Development of Whey Based RTS product from Pineapple

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PROJECT REPORT

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KELAPPAJI COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY
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KERALA, INDIA

2012

DECLARATION

We hereby declare that this project report entitled "**Development of RTS products from Pineapple"** is a bonafide record of project work done by us during the course of project and the report has not previously formed the basis for the award to us of any degree, diploma, associateship, fellowships or other similar title of any other university or society.

Place: Tavanur

Date: 03-02-2012

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CERTIFICATE

Certified that this project report entitled "**Development of Whey based RTS product from Pineapple"** is a record of project work done by Naina. M and Neeraja. H. Nair 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 them.

Place: Tavanur

Date: 03-02-2012

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Naina. M

Neeraja. H. Nair

Dedicated to our loving parents...

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SYMBOLS AND ABBREVIATIONS

%	-	percentage
°c	-	Degree Celsius
BIS	-	Bureau of Indian Standards
BOD	-	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
DO	-	Dissolved Oxygen
E-coli	-	Escherichia Coli
g	-	Gram
K.C.A.E.T.	-	Kelappaji College of Agricultural Engineering and Technology
mg	-	milligram
mg/L	-	milligram per litre
ml	-	millilitre
pH	-	value of pH
ppm	-	parts per million
TDS	-	Total Dissolved Solids
CAS	-	Controlled Atmospheric Storage
RTS	-	Ready To Serve
TSS	-	Total Soluble Solids
BCAA	-	Branched-Chain Amino Acid
MT	-	Million Tonnes

Introduction

CHAPTER 1

INTRODUCTION

1.1 Background

Fruits are important sources of vitamins and carbohydrates like fiber and sugar. They are low in calories and naturally sweet. Fruits and their juices are good sources of water, too. Different fruits contain different vitamins, so it is important to eat a variety of fruits. Mangoes, papayas, melons, citrus fruits, like oranges and grapefruit, pineapple are rich in vitamin C. Cantaloupe, apricots, peaches, and nectarines are sources of vitamin A. Referring to food guide pyramid, fruits are second most important food in our daily life. There is no harm of taking lots of fruits because it will supply us all kind of vitamins which is needed by our body. These vitamins are very important for human being as a supplement and to avoid various kind of sickness.

There are numerous types of beverages in which dairy ingredients may be used. K.J. Burrington, the whey applications coordinator stated that -In most cases, the interest is in adding protein, specifically whey protein. The DMI-supported Wisconsin Center for Dairy Research, Madison pointed out that, The choice of whey protein ingredient should be based on what a manufacturer wants to achieve from a functional and nutritional perspective, as well as the temperature conditions that the final product will endure.

Whey protein contains all of the essential amino acids in the proportions that the body requires for good health. It also provides about 26g per 100g of protein of the branched-chain amino acids (BCAAs) leucine, isoleucine and valine. BCAAs are unique among amino acids in their ability to provide glucose and a readily available energy source during endurance exercise. In addition, preliminary studies show that a certain form of hydrolyzed whey protein may offer advantages in lowering high blood pressure. There are even some suggestions of protection against infections and viruses.

The scopes for this project are:

1. Fresh pineapple used as the source of pure juice since it is abundantly available
2. Utilize whey, which is a by product from dairy industry for the preparation of whey based pineapple juice, which on the other hand can come out as a toxic effluent with high BOD.

Pineapple (*Ananas comosus*), a tropical plant with edible multiple fruit is the most economically important plant in the *Bromeilaceae* family. *Bromeilaceae* is a big plant family including large number of epiphytic plants and pineapple is a terrestrial growing member of this. Pineapple is a very important fruit in many developing countries due to its export value. Total annual production is estimated as 14.6million tones of fruit. It is a native of Brazil and Paraguay area where wild varieties occur in abundance. Major producing areas in the world are Hawaii, Brazil, Malaysia, Taiwan, Australia, South Africa, Singapore, India, Thailand and Sumatra. India is the 5th largest producers of pineapple with an annual output of about 1.2MT. In India cultivation is prevalent in Assam, Meghalaya, Tripura, Mizoram, West Bengal, Kerala, Karnataka and Goa on a large scale and Gujarat, Maharashtra, Tamil Nadu, Andhra Pradesh, Bihar and Uttar Pradesh to a limited extent.

Plate 1: Pineapple (*Ananas comosus)*

Area under pineapple cultivation in India increased by 35% from 57,000ha in 1991-92 to 77,000ha in 2001-02 whereas the production increased by 54% from 8lakh tones to 12lakh tones. Area under pineapple cultivation in kerala is 9.5thousand ha, production is 68.3thousand MT and the productivity is 7.2MT/ha.

Pineapple is a nutritious fruit being relished by everyone owing to its attractive flavor and irresistible taste, are commonly grown at low elevations in areas with a temperature range of 15 to 30°c.The fruit is rich in vitamins A and C and minerals like phosphorous, calcium, magnesium, potassium and iron. It contains proteolytic enzyme- bromelin, which

helps the digestion process. The juice of fruit has a cooling effect and is capable of providing freshness especially during hot season. Pineapple may be consumed fresh, canned, juiced, and are found in a wide array of food stuffs -dessert, fruit salad, jam, yogurt, ice cream, candy, and as a complement to meat dishes.

Table 1.1: Composition of fresh Pineapple per 100g

Nutrients	**Units**	**Amount**
Water	g	85
Digestible Carbohydrates	g	13
Vitamin C	mg	36.2
Raw fat	g	0.1
Raw fibers	g	0.5
Protein	g	0.54
Energy	kJ	230

Percentages are relative to US recommendations for adults. Source: USDA Nutrient Database

Table 1.2: Comparison of vitamin C content of some selected fruits

Fruits	**Ascorbic Acid (mg/100g Fresh Fruit)**
Orange	50
Strawberry	57
Pineapple	36.2
Guava	300

Percentages are relative to US recommendations for adults. Source: USDA Nutrient Database

138tonnes of pineapple was exported in the year of 1999-2000 and it increased to 837tonnes in the year 2001-02. Pineapple fruits are to be harvested with care to avoid mechanical injuries. After harvest, grading on weight is carried out. Grading standard for export of fresh fruits is as follows:

Table 1.3. Criterion for Fruit selection

Extra class	1500g and above
I class	1100g -1500g
II class	800g - 1100g
III class	< 800g

Being a highly perishable fruit, pineapple cannot be stored for long time. Shelf life of harvested fruits depends upon maturity at time of harvest to a considerable extent. Cold storages also can be used for pineapple fruits. Temperature below optimum level results in chilling injury to fruits. Recommended cold storage conditions are 10-13°c and 8-10°c for mature fruits and ripe fruits respectively, both at 85- 90% relative humidity. Recommended controlled Atmospheric Storage (CAS) conditions for pineapple are 10-15°c, 2-5% oxygen and 5-10% carbon dioxide composition.

