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Research Article

EVALUATION OF THE ELITE CLONES OF KARI ISHADA MANGO (*Mangifera indica* L.) FOR THE QUALITATIVE PARAMETERS OF THE FRUITS

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Abstract- The investigation was carried out to evaluate the quality parameters of the elite clones of Kari Ishada mango variety in major growing parts of Uttara Kannada district. Among the 31 Kari Ishada trees selected in the present investigation, 'KIS-24' had the highest values for TSS (22.83 °B), total sugars (21.21 %) and non reducing sugars (13.17 %). 'KIS-25' had highest reducing sugars (8.09 %) while the titrable acidity was highest in 'KIS-8' (0.56 %). The highest shelf life of 8.25 days was recorded in 'KIS- 4' and 'KIS-7'.

Keywords- Kari Ishada, TSS, Total Sugars, Titrable Acidity, Shelf Life

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Introduction

Mango (*Mangifera indica* L.) is one of the most important fruit crops of Anacardiaceae family that consists of dicotyledonous trees and shrubs. Mango originated as an allopolyploid from Eastern India, Assam and Burma. Mango has a large genetic diversity. When a cultivar is grown for a long period, though originated through vegetative propagation, variation may occur due to mutation at micro or macro level. Clonal variations are manifested many times in fruit characteristics besides other vegetative characteristics and yield attributes. Clonal selection within varieties can yield valuable results and hence, it is worth pursuing in countries where certain varieties are in cultivation for a long time. In mango, conventional methods of intravarietal heterogeneity identification are based on fruit quality parameters. The considerable variation exists among trees of the same clone in an orchard of mango with respect to fruit quality. Kari Ishada is a popular mango variety cultivated in Uttara Kannada district of Karnataka. It is mainly grown in Ankola, Kumta, Honnavar and to a certain extent in Sirsi of the Uttara Kannada district. Kari Ishada is sweet and used for table purpose. Each panicle usually bears a single fruit only. Since it carries thick pulp, it is good for consumption. It is a famous variety for preparing a sweet drink locally called as 'Seekarni'.

Identification of superior elite clones is an important activity in the management of genetic resources in mango in the context of the present scenario of rapid extinction of such useful material. Still there is an immense potential of locating superior clones for collection, evaluation, conservation and utilization for the future crop improvement works. The present study aims to identify the superior clones of the Kari Ishada mango variety by the evaluation of their fruit quality parameters.

Material and Methods

An investigation on "Evaluation of the elite clones of Kari Ishada mango variety in major growing parts of Uttara Kannada district" was carried out. The elite clones of Kari Ishada mango of Ankola and Kumta regions of Uttara Kannada district were evaluated. The fruits were studied for qualitative traits in the Department of Fruit Science, Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka state during 2015-16. A total of 31 clones were selected. Ten fruits per tree were collected and were replicated twice with five fruits per replication. The statistical design used was complete randomized design (CRD).

Ten fruits were collected from each of the selected elite trees from the farmers' field in villages of Ankola and Kumta. Twenty five trees from Ankola and six trees from Kumta were selected. The fruits were labeled after they were plucked from the tree.

Total soluble solids of the pulp was recorded with the help of Erma hand refractometer and expressed in °B. The titrable acidity was determined by titrating the known volume of fruit juice against 0.01 N NaOH solution using phenolphthalein as indicator and the value was expressed as gram of malic acid per 100 gram of sample as malic acid is the major acid found in ripe mango [4].

KIS: Kari Ishada selection

Total sugars (%)

The percentage of total sugars present in the fruit pulp was estimated by the principle of reducing sugar after inversion [5]. One milliliter of evaporated extract was taken and kept in boiling water till the alcohol was completely evaporated and allowed it to cool. Then phenolphthalein indicator was added followed by 1 N sodium hydroxide till the solution turned to pink. Again 0.1 N hydrochloric acid was added to discolour the solution. Then, Dinitrosalicylic acid (DNSA) method for estimation of reducing sugar was followed. The values obtained were expressed as percentage on pulp weight basis.

