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EFFECT OF ARTIFICIAL AND NATURAL SWEETENERS ON BIOCHEMICAL COMPOSITION AND ORGANOLEPTIC EVALUTION OF GAUAVA RTS DURING STORAGE

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ABSTRACT

A study was undertaken for preparation of RTS using different natural and artificial sweeteners as the treatments and the processed nectar RTS was analyzed in Completely Randomized Design. Biochemical parameters *viz.*, TSS, acidity, ascorbic acid, reducing sugars, non-reducing sugar and total sugars as well as organoleptic attributes (colour, flavour, taste and overall acceptability) of RTS were evaluated at an interval of 0 days upto 90 days in 30 days interval during the storage. An overall result of fruit RTS prepared from guava was found better in the treatment T_3 (50% Equal + 50% Sugar) which was statistically at par with T_7 (50% Stevia + 50% Sugar). Results indicated that the minimum physico-chemical changes viz., TSS (7.52 -7.93°Brix), acidity (0.29 - 0.42%), reducing sugars (6.23 – 6.42 %), total sugars (14.26 – 14.38%) showed increasing trend while ascorbic acid (30.78 – 28.56 mg/ 100 g), non-reducing sugars(8.03-7.96%) and sensory attributes showed decreasing values with duration of storage. The overall acceptability was recorded maximum in T_3 treatment and ranges between (7.8-7.41). Considering above chemical constituents as well as sensory attributes of processed RTS, both the treatments T_3 (50% Equal + 50% Sugar) and T_7 (50 % Stevia + 50% Sugar) were found better for RTS preparation.

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INTRODUCTION

The guava (*Psidium guajava* L.), popularly known as poor man's apple, is being cultivated in the tropical and sub tropical parts of India. Guava (*Psidium guajava* L.), a member of the botanical family Myrtaceae. This is a highly productive and nutritive fruit crop. The fruit is a rich source of vitamin C, calcium, iron and pectin. Guava is grown as a commercial crop in Northern India due to its high yield and good economic returns. Owing to its nutritional superiority, cheaper prices and characteristic flavor, it has gained wide popularity amongst rich as well as poor strata of the society. It has good potential for marketing both in raw and processed forms because of its taste, texture, colour, and potentiality for processing into products (Karanjakar *et al.,* 2013).

Being a climacteric fruit, guava is very perishable in nature and very short shelf life therefore, may have enormous potential if converted into nutritious beverages with exotic taste. The finished beverages contain about 8 to 14 per cent sugar. Today's consumers expect more and more pleasure from food. They want to drink that type of beverage which should be lower in fat and sugar.

India is second largest producer of fruits and vegetables in the world after china, the present quantity of fruit and vegetable processing is very meager (around 2.2%) as compared to 80% in USA, 70% France, 80% Malaysia and 30% Thailand. The fruit and vegetable processing in India is highly decentralized, small-scale industries accounting for 33%, organized 25%, unorganized 42% and large number of units in cottage/household and small scale sector, having capacities of up to 250 tonnes/ annum. (Singh *et al.*, 2014).

With the changing consumer attitudes, demands and emergence of new market products, it has become impera-tive for producers to develop products, which have nutri-tional 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).

Alternative sweeteners can avoid problems with dental decay and other health risks associated with the excessive consumption of caloric sweeteners, such as sucrose (Cardello and Damasio, 1997). The use of low-calorie sweeteners could improve dietary quality if consumers used energy savings for the consumption of nutrient dense foods (ADA, 2004).

Today's consumers expect more and more pleasure from food. They want it be lower in fat, sugar and calories and to be able to maintain or improve their health conditions. These facts resulted in development of sugar free or low calorie sweeteners. Presently, low calorie sweeteners are being used in a wide variety of foods and other items such as jams, pickles, sauces, fruit preserves, soft drinks, ice creams, pharmaceutical products, tooth paste and mouth (Cook, 2000). RTS is one of the refreshing beverages having zero carbonation, relatively few preservatives and excellent source of several important vitamins and minerals and is used as health drink. Therefore, it is necessary to utilize guava for making nutritious processed health food like nectar and RTS to increase availability over an extended period and to stabilize the price during the glut season.

MATERIALS AND METHODS

This experiment was conducted in the Horticulture Processing Laboratory Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya and Raipur (C.G.) during the year 2014-15.

