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Preparation and storage potentiality of chutney from wild pomegranate (*Punica granatum* L.) fruits

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Abstract
The present investigations were carried out for the development of chutney from wild pomegranate fruit and its quality evaluation during storage of six months. Different combinations of arils, sugar and mint were tried and analysed on the basis of physico-chemical and sensory quality attributes to standardize proper combination for chutney. The chutney prepared by following the best selected recipe (60 % arils, 40 % sugar and 10 % of mint) was packed in glass and PET jars and stored for six months under ambient and refrigerated storage conditions. Chutney could be safely stored for a period of six months under both storage conditions without many changes in quality characteristics. However, changes were slower in refrigerated storage conditions as compared to that under ambient conditions. Both the packaging materials *viz.* PET and glass jars were found suitable, with comparatively less changes occurring in glass jars stored under refrigerated conditions.

Keywords: pomegranate, chutney, storage potentiality, *Punica granatum* L

Introduction
Pomegranate (*Punica granatum* L.), belongs to Punicaceae family and it is a popular fruit of tropical and subtropical regions. Wild pomegranate is a hardy plant and can grow well in arid and semi-arid climatic conditions (Bakshi *et al*., 2013) [1]. The cultivated forms are found in Iran, India and the Mediterranean countries such as Egypt, Turkey, Spain, Tunisia and Morocco whereas; its wild form is widely distributed in Transcaucasia and Central Asia (Ercisli *et al*., 2011 and Chandra *et al*., 2014) [2, 3]. In India it is found in sub mountainous and outer Himalayas of Himachal Pradesh, Jammu and Kashmir and Uttaranchal, up to an elevation of 1800 m above mean sea level (Parmar and Kaushal, 1982 and Saxena *et al*., 1987) [4, 5].
The pomegranate fruit is a rich source of nutrients and have been used for thousands of years to cure a wide range of diseases across different cultures and civilizations. The edible part of the pomegranate fruit is arils, which are rich in sugars, organic acids, vitamins and bioactive compounds (Tehranifar *et al*., 2010) [6]. Hippocrates (400 BC) used pomegranate extracts for a wide variety of ailments such as plaster to reduce inflammations and as an aid to digestion (Adams, 1849) [7]. The fruit is laxative, diuretic and used for curing vomiting, sore throat, brain diseases, spleen complaints, chest troubles, scabies, bronchitis, liver and kidney disorders (Kirtikar and Basu, 1935) [8]. Extracts of tannins (bark, leaves and immature fruit) have been used to treat diarrhoea and haemorrhage, whereas, dried and crushed flower buds are made into tea as a remedy for bronchitis.
Traditionally, wild pomegranate fruit is used for the preparation of dried arils (*anardana*) and used as a spice in Northern India (Kingsly *et al*., 2006) [9]. The use of cultivated pomegranate fruits for various value added products is well known. But only few reports are available for the development of various value added products out of wild pomegranate fruit. So keeping in view its nutritional value and increasing demand of value added products in modern era, the present study has been carried out to standardize the recipe for chutney preparation along with its quality evaluation during storage.

Materials and Methods
Raw material collection and extraction of juice
Wild pomegranate fruits harvested at optimum maturity were procured from Narag area of Sirmour district of Himachal Pradesh during the year 2009-2010 and were used for physico-chemical analysis and preparation of chutney.

Development of fruit chutney
Four combinations of arils were used to develop wild pomegranate chutney at four levels of sugar and two levels of mint extract keeping the TSS constant as per details mentioned in Table 1.

