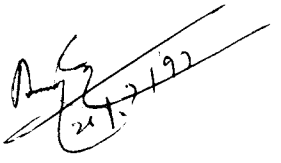
SUITABILITY OF LOCAL MANGO CULTIVARS FOR PULP BASED PRODUCTS



By

IRENE VARGHESE

THESIS

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DECLARATION

I hereby declare that this thesis entitled **"Suitability of local mango cultivars for pulp based products"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Irene V

IRENE VARGHESE

Vellayani,
Date: 15-11-'97

CERTIFICATE

Certified that this thesis entitled **"Suitability of local mango cultivars for pulp based products"** is a record of research work done independently by **Miss. Irene Varghese** 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.

Vellayani,
Date : 15-11-'97

Dr. (Mrs.) MARY UKKURU. P.
(Chairman, Advisory Committee)
Associate Professor,
Department of Home Science,
College of Agriculture, Vellayani

Approved by

Chairman :

Dr. (Mrs.) MARY UKKURU, P.,
Associate Professor,
Department of Home Science,
College of Agriculture, Vellayani

15.11.97

Members :

1. **Dr. (Mrs.) L. PREMA,**
   Professor and Head,
   Department of Home Science,
   College of Agriculture, Vellayani

2. **Smt. SOFFIE CHERIYAN,**
   Assistant Professor,
   Department of Home Science,
   College of Agriculture, Vellayani

3. **Dr. V. A. CELINE,**
   Assistant Professor,
   K.H.D.P.,
   College of Agriculture, Vellayani

15/11/97

External Examiner :

15/11/97

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INTRODUCTION

INTRODUCTION

Fresh fruits are considered as an integral part of any dietary system, since they are the rich sources of minerals, vitamins and dietary fibre. (Mathew and Singh, 1996). Fruits are perhaps the first edible natural product consumed by man and one of the advantages of fruits over other foods are, they can be eaten as such and are tasty and nourishing.

India is one of the major fruit producers in the world (Sethi, 1993). Recent food production statistics indicates that India is the second largest producer of fruits in the world after Brazil with a production, touching 27.83 million tonnes which accounts for around eight per cent of the world production (Rao, 1991). Manimegalai *et al.* (1995) reported that about 25,420 tonnes of fruits have been produced every year in India and are consumed as fresh, partially processed and completely processed form.

A report published by Indian Food Packer (1993) revealed that though India is second to Brazil in the

production of fruits, hardly about one per cent of fruits produced are processed. Still a large amount of fruits perish due to inadequate post harvest processing, packaging and storage facilities. According to Sethi (1993) 20-30 per cent of the fruits produced in this country are not utilized due to post harvest problems.

Roy *et al.* (1993) had ascertained that a surplus production of perishable fruits during seasonal glut could be converted into value added products so as to avoid wastage. Proper post harvest management will lead to more availability of food, more benefits for farmers and consumers, better nutrition, more raw material for industry, high employment opportunity, increase in export, better environment and improvement in quality of life (Susantha, 1995).

Some suitable tropical fruits used for processing according to Menezes (1980) are pineapple, cashew, banana, avocado, guava, papaya, mango and passion fruit.

The fruit and vegetable processing industry has been declared as a thrust area and is likely to take of in the near future as a potential earner of foreign exchange

through export of processed fruits and vegetables (Kapoor, 1993).

Mango (*Mangifera indica*) one among the tropical fruits is a member of the family Anacardiaceae (Hicks, 1990). Through the ages mango has been acknowledged as an excellent fruit, relished by adults and children alike. The fruit appears to have a strong link with the cultural history of India. It has been portrayed in the paintings and sculptures, Hindu folklore and mythology, legends and in the sacred sanskrit scriptures dating back to 2000 BC.

Mango fruits have been an esteemed item of diet and the tree is a subject of great veneration. Because of its economic importance, the fruits are put into multifarious uses right from the first stage of development to maturity and ripening. No other fruit can be utilized for so many diversified uses in the form of processed products as mango.

Mango is popularly known as the national fruit of India and occupies the largest area under fruit cultivation. This fruit with many versatile properties has become an important commodity for processing. The processed product of the fruit has the largest international market than any other

fruit. Mokshapathy (1988) reported that India exported over 50,000 tonnes of mango products in the form of slices, pulp and concentrates to several countries around the world.

The present study highlights the potential of locally available mango cultivars for the development of pulp based products. The objectives of the study include :

1. Identification of the most suitable local mango variety for the preparation of mango pulp based products.

2. Assessment of physico-chemical and nutritional characteristics of different local mango varieties.

3. Organoleptic and shelf life qualities of the products prepared.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The pertinent research work on "Suitability of local mango cultivars for pulp based products" is briefly reviewed under the following subtitles.

2.1 Need for fruit processing

2.2 Mango-its profile and scope

2.3 Importance and nutritional significance of mango as a fruit

2.4 Chemical characteristics of mango

2.5 Varietal influence of mango on the quality parameters

2.6 Organoleptic, chemical and shelf life qualities of pulp based products

2.1 Need for fruit processing

Fruit processing can be defined as treatments from harvest to consumption which include handling, transportation, refrigeration, bleaching, freezing, canning, holding, washing, trimming, drying, irradiation, chemical preservation, packaging, storage and cooking. According to Rao (1991) processing of fruit can be defined as adding value

to conventional and innovative food items through various formulations and combinations providing protection, preservation, packaging, convenience carriage and disposability.

India annually produces about fifty four million tonnes of fruits and vegetables valued at about Rs. 10,000/- crores and is one of the largest producers of fruits and vegetables in the world (Food Industry, 1994). A report published in Indo-U.S. Sub project (1990) had indicated that the annual production of mango is 10.04 million tonnes, which resulted in a post harvest loss of 17.1 to 36.7 per cent. Processing of fruits particularly during surplus production and seasonal glut can go a long way in reducing post harvest loss.

Bourne (1986) has classified the causes of post harvest loss of perishable crops as primary losses due to insects, microbes and mechanical damages and secondary losses due to poor storage and inadequate transport facilities.

Shaw *et al.* (1993) remarked that owing to rich horticultural potential that exist in our country, fruit processing industry can play an important role in salvaging

prices during glut seasons, generating employment opportunity, meeting the requirements of defence forces and earning foreign exchange for the country. Besides it ensures fair returns to the growers and improve their economic conditions.

2.2 Mango - its profile and scope

Mango (*Mangifera indica*) belonging to the family Anacardiaceae is the national fruit of India and is grown throughout the length and breadth of the country, except in the temperate and arid regions. Ranjit Singh (1969) remarked that mango occupies the same position in India as it is occupied by the apple in temperate climates and grapes in subtropical areas and in area, production, nutritive value and popularity no other fruit can compete with it.

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.

Mokshapathy (1988) indicated that the world's largest mango production is in India. Kalra *et al.* (1993) reported that India is the largest producer of mango fruit accounting for about 65 per cent share in the world produce. But only one per cent of it is processed. India has a large production base of mangoes (9.7 million tonnes), which is equivalent to 60 per cent of world production with the added bargain of a wide varietal choice (Indian Food Packer, 1994). With the annual production of over 32 million tonnes of fruits (1994-95) India has emerged as the largest producer of fruits in the world (Chadha, 1995).

Khurdiya and Sahni (1993) has ascertained that India tops in the export of processed mango products. The export of mango and mango pulp products was estimated to be 29,000 tonnes in 1990-91 and fetched Rs.58 crores to the country. The major contribution to the export effort is from Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala and Madhya Pradesh (Indian Food Industry, 1994). India meets almost 59 per cent of the world demand for mangoes and through export earns Rs.50 crores annually in foreign exchange (Indian Food Industry, 1994). Chadha (1995) stated that mango fruit is important from the processing point of view and contributes a

share of 43-44 per cent in the total production of processed fruit and vegetable products.

According to Bose (1990) the popular commercial cultivars of different regions in India are :

Northern Region	:	Dashehari, Langra, Chausa and Bombay green
Eastern Region	:	Himsagar, Langra, Fazli, Zardalu, Krishnabhog and Gulabkhas
Western Region	:	Alphonso, Pairi, Kesar, Rajapuri, Malkurad and Jamadar
Southern Region	:	Bangalora, Neelum, Swarnarekha, Pairi (Peter), Banganpalli, Mulgoa and Badami (Alphonso)

According to Lakshminarayana (1980) varieties of mangoes grown in various countries are :

India	:	Alphonso, Bombay Green, Bangalora (Totapuri), Banganapalli, Chausa, Deshehari, Dushri, Fazli, Gulabi Ghas, Himsagar, Kesar, Langra, Malda, Malkurad, Malgoa, Neelum, Pairi, Raspuri, Rumani, Safeda lucknow, Schooli Shah Pasand, Suvarnarekha, Zardaloo.

Australia	:	Kensington
Brazil	:	Bourbon, Carlotta, Extrema, Haden, Non-Plus-Ultra
Cuba	:	Bizcochuelo, Haden, Macho
Egypt	:	Mabroka
Indonesia	:	Aroomanis, Gadoong, Golek, Wangi
Israel	:	Haden, Maya, Mabroka, Nimrod, Sarafend
Haiti	:	Madame Francis
Mexico	:	Atauffo, Diplomatico, Esmeralda, Haden, Irwin, Keitt, Kent, Manila, Manzana, Naranja, Pina, Canario, Sensation
Philippines	:	Carabao, Pico
Pakistan	:	Sindhri and several Indian varieties
Puerto Rico	:	Colombo, Haden, Mangotino
United States	:	Gouveia, Haden, Irwin, Keitt, Kent, Palmer, Pope, Smith

Gowda and Ramanjaneya (1994) pointed out that there are nearly 1000 mango varieties grown in India out of which only 20 varieties are cultivated commercially. The

characteristics of each variety vary widely and the ultimate quality of the mango products depend largely on the selection of suitable variety.

2.3 Importance and nutritional significance of mango as a fruit

"The choicest fruit of Hindustan" is still the mango, as it was in the days of the poet Amir Khusrau, who sang its praises in the 14th centuary (Hayes 1960). Ranjit Singh (1969) revealed that mango undoubtedly deserves to be the national fruit of India.

According to Bose (1990) mango because of its great utility occupies a prominent place amongst the fruit crops grown in India and is acknowledged as the king of fruits of this country. Singh (1990) identified that mango, due to its excellent taste, flavour and nutritive value is a favourite fruit in all parts of the country. Hicks (1990) had ascertained that mangoes are a very popular fruit and the vast majority are consumed in the fresh state. He also reported that mango is processed into pickles and chutneys, particularly in India and there is also a well established canning industry producing slices in syrup.

Hayes (1960) had suggested that mango is useful from the time the fruits are small and green until they are fully ripe. Bhatnagar and Subramanyam (1973) reported that the fruit mango with many versatile properties had found application for processing into various products, starting from salt pickled green mango slices and chutneys to a wide range of products unparalled by any other fruit.

Teotia and Pruthi (1987) indicated that Andra Pradesh is the leading State in India, producing more than 200 tonnes of mango leather per year. Totapuri is the predominant cultivar being used because of its abundance in the area and availability at lowest cost with higher pulp content.

A report published by Beverage and Food world (1994) had revealed that unripe fruits are pickled, used for chutney, preparation of powder and in culinary preparations and ripe fruits are preserved by canning or used for juice and squash, jams and jellies, murabha and mango leather. Cotyledons of the seeds are also used as food and feed in times of scarcity.

Jain *et al.* (1957) developed a technique for preparing mango cereal flakes which could be used as breakfast food or snack food. Siddappa and Ranganna (1961) succeeded in developing strained baby foods, using mango pulp and found useful in milk diet for children.

Ranjit Singh (1969) had suggested that mango has some medicinal properties and also the ripe fruit is fattening, diuretic and laxative.

Fruits are no longer considered as a luxury since they belong to an important class of protective foods which provide adequate vitamins and minerals needed for the maintenance of health. Hayes (1960) indicated that mang fruit has some medicinal properties and some varieties are excellent sources of vitamin A and C. Jungalwala *et al.* (1963). found that luteoxanthin and violaxanthin, which are seldom found in fruits are present in significant amounts in mango. Bhatnagar and Subramaniam (1973) reported that mango is a fairly good source of carbohydrate, vitamin C and a very rich source of provitamin A. Carbohydrate portions of mango include simple sugars, starch, cellulose, pectic substances and tannin.

A report published by Indian Council of Medical Research (1967) indicated that, mango is considered as a poor man's fruit because a lot of nourishment is packed in it. Mango is probably the richest natural source of carotene, which is a precursor of vitamin A. The carotenoid pigments which are yellow in colour, develop during ripening and are maximum in fully ripened fruits. The main constituents of mango are proteins, carbohydrates, organic acids, minerals and vitamins. Charanjit (1989) reported that ripe mango fruit possessed high calorific value and is an excellent source of carotene.

Verma *et al.* (1988) indicated that during ripening there was a gradual increase in the contents of carotenes in the flesh, resulting in a deep-yellow colouration of the ripe fruits.

Hicks (1990) indicated that, the level of terpenes in mango is also very high particularly in the part of the fruit close to the skin. Nanjudaswamy and Mahadeviah (1993) reported that sixteen carotenoid pigments were identified in the Alphonso mango of which 60 per cent is B carotene. Kaur and Khurdiya (1993) suggested that the richness of

carotenoids in mango has great potential of improving the quality and nutrition of fruit beverage to which it is mixed.

Gowda and Ramanjaneya (1994) suggested that, mango besides having a delicious taste, excellent flavour and attractive fragrance is also an excellent source of vitamin A and C. As reported by Gowda *et al.* (1994), the carotenoid content and vitamin C content was significantly lower in hybrids.

2.4 Chemical characteristics of mango

The chemical composition of mango fruit varies with the variety and stage of maturity.

Leley *et al.* (1943) studied the ripening of mango and found that the fully ripe fruit contained 2.19 per cent glucose, 0.41 per cent fructose and 13.98 per cent non-reducing sugars, which increases during ripening. Some varieties of mango tested by Cheema *et al.* (1950), found that the varieties Hemsagar and Langra contained more than 16 per cent total sugar, while Kawasji Patel contained the least (11.2 per cent). Reducing sugars varied from 1.4 to

4.83 per cent and non-reducing sugars varied from 8.19 to 13.81 per cent.

Lal *et al.* (1960) had found that there is much variation in the analysis of different fruits of the same variety but a typical Badami fruit contain 7.13 per cent reducing sugar, 11.42 per cent non-reducing sugar, 0.38 per cent acid, 1.02 per cent protein and 0.39 per cent ash.

Bhatnagar and Subramaniyam (1973) analysed the chemical composition of 10 varieties of mango viz. Alphonso, Baneshan, Pairi, Totapuri, Neelam, Mulgoa, Dushehari, Fazli, Langra and Chansa) and found that moisture content varies from 76 to 86 per cent, TSS 14 to 24 per cent, pH 4.0 to 5, acidity 0.10 to 0.45 per cent, total sugar 10.5 to 18.5 per cent and reducing sugar 2.0 to 7.5 per cent.

2.5 Varietal influence of mango on the quality parameters

Berry (1979) reported that no fruit compares in flavour with the best ripe mangoes.

Bose (1990) ascertained that the composition of the fruit in general differs with the cultivar and the stage of maturity.

Kulkarni *et al.* (1981) pointed out that among the 22 important Indian mango cultivars, Alampur Baneshan fruit was heaviest (400 gm), Vanraj fruit had maximum pulp (81 per cent) and minimum peel (6.8 per cent) while Fazri had the smallest stone (9.4 per cent) and the Vitamin C content was found to be highest in the variety peddarasam (73 mg/100 gm) followed by chimnarasam fruit (69 mg/100gm) and Langra fruit (66.6 mg/100 gm).

Ghosh *et al.* (1985), in an evaluation of 10 varieties of mango had found that the variety Jangale is superior to other varieties based on the fruit size and fruit pulp weight. The variety Bombay green showed the highest percentage of fruit pulp and a fairly low percentage of peel and stone but the highest moisture percentage was seen as a demerit for longer storage. The fruits of safed pasand were found to be big with an ample amount of pulp and contained highest amount of TSS and total sugar with low moisture while the fruits of Meghlantan were smallest in weight and the fruit quality was very poor with low sugar acid ratio.

Kapse *et al.* (1985) studied four important varieties of mango, for their shelf life at ambient and low

temperatures and found that temperature did not favour the development of any of the factor contributing to fruit quality like colour, flavour or texture but helped in the extension of storage life. All the quality parameters were at the maximum rating at the 10th day of storage at ambient temperature and minimum at 37th day of storage at low temperature.

Studies carried out by Uthaiah *et al.* (1990) on the fruit characters of some less popular mango varieties have shown that the weight of the fruit ranged from 146 gm for the variety pantan to 1005 gm for Mohanbhog variety. The pulp percentage ranged from 49.5 per cent (Kalahapus) to 80.1 per cent (Kalangharas).

Badiyala *et al.* (1990) studied on 12 cultivars of mango grown under Kangra Valley conditions of Himachal Pradesh for their physico-chemical characteristics and found that the fruit weight was high in Fazli and the percentage of fruit pulp was maximum in the variety Mallika. The TSS, TSS/acidity ratio and ascorbic acid content was highest in Dashehari variety followed by Mallika variety. He had also observed that both reducing and non-reducing sugars were highest in Alphonso and Dashehari Varieties. The cultivar

Dashehari was found to attain better quality under Kangra Valley conditions of Himachal Pradesh.

Chakraborthy *et al.* (1993) analysed nine varieties of mangoes viz. Dashehari, Chausa, Safeda, Tamfuria, Malda Fazli, Lucknow Fazli, Mallika, Bhagwankera and Golbhadiya for their suitability for preparing canned nectars and juice. Samples prepared from seven commercial varieties of mangoes, were ranked for colour, aroma, taste and overall acceptability with respect to Badami mangoes. Based on the overall acceptability, Dashehari and Tamfuria was found to be good and comparable to Badami (Alphonso) for preparing canned mango nectar and juice. Malda Fazli, Lucknow, Fazli, Chausa and Golbhadiya were next preferable, nectar and juice made from Safeda and Lucknow Fazli were found significantly inferior.

Gowda *et al.* (1994) studied the physico-chemical and processing qualities of four new mango hybrids, Arka Aruna (H.10), Arka Puneet (H.13), Arka Anmol (H. 17.3) and (4.51) developed by the Indian Institute of Horticultural Research, Banglore in comparison with two commercial cultivars, Alphonso and Totapuri and found that the hybrids

Arka puneet and Arka Anmol were very much comparable with the commercial variety Alphonso with respect to the fruit weight, volume, breadth, TSS, pH, acidity, reducing sugar, total sugar, viscosity and quality of canned juice. Fruits of Arka Anmol were slightly longer than Alphonso and had lower firmness, where as "Arka Puneet" had good firmness at ripe conditions. All hybrids yielded marginally higher pulp and possessed lower peel, stone and fibre contents. Carotenoid contents of all hybrids were significantly lower than those of Alphonso but greater than those of Totapuri, except in case of Arka Aruna.

2.6 Organoleptic, chemical and shelf life qualities of pulp based products

Sensory analysis has been defined as a "Scientific discipline used to evoke, measure, analyse and interpret reaction to those characteristics or foods and material as they are perceived by the sense of sight, smell, taste, touch and hearing". (Cruess, 1966). The organoleptic qualities are usually assessed by the method of sensory evaluation. According to Mahony (1985), the organoleptically assessed samples form a true representative of the products developed

and organoleptic assessment stands essential for the further development of the product. Ylimaki *et al.* (1989) revealed that sensory analysis is a multidisciplinary science that uses human panelists and their senses to measure the sensory characteristics and acceptability of food products. It is applicable to product development and quality control.

Mukherjee *et al.* (1963) reported that pear juice developed good appearance and possessed natural flavour and taste of the fruit, but lacked shelf stability. Nanjundaswamy *et al.* (1964) had suggested that plain gauva juice was a highly acceptable beverage.

Khurdiya *et al.* (1984) studied that jamun, an indigenous fruit having an attractive colour and excellent taste can be profitably used for beverage industry.

Singh *et al.* (1988) developed a method for the preparation of amla juice which was found organoleptically acceptable even after six months of storage. According to Okoli and Ezenweke (1990) papaya juice at the pH of 3.9 was highly acceptable.

Seow *et al.* (1991) pointed out that properly processed fruit products can be stored for more than one year and keeps sound organoleptically.

Seow *et al.* (1991) investigated that processed jack fruit juice kept well for more than 17 days at a storage temperature of 30^{o}C. Kalra *et al.* (1991) revealed that a beverage made from mango-papaya pulp preserved for a period of one year at ambient condition was organoleptically acceptable.

