Journal of Medicinal Plants Studies
www.PlantsJournal.com

ISSN (E): 2320-3862
ISSN (P): 2394-0530
NAAS Rating 2017: 3.53
JMPS 2017; 5(4): 56-60
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Received: 28-05-2017
Accepted: 30-06-2017

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Effect on juice quality of medicinal fruit bottle gourd during storage

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Abstract
Juice based on Bottle gourds (*L. siceraria*) was prepared using Aonla (*Emblica officinalis Gaertn.*), Lemon (*Citrus x limon*) and Ginger (*Zingiber officinale*) juices with 30 experimental combinations and optimized desired quality one. Optimized blend juice was hot filled at 85ºC in 200 ml glass bottles, crown corked and were thermally processed in hot water. Processed juice bottles were kept for long term refrigerated storage. The quality of blend juice in terms of sensory, physicochemical and microbiological characteristics was evaluated during storage condition at 07 ± 02 °C for 6 months. During storage, significant difference ($P<0.05$) was found in the sensory attributes of juice. No significant difference ($P>0.05$) was found in pH, acidity, TSS and total solids of the product during initial 2 month of storage however, significant effect ($P<0.05$) was observed in reducing sugars, non reducing sugars, ascorbic acid contents and microbiological counts during the storage. The total loss of ascorbic acid during storage was 20.10 %. Total plate counts were not found more than 50cfu mL^{-1} during entire storage. The product was acceptable and microbiologically safe at the end of the storage

Keywords: Bottle gourds; Blend juice; Storage; Quality; Sensory; Physicochemical; Microbiological.

1. Introduction
Bottle gourd has long been an important component of indigenous herbal medicine, particularly in Asia (Robinson and Decker, 2004) [1]. Bottle gourd (*Langenaria siceraria*), a vigorous annual climbing vine with large leaves belongs to *Cucurbitaceae* family and known as Calabash, Doodhi, Lauki, White flowered gourd, Trumpet gourd, Calebassier, Courage bouteille (French) Cojombro, Guiro amargo (Spanish); Upo, Talayag, Gucuzzi, Zucca melon (Philippines); Mokwa, Oo Lo Kwa (China) (Axtell and Fairman, 1992; Deore *et al*., 2009) [2, 3]. Bottle gourd fruits having the shape of a bottle are yellowish green with whiter pulp. The length of the fruit varies from 150 to 1000 mm, and the fruit may be long, oblong or round in shape depending upon its variety (Chadha, 2006) [4]. 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)[5]. A 100 g of edible portion of the bottle gourd contains 12.0 mg ascorbic acid, 87.0 mg potassium, 12.0 mg calcium, 37.0 mg phosphorus and 0.3 mg niacin (Rumeza *et al*., 2006; Sawate *et al*., 2009) [6,7].
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) [3]. It is also considered to be beneficial in insanity, epilepsy and other nervous diseases. It has antihyperlipidemic activity (Mohale *et al*., 2008) [8]. A glass of bottle gourd juice taken daily is also considered to prevent premature graying of hair (Hemeda and Khattab, 2010) [9] and can serve as an effective thirst quencher.
Bottle gourd fruit is still underutilized fruit in spite of being one of the cheapest source of nutrients and potential source of natural antioxidants and hence, steps should be taken to preserve this perishable but nutritionally important fruit by extending the shelf- life in the processed form. Production of juice is one way to process the bottle gourd. Low thermal processing is an important process enabling retention of more colour, consistency, fresh flavor, and ascorbic acid content in juice products. To minimize thermal process and to produce highly nutritive and stable blended juice, low acid bottle gourd juice could be blended with relatively high acidic fruit juices such as aonla (Indian gooseberry) and lemon fruits. Organoleptic quality of such vegetable blended juice could be increased by addition of spice extract like ginger juice. The ginger juice also acts as a good source of natural preservative

(Kalpana *et al*., 2008) [10] and has anti-bacterial and anti-fungal properties (Bhardwaj and Mukherjee, 2011) [11]. Ginger blended juice can improve the storability with minimal physicochemical changes and inhibits the microbial growth owing to its inherent antioxidant and antimicrobial properties (Ghosh *et al*., 2011) [12]. Therefore, to improve upon the taste, aroma, palatability, storability and nutritive value of bottle gourd juice, it was thought to blend it with other highly nutritive fruit juices namely aonla and lemon with spice extracts like ginger. Bottle gourd blended juice is not commercially available in the market but have potential scope of development as a natural health drink with adequate shelf-life.

