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RESEARCH PAPER

Optimization of Nutritional Health Drink Developed from Guava, *Jamun* and *Aloe vera*

Sakshi Sharma and Rakesh Sharma*

Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Solan, HP. India

*Corresponding author: drrakes@gmail.com

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ABSTRACT

Guava, *jamun* and *Aloe vera* are valued for their nutritive and medicinal properties, but their utilization as drink is limited due to certain consumer repelling factors like poor appearance and grittiness of guava juice, high astringent taste of *jamun* juice and bitter taste of *Aloe vera* juice. Therefore, present study was designed to optimize the blending of guava pulp with *jamun* and *Aloe vera* juice for developing nutritious health drink. Different formulations, where *jamun* juice concentration varied from 10-50 per cent with two levels of fruit part (10 and 15%) and two levels of TSS (10 and 15°B) were tried for optimizing guava-*jamun* blended drink. Further, *Aloe vera juice* from 1 to 9.0 per cent was added to enhance the nutritive and functional value without compromising overall acceptability of the developed beverage. Out of different formulations, the drink prepared by blending guava-*jamun* in the ratio of 60:40 with 15 per cent fruit part (blended) and 15°B TSS was found the best on the basis of nutritional and sensory characteristics. Herbal fortification with *Aloe vera* juice @ 5 per cent was optimized for improving nutritional and medicinal properties of the developed beverage. Results revealed that the *Aloe vera* fortified guava-*jamun* health drink contained higher values of ascorbic acid (33.91 mg/100g), total phenolics (36.12 mg/100g) and antioxidant potential (13.40 % free radical scavenging activity) compared to control the sample (100% guava drink).

Keywords: Guava, *jamun*, *Aloe vera*, health drink, functional beverages

Fruit, vegetable and medicinal herbs act as protective foods and their consumption has increased because of their disease combating properties (Adefegha 2018; Dukhi and Taylor, 2018; Sharma *et al*. 2019). Recently, increased health awareness around the globe has increased the demand for functional foods especially the beverages which provide necessary nutrients, prevent nutrition-related diseases and improve physical and mental well-being of the consumers (Raj *et al*. 2017; Kaur and Sigh 2017; Sharma *et al*. 2018; Palamthodi *et al*. 2019). Among many fruits, guava (*Psidium guajava* L.) and *jamun* (*Syzygium cumini* L.) are reported to contain several bioactive compounds and have been widely used to treat diabetes by the traditional practitioners over many centuries (Kapoor and Ranote, 2015; Joshi *et al.* 2019). Guava is often included among super fruits, being rich in dietary fibres, vitamin A and C, folic acid and dietary minerals (Singh and Tiwari, 2019). It is a hypoglycaemic fruit and generally, provides less energy (38-57 Kcal/100g) as compared to other fruits like mango, banana etc. and hence suitable for diabetics and for those involved in weight management (Rai *et al.* 2007; Joseph and Priya, 2011). Similarly, *jamun* (Indian blackberry or black plum) is reported to contain vitamins, amino acids, minerals

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and other phyto-chemicals (Kannan and Puraikalan, 2016). It has antioxidant, anti-inflammatory, anti-microbial, antibacterial, antifungal, free radical scavenging, gastro-protective and anti-diabetic properties (Sagrawat *et al*. 2006; Joshi *et al.* 2019). In spite of great nutritional significance of these fruits; cloudy appearance, grittiness and poor taste of guava juice/pulp and high astringency, blunt taste of *jamun* juice are some of the consumer repelling factors and major problems to the juice industry (Sharma *et al*. 2014; Joshi *et al*. 2012; Raj *et al*. 2017). Hence, finding right blend of juices/ pulps to maximize consumer appeal for health and sensory attributes is the alternative for utilization of such fruits (Bhardwaj and Pandey, 2011; Singh and Gaikwad 2012; Heena *et al.* 2017). Furthermore, fortification of beverages with herbal extracts has been reported to improve nutritional and health properties besides enhancing storage/microbial stability (Jairajpuri and Qadri, 2015; Sharma *et al*. 2018). *Aloe vera* (*Aloe verabarbadensis* L.) also known as miracle plant, possess a wide range of medicinal and therapeutic properties such as reducing blood sugar, easing intestinal problems, ulcers etc. (Akinnyele and Odiyi, 2007; Sharma *et al.* 2015). Keeping the above facts in view, the present study was conducted to optimize blending of guava, *jamun* and *Aloe vera* for developing a nutritious health drink.