Table 1: Treatment combinations of fruit chutney

Treatments	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Arils (%)	80	70	60	50	80	70	60	50
Sugar (%)	20	30	40	50	20	30	40	50
Mint (g)	5	5	5	5	10	10	10	10

For the preparation of chutney, first of all the dried spices like black pepper (1 g), ginger (7 g), cumin (2.5 g), cinnamon (2.5 g), red chilli (2.5 g), clove (1 g) and cardamom (2.5 g) were ground into a powder form. Then pastes of freshly extracted wild pomegranate arils, mint, ginger, onion and garlic were made separately in a blender. Pastes of arils, mint, ginger, garlic, onion were mixed and cooked for 5 to 10 minutes, after that sugar and ground spices were added and cooked the mixture till the desired consistency until the TSS of the product reached to 50 ºB. Sodium benzoate (260 ppm) was added in all the treatments as a preservative during product preparation. The chutney prepared by following the best selected combination on the basis of sensory evaluation was packed in pre-sterilised glass and PET jars (Figure 1). All the packed products were properly labelled and stored at ambient (20-25 ºC) and refrigerated (4-7 ºC) conditions for six months. The physico-chemical and sensory characteristics of all the products were analyzed at 0, 3 and 6 months of storage.

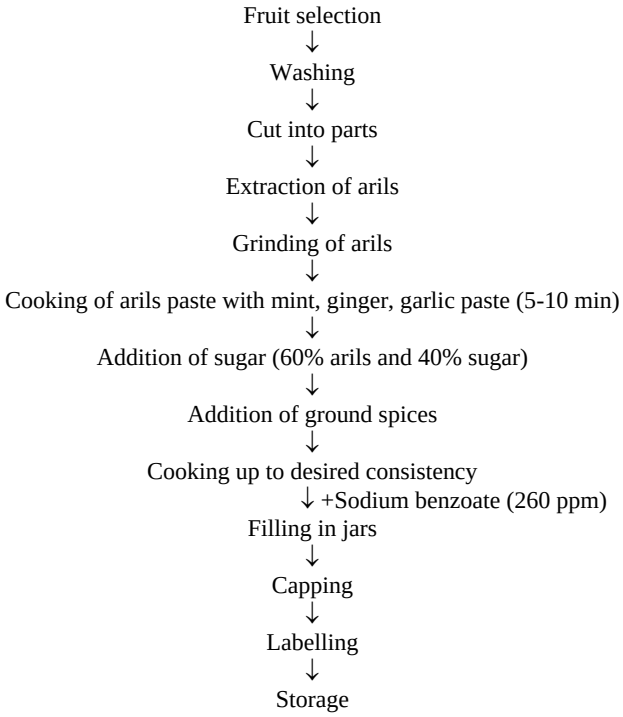


Fig 1: Unit operations for the preparation of wild pomegranate chutney

Physico-chemical analysis and sensory evaluation

The colour of chutney was observed visually by comparing with color cards of Royal Horticulture Society, London and the card numbers were mentioned along with colour. TSS, sugars, titra table acidity, pectin, ascorbic acid content and anthocyanins of chutney were determined according to the standard procedures as described by Ranganna (2009) [10]. Total phenols content was determined by Folin-Ciocalteu procedure given by Singleton and Rossi (1965) [11]. Nine point hedonic rating test was followed for conducting the sensory evaluation of wild pomegranate chutney. The panel of ten judges comprising of faculty members and students of department of Food Science and Technology, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan (HP) were selected to evaluate the products for sensory parameters such as colour, body, taste, aroma and overall acceptability.

Statistical analysis

Data on physico-chemical characteristics of chutney was analysed by Completely Randomized Design (CRD) before and during storage, whereas, data pertaining to the sensory evaluation were analyzed by using Randomized Block Design (RBD) as described by Mahony (1985) [12]. The experiment for recipe standardization was replicated three times and for storage studies five times.

Results and Discussion

Standardization of recipe for the preparation of wild pomegranate chutney

Data pertaining to physico-chemical and sensory characteristics of wild pomegranate chutney prepared by following different recipes are presented in Table 2 and 3.

Physico-chemical characteristics

The visual colour of first four recipes was observed to be Grey Orange 166 (B) and Grey orange 167 (B) for rest of the recipes. The TSS of the chutney was kept constant at 50 ºB. The titratable acidity of the chutney ranged from 1.11 to 1.98 per cent, the maximum titratable acidity was recorded under T_1 which was statistically at par with T_5, whereas, minimum was noticed in T_8. The ascorbic acid content varied from 8.26 to 12.99 mg/100 g. The highest value was recorded in T_1 which was statistically at par with T_5 and lowest in T_4. The pH value of different recipes of chutney was found between 3.29 to 3.93 and highest was observed in T_8 whereas, lowest in T_1 and T_5.

