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Studies on preparation of guava-lime-ginger ready to serve (RTS) beverage

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Abstract
The study was conducted to evaluate the preparation of guava-lime-ginger RTS beverage (GLG RTS). The fixed ratio of fruit juices in guava-lime-ginger RTS beverage was 10:3:2. The prepared RTS was bottled in glass bottles and stored at room (R_1) and refrigerated (R_2) temperature**.** An increasing trend in the acid content of the GLG RTS was observed. The acid content of RTS beverage increasing from 0.252 to 0.305 and 0.252 to 0.298 per cent in R_1 and R_2 samples respectively. The freshly prepared guava-lime-ginger RTS beverages had TSS of 15^o brix and slight reduction was noticed during storage. A gradual increase in reducing sugar content of the RTS was observed. The final reducing sugar content of GLG RTS was increased from 5.98 to 8.28 and 7.98 g per 100 ml in R_1 and R_2 respectively. The initial and final total sugar content of the RTS beverage decreased from 12.24 to 10.95 in R_1 and 11.24 g per 100 ml in R_2 samples. A gradual reduction in the ascorbic acid content was observed in all the samples during storage. The initial and final ascorbic acid content was 8.82 and 7.85 & 7.98 mg per 100 ml (R_1 and R_2) in GLG RTS beverage. A slight increase in the microbial load was noted in the formulated value added fruit products during storage. Initially the bacteria, fungal and yeast count was below detectable level (BDL) and at the end of storage period microbial load slightly increased. The formulated value added fruit product secured highly acceptable to acceptable score value during storage. The mean overall acceptability score values noted in storage ranged from 8.6 to 8.2 in R_1 and 8.7 to 8.48 in R_2 samples at the end of 180 days. Comparative economic analysis of value added production showed that the cost of production of RTS per litre was Rs. 29.74. It was found that maximum profit could be obtained per litre of RTS production at Rs. 6.26 per kg.

Keywords: preparation, guava-lime-ginger, RTS, beverage

Introduction
Guava (*Psidium guajava* L.) is one of the important commercial crops of India. Guava occupies fourth place among important fruits of India after mango, banana and citrus. Guava is referred as the apple of tropics and one of the most common fruits in India. Guava is one of the richest sources of vitamin C, it also contains substantial quantities of carbohydrates (sugars, pectin) and materials like calcium, and phosphorous. Guava is consumed mainly as fresh fruit. It has an excellent digestive and nutritive value with pleasant flavor, palatability and availability in abundance at moderate cost.

Lime has several uses and products made from it have varied applications. Lime processing utilizes each and every portion of lime fruits for high value products, which have a very high market demand. Citric acid has also many applications as food preservative in many food preparations and food processing industries are large consumers. Clarified lime juice is used as health-drink and is mixed in many food preparations. Lime is cultivated in almost all parts of country and the North-East states are not an exception.

Limes are often grown in abundance in tropical and subtropical countries. Their seasonal availability gives rise to gluts in the market, which means that growers do not get the full reward for their labours. Fresh limes are perishable items. It is often difficult to get them to the fruit market in a state where they still fetch a good price. Making the limes into lime juice can alleviate these problems. The technology required is simple and due to the very acidic juice of lime, spoilage or food hygiene problems are minimal. Lime juice is popular as it is an important ingredient in many a cuisine or can be made into a drink.

Ginger is widely used in foods, beverages, confectionery and medicines. It is the most effective flavouring agent known and is used in confectionery, ginger beer, ginger champagnes and beverages. Ginger is also used as preserved ginger and candied ginger and as a carminative and digestive stimulant. Ginger is valued for its manifold medicinal properties and

its manifold medicinal properties and is useful in gastritis, dyspepsia and flatulence and in colds and coughs as an expectorant (ARYA, 2003) [1].

This study was conducted to prepare RTS by combining guava pulp, lime juice with ginger extract and to evaluate the storage stability of the product. This RTS provides good nutrition as well as several medicinal uses to the consumer.

