**Evaluation of Physico-Chemical Attributes of Aonla (*Emblica officinalis* L.) Genotypes Under Eastern Uttar Pradesh Agro-Climatic Conditions**

**Abstract**

Aonla (*Emblica officinalis* Gaertn.), a nutrient-rich fruit crop, belongs to the family *Euphorbiaceae* and is widely cultivated in India, with leading producing state Uttar Pradesh. This study evaluates the physico-chemical attributes of ten aonla genotypes under the agro-climatic conditions of Eastern Uttar Pradesh. The results showed significant variations in morphometric parameters, viz., fruit size, weight, pulp percentage, juice content, and biochemical parameters. In this study, among the genotypes, NA-7 expressed superiority with respect to fruit length (4.38 cm), weight (47.33 g), pulp percentage (89.46%), juice content (38.54%), and ascorbic acid content (583.9 mg/100g). The variations among the genotypes are directly related to the genetic constituents and environmental factors. Due to its nutraceutical importance, aonla is ideal for value-added products such as murabba, candy, barfi, pickle, and juice.

The study emphasizes the need for improved breeding, post-harvest management, and commercialization strategies to enhance its market potential and economic benefits, promoting sustainable cultivation and wider consumer acceptance.

**Key words:** Genotypes, nutraceutical, genetic constitution, and biochemical etc.

**Introduction**

Aonla or Indian gooseberry (*Emblica officinalis Gaertn syn. Phyllanthus emblica L*.) is originated from Tropical India or South East Asia belongs to the family *Euphorbiaceae*. It is an important fruit crop of commercial significance and suitable for semi-arid region and withstands well in acidic and drought conditions. Although, it is widely distributed in throughout the country especially in subtropical and tropical region but Uttar Pradesh is the leading state in both area and production respectively. Due to neutraceutical and commercial significance of aonla fruit makes it popular all over the world (Goyal *et al*., 2007). Furthermore, anola is an excellent source of ascorbic acid antioxidants, minerals (iron, zinc sodium and potassium) and phytochemicals namely polyphenols including flavonoids (rutin) and phenolic acid tannins emblicol, linoleic acid, corilagin and phyllemblin (Ghorai and Sethi, 1996; Murthy and Joshi, 2007; Baliga and Dsouza, 2011, Praveen and Khatkar, 2015). Gallic acid and ellagic acid were the most abundant phenolic compounds in extracts of aonla varieties (Praveen and Khatkar, 2019). Aonla is a significant part of Indian system of medicin namely Ayurveda and Yunani where it acts as remedy for several diseases viz. haemorrhage, dysentery, diarrhoea, gastric disorders, constipation, headache, jaundice and enlargement of liver (Parrotta, 2001; Goyal *et al*., 2007). Moreover, the fruit can be value added in the form of candy, murabba, jam blended juice, beverage pickle and chutney because people unlike it to consume as fresh or table purpose. Amalaki (*Emblica officinalis*) i.e. aonla and its preparations can be used in any type of ill health. It is commonly used in piles, fracture, constipation, vomiting, nausea, diseases related to vision and eye, hick up, fever, jaundice, liver disease, skin disease, and diabetes. The assessment of aonla genotype become crucial for discovering superior varieties with good size of fruits, high yielding varieties, varieties with tolerant to biotic and abiotic stress, and varieties with enrich neutraceutical traits.

This study aims to evaluate the physico-chemical attributes of different aonla genotypes under the agro-climatic conditions of Eastern Uttar Pradesh, with a focus on identifying varieties that are best suited for this region.

**Material and Methods**

The study was conducted during winter season in the laboratory of Department of Horticulture, Babasaheb Bhimrao Ambedkar University Vidya Vihar, Lucknow, Uttar Pradesh. The samples were collected from NDUA&T Ayodya Uttar Pradesh.

**Experimental material**

Ten genotypes and fifty fruits from each genotype with uniform, disease free sample were randomly collected from NDUA&T Ayodya, Uttar Pradesh when fruits are near ripe (mature fruits). The samples were brought to the laboratory and experiment was carried out at the same time in the month of November.



Fig 1: Samples of Aonla (*Emblica officinalis* L.)

**Table no.1-** Details of genotype are as follows

|  |  |  |  |
| --- | --- | --- | --- |
| **S.NO**. | **Name of**  **Varieties /genotypes** | **S.NO.** | **Name of**  **Varieties/ genotypes** |
| 1. | Banarasi | 6. | Laxmi - 52 |
| 2. | Chakaiya | 7. | NA- 6 |
| 3. | Krishna | 8. | NA- 7 |
| 4. | Francis (Hathijhool) | 9. | Anand-1 |
| 5. | Kanchan | 10. | NA-10 |

Statistical design and analysis

The CRBD of statistical design was used in the experiment. The data were statistically analysed by the method given by Panse and Sukhatme (1963).

