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Studies on separation techniques of pomegranate seeds and their effect on quality of *Anardana*

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The dehydrated seeds of wild pomegranate fruits (*Anardana*) are used as acidulent in culinary preparations and in making various medicines. For easy separation of seeds, fruits were subjected to sand roasting, hot water dipping and soaking in cold water. Hot water dip for 2 min saved time required for separation of seeds from fruits (80% excluding treatment time and 74% including treatment time). Due to the high temperature during sand roasting, quality of seeds and *Anardana* was inferior when compared to other treatments. The desirable color and chemical composition of the product *Anardana* was retained in the treatment hot water dipping for 2 min.

Key words: Wild pomegranate, seeds, treatments, separation, quality.

INTRODUCTION

Pomegranate (*Punica granatum L*.) is an important fruit plant of tropical and subtropical regions. It is extensively cultivated in Iran, Spain, Egypt, Russia, France, Argentina, China, Japan, USA, and in India (Patil and Karade, 1996). The versatile adaptability, stable and therapeutic values and better keeping quality are the features responsible for its cultivation on a wide scale (Dhandar and Singh, 2002). In addition to dessert (sweet type) purposes, pomegranate is also found in its wild form in sub mountainous and outer Himalayas of Himachal Pradesh, Jammu and Kashmir, and Uttaranchal in India, up to an elevation of 1800 m above mean sea level (Parmar, 1981; Saxena et al., 1987).

The conventional utilization of wild pomegranate fruit lies in the drying seeds along with pulp (seeds), which constitute the product ''Anardana'' (Pruthi and Saxena, 2005).The dehydrated seeds are acidic (7.8 - 15.4%) and help in improving mouth-feel and digestion. *Anardana* is widely used as acidulent in culinary preparations. Mahajan, Chopra, and Sharma (2004) reported its richness in vitamin C and minerals (Ca, Zn, Mn), and usefulness for making various digestive and other ayurvedic medicines. The removal of seeds for preparation of anardana is a difficult process, since the seeds of wild pomegranate are tightly adhered to each other. Removal of seeds manually results in staining of hands and dress of the workers. Moreover, it is labor consuming and affects the yield and quality of the anardana. Manual extraction of seed is a tedious process and cause drudgery to the worker.

Mahajan et al. (2004) studied the effect of sand roasting on separation of seeds. Due to the high temperature, they observed that the quality of product was inferior. Also, the gelatinization of whole mass due to heat induced water diffusion caused difficulties in separa-tion of seeds. Due to disadvantages in high temperature thermal treatments, various treatments were tried in this present study to loosen the peel of the wild pomegranate fruit for easy separation of seeds.

The objectives of the study were (i) to study the effect of different pretreatments on separation of seeds from wild pomegranate (ii) to study the effect of method of separation on physico-chemical composition and quality of *anardana.*

MATERIALS AND METHODS

Sampling and treatments

Wild pomegranate fruits were harvested at fully ripened stage from

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Table 1. Effect of treatments on separation of seeds from wild pomegranate and their chemical characteristics.

Treatments	Time taken for separation (min)	Labour saving (%)		Titratable reducing ascorbic acid			
		Excluding treatment time	Including treatment time	pH	Acidity (%)	Sugar (%)	(mg/100 g)
CT	13.6 (±5.4)	–	–	6.63 (±0.39)	2.8 (±0.20)	7.2 (±0.2)	19.20 (±0.65)
SR1	8.3 (±3.7)	39.0	3.40	6.16 (±0.16)	3.0 (±0.20)	7.8 (±0.4)	17.70 (±0.71)
SR2	5.8 (±2.6)	57.0	6.02	6.13 (±0.11)	3.1 (±0.23)	7.9 (±0.4)	17.20 (±0.38)
HW1	3.4 (±2.0)	75.0	60.0	6.03 (±0.10)	3.1 (±0.21)	7.8 (±0.2)	19.60 (±0.60)
HW2	2.5 (±1.7)	80.0	74.0	6.10 (±0.13)	3.0 (±0.10)	7.8 (±0.1)	19.47 (±0.55)
WS1	10.0 (±3.0)	–	–	6.70 (±0.16)	2.9 (±0.15)	7.2 (±0.3)	19.30 (±0.75)
WS2	12.1 (±4.1)	–	–	6.80 (±0.20)	2.8 (±0.20)	7.1 (±0.1)	19.56 (±0.45)

field- grown trees at Solan (Himachal Pradesh), India. The fruits were washed with fresh water and subjected to the following treatments:

(i) Sand roasting for 5 min (sand temperature: 165 ± 2°C) (SR1)
(ii) Sand roasting for 7 min (sand temperature: 165 ± 2°C) (SR2)
(iii) Hot water dip for 1 min (water temperature: 80 ± 2°C) (HW1)
(iv) Hot water dip for 2 min (water temperature: 80 ± 2°C) (HW2)
(v) Soaking in water for 5 min (water temperature: 30 ± 2°C) (SW1)
(vi) Soaking in water for 10 min (water temperature: 30 ± 2°C) (SW2)
(vii) Control (without any treatment) (CT).