1.2 Utilization on Commercial basis:

More than 75% of pineapple production in the world is being processed. Major share is utilized for canning. However, in India major portion is being used for fresh fruit consumption. Wide range of products can be prepared from pineapple fruit. The most important universally accepted product is canned slices. Medium to large sized fruits are ideal for canning. Small sized fruits are used for preparation of tit bits. Other products from pineapple having demand are juice, jam, squash, ready to serve (RTS) etc. Apart from these usual products, juice concentrate, de-hydrated pieces and osmo -air- dehydrated slices are also prepared.

Generally, the pineapples are exported as the canned-fruit, concentrated juice and dried pineapple slices .Although there are a number of pineapple products in the market, the food industry still keeps developing new product from pineapple. The benefit of new product development is the elevation of the fresh pineapple demand and it consequently help reducing the pineapple loss caused by the micro organisms, chemical and enzymatic reactions during the peak of harvesting season.

1.3 Whey

Over the years, numerous approaches have been taken in an effort to transform a large volume of whey into products suitable for use as food. Whey is a source of vitamins and minerals as well as a source of high-quality proteins, among which sulphur amino acids are particularly valuable owing to their anticancer activities. Nowadays, whey transformation owing to utilization of its precious constituents is performed by various procedures (concentration and/or fractionation and drying, fermentation or hydrolysis, etc.) resulting in numerous highly valuable products (lactose, whey protein concentrate, whey powder, lacto albumin, lactoglobulin, urea, galactose, glucose, syrup, beverages, alcohol and single cell proteins). As whey has an unappealing taste, relatively high lactose to- glucose ratio and excessive acidity, especially if it belongs to the class of acid whey, numerous procedures have been developed for improving its characteristics aiming to enable its direct utilization in human nutrition.

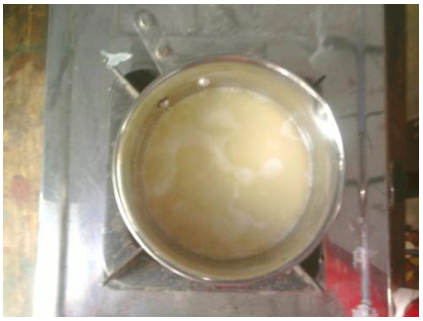


Plate 2: Whey

Whey is a nutritious by product from dairy industry containing valuable nutrients like lactose, proteins, minerals and vitamins etc., which have indispensable value as human food. Whey constitutes 45-50% of total milk solids, 70% of milk sugar (lactose), 20% of milk proteins and 70-90% of milk minerals and most importantly, almost all the water soluble vitamins originally present in milk. In India, it is estimated that about 100 million kg of whey is annually derived as a byproduct which may cause substantial loss of about 70,000 tones of nutritious whey solids. The conversion of whey into beverages through fermentation or without fermentation is one of the most attractive avenues for the utilization of whey for human consumption. Beverages based on fruit and milk products are currently receiving considerable attention as their market potential is growing. Besides being delicious, these beverages are highly nutritious. In terms of functionality, whey protein enhances protein content of beverage while improving its quality.

Whey is the aqueous fraction which separates from the curd during cheese manufacture (Jelen, 1992). Curd formation is achieved by acidification to pH 4.5-4.8 by microbial fermentation of lactose to lactic acid or the addition of acid, and/or by the action of rennet. The fermentation is commonly used in the production of cottage and certain other cheeses. The characteristic flavor of these cheeses is defined by compounds formed in the fermentation process.The dry matter of whey is mainly composed of carbohydrates (lactose), proteins, fat, and minerals. Fat content in whey ranges from 0.5–1.0%, depending on the type of cheese. Lactose is lower in acid whey than in sweet whey due to the fermentation process where some of the lactose is converted to lactic acid. Whey proteins represent <22% of the original milk proteins. About 50% of commercial whey is further processed into various products, but 50% is used as animal feed, fertilizer or discarded.

It contains about half of the milk solids, most of the lactose about one fifth of proteins, most of the vitamins and minerals. Disposal of whey possesses a serious problem of environmental pollution due to the presence of high organic matter. BOD of whey varies from 39,000 to 48,000 ppm, which is roughly 200 times more as treat the whey before disposal, which is found to be uneconomical. Obviously, development of any process for its economical utilization would be of great benefit to the dairy industry.

Whey based fruits beverages are more suitable for health as compared to other drinks. Whey and its biological components have proven its effects in treatments of cervical chronic diseases like cancer, cardiovascular, HIV etc. As it is nutritionally too rich it can also be used in beverages infant Geriatric and Athletic food. Addition of pineapple to whey adds excellent nutritive value, flavour and medicinal properties and show great potential for processing into valuable products.

Table 1.4: Composition of Whey

Constituent	Units	Sweet whey	Acid whey
Water	%	93-94	94-95
Dry matter	%	6-6.5	5-6
Lactose	%	4.5-5	3.8-4.3
Protein	%	0.8-1.0	0.8-1.0
Minerals	%	0.5-0.7	0.5-0.7
pH	-	6.4-6.2	5.0-4.6
Lactic acid	%	traces	Up to 0.8

1.4 Preservation

Food is so important for the survival, so food preservation is one of the oldest technologies used by human beings to avoid its spoilage. Boiling, freezing & refrigeration, pasteurizing, dehydrating, pickling are the traditional few. Sugar, mineral salt and salt are also often used as preservatives food. Food Preservation is basically done for three reasons.

- To preserve the natural characteristics of food
- To preserve the appearance of food.
- To increase the shelf value of food for storage.

In the category of natural food preservatives comes the salt, sugar, alcohol, vinegar etc. These are the traditional preservatives in food that are also used at home while making pickles, jams and juices etc. Chemical food preservatives are also being used for preservation which include: Benzoates (such as sodium benzoate, benzoic acid), Nitrites (sodium nitrite), Sorbates (such as sodium sorbate, potassium sorbate) etc. Artificial preservatives are the chemical substances that stop of delayed the growth of bacteria, spoilage and its discoloration. These artificial preservatives can be added to the food or sprayed on the food. Examples for artificial preservatives include antimicrobials (Benzoates, Sodium benzoate, Sorbates), Antioxidants include the Sulfites, Vitamin E, Vitamin C,Chelating agent has the Disodium ethylenediaminetetraacetic acid (EDTA), Polyphosphates and Citric acid.

