Indian J. Hort. 64(2), June 2007: 155-158

Studies on physico-chemical and nutritional properties of pomegranate rind powder

D.B. Singh*, A.R.P. Kingsly, H.R. Meena and Nirmaljit Kaur**
Central Institute of Post-Harvest Engineering & Technology, Abohar 152116

ABSTRACT

The physico-chemical and nutritional properties of rind powder prepared from wild pomegranate (acidic) and four juice cultivars (sweet) were studied. The maximum yield recovery of rind powder on fruit base was in cultivar White Muskat, and on rind base was in cultivar Ganesh. Highest TSS content was observed in the rind powder obtained from cultivar G-137. The bulk density of rind powder of different cultivars ranged from 627.8 to 704 kg/m³. Rind powder of wild type contained maximum total sugars (3.80%), β-carotene (13.67 ppm), proteins (3.46%), Ca (345 mg/100g) whereas Fe (320 ppm), Mn (6.25 ppm) was highest in Mridula. The study revealed that pomegranate of wild type and cultivar Mridula has the potential for producing nutritional and mineral rich rind powder.

Key words: Pomegranate, rind powder, nutrients, minerals.

INTRODUCTION

Pomegranate is a small tree cultivated in Iran, Spain, Egypt, Baluchistan, Russia, France, Argentina, Iraq, Afghanistan and India. It also exists in wild/semi-wild in Syria, Mt. Carmel, Himachal Pradesh, and Jammu and Kashmir (Himalayan ranges of mountains) of India (Saxena *et al.,* 11; Parmar, 8). Being rich in minerals, tannic acid, flavonoids and proteins (Chavan *et al.,* 3), rind of pomegranate fruit is dried and its powder used as medicine, for making toothpaste and in industries for leather tanning and dying (Salunkhe and Kadam, 10). Pomegranate rind is a powerful astringent; it is administered in the form of decoction for diarrhea and dysentery, often combined with opium, and as an injection in case of leucorrhoea. In addition to most of the important vitamins, proteins and flavonoids, the pomegranate rind powder is rich in minerals like Ca, Mg and Fe, Ca and Fe are important minerals required for healthy living. The rind powder is rich in β-carotene. Due to the protective effect as an antioxidant, β-carotene has come into more true light in new discoveries that implies into more benefit and heavy commercial promotion. Evidence supporting β-carotene having anti-cancer properties comes from the epidemiological studies, animal studies and studies on cultured cells, tissues and organs (Shekelle *et al.,* 12; Colditz *et al.,* 4). Under these circumstances, there is every need to produce more mineral and nutrient rich products for using as protectants, nutrients and in medicines. Although, pomegranate rind powder is used for making various medicines, additives in food products and industrial products, information on the physico-chemical constituents of the different pomegranate cultivars is limited. The present study examines the physico-chemical composition of the wild type and commercially cultivated pomegranates.

MATERIALS AND METHODS

Mature and healthy pomegranate fruits of different cultivars namely Mridula, G-137, Ganesh and White Muskat were procured from farm of the Central Institute of Post-Harvest Engineering and Technology, Abohar (Punjab) and wild type from Solan (Himachal Pradesh), India. Fruits were washed and cut manually to separate the seeds and rind. Rind was cut into small pieces (10-20 mm) using a sharp knife and dried in an air circulatory tray dryer (Narang Scientific Works, New Delhi) at 60°C for 48 h. Dried pieces were cooled and powdered in a heavy duty grinder. For analysis, the powder was sieved using a 60-mesh sieve and packed in 200 gauge high density polyethylene bags (Chavan *et al.,* 3).

The yield recovery of the rind powder was estimated both on fruit and rind basis. The rind powder of different varieties was analysed for various physical and chemical properties. Moisture was determined using hot air oven at 130 ± 2°C for 24 h. The bulk density was calculated and expressed in kg/m . Total soluble solids (°Brix) was estimated by using a hand held refractometer (ERMA, Japan) with a scale of 0-32 °Brix (least count 0.2 °Brix). Titrable acidity (%), total sugars (%), β-carotene and ascorbic acid were determined as described by Ranganna (9). pH was estimated by AOAC methods (1), and proteins and total phenols were measured as described by Malik and Singh (7). The quantitative estimation of minerals

* Corresponding author
** Regional Fruit Research Station, PAU, Abohar 152116

was carried out using an atomic absorption spectrophotometer.

