DEVELOPMENT OF KARONDA (CARISSA CARANDUS.L) BASED PRODUCTS

BY

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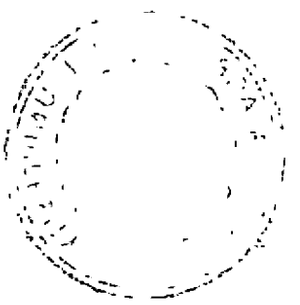

THESIS

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DECLARATION

I hereby declare that this thesis, entitled **"Development of Karonda (Carissa carandus.L) based products "** is a bonafide record of research work done by me during the course of research and that this 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.

Vellayani ,
Date: 1.7.95

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CERTIFICATE

Certified that this thesis entitled "**Development of Karonda (Carissa carandus.L) based products** ", is a record of research work done independently by **SHEEJA MAJEED** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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EXTERNAL EXAMINER

Dedicated
to
My Family.

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INTRODUCTION

INTRODUCTION

India is the home of world's most useful plants thriving in her diverse agro-ecological zones and altitudes. Recent food production statistics indicate that India is the second largest producer of fruits in the world after Brazil with a production touching of 27.83 million tonnes which accounts for around eight per cent of the world production *(Rao 1991)*. As reported by *Bhowmik (1992)* in addition to the major fruits, a larger number of minor fruits accounting for about 5.53 million tonnes are also produced in the country. In Kerala also we find a large variety of fruits grown throughout the state.

The commercial potential of these fruits are immense, but large quantities of fruits are going waste because of improper utilisation. According to *Sethi (1993)* 20-30 per cent of the fruits produced in this country are not utilised due to postharvest problems and only one per cent of the total produce are being utilized for processing. All these wastages can be prevented by proper handling and processing.

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 disposibility *(Rao 1989)*.

India can make a substantial contribution for the exports of horticultural products to fetch foreign exchange. Being predominantly an agricultural country it can fruitfully use this status to step into the world market with its horticultural processed products.

India is also enriched with a variety of delicious indigenous fruits which have great potential for export market. The major items of our export are fruit juices, pulps canned and

dehydrated fruits, pickles and chutneys that account for the export value of Rs.31 crores to 35 crores. But at present the export of the processed products from underexploited indigenous fruits is negligible. Therefore there is a need to make some new products from indigenous raw material having nutritional and medicinal values to open new channel for export market.

Some of the products from bael, ber, jamun, jack fruit , karonda, aonla, lasoda and other similar fruits can be popularized by technical innovations as HEALTH FOODS having nutritional and medicinal properties, delicate flavour and attractive colour in some. Techniques of processing now standardised in the country are mainly related to major fruits. *Bhowmik (1992)* has stated that there is a vast potential to tap the underexploited minor fruits in the country. This food article which is a rich source of vitamins and minerals if well exploited may bring additional revenue through our food wealth. Hence organised efforts for popularising minor fruits have to be made.

The karondâ *(Carissa carandus. L)* is one of such underexploited indigenous fruits grown extensively in India *(Sethi et al 1977)*. This fruit bearing plant is a shrub which requires very little care and expenditure for growing. It bears a profusion of berries but people are not aware of the utility of this fruit *(Singh 1979)*. These fruits with speakable nutritive value are acidic in taste and suitable for production of many processed products. But processing techniques related to fruits like karonda are now limited.

The present study is an attempt to standardise different types of products from karonda and to ascertain the nutritional organoleptic and shelf life qualities of the products developed. Such study would be helpful to recommend for the commercial exploitation of karonda fruits. Use of karonda for making different kinds of value added products is thus attempted.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The pertinent research work in **"Development of karonda based products"** is briefly reviewed under the following subtitles

2.1 IMPORTANCE OF FRUITS AND FRUIT PRODUCTS
2.2 NEED FOR PROCESSING FRUITS
2.3 SIGNIFICANCE AND UTILISATION OF UNDEREXPLOITED FRUITS
2.4 PHYSICO-CHEMICAL CHARACTERISTICS OF KARONDA
2.5 DEVELOPMENT OF FRUIT BASED PRODUCTS
2.6 EFFECT OF PRETREATMENTS ON PROCESSING FRUITS
2.7 SHELF LIFE QUALITIES OF FRUIT BASED PRODUCTS
2.8 EFFECT OF STORAGE CONDITIONS AND MATERIALS

2.1 IMPORTANCE OF FRUITS AND FRUIT PRODUCTS

Rao (1991) reported that India with a population over 860 million produce on an average of about 74 million tonnes of horticultural produce. According to *Pandey (1991)* India ranked third in case of production of fruits after Brazil and United States. *Sethi (1993)* reported that India is one of the largest producer of fruits (27 million tonnes) in the world. According to *Anvilla (1993)* the consumption of processed foods is likely to increase in the future.

2.1.1 Commercial Importance

Kaushal (1987) had stressed on the rise in demand for processed fruits and vegetables because of the increased defence requirements and urbanisation trend. *Shaw (1993)* remarked

that owing to rich horticultural potential that exist in the country, fruit and vegetable industry can play important role in salvaging prices during glut seasons, generating employment opportunity, meeting the requirements of defence forces in border area and earning foreign exchange for the country by development of exports.

Patil (1992) estimated that the export of processed fruits and vegetable in 1991-92 amounts to 73,000 metric tonnes valued at Rs 120 crores and for 92-93 the expected export was 86,5000 metric tonnes valued at Rs. 142 crores. The author further upholds that it has the potential to go upto 1,30,000 metric tonnes valued at Rs. 345 crores in 1996-97. According to him the installed capacity of fruits and vegetable processing has increased to 12.6 lakh tonnes by the end of 1993 from 11.03 lakh tonnes in 1992. This is expected to increase to 20 lakh tonnes by the end of eighth plan.

Kumar (1990) believes that fruits and vegetables can carry 20-23 tonnes higher foreign exchange per unit area than cereals. 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)*.

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. *Pooma (1994)* is also of the view that fruit processing helps to integrate the problem of underemployment during off season in agriculture sector besides it ensures fair returns to the growers and improve their economic conditions.

2.1.2 Nutritional Importance

Geetha (1982) expressed that cheaper fruits also carry high nutritious food value and comprise a rich diet, as they contain large store of essential vitamins and mineral salts. According to *Rao (1991)* fruits and vegetables are the only sources of essential nutrients like

vitamin C and Beta carotene whose intake in a majority of our population are already below par. 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 *(George 1994)*.

Sadashivan and Neelakanthan (1976) had found that jackfruit bulbs are rich in sugar and contain fair amounts of carotene, protein and minerals. Studies conducted at *NIN (1978)* reported that regular consumption of papaya will ensure a good supply of vitamin A & C. *Hayes (1980)* reported that the rind of fruits contain a good amount of pectin. *Khader and Chellappan (1987)* reported that banana is a rich source of energy. About 24 bananas each weighing around 100 gm would provide the energy requirements (2400 cal/day) of a sedentary man. *Sethi (1987)* reported that about 15gms of amla consumed daily could help dietary needs of vital vitamins. *Charanjit (1989)* reported that the ripe mango fruit possessed high calorific value and were an excellent source of carotene.

2.2 NEED FOR PROCESSING FRUITS

Processing fruit based products is a method of reducing post harvest losses of perishable foods like fruits. *Bourne (1986)* has classified the causes of post harvest loss of perishable crops in developing countries as primary losses due to insects, microbes and mechanical damages and secondary losses due to poor storage and inadequate transport facilities.

It has become necessary to preserve fruits in different forms so that they could be made available to a larger number of people during seasons when they are not available readily in the fresh condition *(Siddappa 1967)*.

Cook (1975) reported that high perishability of fruits lead to a high degree of wastage which is reported even in developed countries like the USA with the well advanced and

sophisticated technique and marketing facilities. *Roy (1993)* explore the solution for wastage that the surplus production of perishable fruits and vegetable during the seasonable glut could be converted into durable products in order to avoid wastage.

Nearly 30 to 35 per cent of the total production of fruits and vegetables worth Rs 3,000 crores are allowed to perish for want of post harvest facilities thus depriving the farmers the fruit of their labour (CFTRI 1992). *Poonia (1994)* assessed that nearly 30 per cent of the fruits are lost due to spoilage during handling, transportation and lack of storage and processing facilities.

Kumar (1993) reported that commercial potential of under exploited fruits are immense but large quantities of fruits are going waste as no serious efforts has been made to use the technologies available to convert them into value added products. He further traces that these fruits lack proper post harvest processing which leads to tremendous loss to our fruit wealth. So there is an urgent need to exploit under exploited fruits.

2.3 SIGNIFICANCE AND UTILISATION OF UNDER EXPLOITED FRUITS

Many delicious fruits that are indigenous to India are under utilized. *Eipeson et al (1992)* proclaim that many of these fruits are known for their nutritional, therapeutic and medicinal properties. *Pareek et al (1993)* reported that underutilized fruits lessen our dependence on the conventional fruits. *Suneel (1993)* highlights that several less known fruit species which have the potential for commercial exploitation are yet to be utilized to their potential.

Geetha (1982) reported that cheaper fruits also carry high nutritious food value and comprise a rich diet, as they contain a large store of essential vitamins and mineral salts. According to *Pareek (1993)* the under exploited fruits are rich in vitamins, minerals and proteins. Some of the underexploited fruits like West Indian cherry contain such an

exceptionally high content of ascorbic acid that a single fruit can satisfy daily vitamin C requirement of an adult *(Pareek and Sunil Sharma 1993)*.

According to *Muthukrishnan (1979)* West Indian cherry is suitable for preparation of clarified juice, squash, jam, jelly and pickle. *Kuridiya et al (1984)* pointed out that jamun an indigenous fruit having an attractive colour and excellent taste can be profitably used for beverage industry. He elicits that the juice of ripe fruit is used for the preparation of syrup and wine. . Products like syrup, jam and jelly are also prepared from fig other than dried and dehydrated products (Wood roof 1985). *Singh (1985)* prepared dehydrated ber by exposing blanched fruit to SO_2 for one hour. The fruits were then dried in sun or solar drier . Amla is grown throughout the country and finds use in the manufacture of preserve, pickle, jam, jelly, squash, chutney and various Ayurvedic preparations *(Jain 1986)*.

Ramdas (1988) reported that pulp of passion fruit can be used in preparation of squashes, cordials, syrups and jellies. He highlights that it can also be used for flavouring candy, icecream and cakefilling. According to the author passion fruit with its flavour and colour blends well with other fruit juices. *Thaper (1988)* prepared vinegar from jamun juice. *Rue (1989)* reported that pomegranate is processed for production of syrup, jelly, bottled juice and wine. *Kulam et al (1991)* reported that ber is processed for the production of RTS beverage, candy and wine. A wide variety of products can be prepared utilising under exploited fruits which include different types of beverages, jams, jellies, preserves, candies, canned and dehydrated products *(Bhowmik 1992)*.

2.4 PHYSICO-CHEMICAL CHARACTERISTICS OF KARONDA

Karonda is a minor fruit characterised by pink coloured and dark purple coloured fruits *(Singh et al 1965)*. According to *Sethi et al (1977)* karonda is a small berry like fruit grown extensively in India. Karonda is one of the under exploited indigenous fruit grown commonly as

organoleptically acceptable. *Khurdiya et al (1984)* developed a recipe for wine using jamun which was organoleptically acceptable. *Joshi (1990)* standardised the method for wine from pomegranate. The sensory evaluation studies showed that pomegranate wine had better flavour and colour than grape wine. *Kadam et al (1991)* has standardised the formula for the preparation of wine from ber which was organoleptically acceptable. *Kotecha et al (1994)* standardised a method of preparation of wine from over ripe banana fruits, sensory evaluation studies showed that wine from over ripe fruits was comparable to that from normal ripe fruit.

As early as *1959, Pruthi* standardised a method for concentrates from lemon. *Thirumaran et al (1990)* standardised a recipe for tomato concentrates with a good shelf life. Similarly *Sethi (1994)* developed a method for whole tomato concentrate using chemical preservatives.

2.6 EFFECT OF PRETREATMENTS ON PROCESSING FRUITS

Any treatment given before processing the fruits are generally considered as pretreatment. These are used to enhance the quality and shelf life of products.

Kalra (1990) defines blanching as a partial precooking method in which fruits and vegetables are usually heated in water or on live steam. *Kalra (1990)* has further reported that blanching may extend shelf life quality and organoleptic quality of the product. Commenting on the other outcomes of blanching, he stated that decrease in volume, nutritive value, natural colour and flavour are observed due to blanching. A comparative study was carried out by *Scott et al (1991)* on the effect of low and high temperature blanching on the firmness of canned and frozen fruits. The study revealed that low temperature blanched canned guava and papaya were significantly firmer than high temperature blanched products. On the basis of these observations a temperature of 5°C for blanching was suggested. Experiment conducted by *Shah and Bains (1992)* on peach and apricot pulps had revealed that blanching prior to pulping at a temperature

of 92.5° 21.5° C for 3-5 minutes resulted in better shelf life qualities. *Sharma and Co-workers (1993)* have reported that blanched apricots, while drying showed low discoloration compared to untreated fruits.

Unburised cherries soaked in water for various length of time increase in both weight and firmness *(Bedford et al 1963)*. Subsequent results obtained with cherries soaked for periods ranging from 0-48 hour in water continuously at 45° F and 5° F indicate that water at the lower temperature is more desirable and that the soaking time should be limited to 12 hour or less to prevent excessive cullage, loss of soluble solids and colour *(Robertson et al 1963)*. *Swingle (1965)* reported that cherries lost as much as 44 per cent in weight during a four hour soaking period.

Reeve (1956) revealed that most of the saucing varieties of apples underwent complete cell disintegration and did not produce a firming effect when dipped in $CaCl_2$ solution. He also observed that apples with less open structure of tissues were not so readily impregnated with sugar. Studies conducted by *Jam et al (1968)* indicated that fruits soaked in 5% calcium lactate containing 0.1% potassium metabisulphite gave a better coloured apple preserve with a firmer structure. According to *Sterling (1969)* firmness increase in sucrose solution and solutions with divalent actions overheat with water and decreased in solutions with monovalent actions with special reference to cooked carrots. *Sony et al (1981)* pointed out that before being candied, cherry fruit is usually stored in brine. Traditionally brine contains So_2 and calcium salts. The workers conclude that the addition of calcium salts improve the firmness of tissues.

2.7 SHELF LIFE QUALITIES OF FRUIT BASED PRODUCTS

The quality parameters generally selected to ascertain its suitability for public use and to study the effect of processing method are chemical tests like acidity, pH, TSS and total sugar, physical test like bulk density, microbial tests and sensory evaluation are also ascertained.

2.7.1 Nutritional And Chemical Qualities

Analysis of citrus juice stored over a period of eight months at room temperature showed an increase of 37.25 percent total acidity *(Mehta and Bajaj, 1983)*. Similar findings were reported in mango squash by *Palaniswamy and Muthukrishnan (1974)* and in the stored litchi juice by *Sethi (1985)*. A slight increase in acidity was noticed after 150 days storage of canned papaya products like juice and nectar by *Kulwal et al (1985)*. Studies conducted in amla juice by *Tripathi et al (1988)* exhibited an increase of 0.86 percent in acidity during storage .Studies conducted by *Thirumaran et al* (1990) had noticed similar increase in acidity in tomato juice concentrate and in fermented carrot based RTS (1992).

Dalal and Salunkhe (1974) reported that canned sweet cherries with 40 Brix syrup observed changes during a period of 16 weeks (storage temperature 40-120 F), as storage temperature increases acidity also increases. Guava pulp stored over a period of 45 days showed an increase in acidity during storage *(Kalra and Revath 1981)*. Analysis of dried pomegranate had also revealed a higher acidity content *(Kahtani 1990)*. Changes in chemical characteristics of mangobars during 90 days of storage indicated an increase in acidity *(Mir and Nath 1993)*. Shelf life studies on whole tomato concentrate stored for eight months exhibited an increase of 2.08 percent in titrable acidity *(Sethi 1994)*.

Bawa and Saini (1987) had reported a decrease in acidity during storage period of bottled carrot juice. A study by *Perlette (1992)* reported that acidity showed a decreasing trend with storage in grape juice. Similar studies in amla candy and dehyrates revealed a decrease of 0.02 per cent acidity.

On the otherhand, analysis of preserved grape juice proved that processing and pretreatments had negligible effect on acidity *(Sandhu et al 1988)*. *Kalra et al (1991)* had also reported that acidity did not change significantly during the 12 month storage of mango papaya

blended beverage. Analysis of kinnow juice over a period of storage of six months indicated negligible to slight change in acidity *(Renote et al. 1993)*.

Mehta and Bajaj (1983) had reported that the citrus juice during storage of eight months showed a slight increase in pH. Studies on the chemical characteristics of citrus juice by *Bawa and Saini (1987)* indicated an increase of pH from 4.2 to 4.5 at higher temperature.

Chemical changes during storage in amla juice produced little change in pH *(Tripathi et al. 1988)*. The kinnow RTS stored, showed negligible changes in pH when evaluated for quality *(Renote et al 1992)*. Canned peach and apricot pulp stored well over 24 weeks produced negligible changes in pH *(Shah and Bains 1992)*. Negligible to slight changes in pH was reported by *Renote et al (1993)* in kinnow juice during storage.

Analysis of canned papaya products by *Kulwal et al (1985)* had indicated no change in pH during storage. Chemical changes related to storage were studied by *Tripathi et al (1988)* in amla jam and dehydrated products. The study indicated no change in pH. The analysis of pH on grape juice by *Perlette (1992)* failed to reflect any change in pH during 24 week storage.

In storage studies conducted by *Dalal et al (1965)* in canned sweet cherries and sour cherries the total sugar was increased during a period of 16 weeks. Shelf life studied in amla juice by *Tripathi et al (1988)* produced a one percent increase in total sugar during 135 days.

During storage of carrot juice the total sugar was found to decline by 0.14 percent at room temperature compared to decline of 0.04 per cent at low temperature by *Bawa and Saini (1987)*. Chemical analysis of fermented carrot based RTS indicated a decline in total sugar *(Thirumaran et al. 1992)*. A similar decline was observed in kinnow juice by *Renote et al (1993)*.

Storage studies of *Kulwal et al. (1985)* in canned papaya products namely pieces, juice and nectar exhibited only negligible changes in total sugar.

Earlier studies by *Singh and Mathur (1953)* exhibited an increase in TSS content in cashew apples at different temperature and the increase was greater at higher temperature. Guava pulp stored at different temperature showed an increase in TSS content within 45 days of storage *(Kalra and Revath 1981).* Monthly analysis of citrus juice stored over period of eight months by *Mehta and Bajaj (1983)* showed a slight increase of 1.03 in TSS. Storage evaluation of amla juice revealed that TSS content increased by 1 per cent with storage period *(Tripathi et al. 1988).*

Storage evaluation of dried amla products observed a decrease in TSS of candy after 45 days, while dehydrated amla remained unchanged *(Tripathi et al 1988).* Storage studies conducted by *Thirumaran and co-workers (1992)* observed a decline in TSS in tomato juice concentrate and fermented carrot based RTS.

Sandhu et al (1988) reported that processing and pretreatment had negligible effect on the TSS content. Mango papaya blended beverage stored over a period of one year at ambient condition had shown that TSS content did not change significantly during storage *(Kalra et al 1991).* Similarly kinnow RTS stored at ambient condition over 24 weeks *(Shah and Bajns 1992)* and kinnow juice over a period of six months *(Renote et al 1993)* had indicated negligible changes in TSS.

2.7.2 Organoleptic Qualities And Acceptability

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

Organoleptic evaluation of amla candy and dehydrated amla showed that the acceptability decreased with storage *(Tripathi et al 1988)*. Changes in sensory characteristics of mango bars during 90 days storage at different temperature, were studied by *Mir and Nath (1993)*. The study indicated that storage decreased overall acceptability and colour. The organoleptic evaluation of tuty fruity made from berries indicated that the products were highly acceptable and overall organoleptic score of ber tuty fruity was better than papaya tuty fruity due to its superiority in flavour and taste *(Chavan et.al 1993)*. The organoleptic evaluation of papaya candy during shelf life period indicated a decrease in organoleptic acceptability with storage *(Sheeja 1994)*.

Muthukrishnan (1979) opines that blending lime and pineapple juice with west Indian cherry at 1:1 ratio resulted in acceptable quality. The blended squash stood storage without any deterioration in colour and quality for a period of 9 months. Sensory quality of passion fruit juices and reconstituted concentrates indicated that heat treated fruit juice concentrates had better acceptability with higher flavour and colour scores *(Bhatia 1984)*. Organoleptic evaluation of bottled carrot juice had shown that the product was acceptable for six months and twelve months at room temperature and low temperature respectively *(Bawa and Saini 1987)*. Particularly no change was observed by *Sandhu et al (1988)* in the evaluation of colour, flavour and taste in stored grape juice. In a report published by *Thirumaran et al (1992)* the formula for fermented carrot based RTS was acceptable for all the quality attributes like colour, appearance, flavour and taste for more than six months.

Earlier in *1950, Pruthi* from his studies concluded that there is better retention of colour, ascorbic acid and keeping quality in canned products. Another study by *Pruthi (1954)* revealed that canned juices and squash could be stored for a period of 12-15 months without any serious loss in quality *Rengarna et al (1966)* reported that pinkish discolouration in canned guavas during storage has been attributed to leucoanthocyanins, reactions of queracetin with metals and other factors. At higher temperature the colour turns more. He also found that canning in plain

syrup prevented discolouration and helped to retain the full flavour of the product during storage at room temperature.

Canned guavas stored at room temperature by *Renganna (1968)* was found to keep well for six months. The texture of the product also remained firm at the end of six months storage. According to *Sethi (1987)* canned litchi pulp was found to be acceptable organoleptically for six months stored at room temperature. The periodical cut out analysis and organoloeptic evaluation of canned litchi products by *Chakraborthy et al (1988)* indicated that the products were attractive for its shape and size, firmness and texture and maintained almost original colour and had excellent flavour. According to *Shah and Bains (1992)* canned peach and apricot pulp was found to be acceptable organeleptically for 24 weeks.

Organaleptic evaluation of stored amla jam indicated an increase in acceptability with storage *(Tripathi et al 1988)*. *Bhatnagar (1991)* reported that keeping quality of watermelon jam was reasonably good under ambient storage conditions for a period of six months. Storage studies conducted by *Joshi (1993)* revealed that karonda jam and jelly were organoliptically acceptable and could be successfully stored under ambient conditions for a period of one year. *Sheeja (1994)* reported that, organoleptic evaluation of papaya jam during storage showed a decrease in acceptability of the product with increase in storage time.