Sodium Benzoate is the Sodium salt of Benzoic acid. Both Sodium Benzoate and potassium Benzoate are white, crystalline and hygroscopic, that is, absorb moisture from air. They have to be kept tightly closed or become liquid. When these salts are added to the products, the Benzoic acid is absorbed by the cells, which lowers its pH. It prevents the anaerobic fermentation, actively, depending on the heat, light and the duration the food is used. These preservatives do not kill the bacteria and mould, but inhibit their growth.

Objectives

The objective of the present study is to develop a Whey based Ready To Serve (RTS) product from Pineapple.

Review of literature

Chapter 2

REVIEW OF LITERATURE

Pineapple is the most important fruit of many developing countries due to its export values. Generally, the pineapples are exported as the canned-fruit, concentrated juice and dried pineapple slices. Although there are a number of pineapple products in the market, the food industry still keeps developing new product from pineapple. The benefit of new product development is the elevation of the fresh pineapple demand and consequently helps reducing the pineapple loss caused by the micro organisms, chemical and enzymatic reactions during the peak of harvesting season.

Whey Protein is one of the greatest ways to supplement nutrition. Unlike regular protein powders, whey contains more protein by weight than anything else and is considered one of the best new forms of super food that is out there on the market today. Over the years, numerous approaches have been taken in an effort to transform a large volume of whey into products suitable for use as food. Whey is a source of vitamins and minerals as well as a source of high-quality proteins, among which sulphur amino acids are particularly valuable owing to their anticancer activities

2.1 Whey based RTS:

Irvine et al., (1984) found that whey proteins represent approximately 22% of the original milk proteins. The dry matter of whey is mainly composed of carbohydrates (lactose), proteins, fat and minerals. Fat content in whey ranges from 0.5 – 1%, depending on the type of cheese. Lactose is lower in acid whey than sweet whey due to fermentation process.

Antinone et al., (1994) stated that curd formation is achieved by acidification to pH 4.5-4.8 by microbial fermentation of lactose to lactic acid or the addition of acid, and/or by the action of rennet. The fermentation is commonly used in the production of cottage and certain other cheeses. The characteristic flavor of these cheeses is defined by compounds formed in the fermentation process. Singh *et al.* (1999) attempted to develop a soft beverage from paneer whey and guava.

Sikder *et al*. (2001) formulated different blends of whey beverages by using various levels of mango pulp (8-12%) with 0.04% acidity. Sirohi *et al. (*2005) prepared *Whey*-based mango herbal beverage with 2% *Mentha* extract, found that there was highest overall acceptability on the day of preparation as well as after 30 days of storage.

Sweet whey contains besides whey proteins also glycomacropeptide (GMP) which is obtained by enzymatic hydrolysis of casein. Moreover, whey protein content is quite lower in whey obtained in the process of cheese manufacture from ultrafiltered milk or from milk processed at high temperatures. Acidification of whey down to pH < 3,9 causes whey proteins to become thermoresistant and do not precipitate even during UHT sterilization treatments (Jelen, 2003).

Saravana Kumar(2005), faculty members at Home Science College and Research Institute, TNAU, Madhurai, developed a whey based Mango fruit juice blended RTS Beverage, prepared by blending mango juice at 10% into whey. The TSS andacidity has been maintained at 15° Brix and 0.3% as per FPO specification. After in-bottle pasteurisation and cooling, RTS beverage had shelf life of more than 90 days at 5° to 7° C temperature.

Departamento de Tecnologia de Alimentos, Escuela TÃ©cnica Superior de IngenierÃa Agraria, Universidad de Lleida, Lleida, EspaÃ±a.(2006) is source of the information that orange juice may be a nutrient vehicle that helps to improve diet quality. The addition of whey allows the incorporation of high quality proteins. The aims of the present study were: a) to assess the acceptability of a beverage prepared with orange juice (J) and whey powder (WP) at 7 g/100 g (J+WP7) or at 13 g/100 g (J+WP13); b) to measure available lysine content and ascorbic acid retention of the more accepted formulation, comparing the effect of HIPEF treatment (29 kV/cm, t(acum): 59 micros) with a conventional heat treatment at 75 degrees C, for 15 minutes (HT). The beverages were subjected to sensory evaluation (Friedman test). Available lysine was assessed by the Carpenter method, modified by Booth, and vitamin C by HPLC; minerals Na and K, by flame photometry; Ca, Mg and Zn by atomic absorption spectrometry. There were no significant differences between the acceptance of J and J+WP7. J+WP13 were significantly less accepted ($p < 0.01$), so it was discarded. Available lysine (mg/g protein) in untreated J+WP7 was 60.2 +/- 0.15; after treatments: 50.0 +/- 2.8 (HT) and 51.0 +/- 3.4 (HIPEF). The HIPEF treated J and (J+WP7) retained 100% and 98% of their vitamin C initial content and the HT treated, 91% and 88%, respectively. The amount of whey powder added to the orange juice conditioned the acceptability. The juice

containing 7% of whey powder was well accepted, and after treatment by HIPEF, it retained a good nutritional quality, regarding available lysine, vitamin C retention and provision of mineral nutrients.

Due to high amount of proteins with high nutritional value these beverages are ideal source of energy and nutrients for athletes. Whey proteins are a rich source of branched chain aminoacids (BCAA) like isoleucine, leucine and valine. BCAAs unlike other essential aminoacids are metabolized directly into the muscle tissue and are first amino acids used during periods of exercise and resistance trainings. (Sherwood et al., 2007).

Babar(2008) conducted a study on utilization of pomegranate juice for the preparation of Chakka Whey Beverage (CWB). Pomegranate juice at 0, 10, 15 and 20 per cent with 10 per cent sugar was mixed in chakka whey for manufacture of beverage. The different levels of pomegranate juice had a definite effect on improving the sensory quality of the beverage. The beverage prepared by utilizing chakka whey with 15% pomegranate juice, had secured the highest sensory score (8.81) and ranked as most acceptable product followed by 20% pomegranate juice with 8.65 points sensory score. The percentage of protein total sugar, ash and acidity (% LA) of the product increased with increase in the levels of pomegranate juice. They concluded that the better quality chakka whey beverage could be prepared by admixing 15%pomegranate juice.

