



Short communication

## Genetic diversity in 'Appemidi' pickle mangoes

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### ABSTRACT

Mango is an important fruit crop grown extensively in India. An enormous diversity is seen in its flavour, taste and fruit form unique to particular regions of India. A large diversity for unique pickling types, called 'Appemidi' (tender mangoes), is seen in Uttara Kannada district of Karnataka. With rapid deforestation in several of these areas, surveys were conducted to collect and conserve these unique types. This resulted in collection of 33 unique accessions which have been conserved in the Institute's field gene bank. On evaluation of tender fruit, accessions 'Chansi Appe', 'Dodderi Jeerige', 'Mani Bhatta Appe', 'Gorana Appe', 'Isagoor Appe', 'Malange', 'Gurumurthy Appe' and 'Kashimidi' were found to possess good traits for tender, whole-fruit pickling.

**Key words:** Mango, evaluation, *appemidi*, pickling, conservation

Mango is one of the most popular and choicest fruits of India. Having originated in the Indo-Myanmar region (Mukherjee, 1953), both wild and cultivated forms of mango in India exhibit unusual diversity in fruit forms, flavour and taste (Mukherjee, 1948; Naik and Gangolly, 1950). Diverse climatic conditions prevalent in the country, allopolyploidy and cross-pollinated nature of the crop have resulted in high heterozygosity and greater variability of gene pool in these species. Over a thousand varieties are said to exist in the country (Mukherjee, 1953). Western Ghats and the peninsular region of India are among the diversity-rich centers for *Mangifera indica* varieties. There are several unique types, growing naturally by the side of streams and rivers, used mainly for pickling. These are called *Appemidi* types, found mainly in Uttara Kannada district of Karnataka. These are used for tender, whole-fruited pickles, called '*midi*' in the local language. These unique types are gaining importance in the export market because of their suitability for pickling as whole-fruit (tender mangoes) (Radhakrishna Holla, 2007). With rapid deforestation in several of these areas, surveys were conducted by us to collect for conserving these unique types at our institute. Attempts were also made to evaluate these types, as, very little work has been done earlier.

The experiment was carried out to study diversity in 33 '*Appemidi*' types collected and maintained in the field

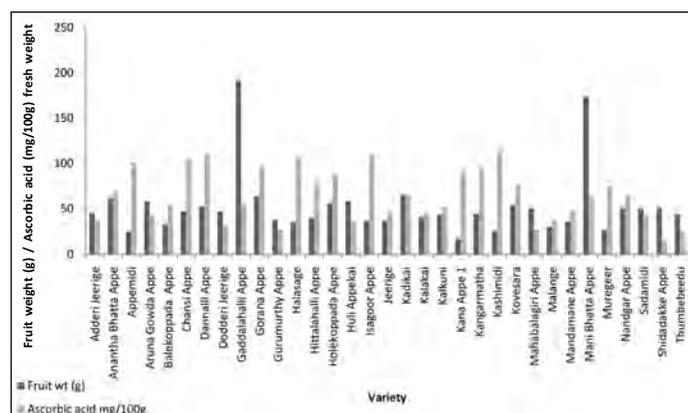
gene bank of the Institute. Passport data was collected and documented from the places where these surveys were conducted in Uttara Kannada district (Table 1). In each accession, three trees were selected to represent three replications and basic statistical measures such as mean, SED, CV and SEM were worked out. The trees selected were of a uniform age group and grown under standard horticultural practices. Ten randomly-selected tender fruits (to the extent possible, before formation of the stony endocarp) were used for biometric observations in each accession and replication. Fruit characters like shape, flavour and latex flow were recorded on visual scoring. Weight of individual fruits was recorded and expressed in grams. Quality parameters like pH, titrable acidity, ascorbic acid content and dry matter content were analyzed as per Ranganna (1986). Fruit firmness was measured using Instron Universal Testing Machine (model 4201) with 3mm dia probe, and was expressed as kg/cm<sup>2</sup> force.