MATERIALS AND METHODS

Materials

Fresh guava and *jamun* fruits were procured from the local fruit and vegetable market, Solan (HP) and brought immediately to the fruit processing unit of Department of Food Science and Technology for further studies. Whereas, *Aloe vera* leaves were procured from the the Herbal Garden, Department of Forest Products, Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan (HP).

Extraction and preservation of pulp/juice

Guava fruits were sorted, washed, cut and heated along with water (1:1) in a pressure cooker for 15 minutes prior to passing through the pulper (BSB, New Delhi) for extraction of pulp. Similarly, *jamun* pulp was prepared by hot break pulping method (Bons and Dhawan, 2013). However, *Aloe vera* juice was extracted as per the method given by Sharma *et al*. (2015). The pulp and juice so extracted were heat preserved and stored under refrigerated temperature till used for product development.

Guava-*jamun* and *Aloe vera* fortified guava-*jamun* drink

Different combinations of guava and *jamun* pulp with varying levels of fruit part and total soluble solids (TSS) were tried for optimization of a suitable combination for the preparation of palatable guava-*jamun* blended drink. The drinks were prepared as per standard methods and specifications of FSSA-2006. The acidity (as % citric acid) was kept constant (i.e. 0.30 %) in all the treatments. The treatment T_1 was kept control which was having 100 per cent of guava pulp (10 % fruit part; 10 ^{o}B TSS). The rest of the treatments (T_2 to T_{21}) were prepared by blending different ratio of *jamun* pulp in guava pulp (10, 20, 30, 40 and 50) with two levels of fruit part (10 and 15%) and two levels of TSS (10 and 15 ^{o}B). Further, five levels of *Aloe vera* juice fortification i.e. 1, 3, 5, 7 and 9 per cent were tried for optimization of a suitable level for the development of *Aloe vera* fortified guava-*jamun* health drink.

Physico-chemical, nutritional and sensory quality analysis

All the beverages were evaluated for their physico-chemical characteristics viz. TSS, titratable acidity, total sugars, reducing sugars, ascorbic acid, total phenols and total anthocyanins as per the standard analytical methods (Ranganna, 2009). Antioxidant activity (Free radical scavenging activity) of juice and beverage was measured as per the method of Brand-Williams *et al.* (1995) by using DPPH (2, 2-diphenyl-1-picrylhydrazyl) as a source of free radical. Sensory evaluation of the product was conducted by a panel of ten judges using 9- point hedonic scale system for different parameters viz. appearance, body, flavour and overall acceptability (Amerine *et al.* 1965).

STATISTICAL ANALYSIS

All the analytical parameters were recorded in triplicates and the mean values of each parameter were described with standard error (SE). The data pertaining to quantitative estimation of physico-chemical characteristics were assessed by factorial CRD, whereas the data regarding sensory evaluation of products were analysed by RBD as described by Cochran and Cox (1967).

RESULTS AND DISCUSSION

Physico-chemical characteristics of fresh guava, *jamun* and *Aloe vera* juice/pulp