The colour of rind powder in terms of L, a and b values was determined using HunterLab miniScan XE plus colorimeter (HAL, USA, Model 45/0-L). L value indicates the lightness or darkness, a, red or green and b, yellow or blue. The data were subjected to LSD test and ANOVA for estimating the coefficient of variance at 95% confidence level.

RESULTS AND DISCUSSION

The powder prepared was slightly granular in texture with mild pomegranate flavour. The recovery of the rind powder varied significantly among the different cultivars (Table 1). Maximum yield recovery on fruit basis was recorded in White Muskat (16.42%) followed by Ganesh (15.75%), which may be due to big size of the fruits. Yield recovery on rind basis was higher in Ganesh followed by White Muskat which may due to the varietal characteristics of the cultivars. The percentage rind in wild type pomegranate is higher, but the recovery was not at par with improved sweet type cultivars.

Moisture content of any food material or the raw material is an important aspect since it decides the quality of final product. Moisture content was highest in the cultivar Mridula and lowest in the wild type.

The bulk density of rind powder of different varieties ranged from 627.8 (wild) to 704.00 kg/m^3 (Ganesh). Food powder and its allied products often exist in the form of a mixture, which depends on the varietal characteristics of the rind powder. This variation in varietal character may be the reason for the differences in bulk density.

TSS of the rind was higher in G-137 followed by Ganesh while minimum was in cultivar Mridula. Titrable acidity of rind powder, in the form of citric acid ranged between 2.81% (Mridula) and 4.27% (wild). The wild pomegranate seeds are highly acidic and that for sweet varieties the acidity ranged 0.189 to 1.784%, which affects the acidity level of particular rind (Mahajan *et al.,* 5; Mali and Prasad, 6). Significant differences in pH of the rind powder of different varieties were observed. The value ranged from 3.41 to 3.63 and minimum value was recorded in wild type, which is influenced by acidity level of the fruit seeds. The total sugars of the rind powder of different cultivars ranged between 3.48 and 3.80 and the maximum was observed in the wild type followed by Mridula. The chemical composition of seeds of the particular cultivars affects the total sugars of its rind also.

Colour is one of the important parameters in deciding the quality of the pomegranate rind powder. The 'L, a and b' values of the rind powder varied depending on the cultivars (Table 2). The 'L' value was maximum (44.27) in rind powder prepared from wild type and minimum (36.42) in G-137. The positive 'a' value indicates that the rind powder from all the cultivars is reddish in colour. However, it was maximum (8.61) in cultivar Mridula. The fresh rind of cultivar Mridula being deep red in colour has attributed towards higher 'a' value. The 'b' value of rind powder of all the cultivars was positive (yellowish) and the maximum (18.17) was in wild type.

Maximum ascorbic acid content was recorded in G-137, followed by wild (Table 3). The ascorbic acid of fresh rind ranged from 3.02 (Ganesh) to 4.50 mg (Wild). The loss of ascorbic acid can be attributed to its instability due to heat, oxygen and light, which is reversibly oxidized to dehydro-ascorbic acid and later

Table 1. Physico-chemical composition of pomegranate rind powder.

