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Research Article

Studies on Physico-chemical Attributes of Genotypes and Varieties of Aonla (*Emblica officinalis* Gaertn.)

Vidya P.*, Shailendra. K. Pandey, C.S. Pandey, Prathibha Parihar

Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur- 482004 Madhya Pradesh

*Corresponding Author E-mail: vidyapraju45@gmail.com

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ABSTRACT

Aonla is an important indigenous fruit crop of Indian subcontinent which is generally used in alternative medicine, health foods, herbal products and beverages. To identify the elite genotypes among the population the matured fruits of Eighteen genotypes and two varieties were analyzed for physico chemical traits like fruit weight, pulp weight, seed weight, fruit volume, specific gravity, moisture content, pulp: stone ratio, total soluble solids, acidity, ascorbic acid, reducing sugars and total sugars. The study revealed that there was a wide variability among the accessions. Individual fruit weight varied from 24.18 to 42.57 g, pulp percent varied from 93.70 to 97.17%, seed weight varied from 1.06 to 2.55g, pulp:seed ratio from 14.91 to 34.59. There is a wide variation in chemical characters also total soluble solids varied from 6.22° to 9.21° brix, titrable acidity from 0.80 to 1.48 %, ascorbic acid varies from 456.22 to 523.23mg/100gm, reducing sugars from 2.06 to 3.00%, total sugars from 3.31 to 4.85 % .Wide variation in physico chemical analysis of genotypes indicated that there is scope for individual plant selection based on these characters for genetic improvement of aonla.

Keywords: *Aonla, Ascorbic acid, Sugars.*

INTRODUCTION

Aonla (*Emblica officinalis* Gaertn.) belongs to family Euphorbiceae, subfamily Phyllanthoideae and its basic chromosome number is 2n=28. It is native to tropical India and south East Asia commonly called Indian gooseberry (Barthakar & Arnold, 1991). Aonla is considered as "wonder fruit of health" (Gaganchari et al., 2010). In India its cultivation is rapidly spreading in semi-arid regions Maharashtra, Gujarat, Rajasthan, Andhra Pradesh, Karnataka, Tamil Nadu and the Arawali regions in Haryana, Kandi area in Punjab and in Himachal Pradesh. In Madhya Pradesh, it is commercially cultivated in many districts *viz*., Mandsaur, Neemach, Ratlam, Jabalpur, Jhabua, Bhopal, Betual, Dewas, Hoshangabad, Chindwara, Sheopur, Tikamgarh, Rewa, etc. In India it occupies nearly 95,000 ha of area with annual production of 11,07,000 MT.

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Uttar Pradesh ranks first in both area and Production of Aonla. (Annonymus, 2019-20).

Aonla is quite hardy, prolific bearer and highly remunerative even without much care. It is a suitable for semi-arid region and withstands severe climatic conditions like acidity and drought hence it found suitable for various type of wastelands. The tree is branched and ranges 8-18 m in height with thin light grey bark, leaves are simple, light green in colour, subsessile, pinnate closely set along the branchlets. Flowers are greenish yellow in axillary fascicles, unisexual, males numerous on short slender pedicels, females few, sub sessile, ovary is 3 celled. The fruits are attractive, round, depressed globus and yellowish green in colour, having six vague perpendicular furrows enclosing seeds. It is a subtropical fruit but its cultivation in tropical climate is quite successfully. It is deciduous under north Indian conditions, however, it is considered as evergreen in the tropics. It can be successfully grown even in sodic and saline soils upto 35 ESP and 10EC/ds respectively with maximum soil pH 9.5.

Aonla is excellent source of ascorbic acid and it is second richest source of Vitamin C (500-750 mg/100mg) after Barbados cherry (Shankar, 1969). It contains gallic acid, elegiac acid which prevent oxidation of vitamin C. It is also a rich source of carbohydrates, pectin carotene, thiamine, riboflavin, and minerals like iron, calcium, phosphorus, magnesium and minerals along with phytochemicals such as polyphenols, tannins, emblicol, linoleic acid, corilagin, phyllemblin and rutin (Ghorai & Sethi, 1996; Jain & Khurdiya, 2004; Murthy & Joshi, 2007; & Baliga & Dsouza, 2011).

