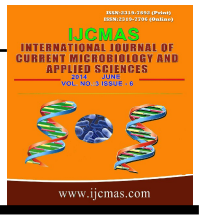
International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 3 Number 6 (2014) pp. 25-31**
http://www.ijcmas.com



Original Research Article

Evaluation of acceptability, nutrient content, antimicrobial activity and storage stability of formulated bitter gourd: Mosambi and bitter gourd: lemon RTS beverages

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A B S T R A C T

Bitter gourd (*Momordica charantia* L.), is a popular traditional medicinal vegetable in tropical and subtropical countries. The bitterness of this vegetable is not liked by a larger population of people and processing into beverages is believed to increase its palatability and acceptability. A study was designed to prepare RTS beverage by blending extracts of bitter gourd with fruit extracts like mosambi and lemon. Six variations of the blends of bitter gourd: mosambi and bitter gourd: lemon at the ratios of (75:25, 50:50, 25:75) was prepared. The organoleptic properties of the variations which were blended in the ratio of 25:75 of bitter gourd: mosambi and bitter gourd: lemon was found to have higher scores than the other variants. The results of the physico- chemical properties showed a decrease in the total soluble solids and pH, whereas the acidity and reducing sugar content increased during the period of storage(60 days).The analysis of nutrients and antioxidants showed that these blends had higher values in terms of energy, carbohydrate, protein and iron than their control (mosambi and lemon RTS). The vitamin C content which was found to be higher in the blends remained the same until the fifteenth day of storage, after which there was observed a gradual reduction on the 30^{th}, 45^{th} and 60^{th} day of the period of storage in both the control and blended beverages. The blends also had higher zone of inhibition on microorganisms like staphylococcus aureus and E.coli. On storage the blends had good sensory attributes and shelf life up to a period of 45 days.

Keywords

Organoleptic; physico-chemical; variations; nutrients; antioxidants; inhibition.

Introduction

Bitter gourd (*Momordica charantia* L.), which belongs to the family cucurbitaceae, is an important vegetable mainly valued for its nutritional and medicinal properties. It is widely grown India, Nepal and other parts of the Indian subcountinent, South east, Asia, China, Africa, the, and Mediterranean countries such as Turkey and Italy (Aboa et al., 2008; Wu and Ng, 2008). They have been used for generations by indigenous populations in Africa, India, and Latin America for food

and folk medicine (Khan and Anderson, 2003; Dey et al., 2006; Lako et al., 2007; Abo et al., 2008). It is found to be highly nutritive with relatively high levels of protein, minerals and vitamins. The extract had the highest value of antioxidant activity and that gallic acid was the predominant phenolic compound in the (Kubola and Siriamornpun 2008). Citrus fruits like mosambi and lemon are excellent sources of free citric acid, natural sugar, calcium and phosphorus. They are responsible for a series of health benefits. Beverages from fruits and vegetables are important in human diet (Kahn, 1998). They are consumed by people of all the groups to quench the thirst and as health food. Presently ready-to-serve beverages have been increasingly gaining popularity among masses. Beverages are considered to be an excellent medium for the supplementation of neutraceutical components for enrichment. Beverages from fruits and vegetables are important in human diet (Kahn, 1998).

Blending could lead to the production of delightful and delicious beverages with improve organoleptic quality and high nutritive value. Blending increases taste and flavour of fruit juices. The blending of juice may also improve aroma, taste and nutrients of the beverages (Bhardwaj and Mukherjee 2011). The study was hence planned to formulate RTS beverages by blending bitter gourd with fruit extracts of mosambi and lemon and determine its acceptability, changes in nutrient and physico-chemical properties and shelf life.

Materials and Methods

Bitter gourd, mosambi and lemon required for the extraction of juice were purchased in the fresh form from the local market in Coimbatore.