Raw material and sample preparation

Fully matured and ripe guava fruits of uniform size, free from mechanical damage, bruises and fungal attack were procured from horticulture orchard, IGKV, Raipur. The fruits were washed with tap water in the laboratory. Fruits were used for preparation of nectar with different artificial and natural sweeteners. The pulp was extracted by using pulper machine and strained through 1 mm stainless steel sieve. The prepared RTS was heated at 85°C for 30 minutes with acidity was maintained 0.3%. . The prepared RTS product was filled into the clean and sterilized plain glass bottle of 200 ml and sealed with crown cork. The filled bottle was pasteurized in boiling water for 30 minutes and cooled and stored in room temperature. The processed products for biochemical evaluation as well as organoleptic evaluation were periodically observed upto 90 days at 30 days interval. The experiment consists of 12 treatment of alternative sweetener and one treatment of 100% sugar combination each for RTS. The treatments were replicated three times in Completely Randomized block design (CRD).

The following treatments were evaluated in the investigation:

T_0	100 per cent sugar	T_7	50 per cent Stevia + 50 per cent Sugar
T_1	100 per cent Equal (Aspartame)	T_8	25 per cent Stevia + 75 per cent Sugar
T_2	75 per cent Equal + 25 per cent Sugar	T_9	100 per cent Splenda (Sucralose)
T_3	50 per cent Equal + 50 per cent Sugar	T_{10}	75 per cent Splenda + 25 per cent Sugar
T_4	25 per cent Equal + 75 per cent Sugar	T_{11}	50 per cent Splenda + 25 per cent Sugar
T_5	100 per cent Stevia	T_{12}	25 per cent Splenda + 75 per cent Sugar
T_6	75 per cent Stevia + 25 per cent Sugar		

Selection of fruits

Firm ripe fruits were selected for the preparation of guava RTS beverages. The fruits were washed in running tap water to remove dirt and dust particles. They were sliced into small pieces.

Extraction of pulp

The slices were blended by adding equal amount of warm water in a waring blender. The whole mass was then sieved to obtain a fine fruit pulp devoid of seeds and skin.

Mixing the ingredients

After extraction of pulp, 10 per cent pulp for RTS was taken. The volume of the final product was maintained by adding water to each recipe combination in each replication. A calculated amount of sugar was added in the pulp to adjust the total soluble solid as 15 per cent for RTS. The acidity was maintained to 0.3 per cent in the final product by the addition of required amount of citric acid.

Filtration

The prepared RTS beverages were again filtered by sieving through a muslin cloth to obtain a product of uniform consistency.

Bottling

The product was poured into hot, sterilized crown bottles of 200 ml capacity and corked air-tight.

Pasteurization

The filled bottles were pasteurized in boiling water till the temperature of product reaches 100°C. It took about 15 minutes to attain required temperature.

Storage

The bottles of RTS beverages were kept at ambient condition for further studies up to 90 days.

Biochemical analysis

Chemical analysis of guava RTS was done initially just after preparation upto 90 days at 30 days interval during storage under ambient condition. TSS of RTS was determined by Hand Refractometer at 20°C and expressed in per cent. The acidity and ascorbic acid of RTS was determined by the procedure given by Ranganna (1986). Sugars (Reducing, non-reducing and total sugars) were determined by the method of Lane and Eynon as described by Ranganna (1986).

Sensory evaluation

The sensory parameters of colour and appearances, aroma, taste and overall acceptability were evaluated with 10 trained panelist based on 9 point Hedonic rating scale as described by Ranganna (1986).

Statistical analysis

The data recorded on different parameters were statistically analyzed using Completely Randomized Design and critical differences (CD) were calculated at 5 % level of significance to compare the treatments as per the method given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The various biochemical changes in guava RTS due to varying recipe (treatment) and storage period are presented in Table 1.

Total soluble solids (TSS)

Maximum total soluble solids were found in (T_0) that was formulated with sugar (100%). Whereas, minimum TSS was recorded in T_9 that was formulated with 100 per cent Splenda (Sucralose). During storage a slight increase in TSS was observed in all samples. The increase in TSS might be due to the formation of pectic substances from protopectin and mono saccharides from disaccharides *i.e.,* degradation of sucrose into glucose and fructose. Similar results have been reported by Sarolia and Mukherjee (2002) in their studies on lime juice.

