QUALITY ANALYSIS AND PRODUCT DEVELOPMENT OF SELECTED MANGO CULTIVARS

by

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THESIS

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my

Papa and Mammy

Dedicated to

DECLARATION

I hereby declare that this thesis entitled "Quality analysis and product development of selected mango cultivars" is a bonafide record of research work done by me during the course of research and that the theses has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title, of any other university or society.

Vellayani,
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CERTIFICATE

Certified that this thesis entitled "Quality analysis and product development of selected mango cultivars" is a record of research work done independently by Miss. BYNI ELIZABETH OOMMEN under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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INTRODUCTION

INTRODUCTION

Mango is one of the choicest and most appreciated of all fruits because of its aromatic flavour and taste. Through the ages mango has been acknowledged as an excellent fruit, relished by adults and children alike. No other fruit, excepting banana, is so closely associated with the history of agriculture, nay, the very history of civilisation itself, as the mango is.

Mango undoubtedly deserves to be the national fruit of India. In area, production, nutritive value and popularity of appeal, no other fruit can compete with it. It occupies the same position in India as is occupied by apple in temperate climates and grapes in sub-tropical areas. According to FAO production report (1994) India has a large production base of mangoes ie, around 10,000 MT which is equivalent to 54 per cent of the world production with the added bargain of wide varietal choice.

There are hundreds of mango cultivars grown all over the world. Mango fruit, irrespective of being tender, mature or ripe, has a specific use for the Indian people (Lakshminarayana, 1980). A vast majority are consumed in the fresh state or processed into a variety of products.

The characteristics of each variety vary widely and the ultimate quality of the mango products depend largely on the selection of suitable variety. The constituents of different commercial mango cultivars has not been studied systematically. The composition in general differs with the cultivars and the stage of maturity.

So this study is an attempt to ascertain the quality aspects of different cultivars of mango based on their physical, proximate composition and organoleptic qualities; which will be beneficial for use by both farmers as well as end users.

The various aspects investigated are:

1. Physical characteristics of the mango varieties selected
2. The chemical composition of the fruits
3. Sensory evaluation of the fruits
4. Clustering of the different mango cultivars based on selected chemical and nutritional composition
5. Determination of the superior variety based on the chemical and organoleptic qualities of the different cultivars.
6. Product development (Mango RTS) with the determined superior variety.
7. Assessment of chemical, organoleptic and shelf life qualities of the product developed.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The study entitled "Quality analysis and product development of selected mango cultivars", was reviewed under the following subtitles.

2.1 Mango - Importance as a fruit.

2.2 Physical characteristics of mango.

2.3 Chemical composition of mango.

2.4 Organoleptic qualities of mango.

2.5 Fruit based product (Ready-To-Serve Beverage).

2.6 Nutritional composition, organoleptic and shelf-life qualities of the product.

2.1 Mango - Importance as a fruit

Among the exotic fruits that have shown strong growth in the United Kingdom in recent years has been the mango (Jabati, 1989).

The introduction of mango to the new world occurred only recently. But records suggest that it has been in cultivation in the Indian subcontinent for well over 4000 years now (Singh, 1968).

It has been, since time immemorial, the favourite of the Kings and commoners alike because of its luscious taste and captivating flavour. According to Bose (1990), mango is the most important fruit of the tropics commanding a unique position in the Indian Horticulture and because of its great utility, occupies a pre-eminent place amongst the fruit crop grown in India and is acknowledged as the 'King of Fruits' of this country.

Giridhari et al. (1986) had pointed out that India is the home of mangoes and a large number of varieties are found in almost all parts of the country. He also reported that mango has earned a reputation of being the apple of the tropics, because it is so wide spread.

Although mango is now being grown in more than 87 countries of the world, yet no where it is so extensively cultivated as in India. It covers the largest area amongst the fruit crops in the country. There are more than one thousand cultivars of this fruit grown in India. These numerous cultivars provide an unusual diversity of flavour and taste.

Inida is by far the largest Mango producing nation in the world, yet hardly 1 per cent of the total mango production in India is processed and only a negligible proportion of our produce is exported as fresh fruit (Pruthi, 1992).

According to a report published by Indian Food Industry (1994) the export of mango and mango pulp products were established to be 29,000 tonnes in 1990-91 and fetched Rs.58 crores to the country.

In India, mango is distributed throughout the length and breadth of the country except in hilly regions. As per the report given by Singh (1990), the leading mango growing states in India are Uttar Pradesh, Andra Pradesh, Bihar, Orissa, West-Bengal, Maharashtra and Tamil Nadu.

Mangoes are reported to be the most nutritious food (Thimmayamma, 1980). Bhatnagar and Subramanian (1973) opined that mango is a fairly good source of carbohydrates, Vitamin C and a very rich source of pro-vitamin A. Carbohydrate portions include simple sugars, starch, cellulose, pectic substances and tannin.

Hicks (1990) indicated that in mango, there is a high content of carotene and vitamin C and also the level of terpenes is very high, particularly in the part of the fruit closer to the skin. Kapur (1974) studied the biochemical changes in mango varieties during growth and he observed that vitamin C content of green, tender mangoes are higher whereas it is much lower in ripe mangoes. Gowda and Ramanjanaya (1994), pointed out that mango is an excellent source of vitamin A and C.

Manay and Shadaksharaswamy (1995) reported that mango fruits contain 10-20 per cent sugar and are an important source of Vitamin A, B and C. They also reported that the mango fruits have a rich, luscious aromatic flavour and a delicious taste in which sweetness and acidity are delicately blended and so this makes the mango fruit one of the most highly prized dessert fruits of the tropics.

2.2 Physical characteristics of mango

It has been pointed out by previous workers engaged in the description of mango varieties that qualitative characters are much more constant and important than the quantitative characters such as the shape of the fruit of a given variety is fairly constant, showing little response to changing environment, as compared to the size of the fruit (Gangolly and Ranjit, 1957).

According to Gangolly and Ranjit (1957) it was reported that, among the fruit characters, they found the shape of the fruit including the presence or absence of the beak as the most important. The commonest fruit shapes reported in mango are roundish, ovate, oblong, cordate and reniform with a number of shapes intermediate between these. It was also reported that the form, size and shape of the seed or stone and also the texture and position of the fibre afford useful information for varietal identification.

According to Manay and Shadaksharaswamy (1995) the mango fruit is a large drupe in varied shape, size, colour and flavour. They also reported that the shapes are normally round, oval or oblong and the size ranges from plum-sized ones to giants (more than 22 cm long).

Some 20 mango varieties were evaluated for physical characters of the fruit by Singh and Yadav (1991-92) and it was reported that *Baneshan*, *Fazli*, *Bangalora*, *Sunderjan* and *Mallika* had high fruit weight coupled with high fruit length and width.

Gowda and Ramanjaneya (1994) studied the physico-chemical characteristics of eleven mango varieties and reported that the peel and stone contents were lowest in *Suvarnarekha* and the fibre content was minimum in *Dasheharl*. *Langra*, *Mulgoa*, *Dasheharl* and *Alphonso* possessed very viscous pulp/juice.

Manay and Shadaksharaswamy (1995) pointed that the pulp of some mangoes are fibrous throughout while the fibre may be absent or very little in others and the flesh may also be firm, soft or juicy, subacid or sweet and richly sweet smelling.

2.3 Nutritional and chemical composition of mango

The nutritional and chemical composition is a major parameter influencing the quality of a fruit. Under this vitamin C, β-carotene, acidity, total soluble solids (T.S.S.),

total sugar, reducing sugar, crude fibre, minerals, crude fat and moisture are mainly considered. Bose (1990) ascertained that the composition of the fruit in general differs with the cultivar and the stage of maturity.

2.3.1 Vitamin C

It is one of the principal vitamins of the mango fruit. Indian cultivars are reported to contain 13.2 to 80.3 mg of vitamin C per 100 g of fruit pulp, whereas some West Indian cultivars vary between 9.3 and 130.8 mg per 100 g of pulp (Singh, 1968).

Kapur (1974) studied the bio-chemical changes in mango varieties during growth ie, *Dashehari*, *Safeda* and *Samar Bahisht Chausa*. He observed that ascorbic acid was at the highest level in the young fruit and relatively more in skin. He also reported that during the process of maturation and ripening, there was a rapid loss of ascorbic acid.

According to Hulme (1971), the rate at which the ascorbic acid decreases is largely conditioned by pH. As the pH increases the ascorbic acid decreases. Thomas (1975) opined that the retention of ascorbic acid was found to be better in fruits ripened at lower temperatures.

Ascorbic acid, according to analysis in Central America, ranges from 41.8 to 172.0 mg per 100 g, whereas in

India, ascorbic acid values may be as low as 13 mg per 100g (Food Science Food Technology and Nutrition, 1993).

2.3.2 Carotenoids

Pro-vitamin A (β-carotene) is also one of the principal vitamins of the mango fruit. The carotene content was found to increase during ripening and is maximum when over ripe. Bhatnagar and Subramanyam (1973) reported that the β-carotene content was found to range between 800 and 13,000 ug/100g.

As per the report given in Food Science Food Technology and Nutrition (1993) the carotene content of mangoes ranged from 0.283 to 1.872 mg per 100g.

Sudhakar and Maini (1994) observed that carotenoids were stable at higher levels of SO_2 and maximum retention of carotenoids was found in the pulps of *Neelum* followed by *Totapuri* and *Chausa*.

2.3.3 Acidity

In most of the table varieties citric acid seems to form a dominant constituent. The acidity in the fruit has been found to be increasing from skin to stone.

ICAR (1967) analysed 22 varieties of mangoes from different parts of India and showed that the acid content

(expressed as malic acid) ranges from 0.067 to 3.66 per cent in green fruits and 0.18 to 0.56 per cent in ripe fruits.

Kapur (1974) observed that the acids attained a maximum value and then declined, when he studied the biochemical changes in mango varieties during growth. He also reported that during the process of maturation and ripening, there was a rapid loss of acid.

Roy *et al*. (1996) analysed the acidity of a few mango varieties (*Dashehari*, *Neelum*, *Mallika* and *Amrapali*) and observed to have 0.18, 0.24, 0.33 and 0.06 per cent acidity respectively.

2.3.4 Total soluble solids

Yadaw *et al*. (1980) carried out investigations with ten varieties of mango and reported that of the ten varieties *Dashehari* was found the best for the maximum content of T.S.S. (21.12 per cent) whereas the variety *Deshi* was found to have the lowest (15.43 per cent).

Kaushik and Kumar (1992) in their study on the storage behaviour of five cultivars of mango found that the T.S.S. content in all the varieties increased during ten days of storage. An increase in T.S.S. during storage of mango was also reported by Deol (1985).

Roy *et al*. (1996) reported that the T.S.S. of the mango varieties - *Dashehari*, *Neelum*, *Mallika* and *Amrapali* were 22.5, 17.0, 24.0 and 21.5°Brix respectively.

2.3.5 Total sugar

Bhatnagar and Subramaniyam (1973) analysed the chemical composition of ten varieties of mango and found that the total sugar varied from 10.5 to 18.5 per cent.

Palaniswamy *et al*. (1974) evaluated 29 varieties of mango for their suitability for the preparation of pulp, squash and canned slices based on their physico-chemical investigations. Regarding the chemical characters, the range of total sugar was between 7.09 - 17.20 per cent.

According to Ghosh *et al*. (1985), the total sugar content analysed among three varieties of mango were found to range between 8.70 and 18.20 per cent.

Physiological and bio-chemical changes occurring during the fruit growth and development were studied in three mango cultivars (ie, *Rumani*, *Baneshan* and *Panchadarakalasa*) and two hybrids (ie, *AU Rumani* and *Neeleshan*) by Rao *et al*. (1988) and it was reported that the total sugar content increased from fruit set to maturity and they were highest in the hybrid *Neeleshan* at maturity.

2.3.6 Reducing sugar

Bhatnagar and Subramaniyam (1973) analysed the chemical composition of ten varieties of mango and found that the reducing sugar varies from 2.0 to 7.5 per cent.

Studies on biochemical aspects of mango by Prasad (1984) found a maximum reducing sugar content (9.97 and 10.10 per cent) for *Alphonso*.

2.3.7 Crude fibre

ICAR (1967) reported that the fibre content is a determining factor of the fruit quantity which may vary from 0.02 to as high as 0.2 per cent.

Gebhardt *et al*. (1982) studied the fibre content of raw mangoes and reported the mean amount per kilogram edible portion to be 8.40 g.

Studies on biochemical aspects of mango by Prasad (1984) revealed that of the ten varieties studied, the highest content of crude fibre was found in the variety *Olour* (2.33 per cent).

2.3.3 Moisture

The moisture content of mango was reported to range between 73.0 and 86.7 per cent (ICMR, 1966).

Bhatnagar and Subramaniyam (1973) analysed the chemical composition of ten varieties of mango and found that the moisture content varies from 76 to 86 per cent.

The green, unripe mangoes contain a higher percentage of moisture compared to ripe mangoes.

The moisture per cent of *Dashehari* mango was reported to be 80.20, 79.45, 77.80, 77.02 and 76.82 after 4, 6, 8, 10 and 12 days of harvest (Sagar and Khurdiya, 1996).

2.3.9 Minerals

Mineral constituents are important for various metabolic activities of the fruit.

Singh (1962) estimated the mineral constituents of the different parts of the mango fruit and found that, except for calcium, the pulp had more than 50 per cent of the total mineral content of the fruit.

Mexican mango, in general consisted of 19, 11 and 1.5 mg of calcium, phosphorus and iron, respectively, while Manila (also from Mexico) consisted of 12, 13 and 0.77 mg/100g, respectively (Hernandez *et al.*, 1971).

Gopalan *et al.* (1977) reported the mineral constituents of ripe mango fruit from India as 400 mg/100 g fruit. Calcium, phosphorus and iron were equivalent to 14, 16 and 1.3 mg/100g respectively.

Thimmayamma (1980) reported that mango fruit is a source of potassium and other trace minerals.

The mineral content of mangoes were reported to be 100, 1.30, 90, 110, 1560, 20, 0.40, 1.10 and 0.27 mg for calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, copper and manganese respectively (Gebhardt *et al*. 1982).

Kaushik and Kumar (1992) conducted an investigation on the storage behaviour of five cultivars of mango and it was observed that calcium content was higher in *S.B. Chausa* and *Bombay green*.

2.3.10 Crude fat

According to the report published by ICMR (1966) the fat content of mango ranged between 0.1-0.8 g per cent.