Divya (2009) made an attempt to develop a soft beverage from paneer whey and guava pulp which pasteurized at different temperatures and timings for estimating its shelf-life. In the preparation of beverages the volume of guava pulp (25%), sugar (10%) and paneer whey (65%) were kept constant while the pasteurization temperatures and timings were varied from 60°C-70°C for 15-35 minutes. The prepared beverages were evaluated for their physico- chemical properties and organoleptic qualities every 15 days till 45 days. Effect of different temperatures, timings and storage periods on the mean sensory sources of whey-guava beverage was significant and significantly changes were observed in total sugars, reducing sugars, non reducing sugars and vitamin C during the storage period. However, whey-guava beverages pasteurized at 70°C for 35 minutes was found to be best in terms of sensory quality after 45 days and pH, acidity, protein, total sugars and reducing sugars found to be high than that of the other samples.

Naik(2009) from College of Dairy Technology, Indira Gandhi Agriculture University, Raipur conducted a detiled study on Whey Based Watermelon Beverage (WBWB) prepared by blending watermelon juice (15%), sugar (7%) and different concentration of Betel leaves distillate (0, 1, 2, 3%) into chhanna whey (78-75 %). The prepared beverage has red colour, highly acceptable taste and overall acceptability. The overall acceptability of beverage improved with increase in betel leaves distillate up-to 2%. After in-bottle sterilization and cooling, the beverage was stored at refrigerated temperature. The storage study showed that there is an increasing trend in the TSS, acidity, and reducing sugar and a decreasing trend in the pH and ascorbic acid but total sugar has non significant effect during storage. The sensory quality of fresh beverage containing 2% betel leaves distillate on the preparation as well as 30 days of storage were found to be highly acceptable. Additions of 3% betel leaves distillate do not improve the mouth-feel but they extend the storage period of the product. This indicates that antimicrobial and anti-oxidant properties in essential oil of betel leaf increase the storage stability of the beverage.

Ritika Yadav, (2010) carried out study on the development and storage of Whey-Based Banana Herbal (WBBH) beverage with the incorporation of *Mentha arvensis* extract (0 to 4%). They concluded that a whey based banana herbal beverage can be prepared successfully with the incorporation of 2% *Mentha* extract. The beverage can be stored at refrigeration temperature without adding any chemical preservative with desirable consumer acceptability up to 15 days. The product can prove a nutritionally as well as organoleptically desirable beverage with agreeable taste, energy providing due to whey proteins and banana juice in it.

Ismail, (2011) Food Research Centre, Khartoum North, Sudan developed a procedure that analyses the development and storage of whey based mango beverage. The study showed that whey could successfully incorporated in beverages. The Storage of whey-based mango juice significantly resulted in increasing the TSS, acidity, reducing sugar and a decrease in the pH and ascorbic acid. It was observed that initial TSS of the whey based mango beverage was 16.28 decreased to 16.17 after 30 days of storage. The initial ascorbic acid content of the beverage 0.68 decreased to 0.66. This slight decrease in acid content occurs due to degradation of ascorbic acid to carbolic acid under storage condition.

The Scientists of Faculty of Agricultural Engineering and College of Dairy Technology, Raipur, attempted to develop a soft drink from paneer whey and mango pulp with addition of lemongrass distillate.

2.2 Preservation

Food preservation is the process which deals with the practical control of factors capable of adversely affecting the safety, nutritive value, appearance, texture, flavor, and keeping qualities of raw and processed foods. Since thousands of food products differing in physical, chemical, and biological properties can undergo deterioration from such diverse causes as microorganisms, natural food enzymes, insects and rodents, industrial contaminants, heat, cold, light, oxygen, moisture, dryness, and storage time, food preservation methods differ widely and are optimized for specific products. (Borgstrom, 1968)

Preservation usually involves preventing the growth of bacteria, fungi, and other micro-organisms, as well as retarding the oxidation of fats which cause rancidity. It also includes processes to inhibit natural ageing and discoloration that can occur during food preparation such as the enzymatic browning reaction in apples which causes browning when apples are cut. Some preservation methods require the food to be sealed after treatment to prevent recontamination with microbes; others, such as drying, allow food to be stored without any special containment for long periods. (N. W. Desrosier, 1970)

Materials & Methods

Chapter 3

MATERIALS AND METHODS

This chapter deals with details regarding procedures and methods followed for the development of Whey based RTS product from pineapple.

3.1 Procurement of whey

Whey was procured from the dairy plant, mannuthy. Whey is obtained after the coagulation of milk protein casein with some coagulating agent. The coagulating agent may be citric acid added as the pure chemical reagents or produced by the action of microorganisms allowed to grow in the milk.

3.2 Preservatives in dairy industry

The nutritious nature of dairy products makes them especially good media for the growth of microorganisms. Milk contains abundant water and nutrients and has a nearly neutral pH. The major sugar, lactose, is not utilized by many types of bacteria, and the proteins and lipids must be broken down by enzymes to allow sustained microbial growth. In order to understand the source of many of the spoilage microflora of dairy products, it is best to discuss how milk can first become contaminated, via the conditions of production and processing.

A Preservative is defined as any substance which is capable of inhibiting, retarding or arresting the growth of micro-organisms, of any deterioration of food due to micro-organisms. Chemical preservatives interfere with cell membrane of micro-organisms, their enzymes or their genetic mechanisms. The compounds used as preservatives include natural preservatives such as salt, sugar, acids etc, as well as synthetic preservatives. Chemical preservatives are generally added after the foods are processed. Chemical preservatives include nitrates, sulphites, benzoic acid etc.

The significant objective of the present study is to develop a beverage that not only is whey based, but which also exhibits desirable taste characteristics.

3.3Procurement of the fruit

The study was under taken using fully ripe pineapple which was procured from the local market.

3.4 Preparation of juice

The ripe pineapples (*Ananas comosus*) of the “Smooth cayenne” variety were obtained at the local market. The pineapples were peeled, cut, crushed and hydraulically pressed to squeeze out the juice. The soluble solid content, colour and pH of the fresh pineapple juice were measured by refractometer, colour meter and pH meter respectively.

The ripe pineapple was selected. It was peeled manually and sliced to a uniform thickness of 1.5cm using a sharp knife. The juice was prepared using a mixer grinder, filtered to obtain clear juice. Store the pineapple juice in a cool dry area. Keep cans in a cupboard or pantry and keep frozen pineapple juice in the freezer. Keep opened juice in a tightly covered container. Do not store in metal containers. Refrigerate opened canned or bottled juice. Use juice by the date listed on the packaging. Look at the "Best if used by," "Best by" or other similar date listing. If juice smells bad or leaks from the container, throw it away. Keep unopened canned juice in a cupboard for up to eighteen months. Frozen pineapple juice stays fresh between 8 to 12 months.

