

III METHODOLOGY

The methodology followed to undertake the study entitled “**Processing and Packaging of Selected Value Added fruit products and their Promotion through Capacity Building Programme**” consisted of four phases:

PHASE I

- A. Production scenario of banana, guava and papaya
- B. Market survey on the availability of processed fruit products
- C. Study on consumer preference

PHASE II

Processing of banana, guava and papaya by dehydration, pulping and pickling techniques

PHASE III

Quality analysis and shelf life study of dehydrated fruits and formulated products and

PHASE IV

Capacity building programme on fruit processing to Self Help Group women and Farmers.

PHASE I:

A. Production Scenario of Banana, Guava and Papaya

The global and national production scenario of banana, guava and papaya were collected from Food and Agriculture Organization statistics and National Horticulture Board (NHB) 2010-2011 sources. The production status of these fruits in TamilNadu state and Coimbatore district was focused for the conduct of the study (Figure 1).



Figure 1: Major Banana, Guava and Papaya Producing States in India

B. Market Survey on the Availability of Processed Fruit Products

Market survey is defined as a study of the spending characteristics and purchasing power of the consumer who are within your business's geographic area of operation; a research method for defining the market parameters of a business.

Three departmental stores and thirty small stores situated in Coimbatore city, and 300 customers who visited these stores during three consecutive days were selected by purposive sampling method to conduct the market survey. A market survey on the availability of processed products from the selected fruits namely banana, guava and papaya was conducted to identify the major selling fruit products and the reasons behind it. This survey also focused to develop a new variety of products. A well framed Questionnaire 1 shown in Annexure 1 was formulated to collect the data regarding, availability of fruit product, preference of consumers for the fruit product, major market outlets of fruit products, satisfactory levels of the consumers on the quality and price of fruit product, and expectations of the consumers on the fruit products.

C. Study on Target Consumer Preference for Product Formulation

The target groups focused were children and adolescents to get the preferences towards the selected fruit products. A total of 200 children in the age group of 10 -12 years and 200 adolescents in the age group of 16-17 years from Angappa CBSE Senior Secondary School, situated in Coimbatore were selected by purposive sampling method to identify the preferences towards processed fruit products by using a well framed Questionnaire2 shown in Annexure 2. The data including availability of fruit product, most preferred new fruit product, quality attributes preferred, place of purchase and factors considered while purchasing were collected. Based on the preferences of the target groups the value added fruit products such as fruit candies and fruit sauces were formulated.

PHASE II: Processing of Banana, Guava and Papaya by Dehydration, Pulping and Pickling Techniques

The formulation of value added products using selected dehydration techniques was carried out by the following steps:

- A. Selection of fruits
- B. Selection of processing techniques
- C. Formulation of value added products

A. Selection of Fruits

India is the second largest producer of fruits after China with a production of 44.04 million tonnes of fruits. The major tropical fruit produced and traded included mango, papaya, guava, pineapple, amla and avocado. The losses are estimated to the extent of 20 to 30 per cent due to lack of proper harvesting, processing and storage facilities which is valued at `230 billion (TNAU, 2010). The major cropped fruits selected for the study were banana, guava and papaya by cluster sampling. Cluster sampling a type of probability sampling in which the population is divided into groups on the basis of some shared characteristic (such as fruit production by geographic region) and a random sample is drawn from each of these groups.

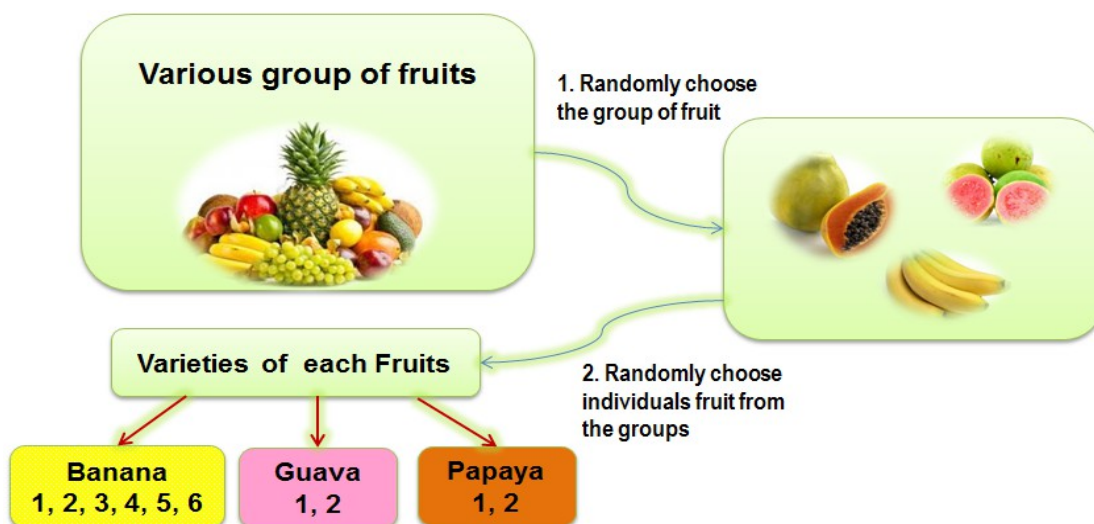


Figure 2: Model Diagram of Cluster Sampling

Banana

There are nearly 24 varieties of banana available and one fourth was selected for the study. The six varieties of banana (*Musa species*) selected for this study are listed below.

