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Studies on storage stability of guava RTS

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Abstract
A study was undertaken for preparation of guava ready to serve and its physiochemical characteristics viz., TSS, acidity, total sugars and microbiological count as well as organoleptic attributes viz., colour, flavour, taste and overall acceptability of RTS were evaluated at an interval of 2 months up to 6 months of storage. Results indicated that the minimum physico-chemical changes viz., TSS (10.11-10.17°Brix), acidity (0.42-0.50%), reducing sugars (3.27-3.58%), total sugars (6.26-7.02%) and sensory attributes showed decreasing values with duration of storage. Considering above chemical constituents as well as sensory attributes of processed nectar. The guava is commercially used in processing industry due its attractive pulp colour and could make significant contribution to food industry.

Keywords: Guava, TSS, bio-chemical parameters, storage

Introduction
Fruit most commonly used for preparing beverages are sweet orange, guava, mulberry, passion-fruit, pineapple, etc. These products are marked under variety of name such as fruit drinks, breakfast drink, ready to- serve (RTS), nectar, ready-to-drink (RTD) and squash etc. Guava is often marketed as "super-fruits" which has a considerable nutritional importance in terms of vitamins A and C. The high content of vitamin C (ascorbic acid) in guava makes it a powerhouse in combating free radicals and oxidation that are key enemies that cause many degenerative diseases. The great national production, the high rate of perishability and lack of appropriate technology are some of the factors responsible for the high amount of waste in the fruit processing sector. The addition of chemical food additives to these products in order to improve the color, aroma, texture and flavor become necessary to benefit the food industry (Queiroz *et al*., 2006) [16]. The main constituents of guava are vitamins, tanins, phenolic compounds, flavonoids, essential oils, sesquiterpene alcohols and triterpenoid acids. These and other compounds are related to many health effects of guava (Haida *et al.*, 2011) [7].
Since the ripe guava is highly perishable when stored at room temperature, it is processed in various commercial products, including pulp, paste, canned slices in syrup and juice. Among these products, guava juice has become economically important in the market. The consumption of tropical fruit juice like guava is currently growing because it is natural, rich in nutrients and used as an alternative to other beverages such as soft drinks, tea and coffee (Choonhahirun, 2013) [4]. With the changing consumer attitudes, demands and emergence of new market products, it has become imperative for producers to develop products, which have nutritional as well as health benefits. In this context, guava has excellent digestive and nutritive value, pleasant flavor, high palatability and availability in abundance at moderate price. The fresh fruit has limited shelf life therefore it is necessary to utilize the fruit for making different products to increase its availability over an extended period and to stabilize the price during the glut season. Guava can be consumed fresh or can be processed into juice, nectar, pulp, jam, jelly, slices in syrup, fruit bar or dehydrated products, as well as being used as an additive to other fruit juices or pulps (Leite *et al*., 2006) [13].

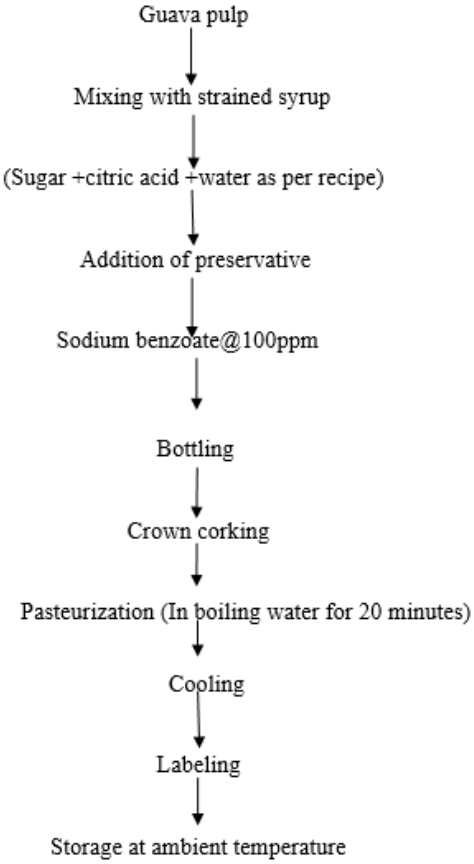
Materials and Methods
Fresh ripened guavas of similar maturation grade were procured from the local market of jammu (India). Guava fruits were cleaned in tap water to remove surface dust and leaves before weighing, sorting. Ready-to-serve drinks of guava was prepared as per the FPO specifications. Total soluble solids and acidity of ready-to-serve beverages were maintained as 10.11ºB and 0.3 per cent by the addition of sugar and citric acid respectively and stored at ambient temperature for six months. Various physico-chemical parameters like TSS (ºB), Reducing sugars (%), Total sugars (%), Titrable acidity (%), pH, organoleptic and micriobial

evaluation was carried out for six months with 30 day interval at ambient conditions during storage period.

