



INTERNSHIP REPORT ON

“Formulation and Sensory Evaluation of Mixed Fruit Juice of Chalta and Tamarind

At

**INSTITUTE OF FOOD SCIENCE & TECHNOLOGY (IFST)
(BCSIR) Dhaka**

SUBMITTED TO:

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Date of Submission: 18/12/2013

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LETTER OF TRANSMITTAL

Date:

Dr.K.M. Formuzul Haque,
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Subject: Submission of Internship Report.

Dear Sir,

I am here by submitting my Internship Report, which is a part of the NFE Program curriculum. It is great achievement to work under your active supervision. This report is based on, “Formulation and Sensory Evaluation of Mixed Fruit Juice of Chalta and Tamarind At IFST,BCSIR, Dhaka”. I have got the opportunity to work in Fruits Technology Research Section, Institute of Food Science and Technology, BCSIR, Dhaka for sixty days, under the direct supervision of Dr .Barun Kanti Shaha, Principle Scientific Officer.

This project gave me both academic and practical exposures. First of all I have gained knowledge about the Formulation and Sensory Evaluation of Mixed Fruit Juice of Chalta and Tamarind. Secondly, the project gave me the opportunity to develop a network with the corporate environment.

I shall be highly obliged if you are kind enough to receive this report and provide your valuable judgment. It would be my immense pleasure if you find this report useful and informative to have an apparent perspective on the issue.

Sincerely Yours

Birupaksha Biswas

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Acknowledgement

First of all, I wish to express my gratitude to the Almighty God for giving me the strength to perform my responsibilities as an intern and complete the report within the stipulated time.

I am deeply indebted to my supervisor **Dr. K.M Formuzul Haque Prof. & Head, Department, of Nutrition & Food Engineering, Faculty of Allied Health Sciences**, Daffodil International University for his whole-hearted supervision during my organizational attachment period. I am very grateful to **Mr. Mainul Ahsan**, Director of IFST, BCSIR, Dhaka, for giving me permission to carry out this research work at this Institute. I am also express my heartfelt appreciation to **Dr. Barun Kanti Saha**, Principal Scientific Officer as my organizational supervisor and **Mr. Md. Motalab**, Scientific Officer to conduct this research very enthusiastic. It would have been very difficult to prepare this report up to this mark without their guidance.

I sincerely like to thanks my Co-Supervisor **Mr. Taslim Ur Rashid, Lecturer**, Department of Nutrition and Food Engineering, Daffodil International University, for his valuable guidance, inspiration to conduct this research very successful. I am also grateful to **Professor Dr Muktaruzzaman**, Department of Nutrition and Food Engineering, Daffodil International University

I also like to thanks **Associate professor Dr. Md. Bellal Hossain, Fouzia Akter, Lecturer and Moonmoon Haque, Lecturer** for their countless inspiration and encouragement during my student life in this department. My gratitude goes to entire NFE Department, of Daffodil international University for arranging Internship Program that facilitates integration of theoretical knowledge with real life situation. I must mention the wonderful working environment and group commitment of this organization that has enabled me to deal with a lot of things.

I would like to express my warmest thanks to **Mehbuba khanam** ,Assistant laboratory Officer, & **Syed Nur-E-Alam**, Co-ordination Officer, Department Nutrition & Food Engineering. I express my deep gratitude to the office/labs staff of the Department of Nutrition & Food Engineering under faculty of Allied Health Sciences, Daffodil International University as well as Fruit Technology Research Section, IFST, BCSIR

