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EVALUATION OF MANGO (*Mangifera indica*) GENOTYPES FROM TRIBAL REGIONS OF WESTERN MAHARASHTRA FOR AMCHUR PROCESSING POTENTIAL

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ABSTRACT

A field survey was conducted during 2024 across the tribal belt of Nandurbar district, Maharashtra, to identify and characterize local mango (*Mangifera indica* L.) genotypes with potential for amchur (dried raw mango powder) processing. Fifty genotypes were collected at physiological maturity and evaluated for morphological and biochemical traits. Considerable variability was observed among the genotypes for all the characters studied. Genotype G-43 recorded the highest fruit weight (372.62 g), pulp weight (268.40 g) and pulp-to-stone ratio (5.71), whereas G-6 recorded the maximum fruit length (11.94 cm) and fruit diameter (15.20 cm). Biochemical characters also exhibited wide variability. Genotype G-18 recorded the highest titratable acidity (8.97%) and ascorbic acid content (188.27 mg 100 g⁻¹), while G-33 recorded the lowest TSS (4.00 °B), TSS ratio (0.63), reducing sugars (0.21%), non-reducing sugars (0.31%) and total sugars (0.52%) regarded as a desirable attribute while selecting superior mango genotypes for amchur processing. Considering the requirements of amchur processing, particularly high acidity, G-18 appeared promising for acidic raw mango characteristics, while G-43 was superior for fruit and pulp yield attributes. The results demonstrated substantial phenotypic and biochemical diversity among the local mango genotypes of Nandurbar district, providing useful material for selection and further evaluation for amchur processing.

Key word: Mango, Amchur, Biochemical, Morphological, Genotypes, etc.

Introduction

Mango (*Mangifera indica* L.) is the leading fruit crop of India and is cultivated across a wide range of agro-climatic zones, giving rise to enormous genetic diversity in seedling and locally selected genotypes (Jena *et al.*, 2021). Much of this diversity persists as unnamed, farmer-maintained trees in tribal and hilly tracts that have not been systematically documented, even though such populations are a valuable reservoir of traits for both fresh-fruit and processing end-uses (Saroj *et al.*, 2023). Among mango-based value-added products, amchur (dried raw mango powder) is a widely used souring agent in Indian cuisine, prepared by slicing, sun-drying and grinding unripe fruit. The suitability of a genotype for

amchur is governed less by ripe-fruit sweetness than by the acid load, ascorbic acid content and pulp recovery of the mature-green fruit, since a high titratable acidity and comparatively low sugar content are considered desirable for a tangy, storable powder (Krishna *et al.*, 2020).

Systematic characterization of morphological and biochemical descriptors is the first step in identifying genotypes suited to a specific end-use and in prioritising material for conservation and breeding (International Plant Genetic Resources Institute [IPGRI], 2006). Recent characterization studies on commercial and indigenous mango genotypes have reported wide variability in fruit weight, pulp:stone ratio, total soluble solids (TSS), titratable acidity, ascorbic acid and sugars, and have used this

variability to identify genotypes suited to table, juice, pulp or drying purposes (Kumar *et al.*, 2021; Megha *et al.*, 2022; Saroj *et al.*, 2023).

Mangoes are always in great demand because of their distinctive flavour and taste. In India, this crop also has social, cultural, and religious significance. It is also a good source of vitamin E and very nutritive in terms of vitamin and carotene content. Its pulp, which is high in carbohydrates, vitamins, and ascorbic acid, is utilized for human consumption. It has a carbohydrate content of 11.8%, 4800 IU of vitamin A, 13 mg/100 gm of ascorbic acid, 12.0-23 TSS (°Brix) and 0.12-0.38% acidity. Mangoes provide up to 40% of the daily requirement for dietary fibre (Chandra and Chandra, 1997; Himabindu *et al.*, 2017).

Despite this body of work on named commercial cultivars, the seedling mango populations of tribal and remote districts of Maharashtra such as Nandurbar remain largely uncharacterized for processing-relevant traits, even though such populations are routinely used by local communities for amchur. The present study was therefore undertaken to survey, collect and characterize fifty local mango genotypes from the tribal regions of Nandurbar district for key morphological and biochemical parameters, and to identify genotypes with the acidity, sugar and pulp-recovery profile best suited to amchur processing.

