# PREPARATION AND QUALITY EVALUATION OF PAPAYA FRUIT LEATHER

BY

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*Affectionately dedicated to*

*my parents*

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# ABSTRACT

Papaya is one delicious tropical fruit abundantly cultivated in Sri Lanka, and they go under utilized or wasted extensively. The post harvest losses in papaya account for an immense figure of 30 to 40 %. Curtailing these losses is paramount importance to the country. Processing papaya into value added products at the locale itself by local small scale processor is one promising strategy.

Processing papaya into fruit leather utilising surplus papaya is one of such strategy. This requires only simple technology and equipment and it can easily be adopted by local small scale processor. To disseminate this technology the processing parameters have to be optimised for high quality product.

This study was directed to establish an optimum time, temperature and tray load relationship for the production papaya leather. A low temperature of 65° C was tested with different tray loads and it was found 7.5 mm thickness of tray load yields a satisfactory, malleable product. However, the results of the sensory evaluation performed to acccss thc aroma, texture, taste and overall acceptance revealed, that papaya fruit leathers attained a flat flavour upon processing and, therefore, poor acceptability. However, the this study sufficiently encourages to warrants further researches on flavour enhancement and quality improvement of papaya fruit leather.

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# CHAPTER - 1

## 0.1 INTRODUCTION

Papaya is one of the widely cultivated backyard crops in Sri Lanka. It has a wide consumer familiarity and acceptance. Papaya fruit is also a very rich source of nutrients. It contains high quantities of vitamin A(beta carotene), vitamin C, riboflavin and niacin and is also a good source of calcium, phosphorus and iron.

Papaya is available in vast quantities almost through out the year. But major portion of it is wasted because of the post harvest deteriorations. The post harvest losses in papaya in Sri Lanka accounts for greater figure of 30 to 40 %. The reasons attributable for this immense loss are; the delicate nature of the fruit with a very thin skin, lack of proper knowledge on post harvest technology and poor infra structure system. Due to these reasons, processors are very reluctant to collect and utilize this commodity and therefore it is under utilized.

Disseminating post harvest knowledge and technology to the cultivators and other intermediaries in the post harvest chain of papaya, improving the existing infra structure or improving the post harvest life of papaya through genetic engineering to minimising or curtail these losses are not feasible in Sri Lankan context. Therefore development of a new strategy is necessary for an immediate action.

One such strategy is to convert the surpluses of papaya into value added products at the point of production. This will suit only the local small scale processors, but still has high potential to serve the purpose. This can reduce the huge post harvest losses that take place in transit, increase income of cultivators and processors, create employment, encourage self employment ventures and can help replacing synthetic items in the market with some nutritious fruit based food products.

The papaya can be processed into variety of products like jams, cordials, frozen chunks, purées, pulp concentrates etc. But all these require high skill, knowledge, technologies, equipment and high energy inputs. Thus, this kind of processing technology will neither help the small scale processors nor reduce the post harvest losses of papaya.

Therefore it is imperative to look for simple technologies which can be successfully introduced to the local small scale processors. Processing papaya into papaya leather is one feasible simple technology to suit this purpose. The papaya leather is basically papaya pulp which has been sweetened, acidified and dried. This utilises very simple technology and requires only few chemical preservatives and equipment. It does not require high skill, knowledge of food processing or equipment.

In addition to this, this procedure can be further simplified using a solar dehydrator. This will not only cut the cost of production, but also will help to reduce the initial investment. Simple solar dehydrators can be fabricated locally at lower cost. Some chemical requirement like citric acid can also be replaced by freely available lime juice.

The papaya leather can be added to cookies, cakes, breads, pie fillings, toppings, sauces and salads. Papaya fruit beverages also can be made by whirring adequate amount of water to papaya leather and blending.

There is also plenty of room for development of new food formulations with papaya fruit leather. Sandwiching papaya fruit leather with pieces of biscuits and using papaya leather as a chewing gum are some of such new formulations.

The papaya leathers can be kept under ambient temperature, with proper packaging, for about 6 months. The longer self life is due to the high acidity, sugar content and lower moisture content of the papaya leather. The colour and the flavour are retained by adding preservatives. However, fruit leathers are highly hygroscopic and may undergo deterioration if not given a moisture barrier packaging materials.

