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RESEARCH PAPER

Rosa damascena: Quality Evaluation and Process Optimization for the Development of Rose Syrup

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Abstract

Rosa damascena also known as *desi gulaab*, belongs to the Damask variety of rose. It is deep red coloured variety with a sweet fragrance and has been used traditionally in different food preparations. Physico-chemical evaluation revealed that it is a rich source of phytochemicals. The content of phenolic compounds, anthocyanins, ascorbic acid and per cent radical scavenging activity in the fresh petals was 2230 mg GAE/100 g, 98.64 mg/100g, 293.37 mg/100 g and 83.91%, respectively. Fresh petals were also a good source of minerals. The content of potassium, phosphorus, calcium, copper and iron was 153.39 mg/100g, 34.59 mg/100g, 13.78 mg/100g, 1.82 mg/100g and 1.33 mg/100g, respectively. It was concluded from the optimization process that 30:70 of rose petals to sugars, produced syrup with high overall acceptability and in compliance with the specifications of Food Safety and Standardization Authority of India. Whereas, the optimization of temperature revealed that heat treatment at 70°C was most suitable to produce a syrup rich in phytochemicals and high sensorial acceptability.

Keywords: *Desi rose*, phytochemicals, FSSAI, rose syrup.

Edible flowers have been used traditionally to improve the aesthetic appearance, taste and value of foodstuffs. Among various civilizations such as Asian, East Indian, European, Victorian English, and Middle Eastern the flowers have been used for food and medicinal purpose since ancient time (Kaisoon *et al.* 2012). Edible flowers are emerging as new source of nutraceuticals due to their nutritional and medicinal value (Mlcek and Rop, 2011). In European countries, the flowers are generally used for preparation of hot beverages (*tisane* or infusion) like tea and a great advantage is that they are free from caffeine (Navarro-González *et al.* 2015). Rosa spp. is diverse and at present over 200 species and more than 18000 cultivars form of the plant has been identified (Boskabady *et al.* 2011). Many species of rose (*Rosa* spp.) were used in ancient Greece and Rome as relishes and flavour enhancers of many sweet and savoury dishes while in the Indian Ayurveda system, various rose preparations were used as tonic, laxative, astringent and antibacterial agent (Verma *et al.* 2011). In ancient India rose petals were preserved in the form of *Gulkand* (rose petals preserve) or fragrant syrup known as *Gulkand Sharbat* (Kumar, 2017). The health benefits of rose are well known and several pharmacological properties including anti-HIV, antibacterial, antioxidant, antitussive, hypnotic, antidiabetic, and relaxant effect on tracheal chains have been reported for this plant (Boskabady *et al.* 2011). Rose and rose products are also used as a cooling agent and as a vehicle for many Ayurvedic medicines (Kaul, 1998). A range of traditional

products have been produced using *desi gulab* (*Rosa damascena*) in North India but a documented record for its physicochemical composition as well as a standard process which meets the Food Safety and Standard Authority of India (FSSAI) specifications is lacking. Therefore, in the present study proximate composition of the flower was determined and a process was optimized to produce artificial additives free rose syrup according to the FSSAI specifications.

MATERIALS AND METHODS

COLLECTION OF RAW MATERIAL

Fresh petals of *desi gulab* were collected from the department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana. The petals were collected on a clear sunny day after the evaporation of dew. Crystalline table sugar used in the study was purchased from the local market, PAU, Ludhiana. The fresh petals were analysed for different physico-chemical characteristics (Table 1).

Standardization of process for production of rose syrup

The optimization was carried in two steps. In the first step the ratio of rose petals to sugar was optimised to produce syrup with TSS in accordance to FSSAI standards i.e. 65 °B. Six treatments comprising rose petals to sugar ratios from 24:76 to 34:66 (Table 3) were selected and the rose syrup was prepared using the osmotic process. Cleaned petals and sugar were filled in glass jars as per the selected treatments and were covered. The filled jars were left at room temperature for 2 days for the slow dissolution of sugar. The jars were stirred occasionally in between. After two days all the jars were subjected to heating at 100°C for the complete dissolution of sugar and to increase the extraction of colour and flavour. In the second optimization the effect of temperature was studied on the quality of rose syrup. The best combination selected for rose petals to sugar was subjected to different temperatures i.e. 70, 80, 90 and 100°C for 1 hour. The schematic diagram of the syrup preparation process is shown in Fig. 1. The prepared syrups were analysed for various physico-chemical and sensory attributes and on the basis of these parameters best temperature was selected for the production of rose syrup.