It has great medicinal significance used as one of the main constituent of many ayurvedic preparations like Triphla and Chyawanprash (Pant et al., 2004; Goyal et al., 2007; & Mishra et al., 2009). It has prominent antibiotic, antiulcerogenic, diuretic, laxative, adaptogenic, antitumor, antiscorbutic, hepatoprotective, cardio tonic, antiviral, and hypoglycaemic properties (Rege et al.,1999; Jose & Kutton, 2000; Dahiya & Dhawan, 2001; Pragati et al., 2003; & Mishra et al., 2009) helpful in the treatment of haemorrhage, dysentery, diarrhoea, gastric disorders, constipation, headache, jaundice and enlargement of liver (Parrotta 2001; & Goyal et al., 2007).

Since it is a seasonal fruit available only from November to February it cannot be consumed raw because of high acidity, polyphenols and tannins. Therefore it needs to be processed to make it available throughout the year. Hence for processing we need to select promising genotypes of aonla with best physical and chemical characteristics. By keeping this in view, an investigation was under taken.

MATERIAL AND METHODS

Experimental site: The experiment was conducted at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh it is located in 23°.18′ N latitude and 79°.95′ E longitude and at an altitude of 412 m above mean sea level.

Details of genotypes and varieties

Twenty genotypes/varieties of aonla *viz*., Jawahar Aonla 101, Jawahar Aonla 102, Jawahar Aonla 103, Jawahar Aonla 104, Jawahar Aonla 105, Jawahar Aonla 106, Jawahar Aonla 107, Jawahar Aonla 108, Jawahar Aonla 109, Jawahar Aonla 110, Jawahar Aonla 111, Jawahar Aonla 112, Jawahar Aonla 113, Jawahar Aonla 114, Jawahar Aonla 115, Jawahar Aonla 116, Jawahar Aonla 117, Jawahar Aonla 118, Francis and Chakaiya were selected to study physico chemical characteristics of the fruits which are collected from Imaliya Farm, JNKVV, Jabalpur, MP. Thirty (30) healthy, uniform sized fruits, free from diseases, pest and brushes are randomly selected from trees of each cultivar from each direction. Matured fruits were harvested in the month of November.

Physical parameters

Thirty fruits from trees of each cultivar were selected for estimation of physical parameters such as fruit weight, fruit diameter, fruit length, fruit volume, stone weight, stone diameter, pulp (%), pulp:stone ratio, specific gravity and moisture.

Weight of the freshly harvested fruit and stone was recorded using the electronic balance. Diameter of fruit and stone and fruit length was measured by digital vernier calliper. The moisture content (%) was calculated by subtracting the dry weight along with the weight of seeds from the fresh weight and expressed as the percent of fresh weight.

Chemical parameters

Thirty fruits from trees of each cultivar were selected for estimation of chemical parameters such as TSS, acidity, ascorbic acid, reducing sugar, non reducing sugar, total sugar.

T.S.S. was recorded using Hand Refractometer for each cultivar. Titratable acidity was estimated by AOAC (2005) method where diluted aonla extract was titrated against 0.1 N Sodium hydroxide using phenolphathlein indicator and it was reported as citric acid (%). Ascorbic acid content was determined by AOAC (2005) method where fresh aonla juice was diluted with equal amount of meta-phosphoric acid and titrated rapidly with indo-phenol dye. Similarly standard ascorbic acid solution and meta-phosphoric acid (blank) solution titrated against the indo-phenol dye. The Fehling's 'A' and 'B' solutions were used to estimate the sugars content and this procedure is suggested by Ranganna (2010).

Statistical analysis:

The statistical analysis of variance (ANOVA) of data was carried out by the method described by Panse and Sukhatme (1961) using Complete Randomized Design experiment with three replication.