### Evaluation for fruit characters

The accessions exhibited a wide variability for different fruit characters (Table 2, Figs. 1 and 2; Plates 1 and 2). Fruit weight was found to vary between 191.75g in 'Gaddalahalli Appe', to 17.43g in 'Kana Appe 1'. Different fruit shapes, viz., elliptic (Anantha Bhatta Appe, Appemidi, Aruna Gowda Appe), Round (Dodderi Jeerige, Gaddalahalli Appe, Kovesara) and oblong (Balekoppa Appe, Chansi

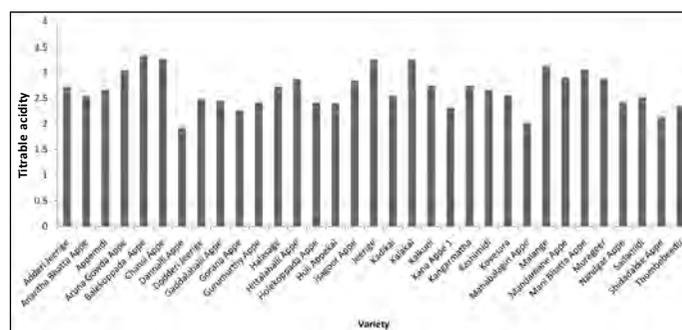
**Table 1. Passport data of mango (*Mangifera indica* L.) accessions used in the study**

IIHR Acc. No.	IC No	Name of the accession	Location	District	State	Longitude	Latitude
19875	IC 391597	Adderi Jeerige	Sagar	Shimoga	Karnataka	75:03:33	14:16:66
19883	IC 391610	Anantha Bhatta Appe	Sagar	Shimoga	Karnataka	75:03:33	14:16:66
19887	IC 391611	Appemidi	Sagar	Shimoga	Karnataka	75:03:33	14:16:66
19893	IC 391617	Aruna Gowda Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
19905	IC 391627	Balekoppa Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20247	IC 391650	Chanshi Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
19923	IC 391663	Dannalli Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
19926	IC 391668	Dodderi Jeerige	Sagar	Shimoga	Karnataka	75:03:33	14:16:66
20250	IC 391679	Gaddalahalli Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20243	IC 391685	Gorana Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
19943	IC 391689	Gurumurthy Appe	Kumta	Uttara Kannada	Karnataka	74:40:00	14:41:66
20246	IC 391691	Halasage	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
19953	IC 391707	Hittalahalli Appe	Sidhapur	Uttara Kannada	Karnataka	74:88:33	14:33:33
19954	IC 391708	Holekoppada Appe	Sidhapur	Uttara Kannada	Karnataka	74:88:33	14:33:33
19955	IC 391709	Huliappekai	Sidhapur	Uttara Kannada	Karnataka	74:88:33	14:33:33
19960	IC 391712	Isagoor Appe	Kumta	Uttara Kannada	Karnataka	74:40:00	14:41:66
19964	IC 391718	Jeerige	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20253	IC 391735	Kadikai	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20254	IC 391738	Kalakai	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20248	IC 391723	Kalkuni	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20023	IC 391739	Kana Appe-1	Perla	Kasargod	Kerala	75:06:66	12:60:00
20242	IC 391724	Kangaramatha	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
19972	IC 391726	Kashimidi	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20430	IC 395077	Kovesara	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20234	IC 391776	Mahabalagiri Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20239	IC 391781	Malange	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20013	IC 391787	Mani Bhatta Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20240	IC 391795	Muregeer	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20245	IC 391784	Mandamane	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20237	IC 391802	Nandgar Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20053	IC 395095	Sadamidi	Sagar	Shimoga	Karnataka	75:03:33	14:16:66
20244	IC 391858	Shidadakke Appe	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66
20258	IC 391870	Thumbbeedu	Sirsi	Uttara Kannada	Karnataka	74:85:00	14:61:66



**Fig 1. Fruit weight and ascorbic acid content in 'Appemidi' types of mango**

Appe, Gorana Appe, Gurumurthy Appe, Halasage, Hitalahalli Appe, Holekoppada Appe, Huli Appekai, Isagoor Appe, Jeerige and Kashimidi) were recorded. Large diversity seen in these types is due to the inherent heterozygosity, coupled with seed propagation; these are found mainly along banks



**Fig 2. Fruit titrable acidity in different Appemidi types of mango**

of streams, and their fruit is carried by the water to distant places. A majority of these accessions bear fruit in clusters and are monoembryonic. Most are named after the place they are found in or after the farmer who has identified the type.

