Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 1295-1299
Received: 20-03-2020
Accepted: 24-04-2020

Mamta Gocher
Department of Horticulture, School of Agriculture and Allied Sciences, H.N.B Garhwal University, Srinagar Garhwal, Uttarakhand, India

Rajendra Gochar
CSIR-Indian Institute of Integrative Medicine Canal Road Jammu, Jammu and Kashmir, India

SS Rawat
Department of Horticulture, School of Agriculture and Allied Sciences, H.N.B Garhwal University, Srinagar Garhwal, Uttarakhand, India

DK Rana
Department of Horticulture, School of Agriculture and Allied Sciences, H.N.B Garhwal University, Srinagar Garhwal, Uttarakhand, India

Corresponding Author:
Rajendra Gochar
CSIR-Indian Institute of Integrative Medicine Canal Road Jammu, Jammu and Kashmir, India

Qualitative and quantities evaluation of *Phyllanthus emblica* L. fruits under valley condition of Garhwal Himalaya

Mamta Gocher, Rajendra Gochar, SS Rawat and DK Rana

DOI: https://doi.org/10.22271/phyto.2020.v9.i3u.11488

Abstract
Indian gooseberry (*Phyllanthus emblica* L.) locally called as '*P. emblica'* is one of the important fruit yielding plants utilized in Indian Ayurvedic system of medicine. Nutritional and medicinal properties of *P. emblica* make it a well-known fruit. It is a richest source of vitamin-C, phytochemicals and minerals. The present study was conducted to evaluate the performance of five different cultivars of *P. emblica* for qualitative and quantities characteristics under valley at department of horticulture, HNB Garhwal University, Srinagar, Garhwal hills Uttarakhand condition. The results revealed that, significant variability was detected among the cultivars for different fruit, seed and biochemical traits. Banarasi cultivar was found superior in term of fruit and pulp weight (22.25 gm), (21.07 gm), pulp thickness (1.32 cm), and pulp: stone ratio (17.07) while NA-7 was maximum in term of diameter (3.29 cm), volume (21.91 ml) and specific gravity (1.21 cc) as compared to other cultivars. The cultivar Chakaiya was found superior compared to other varieties for biochemical characters such as ascorbic acid (643.50 mg/100g) and total sugar (8.37%) content.

Keywords: *P. emblica*, cultivars, quality, ascorbic acid, sugar

Introduction
Indian gooseberry *Phyllanthus emblica* L. (syn.-*Emblica officinalis* Gaertn.), commonly known as '*P. emblica*' is a deciduous tree of the Phyllanthaceae family, and recognized as one of the important indigenous fruits crop of Indian subcontinent (Sonkar *et al*., 2020) [34]. *P. emblica* is known by different names like amla, aonla, emblic, amlika, dhatriphal, amritphal and myrobalan. India has rich diversity of *P. emblica* germplasm which facilitated the development of several varieties like NA-6, NA-7, NA-9, NA-10, Banarasi, Chakaiya, Francis, Krishna, Kanchan, Anand-1, Anand-2, Anand-3, etc. It has been recognized as an important element of crop diversification due to its wider adaptability under various land use systems and agro-climatic zones (Maholiya *et al*., 2014; Pathak *et al*., 2001) [25, 31]. It is well recognized in 'Vedas', Ramayana; Charaka Samhita, Sushruta Samhita and other ancient Indian literature describing its fruits to be highly nutritive, nutraceutical and therapeutic values (Kishore *et al*., 2016) [20]. *P. emblica* is the second richest source of vitamin C (422-566 mg/100 gm) among fruits after Barbados cherry (*Malpighia glabra* L.), amino acid, hydrolysable tannins (emblicanin A and B), minerals, and polyphenols which are considered to be responsible for their antioxidative properties (Bhad *et al*., 2016; Chiranjeevi *et al*., 2018; Tewari *et al*., 2019) [5, 8, 35]. *P. emblica* is a major component of ayurvedic and unani preparations like Triphala and Chavanprash (Kishore, 2017) [19]. Industry as raw material, demand of fresh fruits is increasing worldwide. Besides medicines industry, it has also high demand in small and large scale food industry for preparation of several health-based preserved products like candy, jam, squash, pickle, spray dried *P. emblica* powder, ready to eat *P. emblica* chutney, thokku, dried chips and RTS etc., popular in the markets (Deepika and Panja, 2017; Goyal *et al*., 2008; Pathak *et al*., 2009) [10, 14, 30]. The fruit is acclaimed for being a use for various ailments including diabetes, inflammation, atherosclerosis, acidity, asthma, skin disorders and corpulence. Indian gooseberry is also reported to possess diuretic, restorative, hair tonic, laxative, anti-pyretic, ulcer preventive, liver tonic, common cold and fever along with it have hypolipidemic, hypoglycemic and antimicrobial activities(Jeevangi *et al*., 2013; Kumari and Khatkar, 2018) [18, 23]. Pentagalloyl glucose, found in the amla fruit can inhibit Influenza-A virus replication via two mechanisms: prevention of virus adsorption and suppression of virus release (Dasaroju and Gottumukkala, 2014; Gangal *et al*., 2020) [9, 11].