Abstract

Tamarindus indica L, commonly known as Tamarind, it contains high amount of tartaric acid which have cholesterol reducing capacity and widely used to provide a sweet and tart flavor. *Dillenia indica*, commonly known as chalta and in English known as Elephant apple, is a good source of antioxidant the objectives of this study were to formulate and biochemical evaluation as well as test the acceptability of a natural passion fruit beverage using a mixture of chalta and tamarind. Chalta and Tamarind fruits were collected from the local market of Dhaka city. Juices were extracted from both the fruits by using extractor. The juices of chalta and tamarind were mixed with 1:2 proportions. Different physicochemical, microbiological and organoleptic analyses were done at Institute of Food Science & Technology IFST, BCSIR, Dhaka for mixed juice. Results obtained from the analysis of mixed juice showed that the $P^H = 3.2$, TSS=17% , Titratable acidity = 0.68% , Vitamin C = 75.00 mg% , Total sugar = 13.36% , Reducing sugar =12.3% and Ash = 0.10%.Important minerals Sodium(Na), Potassium (K), Calcium (Ca), Iron(Fe) and Manganese (Mg) were measured by Atomic Absorption Spectroscopy Method (AAS). Results from analysis showed that the mixed juice rich in Na-4.20mg%, K-124.25mg%, Ca-0.46mg%, Fe-1.56mg% and Mg-0.02mg% respectively. Microbiological and sensory evaluations were done to examine suitability and acceptability of the juice. Microbiological analysis showed that the Total viable count 36 Yeast mold count: Nil and Total coli form count: Nil, respectively. Results obtained from overall analysis showed that the juice sample was suitable and highly acceptable for human consumption and can provide higher antioxidant (vitamin C) and important minerals and will be a sustainable health beneficial drink for human.

Keywords: Tamarind, *dillenia indica*, antioxidant, mineral

Executive Summary

This report is prepared on the basis of my two-month practical experience at the Institute of Food Science and Technology, BCSIR, Dhaka. This internship program helped me to learn about the practical scenario of a Formulation and Sensory Evaluation of Mixed Fruit Juice. Institute of Food Science and Technology IFST is the largest National Research and development (R&D) Organization which conducts Research and development activities in the field of Food Science and Technology .The R&D territory covers all types of products from plant and animal origin. This Institute plays an active role in transferring technologies developed by our Scientist to the commercial entrepreneurs of our country .The outcome of a research work is disseminated by means of seminars ,Lecture, Publication and leasing out technologies .In addition to generation of new technology ,IFST has been rendering technical assistants ,analytical and testing service to food industries in the country .It has been helping the fish export sector by extending testing and analytical support to sea off food industries on a regular basis . BCSIR is a dynamic and leading government organization countrywide. This report has been presented based on my observation and experience gathered from the company. The organization has many divisions and departments but I only got the opportunity to work in Processing and quality control department .The report mentions about the Beverage products qualities and processing knowledge.

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Chapter - 1

Introduction:

Tamarind is a leguminous tree in the family Fabaceae . The genus *Tamarindus* is a monotypic taxon, having only a single species. It is indigenous to Bangladesh, it is also cultivated in Europe. [1][2] **Tamarind (*Tamarindus indica*)** is a versatile fruit ,which can be used for many purpose. It has been also used for medicinal pourpose.[3]. It is found throughout most of the tropical regions[4] On the other hand Tamarind is the ripe fruit of the *Tamarindus indica* tree, which is used as a condiment ,or more precisely as an acidulant .Each and every part of Tamarind is beneficial for the human consumption. The sweetish acidity pulp of the fruit is a product of commercial importance .Tamarind preparation are universally recognized and laxatives [5]

tamarind plays an essential subsistence role in rural Bangladesh. This study highlights the importance of tamarind in traditional diets of rural communities in Bangladesh. Tamarind adds vitamins and minerals, as well as the traditionally appreciated sour taste, to drinks and meals. It is consumed daily and year-round by many rural Bangladesh. There are types of tamarinds that are sweeter than most. One in Thailand is known as 'Makham waan'. One distributed by the United States Department of Agriculture's Subtropical Horticulture Research Unit, Miami, is known as 'Manila Sweet'... It can be used in fruit preserving with or without acids and gelatinizes with sugar concentrates even in cold water or milk. It is recommended as a stabilizer in ice cream, mayonnaise and cheese and as an ingredient or agent in a number of pharmaceutical products. . The tamarind is best described as sweet and sour in taste, and is high in acid, sugar, B vitamins and, oddly for a fruit, calcium.:



Scientific classification of Tamarind: ^[6]

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Sub class	Roside
Superorder	Rosanae
Order	Fabales
Family	Fabaceae
Subfamily	Caesalpinioideae
Genus	Tamarindus L
Species	T indica
Tribe	Detarieae
Bionomial name	Tamarindus indica L,

Indian Synonyms of Tmarind:

Language	Region	Names
ASSAMESE	Assam	Teteli
BENGALI	Weast Bengal	Ambli, Tentul
GUJARATI	Gujarat	Ambili, Amlı
HINDI	Haryana , Delhi	Ambli ,Imli
KANNADA	Karnataka	Amla, Amlı, Gotu, Hunase
MALAYALAM	Kerala	Amlam, Madhurappuli, Puli
MARATHI	Maharashtra	Ambali,
ORIYA	Orissa	Kainya, koina
PUNJABI	Punjab	Imbli, Imlı
SANSKRIT	India	Amla, Amlı, Amlıka, Tintırı.
TAMAIL	Tamil Nadu	Ambılam, Tındırını, pulı
TELEGU	Andhra Pradesh	Chınta Sınnta

International synonyms of Tamarind:

Afrikaans: Tamarind

Arabic: Aradeib, Ardeib, Tamar el Hindi, Hhawmar, Humar, Tamar Hindi.

Chinese: Da ma lin, Luo huang Zi, Luo Wang Zi.

Danish: Tamarind

English: Indian date, sweet Tamarind, Tamarind

French: Tamar indien(Assam-India), Tamarin, Tamarinier ,Tamarinier des Indes

German : Indische Dattel, Sauerdattel, Tamarinde, Tamarindenbaum.

Greek: Tamarin

Indonesian: Asam jawa, Asam Kuning

Italian: Tamarandizio, Tamarindo, Tamarindo dolce.

Japanese: Tamarindo

Korean: Ta ma rin du

Nepalese: Amilli, Titrii

Pakistan: Imlii

Philippines: Sampaloc

Portuguese: Tamarindo(Brazil), Tamarindeiro, Tambarina ,

Russian : Finik indiiskii, Indiykiy finik, Tamarind , Tamarind indiiskii

Spanish: Tamarido, Tamarindo de la India

Srilanka: Sinhala

Swedish: Tamarind

Thai: Bakham somkham, Ma khaam, Ma kham wan

Tamarind fruits is used for seasoning, as a food component, to curries and sauces, and also flavour confections and it is a main component in juice and certain beverages. Tamarind fruit pulp is eaten fresh and often made in to juice and can also be processed into jam and sweets. It is used in Bangladesh as sweet drinks to mixe with sugar and honey .Sometimes the Tamarind pulp is also fermented in to an alcoholic beverage. On the other hand Tamarind seed is a by product of Tamarind pulp industries. The presence of tannins and other dyeing matter in product of Tamarind is the Tamarind kernel powder which used in the textile, paper, and jute industries. Tamarind seed is also the raw material used in the manufacture of polysaccharide and tannin. The nutrient and chemical composition of the Tamarind seeds may be adopted as an inexpensive alternative protein source to alleviate protein malnutrition among traditional people living in developing countries. Tamarind leaves and flower can be eaten as vegetable and variety dishes. They are used to make curries , salads and soups, in many countries . Tamarind is a source of carbohydrate, and it must be limited and factored into a well balanced diet. It is best eaten plain in small amounts or used as a condiment to spruce up the flavor of food and beverages. This food is an excellent source of vitamin B, vitamin C, potassium, magnesium, iron, thiamine, phosphorus, riboflavin, and fiber.^[7]

Tamarind juice is a convenient product, prepared by extracting cleaned pulp with boiling water using the counter current principle. ^[8] It contain rich in tartaric acid. ^[9]

The ripened fruit is considered the more palatable, as it becomes sweeter and less sour (acidic) as it matures. It is used in desserts as a jam, blended into juices or sweetened drinks, sorbets, ice creams and all manner of snacks ^[10] . It is also dried and used in place of ripe tamarind for mild flavor. it is added to fish curry masalas, with ground coconut for flavoring. Tamarind is known as *tamarinier* and is used in jams and syrups. hens, tamarind has been found to lower cholesterol in their serum, but not in the yolks of the eggs they laid.^[11]

Due to a lack of available human clinical trials, there is insufficient evidence to recommend tamarind for the treatment of hypercholesterolemia or diabetes.