Table-1 *Tree details of Kari Ishada selections.*

Sl. No.	Tree	Place	Farmer Name
1	KIS-1	Bole, Ankola	Shailesh R. N.
2	KIS-2	Bole, Ankola	Shailesh R. N.
3	KIS-3	Bole, Ankola	Bellu Nayak
4	KIS-4	Bole, Ankola	Bellu Nayak
5	KIS-5	Bole, Ankola	Bellu Nayak
6	KIS-6	Bole, Ankola	Ganesh R.
7	KIS-7	Bole, Ankola	Nagaraj N.
8	KIS-8	Bole, Ankola	Naina nayak
9	KIS-9	Vandige, Ankola	Naina nayak
10	KIS-10	Vandige, Ankola	Venkatraman Raman.
11	KIS-11	Vandige, Ankola	Venkatraman Raman.
12	KIS-12	Jambugodu, Ankola	Shailesh R. N.
13	KIS-13	Seelya, Ankola	Subburaya Nayak
14	KIS-14	Seelya, Ankola	Rajesh S
15	KIS-15	Seelya, Ankola	Manohara S
16	KIS-16	Basugodu, Ankola	Laxman Beeran
17	KIS-17	Basugodu, Ankola	Laxman Beeran
18	KIS-18	Pujigeri, Ankola	Gopalakrishna H
19	KIS-19	Basugodu, Ankola	Balakrishna
20	KIS-20	Basugodu, Ankola	Vanitha Balakrishna
21	KIS-21	HRS Ichkada, Ankola	HRS
22	KIS-22	Ankola	Ganapathi Naraayan
23	KIS-23	HRS Ichkada, Ankola	HRS
24	KIS-24	Ankola	Venkatraman Nayak
25	KIS-25	Ankola	Venkatraman Nayak
26	KIS-26	Kagal Kumta	Honnayya H. Naik
27	KIS-27	Kagal, Kumta	Honnayya H. Naik
28	KIS-28	Kagal, Kumta	Honnayya H. Naik
29	KIS-29	Bada, Kumta	Devidas R
30	KIS-30	Bada, Kumta	Ganesh Vinayak
31	KIS-31	Bada, Kumta	Ganesh Vinayak

Reducing sugars (%)

The percentage of reducing sugars in the mango pulp was determined by Dinitrosalicylic acid (DNSA) method [15]. A known volume of alcohol extract was allowed to evaporate the alcohol completely. Clear solution was taken for the estimation of reducing sugar using DNSA- reagent by following the above method and values were expressed in percentage.

Non reducing sugars (%)

The percentage of non reducing sugars was obtained by subtracting the values of reducing sugars from total sugar which was multiplied by the correction factor.

Non-reducing sugar (%) = [Total sugars (%)- reducing sugars (%)] x 0.95

Brix acid ratio

The ratio of Brix (TSS) to acid was calculated by the following formula

$$\frac{\text{Brix}}{\text{Acid}} = \frac{\text{TSS of the fruit}}{\text{Titrable acidity of fruit}}$$

Post harvest parameters

Physiological loss in weight (PLW)

The physiological loss in weight is calculated by formula and expressed in percentage.

$$\text{PLW} = \frac{\text{W1} - \text{W2}}{\text{W1}} \text{ X } 100$$

W_1 - Initial weight of the fruit.

W_2 - Final weight of the fruit.

Shelf life

The shelf life was determined by the number of days the fruits were edible and acceptable for consumption.

Specific gravity (g/cc)

The specific gravity is calculated by taking the ratio of fruit weight to fruit volume after harvest and expressed as g per cc.

Sensory evaluation of fruits

The sensory evaluation was done by 20 respondents and scores were given based on the score scale for peel colour, pulp colour, pulp texture, taste and overall acceptance.

Score scale used for scoring: Excellent: 7.1-9; Very good: 5.1-7.0; Good: 3.1-5.0; Fair: 1.1-3.0; Poor: 0.0-1.0.

Statistical analysis

The data on various characters were subjected to Fisher's method of analysis of variance and the interpretation of data as given by Panse and Sukhatme in 1967 [20]. The level of significance used for 'F' and 't' tests was p=0.05. Critical difference (CD) values were calculated whenever the 'F' test was significant.

Result and Discussion

Fruit quality parameters

Total soluble solids (TSS) are measure of the amount of material dissolved in water. This dissolved material can include carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, organic ions and others. The TSS which mainly imparts sweetness to the pulp of fruits showed variation among different Kari Ishada selections which ranged from 15.50 ^{o}B in 'KIS-28' to 22.83 ^{o}B in 'KIS-24' [Table-2]. The TSS of mango fruits similarly ranged from 15.31 ^{o}B in 'Gen Alphonso' to 18.07 ^{o}B in 'MA-1' [16]; 10.00 ^{o}B in 'Janisahab Karkan' to 19.50 ^{o}B in 'Clone V-2' [19]; 15.20 ^{o}B in 'BN Acc-20' to 22.00 ^{o}B in 'BN Acc-23' [6]; 14.50 ^{o}B in 'CKR Acc-22' to 19.70 ^{o}B in 'CKR Acc-30' [7] and 15.55 ^{o}B in 'Pusa mango-7' to 21.50 ^{o}B in 'Pusa mango-10' [25].

