International Journal of Agricultural Sciences ☞DOI:10.15740/HAS/IJAS/18.1/40-45
Volume 18 | Issue 1 | January, 2022 | 40-45 ■ ISSN : 0973-130X Visit us : *www.researchjournal.co.in*

RESEARCH PAPER

Bio-chemical evaluation and workout the economics of guava nectar

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Abstract : Experiment includes guava nectar preparation using cultivars *viz.,* Lalit, L-49, Shweta and Gwalior-27 with12 treatments of guava nectar and same level of sugar (600g/kg pulp) and citric acid (1g/kg pulp) under Completely Randomized Design replicated thrice. Physico-chemical parameters *viz.,* TSS, acidity, TSS:Acid ratio, ascorbic acid, total sugar, pH and organoleptic parameters *viz.,* colour, flavour, taste and overall acceptability of nectar were analyzed.TSS was maximum in T_2 (12.90) followed by T_5 (12.51) and minimum in T_7 (10.50) and acidity was also recorded higher in T_2 (0.38%) followed by T_5 (0.37%) and minimum in T_3, T_4 and T_9 (0.28%). TSS/Acid ratio was maximum in T_9 (44.03) followed by T_{12} (41.65) and minimum in T_5 (33.81) and ascorbic acid was higher in T_2 (194.47) followed by T_5 (192.83) and minimum in T_7 (143.55). Total sugar (%) was maximum in T_2 (9.28) followed by T_5 (9.25) and minimum in T_4 (7.60) and pH was maximum in T_2 (3.95) followed by T_5 (3.91) and minimum in T_4 (3.48). The comparative cost of per liter nectar for different recipes was Rs. 63.72. In terms of cost benefit ratio and net return in different treatments, T_2 give maximum value (1.33:1 and 21.28) followed by T_5 (1.25:1and 16.28). Concluded that nectar prepared from guava pulp with different combinations, the physico-chemical and organoleptic aspects was found better in the treatment T_2 [Lalit (100%)] followed by T_5 [G-27+Lalit (50%+50%)].

Key Words : Ascorbic acid, Bio-chemical parameters, Guava, Nectar, Pulp, TSS

View Point Article : Bhadouriya, Poonam, Gurjar, P.K.S., Rajput, Pushpendra, Rathour, Shubham Singh and Burma, Bhuriya (2022). Bio-chemical evaluation and workout the economics of guava nectar. *Internat. J. agric. Sci.*, **18** (1) : 40-45, **DOI:10.15740/HAS/IJAS/18.1/40-45.**

Article History : Received : 02.08.2021; **Revised :** 06.09.2021; **Accepted :** 04.10.2021

INTRODUCTION

Guava (*Psidium guajava* L.) of family Myrtaceae, originatedin Tropical America or Southern Mexico. Fourth main and valuable fruit after Mango, Banana and Citrus in respect of area and production because it is majorly cultivated in tropical and sub-tropical areas. India is the major producer of guava in the world. Total area and production of guava in India is 292 MH and 4361 MT (Agricoop data 2019-20), respectively. Uttar Pradesh is the largest producing state in India.

"Guava also called as Apple of Tropics and Poor man's apple. The fruit consists of 20% peel, 50% flesh and seed core. Guava fruit contains 74-84% moisture, 13-26% dry matter, 0.8-1.5% protein, 0.4-0.7% fat and 0.5-1.0% ash, high level of vitamin C (299 mg/100 g) and pectin (1.15%). The fruit contain good amount of minerals like phosphorus (23-37 mg/100 g), calcium (14-

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30 mg/100 g), iron (0.6-1.4 mg/100 g) as well as vitamins such as riboflavin, thiamine, niacin and vitamin A" (Bal *et al.,* 2014). Guava isa delicious, juicy and highly nutritious fruit. The total soluble solid content in fruit varies from 8.2° to 10.4° brix. Sucrose, glucose and fructose are the predominant sugars in ripe guava fruits. Fructose (59%) is the main sugar in green ripe fruits while sucrose is the main sugar found in fully ripe fruits.

About 22% of post-harvest losses occur in guava. "Guava is generally consumed fresh as a dessert fruit or in processed form such as nectar, juice, toffee, squash, jam, jelly, cheese, concentrate, fruit flakes, powder, syrup, puree, powder, wine, and vinegar, drinks and dehydrated canned products, ready to use snacks etc. The processing of fruit also reduce the losses" (Sinha and Mishra, 2017).