According to *Vaidehi et al (1977)* it is important that a new product is acceptable or not is investigated before introduction to open market. Consumer oriented product development' is concerned with the needs and wishes of the consumer *(Chadha et al 1981)*.

2.7.3 Microbial Aspect

Fruit juice containing 66 percent or more sugar do not ordinary ferment . As early as *1940, Scott and his colleagues* have found that sugar syrup containing 66 per cent sugar have little moisture available for microorganisms to grow or thrive. *Shoen field and Margalith (1962)*

isolated Bacillus group especially B Lichaniformis which caused gaseous spoilage in cans of tomato puree. *Gupta et al (1971)* observed spore forming bacilli associated with the fermentation of commercially prepared vegetable sauce from pumpkin. *Fields et al (1977)* also isolated the same bacteria from home canned tomatoes.

Sethi and Anand (1984) studied the market samples of amla preserve and reported that the microorganisms associated with contamination of preserve are Saacharomyces, polymorphus, and Bacillus cereus. *Allien et al (1986)* reported that spore forming bacilli is the most prevalent one among the Bacillus species identified in fruit products. Analysis on decayed dried pomegranate by *Kahtani (1990)* showed that the organisms responsible were Aspergillus and pencillium. Evaluation on swelling due to gas formation in commercially canned mango pulp showed that it was caused by B. Lichini forms *(Ranganna 1993)*. Analysis of the spoiled samples of tomato concentrate by *Sethi (1994)* indicated that spoilage was either by yeast or Aspergillus.

2.8 EFFECT OF STORAGE CONDITIONS AND MATERIALS ON THE SHELF LIFE QUALITY OF THE PRODUCTS.

Bawa and Saini (1987) reported that the physico-chemical changes were more pronounced at room temperature as compared to low temperature. *Mir and Nath (1993)* had stated that deteriorate changes were temperature dependant. They had further proved that the deteriorate changes were more at higher temperature.

Storage studies by *Manan et al (1982)* on apricot pulp preserved with 547ppm sulphur dioxide has shown that the quality was satisfactory upto 9 months at room temperature. *Sethi (1985)* had reported that pulp from litchi fruit was found acceptable for six months at room temperature and upto 12 months at low temperature. *Kalra et al (1991)* had reported that the mango papaya blended beverage showed a Shelf life of one year under ambient condition.

Kulwal et al (1985) had revealed from his studies that certain undesirable chemical changes like increase in acidity and inversion of sugar were very rapid at higher temperature. Similar result was obtained by *Sethi (1985)* in litchi juice. Studies conducted by *Bawa and Saini (1985)* the effect of storage temperature in bottled carrot juice revealed that refrigerator temperature was quite acceptable. Changes in the chemical textural and sensory characteristics of mango bars during 90 days of storage at -18°C, 27 3° C and 381°C were studied by *Mir and Nath (1993)*. Acidity and reducing sugar increased significantly during storage at higher temperature. The deteriorative changes were minimum at -18°C.

Briston (1971 & 1976) classified containers into two as rigid like cardboard, paper, glass and plastic or flexible like plastic and foil.

Containers such as glass bottles, PVC bottles, HDPE pouches and metal cans are found suitable for storing food products. *Thirumaran et al (1990)* conducted an experiment on the effect of storage containers on tomato concentrate. Among the containers like glass bottles, plastic bottles and polythene covers the best packaging material was found to be glass bottle with a shelf life of 4 months. *Renote et al (1992)* had observed that glass containers are better than metallic pouches for storing kinnow RTS, since the former was superior in sensory quality.

Purushothaman et al (1992) had reported that corrosive products like banana and tomato products could be safely packed in glass bottles. He also evaluated the suitability of indigenously available glass containers for packaging processed products. Reduction in Carotene was less in amber coloured bottles.

Mc Carron (1972) reported that the most satisfactory packaging material is cellophane and cellophane base laminates with respect to aroma.

Saigo and Natsou (1988) studied storage stability of mandarin orange in syrup under the influence of white lamp, mercury, sun with various plastic films. Eg. polythene, cellophane, polyster and laminates as packaging material. They reported that storage in darkness give better stability. According to *Lal (1967)* paperbags, cardboard bottles, jars and aluminated foils are suitable for candied fruits.

Day (1973) studied the use of foil packaging and the extent of protection afforded to confectionery product against moisture absorption, aroma, odour and dirt. The results indicated that the polythylene foil laminate was the most moisture and odour resistant flexible film. *Lane (1973)* reported that the foil containers not only protect the product from physical damage but also play an important part in the processing of product.

Anan (1979) postulated the benefits of cellophane and propylene for flexible packaging. *Mahadeviah (1981)* reviewed the use of packaging material with respect to metal, glass and plastic container. Introduction of aluminium container, heat sterilizable glass containers and plastic laminate and semi rigid containers has been highlighted.

Anan (1970) advocated the use of polypropylene foils coated with Saran for toffees and candies.

Bailey (1990) developed a flexible laminate for packaging hygroscopic food, especially dried fruits. The laminate consists of an inner layer of polystyrene foam with antistock properties. The outerlayer consists of paper or polyethylene film or plastic film.

Critofaru et al (1990) conducted a comparative study of packaging material of fruits juices with glass bottles and cartons. The study revealed little effect of packtype on the quality of the product.

MATERIALS AND METHODS

MATERIALS AND METHODS

The present study entitled ***"Development of karonda (Carissa carandus.L) based products"*** was undertaken to investigate the suitability of locally grown karonda fruit for development of processed products and to assess the organoleptic, nutritional and shelf life qualities and consumer preference for the different products.

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

3.1 SELECTION OF FRUIT

3.2 PHYSICO-CHEMICAL CHARACTERISTICS OF THE FRUIT

3.3 SELECTION OF PRODUCTS

3.4 STANDARDISATION OF PRODUCTS USING KARONDA

- **3.4.1 Karonda Jelly**
- **3.4.2 Karonda Candy**
- **3.4.3 Canned Karonda**
- **3.4.4 Karonda Wine**

3.5 ORGANOLEPTIC QUALITY AND ACCEPTABILITY OF PRODUCTS DEVELOPED

3.6 IDENTIFICATION OF STANDARD PRODUCT

3.7 PREPARATION OF SELECTED PRODUCTS AND ITS DETAILED STUDY

3.8 CONDUCT OF STORAGE STUDY AND ASSESSMENT OF SHELF LIFE BASED ON

- **3.8.1 Changes In The Nutritional And Chemical Qualities During Storage**
- **3.8.2 Microbial Changes**
- **3.8.3 Changes In The Organoleptic Qualities During Storage**

3.9 STATISTICAL ANALYSIS

KARONDA FRUIT

3.1 SELECTION OF FRUIT

Karonda is one of the underexploited indigenous fruit crop grown commercially as a hedge plant. The fruit is highly acidic in taste and suitable for production of many processed products *(Singh 1979)*. Cultivation of new fruits and product formulation from many of the nontable fruits could bring benefit nutritionally and economically *(Swamy et al 1977)*. Presently karonda fruits are processed only to very limited extent owing to lack of adequate processing technical knowhow. Hence little work in respect of karonda fruit was thought of to utilise the fruits being wasted.

Karonda needed for the study was collected from different homesteads. Fresh, sound and clean fruits without microbial attack were selected for the study.

3.2 PHYSICO-CHEMICAL CHARACTERISTICS OF THE FRUIT

Physico-chemical characteristics of the fruit like shape and size, colour, pitting loss, pectin content, acidity, pH, total sugar, TSS, vitamin C and moisture content were studied using metric, visual and standard chemical procedures.

PITTING LOSS

Pitting loss was worked out by taking weight prior to destoning and after removing the seeds.

PECTIN CONTENT

Pectin quality was tested by precipitation with alcohol *(Singh 1991)*.

ACIDITY

Acidity was estimated by the procedure suggested by *Rangana (1987)*.

pH

pH was measured by using a digital pH meter.

TOTAL SUGAR

Total sugar was determined by following a method suggested by A.O.A.C (1975).

TOTAL SOLUBLE SOLIDS

Total soluble solids of the grounded products was measured by using a hand refractometer and expressed as °Brix.

VITAMIN C

Vitamin C content was determined by using the method suggested by *Sadasivam et al (1984)*.

MOISTURE

Moisture content was determined by following a methods suggested by *NIN (1983)*.

3.3 SELECTION OF PRODUCTS

For proper utilisation of the food products available in the country necessary study for utilisation of any product should be conducted *(Vaidehi et al 1977)*. Products selected for development in the present study are

a. Jelly

b. Candy

c. Canned karonda

d. Wine

3.4 STANDARDISATION OF PRODUCTS

3.4.1 Karonda Jelly

Jelly is prepared by boiling fruits with or without water, expressing and straining the juice, adding sugar and concentrating to such consistency that gelatinisation takes place on cooling *(Siddappa 1986)*.

Karonda contains enough of both pectin and acid for making a good jelly *(Singh 1990)*. Hence it was considered with standardising jelly using karonda fruit. According to *Lal et al (1986)* the amount of sugar required for proper setting of jelly depends on the quantity of pectin and acid present. To standardise jelly from this fruit, fruit extract sugar ratio in different proportions were tried. The proportions selected in this study were

a. 1:1

b. 2:1

c. 4:3

The techniques followed in standardisation of jelly using karonda is as detailed below.

FRUIT MATURITY

Slightly underripe fruit yields more pectin than overripe fruit does because as the fruit ripens, the pectin present in it decomposes to pectic acid, which does not form a jelly with acid and sugar *(Lal et al 1986)*. Thus fruits of sufficiently ripe stage (not overripe) having good flavour was used. Fruits were processed with in one to two days after picking inorder to prevent degradation of pectin.

PREPARATION OF FRUIT

Fruits were washed thoroughly with water to remove any adhering dirt. Fruits were then cut into pieces so that the acid and pectin in them could be extracted easily.

EXTRACTION OF PECTIN

Minimum quantity of water was added to the fruit for extraction of pectin. To 1 kg of fruit 1/2 kg of water was added. The fruits were cooked in water till tender. After they were cooked completely, the mass was passed through a fine muslin cloth.

CLARIFICATION

The pectin extract was clarified by allowing the filtrate to settle over night and the supernatant liquid was drained off.

sides of the test tube and was mixed with the extract by rotating the test tube. The mixture was then kept undisturbed for few minutes and observed for pectin quality.

COOKING

Jelly was prepared following the three different fruit extract sugar proportions viz 1:1, 2:1 and 4:3. The three sets were boiled separately. Cooking was continued till it attained jelly consistency.

END POINT DETERMINATION

End point was determined by sheet/flake test (CFTRI 1990). A spoon was dipped into the product and allowed it to fall down from the sides of the spoon. End point was considered when on cooling the product fell in the form of sheets and not in a steady stream. The temperature at which proper jelling took place was also noted using a thermometer. Karonda jelly was properly set at a temperature of 110°C.

BOTTILING

When the jelly was ready, it was poured into clean sterile glass bottles. Care was taken not to entrap air in the jelly mass while pouring. Bottle was sealed when cool.

3.4.2 Karonda Candy

Lal et al (1986) have defined candy as "a fruit impregnated with cane sugar and glucose and subsequently drained and dried". This less known fruit karonda which is available in fairly large quantities in many parts of the state is considered ideal for candying just like cherry *(Lal et al 1986).*

Siddappa (1986) has stated that the process of impregnation with sugar for candy making must not be hurried through because, otherwise the fruit will shrivel and sweat and become unfit for glacing and crystallizing. Thus for standardisation of karonda candy different impregnation periods for attaining required sugar concentration were tried. The durations selected for soaking fruit in sugar syrup for candying in the present trials were

a. 1 week

b. 3 weeks

c. 5 weeks

The process adopted for making candy is the following

FRUIT MATURITY

Firm ripe fruits of even maturation were used for candy making as overripe fruits developed jam like consistency in the syruping process *(Lal et al 1986)*.

WASHING AND PITTING

Fruits were washed in ample quantity of fresh water. After draining water they were halved with a sharp stainless steel knife and pitted for destoning. Pitting is done manually or mechanically *(Cruess 1958)*. The pitting loss is about 15 percentage of the weight of the stemmed cherry *(Cruess 1958)*.

PRETREATMENT

Before impregnation with sugar the fresh fruits were blanched for 3 to 4 minutes in boiling water containing 2 per cent alum. This treatment is considered to facilitate the penetration of syrup to make them soft inactivate enzymes and to minimise astringency *(Singh 1990)*. After this fruits were washed thoroughly in water *(Gupta and Bopaiah 1986)*.

YRUP TREATMENT

Sugar syrup of 30° brix was prepared based on the method of *Siddappa (1986)*. The syrup was taken in three different vessels for preparing candy following the different impregnation timings suggested for standardisation.

For all the treatments on the first day the fruit was placed in a hot sugar syrup of 30°brix containing 0.5 per cent raspberry red food colour. According to *Sethi and Anand (1977)* karonda preserve is manufactured after artificially dyeing the fruits to give them a bright red tinge. Permissible coal tar dyes like erythrosine and carmoisine was found in use for dyeing karonda *(Sethi and Anand 1977)*. Due to the nonavailability of the particular dye raspberry red food colour was used in the sugar syrup for the present trial.

On the following day for treatment a, drained off the syrup and then raised to 40°brix by adding more sugar. After boiling the syrup added the fruit to it and allowed to stand for 24 hours. At this stage citric acid was added at the rate of 0.1 per cent to the syrup to induce partial inversion of sugar and to prevent crystallisation *(Dan 1981)*. Continued this process daily for a week untill the syrup concentration reached 75°brix.

For treatment be, next day drained off the syrup and then raised its strength to 5°brix. This was brought to boil and again placed the fruits in it. Allowed the mixture to stand for 24 hours. Repeated this process daily until the syrup concentration reached to 60°brix. Citric acid at the rate of 0.1 per cent was added. The strength of the syrup was progressively increased (by 5° at a time) by adding more sugar and boiling the mass everyday, until the final concentration reached to 75°brix. Then the fruit was allowed to remain in this syrup for 10 days.

For treatment c, drained off the syrup the following day and then raised to 35° brix by adding more sugar. The strength of the syrup was increased (by 5° at a time) on every alternate days until the final concentration reached to 75°brix by a period of three weeks.

Citric acid was added at the rate of 0.1 per cent to the boiling syrup at the stage of 60°brix. The fruit was again kept in this syrup undisturbed for another two weeks.

DRAINING AND DRYING

After the syruping treatment has been completed the fruit was removed from the syrup and dried for about half an hour in the sun by spreading on a wire mesh tray.

3.4.3 Canned Karonda

Canning is the preservation of sterile food in hermetically sealed containers *(Lal et al 1986)*. *Siddappa (1967)* reported that large quantities of all well known fruits are canned on a large scale as well as on a small scale. Thus in order to formulate a standard procedure for canning of this less known fruit three different treatments were tried to select a good quality product. The following are the treatments used for standardisation.

a. Hardening the fruit and canning as a whole

b. Hardening the fruit and pitting

c. Pitting and without hardening the fruit

The method followed for canning karonda is as follows.

FRUIT MATURITY

Well ripe, but firm, and evenly matured fruits free from all blemishes, insect damage and malformation were used.

WASHING, GRADING AND PITTING

The fruit was thoroughly washed with water and even sized fruits were selected. For treatments (b) and (c) the fruits were halved and pitted for destoning.

HARDENING

For treatment (a) and (b) the fruits were hardened prior to canning. For hardening, fruits were dipped in boiling water containing 2 per cent calcium chloride for 3 to 5 minutes. Calcium hardens the tissues by combining with pectin material *(Cruess 1958)*. Fruits were then washed in fresh water.

CAN FILLING

Acid resistant (AR) cans were used for processing the fruit. Cans were washed with water to remove any adhering dust or foreign matter. Then the karonda fruits were filled into 3 different AR cans to two-third capacity.

SYRUPING

A hot syrup of 45°brix *[following the procedure of Lal (1986)]* with 0.2 per cent citric acid was prepared and strained. The syrup was filled into 3 different cans at a temperature of 79°C to 82°C, leaving suitable headspace of 1.2cm in the can *(Singh 1990)*. *Labelle (1971)* reported that inhibition of enzymatic degradation required a hot fill at about 180°F (82.2°C).

EXHAUSTING

Before sealing the cans finally it was necessary to remove all air from the contents. The process by which this was achieved is known as exhausting. The cans were exhausted by placing in boiling water till the centre of the can attained a temperature of 85°C *(Singh 1990)*. The cans were deaerated for 10 minutes.

SEALING

The exhausted cans were then mechanically vacuum sealed immediately using a double seamer.

PROCESSING

The term processing used in canning technology means heating of canned foods to inactivate bacteria *(Singh 1990)*. Cans were processed in 100°C water bath for 20 minutes for sterilising as suggested by *Randhawa and Singh (1967)*.

COOLING

After processing the cans were cooled in running water rapidly to stop the cooking process *(Randhawa and Singh 1967)*.

LABELLING

The cans were wiped dry with a clean cloth and labelled.

3.4.4 Karonda Wine

Wine is a natural, non toxic, healthful fermented alcoholic product rich in calories, vitamins and minerals *(Joshi 1990)*. According to *Attri et al (1990)* there is a considerable scope for fruit based fermented beverages in India. An attempt was therefore made to develop wine from karonda fruits which has not been accepted as eating as a table fruit.

In the present study wine was standardised with the following trials.

a. Adding boiled and cooled water to the fruit for fermentation.

b. Adding boiled water to the fruit for fermentation.

c. Boiling fruit with water for fermentation.

The method of preparation of karonda wine adopted in this study is explained here.

FRUIT MATURITY

Fully ripe fruits were used for wine making in order to facilitate maximum extraction of colour and flavour in the product and to assist in better fermentation.

WASHING AND CRUSHING

The fruits were washed thoroughly with water. They were crushed and placed in three different jars made of good quality clay.

PREPARATION OF MUST

For treatment a, boiled and cooled water and sugar was added to the fruit in the ratio of 1:1.5:1.

For treatment b, boiled water and sugar was added to the fruit in the ratio of 1:1.5:1.

For treatment c, water was boiled along with fruit and sugar was added in the ratio of 1:1:1.5. Only half the quantity of sugar was added in the initial step.

FERMENTATION

To ferment the juice, a culture of pure wine yeast was added as a starter to each jar and were kept closed. To samples b and c, yeast was added when the temperature of must reached 30°C. The must was stirred everyday with a wooden laddle by opening the jar. Remaining portion of sugar was added to the must in all three samples after fermentation of two weeks. Stirring process was continued till 21st day. The fermentation process required for wine was completed by this time.

FILTRATION AND SEDIMENTATION

The fermented juice was filtered using a double layered muslin cloth. The filtered juice with each treatment was transferred to clean and dry jars. The jars were tightly closed and kept undisturbed for a period of one month for sedimentation and ageing.

SIPHONING

After the sedimentation process the clear wine was siphoned off using a plastic tube and filled in clear sterilised bottles. The different samples of wine were labelled for the purpose of choosing the best product by palatability test through selected judges.

3.5 ORGANOLEPTIC QUALITY AND ACCEPTABILITY OF PRODUCTS DEVELOPED

Quality assurance in food industry is an ordered set of planned and systematic actions necessary to provide adequate confidence that processes, products and services satisfy the requirements of quality *(Rajalakshmi1993)*. Sensory quality is one of the criteria of the acceptability of any food product by the consumer. An overall quality of a product in addition to quantity and nutritional attributes, also depends on the sensory quality *(Mehony1986)*. It is well recognised that chemical indices of deterioration alone will not decide the quality deterioration and it should be correlated sensory evaluation of stored product *(Jellnick 1985)*

Products prepared following three different treatments were assessed for their organoleptic qualities on the basis of various quality attributes. For the conduct of sensory evaluation, the panel members were selected from a group of 25 healthy women in the age group of 20 to 25 using the triangle test. Studies have indicated that a small highly sensitive panel would usually give more reliable results than a large less sensitive group *(Amerine et al 1965)*. Hence from the 25 women participated, 10 very sensitive women were selected by the triangle test. Evaluation card used for the triangle test is presented in appendix I.

The acceptability trials on fresh products namely jelly, candy, canned karonda and wine were carried out at the laboratory with the selected panel members. Scoring test was used for quality evaluation as suggested by *Swaminathan (1974)*. A five point rating scale was applied for each quality. Judges were requested to taste the three samples prepared with all the four products. Water was given in between for the removal of any after taste carried over from

sample to sample. Judges were permitted to take enough time to score the samples leisurely. Testing was conducted in the afternoon between 3pm and 4pm since this time is considered as the ideal time for conducting the quality evaluation studies *(Swaminathan 1974).*

3.6 IDENTIFICATION OF THE STANDARD PRODUCT

To identify a standard recipe for the products under study using karonda fruit the overall acceptability for the three samples in each product were worked out. Mean scores for each attribute was calculated from 10 individual assessors (10 x 5 scores) to find out the overall acceptability. Samples with the highest overall mean score among the particular product was identified as the best one.

Major quality attributes included for assessing jelly, candy and canned karonda by the panel members were taste, flavour, appearance, texture and colour (appendix II). The quality parameters viz strength and clarity were additional characters specially used on wine for judging quality (appendix III). Based on the sensory evaluation the best method for making products viz jelly, candy, canned fruit and wine using karonda fruit was selected.

3.7 PREPARATION OF SELECTED PRODUCTS AND ITS DETAILED STUDY

The selected products were prepared in larger quantities for detailed studies.

MAIN ITEMS OF OBSERVATION DONE ON THE STANDARDISED PRODUCTS ARE

3.7.1 Chemical And Nutritional Composition

Chemical composition is an index to quality of product. Chemical and nutritional composition of the standardised products were analysed and the major components analysed

were acidity, pH, total sugar and total soluble solids. Alcohol content of wine also was tested by the procedure suggested by *Hart (1971)*.

3.7.2 Confirmation With Fpo Requirements

The quality of the preserved product is controlled by the government through the Fruit Product control Order (FPO) 1955 *(Siddappa 1967)*. The FPO requirements of the processed products were taken into consideration while preparing the products in this study.

3.7.3 Cost Analysis

Cost analysis of the different products were worked out by estimating the cost of the ingredients as purchased used for the particular quantity of each product under study. Cost of fuel was also included in calculating cost per unit.

3.7.4 Fruit Product Yield Ratio

Fruit product yield ratio was analysed by taking into consideration the quantity of fruit used to produce a particular unit of each product using karonda

3.7.5 Consumer Acceptance And Consumer Preference Of The Products Standardised

Elizabeth (1990) reported that consumer testing of the process product should also receive attention to determine acceptability of such product. To determine the consumer acceptance and preference of the products developed using karonda fruit, tests were conducted among 50 untrained panel members at the field level. The products were served to 50 consumers at the university campus. These consumers were requested to give scoring based on two responses, the first an assessment of sensory qualities and the second giving preference rank to the products. These field test on consumers were carried out at the same time. The acceptability trials on these consumers were done using the scoring method. The same score card designed for

acceptability on trained panel members were used for field trial among consumers also. The same quality attributes on five point rating scale were assessed in the field trial also.