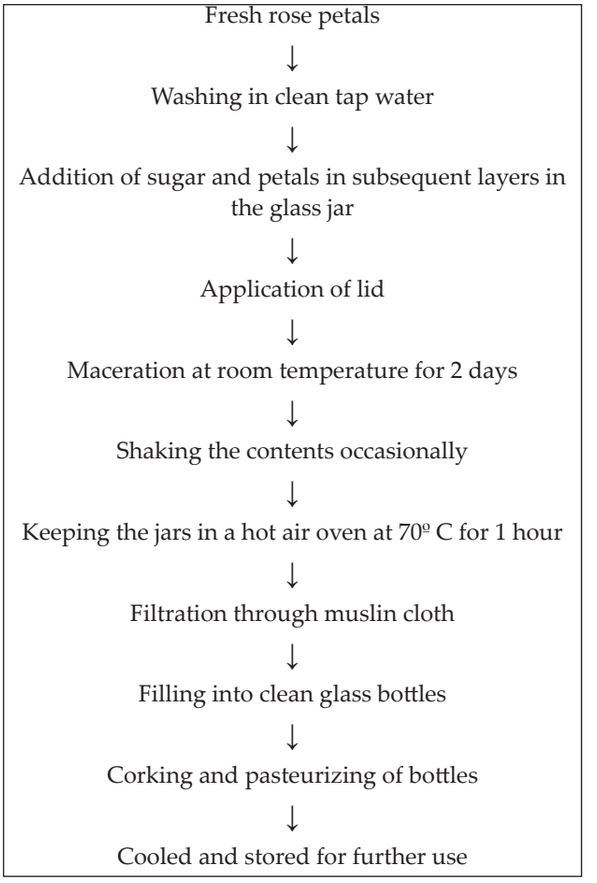

Fig. 1: Schematic diagram for the production of rose syrup

Physico-chemical analysis

The prepared syrups were analysed for different physico-chemical characteristics, *viz*. TSS, totals solids, pH, ash as per the standard methods (AOAC, 1980). Crude protein was measured using Micro Kjeldhal method (AACC, 2000). Total anthocyanins and ascorbic acid were measured as per the method described by Ranganna (1986). Total phenols were estimated using the spectrophotometer at 760nm (Singleton and Rossi, 1965). Antioxidant activity

(free radical scavenging activity) was measured as per the method of Brand-Williams *et al.* (1995) using DPPH (2, 2-diphenyl-1-picrylhydrazyl) dye. Colour was determined using Hunter color lab and the value of the colour was presented as 'L' (lightness), 'a' (redness) and 'b' (yellowness). The value of L varies from 0-100; higher the value of L whiter the product. Lower value of L indicates dark colour. The positive value of 'a' indicates redness while negative value indicates green colour. The positive value of the b indicates yellowness while the negative value indicates blueness.

Minerals

Mineral content of rose petals was determined by thermos-electron inductively coupled plasma atomic emission spectrometry (ICP-AES), model iCAP-630 (Arora and Bajwa, 1994). For this determination 10 ml of diacid was added to one gram of powdered sample and was left overnight. Then the mixture was digested until white fumes were observed, as per the routine practice.

Sensory analysis

Coded samples of the developed rose syrup were served to sensory panel for evaluation after diluting 4 times with potable water. The panelists were asked to rank the intensity of each attribute of the product on a 9 point hedonic scale. Where, 1 means 'dislike extremely' and 9 means 'like extremely'. The judges rinsed their mouth with water in-between the testing of products. All the details were used as prescribed for sensory evaluation of Food (Joshi, 2006).

Statistical analysis

The data was analysed with SPSS 16.0 software and the results are represented as mean ± Standard deviation (SD) of three replicate assays. Significant differences were determined by one way analysis of variance (ANOVA) compared by Duncan's test ($P \leq 0.05$).

RESULTS AND DISCUSSION

Physico-chemical analysis of fresh rose petals

Table 1 depicts the composition of the petals of *desi gulab* locally grown in Punjab. Fresh petals had high moisture content i.e. 86±2.15% and the juice extracted from the petals had a total soluble solids content of 8.37±0.15 °B. Singh (2014) reported a moisture content of 84±1% in fresh marigold flowers.