Hernandez *et al*. (1971) and Gopalan *et al*. (1977) reported that the Indian mango varieties contained 0.4 g per cent of fat whereas the mexican varieties were reported to contain 0.1 g per cent of fat.

2.4 Organoleptic qualities of mango

Sensory evaluation involves the measurement and evaluation of the sensory properties of foods, and other materials (Stone and Sidel, 1993).

According to the Sensory Evaluation Division of the Institute of Food Technologists (Anon, 1975), the sensory evaluation is defined as a scientific discipline used to evoke, measure, analyse and interpret results of those characteristics of foods, and materials as they are perceived by the senses of sight, smell, taste, touch and hearing.

Gangolly and Ranjit (1957) reported that the texture of the flesh, its aroma, juiciness and taste are some of the important fruit characters which cannot possibly be missed. The presence or absence of fibre, the texture and the size of the fibre are also found to be important characters.

Berry (1979) reported that no fruit compares in flavour with the best ripe mangoes. Kalra and Tandan (1983) stated that mango has good flavour and excellent processing qualities.

Singh (1990) reported that the unique taste and flavour developed in some of the top varieties of mango in India, imparting to the fruit a quality par excellence, is unsurpassed anywhere in the world.

2.5 Fruit based product (Ready-To-Serve Beverage)

In India, cold drinks are in demand practically throughout the year. Among these, fruit juices have an important place. Being rich in essential minerals, vitamins

and other nutritive factors, they are quite popular. Besides they are delicious and have universal appeal unlike other beverages. (Siddappa *et al.*, 1986).

Ready-to-serve beverages are increasingly gaining popularity throughout the country. This is evident from the production figures which increased from 16,200 MT in 1984 to 91,625 MT in 1988 (Chakraborty *et al.*, 1993).

Kalra *et al.* (1991) reported that beverage made from mango-papaya pulp preserved for one year was organoleptically acceptable also.

Thirumaran *et al.* (1992) has standardised the formula for the preparation of fermented carrot based RTS which was acceptable even after 6 months.

Manan *et al.* (1992) developed an RTS with acceptable sensory attributes from 9 months stored apricot pulp.

Teotia *et al.* (1992) developed a musk-melon-mango beverage blend and found that the beverage made from 50:50 blend was adjudged to be the best because of its balanced flavour.

Khurdiya (1992) reported that the nectar prepared from the pulp of *Totapuri* and *Amrapali* mangoes at the ratio of 50:50 was found to be superior in colour, carotenoid contents, viscosity and sensory quality.

Papaya ready-to-serve (RTS) beverage standardised by Thirumaran *et al*. (1993) consisted of 25 per cent pulp, 9.5 per cent sugar, 15°Brix and 65 per cent water. The RTS was also found to be highly acceptable organoleptically with a shelf-life of more than 6 months.

Jain *et al*. (1996) evaluated the performance of four late maturing varieties of mango for the preparation of mango nectar and ready-to-serve (RTS) drink and it was observed that the quality of the mango RTS drink and nectar during storage remained acceptable for 3 and 4 months respectively.

2.6 Chemical composition, organoleptic qualities and shelf-life of the product

The quality parameters generally selected to ascertain the products' suitability for public use and to study the effect of processing method are chemical tests like acidity, pH, T.S.S., reducing sugar and total sugar. Physical qualities like juice content, specific gravity, pulp content, microbial tests and sensory evaluation are also ascertained.

2.6.1 Chemical composition

Mango nectar and RTS drink were prepared using mango pulp, sugar and citric acid containing 0.3 per cent acidity each (Roy *et al*., 1972, Rabbani and Singh, 1988, Khurdiya and Roy, 1988).

Analysis of preserved grape juice proved that processing and pre-treatments had negligible effect on acidity (Sandhu *et al.*, 1988).

Kalra *et al.* (1991) had also reported that acidity did not change significantly during the 12 month storage of mango-papaya blended beverage.

The Kinnow RTS stored in ambient condition when evaluated, showed negligible changes in acidity (Renote *et al.*, 1992).

Jain *et al.* (1996) observed that the acidity of *Amrapali* nectar and *Taimuria* RTS drink during storage remained unchanged.

Variation in reducing sugar during storage may be mainly due to the acid hydrolysis of sucrose (Labuza *et al.*, 1970) and the inversion is temperature dependent, the inversion rate being higher at higher temperature. Storage studies conducted by Thirumaran *et al.* had observed an increase in reducing sugar in tomato juice concentrate (1990) and in fermented carrot based RTS (1992).

The chemical analysis of stored Kinnow RTS showed only negligible changes in reducing sugar (Renote *et al.*, 1992) while in a study conducted by Perlette (1992) only a slight change in reducing sugars was obtained during the 24 week storage in grape juice.

The stored kinnow RTS showed negligible changes in pH when evaluated for quality (Renote *et al.*, 1992). Thirumaran *et al.* opined that the pH values remained almost the same during the first and second weeks of storage with a slight change during the third week of storage of tomato juice (1990) and in fermented carrot juice (1992).

Chemical analysis of fermented carrot based RTS indicated a decline in total sugar (Thirumaran *et al.*, 1992). A similar decline was also reported by Renote *et al.* (1992) in Kinnow juice.

Mango - papaya blended beverage stored over a period of one year at ambient condition had shown that T.S.S. content did not change significantly during storage (Kalra *et al.*, 1991). Similarly kinnow RTS stored at ambient condition over 24 weeks (Shah and Bains, 1992) and kinnow juice over a period of 6 months (Renote *et al.*, 1992) had indicated negligible changes in T.S.S. In storage studies by Thirumaran *et al.* had observed a decline in T.S.S. in tomato juice concentrate (1990) and fermented carrot based RTS (1992).

Prasad *et al.* (1968) reported that after storage for 1 year at room temperature the retention of ascorbic acid was 55.20 per cent, 46.20 per cent and 19.00 per cent respectively in amla juice, squash and ready-to-serve beverage. Pruthi (1985) studied the role of vitamin C in the discolouration of

processed products and has reported that there was 10-15 per cent loss of ascorbic acid during storage period. Jellink (1985) had reported that there was a loss of ascorbic acid in processed food products under the influence of atmospheric oxygen. Sahni and Khurdiya (1989a) reported that the ascorbic acid content was reduced during storage of mango RTS.

2.6.2 Organoleptic qualities

According to Herrington (1991) sensory evaluation technology is a method using skilled management and trained panelists to provide confirmation on the acceptability of the product profile, consumer acceptability and consistency.

The formula for fermented carrot based RTS was acceptable for all the quality attributes the colour, appearance, flavour and taste for more than 6 months (Thirumaran *et al.*, 1992).

Sreeja (1996) observed that clarified juice made from cashew apple fruits got maximum score for appearance at sixth month, taste and flavour decreased with advanced storage periods. Whereas for squash all the characters were scored low but at the fresh stage after processing, it was observed an excellent one.

Jain *et al.* (1996) reported that the mango varieties *Amrapali* and *Taimuria* recorded highest organoleptic score for mango nectar and RTS drink.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The study entitled "Quality analysis and product development of selected mango cultivars" is a comprehensive study carried out with an objective to evaluate the quality of different varieties of mango based on physical characteristics, chemical composition and organoleptic qualities so as to identify the most suitable mango variety for the preparation of mango pulp based products.

The methodology followed in the study is presented under the following headings

3.1 Selection of varieties

3.2 Quality parameters

3.2.1 Physical characters

3.2.2 Chemical and nutritional composition

3.2.3 Organoleptic qualities

3.3 Statistical analysis

3.4 Product development

3.4.1 Assessment of chemical constituents and organoleptic qualities of the product

3.4.2 Assessment of shelf-life qualities of the product.

3.1 Selection of varieties

Mango is a tropical fruit found in almost all parts of India and is found to have very rich organoleptic qualities (Bose, 1990).

Twenty dessert varieties of mango including local and improved types were selected for the study. Among these 9 were KAU recommended varieties and the remaining 11 were local varieties. These varieties were included in the study based on their general acceptability in the country for various purposes. The varieties selected are presented in Table 1.

Table: 1 Varieties selected

Sl.No.	KAU Recommended varieties	Sl.No.	Local varieties
1	*Chausa*	1	*Prior*
2	*Kalapady*	2	*Salem*
3	*Neelum*	3	*Moovandan*
4	*Mundappa*	4	*Olour*
5	*Pairi*	5	*Kottukonam*
6	*Baneshan*	6	*Kalkand*
7	*Alampur Baneshan*	7	*Bangalora*
8	*Mulgoa*	8	*Rumani*
9	*Suvarnarekha*	9	*Karpooramanga*
		10	*Kilichundan*
		11	*Panchasara Varikka*

The mango varieties were collected from Government Fruit Farm, Kanyakumari and also from the local markets from time to time during the course of work.

3.2 Quality parameters

A detailed study on different quality parameters of mango viz. (a) physical characters, (b) chemical composition and (c) organoleptic qualities was envisaged.

Among these parameters physical characteristics and organoleptic qualities influence the consumer's appeal immediately. Parameters like chemical composition has little influence on the popularity of the mango varieties among consumers.

Under each parameter a number of indicators (listed below) are available and are reported to influence the quality of mango varieties.

3.2.1 Physical characters

Physical characteristics of the mango varieties were found to be a major determinant of quality and acceptability of mango varieties.

The different indicators ascertained under physical characteristics are:

(a) Size of the fruit
(b) Shape of the shoulders
(c) Form of the fruit
(d) Stalk insertion of fruit
(e) Beak of the fruit
(f) Stone venation
(g) Stone fibre

— Assessed by visual observation

(h) Length - The length of the fruit was measured using a thread and measuring scale

(i) Fruit weight
(j) Peel weight
(k) Stone weight
(l) Flesh weight

— Observed using an electronic balance

(m) Density - Density of the fruit was assessed by dividing the mass of the fruit by the volume of the fruit.

(n) Juice content - The juice of the fruit was extracted and then the content was assessed.

3.2.2 Chemical and nutritional composition

Chemical composition is a major parameter influencing the quality of mango varieties from the point of view of nutritionists.

The different indicators ascertained under nutritional composition are:

(a) Vitamin C - Vitamin C was determined by the method outlined by the A.O.A.C. (1965)

(b) Carotenoids - β - carotene was estimated by the method suggested by Srivastava and Kumar (1994)

(c) Acidity - Acidity was measured by the procedure reported by the A.O.A.C. (1965).

(d) Total soluble solids - Total soluble solids was estimated using a hand refractometer (Ranganna, 1986)

(e) pH - pH was measured using a digital pH meter (Jackson, 1973)

(f) Total sugar - Total sugar was determined by using the procedure suggested by the A.O.A.C. (1965).

(g) Reducing sugar - Reducing sugar was estimated using the procedure suggested by the A.O.A.C. (1965).

(h) Crude fibre - Crude fibre was analysed by the method suggested by Raghuramulu *et al*. (1983).

(i) Calcium - Calcium was estimated by dry ashing followed by the determination of the ash extract in an A.A.S. (Piper, 1966)

(j) Magnesium - Magnesium was determined by dry ashing followed by the determination of the ash extract in an A.A.S. (Piper, 1966)

(k) Potassium - Potassium was analysed with the ash extract using a flame photometer (Piper, 1966)

(l) Sodium - Sodium was analysed with the ash extract using a flame photometer (Piper, 1966)

(m) Phosphorus - Phosphorus in the ash extract was estimated by their vanadomolybdate yellow colour method (Piper, 1966)

(n) Moisture - Moisture was determined according to the procedure outlined by the A.O.A.C. (1965).

(o) Crude Fat - The fat content in the sample was estimated by soxhlet method (A.O.A.C. 1965)

3.2.3 Organoleptic qualities

Organoleptic qualities play an important role in evaluating the quality of a food products. For adjudging consumer acceptability, organoleptic evaluation of any food product is essential.

The panel members for sensory analysis at the laboratory level were selected from a group of students. These judges were selected through triangle test as suggested by Mahony (1985). Details in Appendix-1. Thus 10 members were selected as judges for the acceptability trial.

The sensory analysis of panel members were done using the scoring method and scoring was done as suggested by Swaminathan (1974). The major quality attributes included in the score card were appearance, colour, texture, flavour and taste (Appendix-2). Scores for overall acceptability was obtained by determining the average mean scores for each character.

3.3 Statistical analysis

The statistical analysis was done as follows:

(1) Anova for the comparison of the cultivars with respect to various quality attributes (Snedecor and Cochran, 1967).

(2) Clustering of the mango cultivars was done using Mahalanobis D^2 analysis (Mahalanobis, 1928).

(3) Discriminant function analysis was carried out to determine the superior variety (Fisher, 1936).

3.4 Product Development

Based on the discriminant function analysis the superior variety was selected for product development.

Mango Ready-To-Serve (RTS) beverage was prepared from the mango juice of the superior variety selected (Fig.1). RTS needs no amount of dilution and it is in the ready-to-serve form. RTS beverage is delicious, rich in essential minerals, vitamins and other nutritive factors and have an universal appeal unlike other beverages (Siddappa *et al.*, 1986).

FPO specified tests were administered on the product to evaluate its suitability. The chemical composition, organoleptic and shelf-life qualities of the product prepared was analysed.

3.4.1 Assessment of chemical constituents and organoleptic qualities of the product

FPO specified tests were conducted on the product developed to assess the nutritional and chemical constituents in the product. Different indicators ascertained under this are:

(a) Net volume/weight of juice content

(b) T.S.S.
(c) Acidity
(d) pH
(e) Reducing sugar
(f) Total sugar
] were observed as mentioned earlier

(g) Pulp content (by centrifugation)

(h) Specific gravity (using specific gravity bottle)

Sensory evaluation of the product was done immediately after the preparation was carried out by a panel of 10 judges with the help of a score card. Details in Appendix-3. The panel members for acceptability trials at the laboratory levels were selected by employing the triangle test method as mentioned earlier.