The acidity present in fruit is due to the presence of organic acids, which give the sour taste to fruits. The titrable acidity in the present study was found to be varied from 0.33 per cent in 'KIS-13' to 0.56 per cent in 'KIS-8' [Table-2]. Likewise, titrable acidity ranged from 0.06 per cent in 'Abdullah Great' to 0.30 per cent in 'Clone S-1'[19] and 0.20 per cent in 'Pusa mango-13' to 0.75 per cent in 'Pusa mang-3' [25].

The sweetness of the fruit pulp is due to conversion of starch into sugars resulting from starch hydrolysis [1]. In fruits, different sugars are present in certain forms like reducing and non-reducing in varying amount. Reducing sugars are those sugars (Hexose-$C_6 H_{12} O_6$), which can reduce compounds such as alkaline silver nitrate solution, cupric salt solution *etc*. When these sugars make reduction reactions, they themselves get oxidized [14]. In the present study, the range was from 12.34 per cent in 'KIS-28' to 21.21 per cent in 'KIS-24' for total sugars, 2.13 per cent in 'KIS-28' to 8.09 per cent in 'KIS-25' for reducing sugars and 9.26 per cent in 'KIS-2' to 13.17 per cent in 'KIS-24' for non reducing sugars [Table-2]. Similarly, the total sugars varied from 12.97 per cent in 'Gen Alphonso' to 13.93 per cent in 'AA-5' among the clones of Alphonso [16]. The reducing sugars ranged from 2.12 per cent in 'Pope' to 6.18 per cent in 'Almas' and non reducing sugars ranged from 2.22 per cent in 'Collector' to 9.21 per cent in 'Pope' among mango varieties [11].

The Brix acid ratio mainly creates a sense of taste. Sweetness due to sugars from conversion of the starch and sourness from organic acids are principal components in the taste of many fruits [12]. The quality fruits have higher Brix-acid ratio whereas, fruits of less quality have lower Brix-acid ratio [24]. Brix acid ratio of Kari Ishada selections in the present study ranged from 28.16 in 'KIS-8' to 63.66 in 'KIS-25' [Table-2].

The similar range of Brix acid ratio was reported in the clones of Alphonso from 48.80 in 'Gen Alphonso' to 62.03 in 'MA-2' [16]. The difference in chemical constituents of the fruit can be attributed to the clonal variation. The clone might have mutated at micro and macro level leading to the variation in these quality attributes [16].

Post harvest parameters of the fruits

The developing fruits increase in weight initially and reduce to some extent after ripening [13]. Factors like respiration, transpiration and biological aspects are responsible for the physiological loss in weight (PLW) in mango during ripening. The PLW of Kari Ishada selections were in the range of 3.77 per cent in 'KIS-4' to

6.18 per cent in 'KIS-22' [Table-3]. The similar trend for PLW was reported in Alphonso clones from 6.90 per cent in 'MA-2' to 12.50 per cent in 'Gen Alphonso' [16].

Table-2 *Quality parameters of Kari Ishada selections.*

Selections	TSS (°B)	Titrable acidity (%)	Total sugars (%)	Reducing sugars (%)	Non reducing sugars (%)	Brix acid ratio
KIS-1	19.17	0.40	17.32	6.18	10.58	48.24
KIS-2	17.83	0.44	15.13	5.38	09.26	41.10
KIS-3	20.92	0.35	18.39	7.65	10.20	59.61
KIS-4	20.17	0.37	19.92	6.45	12.79	54.94
KIS-5	16.17	0.45	13.16	3.11	09.55	35.79
KIS-6	17.50	0.44	14.32	4.38	09.45	40.44
KIS-7	19.22	0.35	18.02	6.87	10.59	55.61
KIS-8	15.67	0.56	13.38	2.87	09.99	28.16
KIS-9	17.00	0.43	14.60	3.96	10.10	40.00
KIS-10	16.67	0.55	13.65	3.47	09.67	30.45
KIS-11	17.90	0.43	15.38	4.04	10.77	41.29
KIS-12	16.72	0.40	14.11	3.82	09.77	41.86
KIS-13	19.75	0.33	17.31	7.05	09.74	60.36
KIS-14	18.00	0.45	16.53	4.09	11.82	39.82
KIS-15	19.17	0.34	17.44	4.87	11.93	56.19
KIS-16	18.00	0.41	15.98	4.57	10.84	43.75
KIS-17	16.75	0.45	14.33	3.48	10.30	37.31
KIS-18	17.00	0.41	15.04	3.48	10.98	41.64
KIS-19	17.00	0.44	14.88	3.10	11.19	39.05
KIS-20	17.72	0.41	14.39	3.22	10.61	43.62
KIS-21	18.92	0.40	16.74	4.67	11.46	47.47
KIS-22	17.47	0.43	16.99	4.38	11.98	40.60
KIS-23	19.42	0.39	18.28	6.32	11.36	49.25
KIS-24	22.83	0.38	21.21	7.35	13.17	61.56
KIS-25	21.17	0.34	18.64	8.09	10.02	63.66
KIS-26	17.33	0.48	15.31	4.23	10.52	35.95
KIS-27	18.39	0.41	15.92	4.56	10.79	45.05
KIS-28	15.50	0.53	12.34	2.13	09.71	29.68
KIS-29	17.42	0.47	13.51	3.21	09.79	36.84
KIS-30	16.67	0.45	13.58	2.68	10.36	37.14
KIS-31	16.30	0.47	13.36	2.88	09.95	34.35
S.Em ±	**0.62**	**0.026**	**0.61**	**0.30**	**0.59**	**10.18**
C.D at 5%	**1.80**	**0.074**	**1.76**	**0.87**	**1.72**	**3.53**