Robusta (AAA)

It is a semi-tall variety, grown mostly in TamilNadu and some parts of Karnataka for table purpose. It is a high yielding and produces bunch of large size with well-developed fruits. Dark green fruits turn bright yellow upon ripening depending on ripening conditions. Fruit is very sweet with a good aroma. Bunch weighs about 25-30 kg. Fruit has a poor keeping quality leading to a quick breakdown of pulp after ripening, hence not suited for long distance transportation. Robusta is highly susceptible to Sigatoka leaf spot disease in humid tropics.

Rasthali (Silk AAB)

It is a medium tall variety commercially grown in Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Bihar. Its unique fruit quality has made Rasthali popular and a highly prized cultivar for table purpose. Fruits are yellowish green throughout their development, but turn pale yellow to golden yellow after ripening. Fruit is very tasty with a good aroma.

Poovan (Mysore AAB)

Tamilnadu is the leading producer of Poovan cultivar owing to its climatic and marginal soil condition and it is a perennial crop. Poovan is also commercially cultivated for leaf industry throughout Tamilnadu and in certain parts of Kerala. Fruit is slightly acidic, firm and has typical sour-sweet aroma. Fruits turn to attractive golden yellow on ripening. It is a medium sized bunch, closely packed, good keeping quality and resistant to fruit cracking.

Nendran (AAB)

It is a popular variety in Kerala where it is relished as a fruit as well as used for processing. Commercial cultivation of Nendran has picked up rapidly in TamilNadu in the recent past. Nendran is known to display considerable diversity in plant stature, pseudo stem colour, presence or absence of male axis and bunch size. Bunch has 5-6 hands weighing about 12-15 kg. Fruits have a distinct neck with thick green skin turning buff yellow on ripening. Fruits remain as starchy even on ripening.

Red Banana (AAA)

Red banana is the most relished and highly prized variety of Kerala and Tamil Nadu. The colour of the pseudo stem, petiole, midrib and fruit rind is purplish red. It is a robust plant with bunches weighing 20-30 kg under good management practices. Fruits are sweet, orange yellow coloured and with a pleasant aroma.

Ney Poovan (AB)

Ney Poovan is the choicest diploid cultivar, which is under commercial mono cultivation on a large scale especially in Karnataka and Tamil Nadu. In Kerala it is grown in backyards and now shifting to large-scale cultivation. Ney Poovan is a slender plant bearing bunches of 15-30 kg after 12-14 months. Dark green fruits turn golden yellow with a very good keeping quality. Fruit is highly fragrant, tasty, powdery and firm.

Guava

The two varieties of guava selected for the study are guava country and guava hill and the details are given below.

Country guava (*Psidium guajava* L)

Country guava fruits may be round, ovoid or pear-shaped and 2-4 inches long. Varieties differ widely in flavor and seediness. The better varieties are soft when ripe, creamy in texture with a rind that softens to be fully edible. The flesh may be white, pink, yellow, or red. The sweet, musky odour is pungent and penetrating. The seeds are numerous but small and, in good varieties, fully edible. Actual seed counts have ranged from 112-535. The pink flesh and white flesh varieties guavas were selected.

Papaya

The two varieties of papaya selected for the study are listed below.

Carica papaya CO.7: (Papaya red)

The parent of this variety is Pusa Delicious, CO 3, CP.75 and Coorg Honey Dew. The fruit is oblong in shape and green colour with sparse yellow tint and the flesh is red and firm.

Carica papaya CO.1: (Papaya yellow)

The cultivar of this fruit is Ranchi by TNAU, Coimbatore. The fruit is medium sized and spherical shaped. The flesh is yellow, soft, firm, and moderately juicy and has good keeping quality (Plate 1).

In order to get the desired product, the quality and quantity should also be considered as one of the selection criteria for fruits. So, while selecting fruits following points were considered:

Seasonal fruits were given priority over others

- Since they are perishable, selection was made on use basis.
- Clean, fresh, firm and bright fruits were selected.
- Cracked, wounded and bruised fruits were discarded.
- Over ripe fruits and soggy texture were avoided.
- Fruits giving an off odour were not selected.