Data pertaining to the physico-chemical characteristics of fresh guava, *jamun* and *Aloe vera* juice: Pulp revealed that guava pulp contained 5.02 ºB total soluble solids (TSS), 0.38 per cent titratable acidity, 120.19 mg/100g ascorbic acid, 1.26 per cent reducing sugars, 2.70 per cent total sugars and 3.42 pH (Table 1). Whereas, the total phenolic contents and antioxidant activity in guava pulp were observed as 180.42 mg/100g and 72.80 per cent, respectively. Fresh *jamun* pulp was found to be a rich source of total phenolics (424.24 mg/100g) besides containing 9.97ºB total soluble solids, 0.75 per cent titratable acidity, 2.79 per cent reducing sugars and 6.52 per cent total sugars, respectively. While, ascorbic acid, antioxidant potential and total anthocyanins were estimated as 27.28 mg/100g, 75.56 per cent and 112.50 mg/100g, respectively. Data presented in Table 1 further revealed that *Aloe vera* juice contained 2.20ºB total soluble solids, 0.35 per cent titratable acidity and 102 mg/100g ascorbic acid. Similar findings of these parameters were also reported by Jain and Asati (2009), Abed *et al.* (2012) and Bons and Dhawan (2013) for guava; Chaudhary and Mukhopadhyay (2012) and Kapoor and Ranote (2015) for *jamun* and Sharma *et al.* (2015) for *Aloe vera.*

Optimization of guava-*jamun* and *Aloe vera* fortified guava-*jamun* health drink

The effects of blending of guava pulp with different proportions of *jamun* pulp on sensory attributes of the developed drink are presented in Table 2. It was observed that with the increase in the proportions of *jamun* pulp up to 40 per cent the score for colour and body increased, beyond which it decreased due to cloudy appearance of the drink. The highest colour score (7.80) and body (7.70) was obtained by the drink having 60 per cent guava pulp and 40 per cent *jamun* pulp with 15 per cent fruit part and 15ºB TSS. It is evident from the data that flavour score for different treatments varied from 6.90 to 7.75 with maximum score obtained by the treatment T_{17} (G_{60} + J_{40}). Similar results were also recorded for overall acceptability (Table 2). Blending of guava pulp with appropriate proportion of *jamun* pulp might have enhanced the

Table 1: Physico-chemical characteristics of guava, *jamun* and *Aloe vera* juice/pulp

Parameters*	Mean ± SE		
	Guava pulp	***Jamun* pulp**	***Aloe vera* juice**
TSS (ºB)	5.02 ± 0.10	9.97 ± 0.15	2.20 ± 0.10
Tiratable acidity (%)	0.38 ± 0.02	0.75 ± 0.02	0.35 ± 0.02
Ascorbic acid (mg/100g)	120.19 ± 2.17	27.28 ± 1.70	102.00 ± 1.33
Reducing sugars (%)	1.26 ± 0.04	2.79 ± 0.26	0.42 ± 0.03
Total sugars (%)	2.70 ± 0.50	6.52 ± 0.36	1.64 ± 0.09
Total phenolics (mg/100g)	180.42 ± 1.86	424.24 ± 1.84	198.38 ± 1.45
Antioxidant potential (% free radical scavenging activity)	72.80 ± 1.25	75.56 ± 1.92	84.68 ± 0.92
Total anthocyanins (mg/100g)	ND	112.50 ± 0.13	ND

**Each value is average of three determinations; SE = Standard error; ND = Not detected.*

Table 2: Sensory evaluation of different guava-*jamun* blended drinks

Detail of treatments			Sensory Score*			
Treatment	**Fruit part (% blended pulp)**	**TSS (ºBrix)**	**Colour**	**Body**	**Flavour**	**Overall acceptability**
T_1 (G_{100}) Control	10	10	7.00	7.00	6.90	7.00
T_2(G_{90} : J_{10})	10	10	7.15	7.11	6.95	7.10
T_3(G_{90} : J_{10})	10	15	7.20	7.18	7.00	7.15
T_4(G_{90} : J_{10})	15	10	7.22	7.21	7.15	7.20
T_5(G_{90} : J_{10})	15	15	7.22	7.22	7.15	7.25
T_6(G_{80} : J_{20})	10	10	7.28	7.28	7.18	7.28
T_7(G_{80} : J_{20})	10	15	7.32	7.32	7.25	7.35
T_8(G_{80} : J_{20})	15	10	7.38	7.35	7.30	7.42
T_9(G_{80} : J_{20})	15	15	7.40	7.35	7.30	7.48
T_{10}(G_{70} : J_{30})	10	10	7.50	7.38	7.35	7.55
T_{11}(G_{70} : J_{30})	10	15	7.55	7.40	7.40	7.60
T_{12}(G_{70} : J_{30})	15	10	7.60	7.45	7.50	7.66
T_{13}(G_{70} : J_{30})	15	15	7.63	7.48	7.55	7.66
T_{14}(G_{60} : J_{40})	10	10	7.60	7.50	7.56	7.70
T_{15}(G_{60} : J_{40})	10	15	7.65	7.62	7.60	7.80
T_{16}(G_{60} : J_{40})	15	10	7.70	7.67	7.70	7.72
T_{17}(G_{60} : J_{40})	15	15	7.80	7.70	7.75	7.85
T_{18}(G_{50} : J_{50})	10	10	7.78	7.68	7.72	7.71
T_{19}(G_{50} : J_{50})	10	15	7.79	7.65	7.60	7.69
T_{20}(G_{50} : J_{50})	15	10	7.78	7.55	7.55	7.67
T_{21}(G_{50} : J_{50})	15	15	7.79	7.55	7.55	7.70
$CD_{0.05}$	—	—	0.15	0.13	0.18	0.10

