

*Short communication***Genetic diversity in ‘Appemidi’ pickle mangoes****C. Vasugi, M.R. Dinesh and R. Chithiraichelvan**Division of Fruit Crops
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E-mail: vasuc@ihr.ernet.in**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/cm² 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 |

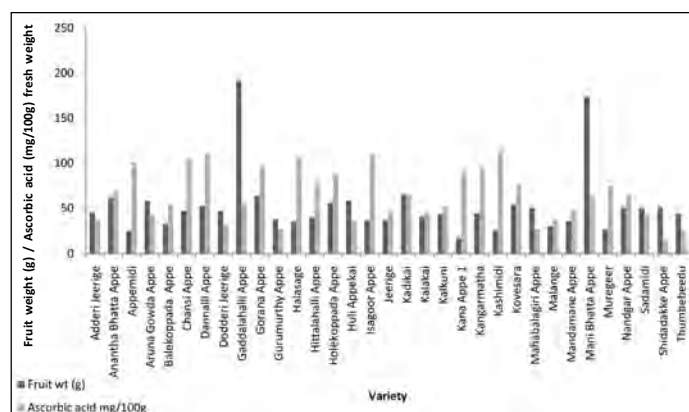


Fig 1. Fruit weight and ascorbic acid content in 'Appemidi' types of mango

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

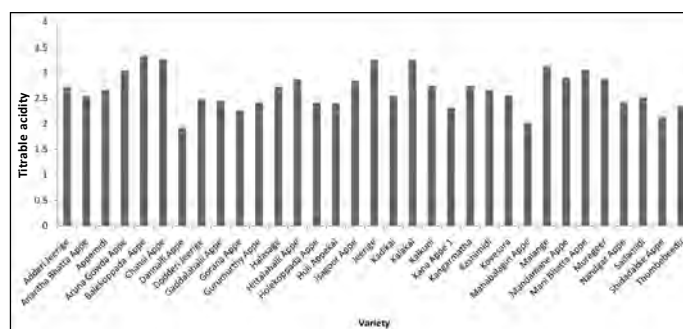


Fig 2. Fruit titrable acidity in different Appemidi types of mango

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 ⁻²) | Acidity (%) | pH | Drymatter (%) content | Ascorbic acid content (mg100g ⁻¹) |
|---------------------|-------------|---------------|------------|-----------------|---|-------------|-------|-----------------------|---|
| 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 |
| Thumbebedu | 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 Thumbe 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⁻¹ pulp), followed by 'Dannalli Appe' (110.40mg 100g⁻¹ pulp) and 'Isagoor Appe' (109.6mg 100g⁻¹). Similarly, accessions Halasage, Chansi Appe, Appemidi had higher ascorbic acid content (more than 100mg 100g⁻¹ pulp fresh weight) and low in 'Shidadakke

Appe' (15.25mg 100g⁻¹), followed by 'Thumbebeedu' (24.40mg 100g⁻¹), 'Gurumurthy Appe' (27.45mg 100g⁻¹) and 'Mahabalagiri Appe' (27.45mg 100g⁻¹). 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/cm² in 'Mahabalagiri Appe' to 21.25 kg/cm² 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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REFERENCES

- Burns, W. and Prayag, S.H. 1921. Indian mangoes. *J. Royal Hort. Soc.*, **26**:755-770
- Desai, A.R. and Dhander, D.G. 2000. Variation in physico-chemical and morphological characters of some mango varieties of Goa. *Acta Hort.*, **509**:243-249
- Dinesh, M.R. and Vasugi, C. 2002. Catalogue of mango germplasm, published by IIHR, Bangalore, pp.160
- Gangolly, S.P., Singh, R., Katyal, S.L. and Singh, D. 1957. The book of the mango. Department of Agriculture, Bombay, Bull. 103
- Kaemmer, D., Weising, K., Beyermann, B., Borner, T., Eppelen, J.T and Kahl, G. 1995. Oligonucleotide fingerprinting of tomato DNA. *Pl. Breed.*, **114**:12-17
- Mukherjee, S.K. 1948. The varieties of mango (*Mangifera indica* L.) *Bull. Bot. Soc. Bengal*, **2**:101-33
- Mukherjee, S.K. 1953. The mango its botany, cultivation, uses and future improvements, especially as observed in India. *Econ. Bot.*, **7**:130-162
- Naik, K.C., and Gangolly, S.R. 1950. Classification and nomenclature of south Indian mangoes. The Madras Department of Agriculture, Superintendent Printing Press, Madras, India
- Radhakrishna Holla. 2007. Guna, Vaishistathegala Khajane Vanya Jaathiya maavu thaligagu *Sujatha Sanchike*, May 17-23
- Rajan, S., Negi, S.S. and Kumar, R. 1999. Catalogue of mango germplasm, Central Institute for Subtropical Horticulture, Lucknow, India
- Ranganna, S. 1986. Handbook of Analysis and Quality Control for Fruit and Vegetable Products, Second Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, pp.1112
- Rick, C.M. and Holle, M. 1990. Andean *Lycopersicon esculentum* var. *cerasiformie*. Genetic variation and its evolutionary significance. *Econ. Bot.*, **44**:69-78
- Singh, L.B. and Singh, R.N. 1956. A monograph on the mangoes of Uttar Pradesh, Superintendent of Printing, UP Government, Lucknow
- Weber, W.E. and Wricke, G. 1994. Genetic markers in plant breeding. In: Advances in Plant Breeding, *J.Pl. Breed.* Suppl.16
- Yeshitela, T. and Nessel, T. 2003. Characterization and classification of mango ecotypes grown in Eastern Hararghe (Ethiopia). *Sarhad J. Agri.*, **19**:179-183

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