Materials and Methods

Matured, firm fruits like guava, lime and ginger were purchased from local market. Non-perishable items such as sugar, citric acid and potassium metabisulphite (KMS) were purchased in bulk from the local market. Glass bottles (capacity 200 ml) with caps were used for storing the prepared Guava, Lime and Ginger RTS beverage (GLG RTS beverage).

Methods

Guava, lime and ginger were used for the study. The flow chart for the preparation of guava, lime and ginger RTS beverage is given in (Fig. 1). The guava pulp (100g) was blended with lime juice and ginger juice (30ml, 20ml). The fruit pulp was taken in a flat-bottomed vessel and mixed with required amount of water. Sugar was added till 15º brix was reached. Citric acid was added. Heated upto 80ºC. Filled in sterilized bottles by leaving head space of 2 cm. Brought down to room temperature Crown corked the bottles immediately. The sealed bottles were processed for 30 min under pressure. Labelled and stored at room and refrigeration temperature.

Processing of guava-lime-ginger RTS beverage

The RTS beverage was prepared by using guava, lime and ginger. FPO specification viz., Fruit pulp –10- 15 %, TSS 15ºbrix, Acidity – 0.25- 0.30 % and Potassium metabisulphite – a pinch.

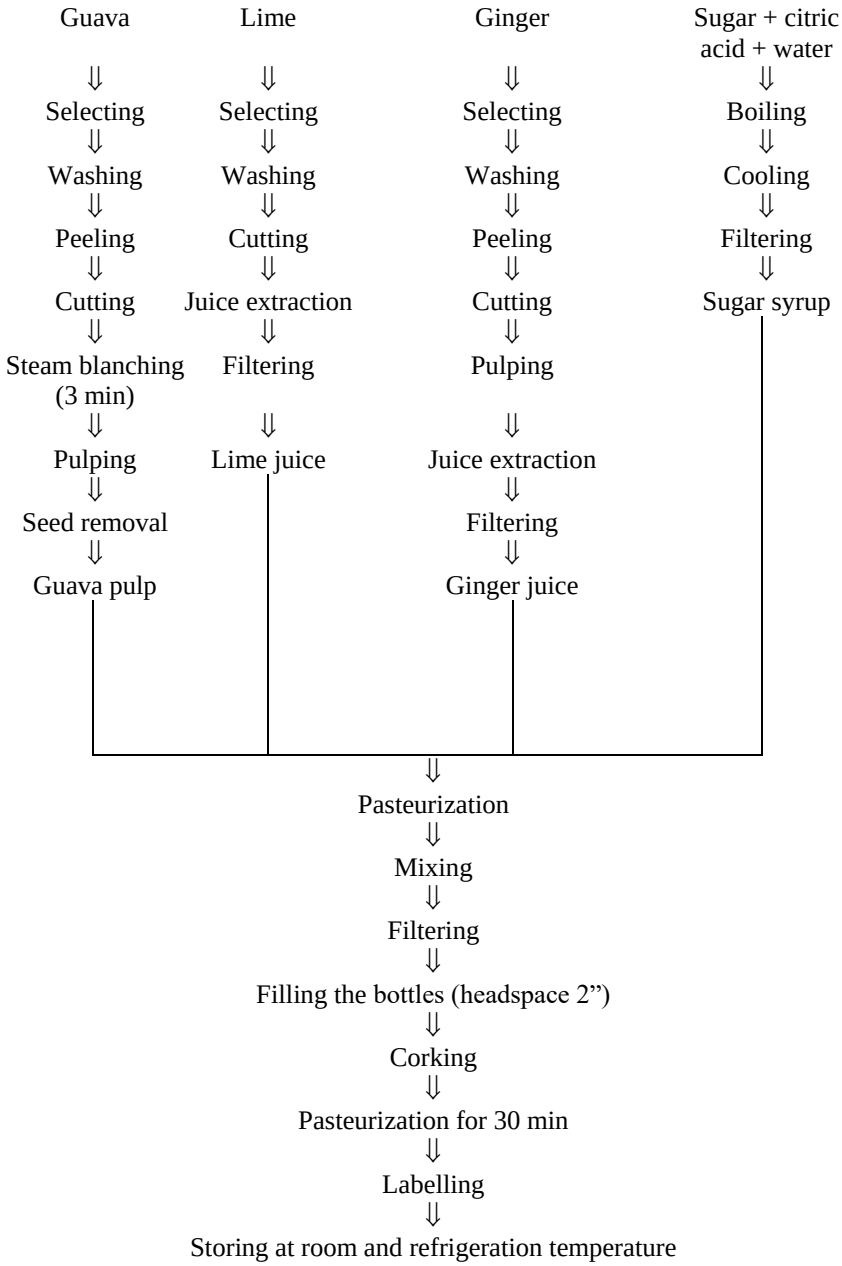

Fig 1: Flow chart for the preparation of guava, lime and ginger RTS beverage

Chemical analysis

The acidity of the sample was estimated by the Ranganna (1995) [8]. The pH of the sample was estimated by the method described by Hart and Fischer (1971) [2]. The total soluble solid of the fruit was found out by using a hand refractometer. The total and reducing sugar content of the sample was determined by the Shaffer Somogyi micro method described by MC Donald and Foley (1960) [6]. Ascorbic acid was estimated following the procedure of Mahadevan and Sridhar (1982). The microbiological load of the stored sample was enumerated at regular intervals by the methods described by Istawankiss (1984) [3].

Organoleptic evaluation

The developed RTS beverage was evaluated for organoleptic characteristics namely colour, appearance, flavour, texture, taste and overall acceptability by using score card with nine point hedonic rating scale (9-1).

Economic feasibility analysis