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

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.

Thirumaran *et al.* (1992) reported that fermented carrot based RTS was found to be acceptable for more than 6 months for all the quality attributes like colour,

appearance, flavour and taste. Manan *et al* (1992) revealed that RTS beverage prepared from apricot pulp was highly acceptable. Chauhan *et al.* (1993) reported that fruit juice beverage prepared from apricot, peach and plum with 20 per cent pulp was found to be best on the basis of sensory evaluation.

Renote *et al.* (1993) pointed out that physico-chemical characteristic and sensory evaluation has revealed that a highly acceptable quality RTS beverage can be prepared from kinnow mandarin. Chakraborthy *et al.* (1993) reported that clarified water melon juice blended with lime juice or pineapple juice yielded RTS beverage of acceptable quality.

Kaushik *et al.* (1994) developed RTS and squash like beverage based on unripe dashehari mangoes and found that RTS beverage prepared from it was acceptable.

Grewal and Saini (1992) had suggested that heat treated fruit juice concentrates showed better sensory qualities.

Manan *et al.* (1992) reported that squash prepared from apricot pulp had a good shelf life period of about six months and was also found to be highly acceptable.

Perlette (1992) had observed that the colour of grape juice improved during storage while acidity decreased.

Thirumaran *et al.* (1986) had standardized the formula for papaya jam and found that it had a shelf life of eight months with an overall acceptability score of 3.75. Tripathi *et al* (1988) revealed that the organoleptic evaluation of stored amla Jam showed an increase in the acceptability with storage.

Bhatnagar (1991) opined that the keeping quality of watermelon rind jam was reasonably good under ambient storage conditions for a period of six months. Joshi (1991) revealed that karonda jam was organoleptically acceptable with a shelf life of about one year under ambient conditions.

Pruthi (1988) studied the role of vitamin C in the discolouration of processed products and has reported that there was about 10 to 15 per cent loss of ascorbic acid during storage periods.

Palaniswamy *et al.* (1976) reported an increase of 0.09 per cent of reducing sugar in lemon juice during

storage. Analysis of citrus juice stored over a period of eight months at room temperature showed an increase of 37.25 per cent total acidity and a slight decline in pH. (Mehta and Bajay, 1983).

Studies conducted by Tripathi *et al.* (1988) in amla juice exhibited an increase of 0.86 per cent acidity during storage and showed negligible change in pH. Sandhu *et al.* (1988) found that preserved grape juice on processing and pretreatments had negligible effect on acidity.

Renote *et al.* (1993) remarked that kinnow RTS stored at ambient condition when evaluated showed only negligible changes in pH, acidity and reducing sugar and a decline in total sugar.

Thirumaran *et al.* (1992) opined that fermented carrot based RTS stored for more than six months showed a declining trend in TSS. Sethi (1994) was of the opinion that shelf life of whole tomato concentrate stored for eight months showed an increase in titratable acidity (2.08 per cent) and TSS (4.84 per cent).

Thirumaran *et al.* (1990) found that packaged tomato concentrate had a shelf life of four months and indicated an increase in acidity (4.46 per cent) and reducing sugar and a decrease in TSS, pH and vitamin C during storage.

Lundahal *et al.* (1983) revealed that strawberry juice concentrate stored at 20^{o}C showed a decrease in quality over six days while the reducing sugar and titratable acidity concentration remained stable. Papaya RTS standardized by Thirumaran *et al.* (1993), contained 25 per cent pulp, 9.5 per cent sugar (15^{o} Brix) and 65 per cent water and was found to be highly acceptable with a shelf life of more than six months.

MATERIALS AND METHODS

MATERIALS AND METHODS

The study entitled "Suitability of local mango cultivars for pulp based products" is a comprehensive study carried out with an objective to identify the most suitable local mango variety for the preparation of mango pulp based products. The study also envisages an attempt to assess the physico-chemical and nutritional characteristics of different local mango varieties and also to analyse the organoleptic and shelf life qualities of the products prepared.

3.1. Selection of mango fruits for the study

Mango is a fruit of great demand and is also considered as a favourite fruit in all parts of India because of its exotic flavour and delicious taste. Singh (1990) reported that no other country can surpass India in the number of mango varieties and no other country enjoys the status it does in India. Mango fruit was selected for the present investigation due to the following reasons :-

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

2. Mango fruits can be processed into large varieties of products, which people will relish with great interest (Jain, 1961)

3. Processing of mangoes can throw up export potentials (Indian Food Packer, 1993)

4. Processing of mango fruits particularly during surplus production and seasonal glut could go a long way in reducing post harvest losses (Roy *et al.* 1993)

5. Mango has got a lot of nourishment packed in it and is found to blend well with other fruits (Kalra *et al.* 1991)

6. Processing of mango fruits can improve the employment potential of the local people and contribute to the overall progress of the region. It also ensures fair returns to the growers and improves their economic conditions.

Maini and Anand (1985) pointed out that development of fruit preservation industries in rural areas can help generate employment, support growers, upgrade local nutrition

and increase the gross national product. Poonia *et al.* (1994) viewed that fruit processing helps to improve the problem of under employment during off season in agriculture sector.

3.2. Procurement of mango fruits

Enquiries were made regarding the availability and abundance of the local mango varieties in Peringamala, Balaramapuram, Katakkada and Thiruvananthapuram local markets. Mango varieties which are locally grown and available readily in the markets of in and around Thiruvananthapuram District were selected for the present study. The cost of the mangoes, seasonal glut of the variety and processing characteristics were the other criteria looked for, in the selection of mango varieties. The fruits that were required for the study were procured in bulk from the local markets of Thiruvananthapuram, Peringamala, Balaramapuram and Kattakkada. Six varieties of local mango cultivars, each variety weighing about 5 kg were collected. Varieties selected for the study were, Kottukonam (V_1), Neelum (V_2), Karpooram (V_3), Panchasara Varikka (V_4), Kappa(V_5) and Moovandan (V_6), since these varieties are now being cultivated abundantly in these areas.

3.3. Physical characteristics of the fruits studied

Physical characteristics of the fruits are very important for identification of the cultivar and also for determining the quality parameters. The six varieties of mango cultivars selected for the study were analysed for various physical characters. This included the average fruit weight, number of mangoes in one kg, colour of skin, thickness of skin, fleshiness of fruit, sweetness and colour of flesh. The yield of pulp per kg of fruit were also recorded.

3.4. Selection of the products proposed

Utilizing the six varieties of mango cultivars selected for the study, pulp based processed products were tried.. The products proposed for the present study included Ready-to-Serve beverage (RTS), Squash, and jam.

3.4.1. Ready-To-Serve beverage

RTS is a fruit juice which is altered in composition with sugar for RTS and water during preparation.

No amount of dilution is necessary for RTS prior to serving and it is in the ready to serve form. This is a product which can be prepared easily and of short shelf life. This is a type of fruit beverage which contains at least 10 percent fruit juice and 10 per cent total soluble solids besides about 0.3 per cent acid (Srivastava and Sanjeev, 1994). According to Siddappa (1986) RTS beverage is delicious, rich in essential minerals, vitamins and other nutritive factors and have an universal appeal unlike other beverages. Khurdiya (1988) reported that fruit beverages offer more variety of flavour, nutrients and other physiological benefits with a greater margin of safety with lower inherent cost. The dietetic value of real fruit based beverage is far greater than that of synthetic products which are being produced in large quantities (Khurdiya 1990) . 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.

3.4.2. Mango Squash

Squash consists essentially of strained juice containing moderate quantities of fruit pulp to which cane

sugar is added for sweetening. According to Srivastava and Sanjeev (1994) Squash is a type of fruit beverage containing at least 25 per cent fruit juice or pulp and 40 to 50 per cent total soluble solids, commercially and it is diluted before serving. Kaur and Khurdiya (1993) explained that fruit beverages are becoming increasingly popular in the market with the growing consciousness of people about the nutritive value of fruits.

3.4.3. Mango jam

According to Siddappa (1986) jam is a product prepared by boiling the fruit pulp with a sufficient quantity of sugar to a reasonably thick consistency, firm enough to hold fruit juices in position. A jam is more or less a concentrated fruit pulp possessing a fairly thick consistency and body. It is a product which is rich in flavour and also it contains a high concentration of sugar which helps to facilitate preservation.

Jam contains 0.5 - 0.6 per cent acid and invert sugar should not be more than 40 per cent (Sreevastava and Sanjeev, 1994). Donchencko and his colleagues (1983) studied that the pectin / sugar solution prepared in the ratio of 1:5

with water at 30 volume per weight of pectin and pH in the range of 2.5 to 6.0 was observed to result in increased jam strength.

3.5. Standardisation of the products

According to Crusius (1984) standardisation of recipe is an essential strive for high quality products. A recipe that is new or has to be changed should be tested in small quantity before being used in regular production. According to Reay (1983) the advantages of the use of standardised recipes are, accurate cost control and portion control, standard buying, issuing and recording of consistent yield, uniformity of size, standard costing and selling price and quick production resulting from the use of steamlined familiar methods. Standardised recipe ensures distribution of work and job satisfaction (Ramdas, 1993).

The recipe that was adopted for the preparation of mango pulp based products were standardised and the products proposed were developed from each variety of mangoes selected. Different proportions of the ingredients used in the recipe were tried out for standardising and the best

proportion among them were selected by testing under a panel of selected judges. Standardisation procedure was reported to get concordant results. The proportion used for the preparation of the pulp based products are as follows.

RTS : 1.6:1:5.6 (pulp, sugar and water)

Squash : 1:1:1 (pulp, sugar and water)

Jam : 1:1 (pulp and sugar)

3.6. Methods of preparation of mango pulp based products

3.6.1. Formulation of RTS beverage

The selected varieties of fresh ripe mangoes were washed in fresh water and the fruit pulp was extracted using a mixie. The pulp was strained through a coarse muslin cloth to remove small pieces of fibre. Citric acid and water were mixed till the sugar was dissolved. Filtered the mixture through a fine muslin cloth. To this mixture, the pulp was added and mixed thoroughly. After mixing, it was strained once again through a muslin cloth, so that all the coarse particles suspended in the juice were removed. This was done because the presence of coarse particles can cause

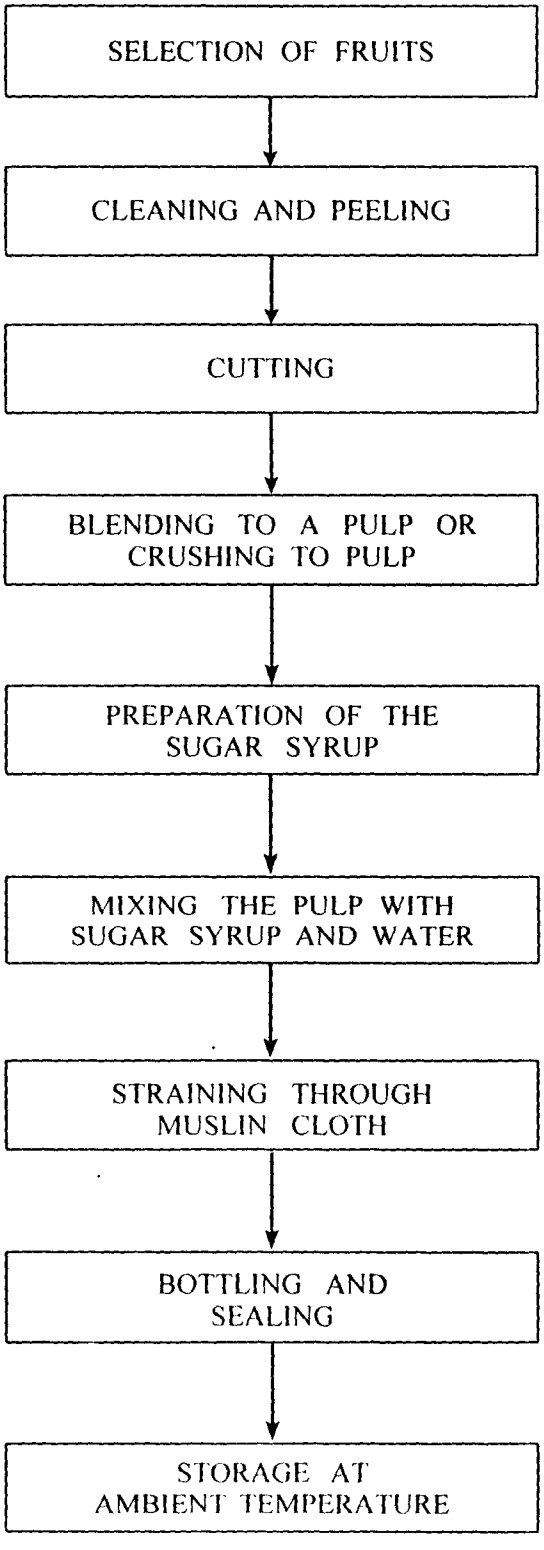
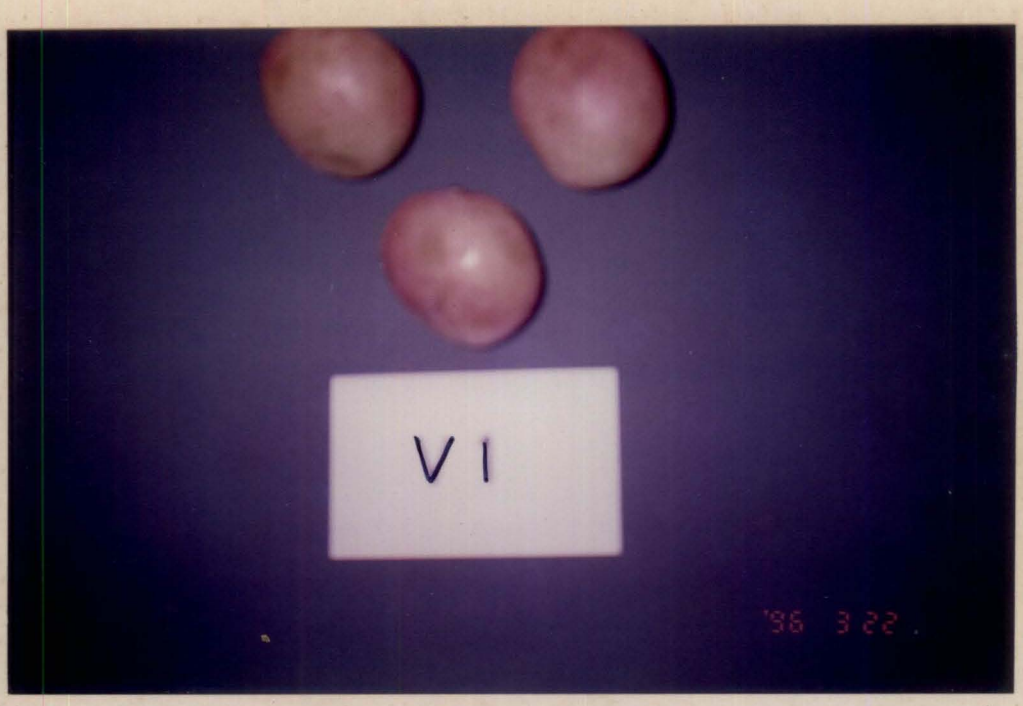
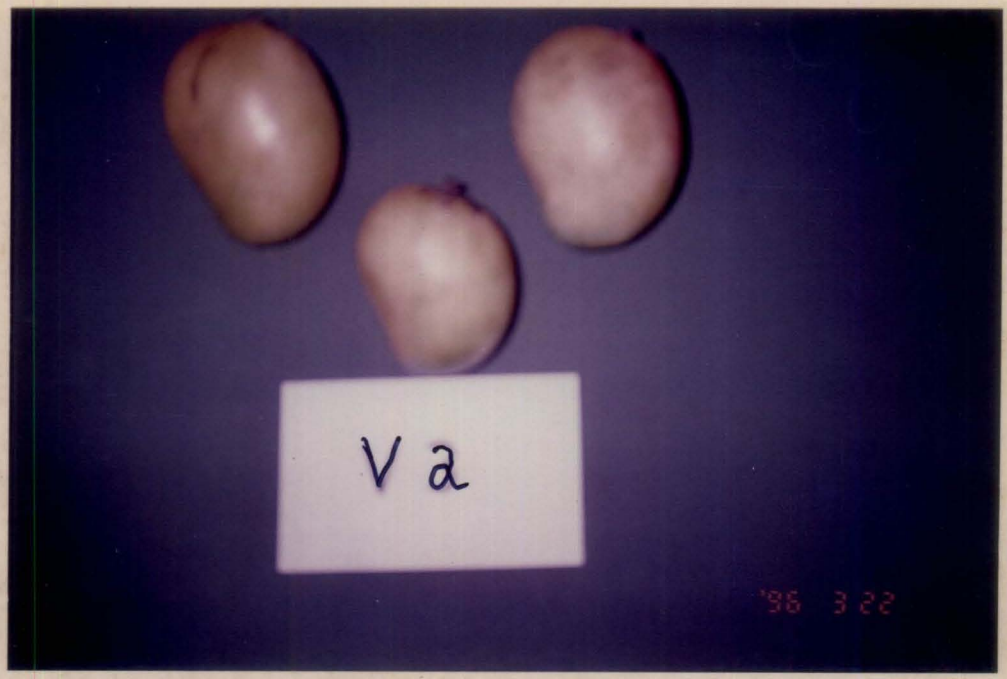


Fig. 1. Flow chart for the preparation of RTS beverage

Mango Varieties





RTS BEVERAGE

deterioration in the quality of the final product. Addition of colour was not found to be necessary since the pure mango RTS beverage itself gave a rich colour to the product.

The beverage was then filled into clean and sterilized narrow mouthed 200ml capacity bottles leaving 2.5cm head space. The bottles were then sealed using crown corks. It was then labelled and stored at ambient conditions for the assessment of shelf-life studies. Sedimentation of RTS beverage occurs during storage, but however it resumes attractive appearance upon shaking of bottles prior to serving.

Steps followed in the preparation of RTS are presented in the flow chart (Fig. 1).

3.6.2. Formulation of Squash

The selected varieties of fresh, ripe, juicy and sound fruits were washed in fresh water and the fruit pulp was extracted using a mixie. The sugar was heated in water till the sugar was dissolved. To this the fruit juice was added, and was strained through a muslin cloth. After mixing the preservatives, prepared squash was filled in sterilised

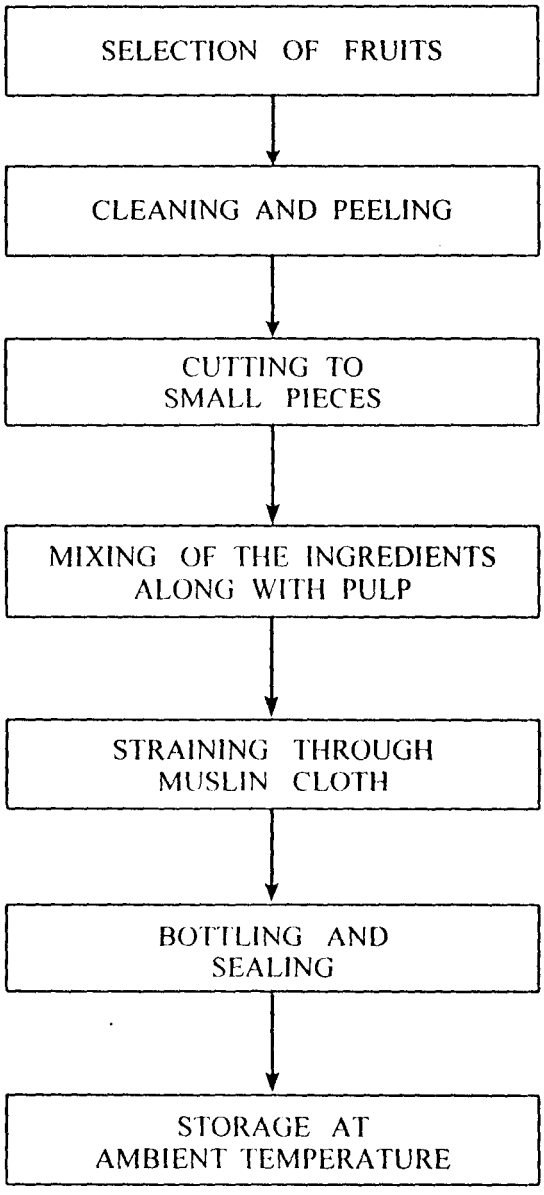


Fig. 2. Flow chart for the preparation of squash

SQUASH

JAM

bottles leaving a head space of 1.2 to 2.5cm. The bottles were then labelled, sealed and stored at ambient conditions for shelf life studies. Steps followed in the preparation of squash are presented in the flow chart (Fig. 2).