- Fruits with holes and burrowing marks, indicating insect infestation were discarded
- Fruits were selected just about to ripen as it is a judicious decision and these fruits will last long.
- For bananas clean, blemish free, crack free, completely attached to stalk, a brown stalk not black and soft but not soggy were selected.

The fully matured ripe varieties of banana and fully matured half ripe varieties of guava and papaya were selected for developing value added products which were collected from the Pazhamudir retail shop at Coimbatore (Plate 2).



Red Banana



Poovan Banana



Nendran Banana



Rasthali Banana



Ney poovan Banana



Robusta Banana



Guava (Country & Hill)



Papaya (Red)



Papaya (Yellow)

PLATE 1: VARIETY OF FRUITS

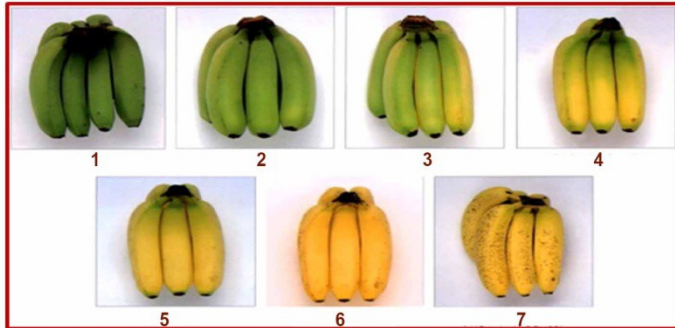


PLATE 2: RIPENING STAGES OF BANANA, GUAVA AND PAPAYA

B. Selection of Processing Techniques

Fruits are highly perishable and hence they have to be preserved for longer use by many techniques of which dehydration seem to be very efficient and cost effective. The fruits selected for dehydration were banana, guava, and papaya. The selected processing techniques for the study were sun drying, dehydration, pulping and pickling which were selected by purposive sampling method. Purposive sampling is a type of nonprobability sampling in which the researcher consciously selects specific elements or subjects for inclusion in a study in order to ensure that the elements will have certain characteristics relevant to the study. Purposive sampling is one arbitrarily selected because there is good evidence that it is very representative of the total population” (Taylor et al., 2007). Dehydration was done by cabinet drying, microwave drying and osmotic dehydration methods. When selecting a cabinet dehydrator the following factors were considered:

- 1. Capacity** -- drying area in square feet (each square foot holds about one pound produce); adequate size; easy to handle and move.
- 2. Construction** -- sturdy, safe and durable (metal and high-grade plastic are superior to wood for safety, durability and cleaning; wood eventually dries, absorbs odors and warps); double-wall construction to cut heat loss; convenient to load and unload; adequate venting; easy to clean; trays slide in and out easily; trays are food-safe plastic, stainless or nylon; trays have durable mesh and are replaceable.
- 3. Operating parts** -- constant heat source; heating element enclosed; parts easy to replace; wattage adequate and suitable for average circuit; temperature dial easy to read; dial easy to adjust; fan for even air distribution that is quiet and durable.
- 4. Economy** -- cost per square foot of drying area; a model with lowest cost per square foot may not be economical if it does not hold enough; electricity use.
- 5. Safety** -- nonflammable construction; enclosed, properly wired electrical components; nontoxic finishes; warranty; repair location; no sharp edges or corners; instructions for use and maintenance.

The obtained fruit pulp was utilized for formulation of value added fruit products. Drying time, yield, colour and texture of the dried fruits banana, guava and papaya were

recorded. The dried banana, guava and papaya were powdered using a blender, sieved and used for the development of value added products. The low cost and simple processing methods selected were easily adopted by the self-help group women and farmers.

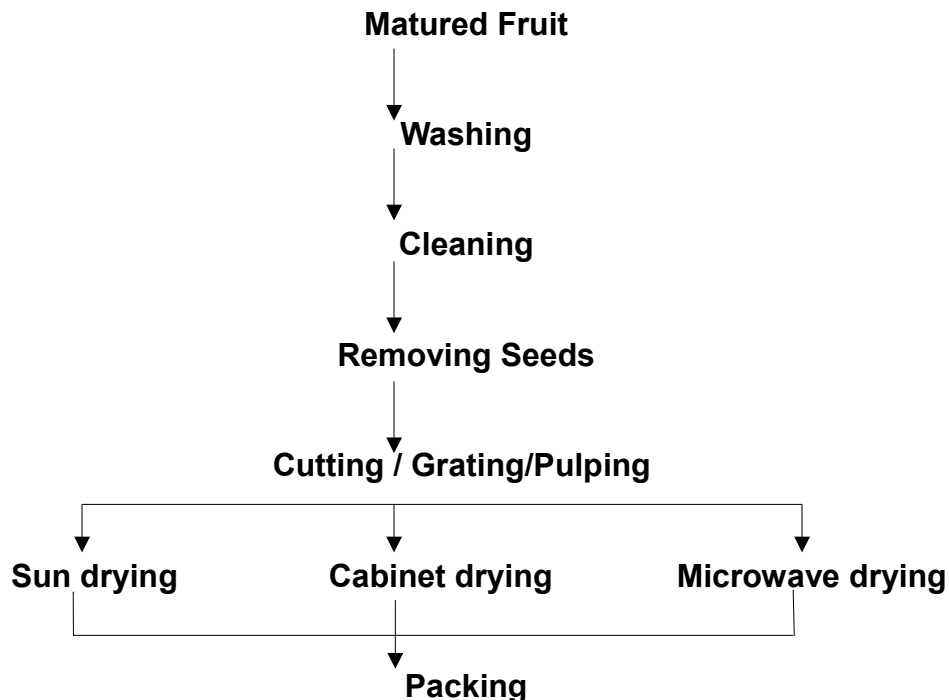
The details of the various drying methods, pulping and pickling are given below.