Materials and Methods

The presentation investigation was conducted during 2024 through a survey and collection programme at different locations in Nandurbar district of Maharashtra. Fifty local mango genotypes were identified and collected during the mango harvesting season and designated as G-1 to G-50. The collected fruits were brought to the Department of Horticulture, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, for morphological and biochemical evaluation. The experimental material comprised locally available mango genotypes representing the indigenous diversity of the study region. Morphological characterization was carried out by evaluating representative fruits of each genotype for fruit length (cm), fruit diameter (cm), fruit weight (g), pulp weight (g), peel weight (g), stone weight (g) and pulp-to-stone ratio. Biochemical characterization was performed for total soluble solids (TSS, °B), titratable acidity (%), TSS-to-acidity ratio, ascorbic acid (mg 100 g⁻¹), reducing sugars (%), non-reducing sugars (%) and total sugars (%). The observations recorded for morphological and biochemical attributes exhibited substantial variability among the evaluated genotypes. The

data were analysed using descriptive statistical methods, and range, mean, standard deviation, variance, standard error and coefficient of variation were calculated to assess the magnitude of variability among the mango genotypes (Panse and Sukhatme, 1989).

Results and Discussion

Morphological observation of fruit Character

The morphological characterization of fifty local mango genotypes collected from different locations of Nandurbar district revealed considerable variability in fruit dimensions and component traits. The observations pertaining to fruit length, fruit diameter, fruit weight, pulp weight, peel weight, stone weight and pulp ratio were presented in Table 1. The observed variability indicated the presence of substantial phenotypic diversity among the evaluated genotypes.

Fruit length (cm)

The results revealed considerable variability among the genotypes, with fruit length ranged from 6.49 to 11.94 cm, with a mean value of 8.99 cm. The maximum fruit length was recorded in G-6 (11.94 cm), followed by G-47 (11.26 cm), G-37 (11.25 cm) and G-42 (11.09 cm), whereas the minimum was recorded in G-15 (6.49 cm). The coefficient of variation was 14.40 per cent, indicating comparatively moderate variability for this trait. The variation in fruit length among the genotypes could have been attributed to inherent genetic differences controlling fruit development and cell expansion. The relatively longer fruits observed in G-6 indicated its superior fruit dimensional characteristics, whereas the shorter fruits of G-15 reflected a comparatively smaller fruit phenotype. Considerable variability in fruit length among mango genotypes had also been reported by Jena *et al.*, (2021), who characterized 58 Indian mango genotypes using a wide range of fruit and leaf descriptors. Similar variation in fruit dimensions had been documented during morphological evaluation of diverse mango germplasm by Khadivi *et al.*, (2022) and Ruchika *et al.*, (2023).

Fruit Diameter (cm)

Fruit diameter ranged from 8.77 to 15.20 cm, with an overall mean of 12.14 cm. The maximum fruit diameter was recorded in G-6 (15.20 cm), followed by G-43 (14.95 cm), G-47 (14.90 cm) and G-37 (14.80 cm), whereas the minimum diameter was recorded in G-15 (8.77 cm). The coefficient of variation was 12.89 per cent, indicating relatively lower variability for fruit diameter than for several other fruit attributes. The observed differences in fruit diameter suggested considerable genotypic variation in transverse fruit growth. The larger diameter recorded in G-6, G-43 and G-47 indicated greater fruit

Table 1: Morphological characters of fifty local mango (G) genotypes from Nandurbar district.