Formulation of bitter gourd RTS beverage

A known quantity of freshly harvested, fully matured bitter gourd were washed and cleaned. Common salt was added at the rate of 8 per cent with small amount of citric acid and kept overnight to reduce bitterness and for softening and firmness. Then it was washed with water. Blanching was done for time and temperature 100^0C for 3 minutes and immediate cooling was done in cold water to prevent further cooking. After completion of pretreatments, it was cut in to pieces and crushed in mixture after that placing in muslin cloth and carry out squeezing with pressing to extract the juice it was then filtered to get clear strained juice.

Formulation of Bitter gourd: Mosambi RTS beverage

Fresh mosambi were washed with clean water to remove dust and outer material. Fruits were cut in to pieces for further processing. The juice was extracted by the traditional method (TNAU, 2009) and filtered through muslin cloth and to get clear strained juice. Variations were brought in bitter gourd: mosambi RTS by blending the extracts of the juices in different proportion namely (75: 25, 50:50, 25:75) of bitter gourd : mosambi respectively. In addition to these extracts ingredients like sugar and citric acid were added. All the ingredients were dissolved through homogenizer.

Formulation of Bitter gourd: Lemon RTS beverage

Fresh lemons were washed with clean water to remove dust and outer material. Fruits were cut in to pieces for further processing. The juice was extracted by

standard method (TNAU, 2009) and filtered through muslin cloth and to get clear strained juice. Variations were brought in bitter gourd: lemon RTS by blending the extracts of the juices in different proportion namely (75: 25, 50:50, 25:75) of bitter gourd: lemon respectively. In addition to these extracts ingredients like sugar and citric acid were added. All the ingredients were dissolved through homogenizer.

The RTS beverages of the vegetables and fruits namely bitter gourd, mosambi and lemon were all blended to get two blends namely bitter gourd: mosambi, bitter gourd : lemon. A total of about six variations were obtained from these ratios. Table I represents the variations of the blended RTS beverages.

Table- I Variations of Formulated RTS Beverages

Ratio / **Variation**	**75:25**	**50:50**	**25:75**
Bitter gourd: Mosambi	A1	A2	A3
Bitter gourd: Lemon	B1	B2	B3

Organoleptic evaluation

Organoleptic parameters namely, colour, flavour, appearance, taste, texture, overall acceptability were evaluated through 5 point scale from 30 semi trained panel members. The variations (75:25), (50:50), (25:75) for two blends (Bitter gourd: Mosambi), (Bitter gourd: Lemon) were subjected sensory evaluation and compared with its respective controls. From the two variation of each combination one variation which is most acceptable is selected. A total of two best variations each belonging to a combination was selected for further analysis.

Physico-chemical analysis

The physico-chemical parameters including Total Soluble Solids (TSS) of the fruit juice was determined by Zeiss Hand Juice Brix Refractometer, values corrected to 20°C and expressed as °Brix. Acidity (as citric acid) was determined by using standard N/10 NaOH solution in the presence of phenolphthalein as an indicator, AOAC (1984). Total sugars in the juice
were determined by the method of Lane and Eynon (1923), and pH was recorded by digital pH meter.

Analysis of Nutrient and Antioxidant content

The most acceptable variant of both the blends along with their control in duplicates were used for the analyses of different nutrients. The carbohydrate content was analysed by Anthrone method and protein by Kjeltech nitrogen analyser. For calcium estimation, it was precipitated as oxalate, dissolved in sulphuric acid and titrated against potassium permanganate. Iron was determined colorimetrically making use of the fact that ferric iron gives a blood red color with potassium thiocyanate.

Phosphorus analysis was carried out by measuring the blue color, which is formed when the ash solution was treated with ammonium molybdate. The phosphomolybdate thus formed was reduced and read calorimetrically. β-carotene was estimated colorinetrically and vitamin C content was estimated for

every fifteen days throughout the period of storage titrimetrically by reducing it with the dye 2, 6, dichlorophenol indo phenol. (Raghuramulu et al 2003). Total antioxidant capacity of selected RTS vegetables and fruits blends were determined by DPPH method.