To determine the consumer preference of the products preference ranking according to the consumers liking was done. The four different products viz jelly, candy, canned fruit and wine were tested to select the preference grading of products.

3.8 CONDUCT OF STORAGE STUDY AND ASSESSMENT OF SHELF LIFE

Samples of the four products were then stored at ambient conditions as detailed below in Table-1

TABLE-1

DETAILS OF SAMPLES KEPT FOR STORAGE STUDIES

NATURE OF SAMPLES	UNIT CAPACITY	QUANTITY STORED
JELLY	200g bottles	20 bottles
CANDY	100g packets	40 packets
CANNED FRUIT	150g / tin	30 cans
WINE	400ml bottles	20 bottles

The different products viz jelly, candy, canned fruit and wine stored at ambient conditions were assessed at monthly intervals for a period of eight months to study the shelf life behaviour of the above products prepared with karonda fruit. The parameters selected to monitor the shelf life quality of jelly, candy, canned fruit and wine are chemical, nutritional, microbial and organoleptic qualities during storage.

3.8.1 Changes In The Nutritional And Chemical Qualities During Storage

Periodical evaluation of chemical and nutritional qualities of all the four products were done every month of storage for a period of eight months to observe the effect of storage and shelf life.

3.8.2 Microbial Changes

The products prepared were assessed for microbial contamination viz bacteria, fungus and yeast using standard plate method (SPC). Nutrient agar, potato dextrose agar and maltose extract agar media were used for detecting the presence of bacteria, fungi and yeast respectively.

3.8.3 Changes In The Organoleptic Qualities During Storage

Monthly assessment of the changes in organoleptic qualities were done every month upto a period of 8 months to find out the deviation in sensory qualities.

3.9 STATISTICAL ANALYSIS OF THE DATA

All the above said observations were statistically analysed. CRD was used as the program for statistical analysis.

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

Results pertaining to the study entitled **"Development of karonda (Carissa carandus.L) based products"** are discussed under the following lines.

4.1. PHYSICO-CHEMICAL CHARACTERISTICS OF KARONDA FRUIT

4.2. DEVELOPMENT OF PRODUCTS USING KARONDA

4.3. INDEPTH STUDIES ON SELECTED KARONDA BASED PRODUCTS

4.4. ASSESSMENT OF SHELF-LIFE

4.1 PHYSICO-CHEMICAL COMPOSITION OF KARONDA FRUIT

The physico-chemical composition of karonda fruit was analysed to study the nature of fruit. The major characters analysed were size of fruit, moisture, acidity, pH, total sugar, TSS and vitamin C and the results are presented in Table-2

Karonda is a small berry used for edible purpose, As detailed in Table-2, on physical examination, the fruits were found to be oblong shaped. The colour of the fruit was observed as pink with white blush. The average weight of the fruit was recorded as 1.89g. Size measurements were made with vernier calipers and the average size (l x d cm) of the fruit was 2.8 x 2.0 cm. The seed content of the fruit was recorded as 10 per cent fresh weight. These physical diameters are in the range reported by *Sethi (1981)* for karonda that the fruit has an average size of (l x d cm) 2.4-3.4 x 1.8-2.8 and the seed content of the fruit formed was 12 per cent.

TABLE-2

PHYSICO-CHEMICAL COMPOSITION OF KARONDA FRUIT

PARTICULARS	FRESH FRUIT
Colour and appearence	Pink with white blush
Average size (lenght x diameter cm)	2.8 x 2.0
Shape	Oblong
Average weight (g)	1.89
Waste/seed (%)	10.00
Moisture (%)	85.60
Acidity (%) Citric acid / g	3.10
pH	3.20
Total Soluble Solids (%)	3.80
Total Sugar (%)	2.10
Vitamin C (mg /100g)	12.50

The composition of the fresh fruit in Table-2 reveals that karonda is a juicy fruit having a moisture content of 85.60 per cent. The fruit is highly acidic in taste and the acid content of the fruit was recorded as 3.10 per cent. The pH of fresh karonda fruit was observed as 3.20 per cent. Total sugar content and TSS of the fruit recorded were 2.10 per cent and 3.80 per cent respectively. Vitamin C content of the fruit was observed as 12.50 per cent. According to *Singh et al (1993)* chemical constituents present in fresh karonda fruit include moisture 87.5-90.0 per cent, acidity 0.60-6.00 per cent, pH- 3.2-3.5, total sugar 0.93-3.73 per cent and vitamin C (mg/100g) 10.30-17.90 per cent.

Qualitative analysis of pectin content of the fruit also was carried out to test its value for jelly making. The quality of pectin was tested by precipitating with alcohol. A big clot of thick firm spongy mass was formed during the test for pectin content. This indicated that the fruit collected was rich in pectin. *Amarsingh (1990)* states that if the extract is rich in pectin, it will form a single transparent lump of jelly like consistency.

From the physico-chemical examination it was noted that the fruit is an oblong shaped small berry with very low percentage waste portion. Chemical nature was highly acidic having a negligible sugar level and good vitamin c content. The pectin value of this non table fruit was found to be high, lending its feasibility for making suitable processed products.

4.2 DEVELOPMENT OF PRODUCTS USING KARONDA

Rajalakshmi et al (1981) reported that product development requires specific guidance from consumer preferences. The identification of the ideal concept of the consumer is of utmost importance in formulating any new product and finetuning it to his requirement. The development of the optimum formulation should also take into account technical feasibility and minimisation of time cost.

Product development is an important aspect in view of utilisation of less known fruits like karonda, a minor fruit of sub tropical regions. Thus in an effort for popularising and increasing utilisation of this fruit, development of suitable products were attempted. The products developed in the present study are

1. Karonda jelly
2. Karonda candy
3. Canned karonda
4. Karonda wine

Earlier trials were conducted in the laboratory to formulate recipes for each product. These recipes were then standardised for consistent quality production applying three different treatments. Sensory evaluation methods, especially the newer procedures, strive to provide specific directions for product development, modification and optimisation. They also provide an estimate of the potential gap between the ideal products of the consumer and the current formulations. Organoleptic qualities of the food products can be assessed by sensory evaluation.

Sensory quality is one of the criteria for acceptability of any food product by the consumer *(Jellnick 1986)*. Moreover the sensory evaluation of the food is assumed to be increasing significance, as this provides information which may be utilised for development of a product and its improvement. The acceptability of the products prepared using karonda were studied in detail by conducting sensory evaluation test on each product using three different treatments. Trials for each product were repeated two times. Mean scores obtained for the two trials were worked out. Major quality attributes studied were taste, flavour, appearance, texture/clarity and colour as these parameters are important in quality determination.

According to *Rolls (1981)* in the various quality attribute test the first evaluation goes to the taste followed by flavour, appearance, texture and colour. Taste is the major attribute which determines the acceptability of food material.

Flavour is the unique character of odour and taste. Appearance of the food is important but it is the flavour that ultimately determines the quality and acceptability of foods *(Tejmuder 1994)*. *Renganna (1986)* stated that flavour is an important factor which enriches the consumer's preference to a particular product.

As the consumers preference to appearance is one of the major factors leading to the increasing demand of the product, it is very essential to keep the appearance of the product quite attractive *(Christensen 1985)*.

According to *Renganna (1981)* texture is the property of food which is associated with the sense of feel or touch experienced by the fingers or the mouth which requires considerable trained personnel.

The first impression of food is usually visual and major part of our willingness to accept a food depends upon its colour *(Jellnick 1986)*.

An additional criteria studied with respect to wine alone is "strength". The most acceptable product in each criteria was given a score of 5 and the least acceptable was given a score of 1. The result of the acceptability trials conducted on karonda products developed, are presented in the forgoing discussion.

4.2.1 Acceptability Of Karonda Jelly

Fruit jelly is a product of gelatinous consistency prepared by boiling strained fruit extract with sugar *(Lal et al 1986)*. In the present trial for the preparation of karonda jelly, fruit extract sugar ratio in different proportions were tried. The proportions were.

Fig.1 represents the various steps in jelly preparation. The mean score obtained for the sensory evaluation trials on samples of karonda jelly prepared with different concentrations of sugar are given in Table-3.

TABLE-3

ACCEPTABILITY LEVELS OF KARONDA JELLY SAMPLES (MEAN SCORES)

QUALITY ATTRIBUTES	TREATMENTS			CD VALUE
	T1	T2	T3	
Taste	1.80	3.50	5.00	0.35**
Flavour	4.30	4.00	4.90	0.25**
Appearance	2.50	3.90	5.00	0.32**
Texture	1.50	2.50	5.00	0.42**
Colour	4.30	4.60	5.00	0.51*
Overall Acceptability	2.80	3.80	4.90	1.4**

** Significant at 1% level

* Significant at 5% level

Fruit extract sugar ratio

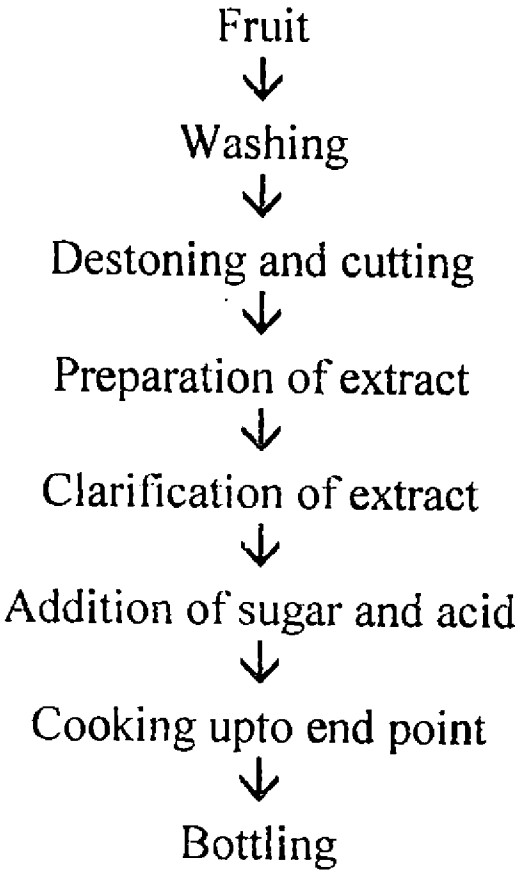
T1 - 1 : 1 proportion

T2 - 2 : 1 proportion

T3 - 4 : 3 proportion

FIG.1

FLOW CHART FOR
PREPARATION OF KARONDA JELLY



As per the Table-3 the highest mean score for taste was observed for the sample (T_3) in which fruit extract sugar proportion was in the ratio 4:3 and which scored cent per cent (5.0). Jelly with proportions 2:1 (T_2) and 1:1 (T_1) obtained lower scores when compared to 4:3 proportion. Among this 1:1 proportion (T_1) ie jelly prepared with equal quantity of fruit extract and sugar had obtained least score (1.8). The mean scores ranged from 1.8 to 5.0. Statistical analysis of the data revealed that significant difference was observed for taste among the different treatments.

From the result it was found that the taste of jelly, was superior in T_3 (4:3 proportion). This revealed that sweetness and acidity of karonda jelly was well balanced in this treatment. In treatment I (1:1 proportion) fruit extract and sugar ratio were in equal proportion where an ideal taste could not be attained as the jelly obtained was more sweet. In 2:1 proportion (T_2) the proportion of sugar was found to be low which resulted in lesser taste acceptability.

In flavour, the score ranged between 4:9 to 4:0 among the treatments. The highest score was attained by 4:3 proportion (4.9) followed by 2:1 proportion (4.3) and 1:1 proportion (4.0). When the flavour of different jelly samples were taken into consideration there existed significant difference between T_2 and T_3 and T_1 and T_3.

The flavour intensity of jelly was found highly acceptable in T_3. The appropriate sugar acid blend of the product might have influenced the flavour also favourably. For the jelly sample in which half quantity of sugar compared to fruit extract was used (T_2) the flavour preference had second place, where as jelly composition in which equal quantity of extract and sugar (T_1) due to its high sugar level, the flavour contributed by the fruit was minimised and had the least preference.

When appearance of jelly samples were assessed the score ranged between 5.0 to 2.5 where T_3 scored the highest and maximum score (5.0). The least score of 2.5 was observed for

T_1. A moderate score was obtained for T_2 (3.9) ie treatment in which fruit extract sugar ratio in 2:1 proportion was taken. Significant difference was observed in the mean scores for appearance of different jelly samples.

As per the result, T_3 performed best in appearance of jelly due to its high clarity, transparency of jelly and well set product. According to *Siddappa (1986)* a perfect jelly is clear, sparkling, transparent and of attractive colour. However in T_2, the appearance was not so good as compared to T_3 because of the low concentration of sugar this jelly was not well set. In T_1, due to high concentration of sugar the jelly appeared to be very hard.

Maximum score in texture of the jelly samples was attained by T_3 (5.0) followed by T_2 (2.5) and T_1 (1.5) 1:1 proportion scored the least. Comparison with CD values showed that there was significant textural difference among treatments.

It was observed that a superior texture was achieved in karonda jelly (T_3) prepared with 4:3 proportion of fruit extract sugar ratio. It could be learned from the data that for the high pectin level of karonda fruit, the sugar used in this treatment for the formation of jelly was ideal. The more concentrated the sugar solution, less water the jelly to support and resulted n stiffer texture as observed in the case of T_1. This finding agrees with the results of the study conducted by Sweetmaker (1983). He reported that if higher amount of glucose is used, than jelly becomes very tough. With regard to T_2, the jelly was not well set because the right amount of sugar required for the proper get formation was not present in it.

Colour attribute evaluation test, of karonda jelly recorded scores ranging between 5.0 to 4.3. The mean values in all the treatments were observed above four. Maximum mean score was maintained by T_3 in colour perception also. 2:1 proportion (T_2) had also obtained a rather good score (4.6) while 1:1 proportion (T_1) rated a comparatively low score (4.3). Statistically no significant difference was noticed for colour among different treatments.

Encouraging results in colour was obtained when jelly was prepared with karonda fruit. Colour attribute of jelly was highly attractive and maximum with T_3. A well balanced proportion of pectin sugar and acid resulted in an attractive colour. Colour of T_2 was also comparable to T_3. Slight colour reduction was observed in T_1 which was due to the dilution of colour because of excess sugar content present in this treatment of jelly sample.

Overall acceptability of jelly appeared dependent on the sensory attributes. The highest mean score of 4.9 was secured by jelly sample T_3 (4:3 proportion) in overall acceptability. T_2 recorded the second mean score value (3.8). Overall acceptability was found to be lowest in T_1 (2.8). Data on the mean score obtained for overall acceptability of different treatment revealed a significant difference.

Considering the taste, colour, flavour, texture and appearance, the best jelly was formed by the procedure attempted with a 4:3 proportion fruit extract sugar ratio (T_3). Three substances are essential for the preparation of a normal jelly. These are pectin, acid and sugar. Of these pectin is the most important. *Lal et al (1986)* reported that proper amount of sugar to be added to fruit extract in jelly making is directly proportional to the amount of pectin and acid present in it. In the present study it was found that 4:3 proportion of fruit extract sugar ratio was the best for karonda jelly, since jelly with the best sensory quality attribute was formed when prepared in this proportion. This result is found in accordance with the report of *Gopalan (1992)*. It can also be inferred from the study that equal amount of sugar (T_1) gave less colour, more sweetness and sticky texture while T_2 was less sweet, inadequately set and had an improper texture.

4.2.2 Acceptability Of Karonda Candy

Candied fruits are fruits which have been impregnated with enough sugar to preserve them. Candy using karonda is another product selected for study. Fruit and sugar are the main

raw materials required for candying. For the standardisation of karonda candy the treatments followed were

One week impregnation in sugar

Three weeks impregnation in sugar

Five weeks impregnation in sugar

Fig.2 shows the steps involved in the preparation of karonda candy. A process of quick sugar soaking was adopted in treatment 1. Syrup concentration was attained at a level of 75°brix within a week in this treatment. In the case of T_2 the process was not hurried as the sugar concentration of 75°brix was attained in 11 days time and the fruit was allowed to remain in the solution for another 10 days. Treatment 3 was a gradual process in which the strength of the syrup was increased on every alternate day and the final concentration was reached in three weeks time. The fruit was kept in this syrup for another two weeks. Table-4 presents the mean scores for different quality attributes obtained for karonda candy made by the treatments described.

TABLE-4

ACCEPTABILITY LEVELS OF KARONDA CANDY SAMPLES (MEAN SCORES)

QUALITY ATTRIBUTES	TREATMENTS			CD VALUE
	T1	T2	T3	
Taste	3.80	4.80	3.50	0.42**
Flavour	3.50	4.50	3.20	0.45**
Appearance	3.20	4.50	3.50	0.45**
Texture	3.60	4.10	3.40	0.49*
Colour	3.80	4.50	4.20	0.42**
Overall Acceptability	3.60	4.50	3.50	1.8**

** Significant at 1% level

* Significant at 5% level

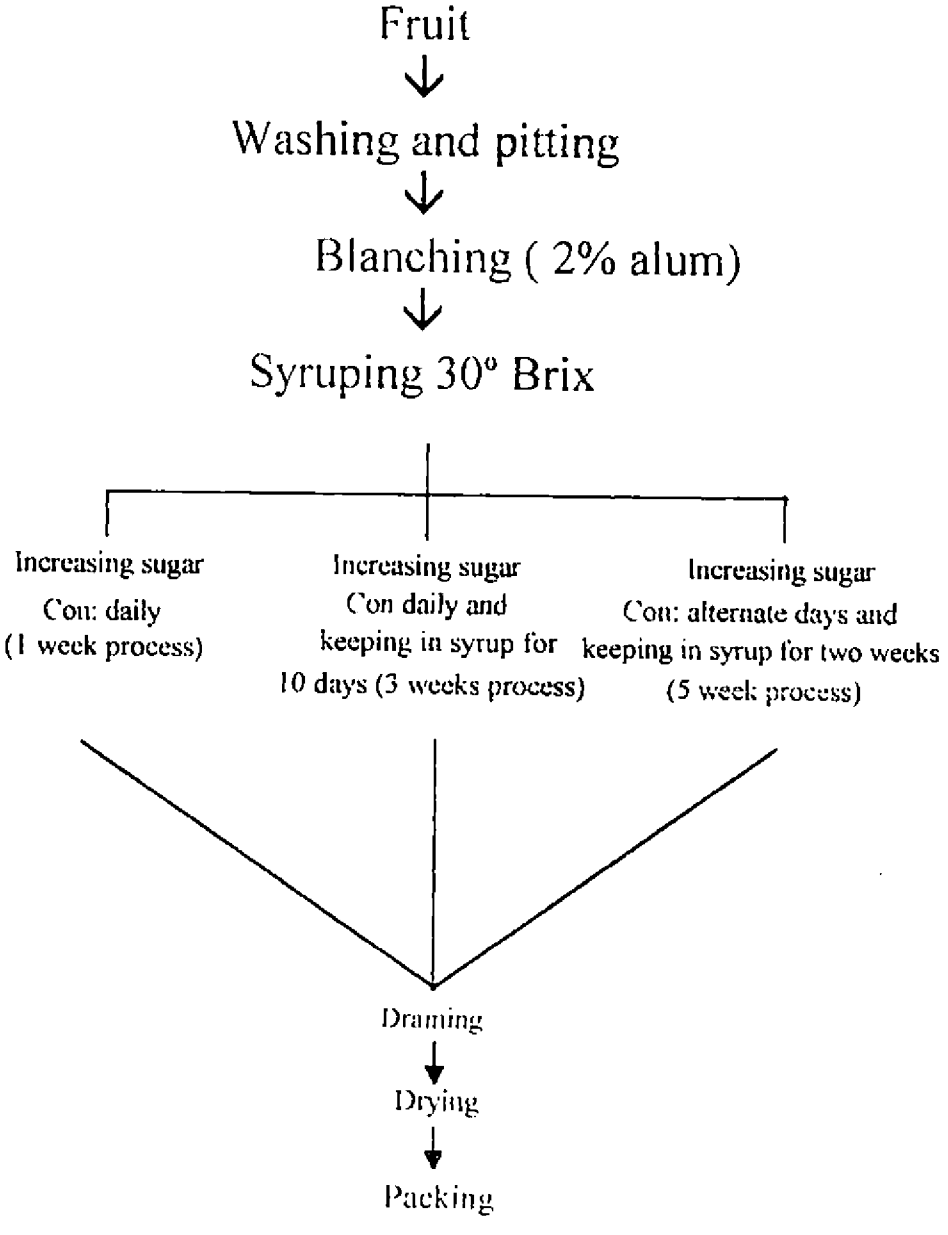
T1 - 1 week impregnation

T2 - 3 weeks impregnation

T3 - 5 weeks impregnation

FIG.2

FLOW CHART FOR PREPARATION OF KARONDA CANDY



As indicated in Table-4 candy prepared with three weeks impregnation in sugar (T_2) gave the highest score in taste (4.8). Candy prepared by one week sugar dipping (T_1) obtained a score of 3.8 and treatment 3 i.e. 5 weeks impregnation in sugar obtained the lowest mean score (3.5). Comparison with CD values showed that there existed significant difference between T_1 and T_2 and T_2 and T_3 but statistically no difference was observed between T_1 and T_3.

From the taste attribute score of candy it was revealed that the best taste performance was shown in the procedure followed with three weeks impregnation in sugar (T_2). This is indicative that sufficient inversion of the cane sugar has occurred with adequate acidity level that helped for the best taste pick up in this sample. Daily raising of sugar concentration and keeping the fruit finally in the syrup for ten days was thus proved an ideal period. Whereas a fast method syruping with one week (T_1) gave candy with lesser taste than T_2. However with delayed and alternate day sugar raising (T_3) the taste attained lowest score. The lower rate of sugar pickup at the initial days facilitated slight fermentation and thus the product had a fermented taste. In this case sugar addition was performed only alternately and this resulted in favourable conditions for the growth of microorganisms. Suitable sugar concentration to inhibit the growth was not present at initial days and thereby the taste attribute for T_3 to the lowest level. *Lal et al (1986)* states that there is a likelyhood of spoilage occurring due to fermentation especially in the initial stages of preparation of preserves and candies when the concentration of sugar in the syrup is low.

The highest and the lowest mean scores for flavour ranged between 4.5 to 3.2. Candy with highest flavour score of 4.5 was attained by T_2 (3 weeks impregnation in sugar) followed by one week sugar dipping (4.0) and T_1 (5 weeks impregnation in sugar). In the case of flavour T_2 and T_3 showed a significant difference statistically. But there was no significant difference between T_1 and T_2.