RESULT AND DISCUSSION

The data (Table 1) revealed that fruit weight, stone weight, volume of fruit, and specific gravity varied according to the genotypes/varieties. The maximum weight of the fruit (42.57 g) and fruit volume (41.77 ml) were significantly noted in JA 117 followed by JA 118. Whereas, minimum fruit weight (24.18 g) and fruit volume (24.13 ml) was found in JA 107. The variation in fruit weight and volume may be due to varied potency of cell division, enlargement and development of inter and intra cellular spaces in different cultivars of aonla (Bharati, 2015). These results are in accordance to the findings obtained by Singh and Pathak (1987). Stone weight was noted maximum in Francis (2.55 g) followed by JA 117 (2.46 g) minimum in JA 109 (1.06 g). This might be due to the enlargement of endocarp (Bajpai, 1968). The specific gravity found maximum in JA 104 (1.05 g/ml) minimum in JA 112 (0.94 g/ml) followed by JA 109 (0.95 g/ml). The main reason for decrease in specific gravity might be due to comparatively increase in volume than weight during fruit growth thereby fruits become more compact during early stage (Singh et al., 1989, & Prasad & Banker, 1993). The data related to fruit diameter, stone diameter and fruit length was presented in Table 2. The maximum fruit diameter was recorded in JA 117 (4.37 cm) followed by JA 112 (4.21 cm) and which are statistically at par with each other. The minimum fruit diameter was noted in JA 116 (3.12 cm). This might be due to genetical characteristics of varieties and rate of enlargement of mesocarp cells of fruits as well as micro-climatic factors. The results are in conformity with the findings of Balasubramanyam and Bangaruswamy (1998). The stone diameter was maximum in Francis (3.41 cm) followed by JA 118 (3.32 cm) and minimum was noted in JA 109 (1.17 cm) variation might be due to genetical difference. The reports of Teaotia (1968) substantiate the present findings. The fruit length was noted maximum in Francis (3.85cm) followed by JA 118 (3.78 cm) and minimum was recorded in JA 109 (2.65cm). The difference observed in fruit length was due to different agro climatic condition (Parveen & Khatkar, 2015). These results are confirmed by the findings obtained by Shakti Chandra Mondal (2017). The data of parameters such as pulp percentage, pulp: stone ratio, moisture and no of segments/fruit were shown in Tabel 3. The maximum pulp per cent was observed in JA 112 (97.17 %)

which is significant over other genotypes and varieties followed by JA 109 (97.14%) and minimum was recorded in Francis (93.70 %). The results are in agreement with findings of Singh and Arora 1967, Gosh et al. 2013. The Pulp: Stone ratio was noted significantly highest in JA 112 (34.59) followed by JA 109 (34.28) while minimum pulp: stone ratio was recorded in Francis (14.91). The difference in this ratio might be due to genetic differences, weight and size of fruit and stone (Chiranjeevi et al., 2018). The highest moisture content significantly recorded in JA 105 (86.50 %) followed by JA 108 (86.10 %) and the minimum moisture was recorded in JA 112 (81.27 %). The difference in variation was observed might be due to the difference in maturity stage and genetic makeup (Parveen & Khatkar, 2015). The similar findings were observed by Priyanka (2012).The genotypes and varieties recorded six capsules/segments per fruits and there was no significant difference among them.

Chemical Parameters

The chemical parameters of different genotypes and varieties have been evaluated in term of TSS, acidity, ascorbic acid, reducing sugar, non reducing sugar and total sugar.

The data (Table 4) revealed that TSS, acidity and ascorbic acid were varied according to the genotypes/varieties. The maximum TSS were noted in JA 104 (9.21°Brix) followed by JA 116 (9.01°Brix) and minimum in JA 115 (6.22°Brix). The variation observed in T.S.S. might be due to existing variability in genotypes and varieties, inheritance, micro-climates, photosynthetic efficiency, synthesis of metabolites and maturity indices. Results are in close proximity with studies conducted by Godra et al. 2004 and Gupta et al. 2003. The acidity was recorded maximum in JA 112 (1.48 %) followed by JA 109 (1.44 %) while, minimum acidity was found in JA 104 (0.80 %). The decrease in total acidity content at final stage of fruit maturity might be due to rapid utilization of organic acids into their salts and sugars either by invertase enzyme (Hawker, 1968) or by the reaction involving in the reversal of glycolytic pathway during ripening period (Ruffner et al., 1975). Ascorbic acid was recorded significantly maximum in JA 112 (525.23 mg/100g) followed by JA 109 (520.82mg/100g), minimum was found under JA 104 (456.22mg/100g). The Ascorbic acid content increased consistently in linear order with the advancement of harvest maturity variation in content may be associated with inherited characters of aonla cultivars (Bharati, 2015).

The data of reducing sugar, non reducing sugar and total sugars were shown in Table 5. The reducing sugar was noted highest in JA 104 (3.00 %) followed by JA 116 (2.94 %) and the minimum reducing sugar was recorded in JA 117 (2.06 %) which are statistically at par with each other. Increase in reducing sugar content might be due to breakdown of sucrose to glucose and fructose or inversion of sugars (Geetha et al., 2006). These results were confirmed by the findings obtained by Sagar and Kumar (1999). Non reducing sugar was recorded maximum in JA 106 (1.90 %) followed by JA 116 (1.88%) while minimum in JA 101 (1.14 %).The results were in accordance by the findings of Shakti (2017). Total Sugar content observed maximum in JA 104 (4.85%) followed by JA 116 (4.82%) and the minimum total sugar content found in JA 109 (3.31%). The increase in sugar content might be attributed to accumulated translocation of photosynthates from leaves to fruits as carbohydrates are manufactured in these leaves. Such findings are in conformation with work done in guava (Gulahane & Gupta, 1974). The increased level of total sugar might be due to degradation of insoluble polysaccharides (Tripathi et al., 1988). Results are in close proximity with studies conducted by Gaurav Singh vishen (2017).