Processing of Fruits

Selected fruits banana, guava and papaya were dried by sun drying and dehydrated by cabinet drying, microwave drying and osmotic dehydration. Before drying the selected fruits were blanched in boiling water about two minutes and removed from the water bath and kept cool at room temperature. The dried fruits were standardized and identified its acceptability by sensory evaluation method. The yield, drying time, wastage and temperature used for dehydration were recorded. The steps followed for drying and dehydration of the fruits are shown below.

1. Dehydration

Steps followed in dehydration of fruits



In sun drying a clean white muslin cloth was used to spread the fruits and covered by netted muslin cloth. The drying plates made of glass and stainless steel was

used in microwave and cabinet drying respectively. Care was taken to separate each cut pieces and turned simultaneously in every one hour.

Preparation of fruit powder

The dried fruits namely banana, guava and papaya were powdered and the fruit powders were used in formulation of value added product.

a. Banana powder

Fully matured ripe (stage2) banana including nendran, poovan, ney poovan, rasthali, robusta and red banana were selected. The fruits were washed, weighed, peeled, cut into one inch thickness slices and dried by sun drying, cabinet drying and microwave drying and powdered in a mixer grinder and sieved finely.

c. Guava powder

Guava powder was made using fully matured ripe (stage 2) country and hill varieties of guava. The fruits were washed, weighed, deseeded and cut into one inch thickness slices and dried by sun drying, cabinet drying and microwave drying and powdered in a mixer grinder and sieved finely.

b. Papaya powder

Fully matured ripe (stage) Honey dew and Pusa varieties of papaya were washed and skinned and seeds were removed. In order to observe the difference of time taken for drying, one kg of papaya was cut into cubes (1 cm), and sun, cabinet and microwave dried and powdered in a mixer grinder and sieved finely.

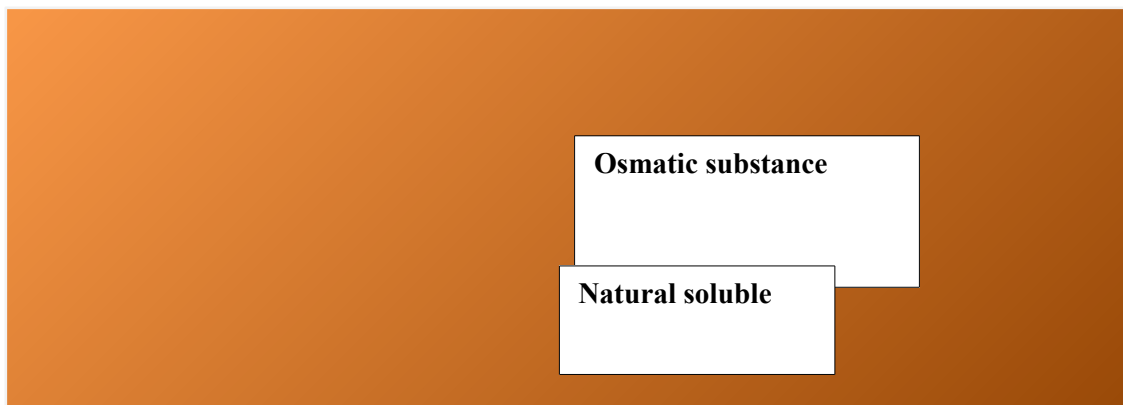
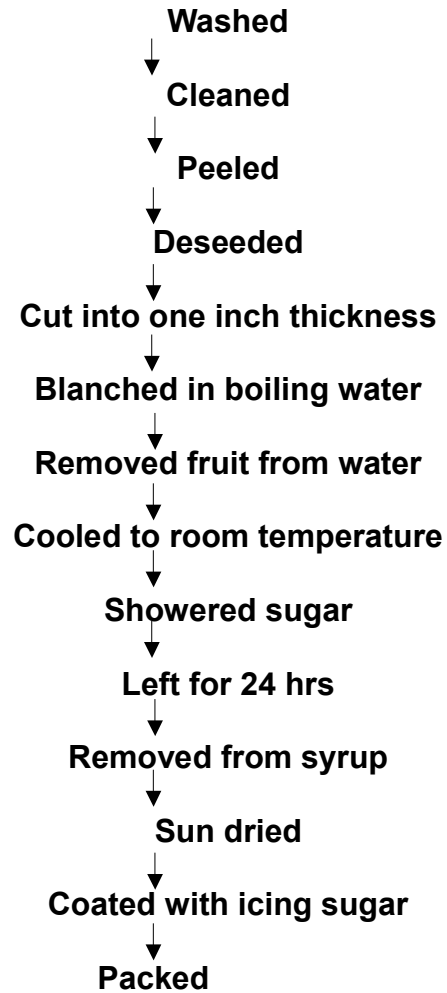
2. Osmotically Dried Fruit Dices