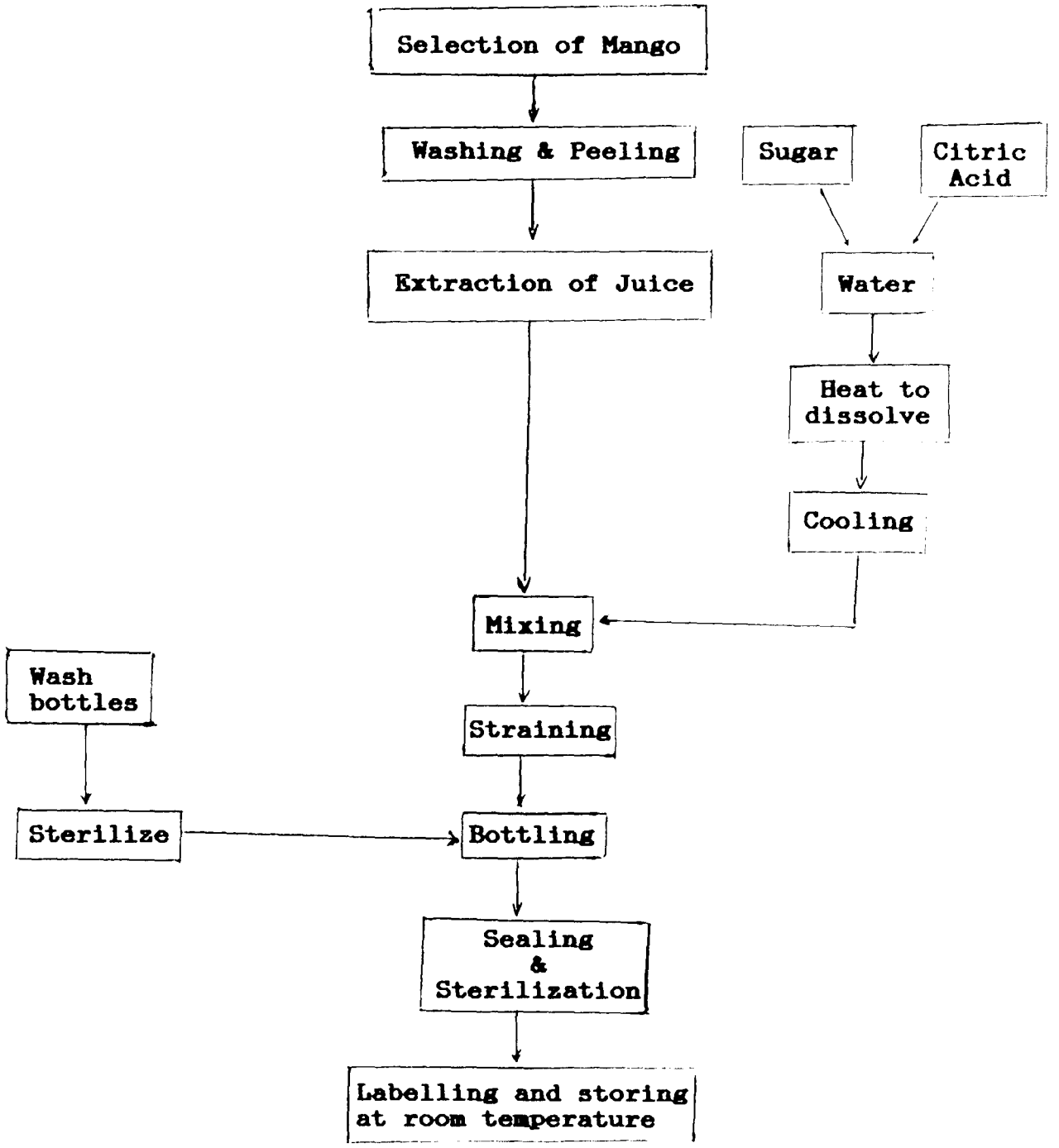
3.4.2 Assessment of shelf-life qualities of the product

The shelf-life qualities of the product was recorded based on the changes in the chemical constituents of the product due to storage and also occurrence of microbial growth in the product.

The product prepared was assessed for microbial contamination viz. bacteria, fungi and yeast. The fermentation test was also conducted.

Fig.1

FLOW CHART FOR THE PREPARATION OF MANGO RTS



RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

Salient findings of the study entitled "Quality analysis and product development of selected mango cultivars' are presented and discussed under the following subtitles:

4.1 Assessment of physical characteristics of selected mango cultivars.

4.2 Assessment of chemical and nutritional composition of different mango cultivars.

4.3 Assessment of organoleptic qualities of different mango cultivars.

4.4 Clustering of the different mango cultivars based on chemical and nutritional composition.

4.5 Determination of the superior variety for product development.

4.6 Assessment of chemical constituents and organoleptic qualities of the processed product.

4.7 Assessment of shelf-life qualities of the product.

4.1 Assessment of physical characteristics of selected mango cultivars

The physical characteristics of different mango cultivars were assessed in order to study the nature of the fruit and also to identify the fruit. The major physical

characteristics assessed in the different mango cultivars were fruit weight, fruit length, peel weight, stone weight, flesh weight, density, size of the fruit, shape of the shoulders, form of the fruit, stalk insertion, beak of the fruit, juice content, stone venation and stone fibre.

The physical characters differ according to the particular cultivar. The size of the fruit was observed to be medium for most of the varieties except *Kalapady*, *Baneshan*, *Alampur Baneshan*, *Mulgoa*, and *Panchasara Varikka*. The varieties *Baneshan*, *Alampur Baneshan* and *Mulgoa* were observed to be large in size whereas the varieties *Kalapady* and *Panchasara Varikka* were found to be small in size.

Among the fruit characters, the form of the fruit is considered very important. The form of the fruit was observed to be ovate oblique for the varieties *Kalapady*, *Neelum*, *Karpooramanga*, *Baneshan*, *Kilichundan* and *Chausa* wereas the varieties *Mulgoa*, *Moovandan* and *Panchasara Varikka* were found to be roundish oblique. The variety *Suvarnarekha* was found to be ovate oblong in form but the variety *Alampur Baneshan* was observed to be obliquely oblong in form. The form was found to be roundish for the varieties *Mundappa* and *Rumani*. The varieties *Pairi*, *Salem* and *Olour* were observed to be ovate in form whereas the varieties *Kottukonam* and *Bangalora* were found to be oblong and the varieties *Prior* and *Kalkand* were found to be oblique.

The stalk insertion of the fruits under evaluation were observed to be either square or oblique. It was found to be obliquely for the varieties *Baneshan*, *Alampur Baneshan*, *Moovandan*, *Karpooramanga*, *Kilichundan* and *Panchasara Varikka*, whereas for the rest of the varieties the stalk insertion was found to be square.

The presence or absence of the beak is also considered as an important fruit character. On visual observation of the nature of the beak of the fruits, it was observed that the beak was slight but distinct for the varieties *Neelum*, *Moovandan* and *Mulgoa* whereas it was found to be just a point for the varieties *Suvarnarekha*, *Salem*, *Karpooramanga* and *Panchasara Varikka*. The beak was found to be slightly prominant for the varieties *Alampur Baneshan*, *Olour* and *Kalkand* whereas it was found to be highly prominant for *Pairi*, *Prior*, *Kottukonam* and *Kilichundan* and prominant in the case of the varieties *Kalapady*, *Bangalora* and *Chausa*. The beak was found to be missing in the varieties *Mundappa*, *Baneshan* and *Rumani*.

The juice content was moderately abundant for the varieties *Kalapady*, *Salem*, *Moovandan*, *Neelum*, *Rumani* and *Chausa* whereas it was found to be moderate for the varieties *Baneshan*, *Prior*, *Olour*, *Bangalora* and *Karpooramanga*. The juice content of the varieties *Mundappa* and *Mulgoa* was found to be moderate

to abundant. In the case of the varieties *Pairi*, *Alampur Baneshan*, *Suvarnarekha* and *Kottukonam* the juice content was found to be abundant whereas the juice content of the varieties *Kilichundan*, *Panchasara Varikka* and *Kalkand* were observed to be scanty.

The nature of the veins on the stone was found to be a varietal character which was taken into consideration for varietal identification. They are usually parallel or forked and may either be slightly raised or slightly depressed, and are rarely either grooved or prominantly ridged (Gangolly and Ranjit (1957). The stone venation was found to be forked and prominant for the varieties *Kalapady*, *Mundappa*, *Baneshan*, *Kilichundan*, *Alampur Baneshan* and *Kalkand* whereas the varieties *Mulgoa*, *Olour*, *Bangalora* and *Chausa* was found to have forked, not prominant type stone venation. It was slightly forked and prominant for the variety *Neelum* and forked, slighly prominant for the varieties *Suvarnarekha* and *Rumani*. The stone venation was found to be forked for the varieties *Pairi*, *Salem*, and *Karpooramanga* whereas it was found to be parallel for the variety *Moovandan*. The stone venation was found to be parallel and prominant for the varieties *Prior* and *Kottukonam* but parallel and not prominant for the variety *Panchasara Varikka*.

The nature and distribution of the fibre on the stone is also considered very important as it is essential for varietal identifications. Gangolly and Ranjit (1957) reported

that the stone fibres may be coarse, stiff or soft and they may be sparse, abundant or intermediate in occurence. In the present investigation it was observed that the varieties *Neelum*, *Pairi*, *Alampur Baneshan*, *Mulgoa* and *Suvarnarekha* had short, soft, fibre all over the stone and the varieties *Bangalora*, *Rumani*, *Kalapady*, *Prior*, *Baneshan*, *Chausa*, *Kalkand* had sparse, short, soft fibres all over whereas the varieties *Karpooramanga*, *Kilichundan*, *Kottukonam* had sparse, coarse fibres all over. The varieties *Mundappa* and *Moovandan* had dense, short, coarse fibres all over whereas the varieties *Salem* and *Panchasara Varikka* had abundant, short, soft fibres all over. Medium, soft fibre type stone fibres were observed for the variety *Olour*.

The shape of the shoulders of different mango varieties were studied and it was observed that the shape of shoulders of the fruit was unequal, with ventral shoulder rounded and slightly higher than the dorsal shoulder for the varieties *Pairi*, *Baneshan*, *Moovandan Alampur Baneshan*, *Neelum*, *Karpooramanga*, *Kilichundan*, *Panchasara Varikka*, *Kottukonam* and *Olour* whereas it was observed that the shape of the shoulders were equal, with ventral shoulder rounded and higher than the dorsal shoulder for the varieties *Kalapady*, *Mulgoa*, *Suvarnarekha*, *Prior*, *Salem*, *Bangalora*, *Rumani* and *Chausa*. Apart from these the shape of the shoulders for the variety *Mundappa* was equal, with ventral shoulder level and rounded whereas for the variety *Kalkand* it was unequal, with ventral shoulder level and rounded.

Table 2 elucidates the average fruit length of different mango cultivars studied. It is clear from the data that the average fruit length ranged between 9 cm and 16.15 cm. The maximum average fruit length was observed for the variety *Bangalora* (16.15 cm) whereas the minimum average fruit length was observed for the variety *Pairi* (9.0 cm). The average fruit length of different polyembryonic varieties of mango at ripe stage was reported to range between 7.24 and 8.63 (Anon, 1989). The statistical analysis of the data revealed that there is significant difference between the different varieties studied.

On analysing the average fruit weight of the different varieties studied, it was observed that the average fruit weight ranged between 142.5 g and 534.0 g. As shown in Table 2, the highest value for fruit weight was obtained in the variety *Bangalora* (534.0 g) whereas the lowest score was observed for the variety *Panchasara Varikka* (142.5 g). Singh and Gangwar (1985) reported that the average fruit weight ranged from 106.6 g to 335.7 g of in nine varieties of mango. There is significant difference among the different varieties studied with respect to fruit weight.

It was observed that the peel weight of the different mango cultivars ranged between 5.18 per cent and 18.46 per cent. As shown in Table 3, the highest percentage of peel weight was observed for the variety *Kalapady* (18.46 per cent)

Table 2 Fruit length and weight of different mango cultivars

Name of the cultivar		Fruit length (cm)	Fruit weight (g)
V_1	*Kalapady*	11.50 (11)	162.5 (18)
V_2	*Neelum*	11.20 (16)	249.0 (11)
V_3	*Mundappa*	11.25 (14)	315.0 (07)
V_4	*Pairi*	9.00 (20)	405.0 (03)
V_5	*Baneshan*	13.25 (08)	307.5 (08)
V_6	*Alampur Baneshan*	13.95 (06)	377.5 (04)
V_7	*Mulgoa*	15.15 (02)	352.5 (05)
V_8	*Suvarnarekha*	12.30 (10)	342.5 (06)
V_9	*Prior*	11.20 (15)	207.5 (15)
V_{10}	*Salem*	14.25 (04)	248.5 (12)
V_{11}	*Moovandan*	14.20 (05)	205.0 (16)
V_{12}	*Olour*	11.15 (17)	222.5 (13)
V_{13}	*Kottukonam*	10.35 (19)	187.0 (17)
V_{14}	*Bangalora*	16.15 (01)	534.0 (01)
V_{15}	*Rumani*	11.50 (12)	270.5 (10)
V_{16}	*Karpooramanga*	14.90 (03)	219.0 (14)
V_{17}	*Kilichundan*	13.10 (09)	151.0 (19)
V_{18}	*Panchasara Varikka*	11.00 (18)	142.5 (20)
V_{19}	*Kalkand*	11.35 (13)	282.5 (09)
V_{20}	*Chausa*	13.45 (07)	419.0 (02)
	F values	44.153**	455.483**
	S.E.	0.278	4.784
	C.D.(0.05)	0.822	14.113

** Significant at 1% level
The number in paranthesis indicate rank order

Table 3 Peel weight and stone weight of different mango cultivars

Name of the cultivar		Peel weight (%)	Stone weight (%)
V_1	*Kalapady*	18.46 (01)	15.38 (11)
V_2	*Neelum*	14.05 (05)	16.06 (09)
V_3	*Mundappa*	9.67 (13)	09.67 (18)
V_4	*Pairi*	5.18 (20)	7.78 (20)
V_5	*Baneshan*	11.38 (07)	14.64 (12)
V_6	*Alampur Baneshan*	7.76 (17)	19.19 (07)
V_7	*Mulgoa*	7.37 (19)	13.21 (15)
V_8	*Suvarnarekha*	7.44 (18)	14.59 (13)
V_9	*Prior*	10.15 (10)	25.29 (02)
V_{10}	*Salem*	10.06 (11)	13.68 (14)
V_{11}	*Moovandan*	14.64 (04)	21.96 (05)
V_{12}	*Olour*	9.65 (14)	22.69 (03)
V_{13}	*Kottukonam*	10.96 (09)	22.01 (04)
V_{14}	*Bangalora*	9.83 (12)	9.82 (17)
V_{15}	*Rumani*	9.42 (15)	15.70 (10)
V_{16}	*Karpooramanga*	11.18 (08)	19.17 (08)
V_{17}	*Kilichundan*	13.24 (06)	20.86 (06)
V_{18}	*Panchasara Varikka*	17.54 (02)	7.95 (19)
V_{19}	*Kalkand*	8.84 (16)	32.62 (01)
V_{20}	*Chausa*	14.91 (03)	11.33 (16)
	F values	101.760**	118.304**
	S.E.	0.341	0.582
	C.D. (0.05)	1.007	1.718

** Significant at 1% level
The number in paranthesis indicate rank order

and the lowest for the variety *Pairi* (5.18 per cent). Minhas *et al*. (1991) reported that the peel weight of different mango cultivars ranged between 27.4 g and 37.8 g. Statistical analysis of the data revealed variation in peel weight among different varieties.