Among the various factors for high production of quality fruits, cultivar is considered to be the prime ones, as this single factor controlled more than 60% of yield and quality attributing characters. Again, appearance of characters of a genotype, which are governed by genes, depends on ecological factors. For this reason, varietal specification of crop in a particular agro-climatic condition is the foremost task for marketable of that crop in a locality or zone (Bhad, 2016, Maholiya, 2014, Patil, 2012) [5, 25, 32]. Internal feature valuation of a fruit plays a very important role while the external characteristic of fresh produce continues to be the core of consumer acceptance and marketability. Various physical and mechanical characteristics of fruit like as shape, size smoothness, shiny surface and firmness are important qualitative attributes for the attraction of consumers (Tewari, 2019) [35]. The flesh of fruit is thick fibrous or non-fibrous depending on the cultivars. Generally wild fruits are small, hardy and bitter in taste. Fruit size, texture, fiber content, taste and acidity vary with the cultivars (Chiranjeevi *et al*., 2018) [8]. *P. emblica* is supposed to be an important fruit of future due to the high economic value, suitability to dry, rainfed and waste land of India. Considering *P. emblica* potentiality, productive and productivity per unit area and hardy nature, there is very possibility for *P. emblica* to be one of the most important fruits of the India (Ghosh *et al*., 2013; Kishore *et al*., 2016; Patil *et al*., 2012) [12, 20, 32]. In *P. emblica*, majority of research work has been conducted under arid and semi-arid conditions, but its varietal production potentials have rarely been investigated in Himalaya hilly regions. The main objective of this study was to compare the qualitative and quantities attributes of different *P. emblica* varieties and to select the suitable varieties for sub-tropical condition of Garhwal hills of India.