3.5Physico chemical analysis

3.5.1Brix

1. A hand refractometer was used to determine the brix.
2. The filtered juice and the pulp were taken in two different Petri dishes and the TSS of the juice and the pulp can be measured with the one having lowest range 0- 32° Brix, while for measuring the TSS higher ranges are made use of.
3. Put a drop of material onto the glass surface of refractometers’ prism, cover gently with the lid and observe the TSS against light.
4. Measure the temperature of the liquid which is being evaluated and apply temperature corrections.

3.5.2Acidity

Acidity in a sample is determined by titrating it against a standard alkali(NaOH) solution using phenolphthalein as the indicator. Appearance of light pink colour is taken the end point. Phenophthalein gives a colour in a medium of pH in the range of 8- 9.6. It is colourless in acidic medium.

To prepare 0.1Normal NaOH

The alkali solution is prepared by weighing 0.4 g of NaOH pellets and dissolves it in 100ml distilled water.

$$\textbf{Weight of NaOH required} = \frac{\textbf{EVN}}{\textbf{1000}}$$

Where, E=Equivalent Weight (NaOH)

V=Volume

N=Normality

Estimation of acidity in the given sample

1. 10 ml of filtered juice sample is pipette out and is then made to 100ml by addition of distilled water.
2. Then 10ml of this is pipette out and is titrated against standard NaOH solution using phenolphthalein as an indicator.
3. Express the acidity as percent anhydrous citric acid or any other acid.

$$\textbf{Percent total acid} = \frac{\textbf{Titrate value} * \textbf{normality of NaOH} * \textbf{Volume made up} * \textbf{Equivalent weight of acid} * \textbf{100}}{(\textbf{volume/weight ofsample taken}) * \textbf{1000}}$$

3.5.3Moisture content in pineapple

The moisture content of pineapple was estimated as per the procedure described in Indian Standards Institution, (1981). Fifty grams of powder was accurately weighed into an petridish and weighed. The dish containing the sample was heated uncovered in an oven at 60 ± 5 °C for 24 hours and cooled in a desiccator. The per cent moisture was calculated from the loss of mass.

$$\textbf{Moisture content} = \frac{\textbf{Final weight(g)} - \textbf{Initial weight(g)}}{\textbf{Initial weight(g)}} \textbf{x 100}\%$$

3.5.4Crude Fibre of Food

1. Crude fibre consists of cellulose, variable proportion of hemicellulose and highly variable proportion of lignin along with some minerals.
2. Estimation is based on treating the moisture and fat free sample successively with dilute acidity alkali.
3. During these steps, oxidative hydrolytic degradation of the native cellulose and considerable degradation of lignin occur.
4. The residue obtained after final filtration is weighed, incinerated, cooled and weighed again
5. The loss in weight gives crude fibre content

Reagents

1. **0.255N(±0.005) H_2SO_4**

   Mix 6.79ml of H_2SO_4 in water and make up to 1 litre.(1.25%)

2. **0.313N(±0.005)NaOH**

   Dissolve 12.5g NaOH in water and make up to 1 litre.(1.25%)

Procedure

1. Since the fat content of pineapple is less than 1% fat extraction with ether could be omitted.
2. And therefore, 2g of the dried sample was ground and boiled with 200ml of H_2SO_4 for 30 minutes bumping chips.
3. Filter through muslin cloth and wash with boiling water until washings are no longer acidic.
4. Boil with 200ml NaOH, 30 minutes
5. Filter through muslin cloth again and wash with 25ml of boiling 1.25% H_2SO_4, 350ml portion of water and 26ml alcohol.
6. Remove the residue.
7. Transfer to ashing dish (W_1).
8. Dry the residue for 2hour at 130±2°C.
9. Cool the dish in the desiccator and weigh (W_2).
10. Ignite for 30 minutes at 600±15°C.
11. Cool in a desiccator and reweigh (W_3).

Calculation:

$$\textbf{\% crude fibre} = \frac{(W_2 - W_1) - (W_3 - W_1)}{\textbf{weight of sample}}$$

3.5.5 Ascorbic acid

Principle

The reduction of dye 2,6 dichloro phenol indophenol by an acid solution of ascorbic acid forms the basis of the estimation.in the absence of interfering agent, the capcity of an extract of the sample to reduce a syandard solution of the dye is directly proportional to ascorbic contents.

Reagents used

4% oxalic acid, standard ascorbic acid, 2 6 dichlorophenol indophenol dye.

Procedure for standardisation of dye

Take 5ml of standard ascorbic acid. Add 5ml of oxalic acid. Titrate with dye solution taken in burette to a pink colour which should persist atleast for 15 seconds.

$$\textbf{Dye factor} = \frac{0.5}{\textbf{titre value}}$$

Estimation of Ascorbic acid content of fruit juice

Take 10ml of fruit juice. Make up to 100ml with 4% oxalic acid. Pipette 10ml of the made up solution into a conical flask. Titrate against the dye taken in a burette to a pink end point, which should persist for at least 15 seconds. Repeat the titration to obtain concordant values (d).

$$\textbf{Ascorbic acid present in 100ml of fruit juice} = \frac{\textbf{dye factor} * \textbf{d} * \textbf{vol.made} * \textbf{100 mg}}{\textbf{Vol.taken} * \textbf{weight of sample}}$$

3.5.6 pH

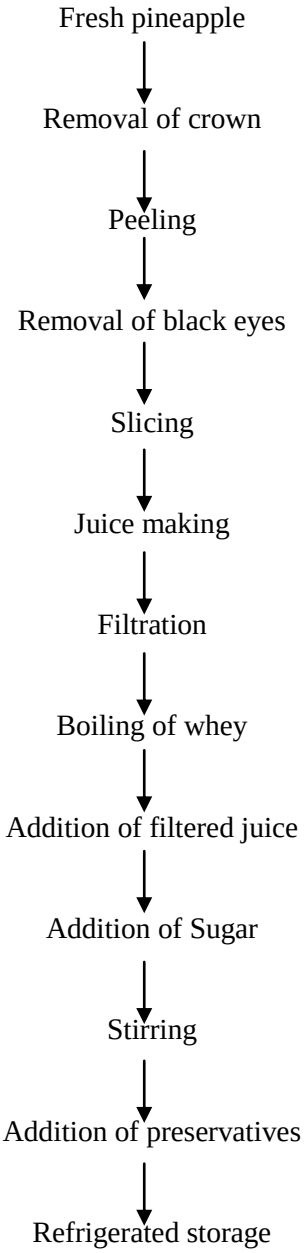
The pH was determined by using a pH paper. Filter paper was dipped in the whey-pineapple juice obtains pH of the solution.