Table 1: Fruit weight, Stone weight, Fruit Volume, Specific gravity of various genotypes and varieties of aonla

Sl No	Genotypes/ varieties	Fruit weight (gm)	Stone weight (gm)	Fruit Volume (ml)	Specific gravity (g/ml)
1	JA 101	30.52	1.22	29.91	0.99
2	JA 102	36.45	1.26	34.8	1.01
3	JA 103	33.15	1.35	31.77	1.03
4	JA 104	26.13	1.43	25.72	1.05
5	JA 105	38.83	2.3	38.02	0.97
6	JA 106	32.05	1.71	30.55	0.96
7	JA 107	24.18	1.35	23.53	1.04
8	JA 108	38.7	1.25	37.6	0.97
9	JA 109	37.12	1.06	36.37	0.95
10	JA 110	27.23	1.29	25.87	0.99
11	JA 111	31.53	1.08	30.81	0.98
12	JA 112	41.35	1.17	38.06	0.94
13	JA 113	25.12	1.33	24.13	1.03
14	JA 114	24.92	1.43	24.19	1.02
15	JA 115	37.18	2.32	34.84	0.99
16	JA 116	35.45	1.92	33.72	1.02
17	JA 117	42.57	2.46	41.77	0.98
18	JA 118	41.38	1.98	40.10	1.00
19	Chakaiya	36.57	2.03	35.81	1.02
20	Francis	40.51	2.55	38.10	0.98
	S.Em ±	0.26	0.058	0.372	0.01
	CD at 5% level	0.743	0.165	1.063	0.027

Table 2: Fruit diameter (cm), Stone diameter (cm), Fruit Length (cm) of various genotypes and varieties of aonla

Sl N0	Genotypes/ varieties	Fruit Diameter (cm)	Stone Diameter (cm)	Fruit Length (cm)
1	JA 101	3.28	2.10	3.15
2	JA 102	3.74	1.30	3.39
3	JA 103	3.78	2.12	2.98
4	JA 104	3.15	2.50	3.73
5	JA 105	4.18	2.30	3.68
6	JA 106	3.57	1.94	2.67
7	JA 107	3.18	2.26	2.96
8	JA 108	3.91	3.10	2.87
9	JA 109	3.48	1.17	2.65
10	JA 110	3.66	2.10	3.48
11	JA 111	3.59	1.21	3.24
12	JA 112	4.21	3.15	3.76
13	JA 113	3.18	2.20	2.75
14	JA 114	3.36	1.30	3.14
15	JA 115	3.94	3.30	3.36
16	JA 116	3.12	3.10	2.79
17	JA 117	4.37	3.20	3.5
18	JA 118	3.86	3.32	3.78
19	Chakaiya	3.59	1.80	3.65
20	Francis	4.34	3.41	3.85
	S.Em ±	0.09	0.056	0.093
	CD at 5% level	0.256	0.159	0.267

Table 3: Pulp %, Pulp: Stone ratio, Moisture (%), No of segments per fruit of various genotypes and varieties of aonla