The stone weight of different mango cultivars studied ranged from 7.78 per cent to 32.62 per cent (Table 3). The highest percentage of stone weight was seen for the variety *Kalkand* (32.62 per cent) whereas the lowest percentage of stone weight was seen for the variety *Pairi* (7.78 per cent). Minhas *et al*. (1991) reported the stone weight of different mango cultivars ranged from 15.4 g to 48.4 g. Statistically it was proved that the varieties were significantly different from each other.

In the case of the flesh weight of the different mango cultivars studied it was noted that the flesh weight ranged from 92.5 g to 432.5 g (Table 4). The highest value was obtained for the variety *Bangalora* (432.5 g) whereas the lowest value was observed for the variety *Panchasara Varikka* (92.5g). Minhas *et al*. (1991) reported that the pulp weight of different mango cultivars ranged between 94.7 g and 117.4 g. When the observed data was statistically analysed it was found that a highly significant difference existed in the flesh weight in all the twenty different cultivars of mango.

Table 4 Flesh weight and density of different mango cultivars

Name of the cultivar		Flesh weight (g)	Density (g/cc)
V_1	*Kalapady*	105.0 (18)	1.020 (16)
V_2	*Neelum*	190.0 (11)	1.035 (14)
V_3	*Mundappa*	252.5 (06)	1.035 (13)
V_4	*Pairi*	95.0 (19)	1.110 (05)
V_5	*Baneshan*	242.5 (07)	1.015 (18)
V_6	*Alampur Baneshan*	207.0 (03)	1.095 (06)
V_7	*Mulgoa*	263.5 (05)	1.115 (04)
V_8	*Suvarnarekha*	265.0 (04)	1.055 (12)
V_9	*Prior*	142.0 (14)	1.055 (11)
V_{10}	*Salem*	164.5 (12)	1.065 (09)
V_{11}	*Moovandan*	121.0 (17)	1.015 (19)
V_{12}	*Olour*	152.5 (13)	1.015 (20)
V_{13}	*Kottukonam*	138.35(15)	1.640 (01)
V_{14}	*Bangalora*	432.5 (01)	1.090 (07)
V_{15}	*Rumani*	202.5 (09)	1.065 (10)
V_{16}	*Karpooramanga*	195.5 (10)	1.070 (08)
V_{17}	*Kilichundan*	132.5 (16)	1.130 (03)
V_{18}	*Panchasara Varikka*	92.5 (20)	1.390 (02)
V_{19}	*Kalkand*	212.5 (18)	1.030 (15)
V_{20}	*Chausa*	382.5 (02)	1.020 (17)
	F values	445.128**	99.352**
	S.E.	4.326	0.015
	C.D.(0.05)	12.763	0.046

** Significant at 1% level
The number in paranthesis indicate rank order

The density of different mango cultivars ranged between 1.015 g/cc and 1.64 g/cc. The data depicted in Table 4 reveals that the highest value (1.64 g/cc) for density was observed for the variety *Kottukonam* whereas the lowest value (1.015 g/cc) was observed for the variety *Olour*. Statistical analysis of the data revealed that there was significant difference among the different varieties studied.

4.2 Assessment of chemical and nutritional composition of different mango cultivars

Bose (1990) reported that the composition of the fruit in general differs with the cultivar and the stage of maturity. In the present study, the chemical components present in different varieties of mango were assessed with regard to their pH, total sugar, reducing sugar, total soluble solids (T.S.S.), moisture, acidity, vitamin C, B-carotene, crude fat, crude fibre and mineral contents.

Table 5 shows that, the pH of the mango pulp of different varieties studied ranged from 3.40 to 4.65. The highest pH value was observed in the variety *Mulgoa* (V7) (4.65) whereas the lowest pH was recorded in the variety *Rumani* (V15) (3.40). Steven and Philip (1980) studied the pH content of some varieties of mango and it was found to range between 3.8 and 5.8.

Table 5 pH value and acidity of different mango cultivars

Name of the cultivar		pH	Acidity (%)
V_1	*Kalapady*	4.12 (07)	0.19 (17)
V_2	*Neelum*	4.06 (11)	0.21 (16)
V_3	*Mundappa*	4.10 (09)	0.41 (06)
V_4	*Pairi*	4.22 (05)	0.16 (18)
V_5	*Baneshan*	3.79 (16)	0.40 (07)
V_6	*Alampur Baneshan*	3.79 (15)	0.43 (05)
V_7	*Mulgoa*	4.65 (01)	0.11 (20)
V_8	*Suvarnarekha*	4.45 (03)	0.45 (04)
V_9	*Prior*	3.60 (18)	0.53 (02)
V_{10}	*Salem*	4.10 (08)	0.34 (11)
V_{11}	*Moovandan*	3.70 (17)	0.40 (08)
V_{12}	*Olour*	4.55 (02)	0.13 (19)
V_{13}	*Kottukonam*	4.25 (04)	0.26 (14)
V_{14}	*Bangalora*	4.04 (13)	0.40 (09)
V_{15}	*Rumani*	3.40 (20)	0.74 (01)
V_{16}	*Karpooramanga*	4.05 (12)	0.29 (13)
V_{17}	*Kilichundan*	3.60 (19)	0.52 (03)
V_{18}	*Panchasara Varikka*	4.09 (10)	0.29 (12)
V_{19}	*Kalkand*	3.85 (14)	0.26 (15)
V_{20}	*Chausa*	4.17 (06)	0.40 (10)
	F values	3.244**	45.116**
	S.E.	0.179	0.222
	C.D.(0.05)	0.529	0.067

** Significant at 1% level
The number in paranthesis indicate rank order

Significant difference in pH was found to exist between the different varieties studied. Significant difference in the pH was observed to exist between the varieties *Mulgoa* (V7) and *Rumani* (V15). The statistical analysis of the data proved that the varieties *Olour* (V12), *Suvarnarekha* (V8), *Kottukonam* (V13), *Pairi* (V4) and *Chausa* (V20) were on par with the variety *Mulgoa* (V7).

The acidity of the different varieties ranged from 0.11 per cent to 0.74 per cent. As indicated in Table 5, the highest score for acidity was observed for the variety *Rumani* (0.74 per cent) and the lowest score was observed for the variety *Mulgoa* (0.11 per cent). When the data was statistically analysed the variety *Rumani* (V15) was found to be superior to the other varieties. The varieties were found to be significantly different. Significant difference was observed to exist between the varieties *Rumani* (V15) and *Mulgoa* (V7).

A decrease in acidity in mango fruits was observed during ripening. Similar reports were also given by Subramanyam *et al*. (1962), Mann and Singh (1976) and Singh *et al*. (1981). During ripening the titrable acidity of the fruit decreases to as low as 0.1 to 0.2 per cent. The reduction of acidity during ripening plays a great part in the acid - sugar balance and, consequently influences the taste and flavour of the fruit (Lakshminarayana, 1980).

The moisture content, as shown in Table 6, for the different varieties studied ranged from 70.55 per cent to 84.56 per cent. It was observed that the highest mean score (84.56 per cent) was observed for the variety *Baneshan* and the lowest mean score (70.55 per cent) was observed for the variety *Karpooramanga*. According to the Indian Council of Medical Research (1966) the moisture content of mangoes ranged between 73.0 and 86.7 per cent. The moisture content showed a decreasing trend with the increase in ripening period. Similar observations were recorded by Krishnamurthy *et al*. (1960), Deleon and Delima (1970), Chaudhary and Farooqui (1969).

The total soluble solid (TSS) of the different mango varieties was observed to range between 13.75 °Brix and 19.65 °Brix. As indicated in Table 6, the highest TSS was observed for the variety *Panchasara Varikka* (V18) (19.65 °Brix) and the lowest was observed for the variety *Prior* (V9) (13.75 °Brix). Lakshminarayana (1980) studied the nutrient composition of 13 mangoes and reported that the TSS content ranged between 15.0 °Brix and 21.0 °Brix. When the data was statistically analysed it was found that the varieties *Chausa* (V20), *Kottukonam* (V13), *Mundappa* (V3), *Kalkand* (V19), *Kalapady* (V1) and *Moovandan* (V11) were on par with the variety *Panchasara Varikka* (V18). Significant difference was found to exist between the varieties.

Table 6 Moisture content and T.S.S of different mango cultivars

Name of the cultivar		Moisture (per cent)	T.S.S. (°Brix)
V_1	*Kalapady*	78.50 (13)	18.50 (06)
V_2	*Neelum*	80.90 (07)	16.50 (12)
V_3	*Mundappa*	80.50 (11)	18.95 (04)
V_4	*Pairi*	82.10 (03)	14.25 (19)
V_5	*Baneshan*	84.56 (01)	16.50 (11)
V_6	*Alampur Baneshan*	75.51 (14)	14.50 (18)
V_7	*Mulgoa*	80.60 (10)	15.50 (15)
V_8	*Suvarnarekha*	80.90 (08)	17.95 (08)
V_9	*Prior*	81.00 (06)	13.75 (20)
V_{10}	*Salem*	75.05 (15)	14.65 (17)
V_{11}	*Moovandan*	70.56 (19)	18.22 (07)
V_{12}	*Olour*	74.57 (16)	14.70 (16)
V_{13}	*Kottukonam*	80.00 (12)	19.50 (03)
V_{14}	*Bangalora*	81.20 (05)	15.50 (14)
V_{15}	*Rumani*	80.60 (09)	17.95 (09)
V_{16}	*Karpooramanga*	70.55 (20)	16.25 (13)
V_{17}	*Kilichundan*	71.57 (17)	17.25 (10)
V_{18}	*Panchasara Varikka*	70.57 (18)	19.65 (01)
V_{19}	*Kalkand*	82.06 (04)	18.84 (05)
V_{20}	*Chausa*	82.47 (02)	19.55 (02)
	F values	15.795**	14.039**
	S.E.	1.139	0.523
	C.D.(0.05)	3.361	1.545

** Significant at 1% level
The number in paranthesis indicate rank order

With the increase in ripening period of mango fruits, rapid increase in total soluble solids (T.S.S.) was reported by many research workers (Singh *et al.*, 1981). The increase in TSS might be due to loss in moisture and hydrolysis of polysaccharides into simple sugars. The changes were steady as reported by Krishnamurthy *et al.* (1960) and Deleon and Delima (1970).

The total sugar, as indicated in Table 7, was observed to range from 12.31 to 17.35 per cent. The variety *Alampur Baneshan* (V6) was observed to have the highest score (17.35 per cent) for total sugar and the lowest in the variety *Suvarnarekha* (V8) (12.31 per cent). The total sugar content of mangoes were reported to range between 11.20 and 16.80 per cent (Food Science Food Technology and Nutrition, 1993). The statistical interpretation of the data revealed that there was significant difference between the different varieties studied and that the highest difference in total sugar was observed between the varieties *Alampur Baneshan* (V6) and *Suvarnarekha* (V8). It was also proved that the varieties *Chausa* (V20), *Kilichundan* (V17) and *Mulgoa* (V7) were on par with the variety *Alampur Baneshan* (V6).

A rapid increase in total sugars was observed with the increase in ripening period of mango fruits and mostly sucrose (12 per cent) formed the major portion among total sugars. (Soule and Harding, 1957, Krishnamurthy *et al.*, 1960 and Singh *et al.*, 1981).

Table 7 Total sugar and reducing sugar of different mango cultivars

Name of the cultivar		Total sugar (Per cent)	Reducing sugar (Per cent)
V_1	*Kalapady*	15.40 (07)	2.97 (18)
V_2	*Neelum*	14.95 (10)	6.25 (02)
V_3	*Mundappa*	15.52 (06)	4.63 (14)
V_4	*Pairi*	13.96 (12)	5.25 (05)
V_5	*Baneshan*	15.25 (08)	4.99 (07)
V_6	*Alampur Baneshan*	17.35 (01)	3.84 (10)
V_7	*Mulgoa*	16.02 (04)	3.54 (15)
V_8	*Suvarnarekha*	12.31 (20)	5.07 (06)
V_9	*Prior*	13.96 (11)	3.81 (11)
V_{10}	*Salem*	12.87 (16)	3.69 (13)
V_{11}	*Moovandan*	13.59 (14)	3.37 (16)
V_{12}	*Olour*	12.83 (17)	3.23 (17)
V_{13}	*Kottukonam*	13.74 (13)	6.44 (01)
V_{14}	*Bangalora*	15.10 (09)	5.39 (04)
V_{15}	*Rumani*	13.27 (15)	4.77 (08)
V_{16}	*Karpooramanga*	12.68 (19)	5.70 (03)
V_{17}	*Kilichundan*	16.39 (03)	3.73 (12)
V_{18}	*Panchasara Varikka*	15.76 (05)	3.92 (09)
V_{19}	*Kalkand*	12.75 (18)	2.06 (20)
V_{20}	*Chausa*	16.75 (02)	2.80 (19)
	F values	11.155**	15.886**
	S.E.	0.454	0.299
	C.D.(0.05)	1.339	0.882

** Significant at 1% level
The number in paranthesis indicate rank order

The increase in total sugar might be due to the high activity of the glucogenic enzyme fructose 1,6-diphosphatase (EC 3-1-3.11) in the ripe fruits of mango. Similar trends of observations were also reported by Rao and Modi (1976) and Kumar and Selvaraj (1990).

After reaching a maximum value the sugar content declined. This might be due to increased ripening of fruits. Similar results were reported by Deleon and Delima (1970), Krishnamurthy *et al*. (1960), Chaudhary and Farooqui (1969) and Sahni and Khurdiya (1989b)..

The reducing sugar content of different varieties, as shown in Table 7, ranged between 2.06 per cent and 6.44 per cent. The highest value was observed for the variety *Kottukonam* (V13) and the lowest value was observed for the variety *Kalkand* (V19). Bhatnagar and Subramanyam (1973) studied the chemical composition of 10 mango varieties and reported that the reducing sugar content ranged between 2.0 and 7.5 per cent. Statistical analysis of the data indicated that there was significant difference between the different varieties studied. And that among these varieties, the varieties *Neelum* (V2) and *Karpooramanga* (V16) were on par with the variety *Kottukonam* (V13).

