



Physicochemical Characterization of Different Citrus varieties Grown Under Semi-Arid Conditions of Bundelkhand Region

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Abstract: This study evaluated the physical and biochemical characteristics of different citrus cultivars grown under semi-arid conditions in the Bundelkhand region of India. The study included four sweet orange, four mandarin, and four acid lime cultivars. The results showed significant variations in fruit quality among the different varieties, with some showing promising traits such as high juice content, acidity, and vitamin C levels. The study found that sweet orange variety Pusa Round had the highest fruit weight, length, and width, while mandarin variety Daisy had the highest juice content and acid lime variety Pusa Udit had the highest vitamin C content. The study also found significant differences in biochemical parameters such as titratable acidity, total sugars, and ascorbic acid content among the different citrus cultivars. The findings of this study have important implications for citrus cultivation and breeding in the region, suggesting that specific cultivars may be better suited to local agro-climatic conditions.

Key words: Citrus, varieties, biochemical characters, ascorbic acid.

The genus *Citrus*, belonging to the family Rutaceae, is one of the most popular and widely grown fruit crops in the world. Various *Citrus* species are cultivated in India, with the most commercially important being mandarin (*Citrus reticulata* Blanco), followed by sweet orange (*Citrus sinensis* Osbeck) and acid lime (*Citrus aurantifolia* Swingle), which account for 45%, 25%, and 26%, respectively, of the total citrus fruit production in the country. The percent share of citrus in total fruit area and in total fruit production is 15.78% and 13.96% respectively with total production of 14.54 mt in 2023. Total area under citrus cultivation in India is 1.10 mha (MoA&FW, 2021). Citrus is cultivated under a wide range of environmental conditions, from the arid and semi-arid regions of Rajasthan, Punjab, and Haryana to the humid tropical areas of northeast India. The Bundelkhand region of Uttar Pradesh also holds significant potential for citrus production. Accordingly, the present study was designed to explore the physical and biochemical characteristics of different citrus cultivars to gain a deeper

understanding of their performance under the specific agro-climatic conditions of Jhansi (Bundelkhand).

Materials and Methods

The present experiment was conducted in College of Horticulture and Forestry, Rani Lakshmi Bai Central Agricultural University, Jhansi, India. The experimental site experiences typical semi-arid climatic conditions, characterized by hot, dry summers and cold winters. The hottest months, May and June, record maximum temperatures ranging from 37.5°C to 46.0°C, while December and January are the coldest months, with temperatures ranging from 10.4°C to 21.0°C.

Fruits of different citrus varieties were collected from the Fruit Cafeteria of the university, where sweet orange, mandarin and acid lime were being grown with four varieties each were maintained following the recommended cultural and management practices for citrus cultivation.. The varieties of sweet orange were Sathgudi, Mosambi, Pusa Sharad and Pusa Round. Varieties of mandarin were Kinnow, Daisy, Murcott, Nagpur mandarin while of acid lime were Kagzi lime NRCC-8 Pusa Udit Pusa Abhinav. The area was notionally divided into randomized blocks

with four replications for each of the four citrus species. The selected plants were uniform in growth and vigor to ensure consistency in the study. Observations were recorded for various physical and biochemical parameters

Biochemical parameters, including titratable acidity, total sugars, reducing sugars, and non-reducing sugars, were estimated following the method outlined by AOAC (1980). Ascorbic acid content was determined using the 2,6-Dichlorophenol-indophenol visual titration method, as described by Ranganna (1995). The quantitative data were analysed in a one-way ANOVA to determine differences within group using standard statistical software (OP STAT, HAU). Critical difference for examining treatment means for their significance was calculated at 5% level of significance.