Geno- types	Fruit length (cm)	Fruit Diameter (cm)	Fruit Weight (g)	Weight of Pulp (g)	Weight of Peel (g)	Weight of Stone (g)	Pulp: Stone ratio
G-1	9.16	12.36	180.4	108.6	27.20	44.6	2.43
G-2	6.50	9.15	86.74	50.00	16.92	19.82	2.52
G-3	9.37	12.84	231.08	159.56	31.48	40.04	3.99
G-4	6.83	9.88	131.7	71.29	21.3	39.12	1.82
G-5	9.54	13.02	219.18	139.52	34.24	45.42	3.07
G-6	11.94	15.20	191.42	124.54	30.12	36.76	3.39
G-7	7.13	9.49	83.54	50.62	13.24	19.68	2.57
G-8	8.76	11.69	153.90	100.78	23.88	29.24	3.45
G-9	8.64	11.81	168.68	113.07	28.66	26.94	4.20
G-10	9.59	12.62	163.78	111.04	25.47	27.26	4.07
G-11	8.51	11.76	215.78	146.44	32.06	37.28	3.93
G-12	10.26	13.89	268.28	158.89	46.50	62.88	2.53
G-13	9.07	11.78	147.32	92.90	22.58	31.84	2.92
G-14	7.89	11.21	182.58	123.26	29.30	29.96	4.11
G-15	6.49	8.77	75.58	43.99	10.98	20.62	2.13
G-16	7.40	10.31	117.22	76.74	19.52	20.96	3.66
G-17	8.23	11.25	148.84	92.92	28.46	27.46	3.38
G-18	9.47	12.05	133.02	87.2	21.16	24.66	3.54
G-19	9.14	12.67	210.22	150.58	29.70	29.92	5.03
G-20	9.01	11.89	149.06	97.02	23.82	28.22	3.44
G-21	8.16	10.63	97.12	64.90	13.64	18.58	3.49
G-22	9.54	12.96	213.20	146.26	31.90	35.04	4.17
G-23	9.15	12.30	168.54	104.08	31.82	32.62	3.19
G-24	9.33	12.06	163.26	106.81	26.13	30.32	3.52
G-25	9.18	11.80	143.28	92.79	22.32	28.18	3.29
G-26	8.85	11.39	103.06	66.2	15.00	21.86	3.03
G-27	7.55	10.09	92.46	61.28	13.76	17.42	3.52
G-28	7.80	10.9	136.84	88.66	21.12	27.06	3.28
G-29	7.65	11.11	147.20	94.62	23.68	28.90	3.27
G-30	8.57	11.51	137.56	94.78	22.12	20.66	4.59
G-31	7.46	10.46	113.40	70.31	15.72	27.36	2.57
G-32	8.39	11.16	150.68	99.74	24.04	26.90	3.71
G-33	8.04	11.37	154.42	101.14	24.76	28.52	3.55
G-34	8.76	12.06	163.54	102.14	29.22	32.18	3.17
G-35	10.03	12.81	216.52	140.03	37.54	38.96	3.59
G-36	7.56	10.61	145.74	90.08	23.84	31.82	2.83
G-37	11.25	14.80	265.64	167.06	57.24	41.34	4.04
G-38	8.13	11.58	252.12	163.23	49.34	39.54	4.13
G-39	9.88	12.91	205.20	143.31	30.26	31.66	4.53
G-40	9.43	12.94	206.70	132.2	39.10	35.40	3.73
G-41	10.73	13.81	199.22	136.74	31.02	31.46	4.35
G-42	11.09	14.64	259.46	168.73	51.30	39.42	4.28
G-43	10.93	14.95	372.62	268.40	57.22	47.00	5.71
G-44	8.13	11.17	143.02	88.00	23.14	31.88	2.76
G-45	9.75	13.52	253.02	172.41	47.86	32.76	5.26
G-46	8.69	12.12	202.54	133.15	38.06	31.34	4.25
G-47	11.26	14.90	263.42	176.84	52.12	34.44	5.13
G-48	10.92	14.46	254.98	167.13	51.94	35.92	4.65

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G-49	10.49	14.26	210.96	138.56	41.86	30.54	4.54
G-50	10.27	14.07	255.60	167.75	52.40	35.44	4.73
Range	6.49 to 11.94	8.77 to 15.20	75.58 to 372.62	43.99 to 268.40	10.98 to 57.24	17.42 to 62.88	1.82 to 5.71
Mean	8.99	12.14	178.99	116.92	30.32	31.74	3.54
S.D.	1.29	1.56	60.03	42.35	12.24	8.36	0.83
Variance	1.68	2.44	3603.81	1794.04	150.03	69.90	0.70
S. E.	0.18	0.22	8.49	5.99	1.73	1.18	0.11
CV	14.40	12.89	33.53	36.23	40.40	26.33	22.83

girth and overall fruit size, which could have contributed to higher fresh fruit mass and greater processing potential. Similar genotype-dependent differences in fruit size and shape had been reported by Megha *et al.*, (2022) during physicochemical characterization of diverse mango genotypes. Such diversity in fruit dimensional characteristics had been observed among mango germplasm by Jena *et al.*, (2021), who reported pronounced polymorphism for several fruit characters.

