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Short communication

Evaluation of traditional mango (*Mangifera indica* L.) varieties of southern Kerala

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ABSTRACT

Investigations were carried out at the Department of Pomology and Floriculture, College of Agriculture, Vellayani, to characterize traditional mango varieties of southern Kerala, based on utility of fruits. Wide publicity was made about the proposed study and an extensive survey was conducted. Fifty traditional mango types could be located from Thiruvananthapuram, Kollam, Pathanamthitta and Alappuzha districts. On evaluation three utility groups were identified, viz., pickling, table and dual purpose types, based on the survey. Variability could be observed for floral, fruit and quality attributes. Flowering round the year was observed in Vellari Type-1, Thali, Kizhakkan Thali and Ambalathara Local. Karpoora Varikka with carotenoid content higher than most leading, superior varieties was identified. Varieties with high content of total sugars were Nedungolan, Vellari Type-2, Perakka manga, Inamanga, Neenda Karpooram, Velutha Muvandan, Karpoora Varikka and Ambalathara Local. Pickling type mangoes gave highest average ascorbic acid content (46.02mg/ 100g). Average titrable acidity (%) and crude fibre content were also the highest in pickling types (1.22% and 1.18%, respectively). In organoleptic evaluation, Perakka manga, Nedungolan, Karpooram manga, Vellari Type-2, Neenda Karpooram, Muthalamookan, Inamanga, Ambalathara Local, Kotookonam Varikka and Velutha Muvandan ranked on top in overall acceptability. These traditional varieties with desirable traits can be used for developing molecular markers to identify particular genes of interest and transfer them to desirable cultivars through genetic engineering.

Key words: *Mangifera indica* L., traditional varieties, flowering, physico-chemical

Mango (*Mangifera indica* L.) is the most important fruit crop of India. Previously, vast areas were under mango cultivation in Kerala. Vellari manga, Karpooram manga, Chenka Varikka, Moovandan, Kotookonam Varikka, Chandrakaran, Koonan, Kalkandamanga, Karakka manga, Chappikudiyan and Kilichundan are some of the traditional mango varieties of Kerala. However, due to changes in the socio-economic situation land-use pattern and shrinking homesteads, area under mango cultivation has reduced. Moreover, there has been a shift in preference of the people towards new varieties and grafts, which resulted in genetic erosion of the traditional mango germplasm. In southern Kerala particularly, Trivandrum, Kollam, Pathanamthitta and Alappuzha districts, there has been over 15% reduction in area between the years 2000-01 and 2003-04 (FIB, 2006). Many of our traditional varieties have gone extinct. The remaining few varieties are confined to homesteads and avenues. Therefore, there is an urgent need to at least catalogue available traditional genetic resources, which are on the verge of extinction. Radha and Manjula (2000) earlier evaluated 12 distinct polyembryonic types of mango in the central part of Kerala based on vegetative, floral and fruit characters.

Quality parameters of the genus *Mangifera* its varieties were studied by Bihari *et al* (2012). In the present study, an attempt has been made to evaluate traditional mango varieties of southern Kerala based on their utility.

Publicity about the study was made in various mass media modes like newspapers, the television and All India Radio to locate the traditional mango varieties. Field visits and survey were undertaken to locate individual trees to collect samples. The Snowball Sampling Technique was used for identifying endangered ecotypes in the four districts of southern Kerala. The standard descriptor prescribed by IPGRI (2006) was used as a guideline to describe vegetative, floral and fruit characters. It being a sample survey, 'summary statistics' tool was employed: arithematic mean, range and weighted average. Based on responses obtained from the survey, mango varieties were classified into three utility groups as: pickling, table and dual types. Average of data obtained from two years' study was taken. Trees were

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classified as 'early flowering' if flowering started in November - December, as 'intermediate' if flowering started in January – February, and 'late' if they flowered after March.

