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Physico-chemical Characteristics of *Rhododendron*Flowers available in Different Regions of Himachal Pradesh

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Abstract **— The present study was carried out in the department of Food Science, Nutrition and Technology, CSK Himachal Pradesh Agricultural University Palampur with the objective to explore the nutritional quality of *Rhododendron* flowers of different regions of Himachal Pradesh. The samples of flowers used in the present investigation were obtained from district Kangra, Kullu and Shimla. *Rhododendron* flower were assessed for physical, chemical, nutritional parameters. Results of the study showed thatthe flowers were found to contain valuable nutrients. The physical characteristics revealed the mean length of petal as 4.92 cm and the color of the flowers of all the areas as red with 8-10 stamens and funnel shaped corolla. The average moisture content in fresh flowers was recorded as 89%. Expressed on dry matter basis the value for average ash content was 3.55% and fat content was 5.42%. The maximum fibre and protein content was noted in *Rhododendron* of Kangra (13.72 and 5.59%). Whereas, *Rhododendron* of Kullu and Shimla contained significantly less fibre and protein content (12.67 and 4.85%; 13.58 and 4.83%). The flower contained calcium and iron in the range of 16.64 to 27.29 and 5.62 to 6.25 mg/100g, respectively.**

Keywords **— Edible Portion, Iron, *Rhododendron arboreum*, Physical Characteristics, Proximate Composition.**

I. INTRODUCTION

Rhododendrons are wildly grown flowers in Himachal Pradesh at high altitude. The genus *Rhododendron* belongs to the heather family, Ericaceae. There are about 80 species (with 10 subspecies and 14 varieties) in different regions and altitudes in the Himalayas. In Himachal Pradesh, *Rhododendron* L. is represented by three species (*Rhododendron arboreum*, *Rhododendron campanulatum and Rhododendron anthopogon*) inhabiting temperate, sub-alpine and alpine regions [6]. *Rhododendron*, a small evergreen tree with soft bark is common in the Western Himalayas, occurring chiefly at a height of 1500 to 5500 m above mean sea level. The tree bears flowers in the months of March to May, which is of intense red/crimson or pink colour.

Traditionally, the petals of the *Rhododendron arboreum* flowers are commonly used in the preparation of chutney by the hill people [2]. Flowers contain anthocyanins and flavonols as the major pigments [7] and the hot water extract of flowers can be used as natural food coloring agent. Flowers are sourish-sweet in taste eaten raw, in Himachal Pradesh it is used for making chutneys, cold drinks and squash; also form an important constituent of local wine, 'sur' [6] which helps in preventing high-altitude sickness. At home scale, small quantities of juice extracted from flower is used for preparing jelly and squash [16] and syrup [3]. The dried flowers are highly efficient in the treatment of diarrhoea, blood dysentery [8]. Fragrant dried and powered flowers mixed with oil are used for massage over the entire body in post-delivery complications like fevers, cough and cold.

The flower of *Rhododendron* exhibits many nutritional, medicinal and aromatic properties. It has a special place in the cultural and economic life of the people of Himachal Pradesh. However, it has been remained neglected and its nutritional qualities have hardly received any attention so far. Keeping in view the significance of this wild edible flower, the present study was proposed with the objective to assess the nutritional profile of *Rhododendron* flowers of different regions of Himachal Pradesh.

II. MATERIALS AND METHODS

A. Collection of Sample

The samples of *Rhododendron arboreum* flowers used in this study were procured from different areas of Himachal Pradesh *viz.* Kangra, Kullu and Shimla.

B. Physico-chemical Characteristics of Rhododendron Flowers

Physical parameters: On an average ten flowers were selected randomly which represent the whole lot of flowers. Flowers were scrutinized for the physical parameters *i.e.* color, shape, weight, length and edible and inedible portion (%). The color and shape of the selected *Rhododendron* flowers was observed from its physical/visual appearance. The length of ten randomly selected petals were measured with the help of standard scale and expressed in centimeters.

Ten randomly selected flowers were taken and weighed on an electronic weighing balance and average weight of a flower was expressed in grams. Then the sexual organs, calyx and stalk were removed from the individual flowers and their weight was recorded as the inedible portion while weight of petals was taken as the edible portion. The content of edible as well as inedible portion was calculated and expressed in percentage on the basis of flower weight.