**Results and Discussion**

**Physical attributes of different genotypes**

The physical characteristics of different aonla genotypes are varied from each other. The length of fruit shows marked variation in different selected varieties/genotypes. The fruit length was found to range from 2.46 cm to 4.48 cm, with the mean value of 3.42 cm. The maximum fruit length was recorded in NA-7, which was 4.38cm. Our results were also anticipated by the findings of Singh *et al.* (2016), where they found fruit having a 2.5cm length, and Krishnaveni and Mirunalini (2010). This variation is due to the genetic characteristics of varieties and the rate of enlargement of mesocarp cells of fruits as well as micro-climatic factors (Balasubramanyam and Bangaruswamy, 1998). The fruit width ranged from 3.07 to 4.66 cm, with the mean value of 3.8 %. The maximum fruit width (4.66 cm) was recorded in NA-7, followed by Krishna and Banarasi. The highest fruit weight was highest in NA-7 with 44.33g among the genotypes, whereas the range of the fruit width was recorded as 3.07cm to 4.66 cm with the mean value of 3.84 cm. Such variation in this character of different varieties/genotypes may be due to the genetic makeup of genotypes or due to the rate of enlargement of cells of the mesocarp. *Supe et al.*, (1995) also reported variability in the weight of fruits in different varieties/genotypes of aonla. The results also confirm the findings of Singh *et al.,* (1987), Singh and Pathak (1987). The specific gravity varied with genotypes, which ranged from 1.05% to 1.77% with the mean value of 1.41. Among the genotypes, NA-7 was found to have the maximum specific gravity (1.77%).

**Table no.2: Physical Characteristics of Different Aonla (*Emblica officinalis*) Genotypes under Eastern Uttar Pradesh Conditions**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Genotypes** | **Length of fruits (cm)** | **Width of fruits (cm)** | **Weight of fruits(gm)** | **Specific gravity** | **Pulp %** | **Stone %** | **Juice %** |
| Banarasi | 3.75 | 4.02 | 35.33 | 1.05 | 54.37 | 5.54 | 30.51 |
| Laxmi -52 | 3.26 | 3.47 | 43 | 1.2 | 48.07 | 9.12 | 32.41 |
| Chakiya | 3.31 | 3.83 | 35.33 | 1.56 | 65.52 | 7.36 | 34.73 |
| Krishna | 2.93 | 4.33 | 40.67 | 1.33 | 59.97 | 7.63 | 33.12 |
| Anand-1 | 3.52 | 3.87 | 36.67 | 1.71 | 63.64 | 7.04 | 33.2 |
| Kanchan | 3.45 | 3.92 | 34 | 1.5 | 62.63 | 7.29 | 25.78 |
| Francis | 3.78 | 3.93 | 30.67 | 1.45 | 88.97 | 6.06 | 37.75 |
| NA-6 | 2.46 | 3.07 | 40.67 | 1.33 | 84.73 | 10.26 | 32.91 |
| NA-7 | **4.38** | 4.66 | 47.33 | 1.77 | 89.46 | 8.4 | 38.54 |
| NA-10 | 3.36 | 3.28 | 34 | 1.25 | 81.2 | 6.51 | 37.58 |
| **Mean** | **3.42** | **3.84** | **37.77** | **1.41** | **69.86** | **7.52** | **33.65** |
| **CD at 5%** | **0.15** | **0.33** | **4.08** | **0.21** | **9.1** | **1.31** | **1.66** |

Each variety/genotype had six capsules/segments per fruit, and there was no difference noted for this trait. This is due to the varietal character of the fruits of different genotypes of aonla. The pulp percentage varied among the genotypes of aonla, and it ranged from 48.07% to 89.46% with the mean value of 69.86%. Among the genotypes, NA-7 was found to have the maximum pulp percentage (89.46 %), whereas the minimum pulp percentage was noted in variety Laxmi-52 (48.07%). Such variation in this parameter is due to genetic make-up and nutrient uptake by plants. The results confirm the findings of Supe *et al.,* (1995*),* Kumar *et al.,* (2001). The stone percentage also varied from 5.54% to 10.26% with the mean value of 7.52 %, and variety NA-6 had the maximum stone percentage (10.26%), whereas the minimum stone percentage was noted in variety Banarasi (5.54%). The results of stone percent are also agreed with the findings of Ram *et al.*, (1983) and Singh *et al.*, (1989). The juice content in aonla was also varied with varieties/genotypes during this study. The juice content among the genotypes was found to range from 25.78 to 38.54 percent. The genotype NA-7 was found superior in terms of juice content with 38.54 percent. Our results are also supported by the findings of Thakur *et al.,* (2018) and Bairwa [*et al*](http://et.al)*.*, (2020) where they found juice content to be 44.50% and 38.70% respectively.