Ten fruits each were taken at maturity and subjected to analysis. Fruit pulp was analyzed for acidity (Ranganna (1977), ascorbic acid content (Sadasivam and Manikam, 1992), total carotenoids (Jensen, 1978), total soluble solids (TSS), total and reducing sugars, and crude fibre content (Saini *et al*, 2001). Organoleptic evaluation was made in the laboratory by ten judges, including a group of teachers and students. Sensory analysis was done using a four-point scale. Major quality attributes scored for were: appearance (fruit shape, skin colour), flesh colour, flavour, taste and texture. Weighted average was calculated by assigning a weight of 6 for taste, 5 for texture, 4 for flavour, 3 for skin colour, 2 for flesh colour and 1 for fruit shape, to obtain overall acceptibility. The accession scoring the highest weighted average was judged as the best.

Results on evaluation of traditional mango types of southern Kerala are discussed below. Fifty mango types were located and these were grouped into three types as pickling (32%), table (34%) and dual (34%) types based on utility of the fruits. A list of the mango types, location collected from and district from which collected is given in Table 1.

Flowering in mango is an important physiological event that sets the on set of fruit production (Ramírez and Davenport, 2010). Varietal influence in secondary (off-season) flowering has been observed in a few varieties. In the present study, frequent secondary flowering was reported in Vellari Type-1, Thali, Kizhakkan Thali and Ambalathara Local (Table 2). Of these, Vellari Type-1 is used for pickling. Ambalathara Local too had good organoleptic scores for fruit shape, flesh colour, texture and taste. Hence, both can be said to be economically very important. Secondary flowering helps obtain fruits off-season.

Composition of the mango fruit, in general, differed with the cultivar (Table 3). A remarkable variability in acidity was seen among varieties. Varieties Nedungolan, Perakka manga, Chadayamangalam Local, Natumav Type-3, Mylapore manga, Kundara manga, and Cheriya Kilichundan quality to be designated as varieties lower acidity (< 0.19%). Varieties with a high ascorbic acid content were: Natumav Type-1, Natumav Type-2, Chadayamangalam Local, Kalluketty, Kandiyoor Local, Vellayani Local, Thali manga, Mavelikkara Local and Kizhakkan Thali (>57.14mg/100g). Among fruits, mango is a good source of carotenoids. In the present study, we identifyied a variety, Karpoora Varikka, with carotenoid content (7.97mg/100g) higher than most leading, superior varieties. Perakka manga (3.84), Kolambi (2.69), Velutha Muvandan (2.65) and Manacaud Local-2 (2.00) are some varieties rich in carotenoid content. The varieties differed greatly in TSS which ranged from 8.77 (Natumav Type-2) to 25.71^0B (Perakka manga). Perakka manga and Karpoora Varikka can be recommended as varieties with high TSS. Among the 50 traditional types analyzed, high content (>4.3%) of reducing sugars was detected in the varieties Pulichi, Kolambi, Perakka manga, Mylapore manga, Neenda Karpooram, Karpooram manga and Ambalathara Local, which resulted in better tasting fruits. Organoleptic and chemical evaluation of fruits of 44 mango varieties under agro-climatic conditions of Punjab in Pakistan by Syed (2009) revealed excellent quality with maximum flavour, taste, colour of fruit, pulp, least fibre and acidity in cvs. Chausa, Anwar Retaul, Dushehari, SS-I, SS-II, SS-III and Hussain Pasand-II.

Variability in fibre content was observed among varieties. Nedungolan, Vellari Type-2, Perakka manga,