Fullest use of surplus papaya and reduction of post harvest losses can be realized, if variety of simple processing technologies available to the local small scale processors to undertake onsite processing. Accordingly, this study was directed to evaluate the feasibility of producing the papaya leather at small scale level.

## 1.2 OBJECTIVES

1. To optimise drying parameters to get papaya fruit leathers of satisfactory quality.
2. To determine the physico chemical properties of fruits leathers produced at above conditions.
3. To evaluate the quality of papaya leather for consumer acceptability.

# CHAPTER 2

## 2.00 LITERATURE REVIEW

### 2.01 Origin of papaya.

It is believed that the origin of papaya is tropical America. But it's precise locale is lost in antiquity. This tree is extensively cultivated or found wild in many of the tropical area of the world and believed that the tree appeared in the Philippines, India, and Africa before the year 1600. However, records indicate that it was introduced to Sri Lanka in the 16th century.

### 2.02 Botany of papaya

The papaya botanically known as *Carica papaya* L. is a small herbaceous evergreen decotyledonous tree. This tree is a perennial and may produce fruits for more than 20 years. The stem is stout with the height ranging from 1 to 10 meter. On the upper portion of the stem is borne a crown of large compound, long petioled leaves. The papaya plant is dioceous and flowers are of two kinds; pistillate and staminate.

The papaya fruit is a berry and the size and shape of the fruit differ with the sex and races. The female plants are usually high yielders and producers of large ovoid fruits. The fruits are thin skinned. The flesh of the fruit is of an orange colour when mature, and with a sweet, juicy taste. The central cavity of the fruit contain the seeds.

## 2.03 Uses of papaya fruit

Papaya is very delicious, wholesome, refreshing fruit with a unique food value. Papaya can be used in many ways. The ripe fruit are used as table fruit and dessert purpose. The green and half ripe fruit are used as vegetable and a filler material in various preserves like soups, jams, and sauce of other fruit. Besides green fruit is used in making chutney, crystallized fruit and cooked in the kitchen. Both ripe and raw fruit of papaya are used in the preparation in the various preserves lick syrups, wines, nectar, jam, jelly, marmalade, pickles, candy, toffee, dehydrated flakes fruit cereals.

## 2.04 Nutrition value of papaya

The fruit of papaya is very nutritious. It contains high quantities of beta carotene, vitamin C, riboflavin and niacin. This is also a good source of calcium phosphorus and ions. As it's caloric value is quite low, it is very suitable for inclusion in non-fattening diets. The nutritional value of papaya is summarised in Table 2.1.

**Table 2.1: The Nutritional value of papaya**

| Composition | Quantity (g/100 g edible portion) |
|---|---|
| Moisture | 89.6 |
| CHO(Carbohydrate) | 9.5 |
| Protein | 0.5 |
| Fat | 0.1 |
| Calorific value | 4.0 |
| Minerals | 0.4 |
| Calcium | 0.01 |
| Phosphorus | 0.01 |
| Iron(mg/100g) | 0.4 |
| Vitamins(mg/100g) | - |
| Beta carotene(vit. A)(IU/100g) | 2020 |
| Thiamine(vit. $B_1$) | 40 |
| Riboflavin( vit.$B_2$) | 250 |
| Nicotine acid | 0.2 |
| Ascorbic acid (vit. C) | 46 |

(Source: Anonymous,1941,Health Bulletin No.23)

The fresh fruit pulp contain sucrose, invert sugar, a resinous substances papain, malic and salt of tartaric and citric acids.

Suberin and Camo (1964) identified 19 carotenoids in papaya fruit. Of these the most abundant were cryptoxanthin 13% Beta-carotene 29 5%

and crypt flavin 13%. The oxygenated carotenoid were hydroxy or epoxy derivatives of beta carotene.

## 2.05 Medicinal value of papaya.

Nearly every part of the papaya tree is said to be of medicinal value. The ripe fruit is stomachic, digestive carminative and diuretic. Syrups and vines made from it are said to be expectorant sedative and tonic. The milk juice of the unripe fruit which give papain is used in tenderizing food like meat, extracting oil from the liver of tuna fish, manufacturing of cosmetics like snow, facial creams, dental paste and as a cosmetic to remove freckles and blemishes from the skin. It is also used for the treatment of necrotic tissues and dyspepsia and other digestive disorder, ring worm and round warm infections, kidney disorders and tonsil infections.