Chemical composition of biocoloured guava RTS

pH

The pH was determined using digital pH-meter [make: Tanco, DB-1011] (Rangana 1986) [18]. The pH meter was calibrated using buffers of pH 4.0 and 7.0 at room temperature. pH of each treatment replicate was determined by squeezing out juice of mulberry fruit and filtered. Electrodes of pH meter were put in beaker and direct reading from pH meter was taken when the reading stabilized.



Flow sheet for the preparation of guava RTS

TSS

The Total Soluble Solids (TSS) value of the guava nectar was recorded by using hand refractometer (Erma, Japan) having range of 0-32 °Brix. In each treatment, three readings were taken and their average value was expressed in °Brix.

Titrable acidity

The titrable acidity of guava nectar was estimated by titrating against 0.1N NaOH solution using phenolphthalein as an indicator, light pink colour is taken as donation of acid of guava nectar (Ranganna, 1986) [18].

Reducing sugars

The titrimetric method of Lane and Eynon described by Ranganna (1986) [18] was adopted for estimation of reducing sugars using methylene blue as an indicator and colour is changed to brick red colour under the heat (indication point of percent of sugar in sample).

Total sugars

Lane and Eynon described by Ranganna (1986) [18] were adopted for estimation of total sugars.

Sensory analysis

The sensory parameters of colour, flavour, taste and overall acceptability were evaluated with 10 trained panelist based on 9 point Hedonic rating scale with maximum score considered as the best (Ranganna, 1986) [18].

Total plate count

Total plate count of micro-organisms was taken according to method given by Harrigan and Mc Cance (1966) [8]. Total plate count was done by serial dilution method.

Result and Discussion

Total Soluble Solids

In biocoloured guava beverage packed in glass bottles stored at room temperature, it was observed in Table 1 that there was increase in TSS during six months of storage. TSS increased from initial mean value of 10.11 to 10.18 ^{0}Brix after six months of storage. A slight increase was observed in during the storage conditions and there was no significant effect of treatment on these parameters. This might be due to conversion of left over polysaccharides into soluble sugars and formation of water soluble pectin from protopectin) Bal *et al.* (2014) [1]. These results are also in conformity with the findings of Chavan *et al.* (2011) [3] while studying the changes in chemical composition of pomegranate RTS beverage as influenced by different per cent of syrup concentrations and storage periods.

Reducing Sugar

In biocoloured guava beverage packed in glass bottles stored at room temperature, it was observed in Table 1 that there was increase in reducing sugar during six months of storage. Reducing sugar increased from initial mean value of 3.27 to 3.53 per cent after six months of storage. Increase in reducing sugars might be assigned to the partial acid hydrolysis of starch and disaccharide of nectar converted into invert sugar and also inversion of part of non-reducing sugars into glucose and fructose and gradual degradation of polysaccharides in pulp through acid hydrolysis. These results were similar with the investigation reported earlier guava beverages guava-aonla blended beverage Mall *et al*., 2007 [14].

Total Sugars

In biocoloured guava beverage packed in glass bottles stored at room temperature, it was observed in Table 1 that there was increase in total sugars during six months of storage. Total sugars increased from initial mean value of 6.26 to 6.91 per cent after six months of storage. Total sugar was increased during storage period is due to solubilization of pulp constituents and hydrolysis of polysaccharides including pectin and starch materials. Similar observation for total sugar of various products have been reported by Rabbani and Singh (1988) [17] in mango nectar and in mango and papaya beverage.

Acidity

In biocoloured guava beverage packed in glass bottles stored at room temperature, it was observed in Table 1 that there was increase in acidity during six months of storage. Acidity increased from initial mean value of 0.42 to 0.48 per cent after six months of storage.