"Nectar is used as healthy and refreshing drink with relatively few preservatives and good source of various important vitamins and minerals having zero carbonation. So, it is important to consume guava for nutritional and healthy value-added processed food like nectar to increase fruit consumption and availability for long time with reasonable prices (Choudhary *et al.,*2008). It offers advantage of utilizing fruits during off season with increased self-life.The processing technique for guava nectar preparation is very simple. This type of fruit beverage having at least 20% fruit juice /pulp and 15% total soluble solids and also about 0.3% citric acid" (Bal *et al.,* 2014). Nectar is not diluted before serving.

Lalit is among the important cultivar of guava which has attractive pink colour pulp. Due to coloured pulp, this is highly suitable for processing. Kalra and Tandon, 1984" analyzed eight samples of guava nectar contains 15% pulp, 12 to 14% TSS and 0.20-0.35% acidity. The nectar was fortified with 100mg vitamin C and stored for 10 months in glass bottles. Organoleptic evaluation indicated that the sample having 14% TSS and 0.25% acidity was found to be the best followed by 14% TSS and 0.20% acidity and 12% TSS and 0.25% acidity. During storage, the TSS and vitamin C decreased while titratable acidity was increased by 0.02 - 0.04.

Lalit cultivar can be processed to form nectar with combination of pulp from different other cultivars such as Gwalior-27, Lucknow-49, Shweta which may give more better and enhanced product. Hence, an experiment was conducted to access the effect of pulp percentage combinations of different cultivars on physico-chemical and organoleptic attributes of guava nectar.

MATERIAL AND METHODS

The present investigation was conducted in the laboratory, Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during the year 2018-19. In winter season, fresh fully mature and uniform size, free from mechanical damage, bruises and fungal attack fruits of four guava cultivars Gwalior–27, Lalit, L-49 and Shweta were taken from the KVK orchard. The selected fruits were washed with tap water to remove dirt and dust particles adhering to the surface of fruit and were allowed to surface dry and used for nectar preparation.

Preparation of different guava pulp recipes:

The pulp was extracted by using pulper machine and strained through 1 mm stainless steel sieve. The amount of pulp, sugar, citric acid, preservative (KMS@2 mg/lit) and water were calculated. For the preparation of guava nectar, known amount of sugar, water and citric acid was mixed, heated and stirred thoroughly, then it was cooled and filtered through muslin cloth and pulp was added as per ratio given in recipes. Prepared guava Nectar filled in clean sterilized glass bottle of 500 ml capacity, bottle closed with cap and stored in dry place at room temperature.

Physico-chemical evaluation:

TSS:

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

Titratable acidity:

The titratable acidity of nectar was analyzed by titrating aliquot against 0.1N NaOH solution using phenolphthalein as an indicator, light pink colour is taken as donation of acid of guava nectar (Ranganna, 1986).

TSS:Acid ratio:

TheTSS and acid ratio is calculated by TSS is divided by titratable acidity.

Ascorbic acid:

The titrimetric method of titration against 2-6 dichlophenol indophenols dye solution was adopted for ascorbic acid determination (Ranganna, 1986).

Total sugars and reducing sugars:

Lane and Eynon method (Ranganna, 1986) was adopted for total and reducing sugars estimation.

Non-reducing sugars:

The value of non-reducing sugars was recorded by the subtracting the value of reducing sugars from total sugars.

pH of pulp:

pH of pulp was determined using Elico digital pH meter.

Sensory analysis:

The sensory parameters of colour, flavour, taste and overall acceptability were conducted first day of preparation and evaluated by a panel with 10 trained panelists based on 9 point hedonic rating scale with maximum score considered as the best (Ranganna, 1986).

Economic analysis:

Product yield:

The product yield of guava nectar was calculated by the following formula:

$$\text{Product yield} = \frac{\text{Wt. of the product}}{\text{Wt. of fresh fruit pulp}} \times 100$$

Cost per liter guava nectar:

Total amount of rupees spent was calculated by simple addition of total cost of guava purchased, cost of sugar, citric acid, chemicals used, cost of fuel utilized in making nectar and cost of packing material. Cost per liter of guava nectar was calculated by the following formula:

$$\text{Cost per liter guava nectar} = \frac{\text{Total amount of repees spent on product}}{\text{Nectar produced in liters}} \times 100$$

Net return (Rs.):

Net returns of nectar were calculated by subtracting total cost from the gross return.

Benefit : Cost ratio:

It is calculated by gross returns divided by total cost.