Antimicrobial activity

Antimicrobial activities of the RTS blends against 2 different pathogenic bacteria (one Gram Positive and One Gram Negative) were investigated by the Agar Diffusion Method. Each RTS Blends were filtered using Whatmann No.1 filter paper & the filtrates obtained were taken as extracts.20µL of the extracts were impregnated into sterile discs and allowed to dry. Muller Hinton Sterile Agar plates were swabbed with pathogenic bacterial strains (Gram Positive *Staphylococcus aureus* and Gram Negative *Escherichia coli*) and the discs were placed on the surface of the Agar. The plates were incubated for 24 hours at 37□C and observed for the zone of inhibition .

Results and Discussion

Organoleptic Evaluation

The results of organoleptic evaluation of the formulated RTS beverages showed that the blends of bitter gourd: mosambi (A3) and bitter gourd : lemon (B3) at the ratio of 25:75 were found to be highly acceptable when compared with the other variations in terms of sensory attributes like appearance, flavour, taste and texture. The other variations in which the concentration of bitter gourd extract was higher scored less in parameters like flavour and taste. Hence the blends A3 and B3 along with their control were used for further analysis of the study.

Physico-chemical analysis

Total Soluble Solids:

On the first day of formulation the TSS content was found to be higher, 4.8^0bx in the blend B3 (bitter gourd:lemon) which was followed by its control B (lemon), 4.5^0bx, A3 (bitter gourd: mosambi) 4.2^0bx and its control A (mosambi) 4.0^0bx. Over the period of storage there is found to be a gradual reduction of TSS for every fifteen days and at the end of the 60^{th} day of storage the TSS was found to be 4.2^0bx, 4.1^0bx, 3.7^0bx and 3.6^0bx for B3, B, A3 and A respectively.

Reducing Sugar:

The content of reducing sugar was found to be highest in B3(bitter gourd: lemon), 5.8%, followed by B(lemon) 5.5%, A3(bitter gourd: mosambi) 5.3% and A(mosambi) 4.5%. The reducing sugar content was found to be proportional to the increase in the period of storage. It gradually raised for every fifteen days and at the end of 60 days it was found to be 6.7,6.4,6.2 and 5.3 for B3, B, A3 and A respectively (Table II).

Table.II TSS (^{0}bx) and Reducing Sugar (%) Content of Formulated RTS Beverages

Storage period	Control A		Control B		A3		B3	
Initial	4.0^{0}bx	4.5%	4.5^{0}bx	5.5%	4.2^{0}bx	5.3%	4.8^{0}bx	5.8%
15th day	3.9^{0}bx	4.7%	4.4^{0}bx	5.7%	4.0^{0}bx	5.5%	4.6^{0}bx	6.1%
30th day	3.8^{0}bx	4.8%	4.3^{0}bx	5.9%	3.9^{0}bx	5.8%	4.5^{0}bx	6.3%
45th day	3.7^{0}bx	5.0%	4.2^{0}bx	6.2%	3.8^{0}bx	6.0%	4.4^{0}bx	6.5%
60th day	3.6^{0}bx	5.3%	4.1^{0}bx	6.4%	3.7^{0}bx	6.2%	4.2^{0}bx	6.7%

Table.III Titrable acidity (%) and pH of Formulated RTS Beverages

Storage period	Control A		Control B		A3		B3	
Initial	5.0%	3.0	5.6%	2.8	4.5%	3.2	5.5%	2.9
15th day	4.8%	3.1	5.2%	2.9	4.3%	3.5	5.1%	3.0
30th day	4.6%	3.5	5.1%	3.1	4.2%	3.7	5.0%	3.3
45th day	4.5%	3.8	4.9%	3.4	4.1%	4.0	4.8%	3.6
60th day	4.2%	4.2	4.7%	3.7	4.0%	4.5	4.5%	4.0