The reducing sugar increased during the ripening process. This might be due to conversion of starch into

reducing sugar and loss of starch during ripening process. (Subramanyam *et al.*, 1976, Morga *et al.*, 1979, Selvaraj *et al.* 1989 and Sagar and Khurdiya, 1996).

The vitamin C content of the different varieties studied ranged between 12.45 and 45.60 mg. As shown in Table 8, the variety *Chausa* was found to have the highest score whereas the lowest score was found for the variety *Karpooramanga*. The statistical analysis of the data revealed that the variety *Chausa* was found to be superior when compared to the other varieties. It was also found that the varieties were significantly different. According to ICMR (1966) the vitamin C content of mango fruit was found to range between 3-83 mg/100g. Singh (1968) reported that the Indian cultivars contained 13.2 to 80.3 mg of Vitamin C per 100 g of fruit pulp.

The ascorbic acid content exhibited a gradual decrease during the process of ripening. The fall in ascorbic acid content might be attributed to its oxidation and enzymic degradation during ripening. Similar findings have been reported by Chaudhary and Farooqui (1969), Hulme (1971), Elahi and Khan (1973) and Gangwar and Tripathi (1973).

Carotenoids are important food constituents, owing to their colour and nutritional value as provitamin A (β-carotene). Mango is reported to contain good amounts of these fat soluble pigments (CFTRI, 1990). According to Jungalwala and Cama (1963) about 50 to 60 per cent of the total carotenoids of mango fruit consisted of β-carotene.

Table 8 Vitamin C and β-carotene content of different mango cultivars

Name of the cultivar		Vitamin C (mg/100g)	β-carotene (ug/100g)
V_1	*Kalapady*	29.90 (03)	1146.74 (03)
V_2	*Neelum*	24.05 (09)	1186.46 (01)
V_3	*Mundappa*	15.75 (18)	1049.94 (09)
V_4	*Pairi*	25.70 (08)	1044.97 (11)
V_5	*Baneshan*	28.90 (04)	1166.57 (02)
V_6	*Alampur Baneshan*	28.20 (06)	1044.98 (10)
V_7	*Mulgoa*	28.70 (05)	1010.23 (15)
V_8	*Suvarnarekha*	17.30 (16)	1131.85 (05)
V_9	*Prior*	18.65 (12)	871.23 (19)
V_{10}	*Salem*	15.75 (17)	1032.57 (14)
V_{11}	*Moovandan*	42.30 (02)	1094.62 (08)
V_{12}	*Olour*	17.40 (15)	829.03 (20)
V_{13}	*Kottukonam*	28.20 (07)	1141.78 (04)
V_{14}	*Bangalora*	18.30 (13)	1040.01 (13)
V_{15}	*Rumani*	14.90 (19)	898.53 (18)
V_{16}	*Karpooramanga*	12.45 (20)	1042.50 (12)
V_{17}	*Kilichundan*	18.30 (14)	1119.44 (07)
V_{18}	*Panchasara Varikka*	19.10 (10)	997.81 (16)
V_{19}	*Kalkand*	19.05 (11)	918.38 (17)
V_{20}	*Chausa*	45.60 (01)	1124.40 (06)
	F values	125.372**	241.784**
	S.E.	0.792	6.503
	C.D.(0.05)	2.338	6.503

** Significant at 1% level
The number in paranthesis indicate rank order

The β-carotene content of the different varieties studied, it was observed to range between 829.03 and 1186.46 ug/100g. As shown in Table 8, the variety *Neelum* was found to have the highest value whereas the lowest value was found to be for the variety *Olour*. When the data was statistically observed the variety *Neelum* was found to be superior compared to the other varieties. Also all the varieties were significantly different from each other. Bhatnagar and Subramanyam (1973) reported that the β-carotene content was found to range between 800 and 13,000 ug/100g.

The carotenoids increased with increase in sugar as days of ripening increased after harvest. Increase in carotene was accompanied by a decrease in acid content and an increase in sugar. Similar works have been reported by Modi and Patwa (1960) and Sagar and Khurdiya (1996).

The crude fat content of different varieties studied ranged between 0.12 per cent and 0.92 per cent. As represented in Table 9, the highest value (0.92 per cent) was observed for the variety *Pairi* whereas the lowest value (0.12 per cent) was observed for the variety *Karpooramanga*. Gopalan *et al*. (1977) reported the fat content of ripe mango to be 0.4 g/100g. When the data was statistically analysed it was observed that there was significant difference among the different varieties studied.

Table 9 Crude fat and crude fibre of different mango cultivars

Name of the cultivar		Crude fat (g/100g)	Crude fibre (g/100g)
V_1	*Kalapady*	0.39 (13)	0.67 (12)
V_2	*Neelum*	0.52 (08)	0.39 (19)
V_3	*Mundappa*	0.70 (03)	0.41 (18)
V_4	*Pairi*	0.92 (01)	0.70 (08)
V_5	*Baneshan*	0.63 (04)	0.59 (15)
V_6	*Alampur Baneshan*	0.50 (09)	0.61 (13)
V_7	*Mulgoa*	0.19 (18)	0.69 (11)
V_8	*Suvarnarekha*	0.55 (06)	0.37 (20)
V_9	*Prior*	0.52 (07)	0.76 (06)
V_{10}	*Salem*	0.42 (12)	0.60 (14)
V_{11}	*Moovandan*	0.49 (10)	0.79 (03)
V_{12}	*Olour*	0.72 (02)	0.77 (05)
V_{13}	*Kottukonam*	0.35 (15)	0.98 (01)
V_{14}	*Bangalora*	0.19 (17)	0.54 (17)
V_{15}	*Rumani*	0.25 (16)	0.69 (10)
V_{16}	*Karpooramanga*	0.12 (20)	0.78 (04)
V_{17}	*Kilichundan*	0.35 (14)	0.76 (07)
V_{18}	*Panchasara Varikka*	0.13 (19)	0.81 (02)
V_{19}	*Kalkand*	0.62 (05)	0.70 (09)
V_{20}	*Chausa*	0.43 (11)	0.59 (16)
	F values	27.033**	535.075**
	S.E.	0.040	0.006
	C.D. (0.05)	0.119	0.019

** Significant at 1% level
The number in paranthesis indicate rank order

The crude fibre content of different varieties studied was found to range between 0.37 and 0.98. Table 9 shows that the variety *Kottukonam* had the highest fibre content (0.98 g). As for the variety *Suvarnarekha*, it had the least fibre content (0.37 g). ICAR (1967) stated that the fibre content is a determining factor of the fruit quantity which may vary from 0.02 to as high as 0.2 per cent. Gopalan *et al.* (1977) reported that the fibre content of ripe mango was found to be 0.4 g/100g. Statistical analysis of the data revealed that there existed significant difference among the different varieties studied.

Mineral constituents are important for various metabolic activities of the fruit. Singh (1962) estimated the mineral constituents of the different parts of the mango fruit and found that, except for calcium, the pulp had more than 50 per cent of the total mineral content of the fruit. Gopalan *et al.* (1977) reported the mineral constituents of ripe mango fruit from India as 400 mg/100g fruit.

The principal minerals in mango were reported to be sodium, phosphorus, potassium and magnesium (Lakshminarayana, 1980). In the present study, the mineral constituents present in different varieties of mango were assessed with regard to their sodium, phosphorus, potassium, calcium and magnesium content. The mineral constituents of different mango cultivars are depicted in Table 10.

Table 10 Mineral constituents of different mango cultivars

Name of the cultivar		Sodium (mg)	Phosphorus (mg)	Potassium (mg)	Magnesium (mg)	Calcium (mg)
V_1	*Kalapady*	25.40 (15)	13.68 (19)	169.59 (15)	261.50 (11)	13.95 (12)
V_2	*Neelum*	23.12 (17)	14.96 (14)	123.60 (20)	268.70 (07)	18.10 (03)
V_3	*Mundappa*	31.30 (01)	20.08 (03)	160.58 (16)	246.90 (18)	14.65 (11)
V_4	*Pairi*	22.52 (18)	20.94 (01)	181.08 (13)	260.40 (12)	16.50 (06)
V_5	*Baneshan*	16.97 (20)	14.31 (18)	529.82 (17)	263.75 (10)	13.10 (17)
V_6	*Alampur Baneshan*	24.99 (16)	18.16 (05)	194.67 (10)	269.65 (05)	16.12 (08)
V_7(	*Mulgoa*	26.63 (12)	14.94 (15)	190.59 (12)	253.70 (14)	15.32 (09)
V_8	*Suvarnarekha*	28.78 (07)	16.06 (10)	219.57 (05)	268.70 (06)	13.68 (13)
V_9	*Prior*	26.30 (13)	16.02 (11)	221.44 (04)	182.82 (20)	11.17 (20)
V_{10}	*Salem*	27.25 (11)	17.57 (07)	141.65 (19)	247.50 (17)	17.00 (04)
V_{11}	*Moovandan*	11.00 (04)	18.28 (04)	214.72 (18)	252.70 (16)	19.05 (01)
V_{12}	*Olour*	27.35 (10)	15.71 (13)	276.68 (01)	245.70 (19)	18.85 (02)
V_{13}	*Kottukonam*	31.05 (02)	14.61 (16)	196.02 (09)	277.55 (03)	13.55 (15)

Name of the cultivar		Sodium (mg)	Phosphorus (mg)	Potassium (mg)	Magnesium (mg)	Calcium (mg)
V_{14}	*Bangalora*	29.75 (05)	14.34 (17)	180.28 (14)	264.22 (09)	12.60 (19)
V_{15}	*Rumani*	28.39 (08)	16.39 (05)	265.47 (02)	256.22 (13)	15.20 (10)
V_{16}	*Karpooramanga*	30.68 (03)	16.65 (08)	202.60 (08)	277.10 (04)	12.80 (18)
V_{17}	*Kilichundan*	29.06 (06)	18.15 (06)	229.94 (03)	282.15 (02)	16.12 (07)
V_{18}	*Panchasara Varikka*	28.26 (09)	20.40 (02)	147.57 (18)	284.90 (01)	16.62 (05)
V_{19}	*Kalkand*	25.55 (14)	15.97 (12)	206.52 (07)	253.10 (15)	13.57 (14)
V_{20}	*Chausa*	18.66 (19)	13.37 (20)	191.13 (11)	266.50 (08)	13.25 (16)
	F values	13.841**	10.567**	21.143**	52.593**	7.057**
	S.E.	1.045	0.685	8.410	2.944	0.825
	C.D. (0.05)	3.084	2.023	24.809	8.685	2.434

** Significant at 1% level
The numbers in paranthesis indicates rank order

The data revealed that the sodium content of the mango varieties under study ranged between 16.97 mg and 31.3 mg/100g. The highest value (31.3 mg) was observed for the variety *Mundappa* while the lowest value (16.97 mg) was observed for the variety *Baneshan*. Gopalan *et al*. (1977) reported that the sodium content of ripe mango was found to be 26.0 mg/100g of edible portion. The statistical analysis of the data revealed that there existed significant difference among the different varieties studied.

With regard to the phosphorus content it was noted that the value for different varieties ranged between 13.37 mg and 20.94 mg. As indicated in Table 10, the maximum value for phosphorus was obtained by the variety *Pairi* while the minimum value was obtained by the variety *Chausa*. The phosphorus content in ripe mango was reported to be equivalent to 16 mg/100g (Gopalan *et al*., 1977). There was significant difference among the different varieties when statistically analysed.

Potassium is reported to be the most abundant mineral in fruits (Arriola *et al*., 1980). Thimmayamma (1980) reported that mango fruit is a source of potassium and other trace minerals. The potassium content of different mango cultivars ranged between 123.6 mg and 276.68 mg. The highest value (276.68 mg) was noted for the variety *Olour* while the lowest

value (123.6 mg) was noted for the variety *Neelum*. The potassium content of ripe mangoes was reported to be 205 mg/100 gms of edible portion (Hernandez *et al*., 1971; Gopalan *et al*. (1997)). The statistical analysis of the data revealed that there existed significant difference among the varieties studied.

The results given in Table 10, indicate that the magnesium content of different mango cultivars studied ranged between 182.82 mg and 284.9 mg. The variety *Panchasara Varikka* had obtained the highest value (284.9 mg) wheras the variety *Prior* had obtained the lowest value (182.82 mg). The magnesium content of ripe mangoes was reported to be 270 mg/100g of edible portion (Gopalan *et al*. (1977). When the data was statistically analysed it was found that all the varieties were significantly different from each other.

On considering the calcium content of the different varieties studied it was noted that the values ranged from 11.17 mg to 19.05 mg. Table 10, elucidates that a higher value was obtained for the variety *Moovandan* with a mean score of 19.05 mg, closely followed by the varieties *Olour* and *Neelum* with a mean score of 18.85 mg and 18.1 mg respectively. The lowest value was obtained for the variety *Prior* with a mean score of 11.17 mg. Hernandez *et al*. (1971) reported that the calcium content of Mexican mango in general was 19 mg/100g.

Whereas, Gopalan *et al*. (1977) reported that the calcium content of Indian mango was 14 mg/100g. When the data was statistically analysed, significant difference was observed among the different varieties.

It is apparent from these studies that at maturity, the content of various biochemical constituents varied significantly among the cultivars and this can be attributed to inherent genetic differences existing in the cultivars and also due to climatic factors. Arriola *et al*. (1980) opined that considerable differences are found among varieties and species of fruit since the climatic and growing conditions affect their level in any given crop. Similar reports were also given by Rao *et al*. (1988).

4.3 Assessment of organoleptic qualities of different mango cultivars

Quality is the ultimate criterion of the desirability of any food product. The overall quality of a food depends on the nutritional and other hidden attributes, and sensory quality as assessed by means of human sensory organs (Manay and Shadaksharaswamy, 1995).