Nutrition Value Of Tamarind

Nutritional Value Per 100 G(3.5 Oz)	
Energy	239 Kcal(1000 KJ)
Carbohydrate	62.5 G
Sugars	57.4g
Dietary Fiber	5.1g
Fat	0.6g
Protein	2.8g
Thiamine(Vit,B ₁)	0.428mg(37%)
Riboflavin(Vit,B ₂)	0.152mg(13%)
Niacin(Vit, B ₃)	1.938 Mg(13%)
Panthonic Acid(Vit,B ₅)	0.143 Mg(3%)
Vitamin B ₆	0.066 Mg(5%)
Folate(Vit ,B ₉)	14µg(4%)
Choline	8.6 Mg(2%)
Vitamin C	3.5 Mg(4%)
Vitamin E	0.1 Mg(1%)
Vitamin K	2.8 µg(3%)
Calcium	74 Mg(7%)
Iron	2.8 Mg (22%)
Magnesium	92 Mg(26%)
Phosphorus	113 Mg(16%)
Potassium	628 Mg (13%)
Sodium	28 Mg(2%)
Zinc	0.1 Mg (1%)

The Ripened Fruit Is Considered The More Palatable, As It Becomes Sweeter And Less Sour (Acidic) As It Matures. It Is Used In Desserts As A Jam, Blended Into Juices Or Sweetened Drinks, Sorbets, Ice Creams And All Manner Of Snacks. In Western Cuisine, It Is Found In Worcestershire Sauce And HP Sauce^[12].

In Karnataka, India, The Tamarind, Called *Hunasae Hannu*, Is Used In *Saaru* (Lentil Soup), *Sambhar* Or *Sambar* (Vegetable Soup), *Gojju* (Sauce), And Several Types Of Chutneys. 5

Chutney And *Pulusu* Use It. Along With Tamarind, Sugar And Spices Are Added To (Regional) Taste For Chutneys Or A Multitude Of Condiments For A Bitter-Sweet Flavor. Andhra Pradesh, Use It To Make *Rasam*, *Amtee*, *Sambhar*, *Vatha Kuzhambu*, And *Puliyogare*. In Andhra Pradesh And Tamil Nadu, Tender Leaves Of Tamarind Called *Chintha Chiguru* And *Puliyankozhunthu* , Respectively, Are Used With Lentils To Make Raw Chutney. It Is Also Dried And Used In Place Of Ripe Tamarind For Mild Flavor. In Southern Parts Of Kerala, Mostly Along The Coastal Belt, It Is Added To Fish Curry Masalas, With Ground Coconut For Flavoring. In Guadeloupe, Tamarind Is Known As *Tamarinier* And Is Used In Jams And Syrups. Hens, Tamarind Has Been Found To Lower Cholesterol In Their Serum, But Not In The Yolks Of The Eggs They Laid.^[13]

Due To A Lack Of Available Human Clinical Trials, There Is Insufficient Evidence To Recommend Tamarind For The Treatment Of Hypercholesterolemia Or Diabetes.