Table 1: Physico-chemical properties of fresh rose petals

Parameter	Value
TSS (°B)	8.37± 0.15
Moisture (%)	86± 2.15
Crude Protein (%)	1.70± 0.28
Crude fat (%)	0.46± 0.06
Crude fibre (%)	2.57± 0.42
Total Phenols (mg GAE/100g)	2230± 26.40
Anthocyanins (mg/100g)	98.64±0.36
Antioxidants (% radical scavenging activity)	83.91±2.53
Ascorbic Acid (mg/100g)	293.37±7.49
pH	5.47±0.06
Ash (%)	0.36±0.02
Colour	
L*- lightness	53.54
a*- + red; - green	17.25
b* - + yellow; - blue	-0.6

The crude protein content of fresh rose petals was 1.70±0.28%. The results are in conformation with Rop *et al.* (2012) who reported 2.66% of proteins in rose. Data (Table 1) revealed that fresh rose petals were rich source of phyto-chemicals such as total phenols, anthocyanins, ascorbic acid and antioxidants. Fresh petals had a total phenolic content of 2230±6.40 mg gallic acid equivalent (GAE) per 100 g of fresh petals. The total phenolic content was well in accordance with Ge and Ma, (2013) who reported a total phenolic content of 2087.43±17.37 mg GAE/100g in fresh edible rose petals of Yunnan, China. The anthocyanin content of *desi gulab* petals was 98.64±0.36 mg/100g which was however; lower than 353.56± 2.50 mg/100g reported for the edible roses of Yunnan region, China

(Ge and Ma, 2013). The difference in anthocyanin content might have been due to the variation in the variety and region. The fat content of fresh rose petals was 0.46± 0.06%. The *damask* rose petals have been reported to have very low content of essential oil and 3000 Kg of rose petals are required to obtain 1 Kg of essential oil (Verma *et al.* 2011). The ascorbic acid content of *desi gulab* was higher (293.37±7.49 mg/100g) compared to 54.5 mg/100g reported by Karami *et al.* (2016) for fresh petals of Persian musk rose (*Rosa moschata Hermm*)). The difference might have been due to the white colour of Persian musk rose. Ash and crude fibre content of petals were 0.36% and 2.57%, respectively.

Colour estimation of rose petals revealed 'L' (lightness) value of 53.54, 'a' value of 17.25 and 'b' value of -0.6. 'L' value of 53.54 revealed that the rose variety used in study was rich in pigments. Positive 'a' value indicates the redness of colour while the negative 'b' value is an indication of blue colour. The intensity of blue and red colour might have been due to the presence of the anthocyanins. The anthocyanins range from red to blue colour (Mazza and Miniati, 1993) and are responsible for the colour of many fruit and vegetables.

Table 2: Mineral content of rose petals per 100g fresh weight basis

Mineral	Content (mg/100g)
Potassium	153.39
Phosphorus	34.53
Calcium	13.78
Sulphur	16.72
Magnesium	12.75
Sodium	7.61
Copper	1.82
Iron	1.33
Zinc	0.29

Table 2 represents the mineral content per 100 g of fresh rose petals. The data revealed that fresh petals had 153.39 mg of potassium, 34.53 mg of phosphorus, 13.78 mg of calcium, 1.82 mg of copper, 1.33 mg of iron and 0.29 mg of zinc per 100 g. These results were in accordance with Rop *et al.* (2012), who reported the content of potassium, phosphorus, calcium, magnesium, iron, copper and zinc as 196.9 mg/100g, 22.5 mg/100g, 27.5 mg/100g, 0.35 mg/100g, 0.23 mg/100g and 0.45 mg/100g, respectively for the variety *Rosa odorata.* The mineral content reflects that a good contribution to the product like syrup can be made if rose petals are used in preparation of such products. Further, the rose petals have appreciable amounts of both macro and micro elements, as revealed by the results (Table 2).

Optimization of rose petals and sugar

Table 3 represents the effect of different ratios of rose petals to sugar on the quality of rose syrup. It is evident from Table 3 that with increase in quantity of rose petals there was a significant increase in total phenols, anthocyanins, antioxidants and ascorbic content. The increase in these parameters might have been due to richness of rose petals in these phytochemicals (Yassa *et al.* 2009; Nowak *et al.* 2014) and same has been also observed in the analysis of fresh rose petals (Table 1).