It has long been recognised that enjoyment of food is essential for good health. Enjoyment would mean choice, and acceptance, and not always nutrition and wholesomeness (Solms and Hall, 1981). The consumer's appreciation of food quality

Table 11 Orgnoleptic qualities of different mango cultivars

Name of the cultivar		Mean score					
		Appearance	Colour	Flavour	Taste	Texture	Overall acceptability
V_1	*Kalapady*	4.0 (01)	4.0 (01)	4.0 (01)	4.0 (01)	4.0 (01)	4.0
V_2	*Neelum*	4.0 (02)	4.0 (02)	4.0 (02)	4.0 (02)	4.0 (02)	4.0
V_3	*Mundappa*	3.5 (06)	3.0 (12)	3.8 (05)	3.0 (12)	3.0 (13)	3.3
V_4	*Pairi*	2.1 (19)	3.0 (14)	2.3 (19)	2.0 (19)	2.4 (16)	2.4
V_5	*Banashan*	4.0 (03)	4.0 (03)	4.0 (03)	4.0 (03)	4.0 (03)	4.0
V_6	*Alampur Banashan*	4.0 (04)	3.8 (06)	3.6 (07)	3.3 (09)	3.4 (09)	3.6
V_7	*Mulgoa*	3.4 (09)	3.3 (09)	3.8 (06)	4.0 (04)	3.0 (12)	3.5
V_8	*Suvarnarekha*	4.0 (05)	4.0 (04)	4.0 (04)	4.0 (05)	4.0 (04)	4.0
V_9	*Prior*	3.2 (10)	3.0 (15)	3.0 (14)	3.3 (08)	3.5 (07)	3.2
V_{10}	*Salem*	3.0 (13)	3.0 (10)	3.2 (12)	3.6 (06)	3.5 (08)	3.3
V_{11}	*Moovandan*	3.0 (14)	3.0 (11)	2.8 (15)	2.6 (14)	2.0 (19)	2.7
V_{12}	*Olour*	2.0 (20)	2.3 (20)	2.4 (18)	2.5 (16)	3.0 (11)	2.4
V_{13}	*Kottukonan*	3.0 (12)	3.9 (05)	3.5 (08)	3.3 (10)	2.4 (18)	3.2

Name of the cultivar	Mean score					
	Appearance	Colour	Flavour	Taste	Texture	Overall acceptability
V_{14} *Bangalora*	3.5 (07)	3.0 (13)	3.2 (11)	3.0 (13)	3.6 (06)	3.2
V_{15} *Runani*	2.3 (17)	2.4 (19)	3.0 (13)	2.4 (17)	2.8 (14)	2.6
V_{16} *Karpooranaanga*	3.2 (11)	3.3 (08)	3.5 (09)	3.2 (11)	3.4 (10)	3.3
V_{17} *Kilichundan*	2.5 (15)	2.6 (16)	2.5 (16)	2.6 (15)	2.5 (15)	2.5
V_{18} *Panchasara Varikka*	2.2 (18)	2.6 (17)	1.6 (20)	1.9 (20)	1.8 (20)	2.0
V_{19} *Kalkand*	2.4 (16)	2.6 (18)	2.4 (17)	2.0 (18)	2.4 (17)	2.4
V_{20} *Chausa*	3.5 (08)	3.4 (07)	3.3 (10)	3.6 (07)	3.8 (05)	3.5
F values	38.487**	13.807**	27.269**	23.878**	25.438**	
S.E.	0.112	0.154	0.131	0.147	0.138	
C.D. (0.05)	0.310	0.427	0.365	0.409	0.384	

** Significant at 1% level
The numbers in paranthesis represents the rank order

The first impression of a food is usually visual, and a major part of our willingness to accept a food depends on its appearance (Manay and Shadaksharaswamy, 1995). As indicated in Table 11, the mean score obtained for appearance ranged between 2.0 and 4.0. The varieties *Kalapady*, *Neelum*, *Baneshan*, *Alampur Baneshan* and *Suvarnarekha* obtained the highest score (4.0) followed by *Mundappa*, *Bangalora* and *Chausa* having the mean score 3.5. The least score was obtained for the variety *Olour* (2.0).

Colour of foods contribute immeasurably to one's appreciation of them. When the colour attribute was taken into consideration, it was noted that the varieties *Kalapady*, *Baneshan*, *Suvarnarekha* and *Neelum* had obtained the highest mean score (4.0) while the least score (2.3) was seen for the variety *olour*.

Appearance of a food is important, but it is the flavour that ultimately determines the quality and acceptability of foods. Manay and Shadaksharaswamy (1995) defined flavour as a sensory phenomenon depending upon taste, odour or aroma, appearance, temperature - sensation of heat and cold, and texture or "mouthfeel" affecting the sense of touch. Sensory evaluation of flavours for analytical purposes is limited to the sensations of taste and smell. While considering the quality attribute flavour, it was noted that the highest score (4.0) was obtained by the varieties

Suvarnarekha, *Baneshan*, *Kalapady* and *Neelum* whereas the least score (1.6) was obtained by the variety *Panchasara Varikka*.

The sense of taste refers to the ability of the taste organs to perceive and recognize the four basic tastes - sweet, sour, salty and bitter. According to Rolls *et al*. (1981), in the various quality attribute tests, the first evaluation goes to taste followed by flavour, texture and colour. For the attribute taste, it was observed that the varieties *Kalapady*, *Neelum*, *Baneshan*, *Mulgoa* and *Suvarnarekha* scored the highest mean score (4.0). On the other hand the least mean score for taste was observed for the variety *Panchasara Varikka* with a mean score of 1.9.

In addition to appearance, taste and smell, the textural aspects of food contribute to food acceptability, taste and flavour. Ranganna (1986) opined that texture is the property of food which is associated with the sense of feel or touch experienced by the finger or the mouth. With regard to the quality attribute texture, it was studied that the varieties *Neelum*, *Kalapady*, *Suvarnarekha* and *Baneshan* secured the maximum score (4.0) but the minimum score (1.8) was secured by the variety *Panchasara Varikka*.

As stated by Kordylas (1990), the overall acceptability depends on the concentration or amount of

particular components, the nutritional and other hidden attributes of a food and its palatability or sensory quality.

A detailed assessment of the organoleptic qualities of the different mango varieties indicated that the varieties *Neelum*, *Baneshan*, *Suvarnarekha* and *Kalapady* were the most acceptable with a score 4.0 followed by the variety *Alampur Baneshan* (3.6) which was closely followed by the varieties *Mulgoa* and *Chausa* with the score 3.5 each. The least mean score (2.0) for overall acceptability was observed for the variety *Panchasara Varikka*.

Results of statistical analysis indicated that there existed significant difference in all the quality attributes. According to Nanjundaswamy (1976) the changes in organoleptic qualities can be attributed to alteration in chemical composition among the different varieties.

4.4 Clustering of mango cultivars based on nutritional and chemical composition

A measure for group distance based on multiple characters was given by Mahalanobis (1928). This method was applied by plant breeders to group/cluster the various genotypes based on multiple characters (Singh an Choudhary, 1985). The cluster analysis (D^2-statistic) is useful in the sense that it allowed further classification of broad

morphological and physiological groups into sub groups. This method is applied in the present study to cluster the mango varieties based on chemical composition.

Clustering by D^2-statistic is useful in this context. The varieties were grouped based on their D^2 values using Tocher method (Rao, 1952). D^2-analysis was carried for mango varieties based on their chemical and nutritional characteristics such as pH, acidity, reducing sugar, total sugar, moisture, crude fibre, crude fat, vitamin C, B-carotene, calcium, magnesisum, sodium, potassium and phosphorus.

D^2-analysis is helpful to group the divergent varieties into various clusters when measurements on a number of related characters are available on a large number of varieties such that the varieties within a cluster are homogeneous with respect to these characters and heterogeneous among the clusters.

Based on D^2 values, varieties of similar characters such as reducing sugar, total sugar, vitamin C, B-carotene, pH, acidity, moisture were grouped together. For clustering, the varieties were arranged in increasing order of their relative distance from each other and the twenty varieties were grouped into six clusters as detailed in Table 12. Eight varieties were included in Cluster I (*Pairi*, *Bangalora*, *Mulgoa*, *Alampur*,

Baneshan, *Mundappa*, *Salem*, *Karpooramanga* and *Panchasara Varikka*); seven in Cluster II (*Suvarnarekha*, *Kilichundan*, *Moovandan*, *Kottukonam*, *Chausa*, *Kalapady* and *Baneshan*), two in Cluster III (*Prior* and *Kalkand*), and one each in Cluster IV, (*Neelum*), Cluster V (*Olour*) and Cluster VI (*Rumani*). The varieties which exhibited minimum divergence based on the 15 characteristics got clustered together.

Table 12 Clustering of mango cultivars based on chemical and nutritional composition

Clusters	Varieties	Total number
I	*Pairi*, *Bangalora*, *Mulgoa*, *Alampur Baneshan*, *Mundappa*, *Salem*, *Karpooramanga* and *Panchasara Varikka*	8
II	*Suvarnarekha*, *Moovandan*, *Chausa*, *Kalapady*, *Baneshan*, *Kilichundan* and *Kottukonam*	7
III	*Prior*, *Kalkand*	2
IV	*Neelum*	1
V	*Olour*	1
VI	*Rumani*	1

PLATE 2

PLATE 3

4.5 Determination of the superior variety

Jain *et al*. (1996) opined that the quality of mango products largely depends on the selection of the suitable variety.

Based on discriminant function analysis superior variety was selected for product development from among the twenty mango varieties taken for study.

Eight chemical characteristics ie, pH, T.S.S., reducing sugar, total sugar, acidity, vitamin C, B-carotene and moisture and organoleptic qualities of the different mango cultivars were taken for the discriminant function analysis.

The selection index based on discriminant function analysis has been represented in Table 13 and Fig.2.

As represented in the Table, the variety *Neelum* (Plate 1) got the highest index score (2603.98) followed by *Baneshan* (Plate 2) (2567.48) and *Chausa* (Plate 3) (2516.31). The varieties *Rumani*, *Prior* and *Olour* had the lowest scores.

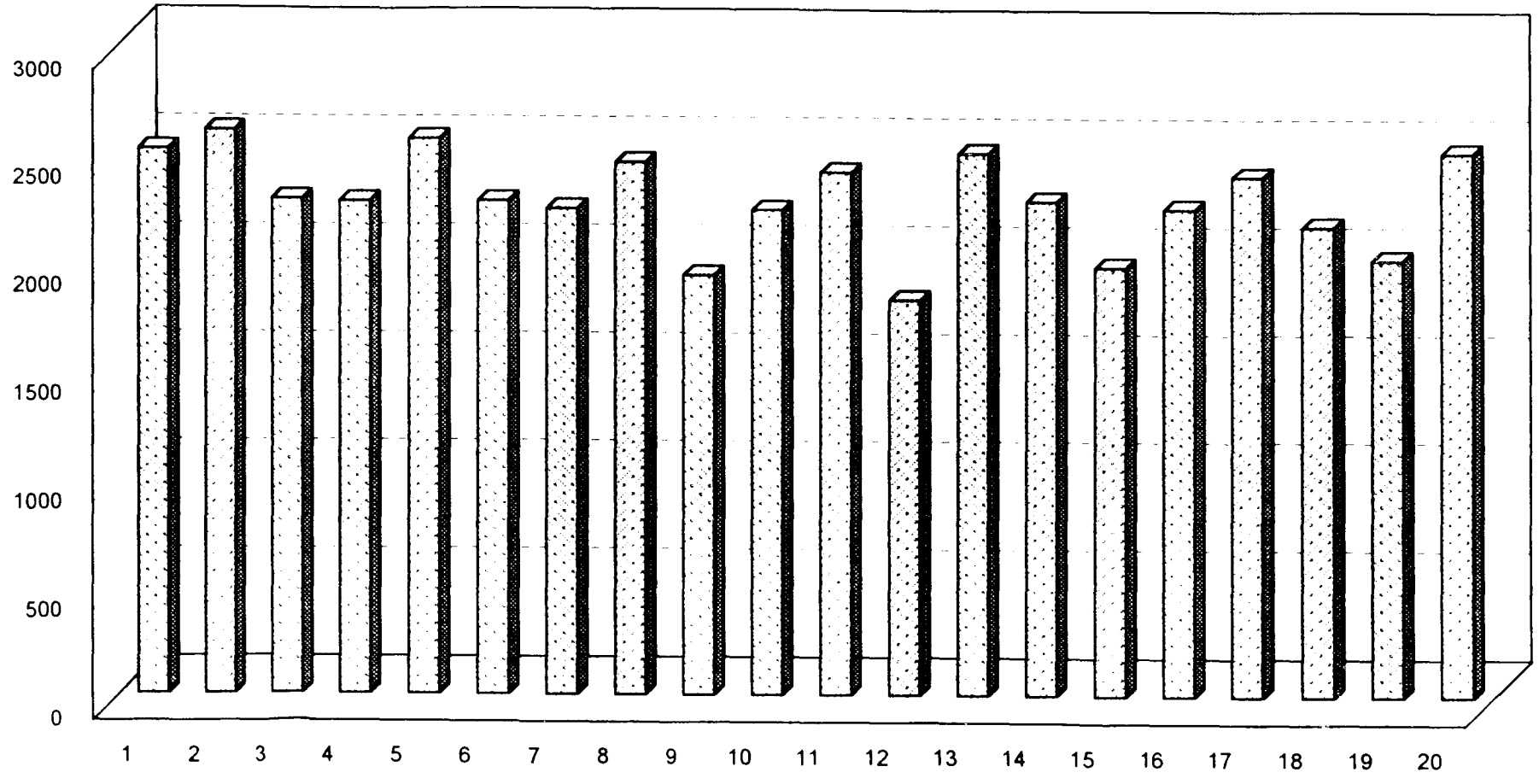
The mango juice from the superior variety *Neelum* was then used for the preparation of mango ready-to-serve beverage.

Table 13 Selection of the superior variety among different mango cultivars

Name of the cultivar		Selection indices
V_1	*Kalapady*	2514.45 (04)
V_2	*Neelum*	2603.98 (01)
V_3	*Mundappa*	2288.73 (09)
V_4	*Pairi*	2278.44 (12)
V_5	*Baneshan*	2567.48 (02)
V_6	*Alampur Baneshan*	2281.80 (11)
V_7	*Mulgoa*	2245.93 (14)
V_8	*Suvarnarekha*	2460.59 (06)
V_9	*Prior*	1940.21 (19)
V_{10}	*Salem*	2241.81 (15)
V_{11}	*Moovandan*	2419.87 (07)
V_{12}	*Olour*	1829.28 (20)
V_{13}	*Kottukonam*	2508.94 (05)
V_{14}	*Bangalora*	2288.53 (10)
V_{15}	*Rumani*	1983.54 (18)
V_{16}	*Karpooramanga*	2256.07 (13)
V_{17}	*Kilichundan*	2407.65 (08)
V_{18}	*Panchasara Varikka*	2174.09 (16)
V_{19}	*Kalkand*	2021.76 (17)
V_{20}	*Chausa*	2516.31 (03)

The numbers in paranthesis represents the rank order

Fig. 2 Selection of superior variety of mango



1 Kalapady
2 Neelam
3 Mundappa
4 Pairi
5 Baneshan
6 Alampur Baneshan
7 Mulgoa
8 Suvarnarekha
9 Prior
10 Salem
11 Moovandan
12 Olour
13 Kottukonam
14 Banglora
15 Rumani
16 Karpooramango
17 Kilichundan
18 Panchasra varikka
19 Kalkand
20 Chausa

PLATE 1

PLATE 4

4.6 Assessment of chemical constituents and organoleptic qualities of the processed product

Fruit beverages are easily digestible, highly refreshing, thirst quenching, appetizing and nutritionally far superior to many synthetic and aerated drinks (Srivastava and Kumar, 1994). Kalra *et al*. (1991) opined that fruit drinks are engulfing the domestic markets and they are encouraged, as they provide much needed vitamins and minerals.