The longer shelf life is beneficial character in selection of the good mango genotypes. The shelf life among Kari Ishada selections ranged from 5.75 days in 'KIS-22', 'KIS-21', 'KIS-12' and 'KIS-29' to 8.25 days in 'KIS- 4' and 'KIS-7' [Table-3]. The shelf life ranged from 4-5 days in 'Faiz Kareem' to 8-10 days in 'Kala Chousa' [21] which is similar to the present study. The shelf life of fruit is reliant on textural softness that is due to cell wall alteration ensuring in structural changes in starch and non-starch polysaccharide [27]. Postharvest shelf life and quality of mango fruits decrease with enhanced textural softness and respiration rate during ripening period [22].

There was non-significant difference among the Kari Ishada selections for specific gravity. However, the specific gravity ranged from 1.01 g per cc in 'KIS-13', 'KIS-14' and 'KIS-19' to 1.07 g per cc in 'KIS- 17' [Table-3]. Similarly, specific gravity of the mango varieties in Kerala varied from 1.00 g per cc in 'H-151' to 1.02 g per cc in 'Alphonso' [3].

Table-3 *Post harvest parameters of Kari Ishada selections.*

Selections	PLW (%)	Shelf life (days)	Specific gravity (g/cc)
KIS-1	4.97	7.00	1.04
KIS-2	4.95	7.50	1.05
KIS-3	4.00	8.00	1.02
KIS-4	3.77	8.25	1.03
KIS-5	6.05	6.00	1.03
KIS-6	5.75	6.25	1.02
KIS-7	4.00	8.25	1.06
KIS-8	5.14	7.00	1.05
KIS-9	5.48	6.75	1.02
KIS-10	5.08	6.75	1.03
KIS-11	4.79	7.25	1.04
KIS-12	4.43	5.75	1.02
KIS-13	5.12	7.25	1.01
KIS-14	5.64	6.50	1.01
KIS-15	5.38	6.75	1.04
KIS-16	5.25	7.00	1.03
KIS-17	5.80	6.00	1.07
KIS-18	5.32	6.75	1.05
KIS-19	5.79	6.00	1.01
KIS-20	5.76	6.25	1.02
KIS-21	6.02	5.75	1.06
KIS-22	6.18	5.75	1.02
KIS-23	5.19	6.25	1.03
KIS-24	4.88	7.25	1.04
KIS-25	5.16	7.00	1.03
KIS-26	5.03	7.00	1.04
KIS-27	4.93	7.00	1.04
KIS-28	5.24	6.75	1.02
KIS-29	5.70	5.75	1.02
KIS-30	5.37	6.75	1.03
KIS-31	5.70	7.00	1.04
S.Em ±	**0.27**	**0.42**	**0.016**
C.D at 5%	**0.77**	**1.20**	**NS**

NS=Non Significant

Sensory evaluation of the fruits

In addition to the fruit morphological and quality parameters, the sensory qualities play a vital role for the overall acceptance of the fruits. Fruit ripening phase plays a key role in the judgment of sensory attributes and acceptability. Ripening of mango involves various metabolic changes *viz.,* ethylene production, softening, increased respiration, breakdown of chlorophyll and conversion of starch into sugars *etc.,* which contribute towards the sensory profile build up of mango [9].The coloration is a quality attribute that is more attractive to the consumer which may vary due to the difference in concentration of pigments [8]. The sensory evaluation score for peel colour varied from 3.08 in 'KIS-31' to 5.92 in 'KIS-2' whereas, the pulp colour score varied from 3.70 in 'KIS-20' to 7.36 in 'KIS-17' [Table-4].