Cultivar	Yield recovery (%)		Moisture (%)	Bulk density (kg/m^3)	TSS (°Brix)	Acidity (%)	pH	Total sugars (%)
	Fruit base	Rind base						
White Muskat	16.42 (±0.23)	37.15 (±1.77)	10.1 (±1.30)	629.4 (±22.8)	4.50 (±0.20)	2.83 (±0.21)	3.58 (±0.02)	3.65 (±0.01)
G-137	15.45 (±0.20)	33.12 (±2.52)	9.2 (±2.55)	704.5 (±33.1)	5.50 (±0.10)	3.83 (±0.27)	3.53 (±0.08)	3.48 (±0.01)
Ganesh	15.75 (±0.35)	37.97 (±3.93)	8.9 (±1.50)	672.6 (±32.5)	5.00 (±0.18)	2.83 (±0.20)	3.63 (±0.12)	3.48 (±0.12)
Mridula	14.95 (±0.31)	32.87 (±2.90)	10.6 (±2.30)	681.6 (±12.0)	4.00 (±0.50)	2.81 (±0.20)	3.57 (±0.15)	3.71 (±0.02)
Wild	15.20 (±0.40)	32.05 (±4.15)	8.8 (±1.90)	627.8 (±15.4)	4.60 (±0.10)	4.27 (±0.34)	3.41 (±0.13)	3.80 (±0.02)
CV (%)	0.66	2.47	0.610	0.09	3.13	1.34	0.85	3.38

Values in parenthesis indicate standard deviation; n = 4.

Table 2. Colour characteristics of rind powder of different pomegranate cultivars.

Cultivar	'L' value	'a' value	'b' value
White Muskat	44.27 (± 0.63)	8.03 (±0.14)	18.17 ± 0.30
G-137	39.96 (±1.1 3)	8.61 (±0.13)	14.74 ± 0.28
Ganesh	36.42 (±0.78)	7.07 (±0.06	16.70 ± 0.41
Mridula	39.96 (±0.37)	7.08 (+0.14)	16.24 ± 0.14
Wild	40.54 (±0.81)	7.94 (±0.1 2)	17.01 ± 0.52

Values in parenthesis are standard deviations; n = 4.

Rind powder of all the cultivars was found quite rich in minerals like Ca, Fe, Mn and Zn. Maximum Ca was found in rind of Wild pomegranate fruits as 3,450 ppm and minimum in White Muskat (2,960 ppm). Iron content ranged from 93.75 ppm (White Muskat) to 147.55 ppm (Mridula). Maximum Cu was recorded in the rind of Ganesh (6.75 ppm) followed by White Muskat (6.40 ppm). Maximum Mn was recorded in Mridula followed by Ganesh and maximum zinc was found in rind powder of G-137 followed by that of Wild type.

Table 3. Nutritional and mineral composition of pomegranate rind powder.

Cultivar	Ascorbic acid (mg/100 g)	β-carotene (ppm)	Protein (%)	Total phenols (%)	Minerals (ppm)				
					Ca	Fe	Cu	Mn	Zn
White Muskat	2.83 ± 0.02 (3.50)	12.57 ± 0.10 (12.66)	2.80 ±0.02	13.57 ±0.20	2960 ±18.0	93.75 ±19.0	6.40 ±10.90	3.25 ±10.02	13.50 ±0.09
G-137	4.27 ± 0.03 (4.40)	13.17 ± 0.10 (13.28)	3.32 ±0.32	20.55 ±0.90	3050 ±16.0	98.00 ±13.0	5.25 ±10.10	52.25 ±10.07	14.07 ±0.50
Ganesh	2.83 ± 0.02 (3.02)	13.45 ± 0.10 (13.60)	3.25 ±0.12	10.57 ±0.41	3110 ±15.0	103.66 ±14.5	6.75 ±10.85	4.25 ±10.05	12.90 ±0.57
Mridula	2.81 ± 0.01 (3.55)	13.52 ± 0.10 (13.59)	3.34 ±0.08	21.95 ±0.71	3200 ±17.0	147.55 ±12.0	3.00 ±10.35	6.25 ±10.05	13.27 ±0.6
Wild	3.83 ± 0.02 (4.50)	13.67 ± 0.50 (13.75)	3.46 ±0.23	16.40 ±0.20	3450 ±15.0	112.75 ±19.8	2.25 ±10.20	4.00 ±10.02	12.03 ±0.36
CV (%)	0.27	0.910	5.72	1.78	10.2	1.82	12.28	11.18	3.52

Values in parenthesis indicates fresh weight basis; n= 4.