To analyse the economic feasibility of the processing plant project, four criteria were considered, viz., I) internal-rate of return, ii) benefit-cost ratio, iii) pay-back period and (iv) break-even point (Rajan, 1984**).**

Statistical analysis

The data obtained from the various experiments were subjected to statistical analysis to find out the impact of storage condition used and storage period. Factorial Completely Randomized Design (FCRD) was applied for the analysis of the study as described by Rangaswamy (1995) [9].

Result and Discussion

Changes in the chemical constituents of the guava-lime-ginger RTS beverage

The chemical constituents such as acid content, pH, TSS, reducing sugar, total sugar, ascorbic acid, microbial load and organoleptic characteristics of the guava-lime-ginger RTS were analysed at regular intervals (once in 30 days) during the study period of 180 days in ambient temperature (R_1) and refrigerated temperature (R_2).

Acid and pH

The changes noted in the acid content of the guava-lime-ginger RTS beverages are presented in Table 2. An increasing trend was observed in the acid content of the RTS throughout the storage period for both R_1 and R_2 temperature samples. From the data it could be seen that the initial acid content of the RTS beverages was 0.252 per cent and was increased to 0.305 per cent in R_1 and 0.298g per cent in R_2 after 180 days of storage. The acidity of the prepared RTS beverages was within FPO standards (0.25%).

The statistical analysis showed that a significant difference in the acid content of the guava-lime ginger RTS beverages during storage period and storage condition.

As the acid content of the RTS beverage increased, the pH decreased during storage. The initial pH was 3.95. At the end of the storage period the pH decreased from 3.95 to 3.58 in R_1 and 3.95 to 3.59 in R_2 respectively. The statistical analysis of the data revealed there existed a significant difference among the RTS beverage, storage period and storage conditions.

Similarly Kumar and Manimegalai (2001) [4] reported that a slight reduction in pH of the mixed fruit RTS beverages stored at room and refrigeration condition during storage. The initial values of pH of RTS ranged from 3.95 to 3.84 which changed to 3.66 to 3.70 and 3.63 to 3.69 at room and in the refrigerated temperature respectively after 150 days of storage.