Osmotic dehydration is a process that entails the partial removal of water of fruits. Osmotic hydration works by soaking food in a higher osmotic pressure solution, sometimes referred to as a hypertonic or concentrated solution. The water then passes through the food into the concentrated solution under the osmotic pressure gradient influence. This process is done because fruits are generally 75 percent water, and as a result spoil rapidly. Osmotic dehydration enables fruits to be stored for a longer period of time. The steps followed for the osmotic dehydration are shown below and in Figure 3.

OSMOTIC DEHYDRATION PROCESS

Matured Ripe Fruit





(Source: Lewicki and Lenart, 1995)

Figure 3: Mass Transfer in Osmotic Dehydration

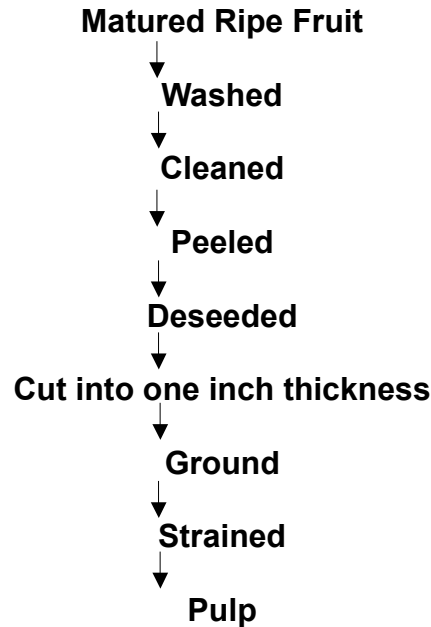
One kilogram of peeled banana slices were blanched in a boiling water for two minutes and allowed to cool and added 650g out of 700g of sugar and kept it for

soaking for four days at room temperature (37°C) in closed vessel separately. Only on second day it was stirred for uniform distribution of sugar syrup while soaking. Later banana slices were removed from the sugar syrup and sun dried for 48 hours. Dried banana pieces were coated with the remaining 50g sugar powder (recipes.more.blog.com. 2010). Three variations were tried out by altering the quantity of sugar in the ratio of 300g, 500g and 700g for 1000g of fruit. Similar procedure was followed for guava and papaya. The syrup formed was used separately which retained the natural flavor of the fruit. The pigments, flavor precursors and volatile compounds were transferred from fruit to osmotic solution. It was suggested that osmotic syrups can be effectively applied to natural additives in food and pharmaceutical industry. Initial weight of the fruit, drying time, moisture content, yield and shelf life of osmotically dried banana, guava and papaya were noted.

3. Pulping of Fruits

The fruits selected for pulping were banana, guava and papaya. Fruit pulp were made mechanically using a mixer grinder and standardised by sensory evaluation method to identify the best pulp for the formulation of value added products. The fruit pulps were used in the development of value added products. Among the varieties, poovan banana pulp, hill guava pulp and honey dew papaya -red flesh pulp were found to be highly acceptable and were used for candy and sauce formulations. Initial weight of the fruit, yield of pulp and wastage of banana, guava and papaya were noted. The steps followed for the preparation of fruit pulp are shown below.

FRUIT PULPING PROCESS



1. Banana pulp

Fully matured ripe poovan variety banana fruit was washed, cleaned, peeled and cut into pieces, ground and strained the pulp by using strainer

2. Guava Pulp

Fully matured ripe hill guava fruit was washed, cleaned and cut into small pieces and mashed using grinder and strained the pulp to remove the seeds.

3. Papaya Pulp

Fully matured ripe honey dew papaya fruit was washed, cleaned, peeled and deseeded and cut into pieces, ground and strained the pulp by using strainer.

4. Pickling of Fruits

Pickling, also known as brining or corning, is the process of preserving food by [anaerobic fermentation](#) in brine (a solution of salt in water), to produce lactic acid, or marinating and storing it in an acid solution, usually vinegar (acetic acid). The resulting food is called a pickle. This procedure gives the food a salty or sour taste.

