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

**Abstract**

Aonla (*Emblica officinalis* Gaertn.), a nutritionally rich fruit from the Euphorbiaceae family, is widely cultivated in India, with Uttar Pradesh leading in production. This study evaluates the physico-chemical attributes of ten aonla genotypes under the agro-climatic conditions of Eastern Uttar Pradesh. The results highlight significant variations in fruit size, weight, pulp percentage, juice content, and biochemical properties. Among the genotypes, NA-7 exhibited superior characteristics, including maximum 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). These variations are attributed to genetic makeup and environmental factors. Given its high nutraceutical value, aonla is ideal for value-added products such as murabba, candy, 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.

**Introduction**

Aonla or Indian gooseberry (*EmblicaofficinalisGaertn syn. Phyllanthusemblica L*.) 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 acidity 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). Furth more, anola is an excellent source of ascorbic acid antioxids 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 medicine 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, diabetes.

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.

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

The each variety/genotype had six capsules/segments per fruits and there was no any difference was noted for this trait. This is due to varietals 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% and with mean value of 69.86%. Among the genotypes, NA-7 was found to have 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 nutrients uptake by plants. The results confirm of the findings of Supe *et. al.* (1995*),* Kumar *et. al.* (2001). The stone percentage also varied from 5.54% to 10.26% with mean value of 7.52 % and variety NA-6 had maximum stone percentage (10.26%), whereas minimum stone percentage was noted in variety Banarasi (5.54%). The results of stone percente are also agreed with finding 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 in among the genotypes was ranged from 25.78-38.54 percent. The genotype NA-7 was found superior in term of juice content with 38.54 percent. Our results are also supported by the findings of Thakur *et. al,*(2018) Bairwa *et.al*, (2020) where they found juice content 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 bio-chemical composition. TSS is an important quality parameter as it indicates sweetness, ripeness, and overall fruit quality. The total soluble solid content in aonla was ranged from 4.3 to 10.21 with the mean value of 8.23. Among the genotypes NA-10 was found to have maximum (10.21) Total soluble. Our results are also supported by the finding of Bairwa *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 Aonlai**s** due to genetic differences, environmental conditions, and cultivation practices. The acidity percentage in aonla during this study was varied from 0.99 to 1.59 percent with mean value 1.3 percent. Similar result was found by Pandey *et. al,* (2014) and Singh *et. al,* (2016). Generally, total acidity gooseberry was low at immature stage and slowly increased with advancement of maturity (Pathak, 2003). Ascorbic acid content in Indian gooseberry accessions exhibited a wide range of variation. The ascorbic acid content among genotypes was exhibited wide range of variation. During this study, the ascorbic acid content was ranged from 420.01 mg – 583.9 mg with the mean value of 524.18 mg whereas the genotype NA-7 had 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 was also occurred among the genotype with regards of total sugar content ranged from 6.9 to 7.75 percent with mean value of 7.55 percent. The genotype NA-7 found to have 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).

**Conlusion:**

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, organic farming, enhancing its market potential and economic benefits.

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