3.6 Preparation of whey.

The basic component of the blends was whey prepared in the laboratory from pasteurized milk. Milk was heated to 37 °C and at this constant temperature exposed to

coagulation, with 100 ml 0.5% solution of himozine, for 1 h. Whey was separated from coagulum by filtration and characterized by applying standard method. The other component was commercially available like nectar of pineapple. They were determined by application of standard methods. The blend quality was improved by adding sucrose. Blending was followed by adding of preservatives and the final products were obtained.

3.7 Preparation of whey-pineapple juice



Firstly, different proportions of pineapple juice(10° Brix) and whey(6° Brix) were added. A minor sensory evaluation was done. Result obtained indicated that equal proportion of whey and pineapple juice was best liked**.** Henceforth, different proportions of honey and

sugar were added in juice of equal proportion of whey and pineapple juice and further evaluation were carried out.

3.8 Sensory evaluation of whey based RTS from pineapple

For better acceptability and sustained marketing of the whe based pineapple RTS, various sensory parameters such as appearance, colour, flavour, taste and overall acceptability were considered. Organoleptic evaluation was performed as per the procedure outlined by Ranganna (1979) by a panel of 4 untrained judges in a 9 point hedonic scale varying from ‘like extremely’ (rated as 9) to ‘dislike extremely’ (rated as1).

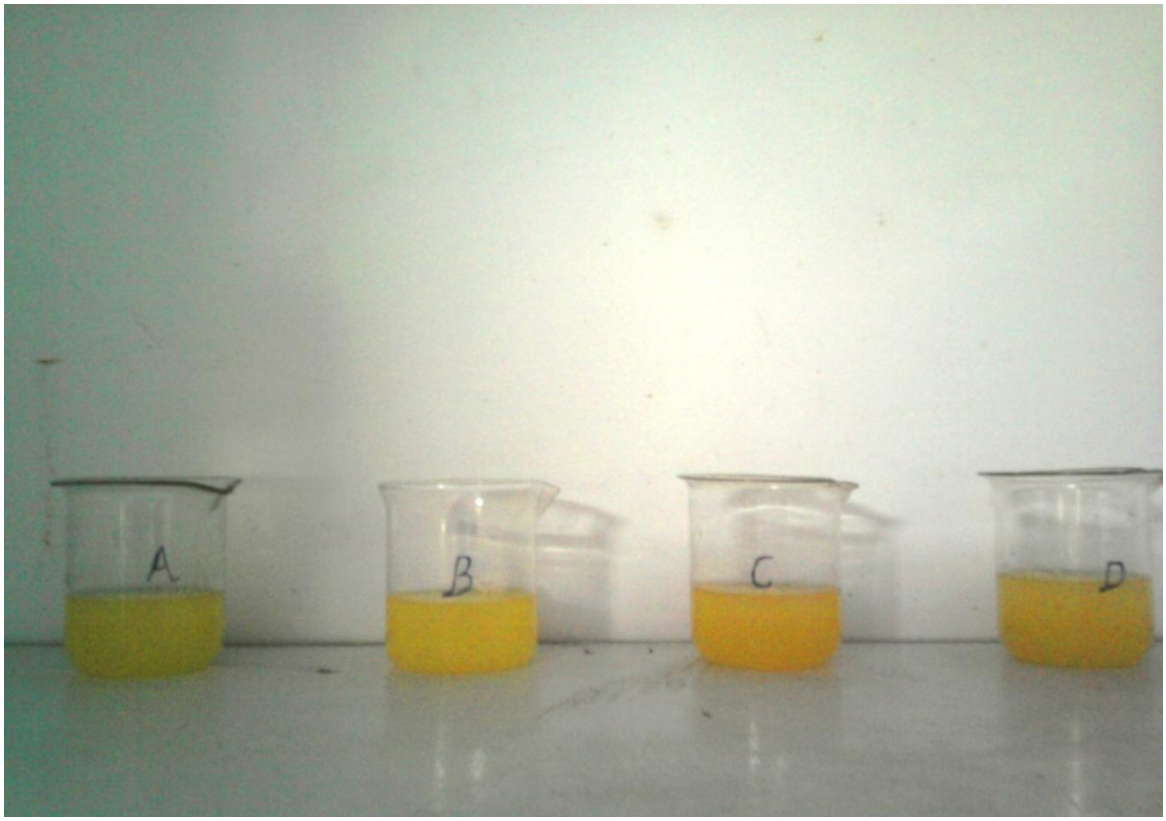


Plate 3: The samples for sensory evaluation

Sample A: 10ml juice + 10ml whey + 15g honey (1:1:1.5)

Sample B: 10ml juice + 10ml whey + 10g sugar (1:1:1)

Sample C: 10ml juice + 10ml whey + 15g sugar (1:1:1.5)

Sample D: 10ml juice + 10ml whey + 10g honey (1:1:1)

Acceptability Test

Score card: Hedonic scale

Judge Name: Date:19-12-2011

Product Name: Whey based Pineapple Juice

Attribute:

Degree of preference	Sample A	Sample B	Sample C	Sample D
Like very much				
Like much				
Like moderately				
Slightly like				
Neither like nor dislike				
Slightly dislike				
Dislike moderately				
Dislike much				
Dislike very much				

Comments:

The experiments were planned according to a factorial design, i.e. two independent variables were kept at two levels. In this way, $2^2=4$ experiments were planned. Additionally, four experiments were performed with the pH values in the middle of the interval, so blends for each fruit were prepared. The blends were exposed to the usual sensor analysis, by a team of four independent experts, who estimated the:

(1) Flavour

(2) over-all liking.

Arithmetic average values of independent estimations, presented in Tables 1 as dependent variables, were used for further analysis.

3.9 Preservation of whey- pineapple juice

Food preservation is the process which deals with the practical control of factors capable of adversely affecting the safety, nutritive value, appearance, texture, flavour, and keeping qualities of raw and processed foods. A Preservative is defined as any substance which is capable of inhibiting, retarding or arresting the growth of micro-organisms, of any deterioration of food due to micro-organisms. Chemical preservatives interfere with cell membrane of micro-organisms, their enzymes or their genetic mechanisms. The compounds used as preservatives include natural preservatives such as salt, sugar, acids etc, as well as synthetic preservatives. Chemical preservatives are generally added after the foods are processed. For the preservation of pineapple-whey juice, we use two preservatives – sodium benzoate, potassium metabisulphite.