**Sensory score recorded on 9-point hedonic scale; 9=like extremely, 1=dislike extremely; G= guava; J= jamun.*

flavour profile of the product and hence rated highest by the panellist on the basis of overall acceptability of the beverage. Tiwari and Deen (2015; Sharma *et al.* (2016) and Sharma *et al* (2018) had observed similar findings in Bael-*Aloe vera* RTS, *Jamun*- mango squash and *Aloe vera*-aonla squash, respectively.

Data pertaining to the effect of *Aloe vera* fortification on sensory quality of guava-*jamun* blended drink is presented in Fig 1. It was found that with the increase in proportion of *Aloe vera* juice up to 9 per cent, the colour score of prepared drink decreased, however all the treatments obtained colour score between 7.72 to 7.80, which were well with the acceptable range (more than 7.00). Whereas, with the addition of *Aloe vera* juice up to a level of 5 per cent, the score for flavour increased, which has resulted in higher overall acceptability score of the products. While, the addition of *Aloe vera* at higher levels (>5%) resulted in decline of overall acceptability score of the products (Fig. 1). Our results are in conformity with earlier studies conducted by Tiwari and Deen (2015) and Pandey *et al.* (2019).

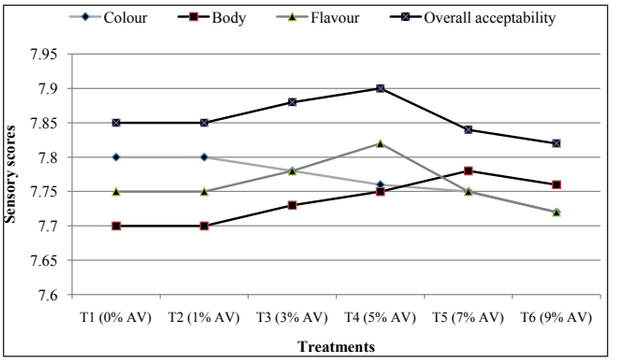

Fig. 1: Sensory evaluation of *Aloe vera* fortified guava-*jamun* blended health drink

Other researchers have also reported that fortification of beverages with herbal extracts improved physico-chemical, sensory, nutritional and microbial quality

of the prepared beverage (Boghani *et al*. 2012; Jairajpuri and Qadri 2015; Sharma and Tandon 2015). Hence, on the basis of sensory evaluation, *Aloe vera* fortification up-to 5 per cent was optimized.

Physico-chemical, nutritional and sensory characteristics of the developed beverage

The data presented in Table 3 revealed that the addition of *jamun* pulp had improved the nutritional quality of drink as evident from its higher total phenolic content (32.75 mg/100g), ascorbic acid content (33.91 mg/100g) and antioxidant potential (11.30 % free radical scavenging activity) compared to standard drink (18.09 mg/100g, 16.16 mg/100g and 8.77 % free radical scavenging activity), respectively (Table 3). Palamthodi *et al.* (2019) studied physicochemical and functional properties of ash gourd/ bottle gourd beverages blended with *jamun* and showed significant increase in bio-accessibility of polyphenols, flavonoids, and anthocyanins. Further, *Aloe vera* fortified guava-*jamun* blended drink so developed has also showed strong antimicrobial activity against human pathogen *E. coli* (Table 3). Similar results have been reported by Kapoor and Ranote (2015) and Sharma *et al*. (2018).