Proximate and Minerals composition: The edible fraction of the flowers was quantitatively separated from the inedible parts and the sample was taken for analysis. Moisture, ash, crude fibre contents were analyzed by using standard methods of AOAC (1990). Nitrogen was analyzed by micro-kjeldhal method and multiplied by

factor 6.25 for converting it into crude protein. The content of the percent available carbohydrates was determined by the method of NIN 1983, by subtracting from 100, the sum of percent values of moisture, crude protein, crude fat, crude ash and crude fibre. The values were expressed as total carbohydrates (%) in the samples.

Minerals composition was analyzed by the method of Ranganna, 2007. The organic matter present in the sample (1g) was wet digested with 25 ml of diacid mixture (HNO_3: $HClO_4$ in 5:1) and kept overnight. Digestion was done on next day by heating till clear white precipitates settle down at the bottom. The crystals were dissolved by diluting in double distilled water. The contents were filtered through Whatman No. 42 filter paper. The filtrate was made up to the volume of 25 ml. The digested samples were analyzed for the determination of calcium and iron by atomic absorption spectrophotometer.

C. Statistical Analysis

The data obtained from various parameters were subjected to statistical analysis with the help of computer using CRD design. The data were analyzed using analysis of variance [5].

III. Results and Discussion

Physico-chemical Characteristics of Rhododendron Flowers

Physical characteristics of *Rhododendron* flowers are presented in Table 1. A perusal of which indicates that the average length of petal in ten randomly selected flowers has come out to be 4.92 ± 0.50 cm. The values were found in the range of 4.4 - 5.6, 3.9 – 6.1 and 4.5 – 5.5 cm in flowers of Kangra, Kullu and Shimla, respectively. The similar outcome has also been observed by Lepcha*et al*. (2014). The average weight of flowers was found to be 24.45 ± 5.02g/flower and the range varies from 19.64 - 31.18, 18.85 - 29.85 and 18.28 - 30.97 g/flower in Kangra Kullu and Shimla, respectively. Similar results have also been shown by the Solanki *et al*. (2013) who reported 24.01 ± 3.92 g/flower weight of this flower. The slight variations in present results might be due to different agro climatic conditions.

Colour was observed as red for *Rhododendron* flowers obtained from all three areas *i.e.* Kangra, Kullu and Shimla (Plate 1). Tamang *et al*. (2005), Shrestha (2009) and Solanki *et al*. (2013) observed bright red and pure red colour whereas, deep scarlet to red with white markings colour of flowers was reported by Srivastava (2012). The shape of corolla was observed as campanulate (funnel shaped) with stamens 8-10 in each flowers. Tamang *et al*. (2005) also reported the similar result. Srivastava (2012) found the shape of corolla as tube spotted, funnel shaped. Kharwal and Rawat (2013) reported the corolla campanulate to tubular shaped.

The range of the edible portion varied from 61.93 to 67.31, 62.36 to 66.83 and 62.36 to 65.36 per cent in flowers of Kangra, Kullu and Shimla, respectively. Whereas, the values of inedible portion were recorded as 32.72 to 37.99, 33.17 to 36.95 and 33.99 to 37.66 per cent, respectively. The average values for edible and inedible portion were recorded as 64.39 ± 1.38 and 35.79 ± 1.69 per cent, respectively. Similar results were also observed by Solanki *et al*. (2013).

Proximate and Mineral composition: Appraisal of data presented in Table 2 revealed the proximate composition of *Rhododendron* flowers obtained from different regions of Himachal Pradesh.

The moisture content of the foods is one of the most important attributes for determining the shelf life and quality of the foods. It is evident from the data that mean moisture content of the fresh flowers was obtained as 89.36 ± 1.04. And the values ranged from 90.37 to 88.29 per cent. The maximum value was observed for *Rhododendron* of Kangra and lowest for *Rhododendron* of Shimla. The difference may be due to agro climatic conditions. The values in the study are found close to the results reported by Solanki *et al*. (2013). On the other hand the difference was observed non-significant for ash (%) and fat (%) with the mean values 3.55 ± 0.04 and 5.42 ± 0.42, respectively.

Data regarding crude fibre content shows that the maximum value has been reported for *Rhododendron* of Kangra (13.72%) whereas the minimum value for fibre is found in *Rhododendron* of Kullu (12.67%) with mean fibre (%) content 13.32 ± 0.57. The difference in fibre content may be due to different agro climatic conditions. Almost similar observations have been reported by Gupta (2008). Protein content of *Rhododendron* flowers was found in the range of 4.83 to 5.59 per cent. The maximum protein content was noted in *Rhododendron* of Kangra (5.59 %). Whereas, *Rhododendron* of Kullu and Shimla contained 4.85 and 4.83 per cent protein content, respectively. The values for ash and protein content are on closer side when compared with the results of Gupta (2008). Non-significant difference in total carbohydrate was found in *Rhododendron* of different areas with the mean value 63.70 per cent. 87.9 per cent total carbohydrate was reported by Gupta (2008). The values were closer to 68.5 per cent reported by Tamang *et al*. (2005).