TSS

The freshly prepared RTS beverages had 15.50º brix of TSS and it was observed that the stored RTS beverage did not show much changes in TSS till 30 days of storage in R_1 and R_2. At the end of storage period TSS content of RTS beverage was reduced to 15.10 in R_1 and 15.24 in R_2 respectively. The statistical analysis of the data revealed that there existed a significant difference in TSS of the RTS beverage of, storage condition and during storage period.

Sindhumathi (2002) [10] stated that the prepared papaya based blended RTS beverages had initial TSS of 15º brix and it was maintained throughout the storage period.

Total and reducing sugar

As the storage period increased, the total sugar content was reduced. The initial total sugar content of the samples were 12.24 g / 100 ml. The retention of total sugar in the R_2 samples were found to be higher than R_1 during the study period. At the end of storage period the total sugar content was decreased to 10.95 and 11.24 g per cent in R_1 and R_2 respectively. The decrease in total sugar was due to hydrolysis into simple sugars. The statistical analysis of the data showed a highly significant reduction in the total sugar content of the guava-lime-ginger RTS beverage during storage period and storage condition.

The conversion of total sugar into simple sugar might have increased the reducing sugar content of RTS beverage. As the storage period increased, the reducing sugar content had also increased in the RTS beverages irrespective of storage conditions. The initial reducing sugar content of the RTS beverage was 5.98 g per 100 ml. The reducing sugar contents of stored samples after 180 days were 8.28 g (R_1) and 7.98 g (R_2) respectively. At the end of the storage period reducing sugar content was slightly increased in R_1 when compared to R_2. The statistical analysis showed that a significant difference in the reducing sugar content of the guava-lime-ginger RTS beverage during storage period and storage conditions.

Ascorbic acid

Fig. 2 represents the changes in the ascorbic acid content of the RTS beverages during storage. A higher quantum of ascorbic acid loss was noted in all the RTS beverages throughout the storage period. Initially the ascorbic acid content was 8.82 mg / 100 ml. After 180 days of storage, the ascorbic acid content was 7.85 mg /100 ml (R_1) and 7.98 mg / ml (R_2) respectively. At the end of storage period the loss of ascorbic acid content was slightly reduced in R_2 when compared to R_1 samples. Such reduction may be due to the oxidation of vitamin C by light and heat.

Significant difference in ascorbic acid was observed in guava-lime-ginger RTS beverage with respect to storage condition and storage period.

Microbial changes of the guava, lime and ginger RTS beverage

An increasing trend in microbial population was noted in the guava, lime and ginger RTS beverage during storage but was highly in an acceptable link (Table 4). Initially bacterial, fungi and yeast count was below detectable level (BDL) and at the end of storage period bacterial count of guava, lime and ginger RTS beverage was increased from 2 to 5 x 10^5cfu/g in

R_1 and 1 to 4 x 10^5cfu/g in R_2 samples, 2 to 5 x 10^4cfu/g in R_1 and 1 to 3 x 10^4cfu/g in R_2 samples in fungi and yeast count was 2 to 5 x 10^3cfu/g in R_1 and 1 to 3 x 10^3cfu/g in R_2 samples during the storage period.

Organoleptic characteristics of guava-lime-ginger RTS beverage during storage

Guava, lime and ginger RTS beverage secured highly acceptable to acceptable score values during the storage (Table 4). The mean overall acceptability score values were 8.30 & 8.50 in R_1 and R_2 samples at the end of 180 days. In general, overall acceptability of guava-lime-ginger RTS beverages was highly acceptable for R_2 samples when compared to R_1 samples.