## 2.06 Varieties

In Sri Lanka, there are no specific varieties. Some time ago the Department of Agriculture had introduced the Solo, Hawaii and Peterson. But today these varieties cannot be identified as they have been freely cross pollinated by other varieties.

In the international market, varieties like Washington and Honey Dew of India, Solo sunrise, line-8 Solo and recently Solo Warminalo of Hawaii are well known and fetch good price

## 2.07 Papaya Production

The papaya is produced in over 30 countries of the world. The total planted area under papaya in the world is not known but it's annual production has been estimated at approximately 1,600,000 metric tone (I.D.Singh, Papaya, 1990). Much of world's papaya is grown for local use. The major papaya producing region are Asia, South America, North Central America and Africa. Asia and South America produce about 64 % of the world production. Another 35 % is produced by North Central America and Africa. However most of the fresh fruit consumed in the internal market of papaya producing countries expect export of papain from countries like that South Africa, Sri Lanka and India to many European countries and to U.S.A.

In Sri Lankan fruit export industry, papaya has recently secured a important place. According to Sri Lanka Customs report, 5121 Kg of papaya was exported in 1995. The EDB recorded a production figure of 13900 mt and cultivated area of 2311 Ha in the same year.

## 2.08 Cultivation practices

Papaya is grown entirely from seed and has no well defined cultivars. It naturally bears fruits which greatly vary in shape, size and other fruit characters from its parents. It is due to the fact that papaya is cross pollinated and the female flower are pollinated by pollens from nearby trees

### 2.08.1 Soil and climate

#### 2.08.1.1 Soils

For successful papaya cultivation, the soil depth, adequate drainage and soil aeration are very important. The pH of the soil should be in the range of 6.5 to 7.0.

#### 2.08.1.2Climate

Although papaya performs best under tropical conditions, it can also be grown in mild subtropical areas. It thrives well at temperature between 38° C and 44° C, but atmosphere temperature below 5° C and frost prove hazardous and damage the papaya production. Very often a strong wind coupled with cold winds or heavy rains spoil the entire papaya plantation. A dry warm climate with little rainfall adds to the sweetness of fruit. Temperature below 10° C retards the process of maturity and ripening of fruit. It also affects vegetative growth and fruit setting under excessive moisture condition. The quality of the fruit is also adversely affected.

### 2.08.2Propagation

Good seed should be selected from high yielding, diseases free mother plants. After the seed are collected the gelatinous cover around the seed is removed by washing in water. Washed seed are dried in the shade before planting. Under ideal storage conditions, seeds will retain viability more than a year.

### 2.08.3 Nursery Raising

The seed should be extracted from selected ripe fruits which show typical characteristics of the cultivar. The seed freshly taken from the fruit should be thoroughly washed to remove the gelatinous matter and then dried in shade in shallow dishes or trays. Seed germination has been observed to be the maximum in freshly extracted seed and their seedlings grow faster than the stored seed.

The seedling can be raised in polyethylene bag of about 20cm X 12.5cm size or in well prepared nursery at a spacing of 5 cm between seeds in rows 15 cm apart at a depth of 1 to 3 cm. The nursery bed may be covered with straw of rice to product the nursery from adverse climatic condition. Before sowing the seed should be treated with 0.1 percent monosan dust or 1.0 percent Agroson GN and also the nursery bed should be treated with 10 percent formaldehyde solution for the prevention of damping off diseases.

The germination takes place in 2-3 weeks and seedling are ready for transplantation after 2-3 months. The seedlings are lift from the nursery with a hand with plenty of soil stuck to its fibrous roots. The nursery beds are to be irrigated a few hours before lifting the seedling from the nursery.

### 2.08.4 Planting

There are two methods for papaya planting.

1. Direct sowing.
2. Raising the plant in nursery and then transplanting.

Seedlings may have male and female plants in equal proportion and a minimum of two seeds be placed at one place to increase the chances of the presence of plant bearing female flowers. The papaya plantations are mostly done in the immediate vicinity of cities and towns for an easy quick and profitable disposal of the crop.