Ratio of fruit weight to that of sand and water in sand roasting and water dip was kept as 1:8 (Mahajan et al., 2004). The temperature during sand roasting, hot water dip and soaking in water was measured using a digital thermometer (0 - 250°C). In each treatment, 1 kg of the fruit was taken for experimentation. The number of fruits per kg ranged from 25 - 28. The experiments were conducted in triplicate to avoid experimental error and the average values were taken for further analysis.

Separation of seeds

After the treatments, the seeds were separated manually using a stainless steel knife, giving vertical cut to the fruits and collecting the seeds. The time taken for separation of seeds was noted down using a stopwatch.

Chemical characteristics of seeds

The chemical characteristics of seeds after separation was determined as described below. Titratable acidity was determined by the procedure given by Ranganna (2000).

Reducing sugars, pH, and ascorbic acid were determined by AOAC (2002).

Preparation of anardana

The seeds separated by various treatments were dried to prepare anardana in an air circulatory tray dryer (0 - 300°C, Narang Scientific Works, New Delhi) at a temperature of 60 ± 2°C (Singh and Sethi, 2003) with an air flow rate of 1.2 m/s. The samples were evenly placed in the aluminum trays with a loading rate of 1.50 kg/m^2. The final moisture content of anardana was kept at 9 ± 1%. The dehydrated samples were packed in lots of 100 g each in Low-density polyethylene (LDPE) bags of 200 gauge thickness and kept at ambient temperature (30 ± 2°C) for physico-chemical analysis.

Physico-chemical characters of anardana

The size (length and breadth) of the randomly selected 20 anardana samples were measured using a micrometer of 0.01 least count. Ascorbic acid, reducing sugars and titratable acidity were determined as mentioned above in Section 2.3.

RESULTS AND DISCUSSION

All the treatments saved time and labour over the manual practices to a significant level (Table 1). Since the seeds were tightly adhered to the rind and with the peel, the manual separation in control treatment was observed to be difficult. The minimum time of separation as 2.5 min/kg of fruit was observed in case of hot water dip of fruits for 2 min. Highest percentage of labor saving (80%) over conventional method excluding treatment time and including treatment time (74%) was also recorded in same treatment.

Sand roasting reduced the seed separation time than the control treatment, but the percentage time taken was more than that of hot water dipping. Due to the high temperature during sand roasting the inner temperature of fruits has increased and lead to gelatinization. This affected the separation of seeds from the fruits, which were treated by sand roasting. A similar effect was reported by Mahajan et al. (2004). Soaking of fruits in water at ambient temperature was not found economical in reducing the separation time.

The chemical constituents of fresh seeds produced by various treatments are reported in Table 1. The titratable acidity of seeds separated by hot water dip and sand roasting treatments was less (6.03 - 6.16%) than in the seeds separated by cold water dip method and control treatment (6.63 - 6.80%). Hot water dip and sand roasting increased the pH level and was found in the range of 3.0 - 3.1, whereas, it was comparatively on lower side in seeds separated by soaking in cold water.

Different treatments affected the reducing sugar content of the seeds separated from the fruits. The reducing sugar content was higher in case of hot water treatment and sand roasting (7.8 - 7.9%) while it was minimum in seeds separated by dipping in cold water for 10 min (7.1%). Ascorbic acid content of the seeds varied signify-

Table 2. Chemical composition of *Anardana* produced from seeds separated by various treatments.