A significant decrease in total soluble solids was found with decrease in the sugar level and it is understandable as the increase in petal ratio decreased the syrup content, hence TSS of the syrup. The most desirable TSS content (as per the FSSAI specifications) was achieved in treatments T4 and T5. The rose syrup proved to be an appreciable source of total phenols and ascorbic acid and accordingly had appreciable antioxidants. There was an increase in the colour and aroma of rose syrup with increase in petal content.

However, the petals content above 30 per cent resulted in a bitter after taste. The bitter taste might have been due to the bitter compounds i.e. tanning matter, fatty oil and organic acids in the rose (Joshi, 2004; Nayeem *et al.* 2006; Boskabady *et al.* 2010). Based on the FSSAI specifications, sensory parameters and phytochemical contents of the treatment T4 was selected for further research.

Table 3: Effect of different ratios of petal sugar ratio on quality attributes of rose syrup

Treatments	T1(24:76)	T2(26:74)	T3(28:72)	T4(30:70)	T5(32:68)	T6(34:66)
Parameters						
TSS (°B)	72.63±1.07 [a]	70.43±0.91 [b]	68.63±0.25 [c]	67.50±0.75 [c]	64.4±0.81 [d]	62.47±1.00 [e]
Total Phenols (mg GAE/100g)	498±12.12[a]	525±9.74[ab]	580±5.72[bc]	625±6.20[cd]	658±7.07[de]	716±5.80[e]
Anthocyanins (mg/100g)	21.87±0.37 [a]	24.01±0.60 [b]	25.79±0.40 [c]	28.05±0.65 [d]	30.28±0.66 [e]	31.84±0.72 [f]
Antioxidants (% radical scavenging activity)	10.20±0.27[a]	13.30±0.30[b]	15.51±0.40[c]	16.75±0.38[d]	18.43±0.26[e]	19.34±0.19[f]
Ascorbic Acid (mg/100g)	14.60±2.03 [a]	16.43±2.97 [b]	19.93±0.5[bc]	21.57±0.78[c]	23.73±0.35[d]	26.83±0.40[d]

*Values are means ± SD of 3 replications. Different superscripts in a column indicate that they are significantly (p≤0.05) different to each other determined by Duncan's tests.

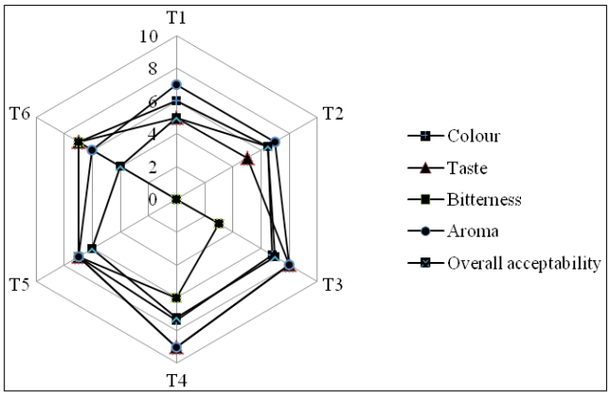

Fig. 2: Sensory profile of different rose syrups prepared in laboratory

Where, T1- 24:76 of rose petals to sugar, T2- 26:74 of rose petals to sugar; T3-28:72 of rose petals to sugar, T4-30:70 of rose petals to sugar; T5- 32:68 of rose petals to sugar, T6: 34:66 of rose petals to sugar

Temperature optimization

To overcome the problems of first standardization i.e. bitter aftertaste and cooked flavour the next optimization was done for the selection of most suitable temperature to prepare a product with refreshing taste of rose, lowest possible bitter aftertaste and maximum phytochemicals. Table 4 depicts the effect of various temperatures on the physico-chemical parameters of rose syrup. Temperature had slight but significant (P≤0.05) effect on the total soluble solids, total solids and pH contents of the rose syrup and an increase in these parameters was recorded with increase in temperature. This increase might have been due to the evaporation of water and more leaching of the soluble compounds from petals at a higher temperature. A significant decrease was found in total phenols and anthocyanins content on decreasing the temperature which might have been due to the incomplete leaching of soluble components at low temperature. Heating is known to soften the plant tissue and weaken the phenol-protein and phenol-polysaccharide interactions (Mokrani *et al.* 2016) and hence more migration of phenols and anthocyanins to the solvent from the petals takes place at a high temperature. Ascorbic acid content was decreased with increase in process temperature which might have been due to the oxidation of antioxidants at higher temperature and same has been observed for pomegranate juice by Paul and Ghosh, (2012). The least lightness value (36.27) for syrup was obtained at 70°C while the redness value was maximum at 70°C and minimum at 100°C which might have been due to the leaching of chlorophyll at high temperature.