The limited researches were carried out on systematic production and long term preservation of this type of blend juice without added chemical preservatives. Technological parameters for the production of bottle gourd based blend juice along with its thermal processing have been studied. The objective of the present experiment was to find out the effect of storage at 07±02 °C on sensory, physicochemical and microbiological quality of minimal thermally processed bottle gourd blend juice during 180 days.

2 Materials and Methods

2.1 Procurement of raw materials and preparation of juices

Bottle gourd (*cv*. ABG-1), fresh aonla (*cv*. Anand-2) and lemon (*cv*. Kagzi) fruits were procured from the Vegetable and Horticultural Farm of the Anand Agricultural University, Anand. Ginger rhizomes were purchased from the local vegetable market of Anand (India). Procured raw materials were thoroughly washed in the running tap water to remove surface adhering extraneous material, insecticides, pesticides, contaminations and the other microbial load. Washed tender bottle gourd fruits were prepared for blanching. The top 20 mm and bottom 15 mm of the bottle gourd was cut and removed. The fruit was sliced to 5mm thickness using a stainless steel slicer machine and were blanched unto peroxidase enzyme inactivated in water bath having temperature control. Fresh and whole aonla fruits were blanched in boiling water unto 6 min as described by Jain and khurdiya, (2002) [13]. Juice from the blanched bottle gourd and aonla was extracted using centrifugal juicer, while lemon juice was extracted squeezing the cut lemon and juice from ginger was prepared using a domestic mixer cum grinder. Extracted juices were prepared strained through muslin cloth.

2.2 Formulation and processing

Design-Expert software (Design expert® 8.0.7.1, Statease Inc., Minneapolis, USA), based on numerical technique was used to formulate 30 experimental combinations of blending the juices prepared as above. Response surface technology statistical models were generated to analyze the responses with respect to the independent variables. Optimized blend juice with the 87.90 ml of bottle gourd, 23.40 ml of aonla, 5.70 ml of lemon and 6.00 ml of ginger juice was hot filled at 85 ^{0}C in pre-sterilized 200 ml glass bottles, crown corked and thermally processed in hot water at atmospheric pressure to meet required criterion of food safety and standards regulations (FSSRs), 2011 as described by Nijhawan, (2012) [14].

2.3 Storage study

Thermally processed blend juice bottles were allowed to be cooled to atmospheric temperature and stored under refrigerated condition (07 ± 02 °C) for 6 months. Stored blend juice samples were analyzed for sensory evaluations, physicochemical characteristics and microbiological counts for 0, 30, 60, 90, 120, 150 and 180 days. Sensory evaluations were carried out in terms of appearance and colour, flavor, taste, consistency and overall acceptability (OAA). The physicochemical characteristics evaluated were pH, total soluble solid, total titratable acidity (% citric acid), total solids, reducing sugars, non-reducing sugars, total sugars and ascorbic acid contents of blend juice. The microbiological counts were in terms of total plate counts, yeasts and molds count, and coli form counts in cfu mL^{-1}.

2.4 Quality Estimation

For sensory quality, a panel of semi trained testers among faculties of the institute was served the juice samples. The acceptance tests and overall acceptability of the blend juice were carried out on 9 point hedonic rating as suggested by Ranganna, (2004) [15]. pH was determined using digital pH meter (Systronics India Limited, Ahmadabad, India**)**.The TSS (^{0}Brix) of the juice were measured using refractometer-PAL-1(ERMA, Japan) having 0-53 ^{0}Brix range. Total acidity was measured by titration with NaOH (0.1N) using phenolphthalein (1%) solution and expressed as percent citric acid. Total solids (%) were determined according to the AOAC, (1990) [16]. Sugars were determined using Lane and Eynon method, ascorbic acid contents (mg/100ml) was estimated by visual titration method using 2, 6-dichlorophenol-indophenol and microbiological counts were carried out as described by Ranganna, (2004) [15]. Required chemicals were procured from Merck, SD Fine Chemicals, Loba Chemie and Hi-Media Laboratories Pvt. Ltd., Mumbai for all the assays.