A candy having highly acceptable flavour was formed in T_2. T_1 also had a comparable flavour. But in T_3, due to fermentation an incipid flavour developed that resulted in lowest acceptability.

The score value of appearance of candy samples ranged between 4.5 to 3.2 in which three weeks impregnation in sugar (T_2) scored the highest (4.5). T_1 and T_3 scored lower when compared to T_2, the mean value obtained was 3.2 and 3.5 respectively. T_1 and T_2 showed a significant difference statistically. But there was no significant difference between T_1 and T_3.

The best candy in appearance was also proved by (T_2) the procedure of daily raising the sugar concentration and completing the syruping process with 3 weeks time. When the process was hurried as in the case of one week sugar dipping it resulted in shrinkage of fruit and this shrieveled appearance was the reason for lowest score in T_1. Whereas for T_2 (3 weeks impregnation in sugar) this was not so as the sugar concentration was slowly raised and allowed to remain in syrup for few days. *Sethi (1981)* reported that slow raising of syrup concentration for making candy helps to retain the size and shape of the fruit with a minimal shrievelling. However when the fruit remained in the sugar solution for longer periods i.e. 5 weeks impregnation in sugar, the chance for shrievelling had not completely been checked. Thus a 3 week schedule was beneficial over a hasty and dragging process for giving good shape and appearance to karonda candy.

On analysing the scores obtained for texture of candy, 3 week impregnation in sugar was found to have attained the highest score of 4.1. T_3 scored the least (3.4). Moderate score was obtained for T_1 (3.6) i.e. 1 week impregnation in sugar. A significant treatment difference was revealed on statistical computation.

From the study it was found that texture wise the best candy was attained with slower raising of sugar concentration as evidenced by T_2 (3 weeks). There was no evidence of crystallisation or sogginess on this sample. The sudden syruping (T_1) resulted in incomplete inversion of sugar and thus harder fruit was formed. while too longer duration in the soaking of fruit caused oversaturation making the candy soggy and slightly disintegrated.

Likewise the characters for the colour appeal of candy also the highest score was attained by T_2 (4.5) followed by (T_3) 5 week sugar dipping (4.2). T_1 recorded the lowest colour appeal (3.8). Statistically there was no significant difference between T_2 and T_3. But a significant difference was observed between 1 week sugar dipping and 3 week sugar dipping.

Contribution of colour also was the maximum in the three weeks process. It has to be inferred from the result that the ideal time for the best colour pickup have been provided in treatment 3. With a period of one week, colour was not found to be absorbing in the fruit properly. It was also noticed from the study that by 3 weeks time, maximum colour absorption was attained but a further longer period (5 weeks) of soaking the fruit could not increase the score for colour of the candy. This can be attributed to leaching of more colour after a certain period into the syrup there by decreasing the colour intensity. In general the use of raspberry red colour was found inferior to dyeing the fruit with erythrosine as practised commercially. This might have resulted in increased loss of colour. Cherries are dyed with a red dye such as erythrosine and are used for canning or candying *(Lal et al 1986)*.

Scores obtained for overall acceptability ranged between 4.5 to 3.5. Three weeks impregnation in sugar was found superior with the mean value of 4.5. 5 week sugar dipping had obtained the least score (3.5). When the overall acceptability of the candy prepared by the different treatments were taken into consideration, there existed significant difference among treatments.

Thus it was evident from the study that the overall superior sensory characteristic was attained by the fruit dipped in sugar solution for 3 weeks with respect to candy preparation. When compared to other durations viz 1 week and 5 weeks. One week process proved a shorter duration for the preparation of candy and the process taking five weeks could not improve the quality attributes other than lowering the qualities in certain aspects like taste, texture and appearance. The candy prepared by treatment 2 maintained all attributes in top rank and was

delicious in taste, could be compared with the popularly known cherry available in the market in appearance and organoleptic quality. The process of daily raising the sugar concentration and finally leaving undisturbed in the syrup within a period of three weeks gave superior sensory quality to the candy.

4.2.3 Acceptability Of Canned Karonda

Among the conventional methods of preservations of fruits and vegetables, canning or bottling occupies a prominent place practically in every part of the world where large quantities of well known fruits are canned. With the view that canning would provide another option for the fresh karonda fruit, an attempt was made in the present study to preserve karonda fruit by canning. The three treatments selected for standardising canning procedure for karonda in the present study were

Hardening the fruit and canning as a whole
Hardening the fruit and pitting
Pitting and without hardening the fruit

In treatments 1 and 2 fruits were hardened using calcium chloride prior to canning process. In treatment 2 and 3 karonda fruits were halved and pitted for destoning.

The flow chart 3 shows the steps involved in the preparation of canned karonda. The sealed tins were cut opened for organoleptic evaluation on the forthcoming day of preparation. Canned karonda samples were subjected to organoleptic assessment to select the best product in its quality parameters. Mean scores obtained for various quality attributes of three different groups of canned karonda, processed for the present study are presented in Table-5.

FIG.3

FLOW CHART FOR
PREPARATION OF CANNED KARONDA

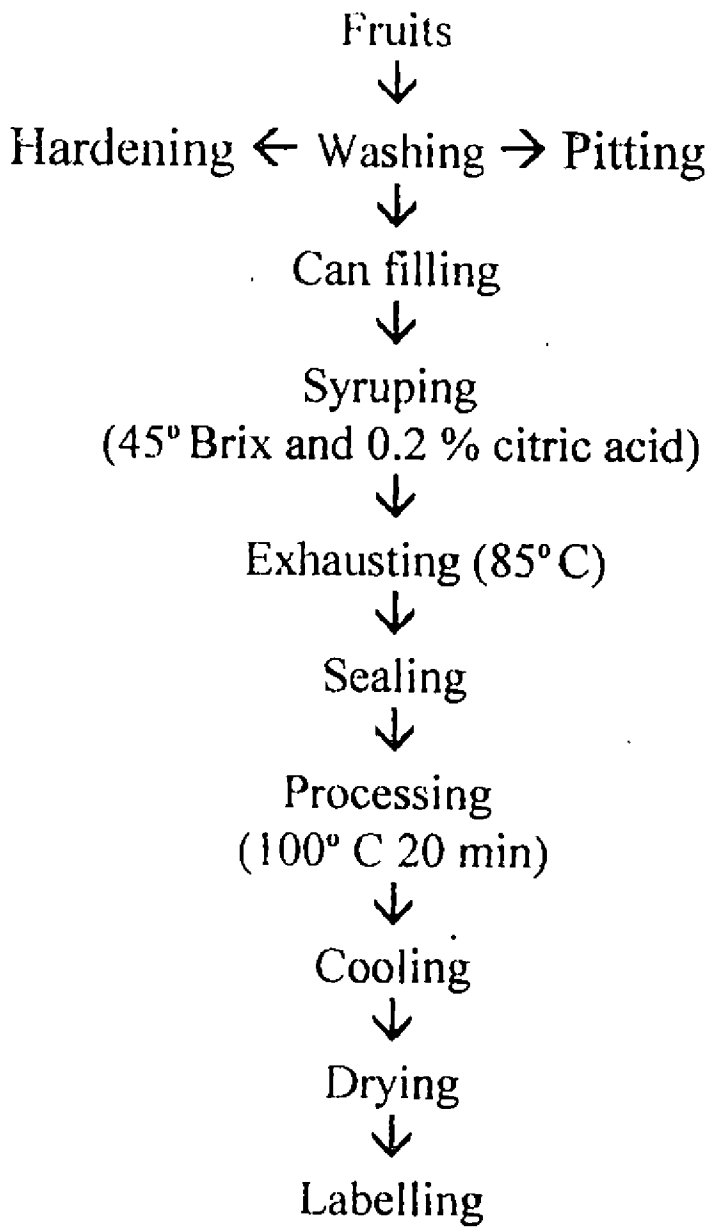


TABLE -5

ACCEPTABILITY LEVELS OF CANNED KARONDA SAMPLES (MEAN SCORES)

QUALITY ATTRIBUTES	TREATMENTS			CD VALUE
	T1	T2	T3	
Taste	3.50	3.80	4.10	0.39*
Flavour	3.90	4.00	4.20	0.30*
Appearance	3.50	3.80	4.20	0.42**
Texture	3.80	3.60	4.00	0.27*
Colour	3.40	3.50	3.80	0.42*
Overall Acceptability	3.60	3.80	4.00	0.21**

** Significant at 1% level

* Significant at 5% level

T_1 - Hardening and canning as a whole

T_2 - Hardening and pitting

T_3 - Pitting and without hardening

The acceptability trials on canned karonda as shown in Table-5 reveals that mean scores obtained for taste of canned karonda fruit samples under study ranged between 4.1-3.5. All the treatments had obtained a mean score above 3.5 for taste when karonda fruit was canned. Among the different treatments tried T_3 (pitting and without hardening the fruit) recorded highest score in taste. While T_1 (hardening and canning as a whole) and T_2 (hardening and pitting the fruit) have secured comparatively lower scores. T_1 had attained the least score for taste attribute for canned karonda (3.5). A significant difference was observed in the mean score for taste between the treatments.

The above results revealed that when the fruit was treated with calcium chloride solution as in the case of T_1 and T_2, the taste was found inferior to fruit that was canned without calcium treatment (T_3). *Lal et al (1986)* reported that karonda can be processed just like cherry. Eventhough soaking calcium chloride prior to canning or freezing had been reported in cherries (Pruthi et al 1982), this treatment affected the taste in trials with karonda. The absorption of calcium in the fruit was seen to downgrade the taste. In tune with this observation *Reeve (1956)*

reported that apples with less open structure of tissues were not readily impregnated with sugar when dipped in calcium chloride. Destoning improved the taste of T_2 when compared to T_1. This could be attributed to the development of slight sour taste around the seeds in T_1 since the seeds were retained. T_3 performed superior in taste owing to the removal of seeds and also due to processing without hardening.

When flavour of different samples of canned karonda fruit was tested by sensory evaluation the score ranged between 4.2-3.9 among the samples. Highest score was attained by T_3 (4.2) followed by T_2 (4.0) and T_1 (3.9). However no significant difference was observed between different treatments in flavour for the canned fruit samples.

As in the case of taste, flavour profile of the canned product was also more pleasant in karonda canned by pitting and not hardened (T_3). The absorption of calcium was seen adversely affecting the flavour in the trial conducted. Again the removal seeds could also influence the flavour as evidenced by higher score in the pitted samples (T_2 and T_3). According to *Sethi and Anand (1987)* if seeds are not removed, it resulted in off flavour of the karonda preserve during storage. Thus the unpitted and hardened sample (T_1) recorded the least acceptability score in flavour.

The range of scores in appearance of the canned fruit varied between 4.2-3.5. Among the different treatments T_3 had secured highest score for appearance while T_2 and T_1 had secured lower scores, T_1 recording the least. Mean scores obtained for appearance of canned karonda were found to be significantly different for different treatments.

Trials on canning proved that treatment 3 could maintain the fruit best in its appearance compared to treatment 1 and 2. Both the calcium dipped samples (T_1 and T_2) recorded lowered score in appearance due to more fading of natural colour compared to treatment 3. This colour

reduction could be attributed to the bleaching action of chlorine present in the solution used for blanching.

While concentrating on the texture of the canned karonda fruit, highest mean score of 4.0 was attained by T_4 (pitting and without hardening the fruit) and the least score of 3.6 was observed for T_2. T_3 secured a moderate score (3.8), when compared to T_4. There was a significant difference among the treatments in the mean scores obtained for texture.

The study reveals that the product maintained the best texture. When treatment 3 was applied, in which the fruit was not hardened. This is supposedly due to the preference of the judges towards the softer cells of the particular sample. *Souty et al (1981)* reported that the addition of calcium salts improves the firmness of tissues. In contrast to the score pattern exhibited in other attributes, second performance was obtained by T_1 in the case of texture of the canned karonda. On comparing the hardened products (T_1 and T_2) the texture was better in unslitted sample than the slitted fruit. This enables us to speculate that absorption of calcium was more effective by slitting the fruit altering the texture more. In T_1 the unbroken peel of the whole fruit enabled to maintain the fruit less hard.

In the evaluation of colour range, mean scores were observed between 3.8-3.4 among the three treatments. T_4 (pitting and without hardening) secured the highest score value (3.8) when compared to other two treatments. The scores for T_2 and T_3 were not varying distinctly. (3.5 and 3.4 respectively). T_1 (hardening and canning as a whole) secured the lowest score. Statistically no significant difference was observed for colour attribute of different samples of canned karonda.

In general the colour of the canned products in the present trials were not highly acceptable. This indicated that addition of colour during the process of canning or dyeing the fruit before the canning process was essential to attain better attribute in colour intensity of

canned karonda. *Lal et al (1986)* reported the addition of ponceau 2R colour to the syrup used for canning strawberries. The authors also reported that cherries that are used for canning and candying were dyed using Erythrosine. In the present study karonda fruits were neither dyed before canning nor any colouring matter was added to the syrup. During processing at higher temperature the natural colour of the fruit was faded to a great extent. The $CaCl_2$ present in the blanching solution might have bleached the natural colour of the fruit. This might be the reason for lower colour score obtained in T_1 and T_2.

Karonda fruit canned by pitting and without hardening as a pretreatment (T_3) observed the maximum overall acceptability having a mean score of 4.0. Score for T_2 (hardened and pitted) was just behind. T_1 for its overall acceptability with a mean score of 3.8 and when the fruit was hardened and canned as a whole (T_1) the acceptability score was least (3.6) among the treatments selected for trial. A significant difference was noted statistically among the samples in overall acceptability.

Considering the total scores the best canned fruit was formed by the procedure attempted with treatment 3 (pitting and without hardening the fruit) improves removal of seeds along with processing the fruit without calcium treatment, its qualities compared to T_1 and T_2. In the case of T_1 and T_2 addition of $CaCl_2$ resulted in an astringent taste making it less acceptable. similarly texture and appearance was also affected as the fruit became hard and appeared more pale. This accounted for lowered overall acceptability score obtained for T_1 and T_2. T_3 recorded better colour scores than T_1 and T_2.

As per the results obtained from the judges, after sensory evaluation treatment 3 ranked first among the three samples with respect to all the quality parameters. This indicated the positive trend towards recommending this method for canning procedure of karonda fruit. Blanching in calcium chloride solution was found to lower most of the palatability attributes when karonda fruit was canned and pitting the fruit and removing seeds was also found advantageous over the canning fruit as a whole .

4.2.4 Acceptability Of Karonda Wine

Fruit wines are alcoholic beverages which are nutritive, very tasty with mild stimulants *(Joshi 1990)*. Wines are made from several types of berries and are named after the particular fruit employed with preparation, *Lal (1986)*.

In the present study the suitability of karonda fruit for fermenting into wine was tried and the product was standardised with the following trials.

Using boiled and cooled water for fermenting
Using boiled water for fermenting
Boiling fruit with water for fermenting

The Fig.4 depicts the step in the preparation of wine. The acceptability of wine prepared following different treatments was assessed after clarification of wine and the mean scores are depicted in Table-6.

TABLE-6

ACCEPTABILITY LEVELS OF KARONDA WINE SAMPLES (MEAN SCORES)

QUALITY ATTRIBUTES	TREATMENTS			CD VALUE
	T1	T2	T3	
Taste	3.80	4.80	4.20	0.38**
Flavour	4.00	4.30	4.00	0.25*
Appearance	4.00	4.90	3.50	0.32**
Clarity	3.50	4.20	3.20	0.42**
Colour	4.50	4.60	4.60	0.47^{NS}
Strength	3.50	4.50	4.20	0.45**
Overall Acceptability	3.80	4.50	4.00	0.51**

** Significant at 1% level

* Significant at 5% level

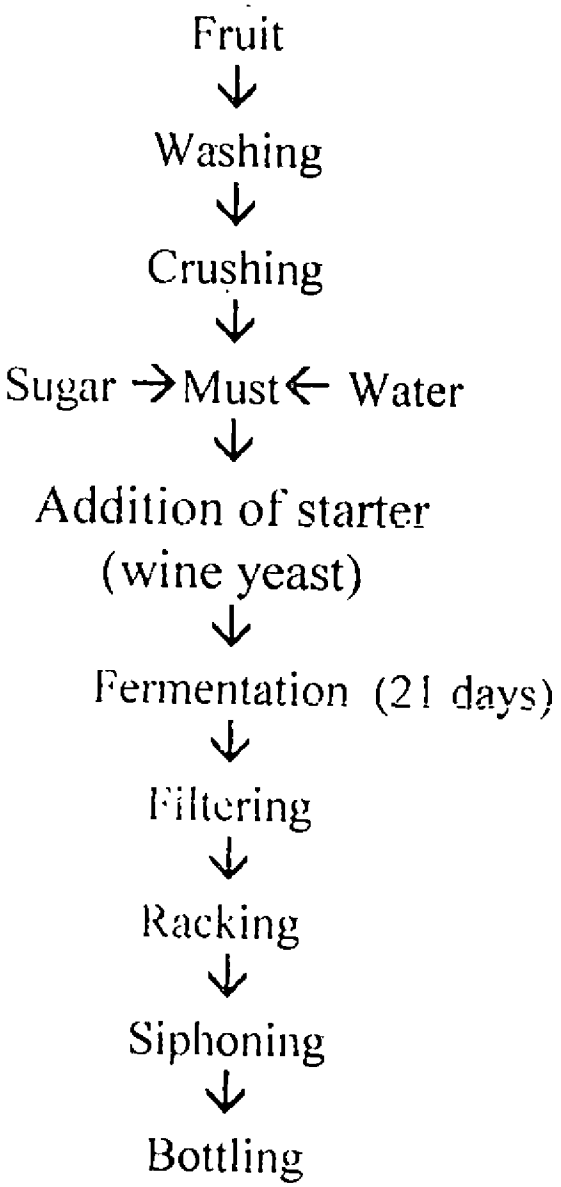
T1 - Using boiled and cooled water for fermenting

T2 - Using boiled water for fermenting

T3 - Boiling fruit with water for fermenting

FIG.4

FLOW CHART FOR
PREPARATION OF KARONDA WINE



The details presented in Table-6 showed that the highest score (4.8) in taste of wine was attained by T_2 (adding boiled water to the fruit) and the least score was for T_1 (adding boiled and cooled water to the fruit) T_3 ie boiling fruit with water prior to fermentation obtained a middle place in score value for taste. A significant difference in taste was observed in the mean score obtained for wine made with different treatments.

From the result it is found that taste of karonda wine was marked best when boiled water was added to the fruit for fermentation (T_2). The addition of boiled water helped the fruit cells to soften enough followed by addition of yeast at the optimum temperature enabled active fermentation which might have contributed to the improvement of taste and aroma. In the case of T_1 when cooled was added to the fruit the reaction between yeast and fruit must not have occurred at a proper rate during the initial days. At the same time for T_3, when both fruit and water were boiled together, there occurs more disintegration of the cells destroying the fruit properties resulting in a musty taste and hence recorded the lowest value in taste attribute.

In flavour intensity also the highest score was obtained by T_2 (4.3). Both T_1 and T_3 attained an equal score of 4.0 with respect to flavour. There was no significant difference between these treatments in flavour attributes of wine, as the differences among the treatments did not exceed the CD value.

Among the three treatments the acceptability for the flavour of wine was also more in T_2. It could be inferred from the results that adding hot water to fruit to make it soft and addition of starter at a luke warm stage as in T_2 helped to develop comparatively good flavour for karonda wine.

The highest mean score of 4.9 was secured by T_2 in appearance of wine. The treatment in which water was used after cooling in wine making (T_1) and when the fruit was boiled with water for fermentation (T_3), the score values were found to be lesser than that obtained for the

procedure followed by using boiled water for making wine. The least score was found for T_1 (3.5). All the samples of wine varied significantly in its appearance.

On analysing the scores obtained for clarity of wine, the mean score ranged between 4.2 and 3.2. The highest clarity performance was exhibited by T_2 having a score of 4.2. T_1 and T_3 had mean scores of 3.5 and 3.2 respectively for clarity. There existed significant difference between T_1 and T_2 and also between T_2 and T3. But the difference between T_1 and T_3 was on par.

Clarity and appearance scored best for T_2 in which case boiled water was added to the fruit. The appearance is linked with clarity since better the clarity, higher scores were desired for appearance. In the case of T_2 effective sedimentation resulted in better setting of the fruit particles which improved appearance. The comparison with T_1 was appreciable eventhough for clarity and appearance less scores were obtained . However for T_3 since boiling of the fruit with water resulted in its disintegration whereby it resulted in more mushed appearance and complete setting of the sediments was not attained which affected its clarity and appearance.

With regard to the colour of wine samples tried both T_2 and T_1 showed the higher score of 4.6. T_1 also secured a comparable mean score with that of T_2 and T_3 and stood very near to it (4.5). Colour of the wine showed statistically no difference between treatments.

Colour attribute of karonda wine in general was highly appreciable and higher score was found in both T_2 and T_3. Colour of T_1 also was comparable. This quality is related to the richness in colour of the fruit under experiment. Colour is a major characteristic that determine the wine quality. *(Sethi and Mathan 1993)*. Scores obtained for colour of wine revealed that karonda fruit when made into wine performed high colour value.

Scores for strength intensity of the wines ranged from 4.5 to 3.5. Treatment 2 (T_2) using boiled water had secured the highest score of 4.5. The least score was obtained by T_1 (3.5) and

T_3 also obtained a better score in strength (4.2). The strength of wine prepared using karonda observed significant difference among samples.

The data obtained proved that the strongest wine was formed by T_2 when compared to the other two treatments. In the case of T_2, boiled water was added to the fruit. An optimum temperature is necessary for the fermentation to proceed at proper rate which was attained by the addition of boiled water where the starter was added at 30°C. The completion of fermentation resulted in the attainment of maximum strength by alcohol formation. However in the case of T_1 the score decreased because in this case cold water was added and hence fermentation rate was lowered and hence the conversion of sugar to alcohol also decreased. While for T_3 the fruit and water were boiled together and this resulted in cooking effect of the fruit flesh which might be the reason for lesser strength since active conversion of sugar to alcohol was not possible.

Scores obtained for overall acceptability of wine ranged between 4.5-3.8. The highest mean score of 4.5 was secured by T_2. T_3 secured the second mean score value (4.0). The least score was obtained by T_1 (3.8). The overall acceptability of wine prepared using karonda observed significant difference among samples.