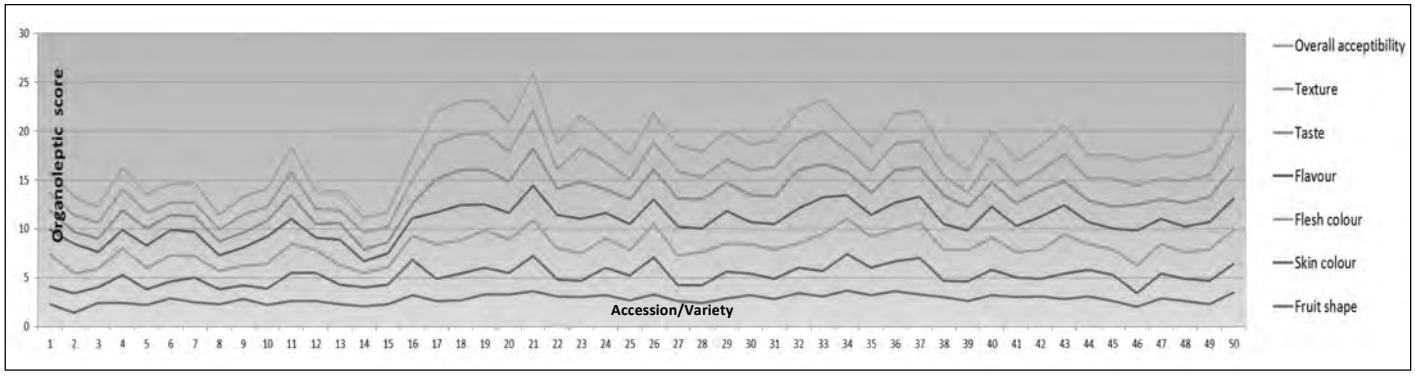

Fig 1. Ogranoleptic evaluation of the traditional mango varieties collected from southern Kerala

Table 1. List of traditional mango types collected from southern Kerala

Acc. No	Local name	Location	District	Latitude	Longitude	Altitude (m above msl)
I	**Pickling types**					
1	Karutha Muvandan	Mavelikkara	Alappuzha	9.2670° N	76.5500° E	15
2	Natumavu type-1	Karunagapally	Kollam	9.6024842° N	76.3404436° E	8
3	Vellari type-1	Kalliyoor	Trivandrum	8.4324437° N	77.0147040° E	53
4	Kalkanda Vellari	Manacaud	Trivandrum	8.4743837° N	76.9491484° E	19
5	Vazhapazhithi	Kalliyoor	Trivandrum	8.4324437° N	77.0147040° E	53
6	Pulichi	Plamoottukada	Trivandrum	8.401648° N	77.087119° E	24
7	Natumavu type-2	Eara	Alappuzha	9.443399° N	76.541992° E	12
8	Chadayamangalam local	Chadayamangalam	Kollam	8.873123° N	76.869393° E	43
9	Komanga	Vallikkal	Pathanamthitta	9.2647581° N	76.787041° E	31
10	Puliyan	Cherthala	Alappuzha	9.6831330° N	76.3373290° E	9
11	Natumav type-3	Parakode	Pathanamthitta	9.148208° N	76.760830° E	46
12	Manacaud local-1	Manacaud	Trivandrum	8.470421° N	76.944771° E	17
13	Kalluketty	Vayalar	Alappuzha	9.7167037° N	76.3376786° E	7
14	Natumav type-4	Mavelikkara	Alappuzha	9.268378° N	76.534° E	15
15	Natumavu type-5	Vayalar	Alappuzha	9.7167037° N	76.3376786° E	7
16	Eara local	Eara	Alappuzha	9.443399° N	76.541992° E	12
II	**Table types**					
17	Muthalamookkan	Karunagapally	Kollam	9.6024842° N	76.3504436° E	8
18	Nedungolan	Chadayamangalam	Kollam	8.873123° N	76.869393° E	43
19	Vellari type-2	Paripally	Kollam	8.804893° N	76.762351° E	57
20	Kolambi	Chadayamangalam	Kollam	8.873123° N	76.869393° E	43
21	Perakka manga	Eara	Alappuzha	9.443399° N	76.541992° E	12
22	Kasthuri	Kalliyoor	Trivandrum	8.4324437° N	77.0147040° E	53
23	Inamanga	Varkala	Trivandrum	8.7333000° N	76.7167000° E	47
24	Panchasara Varikka	Plamoottukada	Trivandrum	8.401648° N	77.087119° E	24
25	Kappa manga	Adoor	Pathanamthitta	9.156651° N	76.730766° E	43
26	Kandiyoor local	Kandiyoor	Alappuzha	9.252969° N	76529675° E	10
27	Thenga manga	Chiranikkal	Pathanamthitta	9.174182° N	76.758532° E	66
28	Mylapore manga	Plamootukada	Trivandrum	8.401648° N	77.087119° E	24
29	Kolimanga	Mavelikkara	Alappuzha	9.268378° N	76.534° E	15
30	Kundara manga	Thykkal	Alappuzha	9.694750° N	76.302689° E	8
31	Neendakara manga	Cherthala	Alappuzha	9.6831330° N	76.3373290° E	9
32	Neenda Karpooram	Parakode	Pathanamthitta	9.148208° N	76.760830° E	46
33	Karpooram manga	Eara	Alappuzha	9.443399° N	76.541992° E	12
III	**Dual types**					
34	Cheriya Kilichundan	Chadayamangalam	Kollam	8.873123° N	76.869393° E	43
35	Valiya Kilichundan	Karunagapalli	Kollam	9.6024842° N	76.3504436° E	8
36	Velutha Muvandan	Eara	Alappuzha	9.443399° N	76.541992° E	12
37	Kotookonam Varikka	Vellayani	Trivandrum	8.431408° N	76.987016° E	24
38	ChampaVarikka	Ambalathara	Trivandrum	8.453766° N	76.950623° E	16
39	Kallu Varikka	Vellayani	Trivandrum	8.431408° N	76.987016° E	24
40	Vellamkolli	Karunagapally	Kollam	9.6024842° N	76.3504436° E	8
41	Vellayani local	Vellayani	Trivandrum	8.431408° N	76.987016° E	24
42	Thali	Manacaud	Trivandrum	8.4743837° N	76.9491484° E	19
43	Karpoora Varikka	Plamoottukada	Trivandrum	8.401648° N	77.087119° E	24
44	Kotamanga	Cherthala	Alappuzha	9.6831330° N	76.3373290° E	9
45	Karimbu mavu	Parakode	Pathanamthitta	9.148208° N	76.760830° E	46
46	Mavelikkara local	Mavelikkara	Alappuzha	9.268378° N	76.534° E	15
47	Kizhakkan Thali	Paripally	Kollam	8.804893° N	76.762351° E	57
48	Ponnadan manga	Cherthala	Alappuzha	9.6831330° N	76.3373290° E	9
49	Manacaud local-2	Manacaud	Trivandrum	8.4743837° N	76.9491484° E	19
50	Ambalathara local	Ambalathara	Trivandrum	8.453766° N	76.950623° E	16