2.5 Statistical analysis

Replicated data obtained (mean ± standard deviation) during the experimentations were analyzed by the statistical software SAS® version 9.3 (SAS Institute Inc., Statistical Analysis System, Cary, NC) and results were interpreted.

3 Results and Discussion

3.1 Sensory characteristics

The mean values for the appearance and color, flavour, taste, consistency and overall acceptability of blend juice during storage period were 6.94 to 6.70, 6.96 to 6.65, 6.87 to 6.63, 6.85 to 6.53, and 6.95 to 6.54, respectively (Table 1). No significant difference ($P>0.05$) was found for sensory scores during 2 months storage except in flavour. However, the sensory scores were gradually decreased along with advancement of storage period and significant difference ($P<0.05$) was found during 6 months storage (Table 2). This gradual decreased might be due to the gradual changes in physicochemical characteristics of blend juice. The blend juice was found to be superior in terms of OAA having score of 6.95 initially and was decreased 5.89% during storage (Table 1). The findings are in agreement with the results reported by Naik *et al*., (2009) [17].

Table 1: Sensory quality of blend juice during storage

Parameters	Storage period (days)						
	0	30	60	90	120	150	180
Appearance & colour	6.94	6.90	6.87	6.82	6.78	6.75	6.70
Flavour	6.96	6.90	6.88	6.81	6.75	6.72	6.65
Taste	6.87	6.86	6.84	6.78	6.75	6.70	6.63
Consistency	6.85	6.84	6.81	6.74	6.70	6.62	6.53
Overall acceptability	6.95	6.95	6.88	6.75	6.67	6.59	6.54

Table 2: ANOVA for sensory quality of blend juice during storage

Source	DF	Type III SS	Mean Square	LSD	F Value	Pr > F
Appearance & colour	6	0.12985714	0.02164286	0.1049	6.03	0.0027
Flavour	6	0.21112381	0.03518730	0.0706	21.67	<.0001
Taste	6	0.14984762	0.02497460	0.0446	38.56	<.0001
Consistency	6	0.25826667	0.04304444	0.0439	68.48	<.0001
Overall acceptability	6	0.51518095	0.08586349	0.0769	44.52	<.0001

3.2 Physicochemical quality

3.2.1 Effect on pH and acidity

The mean values showed a gradual low reduction in pH (3.52 to 3.47) and increase in acidity (0.84 to 0.89) of blend juice during the storage (Table 3). Increased in acidity might be due to conversion of sugars to acid inherently present in blend juice. No significant difference was found at 95 % confidence level (P>0.05) for the pH and total acidity in the product during 2 months storage. However, the significant difference (P<0.05) was found during 6 months storage (Table 4). The significant difference in pH and acidity did not affect the blended juice quality or acceptance which was reflected in the sensory evaluations.

Table 3: Physicochemical quality of blend juice during storage

Parameters	Storage period (days)						
	0	30	60	90	120	150	180
pH	3.52	3.52	3.52	3.51	3.50	3.49	3.47
TSS(ºBrix)	5.17	5.17	5.17	5.17	5.20	5.20	5.23
Total acidity (%)	0.84	0.84	0.84	0.85	0.85	0.87	0.89
Total solids (%)	5.40	5.40	5.43	5.53	5.53	5.57	5.60
Total sugars (%)	3.18	3.18	3.17	3.17	3.16	3.15	3.15
Reducing sugars (%)	2.59	2.61	2.62	2.64	2.67	2.68	2.72
Non- reducing sugars (%)	0.60	0.57	0.55	0.52	0.49	0.47	0.44
Ascorbic acid (mg/100ml)	38.51	37.08	35.70	34.38	33.10	31.93	30.77

Table 4: ANOVA for physicochemical quality of blend juice during storage

Source	DF	Type III SS	Mean Square	LSD	F Value	Pr > F
pH	6	0.00658095	0.00109683	0.0094	38.39	<.0001
TSS(ºBrix)	6	0.01238095	0.00206349	0.1081	0.54	0.7684
Total acidity (%)	6	0.00636190	0.00106032	0.0127	20.24	<.0001
Total solids (%)	6	0.12285714	0.02047619	0.1208	4.3	0.0115
Total sugars (%)	6	0.00272381	0.00045397	0.0115	10.59	0.0002
Reducing sugars (%)	6	0.03685714	0.00614286	0.0101	184.29	<.0001
Non- reducing sugars (%)	6	0.05793333	0.00965556	0.0167	106.72	<.0001
Ascorbic acid (mg/100ml)	6	140.065961	23.3443270	1.3910	37	<.0001