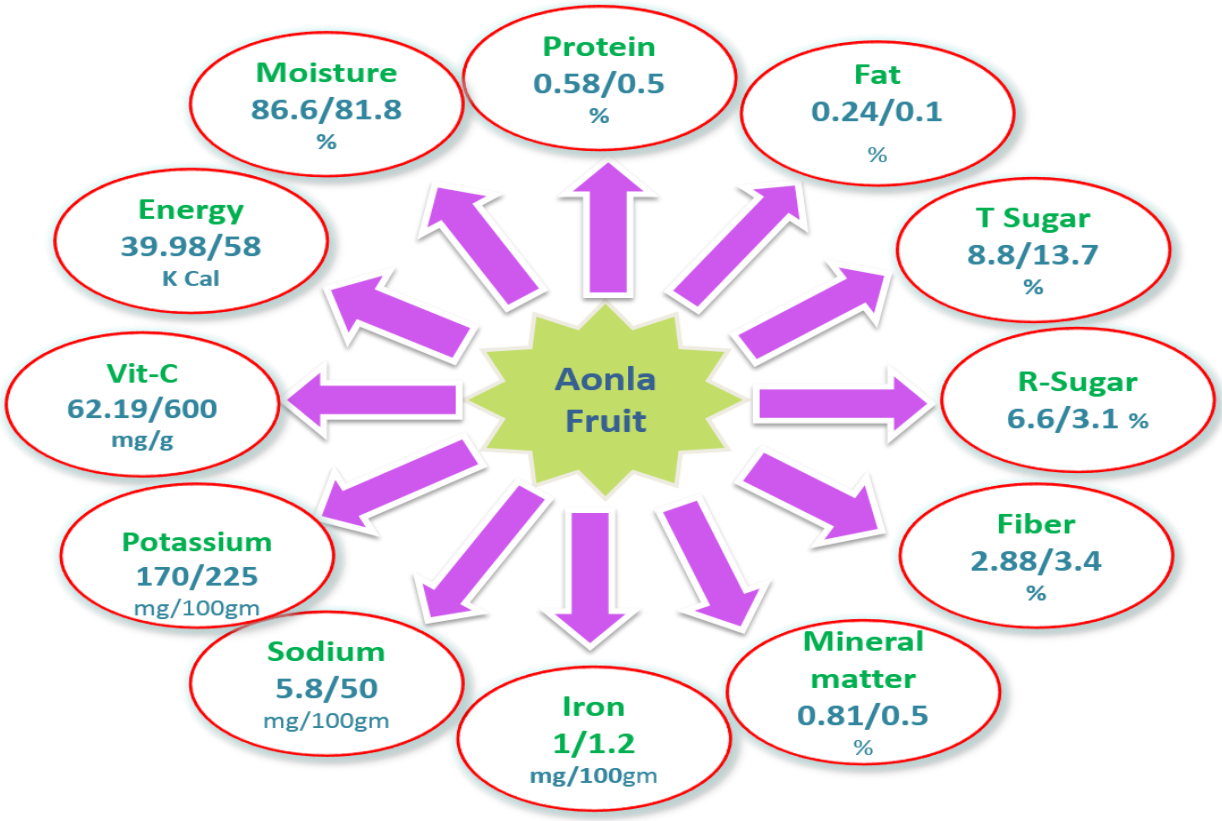

Fig 1: Nutritional composition of Wild/Cultivated verities of *P. emblica* fruits (Nazarudeen, 2010) [27].

Materials and Methods

The present studies were carried out on eleven years old *P. emblica* orchard at Horticultural Research Centre and Department of Horticulture, HNB Garhwal University, Srinagar Garhwal, situated in the Alaknanda valley (78° 47' 30" E longitude and 30° 13' 0" N latitude and at an elevation of 550 m above MSL) Uttarakhand, during the year of 2014-15. Fruits of five *P. emblica* cultivars namely, NA-7, NA-10, Banarasi, Chakaiya and Wild were selected for this study all cultivars were growing under similar set of cultural practices in the field. Mature and ripe fruits of *P. emblica* cultivars were collected randomly from selected plants from the month of November 2014. Physical quality characteristic of fruits observation were recorded *viz*., Average number of fruits per kg, fruit weight (gm), fruit dimension (cm) measured with Vernier caliper, fruit volume (ml), number of segments per fruit, pulp thickness (cm), average pulp stone and seed weight (gm), pulp: stone ratio and moisture (%) in fruits. Chemical fruit parameters TSS (^{0} Brix) was determined by hand refractometer (0-36^0 Brix), Titratable acidity (%) titrating the *P. emblica* juice against 0.1 NaOH using phenolphthalein indicator(A.O.A.C., 1990) [1].

$$\% \text{ Acidity} = \frac{\text{Titrate} \times \text{normality of alkali} \times \text{equivalent weight of acid} \times \text{volume made up}}{\text{volume of sample taken for estimation} \times \text{wieght of sample} \times 1000} \times 100$$

Ascorbic acid (mg/100gm) content was estimated by 2, 6, dichlorophenol indophenols titration method as recommended by Ranganna (1986) [33].

$$\text{Ascorbic acid} = \frac{\text{Titrate} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot of extract taken for estimation} \times \text{Wt. or volume of sample taken for estimation}} \times 100$$

Total and reducing sugar (%) contents were determined by Fehling solution method and methylene blue indicator by(Lane and Eynon, 1923) [24]. The statistical analyses of experimental data were estimated as per treatments suggested by (Chadel, 1984). [7]

Results and Discussion

The perusal variability of the data presented in Table-1 indicated that the cultivars expressed their quantitative morphological potentially at different magnitude in the present agro-climatic situation. In all the cultivars number of fruits per kg ranged from 50.75 to 273.0. Number of fruits per kg was significantly ($p \leq 0.05$) maximum in wild type of cultivar. Number of fruits per kg NA-10 and Chakaiya was 61.0 and 58.75 which was statistically nonsignificant at 5% probability level, while minimum was recorded in NA-7 cultivar. Average fruit length was ranged from 0.46 to 2.05 cm, fruit length was significantly maximum in NA-10 followed by NA-7 and Banarasi were found to be non significant, but in case of fruit diameter NA-7 was highest and it was statistically at par with Chakaiya cultivar, it was concluded that the diameter of fruit was found to be always greater than the length of *P. emblica* fruit. The present investigation the difference may be in cultivars due to its genetic trades in *P. emblica* (Ghosh *et al*., 2013) [12] and in date palm (Muralidhara *et al*., 2016) [26].