Sensory analysis

Fig. 3 depicts the effect of temperature on the sensory

Table 4: Effect of temperature on physicochemical quality characteristics of rose syrup

Temperature / Parameters	100°C	90°C	80°C	70°C
Total soluble Solids (°B)	67.00±1.08 [a]	66.63±0.38 [a]	66.10±0.40 [ab]	65.20±0.26 [b]
Total Solids (%)	68.51±0.24[a]	68.00±0.20[a]	67.17±0.42[b]	66.13±0.40[c]
pH	6.81±0.03[b]	6.80±0.01[b]	6.81±0.03[b]	6.86±0.02[a]
Total phenols (mg GAE/100g)	625±6.20 [a]	576±3.22 [b]	538±3.80 [c]	520±4.67 [d]
Antioxidants (% radical scavenging activity)	16.75±0.38[d]	20.19±0.94[c]	22.80±0.60[b]	24.53±0.76[a]
Ascorbic Acid (mg/100g)	21.57±0.78[d]	25.57±1.76[c]	30.11±1.03[b]	34.87±2.73[a]
Anthocyanins (mg/100g)	28.05±0.65[a]	26.07±0.38[b]	22.96±0.88[c]	21.16±0.30[d]
L	37.31±0.02 [a]	37.21±0.03 [a]	36.93±0.153 [a]	36.27±0.15 [a]
a	-.057±0.012[d]	0.007±0.002[c]	0.53±0.058[b]	0.67±0.058[a]
b	-2.34±0.006 [a]	-2.32±0.010 [a]	-2.31±0.006 [a]	-2.31±0.006 [a]

*Values are means ± SD of 3 replications. Different superscripts in a column indicate that they are significantly (P≤0.05) different to each other determined by Duncan's tests.

attributes of the rose drink on a 9 point hedonic scale. Highest overall acceptability was obtained for the syrup prepared at 70°C. The score for other sensorial parameters like colour, flavour and mouthfeel was also found highest at this temperature.

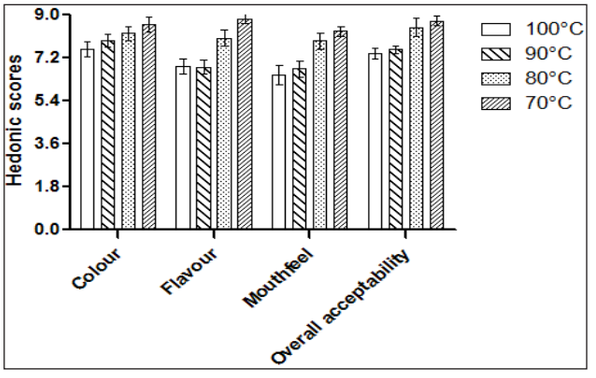

Fig. 3: The effect of temperature on the sensory scores of rose syrup on a 9 point hedonic scale

Flavour and mouthfeel had more effect of temperature as compared to overall acceptability. Based on the physico-chemical (Table 4) and sensory evaluation (Fig. 3) of prepared syrups, it was concluded that a temperature of 70 °C was most suitable to prepare a product rich in phytochemicals and high sensory acceptability.

CONCLUSION

Desi gulab (Rosa damascena) variety of rose is rich in phyto-chemicals such as anthocyanins, phenols, antioxidants and ascorbic acid. It is also a rich source of vital minerals like calcium, phosphorus, potassium, zinc and iron. Further, its deep red colour and pleasant flavour made it suitable for the preparation of natural rose syrup free from chemical colourants and flavourings. A low temperature processing retains maximum phyto-chemicals and gives a relishing pleasant taste. Such syrups can be used as a health tonic and an alternative to existing products which make use of chemical additives.

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