3.6.3. Formulation of mango jam

The selected varieties of fresh mangoes were washed in fresh water and the fruit pulp was extracted using a mixie. To the fruit pulp an equal quantity of sugar was added and mixed thoroughly. The mixture was cooked slowly with occasional stirring, till the mass thickened. When the correct consistency was reached it was filled into clean dry wide mouthed sterilised bottles leaving a head space of 1.2 to 2.5cm. The bottles were closed with lids when it was cooled. The bottles were then labelled and stored under ambient conditions for shelf life studies. Steps followed in the preparation of jam are presented in the flow chart (Fig. 3).

The end point of jam was determined by sheet/flake test (CFTRI, 1990). For this, a spoon was dipped into the product and it was allowed to fall down from the sides of the

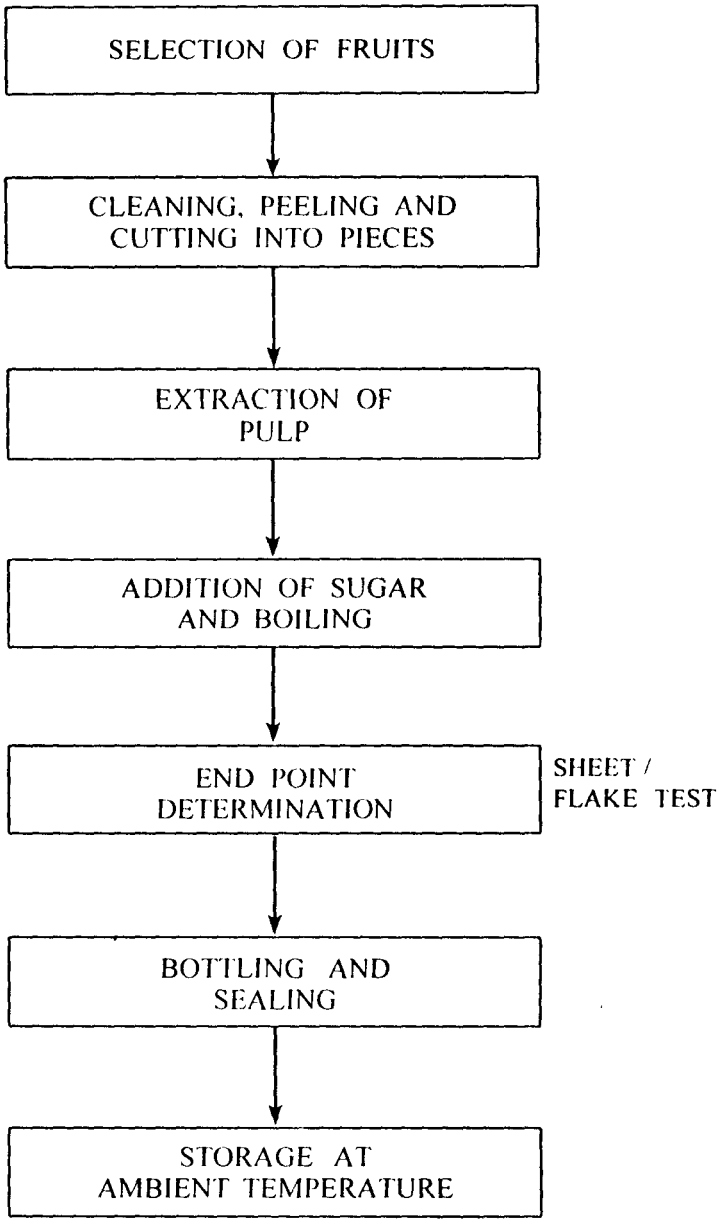


Fig. 3. Flow chart for the preparation of jam

spoon. If the mass falls down in the form of sheets the correct consistency is reached.

3.7. Tests conducted on fresh fruits and processed products

Analytical tests were conducted on the six varieties of fresh samples and also on the products prepared from each variety. The percentage of moisture, acidity, TSS, pH, reducing sugar and total sugar on the fresh samples and acidity, pH and TSS on the processed products were analysed.

Acidity

Determination of acidity was conducted using the procedure reported by AOAC (1960).

Total soluble solids

Total soluble solids was estimated using a refractometer.

pH

pH was determined using a digital pH meter.

Reducing Sugar and Total Sugar

Reducing sugar and Total sugar was determined by using the procedure suggested by AOAC (1960).

3.8. Assessment of organoleptic qualities

Sensory evaluation of the products immediately after the preparation and also during storage at ambient conditions were carried out by a panel of 10 judges with the help of a score card using four point hedonic scale. The panel members for acceptability trials at the laboratory levels were selected by employing the triangle test as suggested by Jellinck (1985). The evaluation card for triangle test is presented in Appendix 1. In a triangle test three sets of sugar solutions of different concentrations were used. Among these three sets, two sugar solutions will have identical concentration and one among them will be of a different concentration. The judges who does the triangle test were instructed to identify the odd sample which was of a different concentration. Mahony (1985) pointed out that a small highly sensitive panel would usually give more reliable results than large sensitive groups.

The three products prepared from the six varieties

of mango cultivars were evaluated based on quality attributes like appearance, colour, flavour, taste and consistency. Scores were assigned for each quality parameter ranging from one to four viz. Very good, good, fair and poor. The scores thus obtained were summed up to obtain the overall acceptability of the products. The products prepared were kept in glasses/glass plates in order to see the colour and appearance very clearly. The judges were given water for rinsing their mouth after the scoring of each sample. They were also given enough time inorder to score the product.

3.9. Cost Benefit Analysis of the products

Cost benefit analysis was carried out based on the prices of different items needed for the preparation of the products. According to How (1990), information as accurate and upto date as possible on supply, demand and prices is essential for anyone directly involved in the business of marketing fresh fruits. The cost was calculated by taking into consideration the cost of the fruit, sugar, preservatives, bottles and also accounting the labour cost.

3.10. Assessment of shelf life qualities of the products

The shelf life qualities of the products were recorded based on the changes in sensory and chemical qualities and occurrance of microbial growth in the product. The stored products were analysed for the chemical changes like acidity, pH, and TSS. Monthly scoring was conducted on the organoleptic qualities to assess the changes in sensory quality in the case of squash and jam while for Ready-to-Serve beverage scoring was done fortnightly.

3.11. Microbial Assessment

The products developed were subjected to assessment of microbial contamination with microorganisms like bacteria, fungus and yeast using standard plate method. The media used for detecting the presence of these microorganisms were nutrient agar, Potato dextrose agar and maltose extract agar.

3.12. Statistical analysis of the data

The data obtained from the study were statistically analysed using Completely Randomised Design (CRD).

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

Salient findings of the study entitled "Suitability of local mango cultivars for pulp based products" are presented and discussed under the following subtitles :

4.1. Assessment of physical and processing characteristics of selected cultivars of mango

4.2. Assessment of processing characteristics of different mango cultivars

4.3. Assessment of chemical composition of different cultivars of mango

4.4. Assessment of organoleptic qualities of the pulp based processed products

4.5. Assessment of chemical components of the processed products

4.6. Assessment of changes in organoleptic and chemical qualities of pulp based products with storage

4.7. Assessment of microbial contamination of processed products with storage

4.8. Assessment of cost-benefit analysis of processed products

4.1. Assessment of physical characteristics of different 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 the shape of fruit, fruit weight, colour of outer skin, thickness of peel, seed weight and the pulp yield.

The shape of mangoes differ according to the particular cultivar. Among the selected mango cultivars the variety Kottukonam was observed to have an oblong shape, while Neelum and Karpooram were observed to be ovate oblique. A roundish oblique shape was seen in the varieties Panchasara Varikka and Moovandan whereas an ovate shape was seen in Kappa variety.

A wide range of variation was seen to exist in the colour of the outer skin in the different cultivars of mango studied. It was noted that the variety Kottukonam had an orangish yellow colour for its outer skin. Neelum variety

possessed an yellowish orange coloured outer skin while karpooram had a reddish yellow colour for its outer skin. Panchasara Varikka has got an yellowish green colour with a green tinge on top for its outer skin. Kappa variety was green in colour with the top portion, yellow in colour. Moovandan possessed a yellow coloured skin with a green tinge on the top portion. Among the different cultivars studied, the varieties Kottukonam and Neelum had an attractive colour when compared with other varieties.

On analysing the peel thickness of the different varieties studied, it was observed that Kappa variety had a very thick peel while Karpooram possessed comparatively less thickened peel, but was thicker than the peel of the other varieties. It was also noted that the variety Panchasara Varikka had a very thin peel. In the case of varieties Kottukonam, Neelum and Moovandan peel was with medium thickness.

Table 1 elucidates the average weight per fruit of different mango cultivars ~~studie~~d ~~Tabl~~e ~~1~~. The average weight per fruit of the variety Kottukonam was 237.9g, Neelum (260.5g), Karpooram (264.2g), Panchasara Varikka (156.8g), Kappa (404.8g) and Moovandan (195.2g). Among the different varieties analysed Kappa variety was found to be the heaviest (404.8g) and Panchasara Varikka, the smallest (156.8g). The

varieties Panchasara Varikka and Moovandan were comparatively smaller when compared with the others but the varieties Kappa and Karpooram were bigger in size. Kottukonam and Neelum varieties were medium sized. Uthaiah *et al.* (1990) studied the fruit weight of thirty mango cultivars cultivated in the coastal Karnataka and had found that the fruit weight ranged from 146g to 1005g. Kulkarni *et al.* (1981) reported that, among the 22 cus analysed Alampur Baneshan fruit was the heaviest (400 g). Statistical analysis of the data revealed that the difference that existed between the varieties Kottukonam and Neelum and also between Neelum and Karpooram were on par, whereas a significant difference was exhibited by all the remaining varieties.

Table 2 depicts the average weight per seed of the different mango cultivars studied ~~Table~~ 2. It was observed that the variety Kottukonam had a seed weight of 42.4g; Neelum (54.5g); Karpooram (42.1g); Panchasara Varikka (26.8g); Kappa (47.2g) and Moovandan (31.8g). The seed weight was observed to be the highest in the variety Neelum (54.5g) followed by the variety Kappa (47.2g). The variety Panchasara Varikka secured the lowest seed weight (26.8g). Other varieties viz., Kottukonam, Karpooram and Moovandan were observed to have medium sized stones. Kulkarni *et al.* (1981) found that, stone size was smallest in Fazri variety (9.4 per cent).

Table 1. Fruit weight of different mango cultivars

Character	V_1 (Kottukonam)	V_2 (Neelum)	V_3 (Karpooram)	V_4 (Panchasara Varikka)	V_5 (Kappa)	V_6 (Moovanda
Average fruit weight (g)	237.9	260.5	264.2	156.8	404.8	195.2
CD interaction	2	22.213				
	3	22.510	22.776			
	4	23.195	23.453	23.735		
	5	26.461	26.688	26.936	27.511	
	6	21.045	21.329	21.638	22.350	25.72
		1	2	3	4	5

Table 2. Seed weight of different mango cultivars

Seed weight	V_1 (Kottukonam)	V_2 (Neelum)	V_3 (Karpooram)	V_4 (Panchasara Varikka)	V_5 (Kappa)	V_6 (Moovandar
Average weight per seed	42.4	54.5	42.1	26.8	47.2	31.8
CD interaction	2	5.215				
	3	5.285	5.348			
	4	5.446	5.506	5.573		
	5	6.213	6.266	6.324	6.459	
	6	4.941	5.008	5.080	5.247	6.039
		1	2	3	4	5

Statistical analysis of the data have shown that no significant difference existed in the seed weight of varieties, like Kottukonam and Kappa, Kottukonam and Karpooram and between Karpooram and Moovandan were on par whereas a significant difference was observed between all the other varieties.

The pulp yield of the different mango cultivars ascertained in Table 3 (Fig 4) indicated that, the pulp yield per kg of fruits ranged from 59.2 per cent to 74.3 per cent. The highest pulp yield was recorded in Karpooram variety (74.3 per cent) preceeded by the variety Kottukonam (70.3 per cent). The lowest pulp yield was observed in Panchasara Varikka (59.2 per cent). Palaniswamy *et al.* (1976) studied the pulp recovery of 29 mango cultivars of Tamil Nadu and found that the pulp yield ranged between 53 to 83 per cent. Kulkarni *et al.* (1981) found that among the 22 cus studied, pulp yield was maximum in Vanraj variety (81 per cent).

The size of the fruit and seed weight in a fruit gives an indirect indication of the pulp content. In the present study, the mango varieties with a smaller stone size

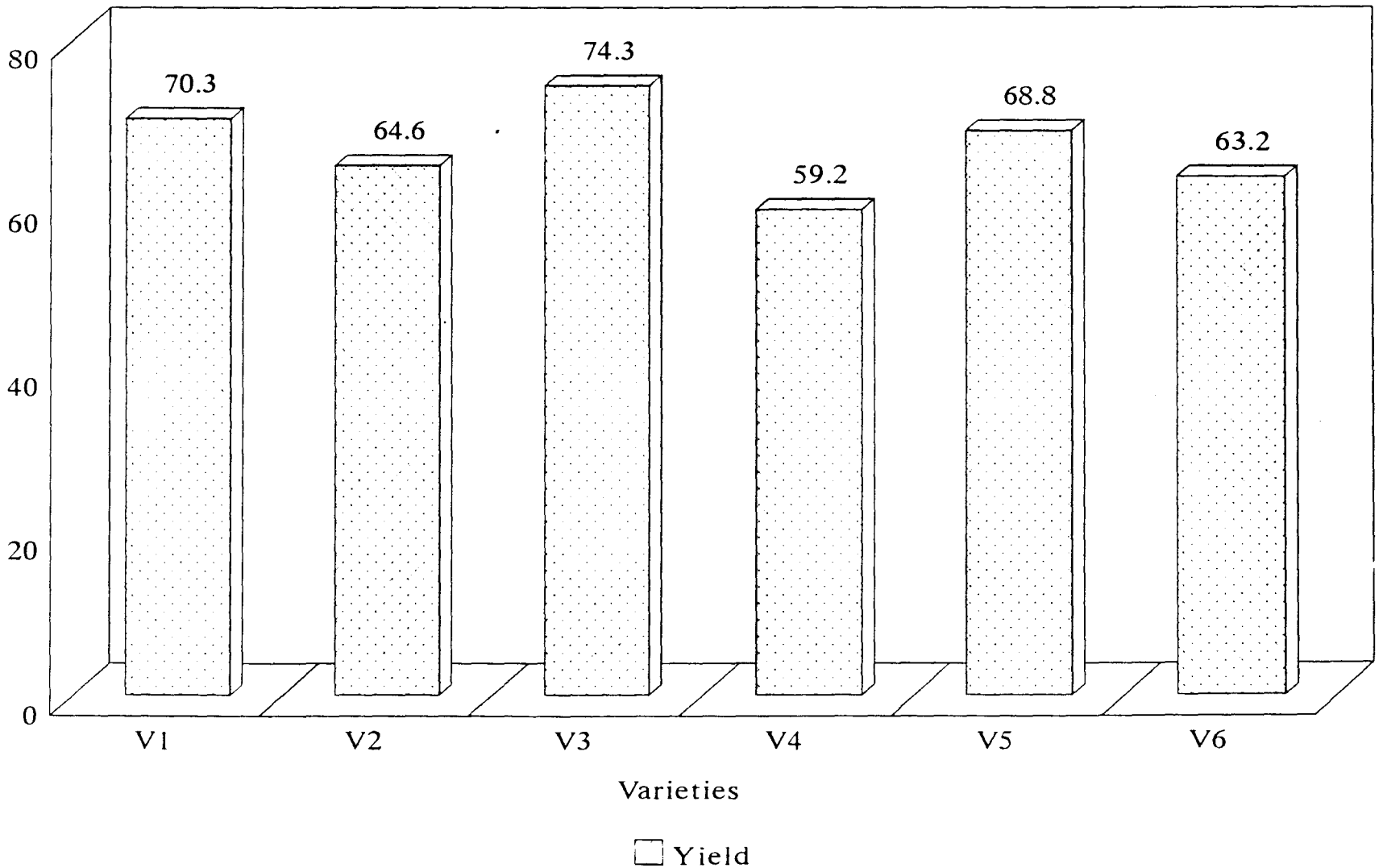


Fig. 4. Fruit to pulp yield of mango cultivars

and bigger fruit size gave higher pulp yield than the varieties with a larger stone size and smaller fruit size.

Table 3. Fruit to pulp yield of the different cultivars of mango

Name of the cultivars		Yield of pulp per kg of the fruit (in percentage)
V_1	Kottukonam	70.3
V_2	Neelum	64.6
V_3	Karpooram	74.3
V_4	Panchasara Varikka	59.2
V_5	Kappa	68.8
V_6	Moovandan	63.2

4.2. Assessment of processing characteristics of different mango cultivars

There is a considerable increase in the consumption of processed foods in India. In order to develop high quality processed products, fruits with good processing

characteristics are necessary. Assessment of processing characteristics of different mango cultivars is therefore highly essential. In the present study, assessment of processing characteristics such as colour, fleshiness, texture, flavour and sweetness of the flesh of different mango cultivars were ascertained.

From Table 4 it is clear that Kottukonam has a dark orange coloured flesh while the varieties Neelum and Panchasara Varikka have an orange and orange blended yellow coloured flesh respectively. It was also noted that Kappa variety had a light yellow coloured flesh while Karpooram and Moovandan were observed to have yellowish orange flesh. Among the six different cultivars analysed, all the varieties with the exception of Kappa had an attractively coloured flesh which is considered as a prime criterion for processing.

Fleshiness is another important characteristic for processing and product development. It also has an equal importance from the economic point of view. On taking into account of the nature of flesh, it was found that the varieties Kappa, Karpooram and Moovandan were very fleshy. It was also noted that Panchasara Varikka was slightly fleshy while Kottukonam and Neelum were moderately fleshy.

Table 4. Processing characteristics of the different cultivars studied

Characteristics flesh	V_1	V_2	V_3	V_4	V_5	V_6
Colour	Dark orange	Orange	Yellowish orange	Orangish yellow	Light yellow	Yellowish orange
Nature	Moderately fleshy	Moderately fleshy	Very fleshy	Slightly fleshy	Very fleshy	Very fleshy
Texture	Slightly fibrous	Not fibrous	Slightly fibrous	Not fiborous	Not fiborous	Slightly fiborous
Flavour	Moderately pleasant	Very pleasant	Very pleasant	Very pleasant	Moderately pleasant	Moderately pleasant
Sweetness	Moderately sweet	Moderately sweet	Slightly sweet	Very sweet	Slightly sweet	Slightly sweet

The flesh texture may vary from cultivar to cultivar and it may have profound influence on the quality of processed products. On analysing the texture of flesh the varieties Neelum, Panchasara Varikka and Kappa were not at all fibrous, while Moovandan, Kottukonam and Karpooram were slightly fibrous. Siddappa and Tandon (1986) had reported that juicy and fibrous varieties of mango were most ideal for making juice, squash and nectar.

When the flavour profile of different cultivars were assessed, the varieties Neelum, Karpooram and Panchasara Varikka were found to have a captivating flavour while Kottukonam and Moovandan were found to be mildly flavoured. The assessment of flavour profile to an extent helps in processing, but more determines its suitability for table purpose. Siddappa and Tandon (1986) reported that the variety of mango fruit, its maturity and the locality have a marked influence on its flavour as well as keeping quality.

Fruits contain fairly large amount of sugars which account for the sweetness of ripe fruits. Sweetness of the fruit is also considered to be important because this character enhances its demand or popularity among the various sectors of population. The sweetness of different varieties of mango were assessed in the study. The variety Panchasara Varikka was found to be highly sweet when compared with the other varieties. It was also found that the varieties Kottukonam and Neelum were moderately sweet whereas the varieties Kappa, Karpooram and Moovandan were only slightly sweet.

In a nut shell, processing characteristics were highly favourable in varieties Kottukonam, Neelum and Panchasara Varikka.

4.3. Assessment of chemical composition of different cultivars of mango

The chemical composition of the fruit in general differs with the cultivar and stage of maturity. Sadhu and Bose (1976) studied the chemical composition of 37 mango cultivars and reported a marked variation in the constituents of different cultivars. In the present study, the chemical components present in different local varieties of mango were assessed with regard to their moisture content, pH, total soluble solid (TSS) content, acidity, total sugar, reducing sugar and vitamin C.