Table 1: Morphology characterization of five different cultivars *P. emblica* fruit.

Cultivars	No. of fruits/kg	Fruit Size (cm)		Average weight (gm)		pulp thickness (cm)	Segments (Nos.)	Volume (ml)	Specific gravity (cc)	Average weight (gm)		Pulp: Stone ratio
		Length	Diameter	Fresh fruits	pulp					Stone	Seed	
NA-7	50.75	1.74	3.29	21.88	20.10	1.27	6.18	21.91	1.21	1.78	0.04	13.28
NA-10	61.00	2.05	2.58	16.90	15.47	1.33	6.10	21.70	1.18	1.44	0.09	16.73
Banarasi	54.25	1.69	2.27	22.25	21.07	1.32	6.20	17.96	1.17	1.18	0.07	17.07
Chakaiya	58.75	1.64	3.22	21.43	20.16	1.19	6.10	18.78	1.15	1.27	0.06	15.20
Wild	273.00	0.46	0.95	3.90	3.41	0.54	5.93	3.14	1.33	0.49	0.05	8.06
SEm±	1.65	0.03	0.06	0.44	0.45	0.02	0.06	0.93	0.05	0.07	0.004	0.64
C.D. 5%	5.10	0.08	0.19	1.36	1.40	0.06	0.18	2.87	0.16	0.20	0.01	1.98

Banarasi cultivar was characterized with higher fruit weight 22.25 gm which was significantly at par with NA-7 and Chakaiya cultivars 21.88, 21.43 gm, respectively however minimum fruit weight was noted with wild cultivar. Increase in fruit weight in Banarasi, NA-7 and Chakaiya may be due to genetic variability and more activeness of monocarp cells which enlarge during fruit development and it also affect climatic and management factors, similar result were reported by (Bhadauria *et al*., 2004; Chiranjeevi *et al*., 2018; Jangid *et al*., 2019a) [6,8,16]. Pulp weight in *P. emblica* is considered as one of the major characters for preparation many values added products and recipes. Highest pulp weight 21.07 gm was recovered in Banarasi. There was no significant difference among Chakaiya, NA-7, 20.16 and 20.10 gm, respectively in *P. emblica* varieties similar finding reported by (Chiranjeevi *et al*., 2018) [8]. The maximum pulp thickness of fruits 1.33 cm was founded in NA-10 cultivar and it was statistically at par with Banarasi and NA-7 cultivars with 1.32 cm and 1.27 cm, respectively. These results are further supported in *P. emblica* by (Jangid *et al*., 2019b) [17] and date palm by (Muralidhara *et al*., 2016) [26]. The highest value 6.2 for number of segments was recorded under Banarasi and it was statistically at par with NA-7, NA-10 and Chakaiya cultivars. The highest volume and Specific gravity of fruits was observed (21.91 ml) and (1.21 cc) in NA-7 and it was statistically at par with NA-10 while least was founded (3.14 ml) and (1.13 cc) in wild type. Volume and specific gravity of the fruit is key constraint for perfect modeling of heat and mass transfer during cooling, drying and estimate floor space during storage and transportation of fruits (Goyal *et al*., 2007; Tewari *et al*., 2019) [13, 35]. Present study average stone weight in *P. emblica* cultivars varied from 0.49 to 1.78 gm. The highest stone-weight 1.78 gm was recorded under NA-7 cultivar and it was significantly spurious other cultivars. The highest average seed weight 0.09 gm was observed with NA-10 cultivar and it was statistically higher over other cultivars. However, the minimum average seed weight 0.04 gm was recorded with NA-7 cultivar. Such variation in stone weight was probably due to inherent variation in fruit(Hazarika *et al*., 2009; Patel *et al*., 2009) [15, 29]. Among five cultivars of *P. emblica*, the maximum pulp: stone ratio 17.07 was obtained in Banarasi cultivar which was statistically at par with NA-10 and Chakaiya cultivars 16.73 and 15.20, respectively.The difference in pulp to stone ratio may be due to its varietal differences, weight and size of fruits, weight and size of stone and also the prevailing weather conditions at the time of fruit development stage of respective variety, similar result were reported by previous studies (Bakshi *et al*., 2015; Kumar *et al*., 2011; Kumar and Singh, 2013) [3, 21, 22].