A slight increase in acidity was found after 90 days of storage. which might be due to accelerated degradation of pectin substance in ready to serve beverage. Kausar *et al*. (2016) [10] also reported that increase in acidity during storage could be attributed partially due to the contribution of inherent acid, naturally present in the beverage and partially to the citric acid purposely added to the beverage at the time of preparation in development and standardization of ready to serve aloe vera lemon functional drink. Decrease in pH during storage was attributed to simultaneous increase in titratable acidity

pH

In biocoloured guava beverage packed in glass bottles stored at room temperature, it was observed in Table 1 that there was decrease in pH during six months of storage. pH decreased from initial mean value of 3.35 to 3.31 after six months of storage. Decrease in pH during storage was attributed to simultaneous increase in titratable acidity.

Sogi and Singh (2011) [19] have also observed similar trend in kinnow RTS beverage and Madan Lal Choudhary *et al*. (2006) [5] in guava RTS beverages. Reported that reduction in pH of beverage may be due to increase in acidity of beverage due to biochemical reaction takes place while studying the qualitative evaluation of mixed fruit based ready to serve (RTS) beverage.

Microbial evaluation

In all treatment microbial growth started after 60 days of storage (Table 1) (3.57×10^2) microbial growth was observed after six months of storage. However, microbial growth was in safe zone. The microbial count was within safe limits in ready to serve beverage. Deka and Sethi (2001) [6] reported that no bacterial growth was observed in spice mixed fruit juice and ready to serve beverage.

Table 1: Effect of storage on the physico-chemical and microbiological characteristics of Guava RTS

	0 Months	2 Months	4 Months	6 Months
TSS (^{0}Brix)	10.11	10.14	10.16	10.17
Titrable acidity (%)	0.42	0.46	0.47	0.50
Reducing sugar (%)	3.27	3.41	3.54	3.58
Total sugar (%)	6.26	6.51	6.90	7.02
pH	3.35	3.33	3.32	3.30
Total plate count	ND	1.95×10^2	2.45×10^2	3.57×10^2

Sensory Evaluation

Taste

The taste rating of guava RTS ranged from 8.33 to 7.54 (Table 2). The decrease in taste might be due to more pulp percentage and the physico-chemical constituent of fresh guava pulp. This could be caused by development of acidity and caramelization. These findings were accordance with, Pandey *et al.* (2004) [15], for guava beverages, Mall and Tondon for guava-aonla blended beverage, Kumar *et al*. for musambi RTS Beverage.

Flavour

The flavor score of guava RTS ranged 8.76 to 6.15 (Table 2). The score of flavour nectar showed decreasing significantly during storage due to high level of acid that reacts with the product unpleasant volatile odour and could be due to the slight fermentation of beverage and gas production. There has been significant decline in flavour score of guava RTS product with the advancement of storage period. These findings were in accordance with kumar *et al*. (2008) [11] in Storage stability of musambi (*Citrus sinensis*) RTS beverage in different storage conditions.

Colour

The colour score of guava RTS decreased from 8.72 to 6.35. The colour score showed decreasing trend during storage which might be due to the action of acidity which enhances the hydrolytic reaction causes browning and acid also enhances the Millard reaction and caramelization which causes more browning in product. Polyphenolic compounds present in fruit pulp also reacts with enzymes to get discoloration. These findings were accordance with Kalra and Tandon (1984) [9] for guava nectar.

Overall acceptability

The overall acceptability of guava RTS was decreased from 8.32 to 5.30. It may be due to non-enzymatic reactions like caramelization and Millard. The score of nectar was declined significantly during storage owing to oxidative reaction to deteriorate the scores of colour, flavour as well as taste which results deterioration in over all acceptability. Similar results were reported by Pandey *et al* (2004) [15] for guava beverages, Kumar *et al*. (2008) [11] for musambi RTS Beverage.

Table 2: Effect of storage on the sensory characteristics of Guava RTS

Sensory Score (9 point Hedonic Scale)	0 Months	2Months	4 Months	6 Months
Color	8.72	7.54	7.44	6.35
Flavor	8.76	7.35	7.24	6.15
Taste	8.33	8.02	7.55	6.97
Over all acceptability	8.32	7.82	6.52	5.30

Conclusion

Guava juice was formulated into ready to serve (RTS) beverage. Different biochemical parameters were analyzed namely TSS (^{0}Brix), Titrable acidity (%), Reducing sugar (%), Total sugar (%), pH. It was found that guava ready to serve (RTS) beverage has many health benefits and can be stored for six months of storage and was found microbiologically safe. The result showed that guava fruit can be processed into valueable product and will also generate opportunity for self-employment by starting small scale processing unit that could be lucrative to the growers and could make significant endowment to food processing industry.

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