Fully matured banana, guava and papaya were cleaned, washed and cut into small pieces and blanched for two minutes in boiling water bath in order to retain the color and allowed to cool. Added table salt and vinegar as a preservative and soaked for three days at room temperature and after three days the pieces were sun dried. After drying, pickle was prepared by adding spices and oil. Based on the standard procedure

(recipesmore.blog.com. 2010), three different combinations of banana, guava and papaya (100g/100g/ 100g), (150g/100g/100g) and (150g/150g/100g) respectively were dried to find out the best proportion of each fruit for the preparation of mixed fruit pickle. Weight of fruits before and after drying, drying time, yield and shelf life of the mixed fruit pickle were observed.

C. Formulation of Value Added Products

1. Selection of value added products for formulation

Among the various processing methods low cost and easier methods such as drying, pickling and pulping which can be adopted by the self-help group women and farmers were selected for the study. Based on the preferences given by the target group children and adolescents fruit candies and fruit sauces using fruit pulp were formulated.

i. Candies

The fruit pulp selected for the development of candy was poovan banana, hill guava, and honey dew papaya. Soya being the rich source of protein, jaggery in iron, and oats in fiber were incorporated in the formulation of candies. Amla being the rich source of vitamin C was added to enhance the nutritional value. Candy is being the most preferred snack by children and adult, hence it was tried with these fruits. Candy is a generic term for sugar-based confections. European candy makers immigrated to America in colonial times and brought their candy-making trade with them. Early American candies included comfits, which were sugar-coated nuts and glazed fruits and were expensive in colonial times. Sugar candies were hard candies, such as barley candy, jaw breakers, lollipops and lemon drops that were sold generically by grocers as penny candy (<http://hubpages.com/hub/An-introduction-on-candy>, 2011).

Ingredients used for Candies: Fruit pulp, jaggery, soya flour, oats flour powder, dried amla, bread crumbs and ghee.

FRUIT CANDY



Methods

- Step 1** : Soya flour, oats and bread were roasted at 100°C for 15 minutes and finely ground into a powdered form and kept aside.
- Step 2** : Amla was also washed, grated and then dried in an oven at 100°C for 45 minutes till it gets dried and kept aside.
- Step 3** : The raw fruits banana, papaya, and guava were weighed, washed and sliced into a desired shape.
- Step 4** : The sliced fruits were ground and sieved to get the pulp.
- Step 5** : Jaggery syrup was prepared at a temperature of 117°C and 10grams of ghee was added and then the fruit pulp was cooked in jaggery syrup.
- Step 6** : Added roasted soya flour, oats and dried amla into a cooked pulp and cooked till it leaves the side.
- Step 7** : Removed from fire and rolled into a desired shape along with bread crumbs in order to prevent from sticking.
- Step 8** : Cooled it and wrapped / packed in packing material.

Variations of fruit candies

The variation 1 was prepared by adding 5 g of fruit pulp, 35 g jaggery, 2 g of oats and Soya flour and small amount of ghee to enhance the taste and avoid charring. In variations 2, 3, 4, 5 and 6 amount of fruit pulp was 10g, 15g, 20g, 25g and 30g respectively. The other ingredients were similar to variation1.

ii. Fruit sauces

A sauce may be defined as a flavorful liquid, usually thickened, that is used to season, flavour and enhance other foods. A sauce adds the qualities to foods like moisture, flavour, richness, appearance (color and shine) and interest and appetite appeal. Certain fruits are blended and pureed and used to accompany sweet desserts or cooked meats (Cisseless Wayne, 2007).All the three fruit banana, guava and papaya pulp was used for fruit sauce formulation.

Ingredients for fruit sauces: Fruit pulp, sugar, salt, vinegar, chili powder, cinnamon powder and clove powder.



Method

Step 1 : Raw fruits were washed, cut and ground to get the pulp.

Step 2 : The ground pulp was sieved to remove the seeds

Step 3 : Spices were mixed together by using vinegar

Step 4 : The mixed spices were tied in muslin cloth and dipped in cooked pulp for a while.

Step 5 : Add the remaining ingredients to the cooked pulp and cooked for some time in a low flame till it reaches the desired consistency.

Step 6 : Remove the mixture from fire and cool it.

Step 7 : Packed and stored at room temperature.

Formulated variations of fruit sauces

The variation 1 was prepared by adding 100 g of fruit pulp, 6.1 g of sugar, 2.11 g of salt, 15 ml of vinegar for papaya and 33 ml for banana and guava; chilly powder 0.2g, cinnamon powder 0.6g and one pinch of cloves. In variations 2 and 3, 110g and 120g of fruit pulp were added respectively. The other ingredients are constant. The fruit sauce tried with more than 120g of fruit pulp found to be very thick consistency and not accepted as sauce consistency and hence only three variations were tried in fruit sauce formulation (Plate 3).