## 2.09 Papaya fruit leather

Papaya fruit leather was first tried out in the Hawaiian papaya industry mainly to utilise the culled or waste papayas. Chan and Cavaletto (1978) studied the feasibility of producing papaya leather from wasted papaya. They reported that dried leather can be made with papaya puree, sugar, and sulphur dioxide. In preparation of puree for the production of papaya leather an improved method suggested by Brekke *et al.*,1972 was adopted by them. The method adopts steaming the whole fruit for 1 minute, slicing, separation of flesh, skin and seeds, pulping, acidifying (pH 3.5), finishing and heat inactivation of the enzymes.

## 2.10 Processing problems in papaya fruit leather production.

The main processing problems encountered in the processing of papaya leather are; gelation, development of unpleasant flavours, odors and browning. Most of these problems are caused by the enzymes that present in papaya.

The gelation phenonminon has been attributed to pectinesterase activity (Yamamoto and Inouye, 1963) Inhibition of pectinesterase activity and gelling had been investigated extensively by scientists This can be accomplished by heat inactivation of enzyme (Stafford *et al.* 1966), by the addition of sucrose to 26$^0$ Brix (Chang et al. 1965; Yamamoto and Inouye, 1963) and by acidification of puree to pH 3.4 (Brekke et al. 1973).

The heat inactivation of enzyme prevents gelation and improves the flavour stability of papaya puree. Acidification to pH 3.5 delays gelation by shifting the pH beyond pectinesterase optimum pH range.

Some of the sources of off-flavour are peel and seeds. These should be separated immediately from the pulp. Latex can also lead to bitterness.

Sugars play an important role in processing of papaya. In papaya puree the action of invertase increases the reducing sugars which adversely affects quality and stability of processed products during storage due to increased susceptibility to browning.

### 2.11 Packaging of fruit leather

In the United States, fruit leather is sold in the form of a roll inter lined with waxed paper. The simplest way of producing this is by pouring the puree in to the trays lined with waxed paper and, when dry, cutting them into sections to give the required weight. The final product may be rolled up, thus inter leaving the wax paper, automatically, between the fruit leather. The role can be then sealed at each end by means of an electric sealer. In Central America fruit leathers have been marketed as tortillas of fruit that is round in shape. Again the discs of dry fruit leather are inter leaved with polyethylene and packed six at a time in heat sealed polyethylene bags

The final product once it is correctly dried should be protected from sun light, moisture and heat to prevent it from developing off-flavours or spoiling. The polyethylene(H.D.P.E) packaging material can prevent the entry of moisture, air and spoilage organism, and therefore suitable for the purpose.

## 2.12 Sensory evaluation

Quality is the ultimate criterion of the desirability of any food product to consumers. Overall quality depends on quantity, nutritional and other hidden attributes and sensory quality. The sensory quality can be defined as combination of different senses of perception coming into play in choosing and eating food. The sensory quality is an important parameter for both producers and consumers _ to the processor, since it attracts consumers; to the consumers, since it satisfies his aesthetic and gustatory sense.

It could be said that carefully selected, well trained, professional sensory panellists serve as proxies for the much larger population in terms of determining what is acceptable quality in many foodstuffs.

There are various sensory evaluation tests available to assess sensory attributes of foods. The descriptive sensory analysis is being extensively employed in product development work. It gives a complete description of sample differences and guides the product developer in modifying product characteristics to meet consumer demands.

# CHAPTER 3

## 3.0 Methods and Materials

### 3.1 Materials

Papaya fruits of local varieties (often hybrids) were purchased from the market outlets in Buttala, Bibilla and Moneragala. Only fully ripen fruits with no defects were selected for the experiments.

### 3.2 Methods

Preliminary studies were directed to identify a suitable thickness of tray load of puree, temperature and time combination which could yield satisfactory quality of papaya fruit leather.

The temperature of the oven was set at 65° C, as this temperature can be reached by a simple solar dehydrators. Four thicknesses of puree load namely 2.5 mm, 5.0 mm, 7.5 mm and 10.0 mm were considered for the study. The time period required to bring down the moisture content of them below 20 % was determined by taking out sanples from oven periodically and measuring the moisture content by Dean and Stak method.

Once the optimum parameters were set, it was decided to test the physico chemical properties of these papaya leathers.