On comparisons of the various attributes like taste, flavour, appearance, colour, clarity and strength best results were attained for. T_2 ie boiled water was added to fruit and this also gained more scores for overall acceptability. This was due to the fact that optimum conditions necessary for preparation of good quality wine was attained in T_2. The action of enzymes also was activated with optimum temperature which resulted in complete settling of the haze particles which yielded good result for clarity and appearance and thus for all quality attributes maximum scores were attained for T_2 since all conditions were accepted. However in case of T_1 since cold water was added the fermentation process was not initiated and for T_3 boiling of fruit and water resulted in disintegration of fruit whereby the result attained was of musty appearance where complete settling of the haze was not possible.

4.2.5 Identification Of The Standard Product

To identify a standard product of the products under the present investigation using karonda fruit, the overall acceptability for the three samples in each product was worked out. Samples with the highest overall mean score among the particular product was identified as the standardised one. The standardised treatment for the different products are presented in Table-7.

TABLE - 7

TREATMENTS IDENTIFIED FOR THE PRODUCTS

PRODUCTS	TREATMENTS SELECTED
Jelly	Fruit extract sugar ratio 4:3 proportion (T3)
Candy	3 weeks impregnation in sugar (T2)
Canned fruit	Pitting and without hardening the fruit (T3)
Wine	Must preparation by addition of boiled water to the fruit (T2)

Jelly with fruit extract sugar ratio in 4:3 proportion possessed in the best sensory quality and was identified as the standard one for making jelly using karonda.

Sensory evaluation studies showed that karonda candy prepared by three weeks impregnation for attaining required sugar concentration rated very high for its quality and was identified as the best treatment.

Trials on canning the fruit proved the treatment with pitting the fruit and processing without hardening as the most ideal an was selected.

Among the treatments imposed wine prepared using boiled water for fermentation had preferable mean score in quality attributes and identify as the best method for making karonda wine.

KARONDA JELLY

KARONDA CANDY

CANNED KARONDA

KARONDA WINE

4.3 INDEPTH STUDIES ON SELECTED KARONDA BASED PRODUCTS

For detailed observations in respect to nutritional chemical and shelf life qualities of the products, the products viz. jelly, candy, wine and canned karonda were prepared in larger quantities following the standardised recipe. The prepared products were packed in suitable bottles/cans/polypropylene covers and were stored at room temperature.

4.3.1 Nutritional And Chemical Composition Of Standardised Products

The nutritional and chemical composition of the various products prepared for detailed study under the present investigation viz jelly, candy, canned fruit and wine was determined the next day after completing the process of preparation of each product. The major components analysed in the four products were acidity, pH, total sugar and TSS. Alcohol content of wine was also tested. Table-8 presents the proximate analysis of fresh karonda products studied in detail in the present investigation.

TABLE-8

NUTRITIONAL AND CHEMICAL COMPOSITION OF FRESH PRODUCTS

PARAMETERS	JELLY	CANDY	CANNED FRUIT	WINE
Acidity % Citric acid / g	0.50	0.65	0.45	0.70
pH	3.55	3.35	3.50	3.50
Total Sugar %	38.35	70.50	5.00	5.45
TSS %	65.00	70.00	36.00	22.50
Alcohol %	-	-	-	6.75

A perusal of data given in Table-8 reveals that jelly prepared from karonda fruit had an acidity of 0.50 per cent. The pH of the jelly was observed as 3.55. The karonda jelly prepared using of the standardised method had a total sugar content of 38.35 per cent and total soluble solids was recorded as 65 per cent. The nutritional and chemical composition of the jelly in the

present study is in accordance with the values reported by *Bhatia et al (1983)* in apple jelly. The jelly had a composition of 0.52 per cent acidity, pH of 3.6, total sugar 38.30 per cent and the TSS was 65 per cent. The values of chemical composition of jelly observed in the present study is an indication of quality nutritionally and chemically.

As per the table, it was found that karonda candy exhibited an acidity of 0.65 per cent and pH value 3.35. Total sugar content and TSS of candy were recorded as 70.50 per cent and 70 per cent respectively. This analysed values are in agreement with the levels reported for candy prepared from ber fruit by *Chavan et al (1991)*. In this study ber candy gave an acidity of 0.69 per cent, pH 3.5, total sugar 74 per cent and TSS 72 per cent. Candy prepared from the same fruit by Gupta (1983) recorded 75 to 80 per cent total sugar, 40 to 45 per cent reducing sugar, 0.40 to 0.50 per cent acidity. The analysed values of proximate composition of karonda candy is in accordance with results obtained by other workers in relevant aspect.

Canned karonda contained acidity of 0.45 per cent and pH value recorded as 3.50. Canned fruit had a total sugar content of 5.0 per cent and TSS was observed as 36 per cent. The results lands support to the findings of *Dang et al (1976)* who reported that canned apple rings had a acidity of 0.43 per cent and pH of 3.60 per cent, total sugar 9.00 per cent and TSS was observed as 35 per cent.

On analysis of the wine prepared from karonda fruit, its composition was observed with an acidity of 0.70 per cent and a pH value 3.50. The karonda wine obtained a total sugar of 5.45 per cent and the TSS per cent was 22.50. The alcohol content of wine prepared was observed to be 6.75 per cent. These values are in the range reported by *Vyas et al (1982)* for wine prepared from plum that had an acidity of 0.65 per cent, pH 3.60, total sugar 5 per cent and alcohol 6.50 per cent.

Chemical characters of all products were in accordance with these characters of similar products prepared with other fruits. This enables us to highlight that products viz jelly, candy, canned fruit and wine with comparable nutritional and chemical contents could be successfully prepared from this neglected fruit as evidenced in the present study.

4.3.2 Confirmation With Fpo Requirements

The quality of preserved products is controlled by the government through Fruit Product Control Order (FPO 1955). Food laws are essential for food safety. These standards are needed to provide a uniform and consistently good quality of food products to the consumers. There is also a need for alignment of FPO specifications with special reference.

The karonda products developed in the present study were thus compared with FPO specifications in its requirements for particular items. The details are presented in Table-9.

TABLE-9

COMPARISON OF PRODUCT VALUE WITH FPO STANDARDS

PARTIC-ULARS	PRODUCTS						
	JELLY		CANDY		CANNED FRUIT		WINE
	% of soluble solids	% of fruit in the final product	% of total sugar	% of reducing sugar to total sugar	Headspace (cm)	Drained weight (%)	Alcohol content (%) w/w (table wine)
FPO Value	65.00	45.00	≥ 70.00	≥ 25.00	≤ 1.60	≥ 50.00	9 - 16
Analysed Value	65.00	53.10	70.50	28.60	1.20	52.00	10.20

As per the FPO specifications, 1955, a product may be called a jelly, if it contains minimum of 65 per cent soluble solids and minimum of fruit on fresh fruit basis in the final product as 45 per cent. The jelly standardised contained 65 per cent TSS and 53.10 per cent fruit

on fresh fruit basis. Thus it can be stated that the jelly in the present study possessed the required characteristics to be considered as a standard jelly.

Similarly by FPO 1955 special characters indicated for candied fruits are, percentage of total sugar (> = 70) and percentage of reducing sugar to total sugar (< = 25). The karonda candy can be developed exhibited a total sugar of 70.50 per cent and per cent of reducing sugar to total sugar was 28.60. The data shows that the comparison of karonda candy with FPO requirements were also found upto the level.

While studying the specification for canned fruits, the special characters taken were head space and drained weight. A reference to the fruit product order 1955 showed a value which ranged from < = 1.6 cm and > = 50 per cent respectively. In the present study the product showed a head space value of 1.2 cm and a drained weight of 52 per cent.

The special character indicated for wine was percentage of alcohol content. The alcohol content of table was observed to vary from 9 to 16 per cent *(Lal et al 1986)*. The data shows that alcohol percentage of karonda wine was 10.20 per cent, it could therefore, easily be called as a table wine.

Details pertaining to the four products in this respect were tested and were found to satisfy the FPO requirements. The comparative values obtained gives the indications that the recipes are properly adjusted for its essential contents according to FPO standards as suggested by *Lal et al (1986)*.

4.3.3 Cost Analysis

Cost analysis was carried out to asses the extent of expense arised to obtain four different karonda products. The cost was worked out based on the cost of various factors needed for the preparation of different karonda products such as cost of fresh karonda fruit, sugar, chemicals

added, bottles, tin cans, polypropylene covers and the overhead charges. Since the cost varies from product to product, it was necessary to find out the actual cost of individual product. Table-10 depicts the cost of different karonda products as found from the present trial.

TABLE-10

COST ANALYSIS OF KARONDA PRODUCTS

PRODUCTS	COST (1kg) Rs.Ps.
Karonda Jelly	26.00
Karonda Candy	19.00
Canned Fruit	28.00
Karonda Wine	22.00

Cost analysis of the products like jelly, candy, canned fruit and wine as computed per kg of the finished product in the present study as estimated in Table-10 illustrates that for preparation of karonda jelly rupees 26.00 was spent per kg of the product. The cost of jelly mainly depend on the cost of sugar. Preparation cost of candy was rupees nineteen. Eventhough sugar syrup for dipping the fruit was required in larger quantities, it was possible to reuse the residual syrup after the fruit attained required concentration. Hence the cost of this left over syrup was not accounted to the cost of the product. The cost of canning per kilogram of fruit went upto twenty eight rupees. The expense for good quality tin cans and its sealing charges resulted in a comparatively high production cost for canned item. For processing karonda wine rupees twenty two was spent on every kilogram product. The fact that water acts as an ingredient in wine contributed to minimising the cost.

A comparison of cost of the karonda products in the present investigation pointed out that candy was the cheapest product among the four item viz. jelly, candy, canned fruit and wine. In cost analysis, wine was found to have the second place in cost benefit parameter . When jelly was prepared the economics aspect stood in the third place while working out the cost per kilogram of the products. The maximum expense was observed for canning the fruit. However

the cost of each karonda product was found to be much lower than similar products based on conventional fruits available. This offers scope for utilisation of karonda fruit by processing industry.)

4.3.4 Fruit Product Yield Ratio

Fruit to product yield ratio gives an estimation of the amount of product obtained for known quantity of the fruit utilised. It also gives us an idea of the amount of the fruit that goes as waste which helps us to ascertain the profit ratio, when a certain fruit is selected. The Table-11 gives the fruit product yield ratio of different karonda products standardised in the present trial.

TABLE-11
FRUIT PRODUCT YIELD RATIO

Fruit	Quality		Ratio
	Fresh fruit	Product yield	
Jelly	1000g	800g	5:4
Candy	1000g	850g	20:17
Canned fruit	1000g	750g	4:3
Wine	1000g	1.400g	5:7

When the fruit product yield ratio was calculated, it was found that the highest yield was obtained for wine followed by candy, jelly and canned karonda.

4.3.5 Consumer Acceptance And Preference Of The Karonda Products Developed

Rajalakshmi et al (1981) reported that consumer awareness and preference decide the success of a product. According to *Vyavasaya Keralam (1994)* consumer testing of the processed products should also receive attention to determine acceptability of products.

Total of 50 consumers from the university campus participated in a test to determine the acceptability levels of consumers towards the developed products and also to rank the products based on their priority of linking. The consumers evaluated the four karonda products. The consumers were asked to rate each products on a numerical hedonic five point scale. The quality parameters included in the consumers score card were taste, flavour, appearance, texture/clarity and colour. The total score of the five quality parameters were added to find out the acceptability level of the consumers towards each product.

CONSUMER ACCEPTANCE OF KARONDA PRODUCTS

The mean scores obtained for consumer acceptance of karonda products are presented in Table-12.

TABLE-12
MEAN SCORES OBTAINED FOR QUALITY ATTRIBUTES OF VARIOUS KARONDA PRODUCTS

QUALITY ATTRIBUTES	JELLY	CANDY	CANNED FRUIT	WINE	CD VALUE
Taste	4.90	4.80	3.70	4.90	0.16**
Flavour	5.00	4.90	4.30	4.90	0.13**
Appearance	5.00	4.90	4.00	4.40	0.14**
Texture / Clarity	4.90	4.90	4.20	5.00	0.12**
Colour	5.00	4.90	3.80	4.50	0.15**
Overall Acceptability	4.90	4.80	4.00	4.70	

According to *Rolls et al (1981)* in the various quality attribute tests, the first evaluation goes to the taste followed by flavour, appearance, texture and colour. Taste is the major attribute which determines the acceptability of food material. Mean scores obtained for the taste of products varied from 3.70 to 4.90. karonda jelly and wine obtained maximum scores (4.90) for this parameter followed by karonda candy (4.80) and canned karonda (3.70) Canned karonda obtained lower scores for their taste when compared with that of others.

Statistical analysis of the data revealed that taste of canned karonda was found to be significantly different from the taste of jelly, candy and wine, while the difference in taste of jelly and candy was on par. It was also found that the difference in the taste of jelly and wine was also on par.

The next criteria evaluated by the consumers was flavour. Appearance of the food is important but it is the flavour that ultimately determines the quality and acceptability of foods *(Tejinder 1994)*. Among the different products evaluated karonda jelly obtained cent per cent score for this parameter (5.00) karonda candy and wine shared an equal score of 4.90. Canned karonda scored the lowest score of 4.30 for flavour.

Statistical analysis of the data revealed that the difference in the flavour, jelly, candy and wine was on par, while the flavour of canned fruit was significantly different from the flavour of jelly, candy and wine.

Next to the flavour the appearance of the processed product was considered. 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 quite attractive *(Christensen 1985)*. Mean scores obtained for appearance of the four products ranged from 4 to 5. Maximum mean score was maintained by jelly in appearance also (5.00) candy and wine had also obtained rather good scores 4.90 and 4.40 respectively while canned karonda scored the least 4.

Statistically a significant difference was noted for appearance scores of various products except between jelly and candy.

According to *Rengama (1991)* texture is the property of food which is associated with the sense of feel or touch experienced by the fingers or the mouth which requires considerable

trained personnel. The texture of the food is an important factor in its acceptance. On evaluating the texture of products the scores ranged between 4.20 to 5.00. The highest score of 5.00 was obtained in wine. Both jelly and candy attained an equal score of 4.90 for texture. Canned fruits had secured for the lowest score of 4.20.

The difference in the texture of jelly, candy and wine was on par when the data was statistically analysed, whereas the texture of canned fruit was significantly different from the texture of jelly, candy and wine.

Another criteria evaluated by the consumer was colour. According to the reports from CFTRI (1990), the aesthetics, safety, sensory characteristics and acceptability of food are all affected by colour. Mean scores for the colour of prepared products varied from 3.80 to 5.00. Maximum mean score was obtained by jelly in colour perception also. Candy also secured a comparable mean score with that of jelly (4.90). Moderate score was obtained for wine (4.50). Canned karonda had obtained the lowest score (3.80).

Statistical analysis of the data revealed that the difference in the colour of jelly and candy on par. But a significant difference was observed in the colour of canned fruit and wine.

After analysing each quality attributes, the overall acceptability was determined by finding out the average mean score for each character. 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 its 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. The overall acceptability score ranged between 4 to 4.90, jelly has secured the highest score of 4.90 followed by candy (4.80), wine (4.70) and canned karonda (4.00).

The score value of consumer acceptability revealed that all the karonda products were highly acceptable to the consumers. It was encouraging to note that none of the products scored below 80 per cent in overall acceptability. When the scores for individual attributes for the various products like taste, flavour, appearance, texture/clarity and colour was analysed, it could be studied that no attribute scored a value less than 75 percentage.

When consumer acceptability level on the basis of score obtained for various attribute was calculated the highest acceptability performance was obtained for jelly (98 per cent) followed by candy (96 per cent). Wine secured a score of 94 percentage and canned fruit had the lowest acceptability score of 80 per cent. In conclusion it would be stated that the consumers accepted jelly, candy and wine with a very high palatability level and canned karonda with reasonably good acceptability.

CONSUMER PREFERENCE

The consumer preference was assessed on various products developed from karonda like jelly, candy, canned fruit and wine and the results are presented in Table-13.

TABLE -13

CONSUMER PREFERENCE LEVEL (Percentage)

PRODUCTS	PREFERENCE LEVEL			
	1st (%)	2nd (%)	3rd (%)	4th (%)
JELLY	28.00	54.00	18.00	0.00
CANDY	22.00	20.00	58.00	0.00
CANNED FRUIT	0.00	6.00	0.00	94.00
WINE	50.00	20.00	24.00	6.00

Consumer Preference Status of Karonda Products

Fig. 5
First Preference Of Consumers For Karonda Products

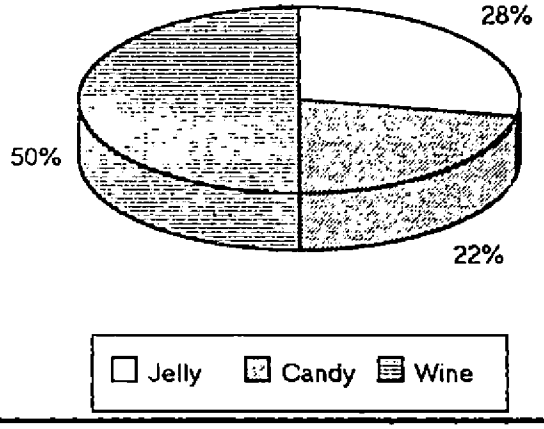


Fig. 6
Second Preference Of Consumers For Karonda Products

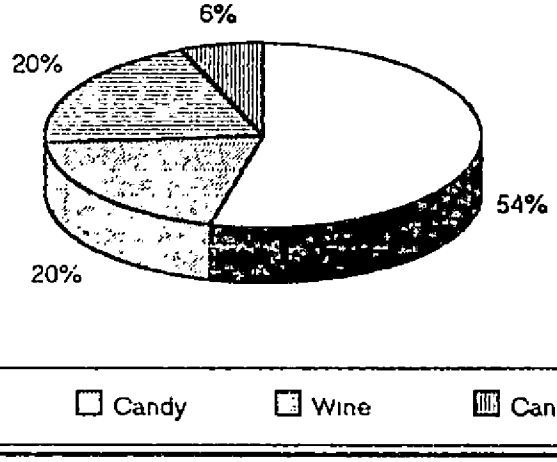


Fig. 7
Third Preference Of Consumers For Karonda Products

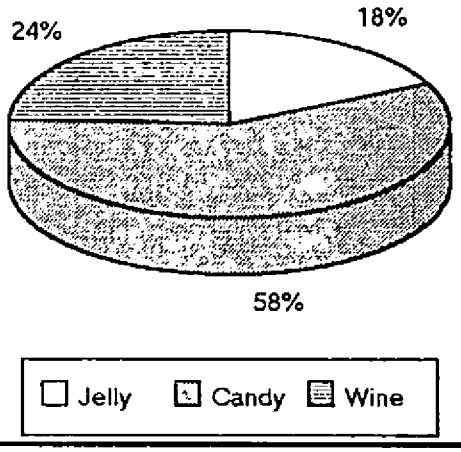
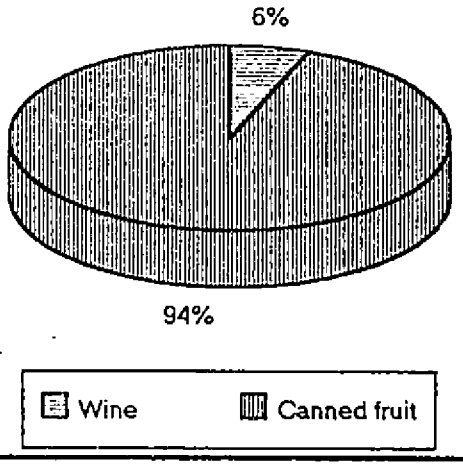


Fig. 8
Fourth Preference Of Consumers For Karonda Products



When the first preference was taken into consideration it was found that the highest per cent (50) of consumers gave their first preference to wine. 28 per cent of the consumers preferred jelly as their first choice. 22 per cent gave preference to candy as the best item. At the same time none of the consumers ranked canned fruit as their first preference.

While taking an account of the second preference by the consumers on karonda products like jelly, candy, canned fruit and wine, the highest per cent (54) liked jelly for a second choice Candy and wine were marked by 20 percentage of consumers each as their second preferred item. While canned fruit was preferred by only 6 per cent of the consumers as their second preference.

When the next preference was analysed highest number, i.e. 58 per cent of consumers liked candy as their third preferred item. The same rank was given by 24 per cent consumers to wine, while jelly was given as the third preference only by 18 per cent consumers and none of the consumers ranked canned karonda to be their third preferred product.

Coming to the fourth preference, it was found that, majority of the consumers (94 per cent) felt canned fruit as the fourth item in the ranking order. While it was seen that only 6 per cent of the consumers could rank wine in the fourth order and none of the consumers accepted candy and jelly as their fourth preference.

Results of preference ranking by consumers revealed that highest percentage of consumers preferred wine first followed by jelly. Majority of the consumers preferred candy as their third liked item and canned fruit was given the fourth priority among their products studied for their preference.

4.4 ASSESSMENT OF SHELF LIFE

Monitoring the storage behaviour is as important as its acceptability testing with respect to any new product formulated. Hence the shelf life quality of karonda products were determined by ascertaining periodically the changes in nutritional and chemical qualities, micro flora and also the changes in ogranoleptic qualities of products during storage.

4.4.1 Changes In The Nutritional And Chemical Qualities During Storage

Chemical components undergo change when the products are stored for a long period. The changes in the chemical components may bring out detrimental changes in fruit products. Hence a monthly assessment on the chemical components were carried out to assess the storage quality of different karonda products studied. The major components assessed were acidity, pH, total sugar and TSS. In wine alcohol content was also tested. All values reported are means of duplicate analysis.

pH is important as a measure of active acidity which influence the flavour or palatability of a product and affects the processing requirement. *Torregian (1993)* reported an increase in pH in the processed food during storage period. It is thought important to study the fluctuation in pH during storage of karonda products.

4.4.1.1 Changes in the nutritional and chemical qualities of jelly during storage

Changes in the nutritional and chemical components of jelly during storage was studied and the result are presented in Table-14. Analysis was carried out with respect to acidity, pH, total sugar and TSS.

TABLE-14

COMPOSITIONAL CHANGES OF JELLY DURING STORAGE

PARAMETERS	STORAGE PERIOD (Months)						CD VALUE
	I	II	III	IV	V	VI	
Acidity % Citric acid/g	0.50	0.54	0.59	0.64	0.70	0.74	0.05**
pH	3.55	3.33	3.20	3.16	3.00	2.80	0.01**
Total sugar %	38.35	38.20	37.35	35.50	35.20	34.00	0.21**
TSS %	65.00	65.00	65.00	65.00	65.00	65.00	NS

** Significant at 1% level

From the results obtained it was found that acidity of jelly was observed to have a steady increase from 0.50 per cent to 0.74 per cent over a period of six months. Statistically no significant difference was observed during the first two months and a difference was observed from the third month onwards. Variation in acidity level in fruit products may be due to changes in the concentration of organic acid present in the fruit.