Table 2: Physico-chemical characteristics of different recipes of wild pomegranate chutney

Treatment	Physico-chemical characteristics				
	Colour	TSS (ºB)	Titratable acidity (%)	Ascorbic acid (mg/100g)	pH
T_1	Grey Orange 166 (B)	50	1.98	12.99	3.29
T_2	Grey Orange 166 (B)	50	1.69	11.17	3.58
T_3	Grey Orange 166 (B)	50	1.33	10.32	3.80
T_4	Grey Orange 166 (B)	50	1.12	8.26	3.90
T_5	Grey Orange 167 (B)	50	1.97	12.96	3.29
T_6	Grey Orange 167 (B)	50	1.68	11.35	3.59
T_7	Grey Orange 167 (B)	50	1.34	10.32	3.82
T_8	Grey Orange 167 (B)	50	1.11	8.44	3.93
$CD_{0.05}$	-	-	0.09	0.87	0.13

Sensory characteristics

The data on sensory characteristics of different recipes of wild pomegranate chutney given in Table 3 indicate that mean colour score was attained highest in T_7 (8.10) and lowest (7.00) in T_4. The same recipe obtained maximum texture score as 8.50 and minimum (5.25) T_4. The highest score (8.60) of taste was awarded to T_7 which was statistically at par with T_3, however, T_4 got the lowest score as 5.60. The maximum (8.00) score of aroma was also obtained in recipe T_7 which was statistically at par with T_3 and minimum score as 6.50 was obtained in T_1 and T_5. The highest (8.25) score of overall acceptability was recorded in T_7 and lowest (5.45) in T_8.

Table 3: Sensory characteristics (score) of different recipes of wild pomegranate chutney

Treatment	Colour	Texture	Taste	Aroma	Overall acceptability
T_1	7.55	6.25	6.00	6.50	6.05
T_2	7.70	7.45	7.00	7.00	6.85
T_3	8.00	8.00	7.95	7.80	7.50
T_4	7.00	5.25	5.60	7.10	5.60
T_5	7.65	6.50	6.25	6.50	6.10
T_6	7.70	7.65	7.50	7.25	7.00
T_7	8.10	8.50	8.60	8.00	8.25
T_8	7.05	5.40	5.75	7.00	5.45
CD $_{0.05}$	0.96	0.46	0.81	0.60	0.64

From above results it was concluded that recipe (T_7) with 60 per cent arils, 40 per cent sugar and 10 g mint was found to be best on the basis of sensory and some physico-chemical characteristics of chutney.

Storage of wild pomegranate chutney

Physico-chemical characteristics

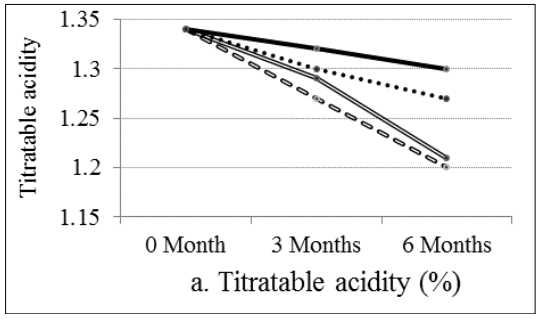
Data in Table 4 indicate that the colour intensity of chutney generally decreased during storage. The colour of chutney changed from Grey orange 167 (B) to Grey orange 162 (A) in both the glass and PET jars under ambient conditions. However, in refrigerated conditions, colour of chutney changed from Grey orange 167 (B) to Grey orange 160 (A) in both the packaging materials.