Acidity

Acidity is also an important attribute because tartness is a major

Table 1: Effect of low calorie sweeteners on biochemical composition of guava nectar RTS during storage

Treatment	Storage periods (days) 0 days	30 days	60 days	90 days
Total Soluble Solids (TSS) (%)				
T_0	15.02	15.12	15.23	15.44
T_1	1.87	1.93	2.02	2.08
T_2	3.75	4.02	4.22	4.37
T_3	7.52	7.63	7.72	7.83
T_4	11.25	11.29	11.37	11.53
T_5	1.5	1.73	1.87	1.96
T_6	4.07	4.17	4.23	4.37
T_7	7.8	7.87	7.94	8.02
T_8	11.34	11.47	11.53	11.63
T_9	1.02	1.32	1.63	1.87
T_{10}	4.13	4.19	4.23	4.38
T_{11}	7.94	8.03	8.16	8.23
T_{12}	11.52	11.62	11.73	11.83
SEm ±	0.009	0.010	0.012	0.010
CD at 5 %	0.02	0.03	0.03	0.02
Acidity (%)				
T_0	0.31	0.33	0.4	0.48
T_1	0.32	0.35	0.42	0.5
T_2	0.33	0.32	0.44	0.52
T_3	0.29	0.31	0.36	0.42
T_4	0.33	0.34	0.46	0.55
T_5	0.32	0.33	0.48	0.57
T_7	0.31	0.32	0.38	0.44
T_8	0.32	0.33	0.39	0.46
T_9	0.33	0.34	0.54	0.64
T_{10}	0.34	0.35	0.52	0.62
T_{11}	0.32	0.33	0.51	0.59
T_{12}	0.34	0.35	0.53	0.63
SEm ±	0.010	0.009	0.009	0.009
CD at 5 %	NS	NS	0.02	0.02
Reducing Sugar (%)				
T_0	6.54	6.69	6.73	6.78
T_1	6.59	6.74	6.78	6.83
T_2	6.63	6.78	6.83	6.88
T_3	6.23	6.32	6.38	6.42
T_4	6.72	6.82	6.85	6.94
T_5	6.76	6.86	6.9	6.98
T_6	6.84	6.89	6.93	7.08
T_7	6.41	6.59	6.64	6.7
T_8	6.48	6.63	6.69	6.78
T_9	7.03	7.19	7.24	7.28
T_{10}	6.96	7.02	7.08	7.15
T_{11}	6.94	7.01	7.07	7.13
T_{12}	7	7.09	7.14	7.19
SEm ±	0.009	0.009	0.009	0.009
CD	0.026	0.028	0.027	0.027
Total Sugar (%)				
T_0	14.39	14.49	14.51	14.54
T_1	14.42	14.52	14.54	14.57
T_2	14.44	14.55	14.57	14.59
T_3	14.26	14.32	14.36	14.38
T_4	14.5	14.57	14.58	14.62
T_5	14.52	14.59	14.61	14.66
T_6	14.56	14.61	14.63	14.69
T_7	14.32	14.43	14.45	14.52
T_8	14.36	14.45	14.48	14.54
T_9	14.72	14.76	14.79	14.81
T_{10}	14.65	14.72	14.75	14.78
T_{11}	14.62	14.69	14.72	14.74
T_{12}	14.64	14.67	14.70	14.72
SEm ±	0.011	0.009	0.011	0.008
CD at 5 %	0.03	0.02	0.03	0.02

Table 1: Cont..........

Treatment	Storage periods (days) 0 days	30 days	60 days	90 days
Non-reducing Sugar (%)				
T_0	7.85	7.8	7.78	7.76
T_1	7.83	7.78	7.76	7.74
T_2	7.81	7.77	7.74	7.71
T_3	8.03	8	7.98	7.96
T_4	7.78	7.75	7.73	7.68
T_5	7.76	7.73	7.71	7.68
T_6	7.72	7.72	7.7	7.61
T_7	7.91	7.84	7.81	7.82
T_8	7.88	7.82	7.79	7.77
T_9	7.59	7.57	7.55	7.53
T_{10}	7.69	7.65	7.61	7.59
T_{11}	7.71	7.68	7.65	7.61
T_{12}	7.64	7.63	7.62	7.57
SEm ±	0.008	0.009	0.010	0.009
CD at 5%	0.02	0.02	0.03	0.02
Ascorbic acid (mg/100ml)				
T_0	30.12	28.73	28.53	26.68
T_1	27.23	27.08	26.68	25.98
T_2	27.32	27.19	26.73	26.23
T_3	30.78	29.18	28.79	28.56
T_4	27.43	27.23	26.79	26.32
T_5	27.48	27.32	26.83	26.53
T_6	27.68	27.89	27.43	26.65
T_7	30.53	28.92	28.68	28.24
T_8	30.36	28.78	28.65	27.92
T_9	25.92	24.83	24.32	23.65
T_{10}	26.12	25.98	24.68	23.78
T_{11}	26.43	26.12	24.73	23.89
T_{12}	26.28	25.28	24.43	23.68
SEm ±	0.012	0.012	0.012	0.013
CD at 5 %	0.03	0.03	0.03	0.04