Increase in acidity during storage was reported in culled apple jelly by *Bhatia et al (1983)* and in amla jam by *Tripathi et al (1988)*. Studies conducted in litchi pulp by *Sethi (1985)* showed an increase in acidity, while no significant change was noticed in peach and apricot pulp by *Shah et al (1992)*. *Sethi (1985)* suggested that the increase in acidity during storage may be due to the formation of organic acid by ascorbic acid degradation.

pH of jelly was analysed on every month of storage and the values obtained based on the analysis are given in Table-14.

As per the table the pH of jelly was slightly declined during storage. It ranged from 3.55 to 2.8 during storage. Statistical analysis of the data revealed that upto the third month there was no significant difference in pH of jelly during storage. A significant difference was noted from the fourth month onwards.

The decreased pH value is directly related to the increase in acidity. the results are in accordance with the findings of *Bhatia et al (1983)* who reported a decrease in pH in culled apple jelly during storage and in tomato concentrate by *Sethi (1994)*.

Variation noted in the total sugar per cent of karonda jelly during different storage periods are presented in Table-14

The change in total sugar was observed to be decreased from 38.35 per cent to 34 per cent during storage. The reduction in total sugar was 4.35 per cent during storage. On the first two months there was no significant difference in total sugar. From third month onwards a significant difference was noted.

From the result, it was found that the total sugar decreased with the increase in storage period. This again may be traced to the increase in acidity and conversion of sugar on storage. This finding has been supported by the work done by *Bhatia et al (1983)* who found that storage decreased the total sugar significantly, in culled apple jelly. *Bhatnagar (1991)* also reported a decrease in total sugar content in watermelon jam during storage.

No change was recorded in total soluble solids of jelly on storage. The variation in TSS was non significant during the storage period.

From the result it was observed that TSS of jelly was constant during the entire period of storage life. In line with the present observation *Tripathi et al (1988)* reported that TSS in amla juice remained unchanged during storage. The steady performance of total solids in jelly was a clear indication that no undesirable change had taken place during storage upto six months.

In a nutshell, considering the nutritional changes in jelly, observations recorded include that in the case of acidity of jelly there was an increase in storage in contrast to pH and total sugar in which case there was a decrease. However on storage of jelly there was a constant TSS.

The jelly remained highly sound for a period of six months as there was no description of undesirable changes in chemical and nutritional constituents.

4.4.1.2 Changes in the nutritional and chemical qualities of candy during storage

Changes in nutritional and chemical components of candy during storage was maintained over a period of eight months. The major components analysed were acidity, pH, total sugar and TSS. The data are presented in Table-15.

TABLE-15

COMPOSITIONAL CHANGES OF CANDY DURING STORAGE

PARAMETERS	STORAGE PERIOD (Months)								CD VALUE
	I	II	III	IV	V	VI	VII	VIII	
Acidity % Citric acid/g	0.65	0.63	0.62	0.60	0.58	0.55	0.51	0.50	0.03**
pH	3.35	3.40	3.46	3.47	3.50	3.51	3.54	3.55	0.05**
Total sugar %	70.50	71.00	71.40	74.50	74.80	77.34	77.35	78.20	0.10**
TSS %	70.00	70.00	70.00	70.00	70.00	70.00	70.10	70.10	NS

The periodical testing for acidity of candy performed slight downward trend in the value with the increase in storage period. Acidity decrease was from 0.65 per cent to 0.50 per cent. Upto the third month there was no significant difference in the acidity value. A statistically significant difference was noticed from fourth month onwards.

Acidity decrease was 23 per cent during storage. This lowered value in acidity may be due to the interaction between organic constituents of product and enzymes which resulted in decrease of acidity. Similar decrease in acidity during storage was reported in pear candy by *Bhatia (1986)* and in amla candy by *Tripathi et al (1988)*. Studies conducted in ber candy showed a decrease in acidity *(Chavan et al 1991)*.

Mean values of pH during the storage period of eight months for karonda candy is presented in Table-15.

pH changes in candy was not much noticeable with a slight increase from 3.35 to 3.55. Increase in pH also corroborated the observation regarding decrease in titrable acidity in stored candy *(Bhatia 1986)*. During the first two months there was no significant difference in pH. From third month onwards a statistically significant difference was noticed.

Studies on the chemical characteristics of pear candy by *Bhatia (1986)* indicated an increase in pH on storage. *Mehta and Bajaj (1983)* had also reported that the citrus juice during storage of eight months showed a slight increase in pH.

The fluctuation of total sugar was very low upto the third month as seen in Table-15. It was found that total sugar increased with subsequent storage months which was conspicuous only from fourth month. The total sugar ranged from 70.50 per cent to 78.20 per cent during the storage period of eight months. Statistically a significant difference was observed from third month onwards.

Amini and Bhatia (1962) reported that there was an increase in sugar in dried banana due to the activity of enzyme amylase or invertase. Storage studies conducted by *Tripathi et al (1988)* with amla candy and *Chavan et al (1991)* with ber candy also reported similar increase in total sugar during storage.

Mean values obtained for TSS during the storage period of eight months (Table-15) recorded no change in TSS during storage. This constant value can be considered as a mark of favourable storage performance of karonda candy under study. Our finding is in tune with the results observed in pear candy by *Bhatia (1986)* and in dehydrated amla by *Tripathi et al (1988)*.

On analysing the changes in the chemical components of candy, during the storage of eight months, there was a decrease in the acidity of candy where as the pH and total sugar was found to have an increase. At the same time the TSS remained constant. The keeping quality of candy improved on storage and possessed good nutritional quality on eight months storage.

4.4.1.3 Changes in the nutritional and chemical components of canned karonda during storage

Cut out examination of the canned fruit was carried at monthly intervals during eight months of storage at room temperature. The canned product was analysed for net weight, drained weight, internal condition of the can, acidity, pH, total sugar, TSS and clarity of the covering syrup to study the major changes on storage.

Results of the cut out examination of canned karonda at various periods of storage are given in Table-16.

On perusal of the data the external and internal conditions of the cans were found to be good. There was no discernible difference in headspace or vacuum in the cans. The headspace fluctuated between 1.2-1.3 cm, where variation occurred in individual cans. The unnoticeable change in headspace indicates that excessive air accumulation has not occurred during storage. The vacuum ranged between 13-16 inches. The drained weight percentage fluctuated within 50-52 per cent, observed on the different cans opened at intervals of study. This may be also due to individual variation of different cans. Drained weight was directly proportional to the fill in weight of the fruit and was inversely proportional to the covering syrup strength. It was encouraging that the above values fall neither beyond the prescribed limits nor any discriminative change has occurred within eight months.

TABLE-16

COMPOSITIONAL CHANGES OF CANNED KARONDA DURING STORAGE

PARAMETERS	STORAGE PERIOD								
	1	2	3	4	5	6	7	8	CDVALUE
Fill in weight (gm)	150	150	150	150	150	150	150	150	
Weight of syrup added	125	125	125	125	125	125	125	125	
Net weight (gm)	275	275	275	275	275	275	275	275	
Vacuum (inches)	13	13	13	13	14	14	15	16	
Head space (cm)	1.2	1.2	1.2	1.3	1.2	1.3	1.2	1.2	
Drained weight (%)	52	52	52	51	50.2	52	51	52	
Internal condition of the can	good	good	good	good	good	good	good	good	
Acidity % citric acid	0.41	0.41	0.42	0.42	0.43	0.44	0.44	0.45	0.03^{NS}
pH	3.56	3.55	3.48	3.46	3.46	3.45	3.4	3.4	0.04^{NS}
Total sugar %	5	5.5	6	6.2	7	8.2	9	10.5	0.01**
TSS %	36	35.5	33.5	32.5	32	31.5	30.5	30.5	0.59**
Clarity of the syrup	clear	clear	clear	clear	clear	clear	clear	clear	

NS-Non signigicant

**Signigicant at 1% level

From the result it was found that the change in acidity and pH were negligible during storage. The acidity of the canned fruit ranged from 0.41 to 0.45 and pH from 3.56 to 3.40. Statistically there was no significant difference in pH and acidity of the canned fruit during the entire period of storage.

Rate of increase in acidity in canned karonda within eight months was lower and this may be due to the interaction of organic acid present in the fruit as like other products studied. The results are in accordance with the findings of *Shah et al (1992)* who reported that negligible changes in pH and acidity were observed in canned peach and apricot pulp stored for 24 weeks. Similarly analysis of canned mandarin segments by *Beerh (1983)* had indicated negligible to slight changes in acidity and pH during storage.

While studying the total sugar content of the canned fruit, it revealed that the total sugar increased with increase in storage period. The total sugar content of the canned fruit varied from 5.00 to 10.50. In the present study the rate of increase in total sugar was significant throughout the storage period.

The increase in total sugar could be due to the hydrolysis of polysaccharides and inversion of non-reducing sugars. This result has been supported by the work done by *Dalal and Salunkhe (1974)* who had stated increase in total sugar in canned sweet cherries and sour cherries during storage.

On examination of the results it was found that TSS of the covering syrup in canned product decreased slightly during storage. It decreased from 36 per cent to 30.5 per cent. Statistically a significant difference was observed in the TSS of canned fruit during the entire period of storage.

The rate of decrease was more during the initial months. This might be due to the more equilibrium difference between the syrup and the fruit in the early storage period. According to *Nilamavdas (1993)* initial TSS of covering liquid decreased slightly with storage due to exchange of solids between solid and liquid phase. Thus the fruit had absorbed more sugar with storage decreasing the sugar content of the syrup.

Syrup was clear at all intervals of examination. Cloudiness in the syrup is an indication that microbial spoilage of the canned product.

Cut out examination of the various parameters of canned karonda resulted in product of desired headspace and drained weight and was found within the standard values prescribed by FPO. No significant change was observed in pH and acidity of the stored product. Total sugar was found to increase on storage while TSS decreased during eight months of storage. The syrup was also very clear.

4.4.1.4 Changes in the nutritional and chemical qualities of wine during storage

The aesthetic appeal of wine depends upon the balance of chemical components that arise from extraction fermentation and ageing *(Mohini and Surjeet (1993).* The nutritional and chemical parameters of karonda wine during consequent storage months were analysed with respect to acidity, pH, total sugar, TSS and alcohol content and the mean values are presented in

TABLE - 17

COMPOSITIONAL CHANGES OF WINE DURING STORAGE

PARAMETERS	STORAGE PERIOD (Months)								CD VALUE
	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	
Acidity % Citric acid/g	0.70	0.70	0.71	0.72	0.72	0.73	0.73	0.74	0.01**
pH	3.50	3.50	3.46	3.44	3.44	3.42	3.43	3.45	0.08^{NS}
Total sugar %	5.45	5.15	4.70	4.40	3.80	3.40	3.20	3.00	0.14**
TSS %	22.50	18.00	13.00	12.10	10.20	9.60	9.00	8.00	0.59**
Alcohol %	6.75	7.20	7.90	8.10	8.70	8.90	10.10	10.20	0.01**

** Significant at 1% level

From the data it was found that the acidity change in wine was minimal during storage of eight months. An increase of 5 per cent was observed in acidity. Statistical analysis of the data during eight months revealed that there was no significant difference in acidity of wine during the first three months. A significant difference was noticed from fourth month onwards.

The volatile acid content of fermented fruit products such as wine is a good indication of soundness and quality *(Joshi 1990)*. This finding on acidity levels during storage is exactly in tune with that reported by *Kadam et al (1992)*. He found that acidity of pomegranate wine increased from 0.71 to 0.75 during storage. Studies on chemical characteristics of ber wine by *Kadam et al (1992)* indicated a slight increase in acidity from 0.70 to 0.75.

A close examination on the pH of wine showed no marked difference during the storage period of eight months. The pH values slightly decreased from 3.50 to 3.45. The variation was statistically non significant.

The difference observed in acidity during storage is the contributing factor for the decrease in pH. In sharp agreement to this result, studies on the chemical characteristics of pomegranate wine by *Kadam et al (1992)* indicated a slight change in pH from 3.50 to 3.48

during storage of eight months. *Vyas et al (1982)* also observed an unnoticeable decrease in pH in plum wine.

Mean values of total sugar obtained during the storage period of eight months for karonda wine indicated that total sugar of wine decreased with increase in storage period. The change in total sugar was observed to be a decrease from 5.45 per cent to 3 per cent. Variation in total sugar was significant during the storage period.

This reduction in total sugar may be explained with the change in unfermented residue left in the wine at the time of storage. Chemical analysis of fermented carrot based RTS indicated a decline in total sugar *(Thirumaran et al 1992)*. *Vyas et al (1982)* also reported a decline in total sugar in plum wine during storage.

Pertaining to total soluble solids in wine a steep decrease was recorded as storage period advanced. The variation in TSS during eight months of storage was recorded as 14.5 per cent where the value decreased from 22.5 per cent to 8 per cent. The difference was statistically significant throughout the storage interval.

Conversion of part of unfermented sugar to alcohol during storage could be attributed to the low level of TSS in wine on storage. Observation supporting to this statement have been reported that during storage of wine, there was decrease in TSS and decrease in alcohol content.

Another evaluation on pomegranate wine by *Kadam et al (1992)* revealed a decrease in TSS during storage period of eight months. Decrease in TSS during storage was reported by *Kadam et al (1992)* also in ber wine.

As per the table value alcohol content of wine registered an increase on storage. The difference in alcohol was observed to be a steady increase from 6.75 per cent to 10.20 per cent

with eight months storage time. On comparison with CD values the variation in alcohol content of wine was significantly different during storage intervals.

Data generated on the behaviour of total sugar and total soluble solids during storage of wine gives a conclusive picture of the variation in alcohol content also. Conversion of more sugar and other solids to alcohol during the storage process of wine under study have helped clearly to effect this rise. An increase in alcohol content was observed in pomegranate wine by *Kadam et al (1992)* during the storage period of eight months and in ber wine by *Kadam et al (1992).*

As a result of experiment conducted it could be observed that in the karonda wine on storage there was an improvement in alcohol content whereas there was a decrease in TSS and total sugar. This decrease was due to the conversion of TSS and total sugar to alcohol. There was also a minimal decrease in acidity and a slight decrease in pH. The quality of wine improved on storage which was due to the desirable change in the chemical components on storage.

4.4.2 Assessment Of Microbial Changes Of Karonda Products

The shelf life quality of processed products depends very much on the microbial safety Hence it was necessary to test the development of spoilage microflora in processed products to find out whether there is any qualitative deterioration. *Sheeja (1994)* stated that the microbial growth or microbial damage of a product is dependent upon certain factors both chemical and physical which are favourable for their growth. Among this pH is one of the important factor that determines the survival and growth of microorganisms during processing and storage.

Monthly analysis of the karonda products like jelly, candy, canned fruit and wine was carried out to test microbial contamination by yeast, fungus and bacteria.

Microbiological examination of jelly at regular intervals of storage showed complete absence of deteriorative organisms over six months storage period. But during the seventh month of storage microbial decay was detected in the product as evidenced by the growth of colonies. On viewing under the microscope, the product showed colonies of yeast, aspergillus and bacillus which indicated the onset of microbial decay.

According to microbial examination of jelly, no activity was observed upto six months of storage which confirmed the successful storage behaviour and shelf life span of the jelly. The same results were observed in watermelon jam during the storage period of six months by *Bhatnagar (1991)*. However presence of microorganisms were detected from seventh month but the count was below the limits as prescribed by Frazier. The results are similar to the findings of *Bhatnagar et al (1984)* who have reported microbial attack on muskmelon jam during the seventh month of storage.

The periodical testing for microbial count of candy on storage revealed complete absence of counts during the entire period of storage. Incubation at 30°C also did not reveal any sign of fermentation. This result enables us to speculate that high sugar concentration and its germicidal action against infection together with the appropriate methodology applied for the preparation of karonda candy have influenced the quality of this product. The results are in accordance with the findings of *Bhatia (1985)* who had reported similar findings on pear candy during the storage period.

Similarly when canned fruit was analysed no bulging, corrosion or metallic taste were observed till the end of storage study for eight months. No visible presence of microflora was observed which confirmed the safety of the product. Thus the results were encouraging and proving the accuracy of technology followed. Similar results were observed in canned apple rings by *Dangh et al (1976)* and in canned mandarin orange segments by *Beerh et al (1983)*.

When changes occurring in microflora of bottled samples of wine was studied, it was observed that there was complete absence of microorganisms. The same results were observed in pomegranate wine during the storage period of eight months by *Kadam et al (1991)*.

The results of the microbilogical analysis upholds that jelly showed storage ability at ambient conditions for a storage of six months. Microorganism responsible for spoilage of processed food products were found to be absent in candy, canned karonda and karonda wine indicating that they were safe for consumption during the entire period of storage.

4.4.3 Changes In The Organoleptic Qualities Of The Products During Storage

On storage fruit products are subjected to change in quality. Quality is a degree of excellence and a composite characteristic determining acceptability. This refers to those characteristics of food which can be identified by our senses such as appearances, smell, taste, feel and sound of food *(Mohini and Surjeet 1993)*.

According to *Kramer and Twigg (1970)* food quality detectable by our senses are broken down into the main categories viz. Appearance, texture and flavour. According to *Kramer (1970)* among the various quality attributes taste is the primary and most important one. And hence due importance to every sensory characters has to be given in assessing the organoleptic qualities.

An attempt has been made to ascertain the influence of storage on the acceptability of the products studied. Changes in various quality attributes on four different karonda based products like jelly, candy, canned fruit and wine during storage were assessed through procedure described earlier.

4.4.3.1 Changes in the organoleptic qualities of jelly during storage

Effect of storage on the organoleptic qualities of jelly was assessed to study the shelf life and also to test the quality change. Major quality attributes studied were taste, flavour appearance, texture, colour and overall acceptability. The mean scores of the organoleptic qualities of karonda jelly during the storage period of six months are presented in Table-18.

TABLE-18

EFFECT OF STORAGE OF JELLY ON VARIOUS QUALITY ATTRIBUTES

QUALITY ATTRIBUTES	STORAGE PERIOD (months)						CD VALUE
	I	II	III	IV	V	VI	
Taste	5.00	4.60	4.50	4.30	3.60	3.30	**.504
Flavour	5.00	4.80	4.60	4.40	4.10	3.50	**.361
Appearance	5.00	5.00	5.00	4.60	4.50	4.00	**.270
Texture	4.90	4.60	4.50	4.20	4.00	3.80	**.376
Colour	5.00	5.00	4.90	4.50	4.40	3.90	**.467
Overall acceptability	4.90	4.80	4.70	4.40	4.20	3.80	**.243

From the Table-18 it was found that the scores obtained for taste of jelly decreased over a period of six months. The maximum score was obtained during the first month (cent per cent) and it was reduced to 92 per cent by the second month. Only a slight decrease in taste was noticed from second month to fourth month since the score from 92 per cent was found lowered only to 86 per cent by the fourth month. The percentage scores for taste on the fifth and sixth months were 72 per cent and 66 per cent respectively.

The taste of jelly was proved to be very good upto fourth month of storage, where 92 per cent of the scores were maintained. However taste attribute during the fifth and sixth months were comparatively lower. This might be assigned to the reduction in total sugar content and increase in acidity of jelly during storage. Earlier studies also revealed that the taste of jelly

decreased with increases in storage time. A decrease in taste was noticed in culled apple jelly during storage by *Bhatia (1981).*

It was found that during the first three months there was no significant difference regarding taste of jelly. A significant difference was noted from fourth month onwards.

Considering the flavour of jelly, superior score was obtained during the first month (cent per cent). Only a slight reduction in score (4 per cent) was recorded by the second month. Similar trend was noticed upto fourth month of storage period and the score was reduced only to 88 per cent by the fourth month. On the fifth and sixth month the reduction in score obtained for taste was 18 per cent and 30 per cent respectively.

From the result, it could be seen that the flavour was highly acceptable upto the fifth month though there was a little deviation from the original flavour. Even on the sixth month the flavour of jelly remained highly satisfactory having 70 per cent score. The minor deviation observed was just normal. *Mir and Nirakanth (1982)* hypothesize that flavour change may be attributed to alteration in chemical composition.

Statistically no significant difference in flavour of jelly was observed during the first three months. A significant difference was noted from forth month onwards.

When the appearance of sample was assessed on various storage periods, it was appreciable to note that the appearance of jelly scored maximum upto third month (cent per cent). Score rate was reduced to 92 per cent by the fourth month. Only a slight decrease of 10 per cent was noticed by the fifth month. Noticeable reduction in score was not recorded on the sixth month also even though comparatively lesser score was obtained for appearance; the score obtained was found highly satisfactory (80 per cent).

In the present attempt the jelly was found to be having very good appearance upto fifth month of storage and the score obtained was 90 per cent at this period. On the sixth month the appearance was slightly affected due to the fading of the bright red colour originally obtained to a slightly faded state. This change is a natural process which can be attributed to oxidation reduction reaction of anthocyanins. A highly appreciable quality noticed was that there was no sign of weeping or syneresis observed in the jelly which is a usual quality change that result on storage. This shows the superior quality of jelly developed from karonda.