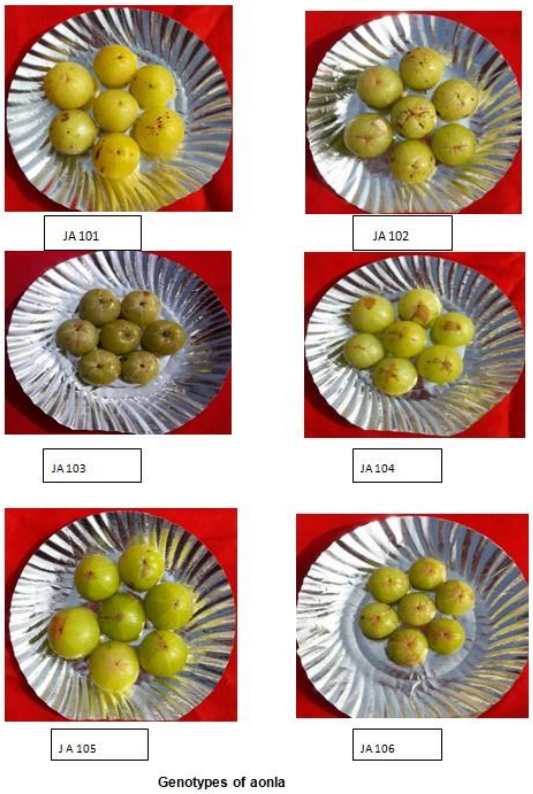
Sl No	Genotypes/ varieties	Pulp %	Pulp : Stone ratio	Moisture (%)	No of segments per fruit
1	JA 101	96.00	24.13	82.26	6
2	JA 102	96.54	28.07	84.02	6
3	JA 103	95.92	23.64	85.42	6
4	JA 104	94.53	17.33	86.10	6
5	JA 105	94.07	15.91	86.50	6
6	JA 106	94.66	17.79	82.20	6
7	JA 107	94.42	16.97	84.21	6
8	JA 108	96.77	30.15	86.10	6
9	JA 109	97.14	34.28	81.33	6
10	JA 110	95.26	20.19	83.34	6
11	JA 111	96.57	28.38	84.09	6
12	JA 112	97.17	34.59	81.27	6
13	JA 113	94.7	17.95	85.76	6
14	JA 114	94.26	16.48	84.25	6
15	JA 115	93.76	15.05	83.40	6
16	JA 116	94.58	17.5	81.96	6
17	JA 117	94.22	16.32	82.70	6
18	JA 118	95.21	19.93	86.08	6
19	Chakaiya	94.44	17.04	85.49	6
20	Francis	93.7	14.91	85.10	6
	S.Em ±	0.139	0.851	0.636	NA
	CD at 5% level	0.398	2.431	1.818	**NA**

Table 4: TSS, Acidity, and Ascorbic acid of various genotypes and varieties of aonla

Sl No	Genotypes/ varieties	Total soluble solids (°Brix)	Acidity (%)	Ascorbic acid (mg /100g)
1	JA 101	6.52	1.16	518.07
2	JA 102	6.45	0.88	464.38
3	JA 103	7.53	0.98	475.89
4	JA 104	9.21	0.80	456.22
5	JA 105	7.55	0.87	468.4
6	JA 106	6.42	1.12	500.25
7	JA 107	9.00	1.27	506.31
8	JA 108	8.31	1.35	515.38
9	JA 109	7.77	1.44	520.82
10	JA 110	6.68	0.90	474.45
11	JA 111	7.55	1.24	490.26
12	JA 112	6.25	1.48	525.23
13	JA 113	6.58	1.33	518.74
14	JA 114	7.13	1.19	515.99
15	JA 115	6.22	0.86	482.36
16	JA 116	9.01	0.83	480.02
17	JA 117	6.35	1.05	501.12
18	JA 118	7.06	1.08	508.73
19	Chakaiya	7.48	1.28	518.82
20	Francis	7.30	1.29	510.92
	S.Em ±	0.173	0.064	0.393
	CD at 5% level	0.495	0.182	1.122

Table 5: Reducing sugar (%), Non reducing sugar (%) and Total sugars (%) of various genotypes and varieties of aonla

Sl No	Genotypes/ varieties	Reducing Sugar (%)	Non reducing sugar (%)	Total Sugar (%)
1	JA 101	2.28	1.14	3.42
2	JA 102	2.33	1.23	3.56
3	JA 103	2.30	1.31	3.61
4	JA 104	3.00	1.85	4.85
5	JA 105	2.53	1.37	3.9
6	JA 106	2.90	1.90	4.80
7	JA 107	2.67	1.43	4.1
8	JA 108	2.64	1.62	4.26
9	JA 109	1.98	1.33	3.31
10	JA 110	2.35	1.54	3.89
11	JA 111	2.51	1.67	4.18
12	JA 112	2.74	1.44	4.18
13	JA 113	2.80	1.81	4.61
14	JA 114	2.57	1.53	4.1
15	JA 115	2.73	1.56	4.29
16	JA 116	2.94	1.88	4.82
17	JA 117	2.06	1.48	3.54
18	JA 118	2.64	1.73	4.37
19	Chakaya	2.74	1.44	4.18
20	Francis	2.65	1.38	4.03
	S.Em	0.088	0.058	0.135
	CD at 5% level	0.252	0.165	0.385



Genotypes of aonla

Genotypes of aonla

Genotypes of aonla

Chakaiya

Francis

Varities of aonla

CONCLUSION

From above investigation variability in physico chemical traits of aonla fruits offers uniue scope for further improvement of aonla through selection of superior genotypes especially with higher ascorbic acid and pulp percentage. On the basis of overall assessment, Jawahar aonla 112 and Jawahar aonla 109 were selected as most promising genotypes. These genotypes have immense potential to be used for further selection and evaluation as commercial variety or as superior gene source in future aonla hybridization programmes.

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