher than TSS. Similar findings have also been reported in bottle gourd juice (Gajera *et al*., 2018) [8].

pH: The pH value of beverages was taken on pen type digital pH meter and described in Table 5. The highest pH value was obtained by T_6 and ranged from 4.36 to 3.77. Whereas lowest was T_1 which is ranged Between 4.26 to 3.67. Significant decrease in pH under all the recipe treatments may be due to corresponding increase in acidity during storage period. The present findings are in agreement with Gajera (2017) [6] in bottle gourd blended juice.

Table 4: Changes in TSS/acid during storage

TSS / acid ratio				
Notation	**Storage periods (in days)**			
	0	**30**	**60**	**90**
T_1	47.58	44.46	40.89	37.39
T_2	48.74	45.90	41.88	39.10
T_3	48.84	46.48	43.23	40.16
T_4	49.49	46.94	44.14	40.93
T_5	49.61	47.04	44.04	41.30
T_6	50.23	48.53	44.90	41.89
CD at 5%	N/A	1.457	2.154	1.174
S.Em ±	0.892	0.468	0.691	0.377
CV	3.146	1.74	2.773	1.627

Table 5: Changes in pH during storage

pH				
Notation	**Storage periods (in days)**			
	0	**30**	**60**	**90**
T_1	4.26	4.09	3.87	3.67
T_2	4.29	4.10	3.88	3.68
T_3	4.31	4.12	3.89	3.68
T_4	4.32	4.16	3.96	3.74
T_5	4.34	4.18	3.99	3.76
T_6	4.36	4.21	3.99	3.77
CD at 5%	0.058	0.072	0.092	0.074
S.Em ±	0.019	0.023	0.03	0.024
CV	0.752	0.961	1.299	1.103

Ascorbic acid (mg/100ml)
The ascorbic acid of beverage was determined by the procedure given by Ranganna (1997) [10]. The data of ascorbic acid was described in Table 6. The maximum ascorbic acid was in T_6 which was ranged from 8.00 to 5.22. The least ascorbic acid content was in T_1 and ranged 3.84 to 1.70 during the course of storage. Significant decrease in ascorbic acid during storage may be due to thermal degradation during processing and subsequent oxidation during storage period as it is highly sensitive to heat, oxidation and light. Similar reduction in ascorbic acid content have also been reported in bottle gourd blended beverage (Agarwal *et al*., 2017) [1].

Sugars: Sugars were determined by the method of Lane and Eynon as described by Ranganna (1997) [10].

Reducing sugar (%)
The data on the reducing sugar of beverage during ambient storage conditions of the various recipe treatments are described in Table 7. The highest reducing sugar ranged between 2.53 to 3.61 of the treatment T_6 and lowest was ranged 1.96 to 2.77 of T_1. Significant increase in reducing sugars during storage might be due to inversion of non-reducing sugars into reducing sugars in the presence of acidic environment of the beverage. Similar results were reported by Dahatonde (2015) [4] in bottle gourd juice.

Table 6: Changes in ascorbic acid

Ascorbic acid (mg/100ml)				
Notation	**Storage periods (in days)**			
	0	**30**	**60**	**90**
T_1	3.84	3.20	2.45	1.70
T_2	4.48	3.73	3.20	2.24
T_3	5.86	5.12	4.37	3.30
T_4	6.72	5.86	5.12	4.05
T_5	7.25	6.50	5.54	4.69
T_6	8.00	7.36	6.50	5.22
CD at 5%	0.45	0.332	0.359	0.303
S.Em ±	0.144	0.107	0.115	0.097
CV	4.151	3.487	4.402	4.767

Table 7: Changes in reducing sugar

Reducing sugar (%)				
Notation	**Storage periods (in days)**			
	0	**30**	**60**	**90**
T_1	1.96	2.13	2.37	2.77
T_2	2.09	2.27	2.55	2.99
T_3	2.19	2.38	2.66	3.08
T_4	2.27	2.48	2.77	3.22
T_5	2.36	2.58	2.90	3.38
T_6	2.53	2.71	3.06	3.61
CD at 5%	0.063	0.059	0.075	0.073
S.Em ±	0.02	0.019	0.024	0.023
CV	1.567	1.356	1.541	1.277

Non reducing sugar (%)
Data related to the changes on the non reducing sugar of beverage during ambient storage (0 to 90 days) conditions is described in Table 8. Non reducing sugar was maximum in the treatment T_1 and ranged between 7.96 to 7.55 whereas minimum in T_6 was between 7.86 to 7.14. The significant decrease in non reducing sugar might be due to inversion of non-reducing sugars into reducing sugars in the presence of acidic environment of the beverage. This type of changes in sugar content was also observed by Dahatonde (2015) [4] in bottle gourd juice.

Total sugar (%)
The data related to total sugar was described in Table 9. The maximum total sugar was observed in T_6 ranged from 10.39 to 10.75 whereas minimum value in T_1 ranged from 9.92 to 10.32. The total sugar increased significantly with increasing storage period which may be due to the hydrolysis of polysaccharides such as starch and their conversion into simple sugars. Similar finding have also been reported in beverage of bottle gourd (Verma, 2009) [13].

Table 8: Changes in non reducing sugar

Non reducing sugar (%)				
Notation	**Storage periods (in days)**			
	0	**30**	**60**	**90**
T_1	7.96	7.84	7.73	7.55
T_2	7.94	7.83	7.70	7.44
T_3	7.93	7.81	7.64	7.41
T_4	7.92	7.77	7.60	7.35
T_5	7.90	7.76	7.55	7.29
T_6	7.86	7.73	7.52	7.14
CD at 5%	0.06	0.069	0.099	0.094
S.Em ±	0.019	0.022	0.032	0.03
CV	0.421	0.493	0.722	0.712

Table 9: Changes in total sugar

Total sugar (%)				
Notation	**Storage periods (in days)**			
	0	**30**	**60**	**90**
T_1	9.92	9.97	10.11	10.32
T_2	10.03	10.10	10.25	10.43
T_3	10.12	10.19	10.30	10.50
T_4	10.20	10.26	10.37	10.58
T_5	10.27	10.35	10.46	10.67
T_6	10.39	10.45	10.58	10.75
CD at 5%	0.111	0.114	0.127	0.138
S.Em ±	0.036	0.036	0.041	0.044
CV	0.605	0.618	0.683	0.729

Conclusion
The bottle gourd was added in different proportion in different treatments with the lime and mint. The best treatment was obtained by organoleptic test which is treatment T_5 pulp 60% (bottle gourd 50% + lime 5% + mint 5%), TSS 15 ºBrix and acidity 0.3% got highest score in respect of colour, appearance and overall acceptability. Hence this recipe was standardized for preparation of bottle gourd beverage blended with lime and mint. The physico-chemical properties of beverage the TSS, acidity, reducing sugar, total sugar were increased as storage period increases and pH, TSS/acid ratio, ascorbic acid, non reducing sugar were decreased as storage period increased.

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