Some of the types were observed to have a strong, raw-mango flavour (Balekoppa Appe, Halasage, Hittalahalli

**Table 2. Physical and chemical quality of mango accessions evaluated for whole-fruit pickle**

Accession	Fruit shape	Mango flavour	Latex flow	Fruit weight(g)	Firmness of fruit (kgcm <sup>-2</sup> )	Acidity (%)	pH	Drymatter (%) content	Ascorbic acid content (mg100g <sup>-1</sup> )
Adderi Jeerige	Oblong	Medium	Medium	45.37	12.78	2.72	2.54	17.6	36.60
Anantha Bhatta Appe	Elliptic	Medium	High	61.53	13.94	2.55	2.52	16.82	68.93
Appemidi	Elliptic	Strong	High	25.23	15.25	2.67	2.98	14.19	101.30
Aruna Gowda Appe	Elliptic	Strong	Medium	57.67	12.99	3.05	2.8	16.2	42.70
Balekoppada Appe	Oblong	Strong	High	33.41	18.39	3.34	2.32	14.6	54.94
Chansi Appe	Oblong	Medium	Medium	47.00	13.63	3.27	2.71	14.60	103.70
Dannalli Appe	Oblong	Strong	High	52.50	14.58	1.92	2.89	15.21	110.40
Dodderi Jeerige	Round	Medium	Medium	46.50	20.19	2.48	2.86	12.48	32.78
Gaddalahalli Appe	Round	Medium	Medium	191.75	17.09	2.45	2.51	19.24	54.92
Gorana Appe	Oblong	Strong	High	63.40	20.62	2.26	3.04	16.00	96.00
Gurumurthy Appe	Oblong	Medium	Medium	37.50	13.77	2.42	2.62	15.51	27.45
Halasage	Oblong	Strong	Medium	34.54	14.79	2.73	2.41	13.85	106.43
Hittalahalli Appe	Oblong	Strong	High	39.60	20.83	2.88	2.80	11.90	79.30
Holekoppada Appe	Oblong	Medium	Medium	55.93	16.2	2.42	2.38	15.22	87.23
Huli Appekai	Oblong	Medium	Medium	58.4	18.0	2.4	2.6	14.93	35.60
Isagoor Appe	Oblong	Strong	High	36.47	18.21	2.85	2.9	18.94	109.60
Jeerige	Oblong	Strong	High	36.3	17.16	3.26	2.26	18.88	45.75
Kadikai	Oblong	Low	Low	65.2	16.24	2.55	2.83	19.2	64.80
Kalakai	Oblong	Medium	High	40.00	13.8	3.26	2.94	14.20	45.75
Kalkuni	Oblong	Low	Low	43.32	13.7	2.75	2.75	19.95	51.85
Kana Appe 1	Oblong	Medium	High	17.43	12.96	2.32	2.67	15.76	90.28
Kangarmatha	Oblong	Medium	Medium	44.50	21.25	2.75	2.91	13.92	95.56
Kashimidi	Oblong	Strong	Medium	26.07	12.67	2.66	3.0	17.8	114.10
Kovesara	Round	Low	Low	54.01	15.6	2.56	2.85	18.98	76.86
Mahabalagiri Appe	Oblong	Medium	Medium	50.20	11.58	2.02	2.70	15.10	27.45
Malange	Round	Strong	High	30.77	19.94	3.14	2.28	17.94	36.65
Mandamane Appe	Oblong	Mild	Low	35.50	11.86	2.91	2.85	11.40	48.03
Mani Bhatta Appe	Round	Strong	High	173.97	19.66	3.07	2.24	18.65	64.15
Muregeer	Oblong	Medium	Medium	26.94	14.68	2.89	2.95	20.08	75.03
Nandgar Appe	Oblong	Strong	High	50.50	15.28	2.43	2.72	15.02	64.05
Sadamidi	Oblong	Strong	High	50.40	18.14	2.52	2.83	13.96	42.70
Shidadakke Appe	Oblong	Medium	High	51.00	15.39	2.13	2.85	16.80	15.25
Thumbbeedu	Oblong	Strong	High	43.90	15.64	2.35	2.70	15.80	24.40
SEd				2.39	1.28	0.85	0.04	1.07	2.62
CV				5.59	9.82	3.90	2.02	8.19	4.96
SEm				1.69	0.90	0.06	0.032	0.76	1.85