Table 2. Flowering behaviour of traditional mango varieties/ accessions in Kerala

	Class (type)	Pickling	Table	Dual	Total
Season of flowering	Early (Nov -Dec)	7 (43.75%)	5 (29.41%)	10 (58.82%)	22 (44.00%)
	Intermediate (Jan- Feb)	9 (56.25%)	12 (70.59%)	7 (41.18%)	28 (56.00%)
	Late (after March)	0	0	0	0
Regularity of flowering	Regular	13 (81.25%)	14 (82.35%)	15 (88.24%)	42 (84.00%)
	Intermediate	3 (18.75%)	2 (11.76%)	2 (11.76%)	7 (14.00%)
	Irregular	0	1 (5.88%)	0	1 (2.00%)
Secondary flowering	Rare	13 (81.25%)	16 (94.12%)	13 (76.47%)	42 (84.00%)
	Intermediate	2 (12.5%)	1 (5.88%)	1 (5.88%)	4 (8.00%)
	Frequent	1 (6.25%)	0	3 (18.75%)	4 (8.00%)

Inamanga, Neenda Karpooram, Kandiyoor Local, Karpooram manga and Ambalathara Local recorded lower fibre content. Of the three utility groups, average crude fibre content was highest (0.58 to 2.92%) in the pickling types, followed by table types (0.4 – 2.4%).