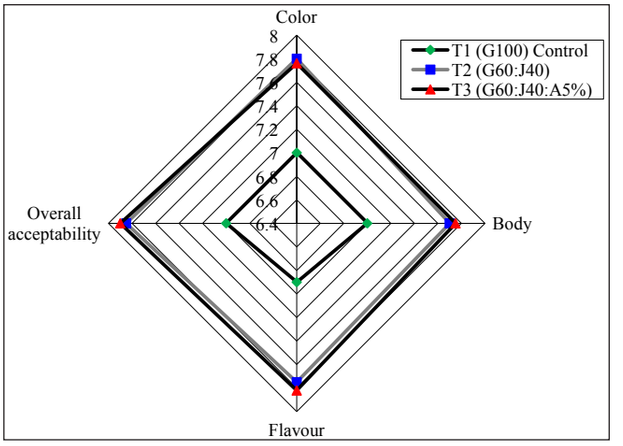

Fig. 2: Sensory attributes of guava drink, guava-*jamun* drink and *Aloe vera* fortified guava-*jamun* health drink

Further, blending has also exerted positive effect on sensory attributes of the beverages as the blended drink had recorded higher score for flavour (7.82) and overall acceptability (7.90) compared to guava drink (Fig. 2). Earlier, many workers have reported blending of two or more fruit pulp/juices in various proportions for making more palatable and nutritious beverages (Boghani *et al.* 2012; Mohamed *et al*. 2014; Sharma *et al.* 2016; Raj *et al.* 2017).

Table 3: Physico-chemical attributes of guava drink, best rated guava-*jamun* drink and *Aloe vera* fortified guava-*jamun* drink

Parameters*	Mean ± SE		
	Guava drink (G_{100})	**Guava-*jamun* drink (G_{60}:J_{40})**	**Guava-*jamun*- *Aloe vera* drink (G_{60}:J_{40}:$A_{5\%}$)**
TSS (ºB)	10.00 ± 0.20	15.00 ± 0.20	15.00 ± 0.20
Tiratable acidity (%)	0.30 ± 0.01	0.30 ± 0.01	0.30 ± 0.02
Total sugars (%)	9.41 ± 0.16	14.06 ± 0.03	14.38 ± 0.13
Ascorbic acid (mg/100g)	16.16 ± 0.15	18.38 ± 0.08	33.91 ± 0.07
Total phenolics (mg/100g)	18.09 ± 0.10	32.75 ± 0.06	36.12 ± 0.02
Antioxidant potential (% free radical scavenging activity)	8.77 ± 0.06	11.30 ± 0.02	13.40 ± 0.02
Total anthocyanins (mg/100g)	1.05± 0.03	10.09 ± 0.03	10.02 ± 0.02
Antimicrobial activity (mm zone of inhibition)	6.5**± 0.03**	9.2**± 0.0**4	14.5**± 0.0**4

SE = Standard error; G= guava; J= jamun; A= Aloe vera; T= TSS.

CONCLUSIONS

Blending guava pulp with *jamun* pulp and *Aloe vera* juice have resulted in improvement of sensory, nutritional and functional properties of the drink. The blended drink prepared by using 60 per cent guava pulp and 40 per cent *jamun* pulp with 15 per cent fruit part and 15°B TSS was optimized for better sensory characteristics. Addition of *Aloe vera* juice up to 5 per cent was found acceptable. *Aloe vera* fortified guava- *jamun* drink contained higher amounts of ascorbic acid, total phenolic content, antioxidant activity and also showed strong antimicrobial activity against human pathogen *E. coli* compared to standard guava drink. So, it was concluded that, guava and *jamun* can successfully be utilized for the development of functional/health beverages by way of blending and/or fortification with *Aloe vera*. Hence, their availability in the market will definitely benefit the health conscious people.

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