PHASE III: Quality Analysis and Shelf Life of Dehydrated Fruits and Fruit Products

A. Standardization of dehydrated fruits by Sensory Evaluation

The steps followed in standardization of fruit products is given below.

- A. Quality analysis and shelf life of dehydrated fruits in various packing material
- B. Quality analysis and shelf life of formulated fruits products

Selection of taste panel members

The product development will be successful only when it is accepted by the consumer. So the acceptability test was undertaken by following sensory evaluation with 30 skilled taste panel members comprising of the faculty members and students in the department of Food Service Management and Dietetics and Food Science and Nutrition in Avinashlingam University, Coimbatore.

a. Sensory evaluation

FSSAI (2009) emphasized that the selection of the panel members is through a vigorous evaluation of scientific expertise of members in their persons capacity and who have established authority in the scientific area through relevant experience (Plate 4).

Sensory attributes (organoleptic study) like appearance, colour, texture, aroma, taste and overall acceptability of all fruit products were assessed using five point score card for the sensory evaluation of dehydrated fruits and a nine point hedonic scale used for the formulated products (Annexure 3).

Hedonic scale was in the following sequence : like extremely-9, like very much-8, like moderately-7, like slightly-6, neither like nor dislike-5, dislike slightly-4, dislike moderately-3, dislike very much-2, dislike extremely-1 (Annexure 4).



PLATE 4: SENSORY EVALUATION BY PANEL MEMBERS

The processed foods were weighed to know how much quantity of yield, out of one kg of fresh fruit along with added ingredients. The colour of a processed food was observed to identify any changes in the pigmentation after processing. Example light orange papaya pulp turned to dark orange.

B. Assessment of nutritional quality of the fresh, dehydrated fruits and formulated fruit products

Analysis of foods is an important part of the quality assurance program in food processing, from ingredients and raw materials, through processing, to the finished products. It is also important in formulating and developing new products and evaluating new processes for making food products, and in identifying the source of the problem for unacceptable products (Nielsen, 2003).

The standardized dehydrated fruits, fruit candies and sauce were analysed for major proximate principles such as energy (Calorimetric method), fat (Volumetric method), carbohydrate (Anthrone method), protein (Microkjeldahl method, Total ash, acid insoluble ash(ICMR standard procedure)Iron, dietary fibre (AAAC method), potassium(ICMR standard procedure) vitamin A (Spectrophotometer method)and vitamin C (Volumetric method), total antioxidant activity(ORAC assay) and compared with the fresh fruits. Analysis of these nutrients was done with the help of Post-Harvest Technology Centre, Tamil Nadu Agricultural University, Coimbatore.

The procedures followed for the analysis of nutrient were given in Annexure 5-18.

C. Assessment of Shelf life of the formulated fruit products

1. Selection of packing materials

Plastic is made from hydrocarbons derived from petroleum or natural gas. The hydrocarbons are formed into chains called polymers, or plastic resins. By combining hydrocarbon molecules in different ways, different types of plastic can be created. Food grade plastic does not contain dyes or recycled plastic deemed harmful to humans. However, this does not mean that food grade plastic cannot contain recycled plastic. The FDA has detailed regulations concerning recycled plastics in food packaging (Plate 5).

The packing materials selected for the study were aluminum foils, food grade plastic container made of poly propylene, plastic cover made up of polyethylene (5

microns) by purposive sampling for the easy access of self-help group women and farmers.



Polyethelene Cover



PVC Container



Aluminium Foil

PLATE 5: TYPES OF PACKING MATERIAL

2. Shelf life study

The shelf life of the dehydrated fruits and the formulated fruit product was observed over a period of 90 days. The parameters used for assessing the shelf life were sensory evaluation, moisture and total plate count which were observed at 0 day, 30th day, 60th day and 90th day.

Moisture content was found out by Gravimetric method, total microbial count was done by HPB method and Sensory evaluation was done by using five point score card and nine point Hedonic scale as mentioned earlier.

a. Sensory evaluation

Sensory evaluation is the key factor for determining the shelf life of many food products. Microbiologically stable food will have their shelf life defined by the changes in their sensory properties. Many fresh foods have relatively prolonged storage, microbiologically safe to eat but may be rejected due to changes in their sensory properties (Gomez, 2002). Sensory evaluation was done during storage of fruit product in order to find out the palatability.

b. Moisture content of dehydrated fruits and formulated products

Moisture assays can be one of the most important analysis performed on a food product. Water is a major constituent of most food products. The approximate, expected moisture content of a food can affect the choice of the method of measurement. It also can guide the analyst in determining the practical level of accuracy required when measuring moisture content, relative to other food constituents (Neilson, 2003). Moisture assays were carried out once in 30 days from the day of development till 90 days to find out the shelf life of the formulated products (Annexure 19).