converted irreversibly in to diketoglutanmic acid (Birch *et al.,* 2). β-carotene content of rind powder ranged from 12.57 to 13.67 ppm. Maximum value, 13.67 ppm, was recorded in Wild type, followed by Mridula (13.52 ppm) and Ganesh (13.45 ppm) on dry weight. β-carotene of fresh rind varied from 12.66 ppm in White Muskat to 13.75 ppm in Wild type of pomegranate. Retention of β-carotene varied from 89.0 to 60.0% indicating that, after drying rind has retained its quality. Dehydration and powdering of fruits and vegetables increases the surface area and leads to poor stability of the carotenoids in general, unless the products are protected from air and light. Maximum retention was in Wild type and Mridula. The deep red colour of rind from pomegranate cultivars Mridula and Wild type may be attributed to the high levels of β-carotene compared to light pink colour of the other varieties. Maximum protein content was found in Wild type, followed by Mridula, while minimum protein content was in White Muskat. Significant differences was observed for total phenolic contents in rind powder, which varied from 10.57 to 21.95%. The maximum value was recorded in Mridula, i.e. 21.95% followed by G-137 (20.55%) and minimum in Ganesh as 10.57%.

The present study reveals that rind powder of all the varieties were found rich in nutrients, minerals such as Ca, Fe, Mn, Cu, Zn and vitamins, such as ascorbic acid (Vitamin C) and β-carotene. Particularly the constituents were found in higher amounts in Wild type. The rind powder of Wild and Mridula were found to retain maximum β-carotene and ascorbic acid after drying. The rind powder containing high concentration of proteins and phenols will enhance the absorption and retention of β-carotene, minerals and other flavonoids when consumed in different forms for nutritional, medicinal and *ayurvedic* purposes.

REFERENCES

1. AOAC. 2000. **In:** *Official Methods of Analysis.* Association of Official Analytical Chemists (17th edn.) (Ed., W. Horwitz). Maryland, USA.
2. Birch, G.G, Bointon, B.M. Rolfe, E.F and Sciman, J.D 1974. *Quality Changes Related to Vitamin* (Eds. Birch, G.G., Parker, K.P). Applied Science, London.
3. Chavan, U.D., Adsule, R.N. and Kadam, S.K. 1995. Physico-chemical properties of pomegranate rind powder. *Beverage* and *Food World* **22**: 36.

4. Colditz, G.A., Stamfer, M.J. and Willet, 1985. Diet and lung cancer. A review of the epidemiology evidence in humans. *Archaeology International Medicine* **147**: 157-60.

5. Mahajan, B.V.C., Chopra, S.K and Sharma, R.C. 1992. Processing of wild pomegranate (*Punica granatum* L.) for Anardana: Effect of thermal treatments and drying modes on quality. *J. Food Sci. Tech.* **29**: 327-28.

6. Mali, P.C. and Prasad, R.N. 1999. Studies on physico-chemical characteristics of pomegranate cultivars grown under arid conditions. *Indian J. Hort*. **38**: 167-71.

7. Malik, C.P. and Singh, M.B. 1980. *Plant Enzymology and Histo-Enzymology. A Text Manual.* Kalyani Publishers, New Delhi.

8. Parmar, C. 1981. *Wild Fruits of Sub-Himalayan Region,* Kalyani Publishers, Ludhiana.

9. Ranganna, S. 1986. *Handbook of the Analysis and Quality Control of Fruit and Vegetable Products.* Tata McGraw Hill Pub. Co. Ltd., New Delhi.

10. Salunkhe, D.K. and Kadam, S.S. 1995. *Hand Book of Fruit Science and Technology.* Marcel Dekker Inc., NewYork.

11. Saxena, A.K., Mevah, J.K. and Berry, S.K. 1987. Pomegranate post-harvest technology, chemistry and processing. *Indian Food Packer* **41**: 43.

12. Shekelle, R., Liu, S. and Raynor, W. 1981. Dietary vitamin A and risk of cancer in the western electric study. *Lancet.* **2**: 1185-90.

(Received: August, 2006; Revised: January, 2007; Accepted: February, 2007)