Fruit Weight (g)

Fruit weight exhibited marked variability among the genotypes and ranged from 75.58 to 372.62 g, with a mean value of 178.99 g. The maximum fruit weight was recorded in G-43 (372.62 g), followed by G-12 (268.28 g), G-37 (265.64 g) and G-47 (263.42 g), whereas the minimum fruit weight was recorded in G-15 (75.58 g). The coefficient of variation was 33.53 per cent, indicating substantial variability for fruit weight. The wide range observed for fruit weight indicated marked genotypic differences in fruit growth and biomass accumulation. The exceptionally high fruit weight of G-43 suggested greater potential for obtaining a larger quantity of raw fruit material per fruit. These findings are in conformity with earlier reports by Khadivi *et al.*, (2022) variation in fruit diameter, this variation may be due to genetic or physiological factors. Such variability in fruit weight was also reported by Megha *et al.*, (2022) among mango genotypes, and was considered an important descriptor for characterization and utilization of mango germplasm.

Pulp Weight (g)

The results revealed considerable variability among the genotypes, with pulp weight ranged from 43.99 to 268.40 g, with a mean of 116.92 g. The maximum pulp weight was recorded in G-43 (268.40 g), followed by G-47 (176.84 g), G-45 (172.41 g) and G-42 (168.73 g), whereas the minimum pulp weight was recorded in G-15 (43.99 g). The coefficient of variation was 36.23 per cent, indicating substantial variability among the genotypes for pulp accumulation.

The considerable variation in pulp weight suggested differential allocation of fruit biomass to the edible

mesocarp among the genotypes. G-43, which recorded the highest pulp weight, would have provided a greater quantity of pulp as raw material for processing. The higher pulp availability was particularly relevant for amchur preparation because it could have increased the quantity of recoverable fruit tissue available for slicing and drying. Similar variability in pulp-related characteristics among mango genotypes had been reported by Deshmukh and Patil (2016) during screening of local mango genotypes for amchur preparation and similar variation in pulp characteristics had also been reported in diverse mango germplasm by Das *et al.*, (2021) and Jadhav *et al.*, (2022).

Peel Weight (g)

Peel weight varied from 10.98 to 57.24 g, with a mean of 30.32 g. The maximum peel weight was recorded in G-37 (57.24 g), closely followed by G-43 (57.22 g), G-50 (52.40 g) and G-47 (52.12 g), whereas the minimum peel weight was recorded in G-15 (10.98 g) and lower peel weight considered the superior character for selection of mango genotypes for amchur. The coefficient of variation was 40.40 per cent, which represented the highest variability among the morphological characters evaluated.

The pronounced variation in peel weight indicated substantial genotypic differences in pericarp development and the relative allocation of fruit biomass to the peel. From a processing perspective, lower peel proportion would generally have been advantageous because a greater proportion of fruit biomass could have been available as usable pulp. However, absolute peel weight was interpreted in relation to fruit weight and pulp weight rather than as an independent selection criterion. Verma *et al.*, (2018) and Das *et al.*, (2021) reported substantial phenotypic and genotypic variability for peel weight in mango germplasm, supporting the presence of considerable genetic variation for this component trait.

Stone Weight (g)

Stone weight ranged from 17.42 to 62.88 g, with a mean of 31.74 g. The maximum stone weight was recorded in G-12 (62.88 g), followed by G-43 (47.00 g), G-5 (45.42 g) and G-1 (44.60 g), whereas the minimum

Table 2: Biochemical characters of fifty local mango (G) genotypes from Nandurbar district.