Following this it was intended to evaluate the quality of the product through a consumer panel test. were scrutined using a descriptive sensory analysis test scores. As no standard papaya leathers were available to compare the quality, the main sensory properties like aroma, texture, taste and overall acceptability were assessed using the score card of descriptive sensory evaluation test.

### 3.2.1 Preparation of papaya puree

The first step of the papaya leather production process is the preparation of papaya puree. An advanced method of papaya puree production suggested by Brekke *et al.* 1972 was followed in this exerciose.

The process started with steaming the whole fruits for 2 minutes. This was carried out to coagulate the remaining latex in the skin of papaya. After cooling the fruits to room temperature, they were peeled manually using a stainless steel knife. Then halving the fruits the seeds were also removed. As seeds and peel are sources of off-flavour, they were immediately separated from the flesh.

Then the flesh was fed into blender (National Food Processor, Model No MK 5080N) for pulping In order to prevent the gelation, off-flavour development and browning. 1% citric acid and 0.1% SMS were added to the flesh and pulped at 2200 rpm for 10 minutes.

The pH of puree was brought to 3.5 by adding stirring 50% solution of citric acid and blending again. This puree then subjected to a heat treatment till the stirred puree reached the temperature of 96°C for heat inactivation of enzymes

### 3.2.2 Preparation of tray load thickness

As trays for dehydrating the puree petri dishes were used. These dishes were washed well and dreid. For each petri dish a very thin coat of edible oil was smeared as releasing agent. In addition to this, HDPE films of 11.9" diamter, finely coated with edible oil, were laid at the bottom of each dish to avoid sticking. The excess oil from petri dishes and film was mopped out using tissue paper. The papaya puree was then poured out evenly onto the petri dishes to required depth.

### 3.2.3 Determination of depth tray load

To identify the suitable depth of puree load to the dryer, three replicates of tray loads with thicknesses of 2.5mm, 5.0mm, 7.5mm and 10mm were placed in the Memmert Type U40 oven set to 65° C. These samples were checked for dryness at 1 hour interval after 12 hours. After the upper surface was dried, the films were flipped off and the leathers were turned upside down to expoture the bottom side to dry. The completion of drying was decided by checking the stickyness of leather surfaces. When both sides of the leather were no longer sticky, the dried leather were taken out, packed and the time taken for drying was recorded. The moisture content of these sample were also detrmined. The process flow chart is given in Figure 3.1.

### 3.2.4 Determination of physico chemical properties of papaya fruit leather

#### 3.2.4.1 Determination of acidity of the leather

A 10 gram of the fruit leather was taken into a pestle and ground well with 50 ml worm distilled water pisttil and a juice was through filter obtained. A 10 ml of this juice was taken into a conical flask and 50 ml water was added to it. After adding 3 drops of phenolpthalein indicator, this solution was titrated against 0.1 N NaOH solution until reaches faint pink colour. This was repeated thrise to get average burette reading. Calculation was done in reference to citric acid.

#### 3.2.4.2 Determination of brix of the leather

An equel weight of papaya leather and water were mixed and minced well to extract the juice. This juice was filtered and leaving fisrt few drops, the rest was taken to hand refractometer prism and the reading was otained. The room temperature was recorded for temperature correction. Corections were also made for dilution

#### 3.2.4.3 Determination of brix to acid ratio

Brix to acid ratio was obtained by dividing the brix value by percent of titrable acidity

Selection of fruit

↓

Washing and draining

↓

Steaming (2 minutes)

↓

Cooling

↓

Peeling and removal of seeds

↓

Cutting into small pieces

↓

Addition of SMS and Citric acid

↓

Pulping

↓

pH adjustment

↓

Heat inactivation of enzymes

↓

Spreading on to trays

↓

Dehydration

↓

Cutting into slabs

↓

Packaging

**Figure 3.1: Flow chart of papaya fruit leather process**

### 3.2.5 Sensory evaluation of papaya fruit leather

A consumer preference test was carried out to evaluate the quality of the papaya fruit leather. Sensory properties aroma, texture, taste and overall acceptability were investigated using a descriptive sensory analysis score card. However, it was not intended to perform a statistical analysis as there were no standards available for papaya leather. An untrained consumer type panel which consisted of 13 university students studying at the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka was used for this purpose. This panel represented all income level people.