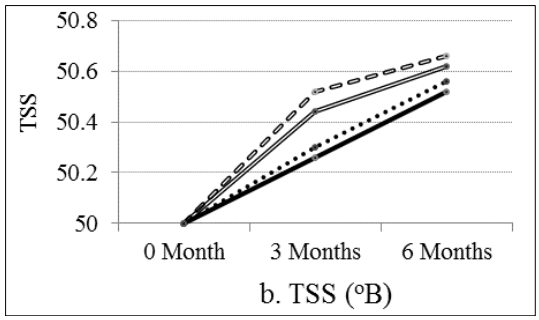
Table 4: Effect of packaging and storage on visual colour of chutney

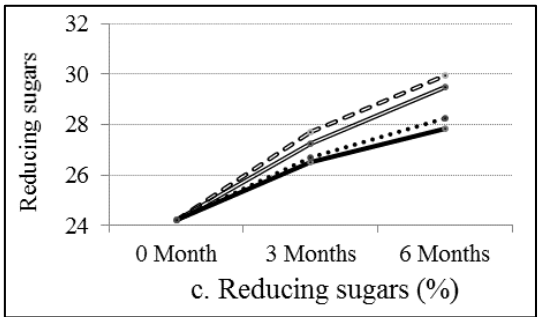
V	Ambient storage (Months)			Refrigerated storage (Months)		
S/T	0	3	6	0	3	6
T_1	Grey orange 167 (B)	Grey orange 166 (B)	Grey orange 162 (A)	Grey orange 167 (B)	Grey orange 164 (B)	Grey orange 160 (A)
T_2	Grey orange 167 (B)	Grey orange 166 (B)	Grey orange 162 (A)	Grey orange 167 (B)	Grey orange 164 (B)	Grey orange 160 (A)

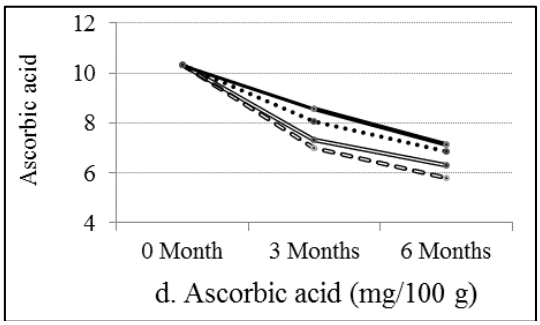
Decrease in colour intensity during storage might be due to degradation of anthocyanins pigment, however, degradation of anthocyanins were induced by light so more loss of colour in ambient conditions. Similar trend of decrease in colour intensity has been reported by Chauhan *et al*., (1994) [13] in wild pomegranate chutney and Sahni (1997) [14] in amla chutney.

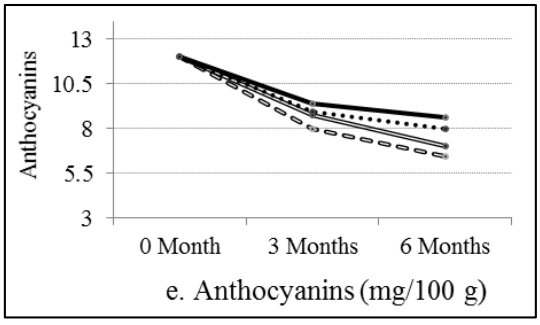
There was a general decreasing trend of titratable acidity of wild pomegranate chutney during storage (Figure 2a), which might be due to co-polymerization of organic acids with sugars and amino acids. Slight increase was experienced in TSS of chutney during storage (Figure 2b) which might be due to the hydrolysis of polysaccharides into monosaccharide and soluble disaccharides (Gould, 1983) [15]. During storage of wild pomegranate chutney, there was a gradual increase in reducing sugars (Figure 2c). More increase in sugars was found in chutney stored under ambient storage conditions as compared to refrigerated conditions. Increase in sugars during storage might be attributed to the hydrolysis of starch into sugars (Heikal *et al*., 1964) [16] and higher increase in reducing sugars might be due to the inversion of non-reducing sugars to reducing sugars. There was a continuous decrease in ascorbic acid content of chutney with advancement of storage period (Figure 2d). However, decrease was significantly lower under refrigerated conditions as compared to ambient conditions. Decrease in ascorbic acid content during storage might be due to its degradation into dehydro-ascorbic acid or furfural. Ascorbic acid is highly sensitive to heat, so its degradation was more in ambient conditions. A significant decrease in anthocyanins content of chutney was recorded during storage (Figure 2e) and less decrease was observed under refrigerated storage conditions than ambient conditions. Loss of anthocyanins in chutney might be due to their high susceptibility to auto oxidative degradation during storage. A gradual decrease in phenols content of chutney was observed during storage (Figure 2f), which might be due to their involvement in the formation of polymeric compounds by complexing with proteins and their subsequent precipitation as observed by Abers and Wrolstad (1979) [17] in strawberry preserve and Premachandran (1982) [18] in apple nectar. There was non-significant decrease in pectin content of chutney during storage (Figure 2g) and possible reason for slight decrease in pectin content of wild pomegranate chutney may be hydrolysis of pectin. Similar results were reported by Sahni (1997) [14] in amla chutney, Joshi *et al*., (1996) [19] in nutmeg chutney, Chauhan *et al*., (1994) [13] and Guleria (2005) [20] in wild pomegranate chutney.