Appe, Isagoor Appe, Jeerige, Kashimidi, Malange, Mani Bhatta Appe, Nandgar Appe, Sadamidi and Thumb beedu). Raw tender-mango with a strong flavour is best suited for pickle making and has a demand in both domestic and international market. Latex flow is an important character in evaluating pickling types. Latex flow was found to be medium in 13 accessions, high in 16 accessions and low in 4 accessions, viz., Kalkuni, Kovesara, Kadikai and Mandamane. pH value of the fruits ranged from 2.24 to 3.04. Accession 'Gorana Appe' recorded significantly higher pH (3.04) while pH was lower (2.24) in 'Mani Bhatta Appe'. Dry weight of fruit was significantly higher (20.08% of fresh weight) in 'Muregeer' and was on par with Kalkuni,

Gaddalahalli Appe, Kovesara, Isagoor Appe, Jeerige, Mani Bhatta Appe, Malange, Kashimidi, Adderi Jeerige, Anantha Bhatta Appe, Shidadakke Appe, Aruna Gowda Appe and Gorana Appe (19.95, 19.24, 18.98, 18.94, 18.88, 18.65, 17.94, 17.8, 17.6, 16.82, 16.80, 16.2, 16.0, 16.00%, respectively). Accessions 'Mandamane' (11.40%) and 'Hittalahalli Appe' (11.90%) had lower dry weight. In ascorbic acid content of fruit, accession 'Kashimidi' was significantly high (114.1mg 100g<sup>-1</sup> pulp), followed by 'Dannalli Appe' (110.40mg 100g<sup>-1</sup> pulp) and 'Isagoor Appe' (109.6mg 100g<sup>-1</sup>). Similarly, accessions Halasage, Chansi Appe, Appemidi had higher ascorbic acid content (more than 100mg 100g<sup>-1</sup> pulp fresh weight) and low in 'Shidadakke

Appe' (15.25mg 100g<sup>-1</sup>), followed by 'Thumbebeedu' (24.40mg 100g<sup>-1</sup>), 'Gurumurthy Appe' (27.45mg 100g<sup>-1</sup>) and 'Mahabalagiri Appe' (27.45mg 100g<sup>-1</sup>). Titrable acidity was observed to be maximum (3.34%) in Balekoppa Appe, Chansi Appe, Kalakai, Jeerige, Malange, Mani Bhatta Appe and Aruna Gowda Appe. Firmness was found to vary from 11.58 kg/cm<sup>2</sup> in 'Mahabalagiri Appe' to 21.25 kg/cm<sup>2</sup> in 'Kangaramatha'. Accessions with high acidity and fruit firmness are best suited for pickling, as, these parameters decide taste and quality of the final product.

Morphological, agronomical and biochemical parameters (Rick and Holle, 1990; Weber and Wricke, 1994 and Kraemmer *et al*, 1995) have been widely used for evaluating several crops. Knowledge of genetic variability strongly facilitates breeding for wider geographic adaptability. Several studies have been conducted from time to time on morphological description of mango (Burns and Prayag, 1921; Mukherjee, 1948; Naik and Gangolly, 1950; Singh and Singh, 1956; Gangolly *et al*, 1957; Rajan *et al*, 1999; Yeshitela and Nessel, 2003; Desai and Dhander, 2000 and Dinesh and Vasugi, 2002).

One of the characteristic features of mango varieties present in India has been expression of a character in a particular environment where the variety may have originated. In the present study, a given unique indigenous type of mango belonging to Western Ghat region has shown distinct characteristics. These types are unique in that they are highly acidic, fibrous and rich in the characteristic raw-mango flavor; these have medium to high latex-flow and a firm pulp with good keeping quality. The pulp, after pickling, remains firm even for 3-4 years. On the basis of tender-fruit evaluation, accessions Chansi Appe, Dodderi Jeerige, Mani Bhatta Appe, Gorana Appe, Isagoor Appe, Malange, Gurumurthy Appe and Kashimidi possessed good traits for pickling.

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