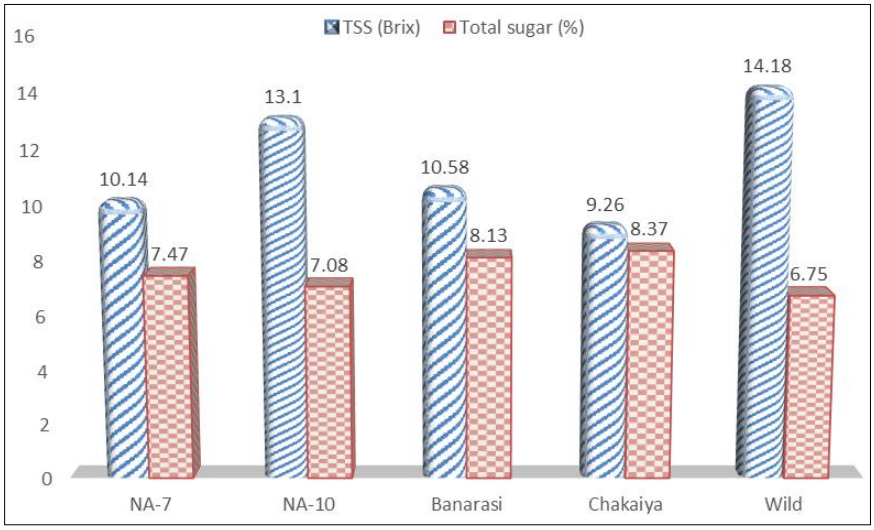

Fig 2: Varietal differences of TSS and total sugar content in *P. emblica*

Table 2: Qualitative characteristics of five cultivars of *P. emblica.*

Cultivars	Moisture %	Total soluble solids (0 Brix)	Acidity (%)	Vitamin-C (mg/100g)	Total sugar (%)	Reducing sugar (%)
NA-7	70.05	10.14	1.83	516.80	7.47	2.10
NA-10	64.41	13.10	1.50	532.43	7.08	1.81
Banarsi	60.85	10.58	1.70	607.05	8.13	2.43
Chakaiya	62.10	9.26	1.78	643.50	8.37	2.53
Wild	69.84	14.18	1.97	248.85	6.75	1.02
SEm±	1.10	0.42	0.06	10.51	0.26	0.09
C.D. 5%	3.37	1.30	0.20	32.39	0.80	0.28

The chemical composition of different cultivars of *P. emblica* fruit is presented in Table 2 and figure 2. Moisture content is necessary to assess the quality of fresh fruits and vegetables as the shelf life of food products mostly depends upon this parameter. The moisture content of different cultivars was ranged from 60.85 to 70.05%, maximum was recorded in NA-7 followed by wild type and moisture percentage of these two cultivars was significantly higher than all other cultivarsIn moisture content significant difference among varieties was observed due to the difference in maturity stage and genetic makeup similar finding was reported by (Sonkar *et al*., 2020; Tewari *et al*., 2019) [32, 35]. Less variation was found in total soluble solid (TSS) and acidity in fruits. The ranged 14.18 to 9.26^0 Brix and 1.97 to 1.50 % TSS and acidity were recorded in present study. The maximum valued obtained in wild type, it was statistically at par with NA-10 and NA-7 in term of TSS and acidity, respectively, the results were all corroborated with (Ahmad *et al*., 2010; Goyal *et al*., 2008; Hazarika *et al*., 2009; Kumar *et al*., 2011; Parveen and Khatkar, 2015) [2, 14, 15, 28]. Among the different cultivars, the ascorbic acid content ranged 248.85 to 643.50 mg/100gm; statistically significant and highest was obtained in Chakaiya cultivar followed by Banarasi while minimum was found in wild type. The variation in ascorbic acid content of different varieties may also be attributed due to genetic character and varietal differences, location and weather condition at the time of harvesting of fruits (Bakshi *et al*., 2015; Bhad *et al*., 2016; Chiranjeevi *et al*., 2018; Ghosh *et al*., 2013; Parveen and Khatkar, 2015; Tewari *et al*., 2019) [3, 5, 12, 28, 35]. Total sugar content ranged from 6.75 to 8.37%. The fruits of Chakaiya variety were found to have the statistically highest value followed by Banarasi and NA-7. On the contrary, the fruit of Wild (Desi) cultivar had the lowest value. Same pattern was noted in observed value of reducing sugar. Observed data was in agreement with data reported in the literature by various researchers(Ahmad *et al*., 2010; Bakshi *et al*., 2015; Basnet, 2018; Kumar *et al*., 2011; Patil *et al*., 2012; Yadav *et al*., 2017) [2, 3, 4, 21, 32, 36].

