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RESEARCH PAPER

Preparation and Evaluation of Functionally Enriched Squash from Rhododendron (*Rhododendron arboreum* Sm.) Flowers

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Abstract

This study was conducted to prepare functionally enrich squash from Rhododendron (*Rhododendron arboreum* Sm.) petals. The prepared product was evaluated for various physico-chemical functional properties. The addition of extract effected all the parameters positively. Antioxidant compounds viz. ascorbic acid 33.12±0.03, 14.93±0.09 and 18.80±0.11mg/100g, total anthocyanins 29.67±0.85, 10.88±0.21 and 14.10±0.18mg/100g and total phenols 34.14±0.43, 20.61±0.15 and 21.00±0.11mg/100g were documented in Rhododendron flowers, sugar based Rhododendron squash and honey based Rhododendron squash, respectively. The advancement of storage decreased TSS, total sugars, reducing sugars, acidity, ascorbic acid, total anthocyanins and total phenols but slight increase in pH value of both type of squashes took place. Overall, 30 per cent rhododendron juice and final TSS 45°Brix is recommended to prepare a good quality honey based rhododendron squash.

Keywords: Rhododendron, flowers, squash, honey, functional properties etc.

Rhododendron arboretum Sm. is a small tree having beautiful bright red flowers. The name "*arboretum*" means "tree like" (Orwa *et al*., 2009). *Rhododendron arboreum* is a state tree of Uttarakhand and national flower of Nepal. Each part of the plant possesses one or other medicinal properties and is used against various infirmities (Shrivastava, 2012). It is widely popular for its flowers and is mainly used to prepare juice and *sharbat*. Among the various functional attributes of flower, antioxidant property is considered the best (Krishnaih *et al*., 2007) and is considered as a critical part in keeping up well-being by protecting the body of the consumers against receptive oxygen species (Lan *et al*., 2007). It is considered useful in various traditional treatments of serious health conditions like heart disease, diarrhea, blood dysentery (Laloo *et al*., 2006). Though *sharbat* and even squash is prepared from it, yet there is no documentation of the same in the literature. Keeping in view, all these properties the flowers are utilized to prepare a health drink by using honey and compared with sugar.

MATERIALS AND METHODS

Raw materials

Rhododendron flowers were obtained from the naturally developing plants in the vicinity of university. Flowers petals were removed and washed with cold water. To extract the juice, hot pulping method was used (Vyas *et al*., 1989). Multiflora honey was purchased from local Patanjali store and used to prepare the squash.

Preparation of squash

The extract was used to prepared two types of

squashes. In one came sugar was used while in other honey was used as a source of sugar. Both the squashes were prepared as per the conventional method (Verma and Joshi, 2000).

Storage of products

Both the squashes were stored for 6 months at ambient and refrigerated storage and were evaluated for physico-chemical and sensory quality.

Biochemical analysis

Biochemical quality characteristics like total soluble solids (TSS) were measured using an Erma hand refractometer and the results were expressed as degree Brix (°B). The readings were corrected by incorporating the appropriate correction factor for temperature variation (AOAC, 2000). Titratable acidity was estimated by titrating a known aliquot of the sample against N/10 NaOH solution using phenolphthalein as an indicator. The titratable acidity was calculated and expressed as per cent citric acid (AOAC, 2000) while pH was measured with the help of digital pH meter standardized with buffer solution. The total and reducing sugars of the fruits and squash were estimated by Lane and Eynon's volumetric method (AOAC, 2000).

Antioxidants properties

Antioxidants viz. ascorbic acid content was determined as per AOAC (2000) method using 2, 6-dichlorophenol-indophenol dye. The amount of total phenols in the sample was determined with the Folin-ciocalteu reagent according to the method of Bray and Thorpe (1954) using catechol as s standard. Total anthocyanins present in the samples were determined by using ethanolic-HCl, the method prescribed by Ranganna (2007).

Sensory Evaluation

The prepared Rhododendron based squashes was evaluated organoleptically by a panel of five judges for sensory characteristics like colour, flavour, mouth feel and overall acceptability(OAA) at room and refrigerated temperature during the advancement of storage at two months intervals on a given proforma (Joshi, 2006).