Panellists were assigned to individual booths for the evaluation. Each booth was facilitated with drinking water to rinse mouth in between tasting, 5 cream cracker biscuits to be taken in between tasting to avoid carrying over effect and serviets.

Each tasting booth was sufficiently illuminated and the panellist were served with a score card for the descriptive analysis with scaling. The sample score card is shown in Figure 3.1

The pannelists were requested to mark a vertical line accross the horizontal line at the point that reflects his perception of the magnitude of the properties assessed

After the panelists had completed their judgements, the scores were tabulated by measuring the length from the left end to the vertical line made by the pannelists.

DESCRIPTIVE ANALYSIS WITH SCALING

Name ........................ Date..........

Please evaluate the aroma, texture, taste and overall acceptance of the sample

1 Aroma - make vertical lines on the horizontal line to indicate your rating of the aroma of each sample. Label each vertical line with the code number of the sample it represents

weak ———————————————— strong

2 Texture - make vertical lines on the horizontal line to indicate your rating of the texture of each sample. Label each vertical line with the code number of the sample it represents

very soft ———————————————— very hard

3 Taste - make vertical lines on the horizontal line to indicate your rating of the taste of each sample. Label each vertical line with the code number of the sample it represents

very raw ———————————————— very pleasant

4 Overall acceptance - make vertical lines on the horizontal line to indicate your rating of the taste of each sample. Label each vertical line with the code number of the sample it represents

————————————————

**Figure 3.2: Sensory evaluation score card**

# CHAPTER 4

## 4.0 RESULTS AND DISCUSSION

### 4.1 Determination of tray load thickness of puree

The prweliminery studies directed to identify suitable tray load thickness of puree, reveals that the initial thickness of puree should at least be 7.5 mm to get satisfactory results.

The 2.5 mm thickness tray loads always resulted to a papery, trasperant and brittle papaya leathers. These leathers were hardly melleable and took longer time to get the mouth feel of them. This could be due to the lower moisture content as result of over drying. The 5.0 mm thickness resulted to better product of papaya fruit leather but it was infereior to the 7.5 mm once. The 10 mm thickness tray load took more than 26 hours duration for drying. But it was not sufficiently dried even after 26 hours. The averge moisture content of it was more than 20% and the shelf life which was found to be very short even under good packing conditions.

The 7.5 mm intial tray load resulted to papaya fruit leather of 1.5 to 2 mm thickness. It's average moisture content was 13%. The appearnce and the texture were also satisfactory with 7.5 mm. The moisture content of the leathers is a critical factor which determines the shelf life of the product. Moisture content of 12-13 % leads to a water activity level of 0.5 to 0.52. This water activity is far low enough to prevent the product from any form of microbial attack. Therefore the thickness 7.5 mm was selected for all other trails. The moisture content of the papaya fruit leathers after 20 hours drying at 65° C and different initial thickness is given in Figure 4.1.

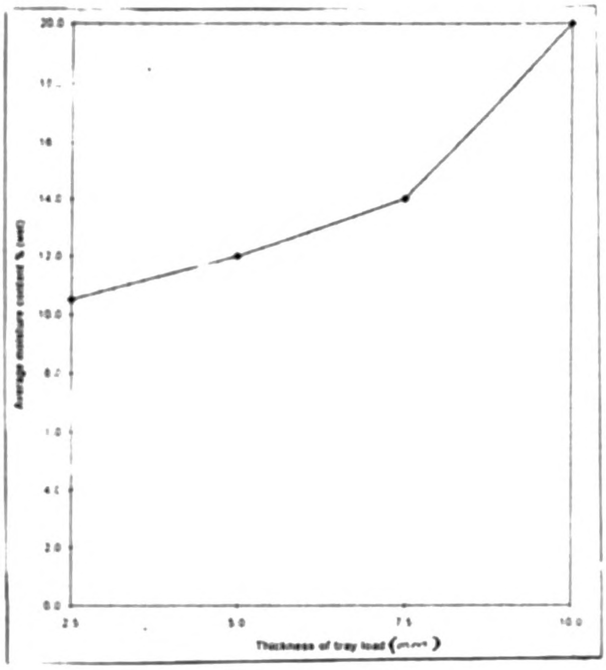

**Figure 4.1: Moisture content of the papaya leathers**

The temperature used was 65°C and the results reveal that the papaya fruit leather can be successfully dried using a solar dryer. When a air flow was provided to the oven used (Memmert type U40), the drying time was slightly reduced and the stickiness of the leathers was also remarkably reduced. It seems that usage of a forced air dryer would reduce the drying time considerably. While using solar dryers provisions should be given to ensure a free air flow to reduce the drying time.