Geno- types	TSS (°B)	Titrateable Acidity (%)	TSS:acidity ratio	Ascorbic Acid (mg 100g ⁻¹)	Reducing sugars (%)	Non-reducing sugar (%)	Total Sugars (%)
G-1	6.92	5.10	1.36	154.16	0.69	1.24	1.93
G-2	10.90	4.22	2.58	141.37	0.87	1.58	2.45
G-3	7.23	5.97	1.21	162.49	0.71	1.35	2.06
G-4	6.17	7.05	0.88	174.29	0.64	1.07	1.71
G-5	7.90	4.83	1.64	154.91	0.72	1.39	2.11
G-6	6.30	7.47	0.84	177.84	0.69	1.20	1.89
G-7	6.30	8.29	0.76	183.67	0.68	1.22	1.90
G-8	9.82	6.52	1.50	144.86	0.75	1.49	2.24
G-9	8.20	5.57	1.47	160.17	0.73	1.42	2.15
G-10	5.10	6.10	0.84	167.23	0.61	0.88	1.49
G-11	8.77	5.85	1.50	161.86	0.74	1.46	2.20
G-12	8.11	4.50	1.80	145.68	0.73	1.41	2.14
G-13	8.80	6.90	1.28	172.69	0.75	1.39	2.14
G-14	5.70	7.30	0.78	175.98	0.61	0.94	1.55
G-15	8.20	4.56	1.80	146.31	0.74	1.43	2.17
G-16	9.64	5.98	1.61	163.04	0.77	1.56	2.33
G-17	6.96	4.98	1.40	157.48	0.69	1.24	1.93
G-18	6.79	8.97	0.76	188.27	0.68	1.23	1.91
G-19	9.20	5.00	1.84	151.8	0.75	1.51	2.26
G-20	7.87	5.74	1.37	161.53	0.72	1.37	2.09
G-21	8.90	6.04	1.47	165.84	0.76	1.40	2.03
G-22	7.20	4.33	1.66	142.99	0.69	1.35	2.04
G-23	8.40	4.57	1.84	146.14	0.75	1.38	2.13
G-24	6.80	8.01	0.85	180.27	0.7	1.29	2.16
G-25	8.05	5.52	1.46	159.82	0.73	1.30	1.99
G-26	7.63	4.73	1.61	148.25	0.71	1.25	1.96
G-27	8.80	6.99	1.26	174.13	0.75	1.41	2.16
G-28	4.80	7.04	0.68	176.01	0.56	0.72	1.28
G-29	9.53	5.40	1.76	158.42	0.81	1.52	2.33
G-30	9.14	6.64	1.38	171.57	0.79	1.51	2.30
G-31	6.10	4.35	1.40	143.61	0.61	0.84	1.45
G-32	8.80	6.90	1.28	173.88	0.75	1.43	2.18
G-33	4.00	6.31	0.63	169.26	0.21	0.31	0.52
G-34	8.90	5.39	1.65	157.09	0.75	1.43	2.18
G-35	7.90	5.17	1.53	154.72	0.72	1.28	2.00
G-36	9.40	6.10	1.54	168.01	0.76	1.53	2.29
G-37	9.20	6.73	1.37	170.34	0.75	1.51	2.26
G-38	5.20	7.80	0.67	180.47	0.40	0.61	1.01
G-39	8.21	5.73	1.43	161.51	0.74	1.33	2.07
G-40	7.89	3.90	2.02	137.93	0.72	1.31	2.03
G-41	8.52	5.20	1.64	157.26	0.74	1.36	2.10
G-42	6.70	6.57	1.02	170.23	0.70	1.19	1.89
G-43	8.91	7.22	1.23	173.49	0.75	1.38	2.13
G-44	9.20	5.24	1.76	158.2	0.79	1.52	2.31
G-45	8.98	7.33	1.23	176.44	0.76	1.44	2.20
G-46	7.50	4.40	1.70	145.82	0.70	1.26	1.96
G-47	7.58	4.10	1.85	140.67	0.73	1.29	2.02
G-48	8.10	4.80	1.69	152.43	0.74	1.32	2.06

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G-49	6.06	5.12	1.18	153.94	0.61	1.27	1.88
G-50	8.20	4.12	1.99	141.53	0.73	1.33	2.06
Range	4.00 to 10.90	3.90 to 8.97	0.63 to 2.58	137.93 to 188.27	0.21 to 0.87	0.31 to 1.58	0.52 to 2.45
Mean	7.79	5.81	1.41	161.12	0.70	1.29	2.00
S.D.	1.44	1.24	0.43	13.02	0.10	0.25	0.35
Variance	2.07	1.54	0.18	169.57	0.01	0.06	0.12
S.E.	0.20	0.17	0.06	1.84	0.01	0.04	0.05
CV	18.49	21.35	30.12	8.08	14.30	19.44	17.391

stone weight was recorded in G-27 (17.42 g). The coefficient of variation was 26.33 per cent, indicating moderate-to-substantial variability among the genotypes.

The differences in stone weight reflected genotypic variation in seed and endocarp development. A lower stone contribution would have been advantageous for processing when accompanied by a high proportion of pulp, as it would have increased the relative recovery of usable fruit tissue. Therefore, stone weight was more appropriately evaluated together with pulp weight and pulp ratio. Deshmukh and Patil (2016) reported considerable variation in stone weight among local mango genotypes screened for amchur production, similar variability in stone weight has been reported by Patel *et al.*, (2005) and Rajwana *et al.*, (2011), further highlighting its significance in influencing pulp recovery and overall fruit quality in indigenous mango genotypes.