RESULTS AND DISCUSSION

Biochemical properties of Rhododendron flowers, the sugar based and honey based squash are given in Table 1. The TSS of fresh flower was 6.82±0.11°B while titratable acidity (as citric acid) recorded was 1.19±0.13%. The reducing sugars, non-reducing and total sugars were found to be 2.03±0.12 %, 3.96±0.09% and 6.00±0.19%, respectively. The pH value of the extract was recorded to be 3.02±0.01. The ascorbic acid content in rhododendron flower was found to be 33.12±1.03mg/100gm. Honey used for preparation

Table 1: Functional properties of fresh rhododendron flowers, and squash

Parameters	Rhododendron flower	Sugar based RS	Honey based RS
Physico-chemical parameters			
TSS(°B)	6.82±0.11*	45.06±0.01	45.26±0.01
pH	3.02±0.01	3.58±0.01	3.73±0.01
Titratable acidity (%MA)	1.19±0.13	0.92±0.08	0.94±0.09
Reducing sugars (%)	2.03±0.12	24.68±0.11	25.81±0.10
Total sugars (%)	6.00±0.19	41.92±0.06	42.95±0.07
Antioxidant parameters			
Ascorbic acid (mg/100g)	33.12±0.03	14.93±0.09	18.80±0.11
Total anthocaynins (mg/100g)	29.67±0.85	10.88±0.21	14.10±0.18
Total phenols (mg/100g)	34.14±0.43	20.61±0.15	21.00±0.11

*Mean ± S.D

Table 2: Effects of storage on physico-chemical characteristics of sugar and honey based rhododendron squash

Parameters	RS	Two months		Four months		Six months		$CD_{(0.05)}$
		AT	RT	AT	RT	AT	RT	
TSS (°B)	Sugar based	44.56	44.78	44.43	44.72	43.50	43.80	0.04
	Honey based	44.44	44.76	44.23	44.40	43.13	43.62	
pH	Sugar based	3.62	3.60	3.64	3.62	3.69	3.65	0.02
	Honey based	3.76	3.75	3.80	3.78	3.84	3.84	
Titrable acidity (%)	Sugar based	0.84	0.89	0.80	0.87	0.77	0.84	0.04
	Honey based	0.88	0.91	0.86	0.90	0.84	0.88	
Ascorbic acid (mg/100g)	Sugar based	12.79	13.04	10.80	12.35	7.79	11.29	0.76
	Honey based	14.93	16.12	13.57	14.24	10.60	11.65	
Total phenols (mg/100g)	Sugar based	10.69	10.80	10.45	10.72	10.32	10.81	0.08
	Honey based	13.91	14.00	13.86	13.92	13.52	13.77	
Total anthocyanins (mg/100g)	Sugar based	19.63	19.76	19.31	19.51	18.79	19.00	0.03
	Honey based	20.51	20.62	20.10	20.21	19.67	19.87	
Reducing sugars (%)	Sugar based	24.00	24.35	23.29	23.65	22.32	22.54	0.29
	Honey based	24.52	24.70	23.21	23.58	22.51	22.74	
Total sugars (%)	Sugar based	39.19	40.71	37.26	39.90	35.33	38.85	0.59
	Honey based	41.06	42.30	39.23	41.75	37.56	39.55	

of beverage had TSS of 78.00°B, whereas its titratable acidity was found to be 0.26% as citric acid. Total phenols and total anthocyanins content in fresh rhododendron flowers was recorded as 34.14±2.43 and 29.67±2.85mg/100gm, respectively. Most of the physico-chemical characteristic of squash was higher in honey based rhododendron squash than sugar based rhododendron squash.

Effect of Storage

The total soluble solids content of honey and sugar based rhododendron squash diminished with the advancement of storage period. In sugar based squash maximum TSS 45.06°B was observed at initial stage, which was diminished to 43.50°B and 43.80°B at ambient and refrigerated temperature, respectively while in honey based rhododendron squash, TSS decreased from 45.26 (Initial day) to 43.13 and 43.62 under ambient and refrigerated temperature. The observations are analogues to those reported earlier by Kumar *et al.* (2001) in aonla squash, Kannan and Thirumaran (2001) in jamun squash and Nath *et al*. (2005) in ginger kinnow squash.

On the advancement of storage period, pH content of sugar and honey based squash increased gradually. At the 1st day of storage, least (3.73) pH was recorded in honey squash which increased to 3.84% on 180th day of storage. The titratable acidity on the other hand decreased in both the squash during storage period. At the 1st day, acidity in sugar squash was 0.92% which was reduced to 0.77% and 0.84% at 180th day of storage in ambient and cold storage. This might be attributed to hydrolysis of polysaccharides, in the presence of organic acid is converting sucrose to hexose sugar. The decreased in acidity during storage was seen in mango squash (Roy *et al*., 1997), in kinnow squash (Sogi *et al.,* 2001) and in aonla squash (Jain *et al*., 2002).

The reducing sugar content of squashes decreased during storage period upto 180 days. The maximum 25.81% reducing sugar was observed in honey based rhododendron squash whereas sugar based squash recorded a lower (24.68%) reducing sugar content.