Results and Discussion

Physical parameters

For sweet orange the maximum fruit weight (281.40 g), fruit length (8.06 cm), fruit width (8.27 cm), rind thickness (0.72 cm) were recorded in variety Pusa Round which was significantly shigher than the other varieties Table 1). Minimum fruit weight (213.60 g), fruit length (6.97 cm), fruit width (7.43 cm),

Table 1. Physical parameters of different varieties of sweet orange, mandarin and acid lime

Treatment detail	Fruit weight (gm)	Fruit length (cm)	Fruit width (cm)	Rind thickness (cm)	No. of seeds	No. of segments	Juice (ml)	Juice (%)
Sweet orange								
Sathgudi	222.40	7.40	7.62	0.52	22.40	11.60	96.60	43.44
Mosambi	213.60	6.97	7.43	0.46	23.60	12.40	94.20	43.87
Pusa Sharad	220.60	7.36	7.47	0.51	26.40	10.80	101.40	45.85
Pusa Round	281.40	8.06	8.27	0.72	32.20	11.00	117.00	41.52
C.D.	34.40	0.542	0.43	0.13	N.S.	1.17	N.S.	N.S.
Mandarin								
Kinnow	174.80	6.20	7.39	0.55	17.20	11.40	70.60	40.36
Daisy	180.60	6.33	7.10	0.35	15.80	11.40	75.40	41.64
Murcott	130.80	5.29	6.72	0.36	17.00	10.40	47.60	36.37
Nagpur mandarin	112.40	5.58	6.25	0.30	10.80	10.00	37.60	33.62
CD	17.82	0.44	0.38	0.06	N.S.	0.89	10.53	4.93
Acid lime								
Kagzi lime	37.80	4.16	3.90	0.23	9.20	10.60	16.00	42.22
NRCC-8	37.40	4.00	3.76	0.27	13.40	10.60	12.60	32.93
Pusa Udit	32.80	3.86	3.72	0.12	6.80	10.20	14.80	45.18
Pusa Abhinav	38.00	4.30	3.94	0.22	5.20	10.20	14.80	38.93
CD	N.S.	N.S.	N.S.	0.03	3.89	N.S.	N.S.	6.81

Table 2. Biochemical parameters of different varieties of sweet orange, mandarin and acid lime

Treatment detail	TSS (%)	Titratable acidity (%)	TSS/Acid Ratio	Reducing sugar (%)	Total sugar (%)	Non- Reducing sugar (%)
Sweet orange						
Sathgudi	8.58	0.38	22.83	0.41	2.51	2.09
Mosambi	8.16	0.32	25.44	0.79	2.32	1.54
Pusa Sharad	8.10	0.58	14.18	0.62	3.43	2.81
Pusa Round	7.40	0.51	14.59	0.68	3.68	3.00
CD	0.26	0.05	2.22	0.07	0.23	0.26
Mandarin						
Kinnow	7.94	0.67	11.94	0.52	1.53	1.01
Daisy	9.98	0.51	19.44	0.42	2.14	1.72
Murcott	8.56	0.42	20.38	0.40	3.29	2.89
Nagpur mandarin	7.04	0.26	27.43	0.47	1.66	1.18
CD	0.66	0.03	2.81	0.04	0.08	0.08
Acid lime						
Kagzi lime	8.48	4.17	2.03	0.16	0.50	0.33
NRCC-8	7.12	4.71	1.51	0.11	0.89	0.78
Pusa Udit	6.58	3.41	1.93	0.10	0.50	0.40
Pusa Abhinav	6.76	3.65	1.86	0.12	0.47	0.35
CD	0.59	0.23	0.11	0.01	0.02	0.04

rind thickness (0.46 cm) was reported from sweet orange variety Mosambi. In case of mandarin highest fruit weight (180.60 g), fruit length (6.33 cm), number of segment (11.40), juice content (75.40 ml) and juice percentage (41.6%) were recorded in variety Daisy while lowest fruit weight (112.40 g), fruit width (6.25 cm), number of segment (10), juice content (37.60 ml) and juice percentage (33.62%) were reported from Nagpur mandarin. Maximum juice percentage (45.18%) noted from acid lime variety Pusa Udit which was found at par with Kagzi lime, whereas minimum juice percentage

(32.93%) noted in NRCC-8. These results are in conformity with the report of Misra *et al.* (2006); Singh (2010); Dubey *et al.* (2015); Varane *et al.* (2016) on various variety and cultivars in different *Citrus* species.