c. Total plate count

Food Safety can only be assured by the use of food safety programmes based on the principles of HACCP. Reliance on microbiological criteria/product testing alone is not sufficient. The criteria formulated by Food Safety Administration as a guide to indicate when food can be considered unacceptable or unsafe. The safe level of total aerobic plate count at 35°C (/g) n = 5 c = 2 m = 10⁵ M = 10⁶, Faecal coliform (/g) n = 5 c = 2 m = <1.8 M = 10⁶, Salmonella

(/25 g) n = 5 c = 0 m = 0 ,Yeasts and moulds (/g) n = 5 c = 2 m = 102 M = 10(www.foodsafety.gov,2010). So the shelf life in terms of Total microbial count was assessed once in 30 days for value added formulated products over a period of 90 days (Annexure 20).

The total plate count TPC (aerobic, mesophilic organisms) defines how many aerobic (oxygen-loving), mesophilic (moderate-temperature-loving), micro-organism colonies such as bacteria, yeast and mould fungi will grow in 72 hours or in agar plate was formed at a controlled temperature of 30°C or 37°C (ISO, 2011).

D. Cost Analysis of Formulated Value Added Products

Recipes are developed with specific ingredient amounts. When additional amounts of ingredients are added to a recipe or recipes are portioned incorrectly, there may be a change in the cost of produce and recipe. Basic food cost analysis may be defined as an investment of time and money in any recipe costing model has a pay off in food cost analysis (Joeckmbar, 2009).

The cost of raw fruits during seasonal and off-seasonal period were noted and calculated the cost of each value added product accordingly and comparison was made so as to understand the need for preserving the surplus fruits available during seasons at reasonable price.

PHASE IV: Capacity Building Programme on Fruit Processing to Self Help Group Women and Farmers

A product success is in the hands of the consumer. Promotion is the key factor to make the product to reach the consumer. While new products need to be promoted to achieve consumer awareness and elicit trial, maintaining interest in long-established products, and introducing consumers to a wider product range, presents a greater challenge. This included the following steps:

1. Selection of area
2. Selection of subjects for capacity building programme
3. Impact of capacity building programme

1. Selection of area

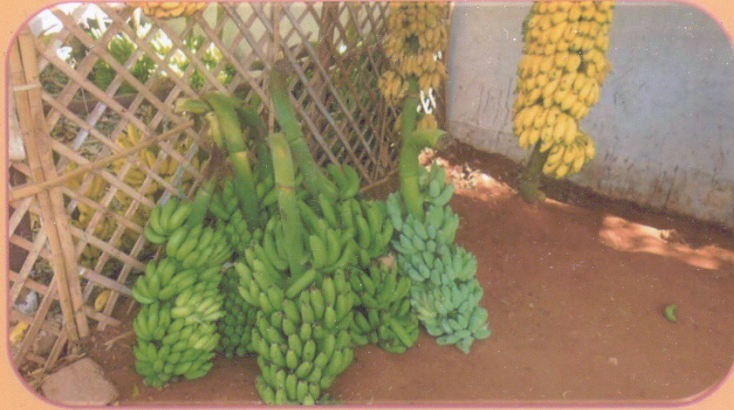
The departments of Home Science Extension Education and Life Long Learning of Avinashilingam Institute for Home Science and Higher Education for Women was selected for the conduct of the capacity building programme for the easy access of the beneficiaries.

2. Selection of subjects for capacity building programme

All the 50 Women Self Help Groups and among the invited farmers only seven who came to the department to attend the capacity programme were selected. The programme was conducted for three consequent days with the duration of six hours per day. The demonstration was carried out in morning sessions by the investigator and all the 50 self-help group women and seven farmers were asked to take part in the demonstration in the afternoon sessions. The processing of banana, guava and papaya by various drying including sun drying, microwave drying, cabinet drying and osmotic drying methods were demonstrated to the participants for the first two days. On the third day power point presentations on the simple techniques of procurement, processing and marketing of banana, guava and papaya were made to the self-help group women.

3. Impact of capacity building programme

Capacity-building on an individual level requires the development of conditions that allow individual participants to build and enhance existing knowledge and skills. It also calls for the establishment of conditions that will allow individuals to engage in the process of learning and adapting to change. The impact of capacity building programme was assessed by finding out knowledge improvement on Prerequisites for fruit processing, financial planning, processing of fruits and marketing of fruit products by using a knowledge check list before and at the end of the capacity building programme. Many participants were interested and started a small scale fruit processing business and two women participants who became a successful entrepreneur as a result of this capacity building programme were observed by a case study.



Stacking of banana immediately after procurement



Separating raw and ripe banana



Proper method of stacking ripe banana for processing



Preparation of banana



Slicing of banana



Analysis of Data

The collected data were analysed statistically by using mean, Standard Deviation (SD), Coefficient of correlation, Rank correlation and Test of significance.