Statistical analyses:

The data were analyzed by Completely Randomized Design suggested by Panse and Sukhatme, 1967. The treatment significancewas tested by 'F' testat 5% level of probability.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Physico-chemical composition of guava pulp:

The analyses revealed that physio-chemically and

Table 1: Physio-chemical evaluation of deferent recipe combination of guava pulp

Treatments	TSS (°Brix)	Acidity (%)	TSS/Acid ratio	Ascorbic acid (mg/100g)	Total sugar (%)	pH
T_1- G-27 (100% Pulp)	11.60	0.31	37.42	187.73	7.89	3.48
T_2- Lalit (100% Pulp)	12.90	0.38	33.95	194.47	9.28	3.95
T_3- L-49 (100% Pulp)	11.21	0.28	40.03	150.21	8.47	3.72
T_4- Shweta(100% Pulp)	10.83	0.28	38.67	192.56	7.60	3.68
T_5- G-27 +Lalit (50%+50% Pulp)	12.51	0.37	33.81	192.83	9.25	3.91
T_6- G-27+L-49(50%+50% Pulp)	11.93	0.34	35.08	176.47	8.23	3.49
T_7- G-27+Shweta(50%+50% Pulp)	10.50	0.30	35	143.55	7.95	3.73
T_8- Lalit+L-49 (50%+50% Pulp)	11.26	0.33	34.12	173.30	8.25	3.57
T_9- Lalit+Shweta (50%+50% Pulp)	12.33	0.28	44.03	184.58	8.14	3.71
T_{10}- G-27+Shweta+L-49 (33.33%+33.33%+33.33% Pulp)	11.24	0.32	35.12	155.95	8.35	3.54
T_{11}- G-27 +Shweta+Lalit (33.3%+33.3%+33.3%Pulp)	11.53	0.32	36.03	181.70	7.91	3.73
T_{12}- G-27+L-49+ Lalit +Shweta 25%+25%+25%+25%Pulp)	12.08	0.29	41.65	188.90	8.79	3.82
S.E.±	0.150	0.010	0.270	0.726	0.062	0.053
C.D. (P=0.05)	0.437	0.030	0.787	2.118	0.181	0.155

Organoleptically treatment T_2 followed by T_5 were found best combination among the all 12 treatments. All the treatments were found significantly different from each other in respect of all parameters.

Total soluble solid was maximum in T_2 (12.90) followed by T_5 (12.51) and minimum in T_7 (10.50) whereas the T_1 and T_3, T_6 and T_{11}, T_8 and T_{10} were equivalent and acidity is also recorded higher in T_2 (0.38%) followed by T_5 (0.37%) and minimum in T_3,T_4 and T_9 (0.28%). The data of TSS/Acid ratio in guava pulp showed difference among all combinations, maximum in T_9 (44.03) followed by T_{12} (41.65) and minimum in T_5 (33.81) whereas the treatments T_2 (33.95) and T_5(33.81) and T_6 and T_{10}were at par (Table 1).

Ascorbic acid content was maximum in T_2 (194.47) followed by T_5 (192.83) and minimum in T_7 (143.55), whereas the T_1 (187.73) and T_{12} (188.90) were statistically at par. Total sugar (%) was maximum in T_2 (9.28) followed by T_5 (9.25) and they were statistically at par and minimum in T_4(7.60) and pH was maximum in T_2 (3.95) followed by T_5 (3.91) and minimum in T_4 (3.48) (Table 1). Similar findings are also recorded by Nidhi *et al.,*2008; Balaswamy *et al.,* 2010; Shankara Swamy and Banik, 2011; Jain *et al.,* 2011; Kumari and Sandal 2011; Jakhar *et al.,* 2012; Jakhar *et al*., 2013; Byanna and Doreyappa Gowda 2012 and Byanna *et al.* (2013).