Table 5 indicates that, the moisture content of mango cultivars studied ranged from 79 to 85 per cent. It was observed that the moisture content of V_1 was 81.35 per cent, V_2 - 82.15 per cent, V_3 - 83.50 per cent, V_4 - 80.60 per cent, V_5 - 84.75 per cent and V_6 - 79.95 per cent. The moisture content of V_5 was observed to be the highest followed by V_3 when compared with the other local varieties of mango while the variety V_6 recorded the lowest moisture content. Lakshminarayana (1980) analysed the moisture content of different cultivars of mango which ranged between 79.00 to 84.20 per cent.

Table 5. Chemical composition of mango varieties analysed

Name of different cultivars	Moisture %	TSS %	pH	Acidity %	Total sugar %	Reducing sugar %	Vitamin C mg/100gm
Kottukonam (V_1)	81.35	19.90	4.45	0.22	14.75	6.72	28.20
Neelum (V_2)	82.15	17.80	4.05	0.22	13.40	6.21	17.65
Karpooram (V_3)	83.50	16.25	4.15	0.22	12.50	5.82	18.85
Panchasara Varikka (V_4)	80.60	19.45	4.60	0.22	15.25	3.82	34.20
Kappa (V_5)	84.75	15.30	4.25	0.22	12.75	3.94	16.35
Moovandan (V_6)	79.75	18.45	3.80	0.32	13.80	3.21	25.90
CD(0.05)	0.265	0.307	0.141	2.447	0.234	2.341	2.828

Statistical analysis of the data revealed that, a significant difference existed in the moisture content of the different mango cultivars studied. The highest noticeable difference (5.0) was observed between the varieties, Kappa and Moovandan.

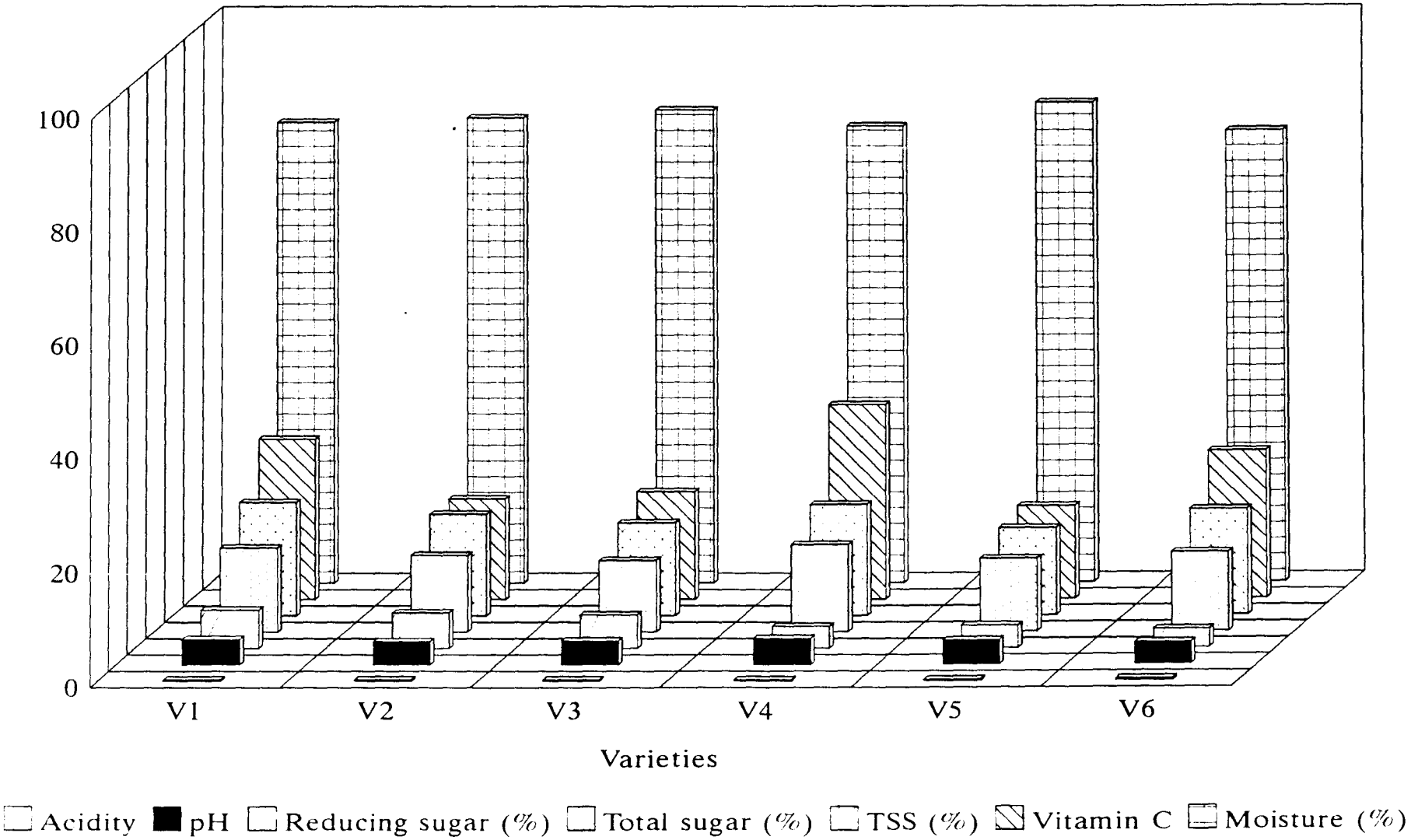


Fig. 5. Chemical composition of mango varieties analysed

On analysing the total soluble solid content present in different mango cultivars, it was evidenced that the TSS content ranged from 15 per cent to 20 per cent. The varieties V_1 and V_4 recorded the highest percentage of TSS, as 19.90 per cent and 19.45 per cent respectively, closely followed by the variety V_6 (18.45 per cent). The lowest TSS percentage was recorded in Kappa variety (15.30 per cent). Bhatnagar and Subramaniyam (1973) analysed the chemical composition of ten varieties of mango and found that the TSS content ranged from 14 to 24 per cent. Singh *et al.* (1985) screened the chemical composition of five mango varieties and found that the TSS content ranged from 16.00 to 22.10^{o} Brix.

When the observed data was statistically analysed it was found that a highly significant difference existed in the TSS content in all the six different cultivars of mango. The highest significant difference in TSS content was observed between the varieties V_1 and V_5 (4.6) and the lowest difference (0.45) existed between the varieties V_1 and V_4.

A detailed assessment of the pH of different cultivars of mango had shown that the pH content of the different varieties ranged from 3.80 to 4.60. The highest pH

was noted in the variety V_4 (4.60) whereas the lowest pH was observed in the variety V_6 (3.80). Steven and Philip (1980) analysed the pH content of some varieties of mango and it was found to range between 3.8 and 5.8. The difference that existed in pH between the varieties V_3 and V_5 and also between V_2 and V_3 were on par, whereas a significant difference was observed between all the other varieties of mango analysed. The highest significant difference in the pH content was observed to exist between the varieties V_4 and V_6.

In the case of acidity, not much of variation was seen among the different local varieties of mango analysed. The percentage of acidity among the different varieties ranged from 0.22 to 0.32. Higher acidity was noted in the variety V_6 (0.32 per cent) whereas in all the other varieties analysed, the acidity percentage remained almost similar (0.22 per cent). Cheema *et al.* (1954) analysed the chemical composition of different varieties of mango and found that the acidity content ranged between 0.27 and 1.44 per cent. Statistical analysis of the data proved that the difference that existed among all the different varieties of mango were on par.

On measuring the total sugar content, it was observed that the total sugar content ranged from 12.50 to 15.25 per cent. The total sugar content was observed to be the highest in the variety V_4 (15.25 per cent) and the lowest in the variety V_3 (12.50 per cent). According to Ghosh *et al.* (1985), the total sugar content analysed among three varieties of mango viz, Bombay yellow, Rani pasand and Safdar pasand were found to range between 8.70 to 18.20 per cent.

The data when interpreted statistically had revealed that a significant difference existed in the TSS of all six varieties of mango analysed. The highest difference in total sugar were observed between the varieties, V_3 and V_4.

The reducing sugar content of the different cultivars ranged from 3.21 to 6.72 per cent. It was observed that the highest reducing sugar content was in the variety V_1 (6.72 per cent) and the variety V_6 (3.21 per cent) recorded the lowest reducing sugar content. Lakshminarayana (1980) screened different mango varieties and found that the reducing sugar content ranged from 3.23 to 6.00 per cent.

Statistical analysis of the data indicated that no significant difference in reducing sugar was noted between the varieties V_1 and V_2, V_2 and V_3, V_1 and V_3 and also between V_4 and V_5.

The Vitamin C content present in the different cultivars ranged between 16.35 and 34.20 mg per 100g. The variety V_4 secured the highest Vitamin C content (34.20mg), while the variety V_5 secured the lowest (16.35mg). A wide range of variation in the vitamin C content was observed in the six different varieties. Mustard and Lynch (1945) in Florida found that the ascorbic acid in 32 varieties of mango ranged between 8.8 to 107.4mg. The difference that existed in vitamin C content between the varieties V_1 and V_6, V_1 and V_3, V_1 and V_2 and also between V_3 and V_5 were on par. All the other varieties showed a significant difference between each other.

From the above findings it can be inferred that TSS, Total sugar, Reducing sugar and Vitamin C content were high in Kottukonam variety, whereas moisture content was high in Kappa. Comparatively high acidity was noted in Moovandan while pH was high in Panchasara Varikka.

4.4. Assessment of organoleptic qualities in processed products

Sensory analysis of food depends upon evaluation through the use of our senses by applying exact scientific testing methods (Skelton, 1984). Sensory evaluation technology is a method using skilled management and trained panelist to provide confirmation on the acceptability of the product in terms of product profile, consumer acceptability and consistency (Herrington, 1991). According to Ranganna (1991), no process can turn out identical unit-to-unit, hour-to-hour or day-to-day and the variations observed in the product reflect the variability of the raw materials, processing techniques, operations, panel members and the other causes. Seow *et al.* (1991) was of the opinion that there will be individual difference in scores among products for a similar pretreatment. Assessment of the organoleptic qualities are generally carried out to draw conclusions about a particular food from a large population through the selection of a limited number of panel members (Singh *et al.*, 1992). Sensory method in which palatability is evaluated by a panel of judges is essential to every standardisation procedure because they answer all important

questions of the food tastes, smells, looks and feels (Mc. Dornett, 1992).

Like most fruits mango undergoes changes in chemical, nutritional and flavour characteristics during processing. The colour, texture and flavour of processed mango are different from those of fresh mango. According to Kramer and Twigg (1970) food quality detectable by our senses can be broken down into the main categories viz., appearance, texture and flavour. According to Mc. laren (1984) the criteria included in food quality system are general acceptance, taste, texture, appearance and aroma of food. Quality is a degree of excellence and a composite characteristic determining acceptability (Neelofur, 1992). For any product, acceptability among the public is the most important quality. Quality is the main criteria on which the acceptability of any product depends (Indian Food Industry, 1995).

The results of organoleptic qualities of the products such as appearance, colour, flavour, taste, consistency and overall acceptability, using six different varieties of mango under investigation are presented in the tables given below. The results presented in the tables are

based on the mean scores obtained for each quality parameter. The maximum mean score that could be obtained for a product was 4.00 and the minimum score was 1.00.

4.4.1. Organoleptic assessment of RTS beverage

The RTS beverages prepared from six varieties of mango were evaluated under a panel of selected judges and the mean scores obtained are given in Table 6.

According to Birch (1977), appearance is the compound of all information about the product and its environment which reaches the eye. According to Christensen (1985), as the consumers preference to appearance is one of the major factor leading to the increasing demand of the product, it is very essential to keep the appearance of the product very attractive. Appearance is one of the most important factor which influences the consumers inclination while buying the fresh as well as processed products, and it is basically the recognition and assessment of properties such as colour and surface structure associated with the product (Sharma and Sarfaraz, 1995).

Table 6. Organoleptic assessment of fresh RTS beverage

Name of cultivars	Average score for organoleptic qualities					Overall acceptability
	Appearance	Colour	Flavour	Taste	Consistency	
V_1	3.70	3.70	3.60	3.30	3.70	3.60
V_2	4.00	4.00	3.80	3.50	3.50	3.80
V_3	3.70	3.40	3.60	3.30	3.30	3.50
V_4	3.60	3.40	3.60	3.50	3.50	3.50
V_5	3.60	3.40	3.30	3.30	3.30	3.40
V_6	3.60	3.20	3.20	3.40	3.20	3.30

CD interaction 0.247

As indicated in Table 6 the maximum mean score for appearance attribute obtained for RTS beverages prepared from six different varieties of mango was attained by the RTS beverage prepared from variety V_2 (4.00) followed by the varieties V_1 and V_3, with mean score of 3.70 each. The mean score obtained for appearance among V_4, V_5 and V_6 were 3.60.

Food colour commonly determines the quality and is an index of ripeness or spoilage (Norman, 1968). CFTRI reports (1990) indicated that shrivelling and colour change are the two main factors that usually occurs in the processed products which effects the appearance of the product. The joint FAO/WHO Expert Committee on food additives recognised that colour has an effect on food choices (Anonymous, 1991).

When the colour attribute of RTS beverages was taken into consideration, it was noted that V_2 variety had secured the highest score of 4.00 followed by V_1 (3.70). The lowest score was attained by the RTS beverage prepared from the variety V_6 (3.20). Higher scores for colour attribute recorded by the RTS beverage prepared from varieties V_1 and V_2 was mainly due to its attractive colour. The average scores attained by the other varieties like V_3, V_4 and V_5 were 3.40.

All our senses are utilised in the appreciation of flavour of the food. According to Birch (1977), flavour is the mingled but unitary experience of sensation produced by a material taken in the mouth perceived principally by the senses of basic smell and by the other cutaneous sensation in

the mouth. Ranganna (1992), stated that flavour is an important factor which enriches the consumers preference to a particular product. Stillman (1993) had stated that flavour is seen in several sensations orginating from the elementals of taste receptors, olfactory receptors and nerve fibres registering touch and chemical feelings.

On taking into account of the flavour attribute of RTS beverage prepared from six different cultivars of mango, it was observed that the variety V_2 had showed a better score for flavour attribute (3.80) whereas the lowest scores for flavour was recorded by the variety V_6 (3.20). The mean scores for flavour attribute possessed by RTS beverages prepared from the other varieties were 3.60 each in varieties V_1, V_3 and V_4 and 3.30 in V_5. The higher score for RTS secured by V_2 variety was due to its intense flavour, which was maintained even after its preparation into RTS beverage.

Kramer and Twigg (1970) had suggested that among the various quality attributes, taste is the primary and most important one. According to Rolls *et al.* (1981), in the various quality attribute tests, the first preference goes to taste followed by flavour, appearance, texture and colour.

In the case of taste attribute, RTS beveragae prepared from varieties V_2 and V_4 obtained the maximum score of 3.50 each followed by V_6 (3.40). The mean scores attained for taste attribute by the other RTS beverages were 3.30 each in varieties, V_1, V_3 and V_5.

According to Norman (1968), consistency may be considered as a textural quality attribute, in many instances consistency also is another factor in food appearance.

When the consistency attribute was taken into consideration it was observed that the RTS beverage developed from variety V_1 had secured the highest score of 3.70 followed by V_2 and V_4 with mean scores of 3.50 each. The mean scores attained by the other varieties for consistency attribute was 3.30 each for V_3 and V_5 and 3.20 for the variety V_6.

According to 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. The absence of nutritional qualities and the presence of

harmful or toxic ingredients are parameters which are of vital interest to the consumer.

Considering the organoleptic qualities of RTS beverages prepared, the overall acceptability score was found to be highest in the variety Neelum (3.8) followed by Kottukonam (3.6). Moovandan (V_6) was found to be the least acceptable for judges with an overall mean score of 3.3. The mean overall acceptability scores of rest of the varieties were 3.5 each for Karpooram and Panchasara Varikka and 3.4 for Kappa variety.

Statistical analysis of the data indicated that a significant difference in the overall acceptability score was shown between the RTS beverages prepared from varieties V_1 and V_6, V_2 and V_3, V_2 and V_5 and also between V_2 and V_6. The highest significant difference was observed between the varieties V_2 and V_6. The difference that existed between all the other RTS beverages prepared from other varieties of mango were on par.

4.4.2. Organoleptic assessment of squash

The squashes prepared from six different local varieties of mango were subjected to evaluation by a panel of 10 judges and the mean scores obtained are presented in Table 7.

Table 7. Organoleptic assessment of fresh squash

Name of cultivars	Average score for organoleptic qualities					Overall acceptability
	Appearance	Colour	Flavour	Taste	Consistency	
V_1	4.00	4.00	4.00	4.00	3.90	3.98
V_2	4.00	4.00	3.90	4.00	4.00	3.98
V_3	3.00	3.20	3.80	3.20	2.90	3.20
V_4	3.70	3.50	3.30	3.10	3.30	3.20
V_5	3.30	3.40	3.10	3.40	3.50	3.30
V_6	3.30	3.10	3.60	3.60	3.70	3.50

CD interaction 0.178

The results given in the Table 7 indicates that from the squashes prepared from six cultivars of mango, a higher score for appearance attribute was exhibited by the varieties Kottukonam and Neelum, the scores being (4.00) in each case. The lowest score for appearance was recorded by the squash prepared from the variety Karpooram (3.00). The reason for the dull appearance of Karpooram (V_3) was attributed due to the thinner pulp obtained from the variety.

The colour attribute scores of mango squashes ranged between 3.10 to 4.00. The varieties V_1 and V_2 was significantly superior to the other varieties contributing to the most attractive colour of squash. The intense colour originally present in the fresh pulp was adequate enough to contribute a pleasing colour to the product also.

With regard to flavour appreciation of mango squash, the scores ranged from 3.10 to 4.00. It is evident from the table that the variety Kottukonam (4.00) secured the highest score for flavour attribute. The variety V_2 also could maintain some what a higher level of acceptance among the judges, the score being 3.90 for flavour. However the flavour of the variety Kappa was comparatively of lesser acceptance as this variety could not make a sharp flavour effect in the senses.

The highest and maximum score for taste was shown by squashes prepared from the varieties V_1 and V_2, with scores being 4.00 for each one. The rich taste produced by these varieties was highly appreciated in the preparation of squash. A low score for taste was recorded in squash prepared from the variety V_4 (3.10).

A detailed assessment of the consistency attribute illustrates that, the maximum score for consistency was observed in squash prepared from the variety V_2 (4.00). It was also noted that V_1 also could maintain a higher level of acceptance with a score of 3.90. The characteristic pulp texture of these mango varieties contributued to such an elevated score for consistency in the product.

The overall acceptability scores of squashes have shown that, the highest score of 3.98 was noted in squashes prepared from the varieties Kottukonam (V_1) and Neelum (V_2), and the squashes prepared from the varieties Karpooram (V_3) and Panchasara Varikka (V_4) was found to be the least acceptable among the judges with a mean acceptability score of 3.20 each. The mean acceptability scores of the other squashes were observed as 3.5 for Moovandan (V_6) and 3.3 for Kappa (V_5).

Statistical analysis have proved that the difference that existed between squashes prepared from varieties like V_1 and V_2, V_3 and V_4, V_4 and V_5, V_3 and V_5, V_4 and V_6 and also between V_5 and V_6 were on par, whereas a noticeable difference was seen to exist between all the other varieties (V_1 and V_3, V_1 and V_4, V_2 and V_3, V_2 and

V_4, V_1 and V_5, V_1 and V_6, V_3 and V_6, V_2 and V_5 and also between V_2 and V_6).

4.4.3. Organoleptic assessment of jam

The jams prepared utilizing six different local cultivars of mango were evaluated under a panel of ten judges for their organoleptic qualities and the mean scores obtained are depicted in Table 8.

Table 8. Organoleptic assessment of fresh jam

Name of cultivars	Average score for organoleptic qualities					Overall acceptability
	Appearance	Colour	Flavour	Taste	Consistency	
V_1	3.30	3.60	3.70	3.60	3.70	3.58
V_2	3.80	3.60	3.60	3.90	3.80	3.74
V_3	3.20	3.30	3.60	3.60	3.80	3.50
V_4	3.80	4.00	3.80	4.00	4.00	3.92
V_5	3.90	3.90	3.50	3.60	3.70	3.72
V_6	3.00	3.00	3.00	3.20	3.20	3.08

CD interaction 0.166

Table 8 elucidates that a higher score for appearance was seen in jams prepared from the variety V_5 with a mean score of 3.90 closely followed by the varieties V_2 and V_4 with a mean score of 3.80 each. A comparatively lower score was secured by the jam prepared from the variety V_6 (3.00). The dull appearance of jam prepared from V_6 variety was due to the unattractive pulp colour of the vareity.