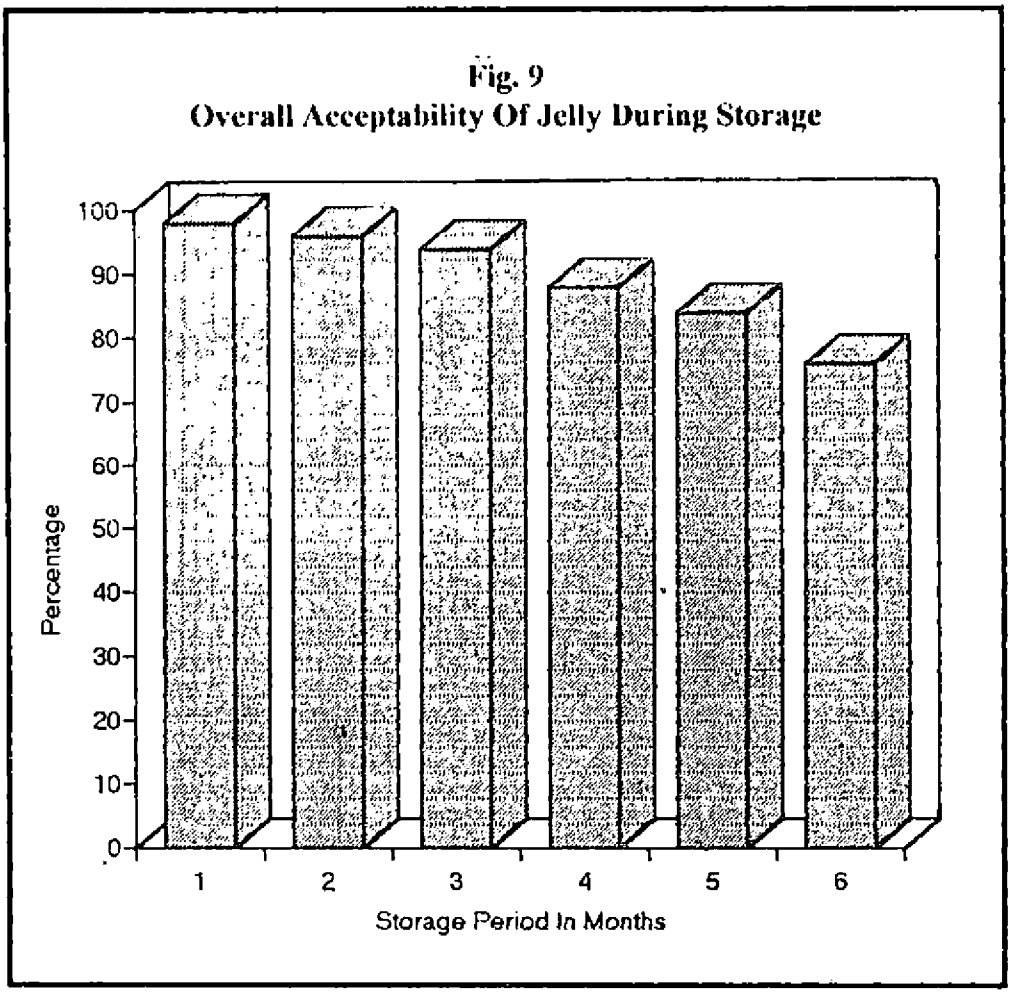
During the first three months there was no significant difference regarding appearance of jelly. A significant difference was noted from fourth month onwards.

For texture of jelly highest score was obtained during the first month (98 per cent). Only a marginal decrease was noted during the second month (6 per cent). On the third month a slight variation was observed and the score was reduced to 90 per cent and to 84 per cent by the fourth month. From fourth month onwards a slow rate of decrease in score value for texture of jelly was noted.

On verifying the values, a highly acceptable texture was noticed upto the third month as the score obtained was 90 per cent at this period. Thereafter a negligible decrease in texture profile was noted which usually occurs on storage of any jelly of standard quality owing to chemical changes. The results are in accordance with the findings of *Bhatnagar (1991)* who reported that the texture of watermelon jam was found downgraded with increase in storage time.

Statistical analysis of the data revealed that there was no significant difference in the texture of jelly for two consecutive months, yet a significant difference was noted between first and sixth month of storage.

Fig. 9
Overall Acceptability Of Jelly During Storage



Concentrating on the score level for colour of jelly it could be seen that maximum highest score was maintained upto second month (cent per cent). An unnoticeable reduction in score (2 per cent) was observed by the third month. It was found to maintain 90 per cent of the score even on the fourth month. The decrease in score was only 12 per cent and attained a score of 78 per cent by the end of the storage period during the fifth month.

Results reveal that colour of jelly was found to be superior upto fourth month of storage where 90 per cent of the score was maintained. On the fifth and sixth month of storage the scores were lowered. In an earlier study conducted by *Bhatnagar (1991)*, the colour of watermelon jam was found decreasing with increase in storage time. According to *Patel (1978)* the colour change is due to oxidation reduction reaction of anthocyanins.

Statistically no significant difference in colour was observed upto the fourth month. A significant difference was noted during the fifth and sixth month of storage period.

Overall acceptability of the product was evaluated by computing the total scores given for various quality parameters such as taste, flavour, appearance, colour and texture by panel members.

In the present study, storage had only little effect on the overall acceptability of karonda jelly. There was only a gradual decrease from 98 per cent to 76 per cent in score level for overall acceptability after six months of storage. The change in overall acceptability noted upto the third month was low and the score was reduced to 94 per cent by the third month. A reduction of six per cent score was noticed during the fourth month. The percentage scores for overall acceptability on the fifth and sixth month were 84 per cent and 76 per cent respectively.

In the present study it was found that overall acceptability of jelly was good on storage for a period of six months even though there was a decrease in score with advanced storage period. It was observed that change in the early and mid storage period was not commendable as it was very less. This deviation in overall acceptability has been supported by the work done by *Mir and Nath (1993)* who reported that storage decreases overall acceptability of fruit products. According to the author the organoleptic quality of jelly degraded as the storage period proceeded resulting change in taste, consistency and colour of the product. It has to be highlighted that the karonda jelly was reasonably good even after six months of storage maintaining superior quality attributes upto mid storage period.

Statistical analysis of the data revealed that during the first three months there was no significant difference in the overall acceptability of jelly. Difference was noted from the fourth month onwards.

On assessing the organoleptic qualities of karonda jelly, it was found that all the quality attributes attained maximum scores during the first month. The score was found to be generally decreasing towards the forthcoming months. However the overall acceptability of the product ranked high.

Thus it could be stated that jelly developed using karonda possessed standard qualities with respect to sensory attributes and was comparable with similar established products in its acceptability and shelf life.

4.4.3.2. Changes in the organoleptic qualities of candy during storage

Candies are valued for their attractive colour, texture, flavour and taste. Sugar crystallisation and off flavours reduces the acceptability. So inorder to study the effect of storage on the organoleptic qualities of candy, sensory evaluation test was conducted. Major quality attributes studied were taste, flavour, appearance, texture, colour and overall

acceptability. The mean scores of the organoleptic qualities of karonda candy during the storage period of 8 months is depicted in Table-19.

TABLE-19

EFFECT OF STORAGE OF CANDY ON VARIOUS QUALITY ATTRIBUTES

QUALITY ATTRIBUTES	STORAGE PERIOD (Months)								CD VALUE
	I	II	III	IV	V	VI	VII	VIII	
Taste	5.00	4.80	4.40	4.20	3.80	3.60	3.40	3.20	0.36**
Flavour	5.00	5.00	4.60	4.40	4.20	4.00	3.80	3.60	0.43**
Appearance	5.00	5.00	4.80	4.40	4.30	4.10	4.00	3.90	0.31**
Texture	4.50	4.20	4.20	4.10	4.00	3.90	3.70	3.60	0.47**
Colour	4.80	4.60	4.50	4.40	4.20	4.00	3.90	3.90	0.37**
Overall acceptability	4.80	4.70	4.50	4.30	4.10	3.90	3.70	3.60	0.22**

** Significant at 1% level

* Significant at 5% level

The results presented in Table-19 revealed that the mean panellist score for taste of candy decreased on storage. The highest score was obtained during the first month (cent per cent). Only a slight reduction in score (4 per cent) was observed by the second month. A linear decrease was observed further and the score was 84 per cent during the fourth month and 64 per cent by the end of the storage period.

From the result it could be seen that the taste of candy was highly acceptable with 84 per cent score upto the fourth month though there was little variation from original taste. Thereafter a decrease in taste was noted. However it could be noted that even in the eighth month of storage the score for taste was maintained at 64 per cent. The score count revealed the high acceptability of the product at the eighth month eventhough the score was decreased slightly. It has been reported by *Tripati et al (1988)* that a decrease in taste was noted in amla candy during storage. This statement stands right as seen by the decrease in taste in the present study. However no particular reason that could claim for the difference in taste was obtained.

Statistical analysis of the data revealed that there was no significant difference in taste of candy obtained for two consecutive months. A significant difference was noted from third month onwards.

The mean scores for flavour intensity of karonda candy was maintained at the maximum level during the first two months. A gradual and linear decrease was noted from the third month. Nevertheless 72 per cent score was obtained even at the eighth month of storage. Comparing the score of flavour month wise, no marked change was found between the values obtained for two consecutive months. But on having an overall assessment it could be noted that as the storage period advanced there was slight decrease in score values.

From the result it was found that the candy had maintained the highest maximum flavour value upto the second month. Thereafter there was a little deviation from the original flavour. But it was encouraging to note that the flavour of the product was highly acceptable upto the eighth month.

Statistical analysis of the data revealed that there was no significant difference in flavour of candy obtained for two consecutive months. From a fourth month onwards significant difference was noted.

When the appearance of candy was analysed on various storage periods, it was found that the appearance of candy scored maximum upto second month (cent per cent). It was reduced to 96 per cent by the third month. A steady and linear decrease was noted from fourth month onwards. The percentage score for appearance was reduced from 88 per cent to 78 per cent during fourth to eighth month of storage.

It was clear from the score level that the appearance was highly acceptable and superior upto the fourth month. Thereafter little change occurred in the appearance of candy due to fading

of colour and minimum level of shrinkage of the fruit. However these changes towards the late storage period had only little effect in the overall acceptability. *Kertesz (1980)* from his studies concluded that appearance of the pear candy decreased with increase in storage period. In the present study the variation in this attribute was minimal.

Statistically there was no significant difference in appearance during the first three months. A statistically significant difference was noted from fourth month onwards.

Coming to the texture of candy highest score was obtained during the first month (90 per cent). The score was reduced to 84 per cent by the second month. However no variation was observed during the third month. From fourth month onwards a slow rate of decrease was noted and stood at a level of 72 per cent during the eighth month.

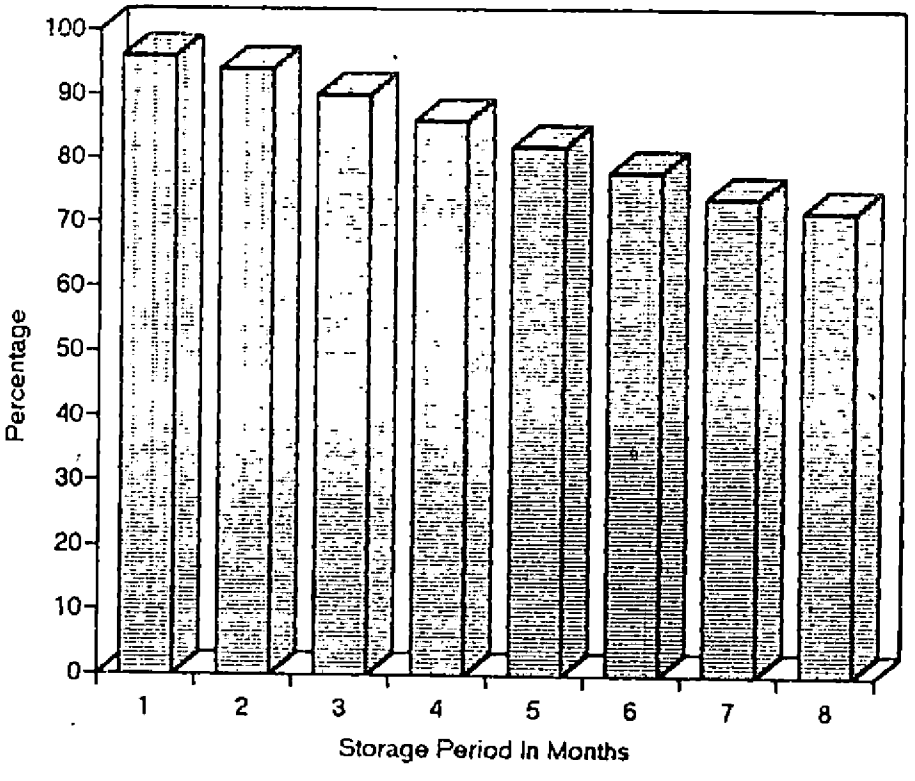
Data revealed that the texture of the candy was highly acceptable even on the eighth month (72 per cent). However a decrease was noted slightly affecting the texture profile of candy on storage for eight months. This reduction in score was mainly due to the moisture loss in candy on storage to a marginal level.

Statistically there was no significant texture change upto five months of storage in candy. From sixth month onwards a significant difference was noted.

The colour of candy declined slightly as shown by the score value. The score obtained was 96 per cent during the first month. On the second month there was a decrease of 4 per cent in the score. Slow decrease was noticed in the following months also upto seventh month and was steady during the eighth month at 78 per cent.

From the result it was noted that colour decreased with increase in storage period. The slight fading of colour on storage was due to the oxidation reduction reaction which resulted in

Fig. 10
Overall Acceptability Of Candy During Storage



bleaching of the colouring pigments. Moreover the use of raspberry red food colour in present trial was contributing to the less colour intensity against the use of erythrocine dye. The method of dyeing prior to syruping process of the fruit if adopted would also have been more beneficial in this aspect. More intense the colour, more appealing the candy will be. On storage the colour diminished lowering the attractiveness of the candy. The observation lends support to the findings of *Karim (1992)* who reported that reduction in colour was observed in chikku leather during storage. However these changes statistically have no significance upto four months. During consecutive months also there was no significant variations. The acceptability was also not affected on this account.

The overall acceptability of karonda candy was described as having only a gradual decrease from 96 per cent to 72 per cent with eight months of storage. Superior score was maintained even on the fifth month, the percentage of score obtained being 82. From fifth month onwards a slow rate of decrease in overall acceptability was noted reflecting the slight reduction in various qualities tested.

Perusal of the data on overall acceptability of candy appeared to be independent on changes in colour, appearance, etc. The marginal decrease could be explained with the result of other investigations carried out. *Tripathi et al (1998)* reported that acceptability of candy and dehydrated product decreases with storage. In another study conducted by *Tripathi et al (1988)* the overall acceptability of amla candy was found to be decreasing during storage. Similarly storage studies on chikku leather also showed a significant difference in overall acceptability *(Taufik 1992).*

Assessment of the organoleptic qualities of candy during different storage periods showed a reduction in score values for various quality attributes which was not significant. The product had maintained fruit shape and firmness, its flavour, texture and taste during storage without under going crystallisation. The overall acceptability was also maintained at a high level. The product was rated reasonably good even after eight months of storage.

4.4.3.3 Changes in the organoleptic qualities of canned karonda during storage

Variation in the organoleptic qualities of canned fruit on storage was measured to study the influence of storage on canned karonda. Major quality attributes studied were taste, flavour, appearance, texture, colour and overall acceptability. The mean scores of the organoleptic qualities of canned karonda during the storage period of 8 months are presented in Table-20.

TABLE-20

EFFECT OF STORAGE OF CANNED KARONDA

ON VARIOUS QUALITY ATTRIBUTES

QUALITY ATTRIBUTES	STORAGE PERIOD (Months)								CD VALUE
	I	II	III	IV	V	VI	VII	VIII	
Taste	4.00	4.20	4.30	4.30	4.10	4.10	4.10	4.00	0.17**
Flavour	4.30	4.10	4.00	3.80	3.60	3.50	3.40	3.20	0.38**
Appearance	4.50	4.20	3.80	3.60	3.40	3.20	3.00	3.00	0.34**
Texture	4.30	4.00	3.80	3.60	3.40	3.20	3.10	3.00	0.34**
Colour	4.20	4.00	3.90	3.80	3.60	3.40	3.30	3.10	0.36**
Overall acceptability	4.20	4.10	3.90	3.80	3.60	3.40	3.30	3.20	0.29**

** Significant at 1% level

* Significant at 5% level

The periodical evaluation of canned fruit recorded a fluctuation in taste performance during the storage period. The percentage score raised from 80 per cent to 86 per cent by the third month and was steady during the fourth month. A decrease in the score level was registered on the fifth month by 4 per cent and there was no change in the subsequent months in taste value of canned karonda.)

Varying levels of acceptability on account of taste of the canned fruit was observed. Initially the taste increased and was found highest during the third and fourth months. This might

be attributable to the sweetness due to gradual absorption of sugar from the solution by the fruit till an equilibrium between the liquid and solid phase was attained. The small variation appeared in the subsequent months could be explained with the negligible increase in acidity.

Statistical analysis of the data revealed that, a significant difference was noticed from first to fourth month. Thereafter the difference was on par.

Flavour attribute was studied to be varying during storage. Highest score was obtained during the first month (86 per cent) and it was gradually lowered to 64 per cent by the eight month.

The flavour of canned fruit was highly acceptable upto third month though there was little deviation from the original flavour. Thereafter the flavour value slightly declined but the score recorded was satisfactory even at the end of storage period and proved that there was no off flavour even after eighth month. *Jonbert (1993)* had reported similar observations that the flavour of the fruit changed with canning. This variation in flavour indicate the behaviour of the treatment applied. Sterilisation under pressure for prolonged heating time would have aggravated softening of the fruit and flavour losses *(Poll 1981)*.

Statistical analysis of the data indicate no significant difference in flavour attribute of canned fruit upto third month and also for two consecutive months during storage period.

The appearance of canned karonda fruit was superior during the first two months being scored 90 and 84 per cent respectively. Acceptability score with respect to appearance was reduced to 60 per cent by the end of storage period.

From the score values it was found that the appearance of canned fruit decreases with increase in storage period. Appearance of canned fruit was good upto sixth month of storage

period. On longer keeping, the appearance turned to be degraded due to slight shrinkage of the peel and shrivelling of the fruit loosing its shape towards the end of storage period. This could be due to osmotic reactions as more water might have drawn off from the fruit. Decolouration of fruit could be another reason for loosing the appearance score on storage.

Statistical treatment gave no difference in appearance during first two months. A significant difference was noted from third month onwards.

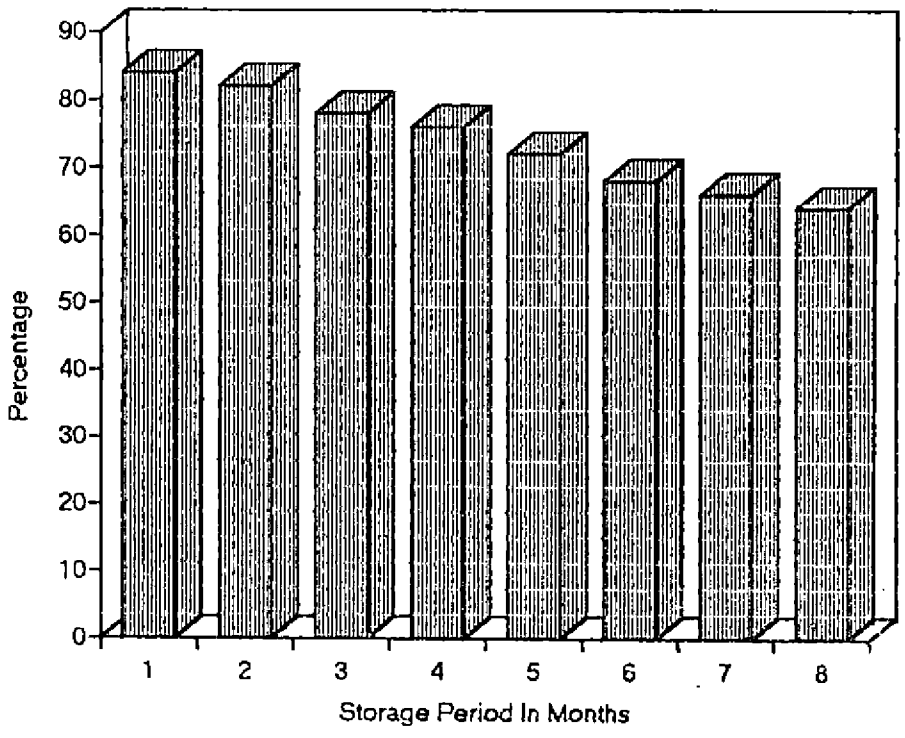
The score count for texture of canned fruit recorded the maximum score during the first month (86 per cent) and it was reduced by 2 per cent during the second month. Gradual change was noted on the consecutive months. The score at the end of the storage period was observed to be 60 per cent.

From the results a decline was noticed in the texture of fruit during storage. The texture of the fruit could be correlated with the acid content of the fruit. The high acid varieties often observed softer texture after canning. Possibly the hydrogen ions in cell sap activated by the thermal processing hydrolysed the pectinic acid into low chain compounds resulting in solubilization into syrup and finally giving a soft textured product as postulated by *Singh et al (1992). Poll (1981)* evaluated that during storage of canned fruit the rigidity of the matrix decreased and cell walls were damaged.

Statistical analysis of the data revealed that there was no significant difference in texture of canned fruit obtained for two consecutive months, but a significant difference was noted from third month onwards.

A decrease in colour perception of canned karonda was not highly discouraging throughout the storage period. The maximum score of 84 per cent was obtained during the first month. This value was reduced to 62 per cent at the end of storage study.

Fig. 11
Overall Acceptability Of Canned Karonda During Storage



Acceptability of colour was downgraded during storage by the panellists. The colour of the fruit leached into the syrup with processing as reported by *Joubert (1993)*. Decolouration of the fruit took place gradually over the storage time of the canned fruit resulting in pale look of the fruit. Dyeing the fruit giving intense colour prior to canning can be suggested as a remedy for checking colour loss to certain extent. Other workers have also reported colour loss of canned food products during storage. *Shah et al (1992)* noticed a decrease in colour during storage of canned peach and apricot pulp. Similarly *Ghosh et al (1981)* also reported a decrease in the yellow colour of mango pulp on storage.

For the first four months there was no significant difference in the colour of canned fruit. The significant difference was noted from fifth month onwards.

As per the result obtained from judges for sensory evaluation, the overall acceptability of canned fruit varied from 84 per cent to 62 per cent during the storage period. It was noticed from the table that there was no highly noticeable reduction in scores in the overall acceptability during the consecutive months.

In the present study with karonda even though the overall acceptability of canned fruit decreases with increase in storage period the score was recommendable for good sensory quality. Even taste increased upto the mid storage period, it had no effect on the overall acceptability due to the lower rating of other attributes. *Mir and Nath (1993)* reported that storage decreases overall acceptability of fruit products. The present result are in accordance with the findings of *Shah et al (1992)* who reported that overall acceptability of canned peach and apricot pulp decreased during storage. *Chakraborthy et al (1988)* also noticed decrease in overall acceptability of canned litchi product during storage.

It was evident from the result that organoleptic qualities of canned fruit during different storage periods showed a reduction in score values in all the quality attributes except in taste profile which exhibited an increase. Initially the variation was slow which was subsequently building up. However no quality deterioration that would adversely influence the product acceptability by panellists was observed in all the characters study. The product had reasonably good acceptability even after eight months of storage life.

4.4.3.4 Changes in the organoleptic qualities of wine during storage

The quality of wine depends upon the chemical composition of the fruit, the type of yeast used and the temperature of fermentation *(Vyas et al 1991)*. During ageing of wine several changes occur before it is stabilised. Influence of storage on the organoleptic qualities of wine was assessed through sensory evaluation tests. Along with the attributes like taste, flavour, colour and appearance, the special characters like clarity and strength were also studied with respect to assessment of wine as these parameters are important in determining quality. Table-21 depicts the mean scores of the organoleptic qualities of karonda wine during the storage period of eight months.