Conclusion

P. emblica has an important position in Ayurveda-an Indian indigenous system if medicine. On the basis of the results obtained in the present study *P. emblica* is a rich source of ascorbic acid and other nutrients, therefore it can be utilized in the form of value added product. The fruit of Wild cultivar had the sufficient nutrient contents such as ascorbic acid, acidity, TSS, sugar content. However, astringency and fibrous nature of this variety restricts the utilization of the fresh fruit as table food. Among all the cultivars in the context of physical characters, NA-10 cultivar was found significant advancement and superior in term of length of fruit, pulp thickness, pulp weight and seed weight as compared to other cultivars. All cultivars had considerable amount of chemical characters *viz*., ascorbic acid, reducing sugar and total sugar content while Chakaiya was found superior with good nutritional value and it can be processed into different kind of *P. emblica* products like juice, squash, ready to serve beverage.

References

1. AOAC. Official Methods of Analysis. 15th Edn. Association of Official Agricultural Chemists, Washington D.C, 1990.
2. Ahmad S, Tomar Y, Rawat J, Vidyawati R. Physico-chemical studies of some aonla (*Emblica officinalis*) cultivars. Advances in Plant Sciences. 2010; 23:129-130.
3. Bakshi P, Wali V, Jasrotia A, Sharma A, Iqbal M. Evaluation of different aonla (*Emblica officinalis*) cultivars under rainfed conditions of lower shivalik foothills of Himalayas. Indian Journal of Agricultural Sciences. 2015; 85:1012-6.
4. Basnet S. Effect of pretreatments on quality of amla (*Phyllanthus emblica*) preserve, 2018.
5. Bhad P, Bharad S, Deshmukh S, Tadas N. Evaluation of aonla Varieties Under Semiarid Climatic Conditions of Western Vidarbha region. Advances in Life Sciences. 2016; 5:204-206.
6. Bhadauria S, Kushwah BS, Pahari G. Qualitative and quantitative analysis of seven cultivars of aonla (*Emblica*