When the colour attribute was assessed it was observed that the variety V_4 had attained the highest score of 4.00 followed by the variety V_5, with a score of 3.90. The score of V_1 and V_2 remained almost same, the score being 3.60 each in both cases. The lowest score for colour was attained by the variety V_6 (3.00). It was assessed that the product prepared from the variety V_4 had an attractive colour and so the jam prepared from this variety could maintain a higher level of acceptance. According to the reports from CFTRI (1990), the aesthetics, safety, sensory characteristics and acceptability of food are all affected by colour.

Mangoes are well known for its exotic flavour. Assessment of flavour profile of jams prepared from the various cultivars revealed that, V_4 (3.80) recorded maximum score for its fragrance closely followed V_1 (3.70). The lowest score was seen in jam developed from the variety V_6 (3.00). A pleasing natural flavour of V_4 variety accounted for their superiority in flavour.

When the different cultivars of mango were assessed for their taste value, it was ascertained that the jam prepared from the variety V_4 attained maximum score of (4.00), which was followed by V_2 (3.90) and the lowest score for taste was secured by the jam prepared from the variety V_6 (3.20).

When the consistency attribute of jams prepared from six different varieties was analysed it was observed that the variety V_4 had attained the maximum score of 4.00, followed by the varieties V_2 and V_3 with scores of 3.80 each. The lowest score for consistency was observed in the variety V_6, the score being only 3.20.

When the overall acceptability of the jams prepared from six varieties of mango was taken into account, it was

observed that the variety Panchasara Varikka (V_4) had secured the maximum overall mean acceptability score of 3.92 followed by the variety Neelum (V_2) with an overall mean acceptability score of 3.74. A low score was observed for the variety Moovandan (V_6) with a score of 3.08. The mean overall acceptability scores for the other varieties were observed as 3.50 for Karpooram (V_3), 3.58 for Kottukonam (V_1) and 3.72 for Kappa (V_5).

Statistical analysis of the data proved that no significant difference was seen among the jams prepared from the varieties V_1 and V_2, V_1 and V_3, V_1 and V_5 and also between V_2 and V_5. However a significant difference was recorded between other varieties of mango viz., V_1 and V_4, V_1 and V_6, V_2 and V_3, V_2 and V_4, V_2 and V_6, V_3 and V_4, V_3 and V_5, V_4 and V_5, V_4 and V_6 and also V_5 and V_6.

As far as the organoleptic qualities of mango pulp based products are concerned, we can come to the conclusion that the variety Neelum (V_2) is best suited for the preparation of RTS beverage followed by Kottukonam (V_1) variety whereas the variety Moovandan (V_6) is the least suitable for the preparation of RTS beverage. In the case of squash preparation, the varieties Kottukonam (V_1) and Neelum

(V_2) were adjudged to be the best, while the varieties Karpooram (V_3) and Panchasara Varikka (V_4), the least. The variety Panchasara Varikka (V_4) was found the most ideal for the preparation of jam followed by Neelum (V_2). The higher scores obtained for organoleptic qualities for processed products such as mango RTS beverage, squash and jam prepared from different mango varieties had proved their suitability in the preparation of various products.

4.5. Assessment of chemical components in processed products

According to Norman (1968), the constituents of foods and their behaviour is fundamental to all phases of food science and technology. In the present investigation, analysis was carried out to find the acidity, pH, and TSS present in the various products prepared out of different mango cultivars viz., RTS beverage, squash and jam.

4.5.1. Assessment of chemical constituents in RTS beverage

Table 9 indicates the chemical constituents analysed in the fresh RTS beverage prepared from different mango cultivars.

Table 9. Chemical constituents of fresh RTS beverage

Name of the cultivars	Chemical constituents of fresh squash		
	Acidity%	pH	TSS °Brix
V_1	0.33	4.60	16.25
V_2	0.33	4.10	18.60
V_3	0.33	4.10	17.05
V_4	0.33	3.70	17.00
V_5	0.33	4.20	16.35
V_6	0.32	4.10	15.50
CD interaction	5.136	2.837	9.563

Considering the acidity of fresh RTS beverage it was observed that the acidity content remained almost similar in all the six RTS beverages (0.33 per cent). No marked variation was observed in the acidity content of the RTS beverages prepared.

Annapurna (1977) observed that the physico - chemical analysis of RTS beverage prepared from passion

fruits showed an acidity value of 0.70 per cent. Kalra *et al.* (1991) revealed that a beverage made from mango - papaya pulp preserved for a period of one year at ambient condition did not show any significant change in acidity.

An assessment of pH of RTS prepared showed that the highest value for pH was attained by the Variety V_1 (4.6) and the lowest in variety V_4 (3.7). Statistical analysis of the data indicated that the difference in pH between the RTS beverages prepared from six different varieties of mango was on par. The physico-chemical analysis of RTS beverage prepared from passion fruit showed a pH of 3.5 (Annapurna, 1977). Khurdiya (1994) reported that carbonated passion fruit drink showed a pH of 3.25.

Total soluble solid (TSS) value is defined as the amount of sugar and soluble minerals present in the fruit and vegetable extracts. On analysing the Tss content present in the RTS beverages prepared from six different cultivars of mango, it was observed that the maximum value for TSS was in the variety V_2 (18.6 per cent) and the minimum value was attained by the variety V_6 (15.5 per cent). Fruit products order (1955) reported the minimum percentage of TSS content

in RTS beverage as 10 per cent. In this context, the prepared RTS beverage conforms with the FPO standards. According to Annapurna (1977), the TSS of RTS beverage prepared from passion fruit was 14 percent. Kadam *et al.* (1991) had ascertained that RTS beverage prepared from ber fruit had a TSS of 15 per cent. Statistical analysis of the data had showed that the difference that existed in TSS content among the RTS beverages from mango varieties were on par.

4.5.2. Assessment of chemical constituents in squashes

Table 10 indicate the results of the analysis of chemical constituents present in mango squash ~~Table 10~~. The acidity of the squashes prepared with different varieties were 0.34 and the acidity remained almost same in all the squashes prepared from Six different Varieties of mango. Sheeja (1994) had reported that the acidity of squashes prepared from papaya ranged from 1.60 to 1.80. Statistical analysis of the data indicated that the difference in acidity between the squashes prepared from different cultivars of mango were on par. Sandhu *et al.* (1988) on studying about preserved grape juice, found that pretreatments had negligible effect on acidity.

Table 10. Chemical constituents of fresh squash

Name of the cultivars	Chemical constituents of fresh squash		
	Acidity %	pH	TSS °Brix
V_1	0.34	4.14	59.21
V_2	0.34	3.61	58.62
V_3	0.34	3.53	58.22
V_4	0.34	3.63	58.52
V_5	0.34	3.31	58.11
V_6	0.34	3.95	59.51
CD interaction	9.608	2.142	3.686

According to Ranganna (1977) pH is a measure of active acidity which influences the flavour or palatability of a product and affect the processing requirements. Table 10 elucidates that the highest value for pH was seen in squashes prepared from the variety V_1 (4.14) and the lowest value was attained by the variety V_5 (3.31). Statistical analysis of the data proved that there was no significant difference in the pH of the squashes prepared from different varieties of mango. Okoli and Ezanweke (1990) had reported

that papaya juice prepared with 10 percent sucrose and preserved with sodium benzoate had a pH of 3.9. Sheeja (1994) in her study had found that the pH of papaya squash ranged from 2.4 to 2.8.

On analysing the Tss content of squashes prepared from different varieties of mango, it was found that the variety V_6 secured the highest value for Tss (59.51) followed by V_1 (59.21). On comparing the values of Tss with the CD values, it was found that there was no noticeable change in the TSS content in the squashes prepared from different varieties of mango. Sheeja (1994) reported that the TSS content of papaya squash ranged from 56.00 to 58.00. According to FPO (1955), the minimum percentage of total soluble solids in squashes were reported as 40 percent. Thus in the present investigation, the squashes prepared satisfy the requirements as suggested by FPO.

4.5.3. Assessment of chemical constituents in jams

Table 11 elucidates the results obtained with respect to the chemical constituents present in mango jam prepared out of different mango cultivars ~~Table 14~~. On

assessing the acidity content present in jams, it was noted that all the varieties showed a similar trend in acidity values and it ranged between 0.13 to 0.14. Statistical analysis of the data also indicated that there was no significant differences in the acidity value of the jams prepared. Sheeja (1994) studied that the acidity percentage in papaya jam ranged from 0.50 to 0.70.

Table 11. Chemical constituents of fresh jam

Name of the cultivars	Chemical constituents of fresh jam		
	Acidity%	pH	TSS°Brix
V_1	0.14	5.43	66.51
V_2	0.13	4.90	66.82
V_3	0.14	4.80	67.21
V_4	0.14	4.63	67.51
V_5	0.14	4.41	67.31
V_6	0.14	4.11	67.81
CD interaction	0.010	8.512	4.539

A detailed assessment of the pH of jams prepared from different local varieties showed that the maximum value for pH was recorded in the Variety V_1 (5.43) and the minimum value was secured by the variety V_6 (4.11). Sheeja (1994) had reported that the pH of papaya jam ranged from 3.00 to 3.90. No significant difference was observed in the pH values of jams prepared from different local cultivars of mango.

On analysing the TSS content of jams developed from different local cultivars of mango, a high value for Tss was secured by the variety V_6, (67.81) which was very closely proceeded by the variety V_4, (67.51). Statistical analysis of the data showed no significant differences in Tss content in jams prepared from different cultivars of mango. According to FPO (1955) the minimum percentage of total soluble solids in jams were reported to be 68 percent. Singh (1990) had suggested that mango jam contains a TSS of 68-70^{o} Brix. In the present study Tss value of jams conforms with the FPO standards.

4.6. Assessment of changes in organoleptic and chemical qualities of pulp based products during storage

The changes in organoleptic qualities were assessed in the present investigation under a panel of ten judges till the end of the shelf life period. The major quality

attributes such as appearance, colour, flavour, taste and consistency were rated in the products throughout the storage period along with the overall acceptability.

4.6.1. Changes in the organoleptic qualities of RTS beverage during storage

The changes in appearance attribute of RTS beverage during storage is presented in Table 12.

Table 12. Mean scores for appearance attribute of RTS beverage during storage

Name of cultivars	Storage period (in weeks)			Percentage of decrease
	1st	2nd	3rd	
V_1	3.70	3.70	3.50	5.41
V_2	4.00	4.00	3.90	2.50
V_3	3.70	3.60	3.00	18.90
V_4	3.60	3.60	3.00	16.70
V_5	3.60	3.60	3.00	16.70
V_6	3.60	3.60	3.00	16.70

CD interaction 0.165

The appearance attribute of RTS beverages prepared from six cultivars of mango were 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 with a percentage decrease of 5.41 per cent in V_1, 2.50 per cent in V_2, 18.9 per cent in V_3 and 16.7 per cent in V_4, V_5 as well as in V_6. The mean scores obtained in the RTS beverages during first week ranged from 3.60 to 4.00 whereas the mean scores by the end of third week ranged from 3.00 to 3.90. The highest score for appearance attribute during the first week of storage was attained by the RTS beverage prepared from the variety V_2 (Neelum) with a mean score of 4.00. The mean scores for appearance attribute obtained by the RTS beverages during storage period anged from 3.70 to 3.50 in V_1, 4.00 to 3.90 in V_2, 3.70 to 3.00 in V_3, 3.60 to 3.00 in V_4, 3.60 to 3.00 in V_5 and 3.60 to 3.00 in V_6.

The data when statistically interpreted, it was found that the difference that existed among the RTS beverages between the first and second weeks of storage was on par. However a significant difference was noted in V_1, V_3, V_4, V_5 and V_6 between the second and third weeks and also

between the first and third weeks of storage. The difference that occurred in Neelum variety between second and third week and also between first and third week of storage was not found to be significant. According to Teotia (1992), the RTS beverage made from musk melon - mango blend resumed attractive appearance upon shaking the bottle prior to serving. According to Hicks (1990), for maximum acceptability the drink must look fresh and should have good fruit appearance.

Thus the RTS beverages prepared from Neelun (V_2) variety remained superior than the other varieties with respect to the appearance attribute.

Changes in colour attribute of RTS beverage during storage is given in Table 13.

A decrease in colour attribute score was observed in the RTS beverage by the end of the storage period. The percentage of decrease in colour during the storage periods was recorded as 8.11 per cent in V_1, 23.5 per cent in V_3, 20.6 per cent in V_4, 26.5 per cent in V_5 and 18.8 per cent in V_6. A centum score for colour attribute was attained by the

RTS beverage prepared from the variety Neelum (V_2). The mean scores obtained by the RTS beverages during the first week of storage ranged from 3.20 to 4.00 and by the end of the storage period the mean scores reduced to 2.50. The mean scores for colour attribute during the storage periods ranged from 3.70 to 3.40 in the case of V_1, remained as 4.00 in V_2, 3.40 to 2.60 in V_3, 3.40 to 2.70 in V_4, 3.40 to 2.50 in V_5 and 3.20 to 2.60 in V_6.

Table 13. Mean scores for colour attribute of RTS beverage during storage

Name of cultivars	Storage period (in weeks)			Percentage of decrease
	1st	2nd	3rd	
V_1	3.70	3.70	3.40	8.11
V_2	4.00	4.00	4.00	0.00
V_3	3.40	3.30	2.60	23.50
V_4	3.40	3.30	2.70	20.60
V_5	3.40	3.30	2.50	26.50
V_6	3.20	3.20	2.60	18.80

CD interaction 0.167

The data obtained when interpreted statistically was found that the difference in colour attribute score in the RTS beverages between the first and second weeks of storage was on par. However a significant difference was seen during the second and third weeks and also during first and third weeks of storage except in the case of beverage developed from V_2 (Neelum) variety. Saini *et al.* (1985) observed decline in colour score of bottled Kinnow juice stored under room temperature for a period of six months.

It can be inferred that, RTS beverage prepared from V_2 (Neelum) variety remained top as far as colour attribute is concerned.

Changes in flavour attribute of RTS beverage during storage is given in Table 14.

The flavour attribute scores obtained for RTS beverages were found to show a decreasing trend during the storage period with the percentage of decrease being 50 per cent in V_1, 52.63 per cent in V_2, 52.78 per cent each in V_3 and V_4, 54.55 per cent in V_5 and 53.13 per cent in V_6. 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 beverages and it was in the range of 3.60 to 1.80 in V_1, 3.80 to 1.80 in V_2, 3.60 to 1.70 in V_3, 3.60 to 1.70 in V_4, 3.30 to 1.50 in V_5 and 3.20 to 1.50 in V_6. There was no significant difference in the flavour attribute scores of RTS beverages between the first and second weeks of storage except in Kottukonam variety. However a significant difference was observed in all the ~~other~~ RTS beverages, between the second and third weeks and also between first and third weeks of storage. The highest significant difference was found in Neelum (2.0) between the first and third weeks of storage. Thorner (1978) reported that regardless of the storage temperature, off flavour develops in the processed products with storage. Tressler (1968) stated that, though passion fruit juice can be preserved by heating, some of the flavour deterioration occur during storage.

Hence, it can be concluded that the flavour profile drastically decreased with storage though it was minimum in Kottukonam variety.

Changes in taste attribute of RTS beverage during storage is given in Table 15.

Table 14. Mean scores for flavour attribute of RTS beverage during storage

Name of cultivars	Storage period (in weeks)			Percentage of decrease
	1st	2nd	3rd	
V_1	3.60	3.40	1.80	50.00
V_2	3.80	3.70	1.80	52.63
V_3	3.60	3.60	1.70	52.78
V_4	3.60	3.50	1.70	52.78
V_5	3.30	3.20	1.50	54.55
V_6	3.20	3.20	1.50	53.13

CD interaction 0.182

Table 15. Mean scores for taste attribute of RTS beverage during storage

Name of cultivars	Storage period (in weeks)			Percentage of decrease
	1st	2nd	3rd	
V_1	3.30	3.30	2.00	39.39
V_2	3.50	3.50	1.80	48.57
V_3	3.30	3.30	1.80	45.45
V_4	3.50	3.40	1.70	51.43
V_5	3.30	3.30	1.70	48.48
V_6	3.40	3.20	1.90	44.12

CD interaction 0.152

When taste attribute of RTS beverage was taken into consideration, not much change was observed during the first and second weeks after which a declining trend in the scores was noted. The percentage of decrease was found to be 39.39 in V_1, 48.57 in V_2, 45.45 in V_3, 51.43 in V_4, 48.48 in V_5 and 44.12 in V_6. The mean scores for taste attribute obtained for RTS beverages during the first week of storage ranged from 3.30 to 3.50. The highest score for taste attribute during the initial period was attained by the RTS beverages prepared from V_2 (Neelum) and V_4 (Panchasara Varikka), the scores being 3.50 each. The mean scores for taste attribute during the storage period ranged from 3.30 to 2.00 in V_1, 3.50 to 1.80 in V_2, 3.30 to 1.80 in V_3, 3.50 to 1.70 in V_4, 3.30 to 1.70 in V_5 and 3.40 to 1.90 in V_6.

On comparing the mean scores for taste attribute, no significant change was observed between the first and second weeks of storage except in V_6 (Moovandan), whereas a slight difference in the mean scores (0.2) was observed between first and second weeks of storage. A significant difference was seen between second and third weeks of storage and also between first and third weeks of storage in the RTS beverages. The highest significant difference of 1.7 was

noted each in V_2 (Neelum) and V_4 (Panchasara Varikka) between the first and third week of storage. According to Mukherjee (1963), during storage taste of a food will change considerably.

As far as taste attribute is concerned, RTS beverage prepared from V_1 (kottukonam) ranked top, leaving behind all the RTS beverages prepared from other cultivars of mango.

Changes in consistency attribute of RTS beverage during storage is given in Table 16.

Taking into account the consistency aspect, a decrease in consistency attribute score was observed with storage in all RTS beverages prepared from six different cultivars of mango. The percentage of decrease were observed as 2.70 per cent in V_1, 8.57 per cent in V_2, 15.15 per cent in V_3, 17.14 per cent in V_4, 12.12 per cent in V_5 and 9.38 per cent in V_6.

A higher score for consistency attribute was attained by the RTS beverage prepared from V_1 (Kottukonam)

during the initial period with a mean score of 3.70. The mean scores for consistency attribute attained by the RTS beverages during storage period were 3.70 to 3.60 in V_1, 3.50 to 3.20 in V_2, 3.30 to 2.80 in V_3, 3.50 to 2.90 in V_4, 3.30 to 2.90 in V_5 and 3.20 to 2.90 in V_6.

Table 16. Mean scores for consistency attribute of RTS beverage during storage

Name of cultivars	Storage period (in weeks)			Percentage of decrease
	1st	2nd	3rd	
V_1	3.70	3.70	3.60	2.70
V_2	3.50	3.50	3.20	8.57
V_3	3.30	3.00	2.80	15.15
V_4	3.50	3.00	2.90	17.14
V_5	3.30	3.00	2.90	12.12
V_6	3.20	3.00	2.90	9.38

CD interaction 0.166

When the data was statistically analysed it was observed that, the difference that existed in RTS beverages prepared from V_1 and V_2 between first and second weeks of storage was on par, whereas all the other RTS beverages showed a significant difference between the first and second weeks of storage. No significant difference was observed in RTS beverages between second and third weeks of storage except in the case of V_2 (Neelum) and V_3 (Karpooram) varieties. However significant difference was exhibited between the first and third weeks of storage in all types of RTS beverages except in the case of the RTS beverage prepared from V_1 (kottukonam) variety. According to Thorner (1978), the RTS beverage during shelflife precipitates and this precipitated material contribute to flavour.

Hence, it can be said that among the RTS beverages prepared from different cultivars, V_1 (Kottukonam) remained superior than others with regard to the consistency aspect.

Changes in overall acceptability scores of RTS beverages are presented in Table 17.