**Biochemical attributes in different genotypes:**

During this study, a great variation was recorded among the genotypes of aonla in respect of biochemical composition. The TSS is an important quality parameter as it indicates sweetness, ripeness, and overall fruit quality. The total soluble solid content in aonla was found to range from 4.3 to 10.21, with the mean value of 8.23. Among the genotypes, NA-10 was found to have a maximum (10.21) total soluble. Our results are also supported by the finding of Bairwa [*et al*](http://et.al)*.,* (2020) and also by Balasubramanyam and Bangaruswamy (1998), where they found fruit growth, color change, and biochemical composition (TSS, sugar, and ascorbic acid) in *Phyllanthus emblica* follow a well-defined developmental pattern, with significant changes occurring up to 120 days after fruit set, indicating the optimal harvest stage. The variation in Total Soluble Solid (TSS) content in Aonla is due to genetic differences, environmental conditions, and cultivation practices. The acidity percentage in aonla during this study varied from 0.99 to 1.59 percent with the mean value of 1.3 percent. A similar result was found by Pandey *et* *al.,* (2014) and Singh *et al.,* (2016). Generally, total acidity in gooseberry was low at the immature stage and slowly increased with the advancement of maturity (Pathak, 2003). Ascorbic acid content in Indian gooseberry accessions exhibited a wide range of variation. The ascorbic acid content among genotypes exhibited a wide range of variation. During this study, the ascorbic acid content was noted to range from 420.01 mg to 583.9 mg, with the mean value of 524.18 mg, whereas the genotype NA-7 had the highest (583.9 mg) ascorbic acid content.

**Table no. 3: Biochemical Attributes of Aonla (*Emblica officinalis*) Genotypes under Eastern Uttar Pradesh Conditions**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Genotypes** | **T.S.S. Brix** | **Acidity %** | **Ascorbic acid (mg/100g)** | **Total sugar %** | **Reducing sugar %** | **Non-Reducing sugar %** |
| Banarasi | 9.17 | 0.99 | 533.2 | 7.47 | 4.23 | 3.08 |
| Laxmi -52 | 8.77 | 1.12 | 535.35 | 6.93 | 4.76 | 2.57 |
| Chakaiya | 7.39 | 1.51 | 566.78 | 7.48 | 4.17 | 3.14 |
| Krishna | 9.17 | 1.26 | 525.69 | 7.5 | 4.33 | 3.02 |
| Anand-1 | 9.55 | 1.37 | 547.24 | 7.53 | 4.19 | 3.17 |
| Kanchan | 7.42 | 1.27 | 541.62 | 7.49 | 3.63 | 3.39 |
| Francis | 9.15 | 1.59 | 420.01 | 7.43 | 3.96 | 3.58 |
| NA-6 | 4.39 | 1.59 | 560.43 | 7.39 | 4.32 | 2.92 |
| NA-7 | 7.12 | 1.31 | 583.9 | 7.75 | 4.49 | 3.01 |
| NA-10 | 10.21 | 1.01 | 427.57 | 7.55 | 4.14 | 3.24 |
| **Mean** | **8.23** | **1.3** | **524.18** | **7.45** | **4.22** | **3.11** |
| **CD at 5%** | **0.58** | **0.07** | **2.57** | **0.22** | **0.18** | **0.22** |

A significant variation also occurred among the genotypes with regards to total sugar content, ranging from 6.9 to 7.75 percent with the mean value of 7.55 percent. The genotype NA-7 was found to have the highest (7.75 %) total sugar content. Our results are also agreed with the findings of Goyal *et al*., (2008). On the other hand, reducing sugar and non-reducing sugar content was highest in Laxmi (4.76 %) and Francis (3.58 %) respectively. These biochemical variations among the genotypes are supported by the finding of Pandey *et al,* (2014).

**Conclusion:**

This study highlights significant variations in aonla genotypes, with NA-7 emerging as the most promising. Aonla’s nutraceutical value makes it ideal for value-added products. Future focus should be on breeding, post-harvest management, climate resilience, and commercialization through improved storage and organic farming, enhancing its market potential and economic benefits.

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