Treatments	Titrable acidity (%)	Ascorbic acid (mg/100 g)	Reducing sugars (%)	Size of seed	
				Length (cm)	Breadth (cm)
CT	6.9 (±0.10)	16.8 (±0.60)	36.5 (±0.95)	0.81 (±0.24)	0.69 (±0.12)
SR1	7.0 (±0.20)	16.0 (±0.47)	36.7 (±0.60)	0.72 (±0.21)	0.62 (±0.11)
SR2	7.1 (±0.17)	16.1 (±0.42)	36.9 (±1.10)	0.68 (±0.17)	0.61 (±0.11)
HW1	6.9 (±0.21)	16.7 (±0.39)	37.2 (±0.76)	0.79 (±0.16)	0.63 (±0.09)
HW2	6.9 (±0.11)	16.8 (±0.50)	37.2 (±0.80)	0.76 (±0.30)	0.63 (±0.20)
WS1	6.4 (±0.18)	16.8 (±0.51)	36.4 (±1.00)	0.81 (±0.11)	0.70 (±0.13)
WS2	6.5 (±0.13)	16.7 (±0.53)	36.4 (±0.75)	0.80 (±0.18)	0.70 (±0.17)

cantly according to treatments. In case of control treatment, cold water dip and hot water dip, ascorbic acid was in the range of 19.20 - 19.60 mg/100 g. But, ascorbic acid content of seeds separated by sand roasting was less. The high temperature during sand roasting has resulted in reduction of ascorbic acid content, as it is heat sensitive. Similar result is also reported by Singh et al (2007), where steaming for 5 min has resulted in loss of ascorbic acid.

The physico-chemical character of *Anardana* prepared from the seeds separated by various treatments is presented in Table 2.The results reveal that length (0.80 - 0.81 cm) and breadth (0.69 - 0.70 cm) of *anardana* prepared from the seeds separated by control and cold water dip treatment was higher. Hot water dip and sand roasting resulted in reduction in size of *Anardana,* which may be due to deformation of seeds and excessive loss of moisture during treating the fruits at high temperature. Gelatinization of seeds was also observed in the fruits treated by sand roasting, which has affected the size of the product. Various treatments have significantly affected the titratable acidity content of anardana produced from seeds separated from fruits. The acidity was found maximum in case of sand roasting of fruits for separation whereas; it was minimum in coldwater dip.

Ascorbic acid content of the product *Anardana* showed similar trend as that of the fresh seeds separated by various treatments. There was no significant difference in the ascorbic acid content of anardana produced from seeds separated manually, hot and cold water dip and the value range between 16.7 and 16.8 mg/100 g, whereas it was minimum in sand roasting treatment (16.0 and 16.1 mg/100 g for roasting for 5 and 7 min respectively). Reducing sugar content was higher in the product *Anardana* than the fresh seeds. A similar observation has been reported by Pruthi and Saxena (2005) and Singh and Sethi (2003).

The reducing sugar content was higher in the *anardana* prepared from the seeds separated by hot water dipping. Color is an important parameter in deciding the quality of anardana. The chromaticity values L*, a*, and b* of the anardana significantly varied depending on the treatments (Table 3) . *Anardana* prepared from the seeds separated by hot water dip and control treatments were

Table 3. Color of *Anardana* produced from seeds separated by various treatments.

Treatments	L	a	b
CT	33.07 (±3.8)	11.69 (±1.7)	13.19 (±2.2)
SR1	29.11 (±5.2)	10.18 (±0.4)	12.42 (±2.9)
SR2	29.90 (±2.6)	10.96 (±2.1)	12.88 (±3.2)
HW1	33.92 (±2.9)	11.37 (±1.8)	13.87 (±1.7)
HW2	33.32 (±4.3)	11.70 (±1.3)	14.36 (±4.1)
WS1	29.81 (±3.8)	11.39 (±1.7)	15.13 (±2.3)
WS2	29.82 (±3.2)	11.42 (±0.6)	15.15 (±1.4)

able to retain the desirable luminance comparatively. Other than sand roasting, rest of the treatments was able to produce the desirable reddish color in *anardana*. Treatments of water soaking and hot water dip produced *anardana* having comparatively more yellowness having 'b' value in range of 13.87 - 15.15, whereas in sand roasting 'b' value was low showing reduction in yellowness.

Conclusion

The effect of treatments on time taken for separation of seeds from wild pomegranate fruits was studied. Fruits dipped in hot water for 2 min required less time for separation of seeds. The acidity and ascorbic acid content of the seeds separated by this treatment was also high. High temperature treatment of sand roasting affected the chemical constituents of fresh seeds and also the product *Anardana*. Size of the anardana prepared from fresh seeds also reduced due to gelatinization during hot water dipping and sand roasting. But, it was found that hot water dipping of fruits for 2 min was economical in terms of labour saving and retained the desirable chemical composition.

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