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Physico-Chemical Characteristics and Standardization of Juice Extraction Method from Wild Aonla (*Phyllanthus emblica* L.) Fruits of Himachal Pradesh, India

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A B S T R A C T

Wild aonla (*Phyllanthus emblica* L.) is one of the unique fruit which has got great commercial importance because of its high antioxidant and medicinal properties. Among various physical characteristics mean length, diameter and weight of wild aonla fruit were found to be 2.38 ± 1.10 cm, 2.35 ± 1.05 cm and 8.78 ± 0.28 g respectively. The mean juice content was found to be 35.65 ± 1.63 per cent (from whole fruit) and 44.50 ± 1.24 per cent (from edible portion). TSS, reducing and total sugar content of fruits was recorded as 10.50 ^{o}B, 5.06 and 6.94 per cent, respectively. The ascorbic acid and total phenol content of fruit was found to be as 598.32 mg/100 g and 15.98 ± 0.86 mg/ g respectively whereas, carotenoids of the same were found as 0.005 mg/100 g. Hydraulic press gave the maximum juice yield of 44.50 per cent and quality of juice obtained by hydraulic press was found to be the best as compared to other methods like manual extraction, food processor and screw type juice extractor.

Introduction

Wild aonla (*Phyllanthus emblica* L.) belongs to Euphorbiaceae family and also known as Indian gooseberry. It is indigenous to tropical South East Asia, particularly in Central and Southern India (Parmar and Kaushal, 1982) from where it spread to Sri Lanka, Malaysia and China (Bose *et al.*, 2002). India ranks first in the world with respect to area and production of cultivated aonla (Priya and Khatkar, 2013). It is widely distributed in Uttar Pradesh, Maharashtra, Gujarat, Rajasthan, Andhra Pradesh, Karnataka, Tamil Nadu, Haryana and Himachal Pradesh. Aonla fruit is a rich source of ascorbic acid, phenols, sugars, pectin, starch and mineral like iron, calcium, phosphorous and magnesium (Nath *et al.*, 1992). Being rich source of ascorbic acid, it contains about 20 times more vitamin C than the citrus fruits (Parmar and Kaushal, 1982). Its fruits are astringent, carminative, digestive, stomachic, diuretic and antipyretic and also useful in curing many diseases like diabetes, cough, asthma, bronchitis, headache, ophthalmic disorders, dyspepsia, colic, flatulence, skin diseases, leprosy, jaundice, scurvy, diarrhoea and greyness of hair

(Ganachari *et al.,* 2010). Due to its high astringency and perishable nature after harvest aonla fruits are not popular as table fruit (Kumar and Nath, 1993). The storage life at atmospheric conditions after harvesting only limits upto 5 to 6 days (Pathak *et al.,* 2009). With the help of appropriate processing techniques and storage conditions the post-harvest losses can be reduced upto 30 per cent (Goyal *et al.,* 2008 and Singh *et al.,* 2009). Good quality raw material with high yield is one of the prerequisite for the development of various value added products. The study of physico-chemical properties and juice extraction techniques may play an important role in food processing industry. So, keeping in view the above factors, present studies on physico-chemical characteristics and juice extraction methods from wild aonla fruit were carried out.

Materials and Methods

Collection of fruit and chemicals

The mature fruits of *Phyllanthus emblica* L. procured from Chandesh area of Mandi district of Himachal Pradesh and used for various physico-chemical analysis and juice extraction. The chemicals and other material used during the entire study were procured from local market.

Juice extraction

The juice from the fruits was extracted by following four different methods viz. manual, power driven food processor, power driven screw type juice extractor and hydraulic pump driven commercial hydraulic press.

Physico-chemical analysis

The colour of randomly selected fruits was observed visually by comparing with the colour cards of Royal Horticulture Society, London and the card numbers were mentioned along with the colour. Length and diameter of fruit samples were measured with the help of Vernier calliper. Digital weighing balance was used to weigh the fruit samples. Fruit volume was observed by water displacement method. Weight divided by volume of fruit gave specific gravity of fruit. Juice, seed, pomace and edible portion content of fruit was observed on weight basis (%). The colour of juice in terms of different units (Red & Yellow) was observed with Tintometer (Lovibond Tintometer Model-E). The apparent viscosity of the juice was determined by using Ostwald viscometer and was expressed in time (flow rate in seconds) taken for samples to pass through the tube. Moisture, total solids, TSS, sugars, titratable acidity, ascorbic acid, crude fibre, carotenoids and ash content of fruit as well as juice were determined according to Ranganna (2009). The pH of the samples was determined by using a digital pH meter (CRISON Instrument, Ltd, Spain). Total phenol content was determined by Folin-Ciocalteu procedure given by Singleton and Rossi (1965).