Overall acceptability depends on concentrations of specific components, nutritional or any other hidden attributes of food, and its palatability or sensory quality. Variety Perakka manga scored best in overall acceptability, followed by Nedungolan and Karpooram manga (Fig.1). Perakka manga, Nedungolan, Karpooram manga, Vellari Type-2, Neenda Karpooram, Muthalamookan, Inamanga, Ambalathara Local, Kotookonam Varikka, and Velutha Muvandan ranked at top positions in overall acceptability. These can be recommended as excellent edible varieties, suited for cultivating in the tropical environment. A similar study was made on physico-chemical quality characteristics of some mango cultivars growing under the Mediterranean subtropical climate in Spain (Pleguezuelo *et al*, 2012). 'Osteen' and 'Tommy Atkins', cultivars of mango with high-quality fruits, were recommended for their performance and sustainable yield in subtropical, marginal environment.

Physico-chemical analysis of fruit samples of 28 elite strains of Punjab revealed that variability found in the indigenous mango population for various qualitative and quantitative attributes not only contributes to biological diversity, nutritional security and livelihood, but can also be used for crop improvement (Singh *et al*, 2012).

Kotookonam Varikka, Kallu Varikka, Champa Varikka, Kasthuri and Vellari Type-1 were more widely prevalent in Thiruvananthapuram district. Muvandan was distributed mainly in Alappuzha district. Natumanga types were more numerous in Pathanamthitta district. Nedungolan (Karpooram) was distributed from Nilamel, Kilimanoor and nearby regions (Trivandrum district) up to Chadayamangalam. Mylapore manga was mostly located in the southern parts of Trivandrum district. Vellari Type-2 was found more commonly in Varkala, Parippally and Chadayamangalam regions. Kolambi manga was located mostly in Kollam district (Chadayamangalam and places nearby). Muthala mookan was mostly located in Chettikulangara, Karunagapalli (Kollam district) and Cherthala (Alappuzha). Mavelikkara and Cherthala of Alappuzha district can be considered as hotspot areas for traditional mangoes in south Kerala, as, many varieties are concentrated in their area.

Traditional mango varieties flowering round the year and those with desirable characters like high TSS, reducing sugars, Vitamin C and carotenoids that can be recommended for growing in tropical environment, could be identified in this study.

In view of the importance of these traditional mango varieties with rare and desirable qualities, and their adaptability to our environmental conditions, these should be conserved. Kerala Agricultural University and State Department of Agriculture, Kerala, have been promoting multiplication of the local varieties through grafting. A concerted effort to exploit genes coding for desirable traits through biotechnological interventions in these genetic resources that stand on the verge of extinction, is the need of the hour.

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Table 3. Fruit quality characters of traditional mango varieties/ accessions in Kerala