Chakraborty *et al*. (1993) reported that ready-to-serve beverages are increasingly gaining popularity throughout the country. Ready-to-serve beverage is a fruit juice which is altered in composition with sugar and water during preparation. It is not diluted before serving and hence it is known as ready-to-serve.

According to Siddappa *et al*. (1986) RTS beverage is delicious, rich in essential minerals, vitamins and other nutritive factors and have an universal appeal unlike other beverages.

4.6.1 Assessment of chemical constituents in the fresh mango RTS beverage

In the present investigation, analysis was carried out to find the pH, T.S.S., reducing sugar, total sugar, acidity, pulp content, net volume/weight of juice content and

specific gravity present in the processed mango product prepared out of the selected mango variety *Neelum*.

Table 14 Chemical constitutents of fresh mango RTS beverage

Chemical constituents	Quantity
pH	4.04
Total Soluble Solids	17.63°Brix
Acidity	0.25 per cent
Reducing sugar	6.25 per cent
Total sugar	12.20 per cent
Net volume/weight of juice content	225.00 g
Pulp content	14 per cent
Specific gravity	1.074

Table 14 indicates the chemical constituents analysed in the fresh RTS beverage prepared from the mango variety *Neelum*.

Considering the pH of fresh RTS beverage it was observed that the pH was 4.04. Rao (1984) reported that pH of cashewapple juice would range from 3.70 to 4.60. Khurdiya (1994) reported that carbonated passion fruit drink showed a pH of 3.25. Irene (1997) reported the pH of fresh *Neelum* mango RTS beverage as 4.10.

An assessment of the total soluble solids of the RTS prepared showed that the total soluble solids was 17.63°Brix. The TSS of mango RTS was reported to be 14 per cent. (Khurdiya and Roy, 1988). Ghosh (1995) mentioned that the total soluble solids of the juice of different types of cashewapples ranged from 13.10 per cent to 17.70 per cent. Irene (1997) reported the TSS of fresh *Neelum* mango RTS beverage as 18.60°Brix.

The reducing sugar of fresh mango RTS was estimated to be 6.25 per cent. Sreeja (1996) reported the reducing sugar in cashewapple to be 15.20 per cent.

Data given in Table 14 revealed that the RTS prepared had a total sugar of 12.20 per cent. The total sugar in mango RTS drink was reported to be 13.80 per cent (Jain *et al.*, 1996).

On taking into account the acidity of the RTS prepared it was noted that the mango RTS prepared from *Neelum* had an acidity of 0.25 per cent. Annapurna (1977) observed that the RTS beverage prepared from passion fruits showed an acidity of 0.70 per cent. Irene (1997) found the acidity of fresh *Neelum* mango to be 0.33 per cent.

The data given in Table 14, revealed that the net volume/weight of juice content was found to be 225 g. It was also noted that the pulp content was 14 per cent and the specific gravity of the product was 1.074.

According to the Food Products Order (1955) the reported minimum percentage of T.S.S. in RTS beverage was to be 10 per cent, the minimum percentage of fruit juice in the fruit was to be 10 per cent and the acidity was to be 0.3 per cent. In the present investigation, the prepared RTS beverage confirms with the required FPO standards.

4.6.2 Assessment of organoleptic qualities of fresh mango RTS beverage

The RTS beverage prepared from the variety *Neelum* was evaluated by a panel of 10 selected judges using a score card. (Appendix-3). The mean scores obtained are given in Table 15.

Table 15 Organoleptic qualities of fresh mango RTS beverage

Product	Average score					
	Appearance	Colour	Flavour	Taste	Consistency	Overall acceptability
RTS beverage	4.00	4.00	3.70	3.60	3.50	3.76

As indicated in Table 15, the maximum mean score for appearance and colour for RTS beverage prepared from *Neelum* mango was 4.00 whereas the maximum mean score for flavour, taste and consistency was 3.70, 3.60 and 3.50 respectively.

The overall acceptability score of the fresh mango RTS beverage was found to be 3.76. The above result is in consonance with Irene (1997) who reported that the overall acceptability score of fresh RTS beverage prepared from *Neelum* mango was 3.8.

4.7 Assessment of shelf-life qualities of the product

Changes in chemical constituents occur during storage which results in the deterioration of processed products. In order to assess the changes in chemical constituents that occurred with storage periodical assessment of selected chemical components were done.

The quality parameters generally selected to ascertain its suitability for public use and to study the effect of processing method are chemical tests like acidity, pH, T.S.S., reducing sugar and total sugar. Physical qualities like microbial tests and sensory evaluation are also ascertained.

4.7.1 Assessment of changes in chemical constituents of RTS beverage during storage

Table 16, indicates the changes in chemical constituents such as pH, T.S.S., acidity, reducing sugar and total sugar of RTS beverage prepared from *Neelum* mango during storage.

Table 16 Changes in chemical composition of RTS beverage during storage

Storage period (in days)	pH	T.S.S. (°Brix)	Acidity (%)	Reducing sugar (%)	Total sugar (%)
0	4.04	17.63	0.25	6.25	12.20
7	4.035	17.63	0.25	6.25	12.20
14	4.035	17.63	0.25	6.57	12.20
21	4.015	17.62	0.26	6.83	12.20
28	4.00	17.62	0.26	6.90	12.20
F values	18.75^{**}	3.833^{*}	1.167^{NS}	6294.5^{**}	0.00^{NS}
SE	0.0039	0.0038	0.00038	0.00039	0.00034
CD	0.0142	0.0086	0.0087	0.0088	0.0127

* Significant at 5% level
** Significant at 1% level
NS Not significant

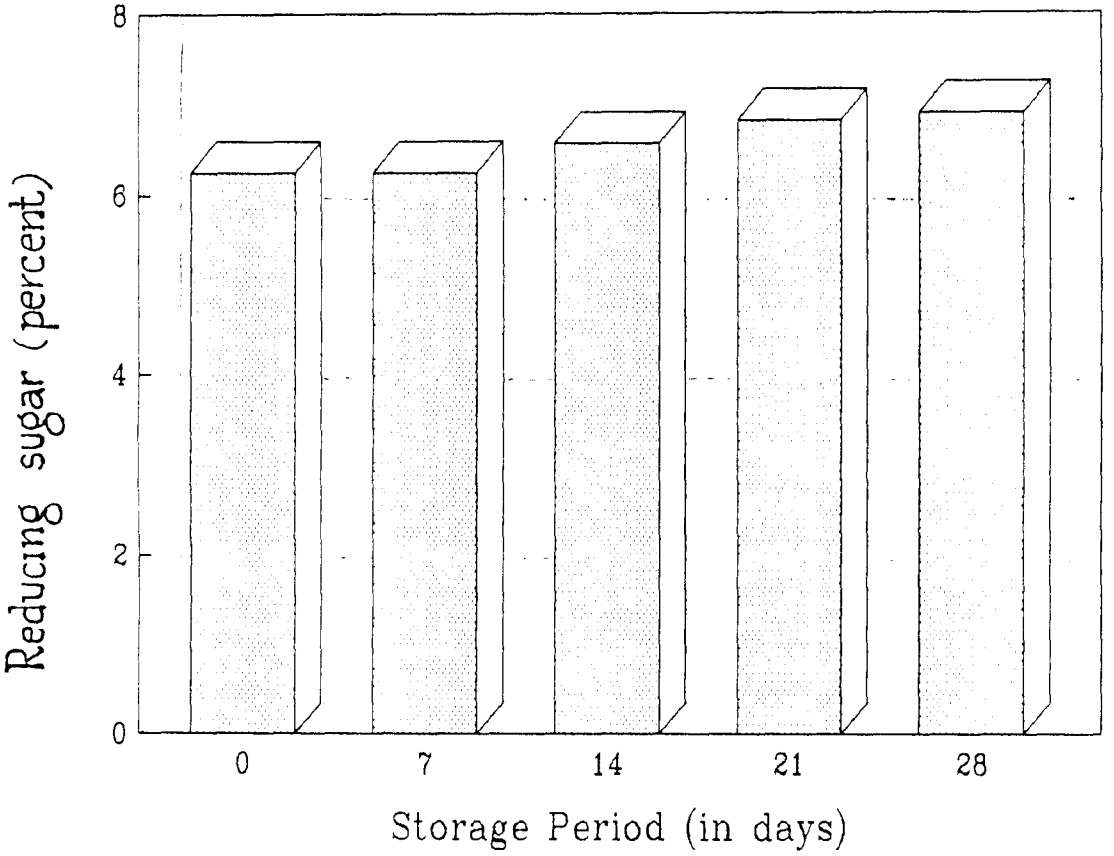
As indicated in Table 16, the pH values remained almost the same during the first and second weeks of storage. But it was found to show a slight change during the third and fourth weeks of storage. The pH values for the RTS beverage during the storage period ranged from 4.04 to 4.00. The pH value showed slight decrease with increase in storage period. The result obtained here were in line with the findings of Irene (1997) in six different mango RTS beverages.

Changes occurred in T.S.S. of RTS beverage during storage is presented in Table 16. As indicated in the Table, only slight change in T.S.S. content was observed between the storage periods. The T.S.S. value ranged from 17.63°Brix to 17.62°Brix. Storage studies conducted by Thirumaran and Seralathan (1993) observed a decline in total soluble solids in tomato juice concentrate and fermented carrot based RTS. Similar studies were also reported by Jain *et al*. (1996) in *Taimuria* mango RTS drink during a storage period of thirty days. Supporting to the above change in T.S.S. content was observed between the storage periods in all the RTS beverages prepared from six different cultivars of mango.

Statistical analysis of the data confirms that there was no noticeable change in acidity in the RTS beverage during the storage period of three weeks. The above result is in consonance with Kalra *et al*. (1991) who reported that acidity did not change significantly during the 12 months storage of mango-papaya blended beverage. Similarly Renote *et al*. (1992) had found that the kinnow RTS stored at ambient condition when evaluated, showed negligible changes in acidity. Diju (1995) reported that there was a steady increase in acidity in passion fruit RTS during six months storage.

The reducing sugar of RTS beverage was found to increase with the increase in the storage period with the values ranging from 6.25 per cent to 6.90 per cent (Fig. 3).

Fig.3 Changes in Reducing sugar of RTS beverage during storage



This may be due to acid hydrolysis of sucrose. Storage studies conducted by Jain *et al.* (1996) observed an increase in reducing sugar in *Taimuria* mango RTS drink. Similarly increase in reducing sugar was observed in beverages made from ripe *Dashehari* mango (Roy *et al.*, 1997).

As indicated in Table 16, the total sugar remained constant throughout the period of storage. The results obtained here were in line with the findings of Jain *et al.* (1996) in *Taimuria* RTS drink and Roy *et al.* (1997) in beverages made from ripe *Dashehari* mango.

4.7.2 Changes in organoleptic qualities of the RTS beverage during storage

The organoleptic changes in RTS beverage during storage has been represented in Table 17 (Fig. 4).

The quality attribute appearance of the RTS beverage prepared was found to remain unaltered during the first and second weeks of storage whereas during the third week, a slight decrease in appearance score was noted. The mean scores for appearance obtained by the RTS beverage during the four weeks storage period ranged from 4.00 to 3.90.

A decrease in colour attribute score was observed in the RTS beverage by the end of the storage period. The mean scores obtained by the RTS beverage during the first three weeks of storage was 4.00 and by the end of the storage period the mean score was reduced to 3.90.

Fig. 4 Changes in the organoleptic qualities of the RTS beverage during storage

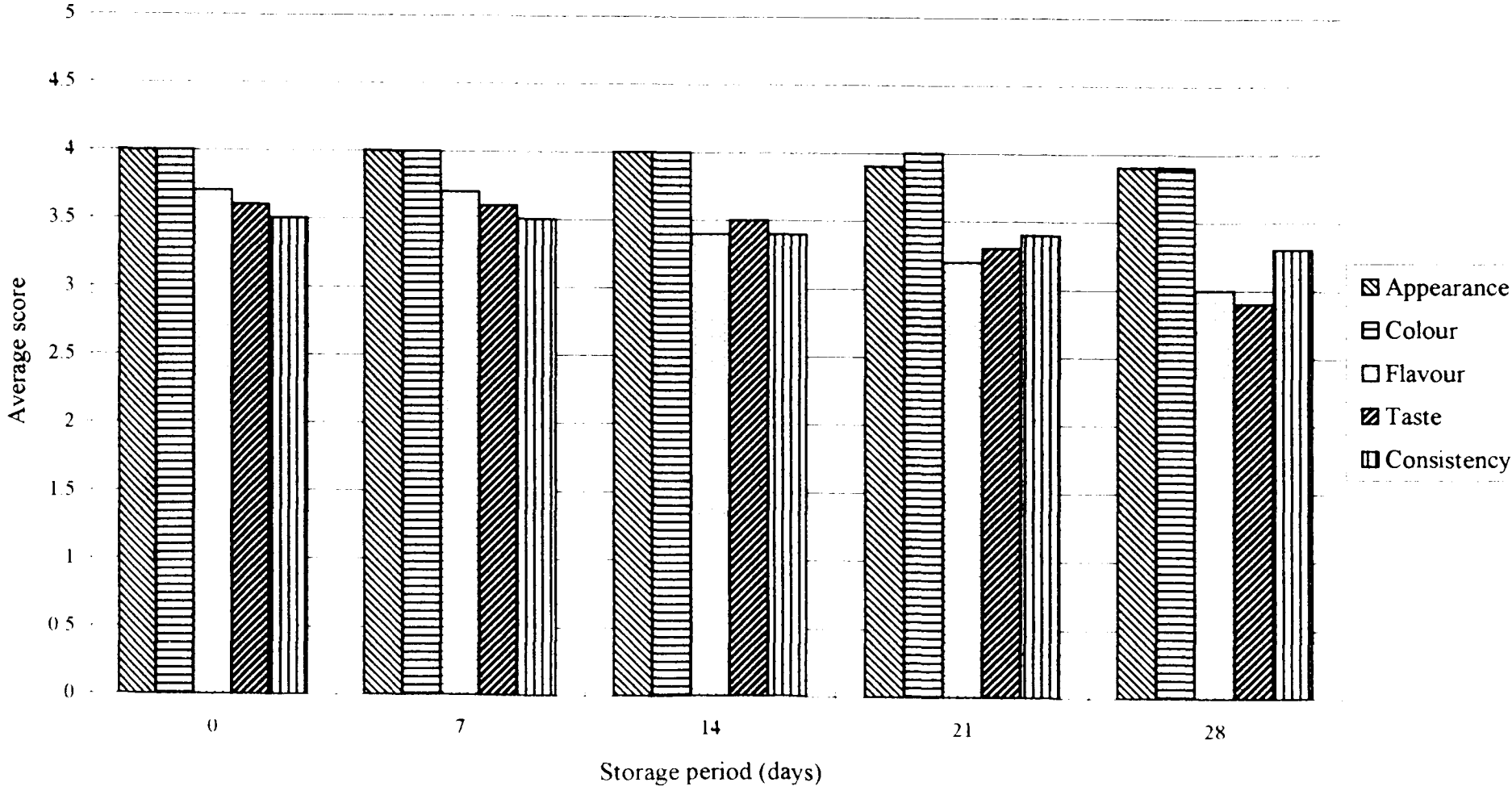


Table 17 Changes in the organoleptic qualities of the RTS beverage during storage