Pulp: Stone ratio

The pulp ratio ranged from 1.82 to 5.71, with an overall mean of 3.54. The maximum ratio was recorded in G-43 (5.71), followed by G-45 (5.26), G-47 (5.13) and G-19 (5.03), whereas the minimum ratio was recorded in G-4 (1.82). The coefficient of variation was 22.83 per cent, indicating appreciable genotypic variation for this processing-related trait. The pulp ratio provided an important indication of the relative proportion of usable pulp in relation to the non-edible stone fraction. Accordingly, a higher pulp ratio was considered advantageous for processing because a greater quantity of pulp could have been obtained relative to the stone. The markedly higher ratio recorded in G-43, together with its highest fruit weight and pulp weight, indicated strong morphological potential for pulp-based processing. Similar variability in pulp-to-stone ratio has been reported by Deshmukh and Patil (2016) and Karate *et al.*, (2023), emphasizing its importance in determining processing efficiency as well as consumer preference.

Biochemical observation of fruit characters

The biochemical characteristics of the fifty local mango genotypes exhibited substantial genotypic variability, particularly for attributes associated with fruit

acidity, soluble solids and sugar composition. The data regarding biochemical parameter evaluated for mango genotypes are presented in Table 2.

TSS (°B)

TSS content ranged from 4.00 to 10.90 °B, with substantial differences among individual genotypes. The maximum TSS was recorded in G-2 (10.90 °B), followed by G-8 (9.82 °B), G-16 (9.64 °B) and G-29 (9.53 °B), whereas the minimum TSS was observed in G-33 (4.00 °B), followed by G-28 (4.80 °B), G-10 (5.10 °B) and G-14 (5.70 °B). The relatively lower TSS recorded in these genotypes indicates comparatively lower accumulation of soluble solids and suggests a more acidic, less sweet fruit profile.

From an amchur-processing perspective, lower TSS may be considered a desirable attribute when it occurs in association with high titratable acidity and low sugar concentration, since excessive soluble solids and sugars can shift the sensory profile towards sweetness and reduce the characteristic sourness required in amchur. These findings are in agreement with Singh *et al.*, (2023) and Deshmukh and Patil (2016), who identified an acidic local genotype as suitable for amchur processing.

Titratable Acidity (%)

The titratable acidity exhibited substantial variation among the genotypes and ranged from 3.90 to 8.97 per cent. The maximum acidity was recorded in G-18 (8.97%), while the minimum was recorded in G-40 (3.90%). The coefficient of variation was 21.35 per cent, indicated considerable genotypic variation for organic-acid accumulation.

Titratable acidity represented one of the most important biochemical attributes for evaluating mango genotypes intended for amchur production because the characteristic sensory quality of amchur was primarily associated with pronounced sourness. The observed variation in titratable acidity was in agreement with Deshmukh and Patil (2016) and Jena *et al.*, (2021), who reported substantial biochemical variability among local mango genotypes, highlighting their potential for specialized utilization.

TSS:acidity ratio

The ratio varied from 0.63 to 2.58, demonstrating substantial variation in the relative proportion of soluble solids to titratable acidity among the genotypes. The highest ratio was recorded in G-2 (2.58), whereas the lowest ratio was recorded in G-33 (0.63). The coefficient of variation was 30.12 per cent, which indicated comparatively high variability among the genotypes for this integrated quality attribute.

A lower TSS ratio was considered desirable for amchur-oriented genotype selection because it reflected a biochemical composition in which acidity predominated relative to soluble solids. Consequently, G-33, which recorded the lowest TSS ratio, was considered particularly promising for further evaluation for amchur preparation. This finding was in agreement with Deshmukh and Patil (2016) and Jena *et al.*, (2021), who reported the usefulness of biochemical traits in differentiating mango genotypes for specific uses. Raj *et al.*, (2025) also emphasized the importance of the TSS-to-acidity ratio in determining fruit quality and processing suitability.

Ascorbic Acid (mg 100g⁻¹)

Ascorbic acid content varied from 137.93 to 188.27 mg 100 g⁻¹. The highest ascorbic acid concentration was recorded in G-18 (188.27 mg 100 g⁻¹), followed by G-7 (183.67 mg 100 g⁻¹), G-38 (180.47 mg 100 g⁻¹) and G-24 (180.27 mg 100 g⁻¹). The lowest value was recorded in G-40 (137.93 mg 100 g⁻¹).