TABLE 21

EFFECT OF STORAGE OF WINE ON VARIOUS QUALITY ATTRIBUTES

QUALITY ATTRIBUTES	STORAGE PERIOD (months)								CD VALUE
	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	
Taste	4.30	4.40	4.60	4.80	4.80	4.90	5.00	5.00	**.34
Flavour	4.30	4.30	4.50	4.60	4.70	4.90	5.00	5.00	**.36
Appearance	4.00	4.00	4.20	4.50	4.60	5.00	5.00	5.00	**.26
Clarity	3.70	3.80	4.40	4.50	4.60	5.00	5.00	5.00	**.34
Colour	5.00	5.00	4.50	4.30	4.20	4.10	4.00	4.00	**.28
Strength	3.70	3.80	4.20	4.40	4.60	4.80	5.00	5.00	**.36
Overall acceptability	4.10	4.20	4.40	4.50	4.60	4.80	4.80	4.80	**.25

** Significant at 1% level

As presented in Table-21 it is evident that the mean scores obtained for taste of wine showed a steady increase on storage. The maximum score was attained during the seventh month (cent per cent) and it was stabilised at the 8th month. On the first month the percentage score attained was 86 per cent, which increased to 88 per cent and 92 per cent respectively during the second and third months of storage. Further increase was noted on the fourth month when taste attained a score of 96 per cent. However no variations were observed during the fifth month, while on sixth month the score was increased to 98 per cent and attained cent per cent score from seventh month onwards.

A close watch on the data revealed that there was a considerable increase in taste with increase in storage period, wine becomes most acceptable on ageing when the alcohol conversion is stabilised and good aroma is developed. The maximum increase in the score was noted from the seventh month of keeping. This enables to speculate that by this period adequate ageing had taken place in karonda wine. The observation lends support to the contention of *Vyas et al (1991)* who reported that during storage of wine, its harsh taste and yeasty odour diminishes. According to *Patel (1978)* the taste characteristics of wine are not only due to the alcohols, aldehydes and esters present in it, but also due to the phenolic substance. Though the sugar content of wine was recorded lowering on storage, increase in alcohol content and accordingly the aroma of the product is descriptive for the superiority gained in this attribute.

Statistical analysis of the data revealed that the increase was significantly different from fourth month onwards.

Similarly in the case of flavour, the scores increased from 86 per cent to cent per cent with in 8 months. During the first two months no increase was observed. However in the 3rd month the score was enhanced to 90 per cent with a steady and linear increase during the consecutive months. By the seventh month of storage flavour was found superior attaining maximum highest score (100 per cent) which remained steady in the eighth month also. Flavour is usually attributed by the aromatic alcohols present. By the seventh month the alcohol content

would have reached the maximum due to completion of ageing process and development of fine aroma. This could be the reason for the enhanced flavour on longer keeping. Again it was noticeable that once the best flavour had developed, there after it remained at that constant level.

During the first five months, statistically there was no significant difference regarding flavour of wine. Sixth month onwards a significant difference was noticed.

Coming to appearance once and clarity of wine as depicted in Table-21, both attained maximum score in the sixth month. The percentage score for appearance was enhanced from 80 per cent to cent per cent while for clarity the increase was from 74 per cent to cent per cent. In the case of appearance no change in score was observed during the second month but progressively there was an increase in the following three months with scores reaching a maximum at the sixth month (cent per cent). Further storage retained appearance value at the highest level. Mean while the clarity performance observed steady increase from the first month itself reaching maximum on sixth month like wise its appearance rating. Cent per cent level could be maintained thereafter in this aspect also.

It is right to describe that the appearance and clarity of wine is interrelated, more clear the wine better is the appearance. In the present study results were evident to prove that appearance and clarity of karonda wine was pronounced with prolonged storage time. Sedimentation of suspended particles owing to the undisturbed storage treatment in the study helped wine to become very clear and thus best in appearance. An increase in appearance value of culled apple wine during storage was reported by *Vyas et al (1991)*.

Results of analysis of variance of the data during different storage periods gave a significant difference in appearance from forth month and the same in clarity from 3rd month of storage.

In contrast to other attributes, on storage the colour of wine declined slightly as shown by the score value. However during the first two months the colour recorded superior scores (cent per cent) and on the third month there was a fall of 10 per cent in the score. Minor decrease was noticed in the following months also upto seventh month and was steady during the eight month.

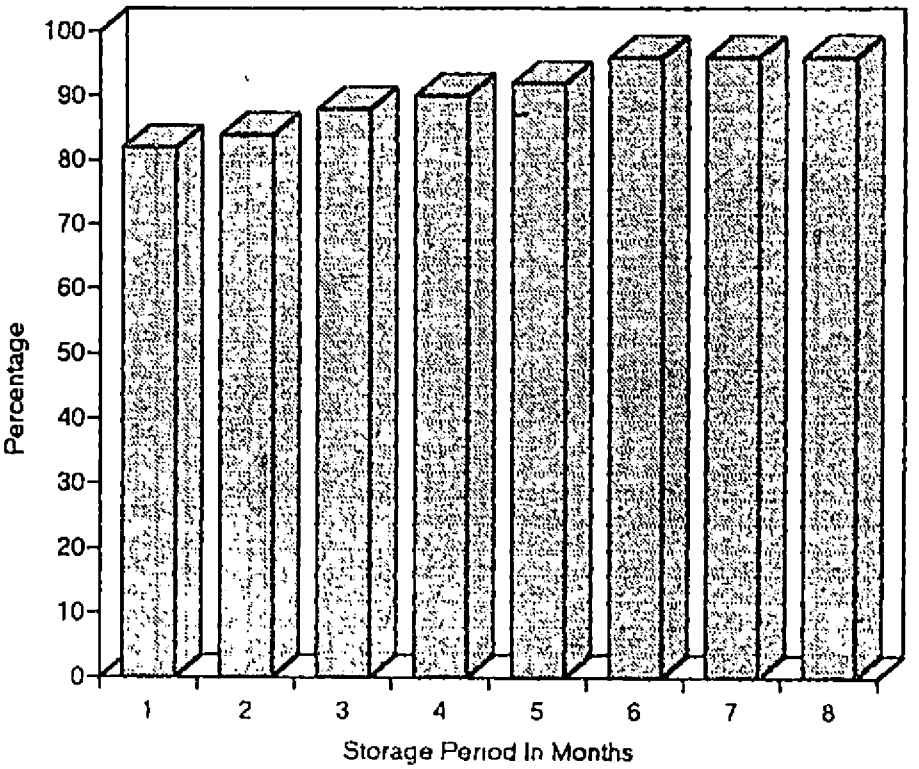
While concentrating on the values obtained for colour of wine on storage, the attribute was downgraded by the panellists from the third month by a lower score . *Subrarao (1978)* reported that astringency and colour of wine are attributed to the phenolic constituents present in it. He also stated that the change of colour occurs in wine as it ages. The colour change could be assumed to be due to oxidation reduction reaction of anthocyanins and tannins present in the fruit. *(Vyas et al 1991).* Since karonda fruit contains higher amount of these constituents the change occurred could be considered a normal characteristic of the fruit. Storage of the rich coloured karonda wine in colourless bottle was another justification for the lower colour appeal on storage. But the reduction was not a considerable one since the lowest value obtained for colour stood at a level of 90 per cent.

Statistical analysis of the data revealed that, the first two months of storage the difference was on par. A significant difference was noted from the third month onwards.

From the Table-21 value it is evident that the wine strength increased on storage. The increase was from 74 per cent on the first month to 100 per cent on the eighth month. A level of two per cent increase was noted on the second month and advanced with a clear rise by 10 per cent during third month. A slow and steady increase was noted as 84 per cent was found raised to cent per cent. Maximum score for strength of wine was retained at the eighth month also

Storage performance of karonda wine revealed that the strength of wine was enhanced considerably upon storage. As the wine aged its alcohol contents and acidity increased. The

Fig. 12
Overall Acceptability Of Wine During Storage



strength of wine is appreciated by its alcohol content. In the present trial ageing upto 7 months could produce table wine of the best choiced strength.

On the first two months there was no significant difference in strength of wine. A statistically significant difference was obtained in strength from the third month onwards.

In accordance with the trend exhibited by the various quality attributes the overall acceptability of wine also increased making a variation from 82 per cent to 96 per cent. There was a sharp increase right from the first month itself with maximum scores being attained during the sixth month and was maintained well in the following months.

On perusal of the pooled data obtained for overall acceptability of the wine it could be stated that the wine improved in acceptability after 8 months at a difference of 14 per cent. The wine showed more acceptability on longer keeping as observed from the result, where overall acceptability attained maximum score from the sixth month (96 per cent). Performance of taste, clarity, strength and appearance have contributed well to this high rating. *Patel (1978)* ascertained that ageing increases the overall acceptability of wine.

For the first three months there was no significant difference in overall acceptability. Fourth month onwards a significant difference was observed.

Attention has been made to study the storage behaviour of karonda wine. This indicated that all the sensory attributes of wine performed appreciable increase on storage except in colour. However no colour deterioration that could diminish the product acceptability was observed. Storage of wine upto eighth month could improve clarity, strength, taste and flavour of wine and almost all these characters in karonda wine scored cent per cent value within a storage time of seven months. Storage favoured almost all the quality characters of karonda wine developed in the present study.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The present study entitled **"Development of karonda [Carissa carandus. L] based products"** was undertaken with the aim of developing products for the utilisation of the underexploited fruits karonda. The investigation also aims to study the organoleptic, nutritional and shelf life qualities and the consumer acceptance and preference of the developed products.

Karonda is an underexploited indigenous profusion of berry, but people are not aware of the utility of this fruit. All or to be exact to a large extent of the produce is going as a waste, since its astringency is unacceptable. However these fruits with speakable nurtitive value are acidic in taste and suitable for production of many processed products and in the present experiment attempts have been made successfully to prepare jelly, candy, canned fruit and wine.

A view on the physico-chemical examination revealed that the fruit is an oblong shaped small berry with very low percentage waste portion. Chemically it is highly acidic having negligible sugar level and appreciable vitamin C content. The pectin value of this nontable fruits was found to be high, lending its feasibility for making suitable processed products.

Product development is an effort for popularisation and increasing utilisation of the fruit. In the present study, suitable products developed were jelly, candy, canned fruit and wine. Products prepared applying three different treatments were assessed for their organoleptic characteristics on the basis of various quality attributes.

Viewing the acceptability of the developed products, it was observed that in the case of karonda jelly, best sensory quality attribute was formed, when the product was prepared in the

4:3 proportion (T_3) of fruit extract sugar ratio. The proper amount of sugar to be added to fruit extract in jelly making was directly proportional to the amount of pectin and acid present in it. It could also be inferred from the study that equal amount of sugar (T_1) gave less colour, more sweetness and sticky texture while with lesser amount of sugar (T_2) the product was less sweet, adequately set and had an improper texture.

In the case of karonda candy, the candy prepared by 3 weeks impregnation in sugar maintained the top score in all attributes being delicious to taste and comparable with the cherry available locally to us. The process of daily raising the sugar concentration (T_1) and finally leaving undisturbed in the syrup within a period of three weeks gave superior sensory quality to the candy.

Canning being an other option for preservation of fresh karonda, an attempt was made to do so and the best results were attained for the treatments by pitting and without hardening with calcium chloride. Blanching in calcium chloride was found to lower most of the palatability attributes when canned, as observed for T_1 and T_2. Pitting and removing seeds were added advantage over the canning of the fruit as a whole.

For wine, best results were attained in case of various quality attributes when boiled water was added to the fruit. This could be attributed to the fact that optimum condition necessary for preparation of good quality wine was attained in this treatment. In addition activation of the enzymes with optimum temperature resulted in complete fermentation and settling of haze particles which improved clarity and appearance in contrast to T_1 and T_3, where for the former case fermentation was not complete and for the later excessive disintegration of the fruit hindered its clarity.

The standardised products were prepared in bulk and stored for shelf life studies.

The nutritional and chemical composition of the standardised products were determined after completion of the process of preparation. The major components analysed in the four products were acidity, pH, total sugar and TSS. The alcohol content of wine was also tested. Jelly prepared from the fruit had an acidity of 0.50 per cent, pH observed was 3.50, total sugar content 38.35 per cent and the total soluble solids was recorded as 65 per cent. In the case of candy an acidity of 0.65 per cent, pH of 3.35, total sugar content of 70.5 per cent and total soluble solids of 70 per cent were exhibited. Canned karonda possessed acidity of 0.45 per cent, pH of 3.5, total sugar 5.0 per cent and total soluble solids of 36 per cent. On analysis of wine its composition was observed with an acidity of 0.70 per cent, pH of 3.5, total sugar of 5.45 per cent and total soluble solids of 22.5 per cent. The alcohol content of the wine was 6.75 percent. Chemical characters of all karonda products were in accordance with the characters of similar products prepared from other fruits. This enables us to highlight that products with comparable nutritional and chemical components would be successfully prepared from this neglected fruit.

The karonda products developed in the present study were compared with FPO specification. A comparison with FPO is essential to provide a uniform and consistently good quality food product to the consumer. Details pertaining to the four products in this respect were tested and were found to satisfy the FPO requirements. All the four products developed had characters and standards in accordance with FPO and these comparative values obtained gives the indication that the recipes are properly adjusted for its essential contents according to FPO standards.

A comparison of the cost of the karonda products in the present investigation pointed out that candy was the cheapest product among the four items. In cost analysis, wine was found to have the second place in cost benefit parameter. When jelly was prepared the economic aspect stood in the third place while working out the cost per kilogram of the products. The maximum expense was observed for canning the fruit due to the comparatively higher expenses of processing and also of tin containers. However the cost of each karonda product was found to be

much lower than similar products based on conventional fruits available. This offers scope of utilisation of karonda fruit by processing industry.

The fruit product yield ratio of karonda products developed in the present study were calculated. It was found that the highest yield was obtained for wine followed by candy jelly and canned karonda.

The consumer acceptance and preference of the standardised products were determined in the present study. When consumer acceptability level on the basis of scores obtained for various attribute was calculated, the highest acceptability performance was obtained for jelly (98 per cent) followed by candy (96 per cent). Wine secured a score of 94 percentage and canned fruit had the lowest acceptability score of 80 per cent. The consumers accepted jelly, candy and wine with a very high palatability acceptance and canned karonda with reasonably good acceptability.

Results of preference ranking by consumers revealed that highest percentage of consumers preferred wine first followed by jelly. Most of the consumers preferred candy as the third like item and canned fruit was given the fourth priority among the products.

The shelf life qualities of karonda products were assessed periodically and the qualities analysed were acidity, pH, total sugar, total soluble solids, organoleptic quality and microbial changes. In the case of wine, alcohol content also was tested.

The periodical evaluation of karonda jelly revealed that, there was an increase in acidity of jelly during storage in contrast to pH and total sugar where there was a decrease. However on storage of jelly a constant TSS was recorded. On assessing the organoleptic qualities of jelly, it was found that all the quality attributes attained maximum scores during the first month. The score was found to be generally decreasing towards the forth coming months. However the overall acceptability of the product ranked high. On examination of the microbiological aspects

it was evident that jelly showed storage ability at ambient conditions for a storage of six months without microbial attack.

Monthly evaluation of karonda candy during the storage period of eight months revealed that, there was a decrease in the acidity whereas the pH and total sugar was found to have an increase. At the same time TSS remained constant. Assessment of the organoleptic qualities of candy during different storage period showed a reduction in score values for various quality attributes which was not significant. The product had maintained fruit shape and firmness, its flavour, texture and taste during storage without undergoing crystallsation. The product was rated reasonably good even after eight months of storage. Negative results were obtained for microbial count.

Cut out examination of canned karonda during the storage period of eight months resulted in a product of desirable head space and drained weight. No significant change in pH and acidity of the product was noticed. Total sugar was found to increase on storage while TSS decreased during storage. The organoleptic qualities of canned fruit during different storage periods showed a reduction in score values in all the quality attributes except in taste profile which exhibited an increase. However no quality deterioration was occurred to influence the product acceptability and reasonably good acceptability was observed even after eight months of storage life. Negative results were obtained for microbial count.

In the case of wine on storage there was an improvement in alcohol content whereas there was a decrease in TSS and total sugar. There was also a minimal increase in acidity and a slight decrease in pH. Organoleptic qualities of wine during storage indicated that all the sensory attributes of wine performed appreciable increase in storage except colour. Storage of wine could improve clarity, strength, taste and flavour of wine and all the characters scored cent per cent value within a storage time of seven months. Storage favoured almost all the quality

characters of karonda wine. Results of microbiological examination revealed that there was complete absence of microorganism.

To conclude, karonda being a nutritious fruit rich in vitamins and minerals, efforts are indeed necessary to avoid its underutilisation. The present experiment had been a successful attempt since good quality products of karonda which were highly acceptable could be prepared. The fruit once considered unacceptable due to its astringency, was converted into good candy, highly fermented good quality wine, excellent jelly and to a good extent successful in canning also. However the drawbacks observed in the colour attribute in the case of candy and canned karonda could possibly be due to the usage of an unsuitable colouring dye and this defect can be rectified by the use of better dyes like erythrocin.

In addition, other good quality products can also be tried for further potential of this fruit which cannot be marketed as a table fruit. Moreover successful product development could also bring additional revenue through our fruit wealth. Standardisation studies to diversify the products successfully developed in the present attempt, can be taken up to introduce variety by blending with other fruits and also preparation of novel products of karonda thereby achieving better acceptability and multiplicity of this precious but neglected berry.

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APPENDICES

APPENDIX- I

PROCEDURE FOR THE TRIANGLE TEST

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

EVALUATION CARD FOR THE TRIANGLE TEST

Name of the product :Sugar Solution

Note :Two of the three samples are identical

Identify The Odd Samples

S.No:	Code No. of samples	Code No.of the identical samples	Code No. of the odd sample
1	X,Y,Z		
2	A,B,C		

APPENDIX-II

SCORE CARD

	A	B	C	D
Taste				
Very good - 5				
Good - 4				
Fair - 3				
Poor - 2				
Very Poor - 1				
Favour				
Very good - 5				
Good - 4				
Fair - 3				
Poor - 2				
Very Poor - 1				
Texture				
Very good - 5				
Good - 4				
Fair - 3				
Poor - 2				
Very Poor - 1				
Appearance				
Very good - 5				
Good - 4				
Fair - 3				
Poor - 2				
Very Poor - 1				
Colour				
Very good - 5				
Good - 4				
Fair - 3				
Poor - 2				
Very Poor - 1				

APPENDIX-II

SCORE CARD

	A	B	C	D

Taste

Very good - 5
Good - 4
Fair - 3
Poor - 2
Very Poor - 1

Favour

Very good - 5
Good - 4
Fair - 3
Poor - 2
Very Poor - 1

Texture

Very good - 5
Good - 4
Fair - 3
Poor - 2
Very Poor - 1

Appearance

Very good - 5
Good - 4
Fair - 3
Poor - 2
Very Poor - 1

Colour

Very good - 5
Good - 4
Fair - 3
Poor - 2
Very Poor - 1

APPENDIX-III

SCORE CARD

	A	B	C	D

Taste

Very good - 5
Good - 4
Fair - 3
Poor - 2
Very Poor - 1

Favour

Very good - 5
Good - 4
Fair - 3
Poor - 2
Very Poor - 1

Clarity

Sparkling clear - 5
Clear - 4
Slightly clear - 3
Slightly cloudy - 2
Very cloudy - 1

Appearance

Very good - 5
Good - 4
Fair - 3
Poor - 2
Very Poor - 1

Colour

Very good - 5
Good - 4
Fair - 3
Poor - 2
Very Poor - 1

DEVELOPMENT OF KARONDA (CARISSA CARANDUS.1) BASED PRODUCTS

BY

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1995

ABSTRACT

ABSTRACT

The present experiment entitled **"Development of karonda based products"** was aimed at developing products for the utilisation of the underexploited karonda. In this study organoleptic, nutritional, shelf life qualities and also consumer acceptance and preference of the developed products were investigated.

Karonda is an underexploited oblong berry with speakable nutritive value, acidic in taste, negligible sugar content, appreciable vitamin C content and suitable for production of many processed products. In this study attempts have been made successfully to prepare jelly, candy, canned fruit and wine following suitably standardised procedures. The fruit had high pectin value lending its feasibility for making suitable processed products.

Visualising the acceptability of the developed products, it was observed that in the case of karonda jelly best sensory quality attribute was found when the product was prepared in the 4:3 proportion of fruit extract sugar ratio. In the case of karonda candy, the candy prepared by three weeks impregnation in sugar maintained the top score in all attributes. Coming to canned karonda the best results were attained for the treatment by pitting and without hardening with $CaCl_2$ and for wine the most acceptable treatment was when boiled water was added to the fruit and this attained the best results in case of various quality attribute.

The nutritional and chemical composition of the standardised products revealed that chemical characters of all karonda products were in accordance with the characters of similar products prepared from other fruits. The karonda products developed were compared with FPO specification and were found to satisfy the FPO requirements.

Cost analysis of the karonda products revealed candy to be the cheapest among the four items, with wine ranking second place and jelly achieving the third place. Cost of canned was comparatively higher due to the expense of processing. However an overall analysis revealed that the cost was lower in comparison with similar products prepared from conventional fruits. Coming to fruit product yield ratio, the highest yield was attained for wine followed by candy, jelly and canned karonda.

Consumer acceptance and preference of the standardised products were determined. The results revealed that the highly acceptable performance was obtained for jelly followed by candy, wine and canned fruit. Results of preference ranking revealed that wine was preferred most followed by jelly, candy and canned karonda.

Parameters selected to ascertain the shelf life qualities of these products were acidity, pH, total sugar, TSS, overall acceptability and microbial examination. There was an increase in acidity during storage for jelly and a minimal increase for wine in contrast to candy and canned karonda where there was a decrease in former parameter and no significant change for the latter. Coming to pH, there was a decrease in pH for jelly and wine while there was an increase in pH for candy and there was no significant change for canned fruit. Considering TSS, for jelly and candy it was constant and a decrease was observed for wine and canned karonda. On storage however for total sugar there was a decrease for jelly and wine in contrast to candy and canned fruit where there was an increase. Storage upto eight months did not alter the sensory attributes to considerable levels. Moreover the palatability of wine could be improved with storage. All the products were organoleptically acceptable and maintained good quality parameters on storage under ambient conditions. For all the four products, microbial examination revealed negative results.

To conclude the present attempt had been a successful innovation in the preparation of highly acceptable products from the underexploited karonda fruit and also an encouragement for preparation of other good quality products which could increase the acceptability and multiplicity of this neglected berry in addition to bring extra fruit wealth to our country. Therefore efforts should be adopted to incorporate standard techniques to diversify the products developed.