When the mean scores for overall acceptability were taken into consideration, it was observed that a gradual

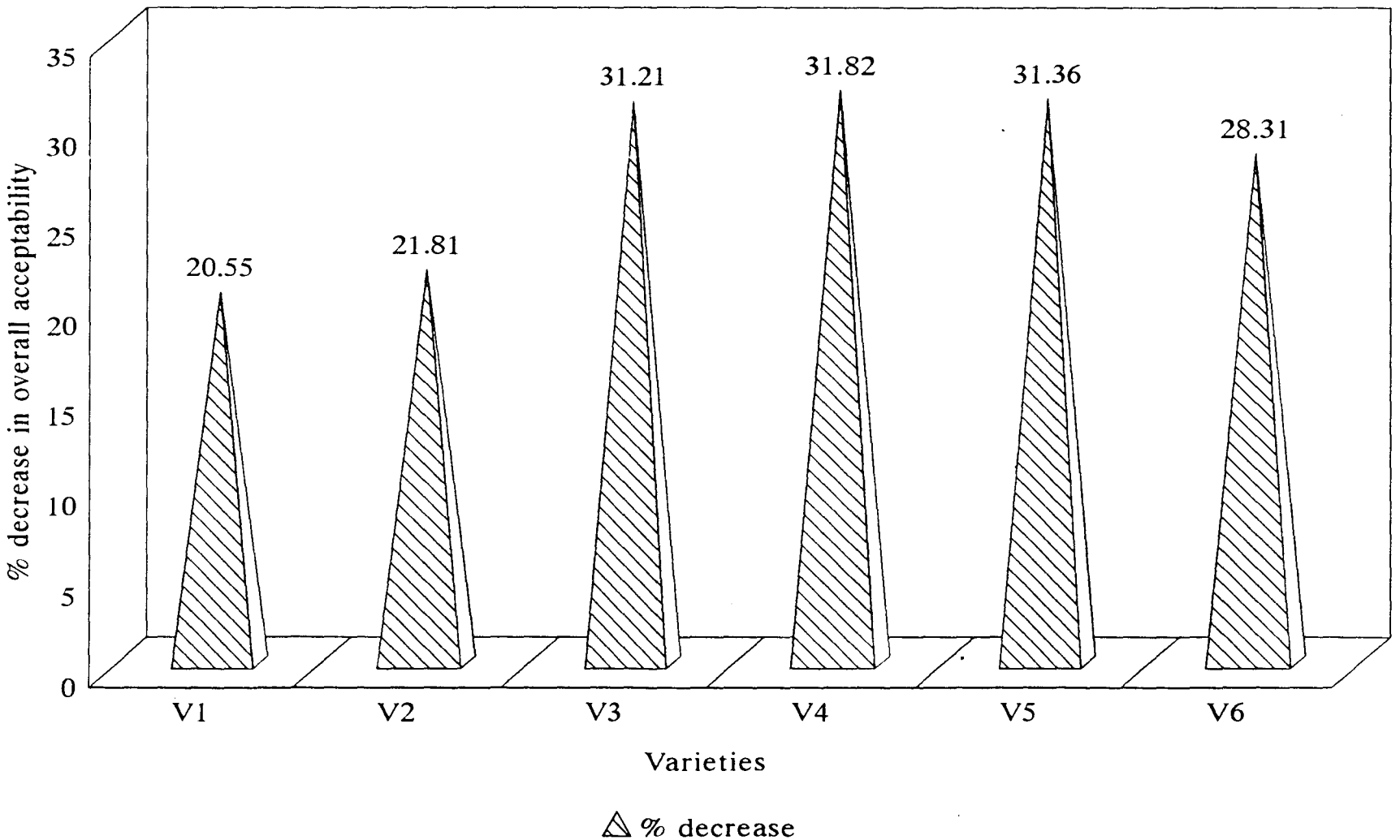


Fig. 6. Percentage decrease in overall acceptability scores of RTS beverages during storage

decrease in the mean scores of overall acceptability had occurred with the storage period. The percentage of decrease in the overall acceptability scores were 20.55 per cent in V_1, 21.81 per cent in V_2, 31.21 per cent in V_3, 31.82 per cent in V_4, 31.36 per cent in V_5 and 28.31 per cent in V_6 (Fig. 6). The overall mean scores obtained for the RTS beverages during the initial period till the end of storage period ranged from 3.60 to 2.86 in V_1, 3.76 to 2.94 in V_2, 3.46 to 2.38 in V_3, 3.52 to 2.40 in V_4, 3.38 to 2.32 in V_5 and 3.32 to 2.38 in V_6.

Table 17. Mean scores for overall acceptability of RTS beverage during storage

Name of cultivars	Storage period (in weeks)			Percentage of decrease in overall acceptability
	1st	2nd	3rd	
V_1	3.60	3.56	2.86	20.55
V_2	3.76	3.74	2.94	21.81
V_3	3.46	3.36	2.38	31.21
V_4	3.52	3.36	2.40	31.82
V_5	3.38	3.28	2.32	31.36
V_6	3.32	3.24	2.38	28.31

CD interaction 0.0737

Statistical analysis of the data indicated that, the difference that existed in overall acceptability scores in the RTS beverages between the first and second weeks of storage was on par. However a significant difference was seen to exist among all the RTS beverages prepared from different varieties of mango, between first and third weeks of storage. According to Kaur and Khurdiya (1993), overall acceptability was highest for mango - pineapple blended nectar.

As far as the changes in organoleptic qualities of the RTS beverages are concerned, RTS prepared from the varieties Neelum (V_2) and Kottukonam (V_1) had the highest score for overall acceptability during storage. Hence these varieties can be recommended for preparation of RTS beverages whereas Kappa variety was the least acceptable for the preparation of RTS beverage.

4.6.2. Changes in organoleptic qualities of squash during storage

The changes in appearance attribute of squash during storage is depicted in Table 18.

Table 18. Mean scores for appearance attribute of squash during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	4.00	3.90	3.40	3.20	20.00
V_2	4.00	4.00	3.30	3.30	17.50
V_3	3.00	3.00	2.40	2.20	26.67
V_4	3.70	3.60	2.30	2.20	40.54
V_5	3.30	3.30	2.40	2.30	30.30
V_6	3.30	3.00	2.10	2.00	39.39

CD interaction 0.206

The mean scores for appearance attribute of the squashes prepared from six different cultivars of mango remained somewhat constant for the first and second months of storage but after that a declining trend was observed with the percentage of decrease being 20 per cent in V_1, 17.50 per cent in V_2, 26.67 per cent in V_3, 40.54 per cent in V_4, 30.30 per cent in V_5 and 39.39 per cent in V_6. The mean scores for appearance attribute obtained for squashes prepared from

different cultivars of mango during storage period ranged from 4.00 to 3.20 in V_1, 4.00 to 3.30 in V_2, 3.00 to 2.20 in V_3, 3.70 to 2.20 in V_4, 3.30 to 2.30 in V_5 and 3.30 to 2.00 in V_6.

Statistical analysis indicates that the difference that existed in appearance attribute during the first and second ~~weeks~~ months of storage was on par. During second and third months of storage, a significant difference in appearance attribute was found in Panchasara Varikka (1.3). The difference that existed during the third and fourth months of storage were also on par. A significant difference of 0.8 in V_1, 0.7 in V_2, 0.8 in V_3, 1.5 in V_4, 1.0 in V_5 and 1.3 in V_6 was observed between the first and fourth months of storage in all the squashes prepared. According to Stillman (1993), colour change is the major factor that usually occur in the processed products which affects the appearance of the product.

From the above observations, it can be concluded that the appearance attribute is best in squash prepared from Neelum followed by Kottukonam.

The changes in colour attribute of squash during storage is presented in Table 19.

Table 19. Mean scores for colour attribute of squash during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	4.00	4.00	3.70	3.30	17.50
V_2	4.00	4.00	3.50	3.20	20.00
V_3	3.20	3.20	2.40	2.40	25.00
V_4	3.50	3.40	3.00	2.20	37.14
V_5	3.40	3.20	2.80	2.20	35.29
V_6	3.10	2.90	2.40	1.90	38.71

CD interaction 0.200

The mean scores for colour attribute showed a decreasing trend towards the end of the storage period, with the percentage of decrease being 17.50 per cent in V_1, 20 per cent in V_2, 25 per cent in V_3, 37.14 per cent in V_4, 35.29 per cent in V_5 and 38.71 per cent in V_6. The mean scores obtained for colour attribute in squashes during the storage period ranged from 4.00 to 3.30 in V_1, 4.00 to 3.20 in V_2,

3.20 to 2.40 in V_3, 3.50 to 2.20 in V_4, 3.40 to 2.20 in V_5 and 3.10 to 1.90 in V_6. The highest score for colour attribute was attained by the squashes prepared from varieties viz., V_1 (Kottukonam) and V_2 (Neelum) with the maximum score of 4.00 each.

It was observed that there was no noticeable difference in the squashes between the first and second months of storage. A significant difference was noted during the second and third months of storage in all squashes prepared from different cultivars of mango and the highest significant difference of 0.8 was shown in V_3 (Karpooram). During the third and fourth months of storage, V_1, V_2, V_4, V_5 and V_6 showed a significant difference whereas the difference that existed in V_3 was on par. A significant difference of 0.7 in V_1, 0.8 in V_2 and V_3, 1.3 in V_4, 1.2 in V_5 and 1.2 in V_6 was observed in the squashes between first and fourth months of storage under ambient conditions.

Thus, as far as the colour attribute of squashes are concerned, the squash prepared from the variety Kottukonam (V_1) remained better than squashes prepared from other varieties of mango. According to Bhatia (1994)

sensory quality of passion fruit juices and reconstituted concentrates indicated that heat treated fruit juice concentrates had better acceptability with higher colour scores.

The changes in flavour attribute of squash during storage is presented in Table 20.

Table 20. Mean scores for flavour attribute of squash during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	4.00	3.90	3.00	3.00	25.00
V_2	3.90	3.70	2.70	2.40	38.46
V_3	3.80	3.80	2.80	2.40	36.84
V_4	3.30	3.20	2.00	1.90	42.42
V_5	3.10	2.80	1.90	1.80	41.94
V_6	3.60	3.40	2.10	1.90	41.67

CD interaction 0.177

The flavour attribute scores of squashes showed a declining trend towards the end of storage period, the percentage of decrease being 25 per cent in V_1, 38.46 per cent in V_2, 36.84 per cent in V_3, 42.42 per cent in V_4, 41.94 per cent V_5 and 41.67 per cent in V_6. The mean scores for flavour attribute obtained for the squashes during storage period ranged from 4.00 to 3.00 in V_1, 3.90 to 2.40 in V_2, 3.80 to 2.40 in V_3, 3.30 to 1.90 in V_4, 3.10 to 1.80 in V_5 and 3.60 to 1.90 in V_6. When compared to other attributes, flavour change was more pronounced in squashes.

The statistical analysis of the data proved that between the first and second months of storage there was no significant difference in the flavour scores in the varieties viz., Kottukonam, Karpooram and Panchasara Varikka whereas a significant difference was observed in all the other squashes between the first and second months of storage. However a significant difference was observed in the squashes between the first and third months, first and fourth months, second and third months and also between second and fourth months of storage whereas no significant difference was observed in the varieties viz. Kottukonam, Panchasara Varikka and Kappa between third and fourth months of storage. According to Hicks (1990), appearance is a strong indicator of flavour.

The changes in taste attribute of squash during storage is depicted in Table 21.

Table 21. Mean scores for taste attribute of squash during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	4.00	4.00	3.00	2.70	32.50
V_2	4.00	4.00	2.80	2.60	35.00
V_3	3.20	3.00	2.60	1.90	40.63
V_4	3.10	2.80	1.80	1.70	45.16
V_5	3.40	3.40	2.40	2.00	41.18
V_6	3.60	3.40	2.70	2.20	38.89

CD interaction 0.172

It is clear from the table that the mean scores for taste attribute in squashes during the storage period ranged from 4.00 to 2.70 in V_1, 4.00 to 2.60 in V_2, 3.20 to 1.90 in V_3, 3.10 to 1.70 in V_4, 3.40 to 2.00 in V_5 and 3.60 to 2.20 in V_6.

Statistical analysis of the data revealed that Panchasara Varikka showed the highest difference for taste during the first and second months of storage. A significant difference existed in V_3, V_4 and V_6 between the first and second months of storage while the differences that existed in squashes prepared from varieties V_1, V_2 and V_5 were on par. During the second and third months of storage a highly significant difference existed among all the squashes prepared. Whereas during the third and fourth months of storage a significant difference existed in V_1, V_2, V_3, V_5 and V_6. A significant difference was shown by all squashes prepared from different cultivars of mango, between the first and fourth months of storage. Siddappa (1986) had opined that the oxygen of the air adversely affects the taste and aroma of the food.

Hence, it is proved that among the squashes prepared from different cultivars of mango, the squash prepared from V_1 (Kottukonam) variety scored highest as far as the taste attribute is concerned.

The changes in consistency attribute of squash during storage is presented in Table 22.

Table 22. Mean scores for consistency attribute of squash during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	3.90	3.90	3.00	2.70	30.77
V_2	4.00	4.00	3.30	3.20	20.00
V_3	2.90	2.70	1.40	1.40	51.72
V_4	3.30	2.80	2.10	2.10	36.36
V_5	3.50	3.50	2.30	1.90	45.71
V_6	3.70	3.50	2.50	2.20	40.54

CD interaction 0.191

Taking into account of the consistency attribute of squashes prepared, a decrease in consistency scores were observed by the end of storage period. It was noted that the mean scores for consistency attribute ranged from 3.90 to 2.90 in V_1, 4.00 to 3.20 in V_2, 2.90 to 1.40 in V_3, 3.30 to 2.10 in V_4, 3.50 to 1.90 in V_5 and 3.70 to 2.20 in V_6. The percentage of decrease was observed as 30.77 per cent

in V_1, 20 per cent in V_2, 51.72 per cent in V_3, 36.36 per cent in V_4, 45.71 per cent in V_5 and 40.54 per cent in V_6.

A significant difference for consistency attribute was shown between the first and second months of storage in the squashes prepared from varieties V_3, V_4 and V_6 whereas the difference observed was on par in varieties like V_1, V_2 and V_5. The consistency attribute scores during the second and third months of storage showed a significant difference of 0.9 in V_1, 0.7 in V_2, 1.3 in V_3, 0.7 in V_4, 1.2 in V_5 and 1.0 in V_6 during the second and third months of storage. During the third and fourth months of storage, a significant difference existed in squashes prepared from the varieties V_1, V_5 and V_6 while the difference that existed in varieties viz. V_2, V_3 and V_4 were on par. A significant difference was exhibited by all the varieties during the first and fourth months of storage.

Changes in overall acceptability scores of squashes are presented in the Table 23.

Overall acceptability scores decreased by the end of the storage period in the squashes prepared. The

percentage of decrease was found to be 25.13 in V_1, 26.13 in V_2, 36.02 in V_3, 40.24 in V_4, 38.92 in V_5 and 41.04 in V_6 (Fig. 7). The overall mean scores observed in the squashes prepared from different cultivars of mango during the storage period ranged from 3.98 to 2.98 in V_1, 3.98 to 2.94 in V_2, 3.22 to 2.06 in V_3, 3.38 to 2.02 in V_4, 3.34 to 2.04 in V_5 and 3.46 to 2.04 in V_6.

Table 23. Mean scores for overall acceptability of squash during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	3.98	3.96	3.22	2.98	25.13
V_2	3.98	3.94	3.12	2.94	26.13
V_3	3.22	3.18	2.32	2.06	36.02
V_4	3.38	3.16	2.24	2.02	40.24
V_5	3.34	3.34	2.36	2.04	38.92
V_6	3.46	3.24	2.36	2.04	41.04

CD interaction 0.110

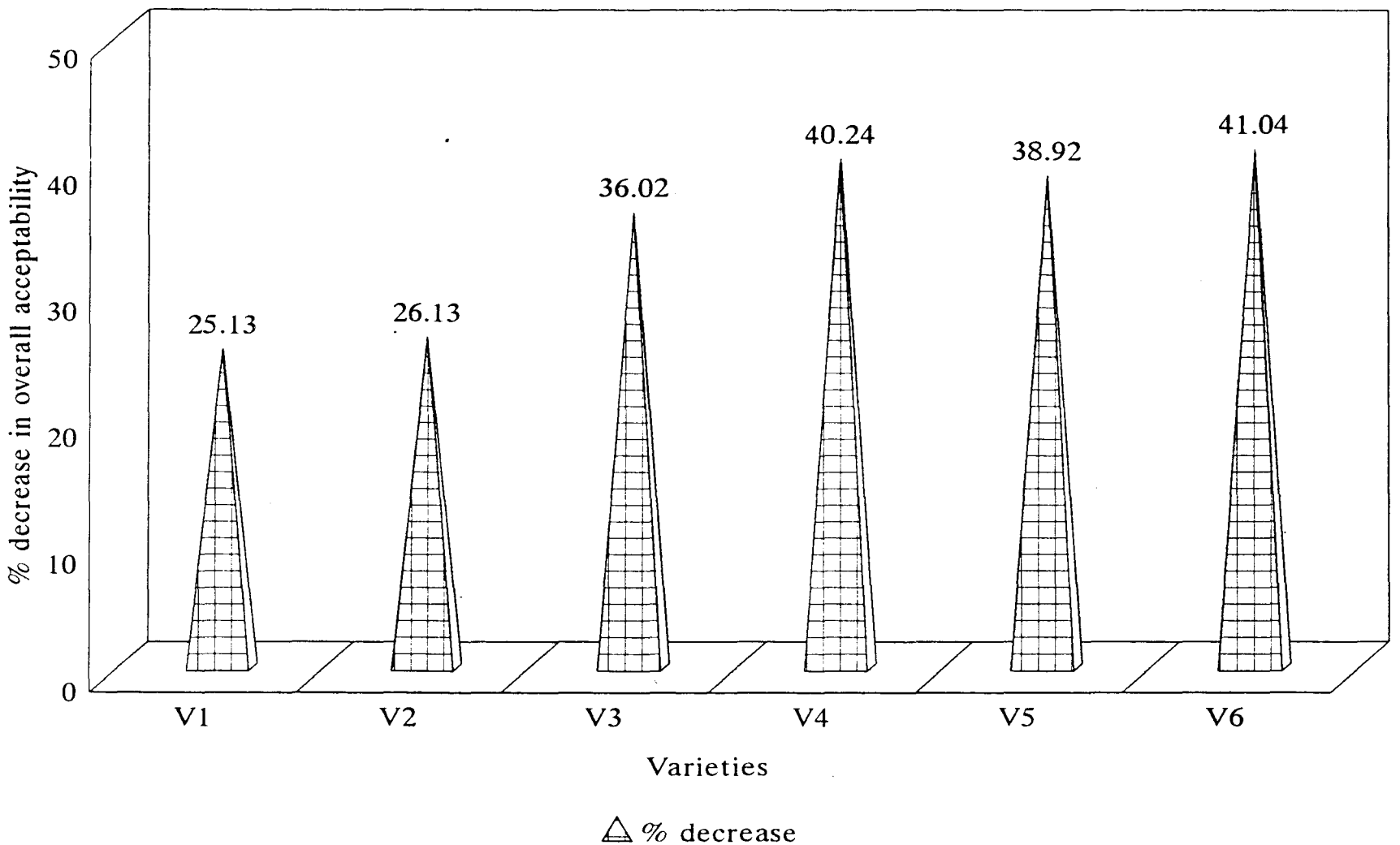


Fig. 7. Percentage decrease in overall acceptability scores of squash during storage

Statistical analysis of the data had revealed a significant difference in the squashes prepared from varieties V_4 and V_6 between the first and second months of storage but the difference that existed between the varieties V_1, V_2, V_3 and V_5 were on par. A significant difference was observed to exist among all squashes prepared from different cultivars of mango between the second and third months, third and fourth months and also between the first and fourth months of storage.

Based on the changes in organoleptic qualities of squashes analysed, it can be confirmed that the variety Kottukonam was best acceptable for the preparation of squash followed by Neelum variety and the variety Panchasara Varikka was adjudged to be least acceptable with a mean overall acceptability score of 2.02.

4.6.3. Changes in the organoleptic qualities of jam during storage

Table 24 depicts the mean scores obtained for appearance attribute in jams prepared from six different cultivars of mango ~~Table~~ ~~24~~. The scores obtained clearly indicate that the appearance attribute of jams remained

almost similar during the first and second months of storage but gradually declined towards the end of storage period. The percentage of decrease was found to be 6.06 per cent in V_1, 10.53 per cent in V_2, 18.75 per cent in V_3, 13.16 per cent in V_4, 10.26 per cent in V_5 and 36.67 per cent in V_6. The mean scores obtained for appearance attribute in the jams prepared from different cultivars of mango ranged from 3.30 to 3.10 in V_1, 3.80 to 3.40 in V_2, 3.20 to 2.60 in V_3, 3.80 to 3.30 in V_4, 3.90 to 3.50 in V_5 and 3.00 to 1.90 in V_6.

Table 24. Mean scores for appearance attribute of jam during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	3.30	3.30	3.30	3.10	6.06
V_2	3.80	3.80	3.60	3.40	10.53
V_3	3.20	3.10	2.70	2.60	18.75
V_4	3.80	3.80	3.40	3.30	13.16
V_5	3.90	3.80	3.60	3.50	10.26
V_6	3.00	3.00	1.90	1.90	36.67

CD interaction 0.164

The statistical analysis have revealed that the difference that existed in the jams prepared between the first and second months of storage was on par. During the second and third months of storage, a highly significant difference was shown in the jam prepared from V_6 (Moovandan) variety, whereas Kottukonam and Neelum showed significant difference between the third and fourth months of storage. The difference that existed in the varieties viz. V_3, V_4, V_5 and V_6 were on par. A significant difference was exhibited by all the varieties between the first and fourth months of storage. Sheeja (1995) was of the opinion that, appearance of the processed products decreased with storage.