The high ascorbic acid content of G-18, together with its maximum titratable acidity, indicates a favourable biochemical profile from a nutritional and acidic-quality perspective. Although ascorbic acid alone is not a definitive criterion for amchur suitability, its higher concentration adds nutritional value to the raw material and strengthens the processing potential of promising acidic genotypes. Such genotype-dependent variation in biochemical characteristics is consistent with the diversity reported among Indian mango germplasm by Jena *et al.*, (2021).

Reducing sugars (%)

Reducing sugar content varied from 0.21 to 0.87 per cent. The maximum reducing sugar content was recorded in G-2 (0.87%), while the minimum was recorded in G-33 (0.21%). G-33 therefore exhibited the lowest concentration of reducing sugars among the evaluated genotypes.

From the standpoint of amchur-oriented selection, lower reducing sugar concentration may be advantageous when associated with adequate acidity because the

desired product profile is predominantly sour rather than sweet.

Accordingly, the very low reducing sugar content of G-33 (0.21%), together with its low TSS and low TSS ratio, strengthens its suitability for further amchur evaluation. Such variation in sugar fractions among mango genotypes was also reported by Megha *et al.*, (2022) and Singh *et al.*, (2023), highlighting the role of sugar composition in flavour balance and processing suitability of unripe mango.

Non-reducing sugar (%)

Non-reducing sugar content ranged from 0.31 to 1.58 per cent. The highest value was recorded in G-2 (1.58%), followed by G-16 (1.56%) and G-36 (1.53%), whereas the lowest value was observed in G-33 (0.31%).

The comparatively low non-reducing sugar concentration in G-33, in combination with its low reducing sugar content, indicates substantially lower overall sugar accumulation. This biochemical characteristic is desirable for identifying raw mango genotypes with a strongly acidic and less sweet profile for amchur processing. Similar differences in sugar fractions were reported by Megha *et al.*, (2022).

Total Sugars (%)

Total sugar content ranged from 0.52 to 2.45 per cent. The maximum total sugar content was recorded in G-2 (2.45%), whereas the minimum was recorded in G-33 (0.52%). The markedly lower total sugar concentration of G-33, together with its minimum TSS and TSS ratio, indicates a distinctly acidic and less sweet biochemical profile.

For amchur processing, lower total sugar concentration may be considered favourable when accompanied by high acidity, as the characteristic quality of amchur is based primarily on sourness. Therefore, G-33 represents an interesting processing-oriented genotype because it combined minimum TSS (4.00 °B), minimum reducing sugars (0.21%), minimum non-reducing sugars (0.31%), minimum total sugars (0.52%) and minimum TSS ratio (0.63). These characteristics collectively distinguish G-33 as a promising candidate for further evaluation for amchur preparation.

Conclusion

The present investigation revealed substantial morphological and biochemical variability among the fifty local mango genotypes collected from Nandurbar district, indicating considerable diversity for traits associated with amchur processing potential. The genotypes varied in fruit size, pulp weight, peel and stone proportion, and pulp ratio,

thereby providing useful variation for identifying genotypes with favourable physical attributes for processing. Biochemical characterization further differentiated the genotypes for TSS, titratable acidity, TSS ratio, ascorbic acid and sugar fractions. For amchur-oriented selection, higher titratable acidity combined with lower TSS, lower sugar content and a lower TSS ratio was considered desirable for obtaining a pronounced acidic product. Based on the combined morphological and biochemical attributes, G-3, G-33, G-37 and G-43 exhibited promising characteristics for further evaluation. The identified diversity provided valuable scope for selection, conservation and future breeding or clonal multiplication of superior local mango genotypes, thereby supporting the utilization of indigenous mango resources and strengthening value-added amchur production in the tribal region of Nandurbar.