officinalis) growing in alkali soils. Indian Journal of Plant Physiology (India). 2004; 9:451-454.
7. Chadel SRS. Principal of Experimental Designs. A handbook of Agriculture Statistics, 1984.
8. Chiranjeevi M, Muralidhara B, Hongal S, Sneha M. Physico-chemical characterization of aonla fruits grown under bengaluru conditions. International Journal of Current Microbiology and Applied Sciences. 2018; 7:3611-3615.
9. Dasaroju S, Gottumukkala KM. Current trends in the research of *Emblica officinalis* (Amla): A pharmacological perspective. International Journal of Pharmaceutical Sciences Review and Research. 2014; 24:150-9.
10. Deepika D, Panja P. Enrichment on quality of aonla (*Emblica officinalis* G.) fruit bars by blending. Journal of Applied and Natural Science. 2017; 9:162-166.
11. Gangal N, Nagle V, Pawar Y, Dasgupta S. Reconsidering Traditional Medicinal Plants to Combat COVID-19. Advanced International Journals of Research, Preprints. 2020; 34:1-6.
12. Ghosh S, Roy S, Bera B. Study on performance of aonla cultivars in laterite soil of West Bengal. Journal of Crop and Weed. 2013; 9:36-38.
13. Goyal R, Kingsly A, Kumar P, Walia H. Physical and mechanical properties of aonla fruits. Journal of Food Engineering. 2007; 82:595-599.
14. Goyal RK, Patil RT, Kingsly ARP, Walia H, Kumar P. Status of Post harvest Technology of Aonla in India-A Review. American Journal of Food Technology. 2008; 3(1):13-23.
15. Hazarika B, Deka BC, Choudhury S, Sarma B. Studies on variability in physico-chemical characters of different aonla accessions from Jorhat region of Assam. Indian Journal of Horticulture. 2009; 66:190-192.
16. Jangid G, Mandal G, Kumari U. Effect of nutrients on yield and chemical characteristics of aonla (*Emblica officinalis* Gaertn) cv. chakiya. Journal of Medicinal Plants. 2019a; 7:106-108.
17. Jangid G, Mandal G, Kumari U. Response of zinc and boron sprays on growth and yield of aonla (*Emblica officinalis* Gaertn) cv. Chakiya. Journal of Pharmacognosy and Phytochemistry. 2019b; 8:1290-1292.
18. Jeevangi S, Manjunath S, Sakhare PM. A study of anti-hyperlipidemia, hypolipedimic and anti-atherogenic activity of fruit of *Emblica officinalis* (amla) in high fat fed albino rats. International Journal of Medical Research and Health Sciences. 2013; 1:70-77.
19. Kishore K. Phenological growth stages of Indian gooseberry (*Phyllanthus emblica* L.) according to the extended BBCH scale. Scientia Horticulturae. 2017; 225:607-614.
20. Kishore K, Samant D, Singh H, Srinivas P. Flowering behaviour, yield dynamics and fruit quality of Indian gooseberry (*Emblica officinalis*) in eastern tropical region of India. Indian Journal of Agricultural Sciences. 2016; 86:1220-4.
21. Kumar S, Chithiraichelvan R, Karunakaran G. Performance of aonla cultivars for yield and physico-chemical properties under Coorg conditions. Indian Journal of Horticulture. 2011; 68:268-269.
22. Kumar S, Singh I. Physio-chemical studies of various cultivars of aonla fruits. Progressive Horticulture. 2013; 45:80-82.
23. Kumari P, Khatkar B. Nutritional composition and drying kinetics of aonla fruits. Journal of Food Science and Technology. 2018; 55:3135-3143.
24. Lane JH, Eynon L. Determination of reducing sugars by means of Fehling's solution with methylene blue as internal indicator. Journal of the Chemical Society, Transactions, 1923, 32-36.
25. Maholiya B, Heerendra P, Nipun R. Studies on the comparative performance of aonla (*Emblica officinalis* G.) cultivars under Marathwada condition. International Journal of Plant, Animal and Environmental Sciences. 2014; 4:1-4.
26. Muralidhara B, Singh R, Bhargava R, Veena G, Kumar MK. Morphological characterization of date fruits at different growth stages under hot arid conditions. Environment and Ecology. 2016; 34:1234-1237.
27. Nazarudeen. A Nutritional composition of some lesser-known fruits used by the ethnic communities and local folks of Kerala. Indian Journal of Traditional Knowledge. 2010; 9(2):398-402.
28. Parveen K, Khatkar B. Physico-chemical properties and nutritional composition of aonla (*Emblica officinalis*) varieties. International Food Research Journal. 2015; 22:2358.
29. Patel D, Patel H, Sarvaiya S, Masu M. Physico-chemical status of different genotypes and hybrids of aonla. Asian Journal of Horticulture. 2009; 4:461-463.
30. Pathak P, Preeti D, Sunil K. Effect of post-harvest treatments on shelf-life of aonla (*Emblica officinalis*) fruits damaged during harvesting. Journal of Food Science and Technology Mysore. 2009; 46:283-285.
31. Pathak R, Pathak S, Singh R. Fruit production in problematic soils. Indian Journal of Horticulture. 2001; 58:16-22.
32. Patil S, Sonkamble A, Ganvir M. Physico-chemical status of different aonla (*Emblica officinalis*) cultivars under tropical conditions of Central India. International Journal of Agricultural Sciences. 2012; 8:407-409.
33. Ranganna S. Manual of analysis of fruits and vegetable products, Tata McGraw Hill publishing Co. Ltd., New Delhi, 1986, 441- 495.
34. Sonkar N, Rajoriya D, Chetana R, Murthy KV. Effect of cultivars, pretreatment and drying on physicochemical properties of Amla (*Emblica officinalis*) gratings. Journal of Food Science and Technology. 2020; 57:980-992.
35. Tewari R, Kumar V, Sharma H. Physical and chemical characteristics of different cultivars of Indian gooseberry (*Emblica officinalis*). Journal of food science and technology. 2019; 56:1641-1648.
36. Yadav A, Singh U, Yadav A. Aonla, physico-chemical and microbial quality during storage-A REVIEW. International Research Journal of Chemistry. 2017; 18:8-14.