By taking into account of the appearance attribute of jams, it was shown that the jam prepared from variety V_5 (Kappa) was better in appearance when compared to the others.

As indicated in Table 25 the colour attribute scores of jams prepared from six different cultivars of mango showed a declining trend towards the end of the storage period, the percentage of decrease being 8.33 per cent in V_1, 11.11 per cent in V_2, 21.21 per cent in V_3, 17.50 per cent in

V_4, 12.82 per cent in V_5 and 40.00 per cent in V_6. The mean scores obtained for the jams prepared during the initial month ranged from 3.00 to 4.00 while the decrease in mean scores by the end of the fourth month ranged from 1.80 to 3.40. The mean scores for colour attribute in jams prepared ranged from 3.60 to 3.30 in V_1, 3.60 to 3.20 in V_2, 3.30 to 2.60 in V_3, 4.00 to 3.30 in V_4, 3.90 to 3.40 in V_5 and 3.00 to 1.80 in V_6 during the storage period.

Table 25. Mean scores for colour attribute of jam during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	3.60	3.50	3.40	3.30	8.33
V_2	3.60	3.50	3.10	3.20	11.11
V_3	3.30	3.20	2.70	2.60	21.21
V_4	4.00	3.80	3.40	3.30	17.50
V_5	3.90	3.80	3.60	3.40	12.82
V_6	3.00	3.00	2.00	1.80	40.00

CD interaction 0.171

A significant difference existed during the first and second months of storage in the jams prepared from Panchasara Varikka and the differences shown by V_1, V_2, V_3, V_5 and V_6 were on par. Between the second and third months of storage a significant difference existed in the jams prepared from V_2, V_3, V_4, V_5 and V_6 but the difference that existed in V_1 (Kottukonam) was on par. The highest significant difference was found in Moovandan (1.0) between the second and third months of storage. Significant difference was observed during the third and fourth months in the jams prepared from V_5 and V_6, whereas the differences exhibited by the jams prepared from varieties viz., V_1, V_2, V_3 and V_4 were on par. A significant difference of 0.3 in V_1, 0.4 in V_2, 0.7 in V_3 and V_4 each, 0.5 in V_5 and 1.2 in V_6 were noted between the first and fourth months of storage. According to Potter (1986) complex colour changes occur when many organic chemicals present in food come in contact with air. The results obtained in the study was in line with Bhatnagar (1991), who had reported that the colour of watermelon jam decreased with storage.

As per the above result, it can be concluded that the jam prepared from Kappa variety scored best with respect to the colour attribute.

As per the Table 26 a decrease in flavour attribute scores were noted by the end of the storage period, with the percentage of decrease being 43.24 per cent in V_1, 41.67 per cent in V_2, 36.11 per cent in V_3, 31.58 per cent in V_4, 48.57 per cent in V_5 and 33.33 per cent in V_6. The mean scores obtained for flavour attribute in jams prepared from different cultivars of mango during the storage period ranged from 3.70 to 2.10 in V_1, 3.60 to 2.10 in V_2, 3.60 to 2.30 in V_3, 3.80 to 2.60 in V_4, 3.50 to 1.80 in V_5 and 3.00 to 2.00 in V_6.

Table 26. Mean scores for flavour attribute of jam during storage

Number of cultivar	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	3.70	3.30	3.10	2.10	43.24
V_2	3.60	3.40	3.10	2.10	41.67
V_3	3.60	3.40	3.10	2.30	36.11
V_4	3.80	3.80	3.30	2.60	31.58
V_5	3.50	3.40	3.10	1.80	48.57
V_6	3.00	3.00	2.50	2.00	33.33

CD interaction 0.205

Analysis of the data indicated that between the first and second months of storage, a significant difference was found in Kottukonam, but the differences that existed among V_2, V_3, V_4, V_5 and V_6 were on par. During the second and third months of storage, significant difference existed in jams prepared from varieties viz., V_2, V_3, V_4, V_5 and V_6 whereas the difference shown by V_1 between the second and third months of storage was on par. However, a significant difference was seen in all the six varieties of jams during the third and fourth months of storage and the jam prepared from the variety V_5 (Kappa) showed the highest significant difference of 1.3 during the period of storage. Ranganna (1984) stated that flavour is an important factor which enriches the consumers preference to a particular product.

The obtained results confirms that the jam prepared from the variety Panchasara Varikka (V_4) attained a superior position with flavour attribute when compared with the other varieties of mango.

The changes in taste attribute of jam during storage is given in Table 27.

Table 27. Mean scores for taste attribute of jam during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	3.60	3.40	3.00	3.00	16.67
V_2	3.90	3.60	2.90	2.30	41.03
V_3	3.60	3.40	3.20	3.20	11.11
V_4	4.00	3.90	3.50	3.30	17.50
V_5	3.60	3.30	3.20	3.10	13.89
V_6	3.20	3.20	2.00	1.90	40.63

CD interaction 0.180

As indicated in the table, the scores during the storage period were observed to decrease during the storage period with a percentage decrease being 16.67 in V_1, 41.03 in V_2, 11.11 in V_3, 17.50 in V_4, 13.89 in V_5 and 40.63 in V_6. The mean scores in jams were observed to range from 3.60 to 3.00 in V_1, 3.90 to 2.30 in V_2, 3.60 to 3.20 in V_3, 4.00 to 3.30 in V_4, 3.60 to 3.10 in V_5 and 3.20 to 1.90 in V_6.

The jam prepared from variety Kottukonam showed a significant difference between the first and second months and also between the second and third months, whereas towards the end of the storage period no significant difference was observed. The flavour attribute scores of jams prepared from Neelum showed only a slight difference between the first and second months of storage whereas between the second and third months of storage and also between the third and fourth months of storage a highly significant difference of 0.7 and 0.6 was observed. In the case of jams prepared from Karpooram variety, a significant difference of 0.2 was observed between the first and second months of storage and also between second and third months of storage. In the jam prepared from Panchasara Varikka the difference that existed between the first and second months of storage was on par and a significant difference of 0.4 was seen between the second and third months of storage. In the case of jam developed from Kappa variety, the highest significant difference of 0.3 was indicated during the first and second months while in jam prepared from Moovandan variety, the significant difference was highest during the second and third months (1.2) of storage. Bhatia *et al.* (1983) reported a decrease in taste attribute in culled apple jelly during storage.

Thus, the jam prepared from variety, Panchasara Varikka bagged the highest score for taste attribute during storage when compared with the jams prepared from the other varieties of mango.

The changes in consistency attribute of jam during storage is presented in Table 28.

Table 28. Mean scores for consistency attribute of jam during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	3.70	3.60	3.40	3.10	16.22
V_2	3.80	3.80	3.30	3.00	21.05
V_3	3.80	3.60	3.30	2.90	23.68
V_4	4.00	3.80	3.50	3.40	15.00
V_5	3.70	3.70	3.40	3.10	16.22
V_6	3.20	3.00	2.00	1.90	40.63

CD interaction 0.174

The consistency attribute scores in all the jams were found to show a decreasing trend towards the end of the storage period, with the percentage of decrease being 16.22 per cent in V_1, 21.05 per cent in V_2, 23.68 per cent in V_3, 15 per cent in V_4, 16.22 per cent in V_5 and 40.63 per cent of V_6. The mean scores obtained for the colour attribute in jams during the storage period were found to range from 3.70 to 3.10 in V_1, 3.80 to 3.00 in V_2, 3.80 to 2.90 in V_3, 4.00 to 3.40 in V_4, 3.70 to 3.10 in V_5 and 3.20 to 1.90 in V_6. The scores for consistency attribute were found to remain almost similar during the first two months but was found to decline gradually after the second month of storage.

Statistical analysis of the data indicated that a significant difference in consistency attribute was exhibited in the jams prepared from different varieties of mango between the first and second months of storage while the difference that existed in the varieties viz., V_1, V_2 and V_5 were on par. During the second and third months of storage all the jams prepared from different cultivars showed a significant difference and it was found to be the highest in Moovandan with the difference being 1.0. Between the third and fourth months of storage a significant difference in

consistency scores existed in jams prepared from V_1, V_2, V_3 and V_5 but the difference that existed in the varieties viz., V_4 and V_6 were on par. This finding was in line with Bhatnagar (1991). He had reported that the texture of water melon jam decreased with increase in storage time.

Changes in overall acceptability scores of jams are presented in the Table 29.

Table 29. Mean scores for overall acceptability of jams during storage

Name of cultivars	Storage period (in months)				Percentage of decrease
	1st	2nd	3rd	4th	
V_1	3.58	3.42	3.24	2.92	18.44
V_2	3.74	3.62	3.20	2.80	25.13
V_3	3.50	3.34	3.00	2.72	22.29
V_4	3.92	3.82	3.42	3.18	18.88
V_5	3.72	3.60	3.38	2.98	19.89
V_6	3.08	3.04	2.08	1.90	38.31

CD interaction 0.104

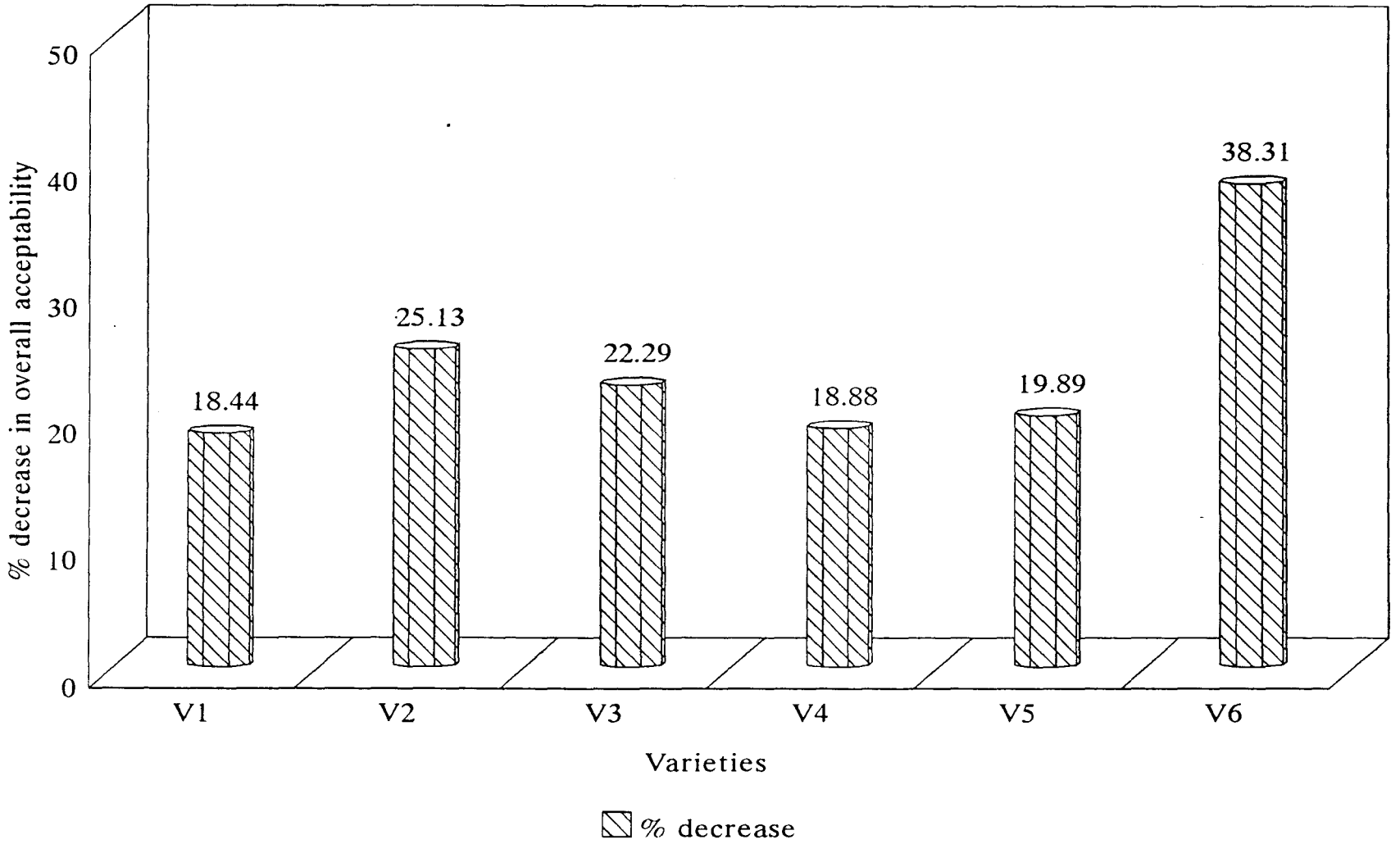


Fig. 8. Percentage decrease in overall acceptability scores of jam during storage

Assessment of overall acceptability of jams prepared from different mango cultivars indicated that, there was a steady decrease in the overall acceptability scores during the storage period, with the percentage of decrease being 18.44 in V_1, 25.13 in V_2, 22.29 in V_3, 18.88 in V_4, 19.89 in V_5 and 38.31 in V_6. The mean scores for overall acceptability ranged from 3.58 to 2.92 in V_1, 3.74 to 2.80 in V_2, 3.50 to 2.72 in V_3, 3.92 to 3.18 in V_4, 3.72 to 2.98 in V_5 and 3.08 to 1.90 in V_6.

There was a significant difference in the overall acceptability scores of jams prepared from the varieties V_1, V_2, V_3 and V_5 between the first and second months of storage whereas the difference shown by the varieties V_4 and V_6 was on par. A significant difference was exhibited by jams prepared from all the six different cultivars of mango between the second and third months, third and fourth months and also between first and fourth months of storage. Mir and Nath (1993) had reported that storage decreases overall acceptability of fruit products.

Above findings clearly confirms that the variety Panchasara Varikka is best suited for the preparation of jams

followed by Kappa variety whereas the variety Moovandan is least suitable for jam preparation.

4.7. Assessment of changes in chemical constituents of pulp based products with storage

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 occur with storage, periodical assessment of chemical components are to be done. Bawa and Saini (1987) indicated that the physico- chemical changes are more pronounced at room temperature when compared to low temperature

4.7.1. Assessment of changes in chemical constituents of RTS beverages with storage

Table 30 indicates the changes in acidity of RTS beverages prepared from six different cultivars of mango during storage.

Statistical analysis of the data confirms that there was no noticeable change in acidity in the RTS

beverages during the storage period of three weeks. The acidity content of the RTS beverages prepared from Six different local cultivars of mango ranged from 0.32 to 0.33 percent. The above result is in consonance with Vyas (1989) who reported that there was no appreciable change in the acidity of Rhodopetal RTS beverage during storage. Similarly Kalra *et al.* (1991) had found that the acidity did not change significantly during the twelve months storage of mango - papaya blended beverage. It was also reported by Renote *et al.* (1993) that, Kinnow mandarin RTS beverage stored at ambient conditions when evaluated showed negligible changes in acidity.

Table 30. Changes in acidity of RTS beverages during storage period

Name of cultivars	Storage period (in weeks)		
	1st	2nd	3rd
V_1	0.33	0.33	0.33
V_2	0.33	0.33	0.33
V_3	0.33	0.33	0.33
V_4	0.33	0.33	0.33
V_5	0.33	0.33	0.33
V_6	0.32	0.32	0.32

CD interaction 3.64

Table 31 depicts the pH values obtained for RTS beverages prepared from different mango cultivars with storage Table 31. As indicated in the table, 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 third week of storage with values that ranged from 3.6 - 4.5. The highest value for pH was attained by Kottukonam with a pH value of 4.6 and the lowest by the variety Panchasara Varikka (3.70). The pH values for RTS beverages during the storage period ranged from 4.60 to 4.50 in V_1, 4.10 to 3.90 in V_2, 4.10 to 3.90 in V_3, 3.70 to 3.60 in V_4, 4.20 to 4.10 in V_5 and 4.10 to 3.90 in V_6. The percentage of decrease was found to be 2.17 per cent in V_1, 4.88 in V_2, 4.88 in V_3, 2.70 in V_4, 2.38 in V_5 and 4.88 in V_6.

Statistical analysis of the data revealed no significant changes in the pH values of RTS beverages prepared from different local cultivars, between the storage periods.

The results obtained here were in line with the findings of Palaniswamy (1976) in Lime ginger cocktail and gingerale. Similar observations were reported by, Sethi

(1985) in litchi juice, Tripathi *et al.* (1988) in amla juice, Thirumaran *et al.* (1990) in tomato juice and Thirumaran *et al.* (1992) in fermented carrot juice.

Table 31. Changes in pH of RTS beverages during storage

Name of cultivars	Storage period (in weeks)			Percentage of decrease
	1st	2nd	3rd	
V_1	4.60	4.60	4.50	2.17
V_2	4.10	4.10	3.90	4.88
V_3	4.10	4.10	3.90	4.88
V_4	3.70	3.70	3.60	2.70
V_5	4.20	4.20	4.10	2.38
V_6	4.10	4.10	3.90	4.88

CD interaction 3.64

Changes occurred in Tss of RTS beverages during storage is presented in Table 32.

As indicated in the Table, negligible change was noted in the Tss content of the RTS beverages prepared from

the six different varieties of mango during first week till the third week of storage which ranged from 15.50 to 18.60.

Table 32. Changes in TSS of RTS beverages during storage

Number of cultivar	Storage period (in weeks)			Percentage of decrease
	1st	2nd	3rd	
V_1	16.20	16.20	16.20	0.31
V_2	18.60	18.55	18.55	0.81
V_3	17.05	17.00	17.00	0.29
V_4	17.00	17.00	17.00	--
V_5	16.35	16.30	16.30	0.61
V_6	15.50	15.50	15.50	--

CD interaction 7.613

Only slight change in TSS content was observed between the storage periods among all RTS beverages prepared from different cultivars of mango. The TSS values for RTS ranged from 16.20 to 16.20 in V_1, 18.60 to 18.55 in V_2, 17.05 to 17.00 in V_3, 17.00 to 17.00 in V_4, 16.35 to 16.30 in V_5,

and 15.50 to 15.50 in V_6. The percentage of decrease was found to be 0.31 in V_1, 0.81 in V_2, 0.29 in V_3, and 0.61 in V_5.

Statistical analysis of the data revealed, no significant difference in the TSS contents of RTS beverages, during the storage periods.

Supporting to the above result Vyas (1989) reported that the analysis of total soluble solids in RTS nectar from rhodopetals did not show any appreciable change during storage. According to Kalra *et al.* (1991), no significant change in Tss was noted in mango - papaya blended beverage stored over a period of one year at ambient conditions. Similar findings were reported by shah and Bains (1992) and Renote *et al.* (1993).

4.7.2. Assessment of changes in chemical constituents of squash with storage

Table 33 elucidates the changes in acidity of squashes prepared from six different cultivars of mango during the storage period. As indicated in the table the

acidity of squash prepared from different cultivars ranged from 0.33 to 0.34 per cent during the first and second months of storage and a gradual increase was noted thereafter till fourth month of storage. The increase in acidity during the storage period ranged from 0.34 to 0.82 per cent and the percentage of increase was observed as 56.41 in V_1, 58.54 in V_2, 56.41 in V_3, 58.54 in V_4, 57.69 in V_5 and 56.41 in V_6.

Table 33. Changes in acidity of squash during storage

Name of cultivars	Storage period (in months)				Percentage increase in acidity during storage
	1st	2nd	3rd	4th	
V_1	0.34	0.34	0.59	0.78	56.41
V_2	0.34	0.34	0.56	0.82	58.54
V_3	0.34	0.34	0.54	0.78	56.41
V_4	0.34	0.34	0.53	0.82	58.54
V_5	0.34	0.34	0.57	0.79	57.69
V_6	0.34	0.33	0.54	0.78	56.41

CD interaction 7.154

There was no significant difference in the acidity values between the consecutive months in the squashes prepared from different cultivars of mango during the storage period.

The variation in acidity level in stored juices may be due to changes in concentration of organic acids or due to formation of organic acids by degradation of the sugars. The results obtained in this study was supported by the findings of Thirumaran *et al.* (1990) in tomato juice concentrate and Sethi (1994) during shelf life studies of whole tomato concentrate. Sheeja (1994) studied the acidity of papaya squash during storage and found that there was no change in acidity upto 4 months of storage and then a steady increase was observed from 1.60 to 1.95 per cent.