References

- Chandra, A. and Chandra A. (1997). *Production and Postharvest Technology of Fruits*, NBS pub. and Distributors, Bikaner, India.
- Das, S.S., Kishore K., Lenka D., Dash D.K., Samal K.C., Samant D., Panda C.M., Sahoo S.C. and Dash S.N. (2021). Assessment of genetic diversity in morphological traits of mango genotypes using D² statistics. *International Journal of Plant and Soil Science*, **33**(17), 31–42.
- Deshmukh, P.L. and Patil S.D. (2016). Screening of local mango genotypes for making amchur. *Bioinfolet*, **13**(4), 632–636.
- Himabindu, A., Srihari D., Rajasekhar M., Sudhavani V., Subbarammamma P., Uma Krishna K. and Paratpara Rao M. (2017). Genetic diversity for fruit morphological and biochemical characters of indigenous mango (*Mangifera indica* L.) cultivars of coastal districts in Andhra Pradesh using principal component analysis. *Electronic Journal of Plant Breeding*, **8**(3), 772–778.
- IPGRI. (2006). *Descriptor for mango (Mangifera indica L.)*. International Plant Genetic Resources Institute, Rome, Italy.
- Jadhav, S.D., Shinde V.N. and Kakade V. (2022). Characterization of leaves and fruits of mango (*Mangifera indica* L.). *The Pharma Innovation Journal*, **11**(4), 411–416.
- Jena, R.C., Agarwal K. and Chand P.K. (2021). Fruit and leaf diversity of selected Indian mangoes (*Mangifera indica* L.). *Scientia Horticulturae*, **282**, 109941.
- Karate, M., Kamble K. and Khobragade U. (2023). Physical and engineering properties of raw mango fruit relevant to raw mango cutting machine. *An International Refereed, Peer Reviewed and Indexed Quarterly Journal for Applied Science*, **13**(47).
- Khadivi A., Mirheidari F., Saeidifar A., and Moradi Y. (2022). Identification of the promising mango (*Mangifera indica* L.) genotypes based on morphological and pomological characters. *Food Sci. Nutr.* **10**(11), 3638–3650.
- Krishna, B., Banik A.K. and Das S. (2020). Quality and storage behaviour of amchur (Raw mango powder) as influenced by varietal differences of mango grown in Malda district. *The Pharma Innovation Journal*, **9**(3), 144–148.
- Kumar, V., Ram R.B., Verma R.S., Lata R. and Prakash S. (2021). Studies on genetic diversity for morphological and biochemical aspects of mango (*Mangifera indica* L.) genotypes. *The Pharma Innovation Journal*, **10**(9), 2187–2190.
- Megha, R., Singh S.K., Srivastav M., Prakash J., Saha S. and Pradhan S. (2022). Physico-chemical characterization and biochemical profiling of mango genotypes during different fruit development stages. *South African Journal of Botany*, **149**, 476–486.
- Panse, V.G. and Sukhatme P.V. (1989). *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.
- Patel, K.S. and Khimani R.A. (2005). Characterization and evaluation of different cultivars and genotypes of mango (*Mangifera indica* L.). M.Sc. (Agri.) Thesis (Unpub.) Anand Agricultural University; Anand, Gujrat.
- Raj, S., Kumar B., Khokhar D., Dewangan R.K., Nag G.P., Singh D.P., Sahu N.K., Sahu P.K. and Keval (2025). Evaluation of physico-chemical properties of raw mango (*Mangifera indica* L.) cv. Langra in Bastar district, Chhattisgarh. *International Journal of Advanced Biochemistry Research*, **SP-9**(10), 855–857.
- Rajwana, I.A., Khan I.A., Malik A.U., Saleem B.A., Khan A.S., Ziaf K., Anwar R. and Amin M. (2011). Morphological and biochemical markers for varietal characterization and quality assessment of potential indigenous mango (*Mangifera indica*) germplasm. *International Journal of Agriculture and Biology*, **13**, 151–158.
- Ruchika, Rama Bhat, P. and Ravishankar K.V. (2023). Qualitative and quantitative assessment of wild genotypes of mango (*Mangifera indica* L.) in coastal districts of Karnataka, India. *Journal of Horticultural Sciences*, **18**(2), 271–275.
- Saroj, N., Prasad K., Singh S.K., Kumar V., Maurya S., Maurya P., Tiwari R.K., Lal M.K. and Kumar R. (2023). Characterization of bioactive and fruit quality compounds of promising mango genotypes grown in Himalayan plain region. *Peer. J.*, **11**, e15867.
- Singh, R.P., Piloo N.G., Kumar S., Kumar A., Rizwanullah M., Kumar P. and Singh D. (2023). Studies on physico-chemical characteristics of unripe fruits of local mango (*Mangifera indica* L.) cv. Heinou Khongnembu fruit of Manipur. *The Pharma Innovation Journal*, **12**(6), 4748–4752.
- Verma, S., Gupta R. and Sharma P. (2018). Genetic basis of fruit shape and size in mangoes. *Journal of Agricultural Genetics*. **15**(3), 178–185.