Color changes are attributed with biochemical changes like degradation and accumulation of various carotenoids pigments such as esters, lycopene, β-carotene and xanthophylls [2], [26]. Yellow color dominates orange color [10].

The sensory evaluation score for pulp texture varied from 4.93 in 'KIS-20' to 7.38 in 'KIS-24' while the score for taste varied from 3.96 in 'KIS-20' to 7.96 in 'KIS-11' [Table-4]. The sensory evaluation score for overall acceptance ranged from 3.96 in 'KIS-20' to 7.53 in 'KIS-3' which was most acceptable among the Kari Ishada selections. Along with 'KIS-3', the selections 'KIS-15', 'KIS-7', 'KIS-13' and 'KIS-4' were excellent for the overall acceptability [Table-4]. Similary, overall acceptance was maximum in 'MA-1' followed by 'AA-4' [16]. The score ranged between 4.48 in 'Fazri' and 8.85 in 'Samar Bahisht Chousa' for overall acceptance (Naz *et al.,* 2014) [18]. The results are also in confirmation with Nagabhushanam and Mathew (1994); Anila and Radha (2003); Rajwana *et al*. (2011); Ribeiro *et al*. (2013) and Naz *et al.* (2014) [17,3,21,23,18].

Table-4 *Sensory evaluation of Kari Ishada selections.*

Selections	Peel colour	Pulp colour	Pulp Texture	Taste	Overall acceptance
KIS-1	5.15	6.88	5.15	4.82	5.25
KIS-2	5.92	5.54	5.82	5.36	5.54
KIS-3	5.61	6.82	7.17	6.95	7.53
KIS-4	5.15	6.97	6.21	7.26	7.27
KIS-5	4.74	6.74	6.86	6.44	6.00
KIS-6	4.00	6.20	5.75	5.25	5.79
KIS-7	5.44	6.56	6.38	7.56	7.41
KIS-8	4.14	5.93	5.34	4.82	4.66
KIS-9	3.64	6.18	6.18	4.44	5.10
KIS-10	3.32	6.79	6.35	5.86	5.48
KIS-11	4.57	6.83	7.33	7.96	7.31
KIS-12	3.35	5.46	6.12	5.18	5.77
KIS-13	5.71	6.34	6.96	7.44	7.32
KIS-14	5.43	5.72	6.01	7.04	6.81
KIS-15	4.11	7.14	7.08	7.58	7.43
KIS-16	4.44	6.63	5.88	5.44	5.63
KIS-17	4.45	7.36	6.69	6.54	6.91
KIS-18	4.70	7.01	6.05	6.86	6.82
KIS-19	4.55	5.71	5.99	5.09	5.38
KIS-20	4.01	3.70	4.93	3.96	3.96
KIS-21	3.71	5.07	5.91	6.22	6.40
KIS-22	3.25	6.66	5.71	6.63	5.55
KIS-23	4.14	5.99	5.82	5.15	5.41
KIS-24	5.36	6.78	7.38	6.74	7.23
KIS-25	4.97	5.57	6.40	6.94	6.23
KIS-26	3.22	5.36	6.21	5.76	6.11
KIS-27	3.69	5.79	6.11	6.56	6.88
KIS-28	3.61	5.25	6.29	5.65	5.47
KIS-29	3.16	4.57	5.24	4.04	5.20
KIS-30	3.29	5.28	5.06	4.90	5.01
KIS-31	3.08	4.65	5.81	5.91	4.51
S.Em ±	**0.30**	**0.35**	**0.31**	**0.29**	**0.34**
C.D at 5%	**0.87**	**1.01**	**0.89**	**0.82**	**0.98**

Sensory scores: Excellent (7.1-9.0); Very good (5.1-7.0); Good (3.1-5.0); Fair (1.1-3.0) and Poor (0.0-1.0)

Conclusion

Among the 31 Kari Ishada trees selected in the present investigation, 'KIS-24' had the highest values for TSS (22.83 °B), total sugars (21.21 %) and non reducing sugars (13.17 %). 'KIS-25' had highest reducing sugars (8.09 %) while the titrable acidity was highest in 'KIS-8' (0.56 %). The highest shelf life of 8.25 days was recorded in 'KIS- 4' and 'KIS-7'.

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Author contributions

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