Acc. No.	TSS (°Brix)	Carotenoid content (mg/100g)	Vitamin C content (mg/100g)	Titrable acidity (%)	Crude fibre (%)	Total sugars (%)	Reducing sugars (%)	Pulp %
I Pickling types								
1	12.71	1.66	18.75	1.08	0.89	6.06	1.54	61.64
2	13.77	0.55	68.75	1.66	1.14	6.90	2.27	46.44
3	11.69	0.32	45.00	0.32	0.65	5.06	3.33	70.58
4	10.69	0.36	42.00	1.20	0.82	4.90	1.60	67.73
5	9.69	1.46	9.52	0.32	0.75	5.33	2.94	58.43
6	15.00	0.69	46.88	1.15	2.80	10.81	5.00	61.66
7	8.77	0.5	119.05	1.40	1.40	2.90	1.36	50.59
8	11.69	0.34	90.72	0.18	0.92	3.36	2.11	58.06
9	13.78	0.87	36.92	1.28	0.67	5.55	1.58	54.38
10	10.69	0.58	23.81	0.83	1.20	3.90	1.50	33.71
11	11.69	0.56	12.31	0.13	2.92	7.27	1.98	61.3
12	12.77	1.38	37.50	0.42	1.20	5.97	2.08	61.54
13	11.77	0.59	66.67	2.80	0.90	2.31	0.90	62.00
14	12.77	0.21	47.62	0.57	0.82	2.01	1.20	49.23
15	9.69	0.28	46.20	2.20	1.50	3.50	1.70	44.00
16	14.73	0.68	24.62	4.03	0.58	5.33	1.63	73.38
Average	11.99	0.69	46.02	1.22	1.188	5.07	2.05	61.02
Range	8.77-15.00	0.21-1.66	9.52-119.05	0.13-4.03	0.58-2.92	2.01-10.81	0.9-5.0	33.71-73.38
II Table types								
17	14.61	0.98	9.23	0.30	0.61	9.11	3.45	81.87
18	19.00	1.10	12.50	0.12	0.40	13.90	4.10	78.26
19	16.61	1.88	24.62	0.26	0.47	14.29	2.50	76.98
20	17.78	2.69	25.00	0.96	0.63	12.69	5.71	69.96
21	25.71	3.84	33.33	0. 19	0.52	18.40	6.10	70.74
22	12.18	1.29	12.50	0.40	0.90	10.26	3.64	64.88
23	18.66	0.88	31.25	0.26	0.60	15.10	3.08	61.34
24	19.79	1.58	9.52	0.38	0.76	6.45	3.45	77.92
25	13.78	1.12	28.57	1.00	1.61	6.56	1.69	79.58
26	14.77	1.50	62.50	0.26	0.45	6.15	3.85	56.03
27	15.69	1.36	24.62	0.23	0.50	11.11	4.17	79.29
28	15.78	1.69	23.80	0.13	2.40	9.10	5.41	59.62
29	15.67	0.62	33.33	0.52	1.30	8.70	2.60	66.26
30	15.78	1.38	9.52	0.13	0.88	8.82	3.17	80.41
31	15.78	0.98	3.08	0.25	0.64	8.88	4.17	76.34
32	18.66	1.11	12.31	0.20	0.60	22.20	5.40	74.30
33	19.71	1.25	31.20	0.41	0.46	13.70	4.33	75.87
Average	17.06	1.49	22.76	0.35	0.81	11.50	3.93	72.33
Range	12.18-25.71	0.62-3.84	3.08-62.5	0.12-1.00	0.40-2.40	6.15-22.2	1.69-6.10	56.03-81.87
III Dual types								
34	17.78	1.83	18.75	0.19	0.71	10.26	3.20	75.61
35	15.70	1.45	12.50	0.72	0.80	9.09	2.82	66.14
36	19.71	2.65	31.20	0.31	0.75	13.92	3.70	67.53
37	17.68	0.69	37.10	0.32	0.97	10.88	3.77	75.60
38	14.67	1.88	12.31	0.35	0.59	11.11	3.03	68.60
39	13.67	1.12	12.50	0.68	1.00	7.41	3.64	70.67
40	12.77	1.36	37.50	0.25	0.76	5.63	3.33	70.21
41	13.77	0.67	61.90	0.62	0.80	7.20	2.00	72.65
42	12.71	0.93	57.14	0.50	0.47	8.08	2.33	51.59
43	20.66	7.97	24.62	1.20	0.84	13.79	2.67	70.57
44	14.78	0.73	23.50	0.40	0.75	7.90	3.10	64.17
45	12.18	0.80	46.88	0.45	0.67	6.25	2.30	68.09
46	15.78	0.96	71.43	0.70	1.30	6.67	2.78	49.84
47	13.77	1.10	57.14	0.66	0.79	6.67	1.87	61.78
48	13.77	1.20	12.40	0.58	0.70	7.17	3.17	41.00
49	14.73	2.00	12.31	0.50	0.97	7.89	3.90	66.90
50	17.78	0.96	27.69	0.35	0.54	13.40	5.33	80.53
Average	15.41	1.66	32.76	0.52	0.79	9.02	3.11	65.97
Range	12.18-20.66	0.67-7.97	12.31-71.43	0.25-1.20	0.47-1.30	5.63-13.92	1.87-5.33	41.00-80.53

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