Economics of guava-lime-ginger RTS beverage production

Economics of guava-lime-ginger RTS production @ 100 litres / day production capacity and operating season of 300 days in a year revealed a fixed cost (operation and maintenance cost) of Rs. 30,050 for the processing plant. The total variable cost (production cost) was worked out to be Rs. 8, 62 lakhs. It was found that annual total cost of production was Rs. 8.92 lakhs and gross return estimated to be 30 tonnes of guava-lime-ginger RTS produced was Rs. 10.80 lakhs by using prevailing product market price. In nutshell, it was found that the cost of production of guava-lime-ginger RTS /litre was Rs. 29.74. Also profit per litre of guava-lime-ginger RTS was estimated to be Rs. 6.26.

Economic feasibility analysis (Table 5)

It could be seen from the table that the internal rate of return was 89.43 per cent which was more than current bank rate indicating that the proposal of setting a plant producing 100 litres / day for 300 days of operating capacity can be commercially viable. The benefit cost ratio was workout to be 1.16 for this processing plant. A project can be accepted, if the benefit cost ratio was more than unity. Hence the proposal for setting up this plant was found to be economically feasible.

For determining breakeven point, the total fixed cost was found to be Rs. 30,050. The variable cost per litre was Rs. 28.74 and the unit contribution to fixed cost was analysed as Rs 2.87/ litre. The analysis showed that breakeven point for the above said processing plant was 4,137 litres/year. It was the minimum production required for successful operation of the plant.

The payback period was workout to be within one year. Hence, this analysis showed that greater benefit could be accrued as profit from second year onwards.

Conclusion

The results of the study showed that value added fruit product of guava, lime and ginger RTS beverage. Storage condition and packaging the value added products in suitable packaging materials (Glass bottles- capacity 200 ml) could extend the shelf life of the product with minimum changes in the chemical composition. Value added fruit products of guava, lime and ginger RTS beverage showed an increasing trend in acidity and reducing sugar whereas a decreasing trend in pH, TSS, total sugar and ascorbic acid contents were noticed during storage. A slight increase in the microbial population was observed in the product. Among the value added fruit product of guava, lime and ginger RTS beverage had secured higher sensory score values. So that the market structure for fruits might be more competitive and the benefits could be proportionally shared by fruit growers in the study area.

Table 1: Changes in the acidity, pH and TSS (°Bx) content of the guava, lime and ginger RTS beverage during storage

Storage period (S) (days)	Acidity (g/100ml)		pH		TSS (°Bx)	
	Storage condition (R)		Storage condition (R)		Storage condition (R)	
	R_1	R_2	R_1	R_2	R_1	R_2
0	0.252	0.252	3.95	3.95	15.50	15.50
30	0.265	0.248	3.90	3.92	15.50	15.50
60	0.272	0.265	3.84	3.87	15.45	15.48
90	0.279	0.270	3.78	3.80	15.38	15.40
120	0.285	0.279	3.71	3.72	15.30	15.35
150	0.297	0.285	3.62	3.61	15.22	15.30
180	0.305	0.298	3.58	3.59	15.10	15.24

Acidity (g/100ml)			pH			TSS (°Bx)		
	SED	CD (0.05)		SED	CD (0.05)		SED	CD (0.05)
S	0.00054	0.00111**	S	0.00792	0.1622**	S	0.04770	0.09771**
R	0.00029	0.00059**	R	0.00423	0.00867**	R	0.02550	0.05223*
SR	0.00077	0.00157**	SR	0.01120	0.02294^{NS}	SR	0.06746	0.13819^{NS}

R_1-Room temperature R_2-Refrigeration temperature

Table 2: Changes in the total and reducing sugar (g/100 ml) content of the guava, lime and ginger RTS beverage during storage

Storage period (S) (days)	Total sugar (g/100 ml)		Reducing sugar (g/100 ml)	
	Storage condition (R)		Storage condition (R)	
	R_1	R_2	R_1	R_2
0	12.24	12.24	5.98	5.98
30	12.10	12.18	6.85	6.25
60	12.00	12.05	7.12	6.89
90	11.86	11.92	7.45	7.05
120	11.45	11.75	7.86	7.28
150	11.18	11.52	7.99	7.45
180	10.95	11.24	8.28	7.98