Storage period (in days)	Average Score					
	Appearance	Colour	Flavour	Taste	Consistency	Overall Acceptability
0	4.00	4.00	3.70	3.60	3.50	3.76
7	4.00	4.00	3.70	3.60	3.50	3.76
14	4.00	4.00	3.40	3.50	3.40	3.66
21	3.90	4.00	3.20	3.00	3.40	3.56
28	3.90	3.90	3.00	2.90	3.30	3.40
F values	12.155**	9.990**	43.491**	103.075**	11.247**	
SE	0.0020	0.0015	0.0045	0.0029	0.0024	
CD	0.0057	0.0044	0.1285	0.0082	0.0071	

** Significant at 1% level

The flavour attribute scores obtained for RTS beverage was found to show a decreasing trend during the storage period. Development of off flavour was noted towards the end of the storage period. When compared to the other attributes, flavour changes were found to be more pronounced in RTS beverage and it was found to range between 3.70 and 3.00 during the period of storage.

When taste attribute of RTS beverage was taken into consideration, not much changes was observed during the first and second weeks of storage, after which a declining trend in

the scores was noted. The mean scores for taste attribute obtained for the RTS beverage during the storage ranged from 3.60 to 2.90.

Taking into account the consistency aspect, a decrease in consistency attribute score was observed with storage. The mean score for the attribute consistency ranged between 3.50 and 3.30.

The data when statistically interpreted, it was found that a significant difference existed in the case of all the quality attributes of the RTS beverage during the four weeks storage period.

When the mean scores for overall acceptability were taken into consideration, it was observed that a gradual decrease in the mean scores of overall acceptability had occurred during the storage period. The overall mean scores obtained for the RTS beverage during the initial period till the end of the storage period ranged from 3.76 to 3.40.

4.7.3 Assessment of microbial contamination and fermentation of the processed product during storage

The keeping quality of products depends upon the microbial contamination. Microbial infestation in the product prepared was detected by the changes in chemical and organoleptic qualities that had occurred due to the action of microorganisms.

Among the chemical changes that occur in a product, pH is an important factor which helps to determine the growth of microorganisms during the storage period. Determination of pH reveals the acidity and alkalinity of the product which in turn give positive indication of deteriorative products. The pH of the RTS beverage prepared were observed to show a decreasing trend with storage which revealed the deterioration of the product.

The product was found to be free from contamination by microorganims during the early period of storage. Changes in appearance, colour, flavour, taste and consistency were detected after three weeks of storage in the RTS beverage. Presence of off flavour and a loss of appetizing appearance and taste towards the end of the storage period indicated the microbial decay.

The mango RTS beverage was viewed under the microscope to analyse the microbial infestation in the product such as bacteria, yeast and fungi. The fermentation test was also conducted. Colonies of Pencillium was detected in RTS beverage after four weeks of storage. Also the fermentation tests were found to be positive after four weeks of storage. Sethi (1994) on analysing the spoiled samples of tomato concentrate indicated that its spoilage was due to microorganisms such as yeast or aspergillus.

SUMMARY AND CONCLUSION

SUMMARY

The present study entitled 'Quality analysis and product development of selected mango cultivars' is a comprehensive study carried out with an objective to evaluate the quality of different varieties of mango based on physical characteristics, chemical composition and organoleptic qualities so as to identify the most suitable mango variety for the preparation of mango pulp based products.

Twenty dessert varieties of mango including local and improved types were selected for the study. Among these, 9 were Kerala Agricultural University recommended varieties and the remaining 11 were local varieties. The mango varieties were collected from the Government Fruit Farm, Kanyakumari and also from the local markets.

A detailed study on the different quality parameters of mango such as physical characters, chemical and nutritional composition and organoleptic qualities were envisaged.

The physical characteristics of different mango cultivars were assessed in order to study the nature of the fruit and also to identify the fruit. The major physical characteristics assessed in the different mango cultivars were

fruit weight, fruit length, peel weight, stone weight, flesh weight, density, size of the fruit, shape of the shoulders, form of the fruit, stalk insertion, beak of the fruit, juice content, stone venation and stone fibre.

Of these, the maximum average fruit length was observed for the variety *Pairi* whereas the highest score for fruit weight was observed for the variety *Bangalora*. The highest percentage of peel weight was observed for the variety *Kalapady*. The variety *Kalkand* had obtained the highest percentage of stone weight. The maximum value for flesh weight was observed for the variety *Bangalora*. In the case of density of the fruit, the highest value was observed for the variety *Kottukonam*.

In the present study, the chemical components present in different varieties of mango were assessed with regard to their pH, total sugar, reducing sugar, total soluble solids, moisture, acidity, vitamin C, β carotene, crude fat, crude fibre and mineral contents.

The highest value for pH was noted for the variety *Mulgoa*. The variety *Baneshan* had obtained the maximum mean score for moisture. The highest score for acidity was observed for the variety *Rumani* whereas the lowest score was observed for the variety *Mulgoa*.

On measuring the total soluble solid, it was observed that the highest value was seen for the variety *Panchasara Varikka*. In the case of total sugar, the highest mean score was observed for the variety *Alampur Baneshan* whereas the variety *Kottukonam* had the highest mean score for reducing sugar.

Studies on the vitamin C content of different varieties revealed that the maximum score was found for the variety *Karpooramanga*, whereas the β-carotene content was found to be highest in the variety *Neelum*.

The varieties *Pairi*, *Kottukonam* was found to have the highest mean score for crude fat and under fibre respectively.

On taking into account the mineral constituents it was found that the variety *Mundappa* had the maximum mean score for sodium. Whereas the variety *Olour* had the highest mean score for potassium. The highest mean score for phosphorus was obtained by the variety *Pairi*. The varieties *Moovandan* and *Panchasara Varikka* scored the highest values for calcium and magnesium respectively.

The organoleptic qualities of the fresh fruit such as appearance, colour, flavour, taste, consistency and overall acceptability using the twenty different varieties of mango were analysed.

The varieties *Kalapady*, *Neelum*, *Baneshan* and *Suvarnarekha* was observed to have the maximum mean scores for the quality attributes appearance, colour, flavour, taste, texture and also over all acceptability.

The cluster analysis was carried for the mango varieties based on their chemical and nutritional characteristics and based on the D^2 values the varieties of similar characters were grouped together. Eight varieties were clustered together in cluster I, followed by 7 in Cluster II, 2 in cluster III and 1 each in the clusters IV, V and VI.

Based on the discriminant function analysis the superior variety was selected for the product development from among the twenty mango varieties taken for study. The variety *Neelum* had obtained the highest index score followed by *Baneshan* and *Chausa*.

The mango juice from the superior variety *Neelum* was then used for the preparation of mango Ready-To-Serve beverage.

FPO specified tests were administered on the product to evaluate its suitability. The nutritional composition, organoleptic and shelf life qualities of the product prepared was analysed.

The product was stored for a period of 1 month and the chemical analysis was carried out at weekly intervals and compared with the fresh product.

The chemical analysis of the product showed that the pH, T.S.S., acidity, reducing sugar and total sugar remained almost the same during the first and second weeks of storage. Slight variations were seen during the end of the third and fourth weeks of storage. The pH and T.S.S. values showed slight decrease with the increase in storage period whereas the acidity and reducing sugar showed an increase with increase in storage period. The total sugar remained constant throught the period of storage.

The organoleptic qualities like appearance, colour, flavour, taste and consistency were found to remain unaltered during the first and second weeks of storage. But a slight decrease was seen in all the quality attributes by the end of the third and fourth weeks of storage. Sensory evaluation of the R.T.S. beverage after four weeks of storage at ambient temperature showed that the overall acceptability declined for all the attributes and the decline was found to be gradual.

The microbial and fermentation tests were conducted during weekly intervals. The product was found to be free from contamination by microorganisms during the early period of storage. Presence of off flavour and a loss of appetizing appearance and taste towards the end of the storage period indicated the microbial decay.

Colonies of Pencillium was detected in the RTS beverage after four weeks of storage. Also the fermentation tests were found to be positive. Thus, the product was found to be shelf stable for a period of one month.

From the above observations and findings it is clear that, it is possible to develop an organoleptically and nutritionally adequate pulp based product using the mango variety *Neelum*. Processing of *Neelum* mango fruits particularly during the seasonal glut could go a long way in reducing post-harvest losses and also in improving the employment potential of the local people.

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* Original not seen

APPENDICES

APPENDIX-1

EVALUATION CARD FOR TRIANGLE TEST

In the triangle test three sets of sugar solution of different concentration were used. Of the three sets two solutions were of identical concentrations and the members were asked to identify the third sample which was of different concentration.

Name of the product : Sugar solution

Note: Two of the three samples are identical, identify the odd, sample.

Sl. No.	Code No. of the samples	Code No. of the identical samples	Code No. of the odd sample
1.	XYZ		
2.	ABC		

(Signature)

APPENDIX-2

SCORE CARD FOR ASSESSING THE ORGANOLEPTIC QUALITIES OF MANGO VARIETIES

Criteria	Score	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}	V_{11}	V_{12}	V_{13}	V_{14}	V_{15}	V_{16}	V_{17}	V_{18}	V_{19}
1. Appearance																				
Very good	4																			
Good	3																			
Fair	2																			
Poor	1																			
2. Colour																				
Most acceptable	4																			
Acceptable	3																			
Less acceptable	2																			
Not acceptable	1																			
3. Flavour																				
Most acceptable	4																			
Acceptable	3																			
Less acceptable	2																			
Not acceptabe	1																			
4. Taste																				
Very good	4																			
Good	3																			
Fair	2																			
Poor	1																			
5. Texture																				
Fleshy	4																			
Less fleshy	3																			
Fibrous	2																			
Too fibrous	1																			

(Signature)

APPENDIX-3

SCORE CARD FOR ASSESSING THE ORGANOLEPTIC QUALITIES OF MANGO RTS

Criteria	Score	Mango RTS
1. **Appearance**		
Very good	4	
Good	3	
Fair	2	
Poor	1	
2. **Colour**		
Most acceptable	4	
Acceptable	3	
Slightly acceptable	2	
Not acceptable	1	
3. **Flavour**		
Most acceptable	4	
Acceptable	3	
Slightly acceptable	2	
Not acceptabe	1	
4. **Taste**		
Very good	4	
Good	3	
Fair	2	
Poor	1	
5. **Consistency**		
Very good	4	
Good	3	
Fair	2	
Poor	1	

(Signature)

ABSTRACT

QUALITY ANALYSIS AND PRODUCT DEVELOPMENT OF SELECTED MANGO CULTIVARS

by

BYNI ELIZABETH OOMMEN

ABSTRACT OF THE THESIS

Submitted in partial fulfilment of the requirement for the degree

MASTER OF SCIENCE IN HOME SCIENCE

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ABSTRACT

The present study entitled 'Quality analysis and product development of selected mango cultivars' is a comprehensive study carried out with an objective to evaluate the quality of different varieties of mango based on physical characteristics, chemical composition and organoleptic qualities so as to identify the most suitable mango variety for the preparation of mango pulp based products.

Twenty dessert varieties of mango including local and improved types were selected for the study. Among these, 9 were Kerala Agricultural University recommended varieties and the remaining 11 were local varieties.

A detailed study on the different quality parameters of mango such as physical characteristics, chemical and nutritional composition and organoleptic qualities was envisaged.

Cluster analysis was carried for the mango varieties based on then chemical and nutritional characteristics and based on the D^2 values the varieties of similar characters were grouped together.

The superior variety was selected for the product development among the twenty mango varieties taken for study. The variety *Neelum* obtained the highest score.

The mango juice from the superior variety *Neelum* was then used for the preparation of mango Ready-To-Serve beverage.

FPO specified tests were administered on the product to evaluate its suitability. The nutritional composition, organoleptic and shelf-life qualities of the product prepared was also analysed.

The product was stored for a period of 1 month and the chemical analysis was carried out at weekly intervals and compared, with the fresh product.

The chemical composition and organoleptic qualities of the RTS beverage remained unaltered during the first and second weeks of storage. Slight variations in the chemical composition and organoleptic qualities were seen during the end of the third and fourth weeks of storage.

Sensory evaluation of the RTS beverage after four weeks of storage at ambient temperature showed that the overall acceptability declined for all the attributes.

Microbial and fermentation tests were conducted during weekly intervals. Colonies of Pencillium was detected in the RTS beverage after four weeks of storage. Also the fermentation test were found to be positive. Thus, the product was found to be shelf stable for a period of one month.

From the above observations and findings it is clear that, it is possible to develop and organoleptically and nutritionally adequate pulp based product using the mango variety *Neelum*. Processing of *Neelum* mango fruits particularly during the seasonal glut could go a long way in reducing post-harvest losses and also in improving the employment potential of the local people.