Biochemical parameters

Analysis of variance revealed significant difference for the different biochemical parameters with in different citrus varieties (Table 2 and Fig.1). Highest TSS (8.58%), TSS/Acid ratio (25.44) and total sugar (3.68%) was

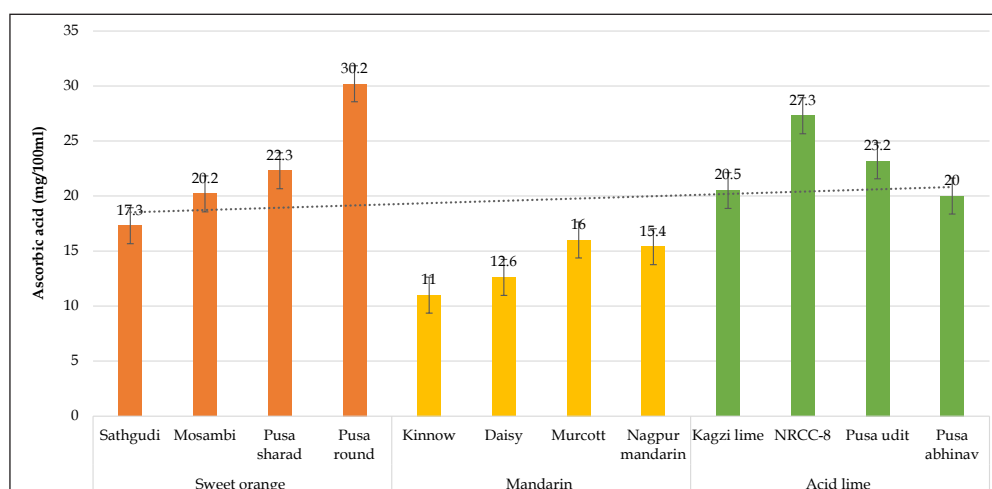


Fig 1. Vitamin C content in different citrus and their varieties.

recorded in sweet orange variety Sathgudi, Mosambi and Pusa Round respectively. Whereas, lowest TSS (7.40%), TSS/Acid ratio (14.18) and total sugar (2.32%) reported from Pusa Round, Pusa Sharad, and Mosambi respectively. Maximum TSS (9.98), acidity (0.67%), TSS: Acid ratio (27.03) reported from Daisy mandarin, Kinnow mandarin and Nagpur mandarin respectively. However, minimum TSS (7.04) and acidity (0.26%) reported from Nagpur mandarin, and TSS: Acid ratio (11.94) reported from Kinnow mandarin. Amongst the acid lime variety greatest value of titratable acidity (4.71%) and ascorbic acid (27.30 mg/100 ml) reported from NRCC-8. Whereas, least value of titratable acidity (3.41%) and ascorbic acid 20.00 reported from Pusa Udit and Kagzi lime respectively. The similar varietal effect on biochemical parameters of citrus was also reported by Debbabi *et al.* (2013); Sharma *et al.* (2015); Patel *et al.* (2016) and Dubey *et al.* (2019). These variation in different biochemical parameters among the different citrus species variety is due to variation in genetic composition and their adaptability to the agroclimatic condition of Jhansi.

Conclusion

In conclusion, the present study provides a comprehensive analysis of the physical and biochemical characteristics of different citrus cultivars grown under semi-arid conditions in the Bundelkhand region of India. The results highlight the significant variations in fruit quality among the different varieties, with some showing promising traits such as high juice content, acidity, and vitamin C levels. These findings have important implications for citrus cultivation and breeding in the region, suggesting that specific cultivars may be better suited to local agro-climatic conditions. Furthermore, the study underscores the need for continued evaluation and improvement of citrus varieties to enhance fruit quality, productivity, and sustainability. Overall, the results of this study contribute to our understanding of citrus cultivation in semi-arid regions and provide valuable insights for future research and breeding programs aimed at improving citrus production in India.

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