❖ Total sugar (g/100 ml)			❖ Reducing sugar (g/100 ml)		
	SED	CD (0.05)		SED	CD (0.05)
S	0.01225	0.02509**	S	0.01990	0.04077**
R	0.00659	0.01341**	R	0.01064	0.02179**
SR	0.01732	0.03548**	SR	0.02814	0.05765**

R_1- Room temperature R_2-Refrigeration temperature

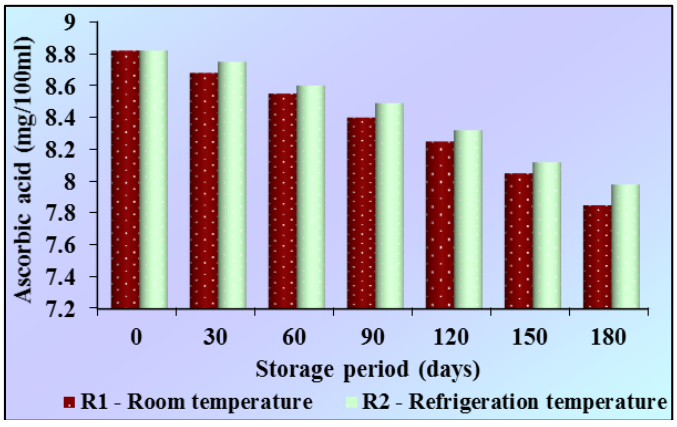

Fig 2: Changes in the ascorbic acid (mg/100ml) content of guava-lime-ginger RTS during storage

Table 4: Changes in the microbial population of guava, lime and ginger RTS beverage during storage

Storage period (S) (days)	Bacteria (x10^5/g)		Fungi (x 10^4 /g)		Yeast (x 10^3 /g)	
	R_1	R_2	R_1	R_2	R_1	R_2
0	BDL	BDL	BDL	BDL	BDL	BDL
30	2	1	2	1	2	1
60	2	2	2	1	2	1
90	3	3	3	2	3	2
120	4	3	3	3	4	2
150	4	4	4	3	4	3
180	5	4	5	3	5	3

BDL–Below Detectable Level

R_1- Room temperature R_2-Refrigeration temperature

Table 5: Organoleptic characteristics of guava, lime and ginger RTS beverage

Storage period (S) (days)	Quality attributes							
	Room temperature (R_1)				Refrigeration temperature (R_2)			
	Colour and appearance	Flavour	Taste	Overall acceptability	Colour and appearance	Flavour	Taste	Overall acceptability
0	8.6	9.0	8.6	8.55	8.7	9.0	8.7	8.75
30	8.6	9.0	8.6	8.55	8.7	9.0	8.7	8.75
60	8.6	9.0	8.4	8.50	8.7	9.0	8.6	8.75
90	8.5	8.6	8.4	8.45	8.6	9.0	8.5	8.65
120	8.5	8.5	8.4	8.45	8.6	8.9	8.5	8.60
150	8.4	8.5	8.3	8.35	8.5	8.8	8.4	8.55
180	8.4	8.4	8.2	8.30	8.5	8.6	8.4	8.50

R_1-Room temperature R_2-Refrigeration temperature

Table 6: Economic analysis of value added guava, lime and ginger RTS beverage productions

S No.	Analysis particulars	Guava lime ginger RTS production (in litres)
A	**Economics of production**	
1	Cost of production/unit (Rs/unit)	29.74
2	Production/year (litres/kgs)	30,000
3	Price /unit (Rs/unit)	36.00
4	Profit/Year (Rs)	1.87 lakhs
5	Profit/unit (Rs/ litres)	6.26
B	**Economic Feasibility Analysis**	
1	Internal rate of return (%)	89.43
2	Benefit -cost ratio	1.16
3	Break-even point (litres/kgs/year)	4,137

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