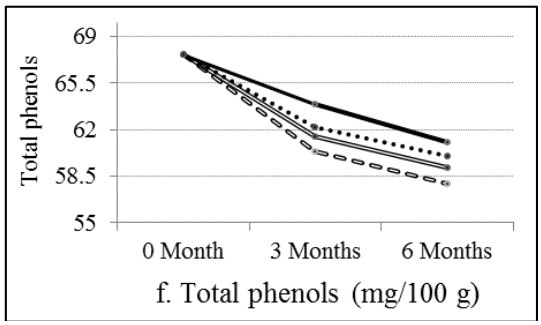












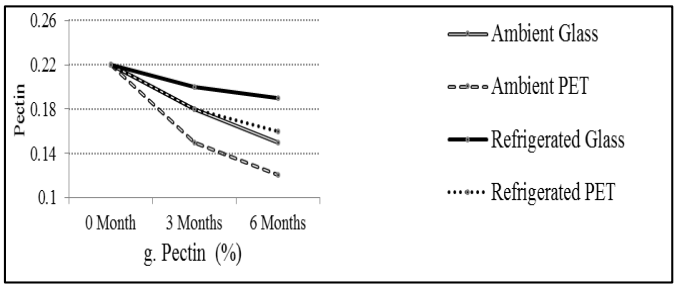


Fig 2: Effect of storage on physico-chemical characteristics of wild pomegranate chutney

Sensory characteristics

The sensory characteristics scores of chutney decreased significantly during storage (Figure 3-6). The colour scores of chutney decreased significantly during storage which might be due to degradation of colour pigment (anthocyanins) and browning caused by copolymerization of organic acids with sugars and amino acids of the product. Texture scores of chutney decreased with advancement of storage period and decreased less in refrigerated storage conditions than ambient. As far as the packaging material is concerned, more texture scores were awarded by judges to the chutney packed in glass jar than PET jar. The possible reason for decrease in texture scores might be due to the change in consistency of the product as a result of degradation of pectin which led the judges to award lower scores. The taste scores of chutney decreased significantly during storage which might be due to the loss of sugar-acid-salt blend responsible for taste during storage. Aroma scores of chutney decreased during storage and this decrease was more in ambient storage conditions as compared to refrigerated. The decrease in aroma scores during storage might be due to degradation of aromatic compounds in the product. There was a decrease in overall acceptability scores of chutney during storage. Decrease in overall acceptability scores might be due to the loss in appearance, flavour compounds and uniformity of the product. Similar results were reported by Chauhan *et al*., (1994) [13], Guleria (2005) [20] in wild pomegranate chutney, Sahni (1997) [14] in amla chutney and Tummala *et al*., (2006) [21] in tamarind chutney.