3.9.1 Preservation using sodium benzoate

Sodium benzoate is commonly used chemical preservative in food industry. It is bacteriostatic and fungistatic under acidic conditions. It is most widely used in acidic foods such as salad dressings (vinegar), carbonated drinks (carbonic acid), jams and fruit juices (citric acid), pickles (vinegar), and condiments. Sodium benzoate is produced by the neutralization of benzoic acid with sodium hydroxide. Benzoic acid is detectable at low levels in cranberries, prunes, greengage plums, cinnamon, ripe cloves, and apples. Though benzoic acid is a more effective preservative, sodium benzoate is more commonly used as a food additive because benzoic acid does not dissolve well in water. Concentration as a preservative is limited by the FDA in the U.S. to 0.1% by weight. The International Programme on Chemical Safety found no adverse effects in humans at doses of 647–825 mg/kg of body

weight per day. The mechanism starts with the absorption of benzoic acid into the cell. If the Intracellular pH changes to 5 or lower, the anaerobic fermentation of glucose through phosphofructokinase is decreased by 95%, thereby inhibiting the growth and survival of micro-organisms causing food spoilage.

3.9.2 Preservation using potassium metabisulphite

Potassium metabisulphite has been used in foods for long as a general preservative. It is used in the treatment of fruits and vegetables before and after dehydration to extend the storage life in the manufacture of fruit juices. The antimicrobial activity of the preservative is due to the reaction of bisulphite with acetaldehyde in the cell, forms an additional compound which interferes with respiration and prevents spoilage due to micro organisms.

For the preservation of pineapple- whey juice, both sodium benzoate and potassium metabisulphite was added to the juice at the rate of 25mg per 250ml of prepared juice as per FPO specifications. The juice was stored for 3 weeks and analysed after two days interval.

3.10 Colour

Hunter lab colour flex meter (Plate 3.6) was used for the measurement of colour of pineapple whey juice. It works on the principle of focusing the light and measures energy reflected from the sample across the entire visible spectrum. The colour meter uses filters rely on "standard observer curves" that define the amount of red, green and blue colours. The primary lights required to match a series of colours across the visible spectrum and mathematical model used to describe the colours are called as Hunter model. It provides reading in terms of L, a and b. Where, luminance (L) forms the vertical axis, which indicates whiteness to darkness. Chromatic portion of the solids is defined by: a (+) redness, a (-) greenness, b (+) yellowness, and b (-) blueness.The colour of the fruit juice was measured by using CIELAB scale at 10^{o} observer at D_{65} illuminant. Before measuring the colour of the samples, the instrument was standardized by placing black and white standard plates. The sample colour was measured by filling the pulp in the transparent cup without any void space at the bottom. The deviation of the colour of the samples to standard was also observed and recorded in the computer interface.

Plate 4: The Hunter-Lab Colourimeter

Results & Discussion

Chapter 4

RESULTS AND DISCUSSION

An experiment was conducted to develop RTS products from pineapple. The results obtained from the study were analysed to standardize the whey-pineapple juice and the preservation techniques under different storage conditions. The results of the study were discussed in this chapter under the following sub heads.

4.1 Standardization of the Whey-pineapple juice.

Chemical analysis of whey, pineapple juice and the mixture of whey and pineapple were carried out.

4.1.1Brix

Total soluble solid content of the filtered, unfiltered juices and of whey were measured using hand refractometer. The lowest range of 0°- 32° Brix measuring refractometer was used for all the above.

TSS of filtered pineapple juice 10° Brix

unfiltered pineapple juice 13° Brix.

whey 6° Brix.

Brix of the four samples kept for sensory evaluation were predetermined using a hand refractometer.

The result obtained was:

Sample A: 17.2° Brix

Sample B: 17° Brix

Sample C: 18.6° Brix

Sample D: 15.4° Brix

Sample B i.e., equal proportions of pineapple juice(10° Brix) and whey(6° Brix) were added along with 10g sugar was best liked by the panelists.

4.1.2 Ascorbic acid

The estimation of ascorbic acid was done by using the dye, 2,6 Dichlorophenol indophenol and 4% oxalic acid.

Dye factor was estimated to be 0.16.

Table 5.1: Titre value for estimation of Ascorbic acid

Material	1st titre value	2nd titre value	3rd titre value
Pineapple juice	1.3	1.1	1.1
Whey-pineapple juice	0.8	0.7	0.7

Ascorbic acid content of pineapple juice was found out to be 35.2mg/100g juice.

Ascorbic acid content of whey-pineapple juice was found to be 22.4mg/100g juice.

4.1.3 Moisture content of pineapple

The pineapple sample of 50g was kept open in oven for 24 hours at 60±5°C. The moisture content of the sample was estimated as 81.6%.

4.1.4Acidity

All the 3 samples, i.e., pineapple juice, whey and whey-pineapple mix were subjected to acidity test.

The samples were titrated against standard NaOH solution of 0.1N. Phenophthalein was used as the indicator. Appearance of light pink colour was marked as the end point.

After the titration acidity was found to be:

Pineapple juice 2.6%

Whey 9.2%

Whey-Pineapple juice 4.8%

Table 5.2: Titre value for estimation of Acidity.

Material	1st titre value	2nd titre value	3rd titre value
Pineapple juice	0.7	0.65	0.65
Whey	2.4	2.3	2.3
Whey-Pineapple juice	1.3	1.2	1.2

4.1.5 Crude fibre of pineapple

The 2g ground sample was first boiled in 200ml H_2SO_4 for 30 minutes was then filtered through muslin cloth and washed with boiling water. It was then again boiled with 200ml solution of NaOH for 30 minutes followed by filtration and the residue was transferred to ashing dish after weighing (W1). Then it was dried for 2 hours at 130±2°C, cooled and was weighed (W2). It was then transferred to muffle furnace were the temperature was maintained at 600±5°C. Cooled in a desiccator and reweighed (W3).

W1=3.9g

W2=3.2g

W3=0.1g

Crude fibre content=15.5%

4.1.6 pH

pH of the samples were measured using pH paper.

And the results are as follows:

pH of whey= 4.5 - 6.5

pH of pineapple juice=3.3 - 3.6

pH of whey pineapple juice=6

4.2 Sensory evaluation of whey-pineapple juice

The developed whey-pineapple beverage made by adding the equal volumes of whey and pineapple juice was further undergone a sensory evaluation. In that different proportions of sugar as well as honey were added. Four samples were kept for the evaluation.