Table 2 : Organoleptic evaluation of different recipe combination of guava pulp

Treatments	Colour	Flavour	Taste	Overall acceptability
T_1- G-27 (100% Pulp)	7.53	8.00	8.20	7.43
T_2- Lalit (100% Pulp)	8.53	8.70	8.87	8.67
T_3- L-49 (100% Pulp)	7.67	8.10	8.10	8.23
T_4- Shweta(100% Pulp)	7.57	7.83	8.13	7.90
T_5- G-27 +Lalit (50%+50% Pulp)	8.43	8.67	8.80	8.47
T_6- G-27+L-49(50%+50% Pulp)	6.87	8.30	8.80	8.23
T_7- G-27+Shweta(50%+50% Pulp)	7.53	7.80	7.27	7.87
T_8- Lalit+L-49(50%+50% Pulp)	7.53	8.07	8.00	7.67
T_9- Lalit+Shweta (50%+50% Pulp)	7.47	7.97	8.13	7.20
T_{10}- G-27+Shweta+L-49 (33.33%+33.33%+33.33% Pulp)	7.77	7.87	8.10	7.87
T_{11}- G-27 +Shweta+Lalit (33.3%+33.3%+33.3%Pulp)	7.90	7.83	7.90	7.77
T_{12}- G-27+L-49+Lalit+Shweta(25%+25%+25%+25%Pulp)	7.87	7.56	7.93	8.13
S.E.±	0.139	0.287	0.224	0.249
C.D. (P=0.05)	0.406	0.838	0.654	0.725

Table 3: Economics of different treatment

Treatments	Cost of pulp (Rs.)	Cost of sugar (Rs.)	Other expences (Rs.)	Total cost (Rs.)	Assumed product value	Gross return (Rs.)	Net return (Rs.)	B:C ratio
T_1	22.72	12	29	63.72	65	65	1.28	1.02:1
T_2	22.72	12	29	63.72	85	85	21.28	1.33:1
T_3	22.72	12	29	63.72	65	65	1.28	1.02:1
T_4	22.72	12	29	63.72	65	65	1.28	1.02:1
T_5	22.72	12	29	63.72	80	80	16.28	1.25:1
T_6	22.72	12	29	63.72	65	65	1.28	1.02:1
T_7	22.72	12	29	63.72	65	65	1.28	1.02:1
T_8	22.72	12	29	63.72	75	75	11.28	1.17:1
T_9	22.72	12	29	63.72	75	75	11.28	1.17:1
T_{10}	22.72	12	29	63.72	65	65	1.28	1.02:1
T_{11}	22.72	12	29	63.72	75	75	11.28	1.17:1
T_{12}	22.72	12	29	63.72	75	75	11.28	1.17:1

Organoleptic evaluation:

Data analyses revealed that treatment T_2 followed by T_5 were found best combination. The maximum reading of colour, flavour, taste and overall acceptability were noted in treatment T_2 (8.53, 8.70, 8.87 and 8.67) followed by T_5 (8.43, 8.67, 8.80 and 8.47) respectably. However, minimum colour, flavour, taste and overall acceptability value were recorded in T_6(6.87), T_{12}(7.56), T_7 (7.27) and T_1 (7.43) respectably (Table 2). These findings are in accordance with Nilugin, 2010; Balaswamy *et, al.* 2010; Jakhar *et al*., 2012; Byanna and Doreyappa Gowda, 2012; Jakhar *et al.*, 2013 and Pasupuleti and Kulkarni, 2014.

Economics analysis:

Product yield (%):

In winter season, a total of 18 kg guava of all four varieties were purchased @ 40/kg and used for preparation of nectar and total 36 litres nectar was obtained. Hence, the product yield is 200%.

Cost per litre of guava nectar:

The total manufacturing cost of guava nectar/ litre for different recipes are Rs. 63.72.

Net return:

The net returns of nectar were noted higher in treatment T_2 (21.28) followed by T_5 (16.28) and minimum in T_1, T_3, T_4, T_6, T_7 and T_{10} (1.28) and in the remaining treatments net returns value were found similar (11.28).

Benefit : Cost ratio:

In terms of benefit cost ratio among the different treatments T_2 gave the maximum cost benefit ratio (1.33:1) followed by T_5 (1.25:1) and minimum in T_1, T_3, T_4, T_6, T_7 and T_{10} (1.02:1) and in the remaining treatments Benefit: Cost ratio value were found similar (1.17:1).

Economics:

The total manufacturing cost of guava nectar for different recipes from 63.72 [pulp cost in (22.72) +labour cost and other expensive in (29) + cost of sugar in (12)]. In terms of net return and benefit cost ratio treatments T_2 and T_5 found more acceptable for preparation of guava nectar. These findings are in agreement with the findings of Roy *et al.,* 2015 and Kuchi *et al*., 2015.

Conclusion:

All the treatments were significantly different from each other with respect of all parameters. The physico-chemical and organoleptic parameters were found best when nectar was prepared using 100 % pulp of Lalit cultivar alone followed by combination of pulp with 50 % Gwalior-27 and 50 % Lalit.

Acknowledgement:

The authors are thankful to Dr. R. Lekhi for their guidance. This research is a part of Master's Research program of Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P).

Conflict of interest:

The authors should declare that they do not have any conflict of interest.

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