Table 34 demonstrates the changes in pH of squashes prepared from different cultivars of mango during storage ~~Table 34~~. It was observed that the pH content showed a declining trend during storage. The pH content ranged from 3.31 to 1.85 in the squashes during the first month till the fourth month of storage. Comparatively higher pH was observed in the squash prepared from Kottukonam variety (4.14) which was decreased to 2.62 by the end of the fourth

month. The pH content of the squashes prepared from different local cultivars of mango during the storage period ranged from 4.10 to 2.60 in V_1, 3.60 to 1.90 in V_2, 3.50 to 2.00 in V_3, 3.60 to 1.90 in V_4, 3.30 to 1.80 in V_5 and 3.90 to 2.40 in V_6 and the percentage of decrease was observed as 36.7 per cent in V_1, 46.54 per cent in V_2, 41.93 per cent in V_3, 49.04 per cent in V_4, 44.71 per cent in V_5 and 39.14 per cent in V_6.

Table 34. Changes in pH of squash during storage

Name of cultivars	Storage period (in months)				Percentage of decrease in pH during storage
	1st	2nd	3rd	4th	
V_1	4.10	3.80	2.90	2.60	36.70
V_2	3.60	3.50	2.20	1.90	46.54
V_3	3.50	3.10	2.40	2.10	41.93
V_4	3.60	2.90	2.20	1.90	49.04
V_5	3.30	2.80	2.20	1.80	44.71
V_6	3.90	3.40	2.60	2.40	39.14

CD interaction 1.51

Statistical analysis of the data revealed that the difference in pH content of squashes prepared were on par during the first and second months, second and third months and also during the third and fourth months of storage. A significant difference of 1.52 in V_1, 1.68 in V_2, 1.78 in V_4 and 1.55 in V_6 were observed between the first and fourth month of storage whereas the difference in squashes prepared from V_3 and V_5 was on par. These findings were in consonance with Sethi (1994) who reported a decrease in the pH of whole tomato concentrate with storage.

Table 35 depicts the changes in TSS of squash prepared from different cultivars of mango during storage ~~Table 35~~. The table given above clearly shows that the TSS content remains unaltered from the first month upto fourth month of storage. The TSS content of the squashes ranged from 58.11 to 59.51 during the initial period. The highest value for TSS was shown by the squash developed from variety Moovanadan with a value of 59.51. The TSS values of squashes prepared from different cultivars of mango during the storage period ranged from 59.21 to 59.20 in V_1, 58.62 to 58.62 in V_2, 58.22 to 58.21 in V_3, 58.52 to 58.51 in V_4, 58.11 to 58.11 in V_5 and 59.51 to 59.51 in V_6. The percentage of

decrease was found to be 0.017 in V_1, 0.00 in V_2, 0.017 in V_3, 0.017 in V_4, 0.00 in V_5 and 0.00 in V_6.

Table 35. Changes in TSS of squash during storage

Name of cultivars	Storage period (in months)				Percentage of decrease in TSS during storage
	1st	2nd	3rd	4th	
V_1	59.21	59.20	59.20	59.20	0.017
V_2	58.62	58.62	58.62	58.62	0.000
V_3	58.22	58.21	58.21	58.21	0.017
V_4	58.52	58.51	58.51	58.51	0.017
V_5	58.11	58.12	58.12	58.11	0.000
V_6	59.51	59.51	59.51	59.51	0.000

CD interaction 4.38

The data when analysed statistically had revealed that there was no noticeable difference in TSS of squashes between the consecutive months of storage. Shreshta (1982) reported that there was practically no change in total soluble solids during storage in apple juice. The results

obtained in the study was also in line with the findings of Mehta *et al.* (1983), Sethi (1985 and 1994) and Sheeja (1994).

4.7.3. Assessment of changes in chemical constituents of jam with storage

Table 36 denotes the changes in acidity of jams developed from different local cultivars of mango Table 36. The acidity values were found to increase gradually from first month upto fourth month of storage and the values increased from 0.14 to 0.46 during the storage period. The acidity values ranged from 0.14 to 0.46 in V_1, 0.13 to 0.45 in V_2, 0.14 to 0.44 in V_3, 0.14 to 0.45 in V_4, 0.14 to 0.46 in V_5 and 0.14 to 0.45 in V_6 and the percentage of increase was found to be 69.57 per cent in V_1, 71.11 per cent in V_2, 68.18 per cent in V_3, 68.89 per cent in V_4, 69.57 per cent in V_5 and 68.89 per cent in V_6.

Statistical analysis of the data indicated that the acidity content of squashes showed a significant difference between the storage periods. The result of this study is in line with the findings of Kalra and Revathi (1981) where a rise in acidity was observed during storage in gauva pulp, and also in amla jam by Tripathi *et al.* (1988).

Table 36. Changes in acidity of jam during storage

Name of cultivars	Storage period (in months)				Percentage of decrease in acidity during storage
	1st	2nd	3rd	4th	
V_1	0.14	0.23	0.35	0.46	69.57
V_2	0.13	0.24	0.35	0.45	71.11
V_3	0.14	0.23	0.35	0.44	68.18
V_4	0.14	0.23	0.35	0.45	68.89
V_5	0.14	0.23	0.34	0.46	69.57
V_6	0.14	0.24	0.35	0.45	68.89

CD interaction 0.01

Table 37 demonstrates the changes in pH of jam prepared from six different cultivars of mango ~~Table 37~~. As indicated in the table the pH was found to decrease gradually during storage in all the jams prepared from different cultivars of mango. The pH of jams ranged from 4.42 to 5.43 per cent during the first month, 4.11 to 4.93 per cent in the second month, 3.22 to 3.94 per cent and 3.00 to 3.52 per cent consecutively in the third and fourth months. A higher

value for pH was possessed by V_1 variety, the value being 5.43 per cent and a lower value was attained by the variety V_6 - 4.11 per cent. The decrease in pH values during storage of jams ranged from 5.43 to 3.52 in V_1, 4.90 to 3.05 in V_2, 4.80 to 3.00 in V_3, 4.63 to 3.52 in V_4, 4.41 to 3.32 in V_5 and 4.11 to 3.20 in V_6 and the percentage of decrease was found to be 35.17 in V_1, 37.76 in V_2, 37.50 in V_3, 23.97 in V_4, 24.89 in V_5 and 29.36 in V_6.

Table 37. Changes in pH of jam during storage

Name of cultivars	Storage period (in months)				Percentage of decrease in pH during storage
	1st	2nd	3rd	4th	
V_1	5.43	4.93	3.63	3.52	35.17
V_2	4.90	4.51	3.22	3.05	37.76
V_3	4.80	4.42	3.94	3.00	37.50
V_4	4.63	4.16	3.72	3.52	23.97
V_5	4.42	4.41	3.51	3.32	24.89
V_6	4.53	4.11	3.43	3.20	29.36

CD interaction 1.32

When the data was interpreted statistically it was found that there was no significant difference in the pH of jams prepared out of different varieties between the first, second and third month of storage, however a significant difference was noted between the first and fourth month of storage in the varieties V_1, V_2, V_3 and V_6. The difference that existed in the varieties V_4 and V_5 during the first and fourth months of storage was on par.

The result obtained in this study was supported by Sheeja (1994) where a decrease in pH during storage was observed in papaya jam at ambient conditions. However Tripathi *et al.* (1988) studied the chemical changes related to storage in amla jam and found that there was no change in pH.

Table 38 indicates the changes in TSS of jams prepared from six different cultivars of mango during storage. The TSS content was observed to remain unaltered throughout the storage periods. The TSS values obtained for jams prepared from different varieties ranged from 67.22 to 67.81. The highest value for TSS during the initial period was attained by jam prepared from V_6, (67.81) and the lowest for V_1 (66.52).

Table 38. Changes in TSS of jam during storage

Name of cultivars	Storage period (in months)				Percentage of decrease during storage
	1st	2nd	3rd	4th	
V_1	66.52	66.52	66.52	66.51	0.015
V_2	66.84	66.82	66.82	66.82	0.029
V_3	67.22	67.21	67.21	67.21	0.015
V_4	67.52	67.52	67.52	67.51	0.015
V_5	67.33	67.32	67.31	67.31	0.029
V_6	67.81	67.81	67.81	67.81	--

CD interaction 0.06

Statistical analysis proved that there was no significant difference in the TSS content in jams between the storage periods.

4.8. Assessment of microbial contamination of processed products with storage

Microbial infestation in the products prepared from six different cultivars of mango were detected by the changes

in chemical and organoleptic qualities that had occurred due to the action of micro organisms. Among the chemical changes that occur in a product, pH is an important factor which helps to determine the growth of micro organisms during the storage period. Determination of pH reveals the acidity and alkalinity of the product which in turn gives a positive indication of deteriorative products.

The products prepared from different mango cultivars viz., Mango RTS beverage, Mango squash and Mango jam were viewed under the microscope to analyse the microbial infestation in the products such as bacteria, yeast and fungi. The products were found to be free from contamination by micro organisms during the early months of storage.

Changes in appearance, colour, flavour, taste and consistency were detected after three weeks of storage in RTS beverages and after four months of storage in the case of squashes and jams. 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 RTS beverages after three weeks of storage and colonies of

Aspergillus species in squashes and jams after four months of storage. The media used for detecting micro organisms was potato-dextrose agar.

The pH of the three products prepared were also observed to show a decreasing trend with storage which revealed the deterioration in the products. Sethi (1994) on analysing the spoiled samples of tomato concentrate indicated that its spoilage was due to micro organisms such as yeast or Aspergillus. Pradnya *et al.* (1992) while isolating micro organisms from home made mango jam had found that the fungus Aspergillus niger was responsible for the spoilage in the jam samples.

4.9. Assessment of cost-benefit analysis of the products

Prices often fluctuate from day to day, month to month and year to year and different prices usually exists for the same commodity at different locations or different stages in the marketting process (How, 1990). Cost-benefit analysis endorses the potential to assess the cost attained for the development of a product. Hence, in this study, cost-benefit analysis was done based on the ingredients used

and also by considering the overhead charges. The expense of the products obtained are shown in Table 39.

Table 39. Cost-benefit analysis of the products

Cultivars	Cost per kg/litre		
	RTS beverage	Squash	Jam
V_1 (Kottukonam)	13.00	24.00	22.00
V_2 (Neelum)	14.00	26.00	24.00
V_3 (Karpooram)	13.00	25.00	23.00
V_4 (Panchasara Varikka)	13.00	24.00	22.00
V_5 (Kappa)	14.00	26.00	24.00
V_6 (Moovandan)	12.00	24.00	22.00

As per the Table 39 given, the cost of RTS beverages ranged from Rs. 12.00-14.00 per litre. The cost incurred for the RTS beverage made from the varieties Neelum and Kappa were found to be comparatively high (Rs. 14.00). The fluctuations arised in the cost of RTS beverages is mainly due to the cost of mango varieties.

The cost of squashes prepared from different cultivars of mango were found to range between Rs. 22.00 - 24.00. As in the case of RTS beverages, the squashes prepared from Neelum and Kappa was found to be expensive than the other varieties with a cost of Rs. 24.00 each followed by squash prepared from the variety Karpooram with a cost of Rs. 23.00 per litre.

The cost of production of jams was found to range between Rs. 24.00 - 26.00. The jam developed from the variety Neelum and Kappa was found to be the most expensive with a cost of Rs. 26.00 per kg followed by jam prepared from Karpooram variety.

From the foregoing results on cost-benefit analysis, we can come to the conclusion that the cost of RTS beverage was low when compared with the cost of squashes and jams. The cost of products prepared from the varieties Neelum and Kappa was found to be high because of the higher cost of these varieties. All the prepared products were found to be acceptable, nutritious as well as economical when compared with the marketted products.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The present study entitled "Suitability of local mango cultivars for pulp based products" was taken up for optimising the protocols of developing mango pulp based products viz. Mango RTS beverage, Mango Squash and Mango jam using six different cultivars of mango. The physical and processing characteristics, the chemical composition of different mango cultivars, the chemical and organoleptic qualities of products as well as changes in the products with storage and also the cost-benefit analysis were investigated in this study.

On viewing the physical characteristics, a wide range of variation was seen to exist in the shape of mango, colour of outer skin and thickness of peel. Kappa variety was found to be the heaviest (404.8 g) while Panchasara Varikka, the lightest (156.8 g). Pulp recovery was maximum in Karpooram Variety (74.3 percent) and was lowest in Panchasara Varikka (59.2 percent).

When processing characteristics of the six different mango cultivars were analysed, it was observed that all the varieties except Kappa Variety excel in their flesh colour. The varieties Kappa, Karpooram and Moovandan were very fleshy, and the texture of the varieties Neelum, Panchasara varikka and Kappa was not at all fibrous. Captivating flavour was possessed by the varieties Neelum, karpooram and Panchasara varikka, while Panchasara varikka excel in their sweetness.

Chemical composition of different local varieties of mango were assessed with regard to their moisture content, pH, TSS, acidity, total sugar, reducing sugar and vitamin C. The moisture percentage varied with the cultivar. The highest value for moisture (84.75 per cent) was observed in kappa variety and the lowest value (79.75 per cent) in Moovandan. The Tss content was found to be high in kottukonam variety (19.90 per cent). Among the six different varieties of mango pH was found to be highest in Panchasara varikka (4.60) and the acidity was observed to be similar in all varieties (0.22 per cent), except in Moovandan variety (0.32 per cent). The total sugar content was highest in Panchasara varikka (15.25 per cent) and the reducing Sugar

content was highest in Kottukonam Variety (6.72 per cent) The vitamin C content showed marked variations among different cultivars. The highest value for vitamin C was observed in Panchasara Varikka (34.20 mg per 100 g).

On comparing the Organoleptic qualities of fresh RTS beverage prepared, Neelum variety had attained maximum score for appearance and colour attributes (4.00). Flavour score of RTS beverage prepared from Neelum variety was higher (3.80) when compared with the other varieties. The variety Neelum and Panchasara Varikka obtained the highest score of 3.50 each for taste attribute whereas in the case of Consistency attribute the RTS beverage prepared from the variety Kottukonam was found to have the highest score of 3.70. RTS beverage prepared from the Neelum Variety was adjudged to be the best, as indicated from the overall acceptability score.

The Organoleptic qualities of fresh squash prepared from different mango cultivars indicated that the varieties Kottukonam and Neelum secured the maximum scores for appearance and colour attributes, the scores being 4.00 each for both attributes. The variety Kottukonam also bagged

maximum for flavour and taste attribute. However consistency attribute was highly in favour of Neelum variety, with a centum score of 4.00. Thus Kottukonam and Neelum varieties were adjudged to be highly suitable for making squash among the different cultivars studied.

Taking into account of the Organoleptic assessment of fresh jam, the Variety Kappa obtained the highest score of 3.90 for appearance attribute followed by Panchasara Varikka and Neelum varieties. The flavour attribute score was highest in Panchasara Varikka (3.80) followed by Kottukonam (3.70). The variety Panchasara Varikka attained the highest score for taste and consistency attributes with a centum score of 4.00 each in both cases. The overall acceptability score of the variety Panchasara Varikka was the highest (3.92) followed by Neelum (3.74). The overall acceptability scores of the three products were above 3.00 which indicated that all the products prepared were organoleptically acceptable.

Evaluation of chemical constituents in fresh RTS beverage revealed that the acidity content remained almost similar in all the RTS beverages prepared (0.33 percent). The pH was found to be maximum in Kottukonam variety (4.60)

and the maximum value for Tss was observed in Neelum variety (18.6 percent). On considering the pH content of squashes prepared from six different cultivars of mango it was observed that the highest value was in Kottukonam variety (4.14) and the Tss content was found to be the highest in Moovandan (59.51). When the chemical constituents present in jams were analysed, it was observed that the acidity remained almost similar in all the varieties which ranged from 0.13 to 0.14 percent. The pH content was found to be highest in Kottukonam variety (5.43) and the highest percentage of Tss was attained by the variety Moovandan (67.81 per cent).

Changes in Organoleptic qualities of the pulp based products during storage revealed that the quality attributes such as appearance, colour, flavour, taste and consistency showed a declining trend with storage, in all the three products prepared. However, the RTS beverage was acceptable for a period of three weeks and all the other products were acceptable for a period of four months.

On analysing the changes in chemical constituents that occurs during storage in RTS beverages, the acidity was found to remain unaltered during the storage period of three

weeks whereas the pH showed a slight decrease after second week of storage. The Tss content of all the RTS beverages prepared from different mango cultivars remained unaltered during the storage period. Taking into account of the changes in chemical constituents of squashes prepared from different cultivars, the acidity remained almost similar for the first two months and then after second month a gradual increase was noted in the acidity content. The pH showed a decreasing trend with storage. The Tss content in all squashes remained unaltered during the storage period. With regard to the changes in chemical constituents of jam with storage, the acidity was found to increase with storage, whereas the pH showed a decreasing trend.

The Tss content of the jams prepared from different cultivars of mango remained unaltered throughout the storage period.

Evaluation of microbial infestation in the stored products revealed, the presence of pencillium in RTS beverages after three weeks of storage and colonies of Aspergillus were seen in squashes and jams after four months of storage.

Cost-benefit analysis of the products when assessed revealed that RTS beverage was the cheapest with costs ranging from Rs. 12.00 to 14.00 per litre followed by jam whose cost was found to range from Rs. 22.00 to 24.00. Cost of squash was found to be the more expensive.

Thus varietal analysis of the mangoes revealed that, organoleptically sound, and shelf stable products can be prepared using local cultivars of mango.

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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 were identical, identify the odd sample

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

APPENDIX - 2

SCORE CARD

Criteria		RTS						Squash						Jam					
		V_1	V_2	V_3	V_4	V_5	V_6	V_1	V_2	V_3	V_4	V_5	V_6	V_1	V_2	V_3	V_4	V_5	V_6
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 acceptable	1																		
4. **Taste**																			
Very good	4																		
Good	3																		
Fair	2																		
Poor	1																		
5. **Texture**																			
Very good	4																		
Good	3																		
Fair	2																		
Poor	1																		
6. **Consistency**																			
Very good	4																		
Good	3																		
Fair	2																		
Poor	1																		

SUITABILITY OF LOCAL MANGO CULTIVARS FOR PULP BASED PRODUCTS

By

IRENE VARGHESE

ABSTRACT OF A THESIS
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DEPARTMENT OF HOME SCIENCE
COLLEGE OF AGRICULTURE
VELLAYANI, THIRUVANANTHAPURAM

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ABSTRACT

The present study entitled "Suitability of local mango cultivars for pulp based products" was taken up for optimising the protocols of developing mango pulp based products viz., Mango RTS beverage, Mango squash and Mango jam using six different cultivars of mango. The physical and processing characteristics, the chemical composition of different mango cultivars, the chemical and organoleptic qualities of fresh products as well as in the products with storage and also the cost-benefit analysis were investigated in this study.

On assessing the physical and processing characteristics of wide range of variation was seen to occur among all the six different varieties of mango.

The chemical composition was also found to differ from cultivar to cultivar.

On visualising the acceptability of the developed products, it was observed that the variety Neelum was best

suited for the preparation of RTS beverage, while the varieties Kottukonam and Neelum were adjudged to be the best for squash preparation. In the case of jam preparation, the variety Panchasara varikka and Kappa was found to be the most suitable.

When the chemical parameters like acidity, pH and Tss in fresh products were considered, it was seen that the acidity content remained almost similar in all the RTS beverages, squashes and jams prepared from different cultivars of mango whereas the pH content of the products prepared was found to vary according to the variety. The Tss content was also found to differ according to the variety.

Assessment of changes in organoleptic qualities of pulp based products with storage, indicated a declining trend in all the quality attributes such as appearance, colour, flavour, taste, consistency and overall acceptability.

When the changes in chemical constituents that occurs in pulp based products with storage was considered, it was ascertained that in RTS beverages the acidity and Tss content remained unaltered during the storage period of three

weeks whereas a slight decline in pH was noted after second week or storage. In the case of squashes and jams a gradual increase in acidity was noted during the storage period whereas the pH showed a decreasing trend with storage. The Tss content remained unaltered during storage in the case of squashes and jams also.

Evaluation of microbial contamination in the stored products revealed the presence of pencillium colonies in RTS beverages after three weeks of storage and colonies of aspergillus were seen in squashes and jams after four months of storage.

Cost-benefit analysis revealed that the cost of RTS beverages ranged from Rs. 12.00 to 14.00 per litre, cost of squashes ranged from Rs. 24.00 to 26.00 and the cost of jams ranged from Rs. 22.00 to 24.00.

Thus physico-chemical, organoleptic and shelf life assessment of the pulp based products utilizing local mango cultivars encourages the utilization of above in product development.