Sensory evaluation

The sensory evaluation of samples was carried out by hedonic rating test (Amerine *et al.,* 1965). The samples were evaluated for sensory qualities based on colour, body, taste, aroma and overall acceptability. Sensory panel (10 numbers at a time) comprised of faculty members and postgraduate students of Department of Food Science and Technology, UHF, Solan (HP) were selected randomly with the care to accommodate different sections and age groups to evaluate the sensory parameters.

Statistical analysis

The data on physico-chemical characteristics of juice extracted from aonla fruits by

different methods were analyzed by the Completely Randomized Design (CRD) (Cochran and Cox, 1967). Randomized Block Design (RBD) was used for the analysis of various sensory characteristics (Mahony, 1985). The parameters for various chemical and sensory characteristics of fruit conducted in these studies were replicated three times and for the physical characteristics were replicated ten times.

Results and Discussion

Physico-chemical characteristics of fruit

The data presented in Table 1 reveal that mean length and diameter of wild aonla fruit were found to be 2.38 ± 1.10 cm and 2.35 ± 1.05 cm, respectively. Nearly similar results for these parameters of wild aonla fruit have also been reported by Shukla *et al.,* (2005) and Krishnaveni and Mirunalini (2011). Further, mean weight and volume of the fruits were recorded as 8.78 ± 0.28 g and 7.94 ± 0.78 ml, respectively. The mean specific gravity of fruit was found to be 1.13 ± 0.02. Nearly similar results of weight of wild aonla fruit have been reported by Parmar and Kaushal (1982). The visual colour of fruit was observed as Yellow green group 144 (A). The mean juice content was found to be 35.65 ± 1.63 per cent (from whole fruit) and 44.50 ± 1.24 per cent (from edible portion) which were near to the values recorded by Shukla *et al.*, (2005). The mean seed and edible content were found to be 28.02 ± 1.52 and 71.98 ± 0.31 per cent, respectively. Nearly similar results of seed content of wild aonla fruit have been reported by Sahu (2013).

Perusal of data mentioned in Table 2 shows that the average moisture and total solids content of fruit were found 82.48 ± 0.80 and 17.52 ± 0.80 per cent, respectively. The mean TSS content of fruit was found to be 10.50 ± 0.50 ^{o}B, whereas, titratable acidity and pH of the same were recorded as 3.07 ± 0.15 per cent (citric acid) and 2.62 ± 0.01, respectively. The ascorbic acid content of fruit was found to be 598.32 ± 1.02 mg/100 g of fruit. The total sugar content of fruit was observed as 6.94 ± 0.47 per cent out of which the reducing sugars were found to be 5.06 ± 0.15 per cent.

Crude fibre content of the wild aonla fruit was found to be 1.20 ± 0.10 per cent. Carotenoids and total phenol content of the fruit were found to be 0.005 ± 0.01 mg/100 g and 15.98 ± 0.86 mg/ g, respectively. Whereas, ash content in the fruit was observed as 1.56 ± 0.13 per cent. Our results of chemical characteristics of wild aonla fruit are near to the values recorded by Parmar and Kaushal (1982), Singh and Pathak (1987), Singh *et al.*, (1987), Ghorai and Sethi (1996), Dahiya and Dhawan (2001), Bose *et al.,* (2002), Chaudhary *et al.,* (2012), Nayak *et al.,* (2012), Sahu (2013) and Ravani and Joshi (2014).

Screening of juice extraction method

The data pertaining to physical, chemical and sensory characteristics of wild aonla fruit juice extracted by four different methods/modes viz., manual, food processor, screw type juice extractor and hydraulic press are given in the Table 3.

Physical characteristics

The yield of juice extracted by using different methods/modes ranged between 24.73 to 44.50 per cent. The maximum (44.50 %) juice yield was observed in hydraulic press, whereas, the lowest (24.73 %) was recorded in juice extractor (screw type). Our values of juice yield were found near to the values recorded by Shukla *et al.,* (2005), in wild aonla fruits. Corresponding to the juice yield the pomace left after extraction of juice by different methods ranged between 55.50 to 75.27 per cent.

The visual red and yellow TCU of extracted juice from different methods/modes ranged between 1.40 to 1.73 and 15.25 to 19.96, respectively. The maximum apparent viscosity (205.45 sec) was found in juice extracted with juice extractor (screw type) while the lowest (194.77) was found in juice extracted by hydraulic press. The higher juice recovery by hydraulic press and food processor might be due to complete extraction of juice from wild aonla fruit as compared to other methods. Variation in the apparent viscosity of juice in different methods/ modes might be because of the pulp content in the juice which further might have affected the colour units in different methods/ modes.