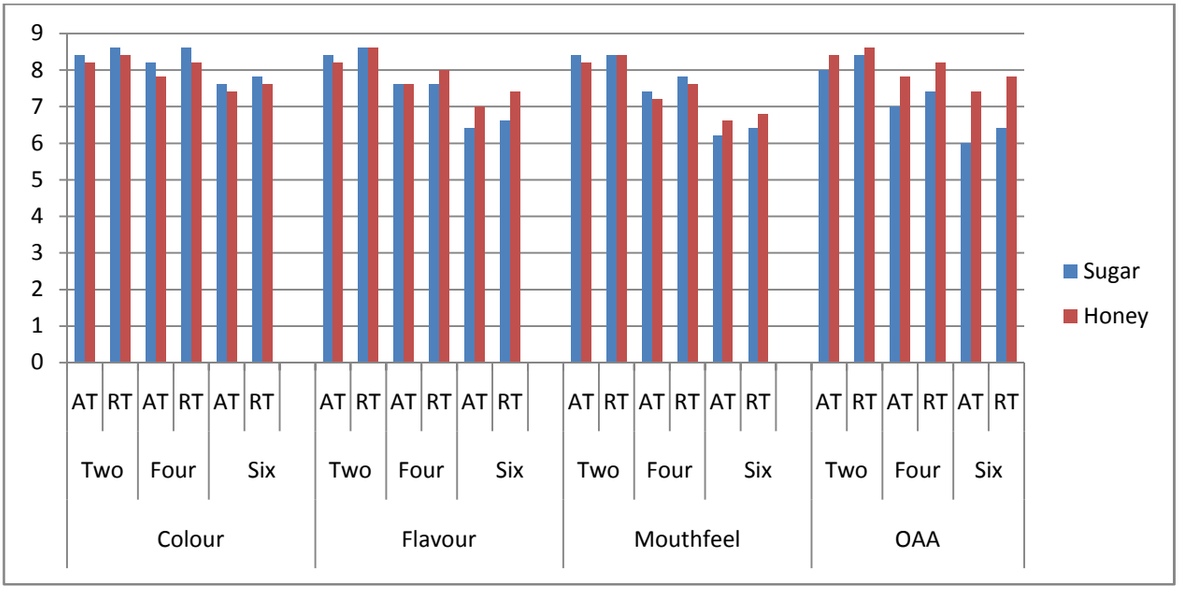
Total sugars content of the squashes stored at room and refrigerated temperature were significantly

decreased with increase in storage period. The findings are similar to the discoveries of Byanna and Gowda (2012) on beverage made from sweet orange. Kumari *et al.* (2015) additionally assessed same results on fig based functional food products during storage. Comparative findings have been accounted by Walia (2010) and Kotecha and Kadam (2003) in bamboo and tamarind syrup, separately.

On the 1st day of storage maximum (18.80mg/100g) ascorbic acid was found in honey squash and minimum (14.93mg/100g) was found in sugar based squash. The ascorbic acid decreased gradually on advancement of storage period in both type of squashes. Gradual decrease of ascorbic acid content may be due to oxidative decimation of ascorbic acid in the presence of molecular O_2 by enzymes (Seung and Adel, 2000).

A noteworthy decline in total phenol content of rhododendron squash was obtained in both the squashes in different storage condition. Losses were higher at ambient storage as compared to low temperature of storage. The results are in contradiction to those Zhang *et al*. (2008) who recorded no significant changes in total phenolic content of apple juice upto five days of storage which decreased significantly after five days storage at ambient temperature. Miller *et al*. (1995) also reported the same findings for apple juice stored at 4°C over 10 days. Raj *et al*. (2011) revealed a critical reduction in the phenolic content of sand pear and apple juice blends during six months storage. The reduction in total phenolic content caused by heating is in line with that observed in fermented black soybeans by Lin and Chou (2008).

The sensory evaluation of sugar and honey enriched rhododendron squash is graphically represented in Fig 1. Colour of sugar based rhododendron squash remained similar in both the storage conditions and storage interval while the flavor of honey based squash showed improvement over sugar based Rhododendron squash. In case of mouth feel, sugar based Rhododendron squash was observed to be



*AT= Ambient temperature; RT= Refrigerated temperature; two, four and six are storage intervals

Fig. 1: Effect of storage durations and conditions on sensory parameters of sugar and honey based rhododendron squash

better for four months of storage period under both the storage conditions and afterword honey based squash was better than sugar based rhododendron squash. The sensory evaluation for colour, taste and overall acceptability (OAA) of sugar and honey enriched rhododendron squash reveals that highest mean after six months of storage were observed in honey based rhododendron squash stored under refrigerated temperature.

CONCLUSION

It is clear from this study that Rhododendron squash can be made up by utilizing honey as a sweetener and sensory acceptability was higher for squash prepared it in contrast to squash prepared with sugar. Honey based Rhododendron squash can be prepared by using 30 per cent juice and 45°Brix TSS with acceptable quality. Honey based rhododendron squash was better to keep up the quality attributes during storage of 6 months.

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