Table.IV Nutrient Content of Formulated RTS Beverages

Nutrient Parameters	Control A	A3	Difference	Control B	B3	Difference
Energy (kcal)	32.25	34.5	2.75	42.25	45.75	0.5
Carbohydrate(g)	9.2	10.8	1.6	11.0	11.3	0.3
Protein(g)	0.7	1.0	0.3	1.0	1.1	0.1
Calcium(mg)	56	77	21	75	102	27
Iron (mg)	0.6	0.65	0.05	0.25	0.34	0.9
Phosphorus(mg)	30	40	10	10	25	15
Vitamin C (mg)	48.9	51.6	2.7	39.5	55.8	16.3
β carotene µg	65	90	25	88	130	42
Total antioxidants (%)	11	26	15	22	51	29

Titrable Acidity:

The titrable acidity was found to be highest in B (lemon) 5.6%, followed by B3 (bitter gourd:lemon) 5.5%, A (mosambi) 5.0% and A3 (bitter gourd: mosambi) 4.5%. Over the period of storage there was a gradual reduction in the acidity for every fifteen days until the 60th day of storage. On the final day of the acidity was found to be 4.7%, 4.5%, 4.2% and 4.0% in B, B3, A and A3 respectively.

pH: The results of pH showed that B(lemon) has the lowest pH of 2.8, followed by B3(bitter gourd:lemon) 2.9, A (mosambi) 3.0 and A3(bitter gourd: mosambi) 3.2.During the period of storage there was a gradual rise in pH for every fifteen days until the 60^{th} day of storage. At the end of the 60^{th} day the pH was bound to be 3.7, 4.0, 4.2 and 4.5 for B, B3, A and A3 respectively (Table III).

Nutrient content

The results of nutrient analysis showed that the nutrient content of the blended RTS beverages had higher levels of nutrients than its control counterparts. In the case of A3 (bitter gourd: mosambi) the content of nutrients namely energy, carbohydrate, protein, calcium, iron, phosphorus, vitamin C, β carotene and antioxidants were greater by 2.75 Kcal, 1.6g, 0.3g, 21mg, 0.05mg, 10mg, 2.7mg, 25µg and 15% respectively than its control A(mosambi). The RTS beverages formulated by blending bitter gourd and lemon (B3) the nutrients namely energy, carbohydrate, protein, calcium, iron, phosphorus, vitamin C, β carotene and antioxidants were found to be higher by 0.5Kcal, 0.3g, 0.1g, 27mg, 0.9mg, 15mg, 16.3mg, 42µg, 29% respectively (Table IV).

Antimicrobial activity

The blended RTS beverages were found to be highly active against both gram positive and gram negative bacteria. The zone of inhibition for Staphylococcus aureus was higher in A3 and B3 (0.6mm) and for E.coli it was higher in B3 (0.3mm), A3 (0.2mm) than the control A and B (0.1mm).

Storage stability

The formulated RTS beverages were found to have the similar organoleptic parameters until the fifteenth day of storage. With the increase in the period of storage the organoleptic properties decreased gradually in all the formulated beverages. In the case of microbial growth the number of colony forming units of bacteria were found in the control beverages after 30 days whereas in the blended RTS it was found only on the 69^{th} day. Moreover there was no fungal growth in any of the formulated beverages. On storage there was no change in the vitamin C content until the fifteenth day of storage. Later with an increase in the storage period there was a slight reduction in the vitamin C content of the formulated beverages.

Consumption of fruits and vegetable has got an important role in imparting good health. The study designed to prepare RTS beverage by blending extracts of bitter gourd with fruit extracts like muambi and lemon in order to improve the acceptability and palatability of bitter gourd. Six variations of the blends (75:25, 50:50, 25:75) of bitter gourd: musambi and bitter gourd: lemon were prepared.

It showed that the blending of vegetable and fruits juice was highly acceptable and the quality was also found to be good. The analysis of nutrients and antioxidants showed that these blends had higher values than the control (musambi and lemon RTS). It also had improved nutritional content, antioxidant content and antimicrobial activity.

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