Chemical characteristics

The data of chemical characteristics of juice presented in the Table 3 show that, there were no significant differences among the various methods of juice extraction with respect to all chemical characteristics of juice.

Table.1 Physical characteristics of wild aonla fruit

Characteristics		Mean Values
Size	Length (cm)	2.38 ± 1.10
	Diameter (cm)	2.35 ± 1.05
Weight (g)		8.78 ± 0.28
Volume (ml)		7.94 ± 0.78
Specific gravity		1.13 ± 0.02
Visual colour		*Yellow green 144 (A)
Juice (%) (from whole fruit)		35.65 ± 1.63
Juice (%) (from edible fruit)		44.50 ± 1.24
Seed (%)		28.02 ±1.52
Edible portion (%)(from edible fruit)		71.98 ± 0.31
*** Colour card number of Royal Horticulture Society, London**		

Table.2 Chemical characteristics of wild aonla fruit

Characteristics	Mean values
Moisture (%)	82.48 ± 0.80
Total solids (%)	17.52 ± 0.80
TSS (^{o}B)	10.50 ± 0.50
Titratable acidity (% Citric acid)	3.07 ± 0.15
pH	2.62 ± 0.01
Ascorbic acid (mg/100 g)	598.32 ± 1.02
Reducing sugars (%)	5.06 ± 0.15
Total sugars (%)	6.94 ± 0.47
Crude fibre (%)	1.20 ± 0.10
Carotenoids (mg/100 g)	0.005 ± 0.001
Total phenols (mg/ g)	15.98 ± 0.86
Ash (%)	1.56 ± 0.13

Table.3 Physico-chemical and sensory characteristics of wild aonla juice extracted by different methods

		Manual	Food Processor	Juice Extractor (Screw type)	Hydraulic Press	$CD_{0.05}$
Physical characteristics						
Juice yield (%)		35.64	37.33	24.73	44.50	0.63
Pomace (%)		64.36	62.67	75.27	55.50	0.63
Tintometer Colour Units	Red(TCU)	1.60	1.60	1.40	1.73	0.20
	Yellow(TCU)	17.02	16.74	19.96	15.25	0.66
Apparent viscosity (sec)		196.83	202.34	205.45	194.77	0.31
Chemical characteristics						
TSS (^{o}B)		10.22	10.56	10.40	10.75	NS
Titratable acidity (%)		3.07	3.07	2.94	3.13	NS
pH		2.62	2.62	3.23	2.58	NS
Ascorbic acid (mg/100 g)		603.68	604.56	604.93	603.51	NS
Reducing sugars (%)		4.88	4.92	4.71	4.95	NS
Total sugars (%)		6.75	6.82	6.50	6.85	NS
Carotenoids (mg/100 g)		0.007	0.008	0.006	0.004	NS
Total phenols (mg/ g)		15.63	15.75	15.71	15.82	NS
#Sensory scores						
Colour		7.15	6.62	4.57	8.00	0.11
Body		7.12	6.90	5.70	7.87	0.19
Taste		7.27	6.96	6.50	7.97	0.26
Aroma		7.35	7.23	7.15	7.65	0.25
Overall acceptability		7.22	6.90	5.09	7.90	0.14

#: Based on 9 point Hedonic scale

Sensory characteristics

It is clear from the data (Table 3) that maximum colour (8.00), body (7.87), taste (7.97), aroma (7.65) and overall acceptability (7.90) scores were observed in the juice extracted with the help of hydraulic press among different juice extraction method used. Whereas, minimum scores for colour (4.57), body (5.70), taste (6.50), aroma (7.15) and overall acceptability (5.09) were observed in juice extracted with the help of juice extractor (screw type).

Physical and chemical characteristics of wild aonla were estimated and among the various quality characteristics like weight and volume of fruit were found as 8.78 g and 7.94 ml, respectively. The specific gravity of fruit was recorded as 1.13, whereas, the juice percentage of the same was recorded as 44.50 per cent. The moisture content of fruit was recorded as 82.48 per cent and total solids as 17.52 per cent, whereas, TSS content of fruit was recorded as 10.50 ^{o}B. The reducing and total sugar content of fruit were observed as 5.06 and 6.94 per cent, respectively. Wild aonla contained acidity and pH as 3.07 per cent and 2.62, respectively.

The ascorbic acid content of fruit was found to be as 598.32 mg/100 g and carotenoids of the same were found as 0.005 mg/100 g. Wild aonla contained 1.20 per cent crude fibre and 1.56 per cent ash content. The total phenol content of this fruit was recorded as 15.98 per cent. On the basis of sensory attributes and some physical characteristics of juice it was concluded that hydraulic press was found to be the best method/mode for extraction of juice from wild aonla fruits as compared to others.

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