3.2.2 Effect on TSS and total solids

Blend juice TSS initial value was 5.17ºBrix and increased unto to 5.23ºBrix at the end of storage while, total solids were significantly increased during storage in the blend juice (Table 3 & 4). No significant difference was at 95 % confidence level (P>0.05) for the TSS and total solids of the product during 2 months storage. A gradual increased in TSS (5.17 to 5.23) was during storage might be due to the hydrolysis of complex carbohydrates present in blend juice. Similar results were reported by Jan *et al*., (2012) [18] and Kausar *et al*., (2012) [19].

3.2.3 Effect on sugars

The mean values of total, reducing and non-reducing sugars of blend juice were to be in the range 3.18-3.15, 2.59-2.72 and 0.60-0.44, respectively during storage period (Table 3) The reducing and non-reducing sugars were increased significantly (P<0.05) (Table 4), while total sugars was decreased followed by reducing and non-reducing sugars during storage might be due to inversion of non-reducing sugars into reducing sugars in the presence of acidic environment of the blend juice. The finding was in agreement with the result reported by Majumdar *et al*., (2011) [20].

3.2.4 Effect on ascorbic acid

The ascorbic acid content of blend juice was 38.51 mg/100 ml and was decreased to 30.77 mg/100 ml during storage (Table 3). The significant difference was found (P<0.05) for the ascorbic acid content during 6 month storage (Table 4). The ascorbic acid content of blend juice was decreased up to 20.10 % during storage might be due to enzymatic and non-enzymatic reactions. Result showed that the prolonging storage time increased the ascorbic acid loss gradually. The finding was in agreement with the results reported by Kalpana *et al*., (2008) [10] and Li *et al*., (2009) [21].

3.3 Microbiological quality

The total plate count of the blend juice was 33cfu mL^{-1} and decreased to 2cfu mL^{-1} from initial followed by increase in yeast and mould counts at the end of storage (Table 5). The t test (LSD) analysis revealed that significant difference (P<0.05) was found for the total plate count during storage (Table 6). However, no significant difference was found at 95 % confidence level (P>0.05) for the total plate count and, yeasts and moulds count during 150 to 180 days storage. Total plate count of the blend juice were decreased significantly along with advancement of storage period followed by increase in yeast and mould count might be due to the inhibitory effect of acidic blend juice towards the total plate count and favorable conditions toward the yeast and mould count. The findings are in agreement with the results reported by Derossi *et al*., (2011) [22] and William, (2011) [23]. The coli form count cfu mL^{-1} in the blend juice was nil initially and were nil during storage (Table 5).

Table 5: Microbiological quality of blend juice during storage

Parameters	Storage period (days)						
	0	30	60	90	120	150	180
Total plate count (cfu mL^{-1})	33	18	8	5	4	3	2
Yeasts & moulds count (cfu mL^{-1})	2	4	5	6	7	8	8
Coli form count (cfu mL^{-1})	0	0	0	0	0	0	0

Table 6: ANOVA for microbiological quality of blend juice during storage

Source	DF	Type III SS	Mean Square	LSD	F Value	Pr > F
Total plate count (cfu mL^{-1})	6	2329.3333	388.22222	1.9486	313.56	<.0001
Yeasts & moulds count (cfu mL^{-1})	6	93.142857	15.523810	1.1464	36.22	<.0001

4 Conclusions

Storage study was extremely important to check the quality and shelf- life of thermally processed blend juice as per the food safety and standards regulations. The physicochemical quality did not have remarkable effect on the sensory attributes for the acceptance of product during storage condition at 07 ± 02 °C. The loss of ascorbic acid was about 20.10 % and the total plate counts were not found more than 50cfu mL^{-1} during entire storage. The product was stable and microbiologically safe in line with food safety and standards act 2006, rules and regulations (FSSRs), 2011 during 6 months storage. A quality blend juice can be produce from medicinal fruit bottle gourd, without added any chemical preservatives in it having adequate self-life of 180 days satisfying the sensory, physicochemical and required microbiological criteria.