## 4.2 Physico chemical properties of papaya leathers

The physico chemical properties are important parameters determining the organoleptic properties and shelf life of fruit products. The balance between the brix to acid ratio deterines the taste. The physico chemical properties of the papaya leathers determined are given table 4.1.

**Table 4.1: Physico chemical properties of papaya leather.**

| | |
|---|---|
| Moisture % | 13.0 |
| °Brix | 45 |
| Acidity | 1.11 |
| °Brix/Acid | 40.9 |

## 4.3 Sensory evaluation

As no standards were available to compare the quality of the product it was intended to evaluate their sensory parperties using a descriptive scale. The sensory properties aroma, texture taste and overall acceptbility were considered. The chosen panelists were untrained and representing all income group of people. The score given by the paneluists are summarized in Table 4.2.

**Table 4.2: Sensory evaluation scores**

| Judges | Sensory properties | | | |
|---|---|---|---|---|
| | Aroma | Texture | Taste | Overall accetability |
| 1 | 4.2 | 9.3 | o.7 | 1.0 |
| 2 | 1.0 | 6.2 | i.3 | 1.0 |
| 3 | 7.2 | 7.7 | 3.8 | 1.5 |
| 4 | 3.5 | 7.6 | 2.4 | 2.2 |
| 5 | 5.2 | 9.4 | 2.3 | 3.3 |
| 6 | 1.6 | 8.4 | 3.4 | 0.9 |
| 7 | 1.7 | 2.0 | 5.0 | 4.3 |
| 8 | 0.8 | 8.9 | 0.8 | 1.0 |
| 9 | 2.3 | 8.9 | 3.5 | 0.4 |
| 10 | 0.8 | 9.4 | 0.4 | 0.6 |
| 11 | 7.2 | 9.3 | 9.5 | 2.9 |
| 12 | 3.2 | 10.0 | 2.6 | 0.4 |
| 13 | 1.1 | 7.6 | 6.9 | 5.5 |
| Total | 34.1 | 104.7 | 42.6 | 25.0 |
| Mean | 2.62 | 8.05 | 3.27 | 1.92 |

The lower mean values obtained for aroma, taste, overall cceptability shows that the product flavour is not desirable. The texture of the product was rated to be very high and it indicates that the papaya leather produced were considerably hard.

The reason for the poor flavour quality may again be attributable to the inherent nature of papaya which involves lot of chemical reactions It seems that papaya fruit leather attains a flat flavour upon processing

However, it the results shows that it can be dried to a below 20 % moisture content with in 20 hours at 65 ° C. Thus, it has a potential of drying fast to a lower moisture under this conditions. Perhaps, going for a particular papaya variety bred for processing can lead to desirable papaya leather product, but it is beyond our objective and too unpracticable.

# CHAPTER 5

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

## 5.1 CONCLUSIONS

Papaya leathers can be successfully dehydrated at the lower temperature of 65° C taking 20 hours.

The initial tray load thickness is critical in determining the moisture and other sensory characteristics of the final product of papaya leathers.

The tray load thickness of 7.5 mm gives a malleable fruit leather product comparing to other thicknesses 2.5 mm, 5.0 mm and 10 mm.

The papaya fruit leathers seem attaining a flat flavour upon processing.

The sensory characteristics aroma, texture and taste of the papaya leather assessed to be low and need to be improved substantially to achieve a reasonably acceptable product.

## 5.2 RECOMMENDATIONS

The flavour qualities of papaya leathers can be improve by incorporating other locally available compatible fruits.

The duration of the process, the stickiness the product surface can be reduced, if osmotic dehydration is adopted before pulping the papaya fruits

The acidification process can be accomplished by lime juice and it can also contribute to the enhancement flavour quality of papaya fruit leather.

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