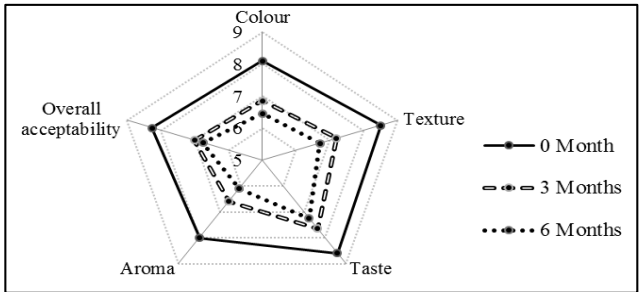


Fig 3: Effect of storage on sensory characteristics of wild pomegranate chutney packed in PET jars stored under ambient conditions

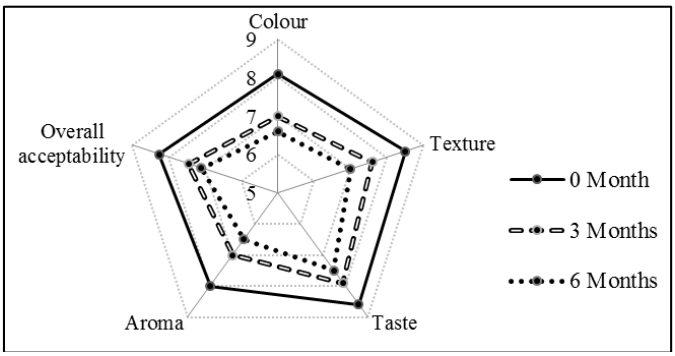


Fig 4: Effect of storage on sensory characteristics of wild pomegranate chutney packed in glass jars stored under ambient conditions

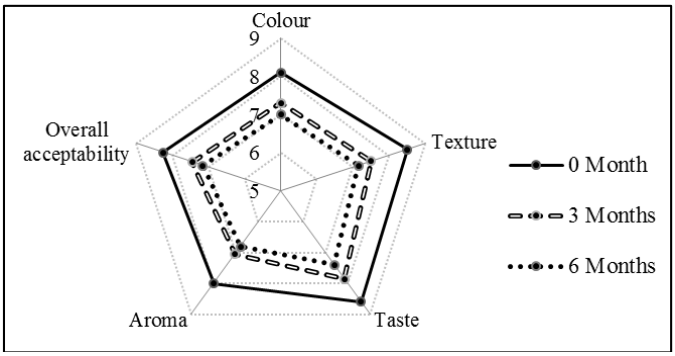


Fig 5: Effect of storage on sensory characteristics of wild pomegranate chutney packed in PET jars stored under refrigerated conditions

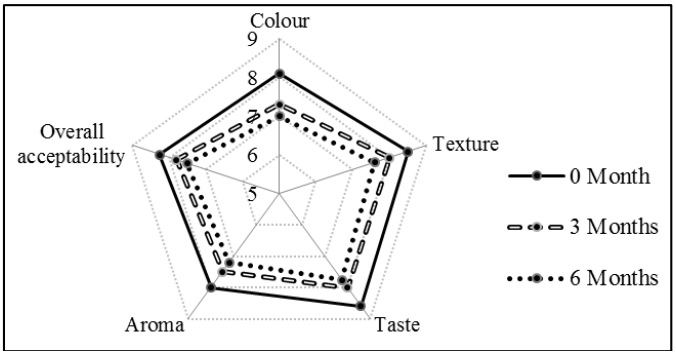


Fig 6: Effect of storage on sensory characteristics of wild pomegranate chutney packed in glass jars stored under refrigerated conditions

Conclusion

Chutney prepared with 60 per cent arils and 40 per cent sugar with 10 per cent of mint (T_7) and spices like black pepper (1 g), ginger (7 g), cumin (2.5 g) cinnamon (2.5 g), red chilli (2.5 g), clove (1 g) and cardamom (2.5 g) was adjudged to be best on the basis of its sensory and some physicochemical characteristics. Chutney could be stored for a period of six months with minimal changes in physico-chemical, sensory and microbial characteristics. However, fewer changes were observed in the chutney packed in glass jar and stored under refrigerated storage conditions as compared to ambient conditions.

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