Sample A: 10ml juice + 10ml whey + 15g honey

Sample B: 10ml juice + 10ml whey + 10g sugar

Sample C: 10ml juice + 10ml whey + 15g sugar

Sample D: 10ml juice + 10ml whey + 10g honey

The average score attained by each sample is;

Sample A=6.75

Sample B=7.75

Sample C=7.5

Sample D=6.75

According to the sensory evaluation the equally proportioned whey-pineapple drink with 10g of sugar (i.e., Sample B of 17° Brix) was best liked by 3 out of 4 of the panellists.

4.3 Preservation studies

Efforts were made to conduct the preservation study of the whey-pineapple beverage.

According to FPO specifications, the standard values the amounts of 2 preservatives added were:

Sodium benzoate = 25mg for 250ml

Potassium metabisulphite = 25mg for 250ml

The beverage to which sodium benzoate was added remained fresh for 3 weeks in refrigerated condition while the one with potassium metabisulphite fouled up after 5 days of refrigerated storage.

4.4 Colourimeter readings.

A graph was plotted using the L (lightness), a (redness), and b (yellowness) values obtained from the Hunterlab colourimeter.

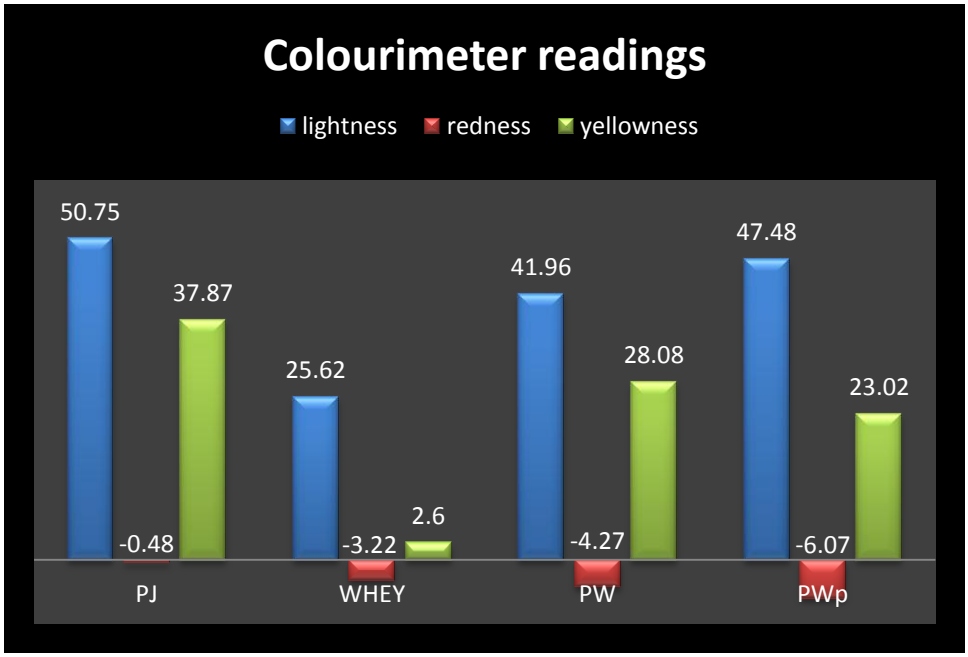


Figure 1: Graph for comparing the colourimeter readings of various samples:

Fresh pineapple juice- PJ,

Whey- WHEY,

Best liked sample of Whey based Pineapple RTS- PW and

Second best liked sample of Whey based Pineapple RTS- PWp.

Here the graph of colourimeter readings gives a comparison between the various samples. The graph depict that there is only a slight difference between the colour of fresh pineapple juice as well as the Whey based RTS from pineapple. So the consumer will not be able to find a difference in Whey based pineapple RTS and fresh pineapple juice just by its colour.

Summary & Conclusion

Chapter 5

SUMMARY AND CONCLUSION

From the results, it showed the practicability of producing RTS products from pineapple by blending whey, the by product from the dairy industry with filtered pineapple juice and the pineapple powders from the mixture of fresh pineapple juice and the liquid glucose by applying the spray drying method.

The developed whey-pineapple beverage made by adding the equal volumes of whey and filtered pineapple juice. According to the sensory evaluation the equally proportioned whey-pineapple drink (10ml each) with 10g of sugar (i.e., Sample B of 17° Brix) was best liked by 4 out of 5 of the panellists.

The physio chemical analysis was carried out to standardize the developed whey-pineapple juice and it showed the following results:

Acidity =4.8%

pH =6

TSS =17° Brix

Vitamin C =22.4mg/100g of juice

Recommended dose preservative;

Sodium benzoate-25mg for 250ml

Colourimeter readings:

Lightness, L= 47.48

Redness, a= -6.08

Yellowness, b= 23.02

Moisture content of pineapple =81.6%

Crude fibre content of pineapple=15.5%

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Development of Whey Based RTS product from Pineapple

By

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ABSTRACT OF THE PROJECT REPORT

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Bachelor of Technology

in

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Faculty of Agricultural Engineering and Technology
Kerala Agricultural University

Department of
Post Harvest Technology and Agricultural Processing

KELAPPAJI COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY
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ABSTRACT

The growing demand for the consumption of fruits is increasing day by day. In order to meet the demand of the market throughout the year in all areas, the commodities are preserved using different techniques.

The objective of the present study is to develop a Whey based RTS from pineapple.

Pineapple is one of the most important tropical fruit of many developing countries due to its export values. Whey is the milk serum that is obtained during the manufacture of cheese after separation of casein and fat during milk coagulation.

Fresh pineapple juice(0% diluted)was filtered. This filtered juice was added to boiled whey. The whey was obtained from the dairy plant, Mannuthy, by the coagulation of milk serum protein by the action of some coagulating agents. The filtered pineapple juice and the whey were taken in equal amounts. This mixture of whey-pineapple juice was added with different composition of sugar as well as honey.

A sensory evaluation was conducted with a panel of 4 judges with four samples. Among that the mixture of 1:1:1[pineapple juice(ml):whey(ml):sugar(g)] proportion of sugar was best liked by 3 among four of the panelists.

Chemical analysis of this sample was then conducted.

Storage study was carried out using sodium benzoate and potassium meta-bisulphite as per FPO standards. Samples were checked after every three days interval. The sample with sodium benzoate (25mg for 250ml) remained intact for one month, whereas the other sample with potassium meta-bisulphite lasted hardly for one week.