factor in the acceptability of guava drink. Acid gives the characteristic sourness to the product. Highest acidity was recorded in T_9 (Splenda 100%) while, lowest was observed in T_3 (50% Equal + 50% Sugar). There was gradual increase in acidity were observed in all treatments during storage upto 90 days. However, non significant variation in acidity was observed at storage interval of 0 and 30 days. This increase in acidity was attributed to the degradation of sugars into carboxyl acids.

Ascorbic acid

Marginal differences in ascorbic acid contents were observed in various treatments. Ascorbic acid contents decreased significantly at all storage intervals. These losses of ascorbic acid were attributed to the effect of processing, storage time and exposure to light. Highest ascorbic acid was recorded in T_3 (50% Equal + 50% Sugar) while lowest was observed in T_9 (100% Splenda). The decrease in ascorbic acid content may be due to the degradation of ascorbic acid in juice or drink may follow aerobic and an-aerobic pathways (Moshonas and Shaw, 1989). Similar decreasing trend for ascorbic acid contents in different fruit beverages were also reported by the Ranote and Bains (1982).

Reducing sugar

Reducing sugars increased significantly during storage. It is very important component for a processed product with respect to quality, shelf life, taste and discoloration during storage. Highest reducing sugar was observed in T_9 (100% Splenda) while lowest reducing sugar was recorded in T_3 (50% Equal + 50% Sugar). 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 agreed with the investigation reported earlier for canned mango nectar, guava nectar, and guava-aonla blended beverages .

Non-reducing sugar

Non-reducing sugars in guava RTS showed lowest in treatment T_9 (100% Splenda) and highest in T_3 (50% Equal + 50% Sugar) during storage. This gradually decreased during storage which might be due to significant increase in reducing sugar by acid hydrolysis of reducing sugar and there by inversion of non-reducing sugar to reducing sugar, However, the pattern of decrease of non-reducing sugar percent varied according to treatments. Similar type of observation were also reported by Choudhary *et al*. (2008) in guava nectar.

Total sugar

Total sugar of guava RTS showed significantly increasing trend during three months of storage. The lowest total sugar was observed in treatment T_3 (50% Equal + 50% Sugar) and highest total sugar was observed in T_9 (100% Splenda). Total sugar was increased during storage period is due to solubilization of pulp constituents and hydrolysis of polysaccharides including pectin and starch materials. Similar type of observation for total sugar of various products have been reported by Choudhary *et al*. (2008) in guava nectar, Pandey (2004) stability of guava beverages.

Organoleptic evaluation

The effect of artificial and natural sweeteners on organoleptic qualities of guava RTS during storage are presented in the Table 2.

Colour and appearances

The maximum organoleptic score for colour and appearance of guava RTS was recorded in treatment T_3 (50% Equal + 50% Sugar) is statistically at par with T_7 (50% Stevia + 50% Sugar) during storage. The organoleptic score for colour and appearance 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 compound present in fruit pulp also reacts with enzymes to get discoloration. These findings were accordance with Kalra & Tandon (1991) in guava nectar.

Aroma

The maximum score for taste of guava RTS was recorded in treatment T3 (50% Equal + 50% Sugar) which is statistically at par with T_7 (50% Stevia + 50% Sugar) during storage.

Taste

The maximum score for taste of guava RTS was recorded in treatment T_3 (50% Equal + 50% Sugar) which is statistically at par with T_7 (50% Stevia + 50% Sugar) during storage. These findings were accordance with Kalra & Tandon (1991) and Choudhary *et al*. (2008) for guava nectar, Chakraborthy *et al*. (1991) for canned mango nectar, Pandey (2004) for guava beverages, Mall and Tandon (2007) for guava-aonla blended beverage, Kumar *et al*. (2008) for musambi RTS Beverage.

Overall acceptability

The maximum score for overall acceptability of guava RTS was found in treatment T_3 (50% Equal + 50% Sugar) during storage. It may be due to non-enzymatic reactions like caramelization and millard. The score for overall acceptability of RTS was declined significantly during storage owing to oxidative reaction to deteriorate the scores of colour, flavour as well taste. These findings were accordance with Kalra and Tandon (1991) and Choudhary *et al*. (2008) for guava nectar.

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