5. References

1. Robinson RW, Decker-Walters DS. Major and minor crops. Cucurbits; CABI Publishing, USA. 2004, 88-92.
2. Axtell BL, Fairman RM. Minor Oil Crops in: FAO Agriculture Services Bulletin, United Nations Rome, Italy. 1992; 94:101-365.
3. Deore SL, Khadabadi SS, Patel QR. *In vitro* antioxidant activity and quantitative estimation of phenolic content of Lagenaria siceraria. Rasayan Journal of Chemistry. 2009; 2:129-132.
4. Chadha KL. Vegetable crops. Handbook of Horticulture; ICAR Publication; New Delhi. 2006, 352-355.
5. Thomas SC. Nutritional and therapeutic values of vegetables, in: Vegetables and Fruits: Nutritional and Therapeutic Values, Chap. 1, CRC Press, London. 2008, 23-24.
6. Rumeza H, Zafar I, Mudassar I. Use of vegetables as nutritional food: role in human health. Journal of Agricultural and Biological Science. 2006; 1:18-22.
7. Sawate AR, Bhokre CK, Kshirsagar RB, Patil BM. Studies on preparation and quality evaluation of powder and candy from bottle gourd. Beverage and Food World. 2009; 36:27-30.
8. Mohale DS, Dewani AP, Saoji AN, Khadse CD. Antihyperlipidemic activity of isolated constituents from the fruits of Lagenaria siceraria in albino rats. International Journal of Green Pharmacy. 2008; 2(2):104-107.
9. Hemeda HM, Khattab HAH. Impact of bottle gourd seeds husks on rheological properties of pan bread and lipid profiles in hypercholesterolemic rats. World Applied Science Journal. 2010; 9(7):764-778.
10. Kalpana R, Khan MDK, Sahoo NR. Effect of storage on quality of stone apple ready-to-serve beverage. Journal of Agricultural Engineering. 2008; 45:62-68.
11. Bhardwaj RL, Mukherjee S. Effects of fruit juice blending ratios on kinnow juice preservation at ambient storage condition. African Journal of Food Science. 2011; 5(5):281-286.
12. Ghosh AK, Banerjee S, Mullick HI, Banerjee J. Zingiber officinale: A natural gold. International Journal of Pharma and Bio Science. 2011; 2:283-294.
13. Jain SK, Khurdiya DS. Studies on juice extraction of aonla (Emblica officinalis Gaertn.) cv. 'Chakaiya'. Journal of Food Science and Technology. 2002; 39(5):515-516.
14. Nijhawan R. Food safety and standards act 2006, rules and regulations 2011. International Law Book Company Publications, New Delhi. 2012, 260-647.
15. Ranganna S. Hand book of analysis and quality control for fruit and vegetable products. (2nd edn), Tata McGraw-Hill Publications, New Delhi, India, 2004.
16. AOAC. Official methods of analysis. Association of Official Analytical Chemists (15th Edn.), Washington DC, USA, 1990.
17. Naik YK, Khare A, Choudhary PL, Goel BK, Shrivastava A. Studies on physico-chemical and sensory characteristics of whey based watermelon beverage. Asian Journal Research Chem. 2009; 2:57-59.
18. Jan A, Masih D. Development and quality evaluation of pineapple juice blend with carrot and orange juice. International Journal of Science and Research Publications. 2012; 2:1-8.
19. Kausar H, Saeed S, Ahmad MM, Salam A. Studies on the development and storage stability of cucumber-melon functional drink. Journal of Agric Research. 2012; 50:239-248.
20. Majumdar TK, Wadikar DD, Vasudish CR, Premvalli KS, Bawa AS. Effect of storage on physico chemical,

microbiological and sensory quality of bottle gourd-basil leaves juice. American Journal of Food Technology. 2011; 6:226-234.
21. Li J, Miao S, Jiang Y. Changes in quality attributes of longan juice during storage in relation to effects of thermal processing. Journal of Food Quality. 2009; 32:48-57.
22. Derossi A, Fiore AG, De Pilli T, Severini C. A review on acidifying treatments for vegetable canned food. Critical Review in Food Science and Nutrition. 2011; 51:955-964.
23. William M. The importance of food pH in commercial canning operations. Food Technology Fact Sheet, 2011; fapc118, pdf. http://www.fapc.biz/files.