The minerals *viz*. calcium and iron content of *Rhododendron* flowers were determined. According to the results obtained (Fig. 1), it has been observed that the maximum and minimum calcium and iron contents in *Rhododendron* flowers were observed in Kangra (27.29 and 6.25 mg/100g) and Kullu (16.64 and 5.62mg/100g) areas respectively. On a whole, *Rhododendron* of Kangra contains good amount of calcium and rich source of iron.

IV. Conclusion

The study concluded that *Rhododendron* flower from all the selected regions of Himachal Pradesh *i.e.* Kangra, Kullu and Shimla are rich in valuable nutrients with slight variations in moisture, fibre and protein contents. The observations recorded on the nutritional quality of *Rhododendron* in the present study indicate that this flower is not only beautiful due to its deep red color but also healthy and can be used to develop various value added products.

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Plate 1: Physical appearance of *Rhododendron arboreum* flower.

Table 1. Physical characteristics of *Rhododendron* flowers

Physical characteristics	**Location**			**Mean± SD**
	Kangra	**Kullu**	**Shimla**	
Length of petal (cm)	5.04±0.47 (4.4 - 5.6)	4.93±0.67 (3.9 – 6.1)	4.80±033 (4.5 – 5.5)	4.92±0.50
Weight (g)	25.44±5.84 (19.64 – 31.18)	24.01±4.62 (18.85-29.85)	23.91±4.94 (18.28-30.97)	24.45±5.02
Color	Red	Red	Red	-
Shape				
Corolla	Campanulate (funnel shaped)	Campanulate (funnel shaped)	Campanulate (funnel shaped)	-
Stamens	8-10	8-10	8-10	-
Edible portion (%)	64.74±1.66 (61.93 – 67.31)	64.70±1.37 (62.36 – 66.83)	63.71±0.85 (62.36 – 65.36)	64.39±1.38
Inedible portion (%)	35.67±2.43 (32.72 – 37.99)	35.47±1.40 (33.17- 36.95)	36.22±1.01 (33.99 - 37.66)	35.79±1.69

Table 2. Proximate composition of *Rhododendron* flower petals

Parameters	Location				
	Kangra	Kullu	Shimla	Mean	C.D. (P≤0.05)
Moisture (%) (Fresh)	90.37	89.42	88.29	89.36±1.04	0.74
Ash (%)	4.53	3.06	3.07	3.55±0.04	NS
Fat (%)	5.87	5.03	5.34	5.42±0.42	NS
Crude Fibre (%)	13.72	12.67	13.58	13.32±0.57	0.87
Crude Protein (%)	5.59	4.85	4.83	5.09±0.44	0.58
Total Carbohydrate (%)	61.58	65.58	63.97	63.70±2.01	NS

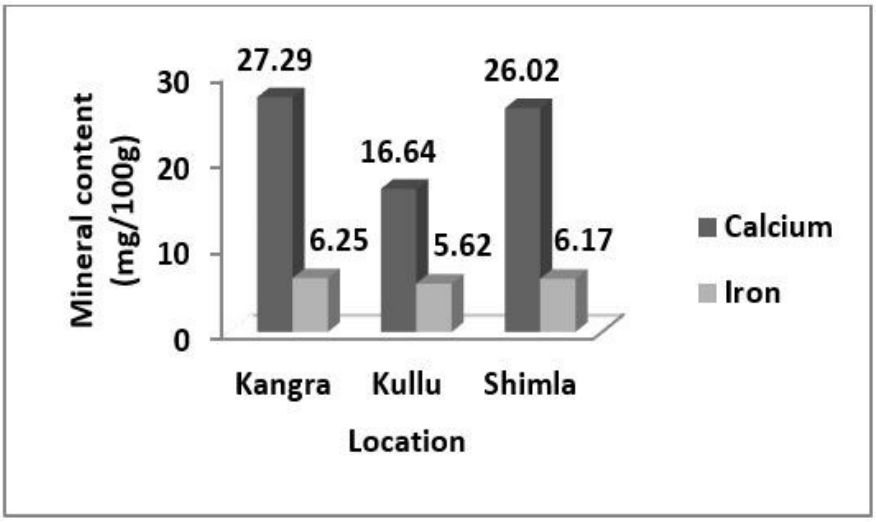

Fig. 1. Mineral composition of *Rhododendron* flower petal