Dillenia Indica, Commonly Known As Elephant Apple And Locally Known As Outenga, Is The Handsome Ever Green Tree Grows In The Moist Forest Of Sub-Himalayan Region To Assam. The Fruit Grows In Abundance And Due To Lack Of Knowledge And Technical Knowledge; Most Of These Fruits Are Wasted. In Assam, Traditionally The Unripe Fruits Are Used To Make Curries Be Cause Of Its Sour Taste And Ripe Fruits Are Making Pickles. The Fruits Are Generally High In Fiber And Due To Presence Of Gummy Substances, Extraction Of Juice Becomes Difficult. The Plant Grows About 15 M Tall. Not Only The Fruits Have Medicinal Values But The Leaves And The Bark Also Showed Numerous Pharmacological Activity. The Studies Showed That The Plant Possesses Various Activities Like Antimicrobial, Antioxidant, Analgesic, Anti-Inflammatory, Dysentery, Anti-Diabetic Etc. The Fruits And The Juice Of The Plant Are Traditionally Used For The Treatment Of Various Diseases And One Of The Major Diseases Is Diabetes Mellitus. It Was Also Proved From The Review Of Literatures That This Plant Possesses Some Anti-Diabetic Properties (Sunil Kumar Et.Al). Thus In This Review We Gave Some Emphasis On The Traditional And Clinical Use Of *Dillenia Indica* (Outenga Or Elephant Apple) As An Anti-Diabetic Herb.^[14]

Dillenia Indica (Outenga Or Elephant Apple) Is The Common Fruit That Is An Integral Part Of

Grandma's Recipe, Which Has More To It Than Just Its Bitter Taste And Flavour. It Is Also A Favourable Dish Of Assamese Cuisine. The Jelly Like Pulp Of The Fruit Is Applied To Scalp For Curing Dandruff And Falling Hairs. The Sepals Are Traditionally Used For Stomach Disorder. The *D. Indica* Is An Evergreen Large Shrub Or Small To Medium-Sized Semi Deciduous, Branches Spreading Tree Growing To 15 M Tall. Leaves Are Fascicled At The End Of The Branches, Oblong-Lanceolate, Acuminate, 20-30 Cm Long And Sharply Serrate¹. Flowers Are White, Large, Up To 15 Cm Diameter, Solitary, Towards The End Of Each Branch. The Fruit Are Large With 7.5-10 Cm Diameter. In The Present Review An Attempt Was Made To Focus *D. Indica* For It's As Anti-Diabetic Use. Allopathic Medicines Used For Treatment Of Diabetes Have Side-Effects In The Long Run. So It Is Better To Use Indigenous Traditional Knowledge System To Treat Diabetes .^[15] .



Scientific Classification:

Kingdom: Plantae-Plants

Subkingdom: Tracheobionta-Vascular Plants

Superdivision: Spermatophyta-Seed Plants

Division: Magnoliophyta-Flowering Plants

Class: Magnoliopsida-Dicotyledons

Subclass: Dilleniidae

Order: Dilleniales

Family: Dilleniaceae–Dillenia Family

Genus: Dillenia.-Dillenia

Species: Dillenia Indica-Chulta ^[16].

Other Name:

English: Elephant Apple ,Indian Catmon, Hondapara Tree, Ma –Tad

Hindi: Chalta, Karambel

Sanskrit: Avartaki

Assamese: Outenga

Bengali: Chalta, Chalita ^[17]

The Gelatinous Pulp Surrounding The Sepals Inside An Elephant Apple Is Generally Pleasant, But Acidic. The Fruit Is Seldom Consumed Raw, But Those Who Choose To Eat It Typically Add Sugar To Improve The Taste. At Its Best, Taste Resembles Unripe Apples; At Worst, It's Mealy And Possesses An Odor Offensive To Some.

Nutritional Value Of Elephant Apple

According To The Book, “The Encyclopedia Of Fruit And Nuts,” The Nutritional Value Per 100g Of Edible Elephant Apple Flesh Is:

Energy	59kcal
Protein	.8%
Fat	.2-2.5%
Fiber	2.1-2.5%
Ash	3.54%
Calcium	16mg
Phosphorous	26mg

Ascorbic Acid 4mg



Objectives of the research:

- The objective of this work was to formulate and test the acceptability of a natural passion fruit beverage using a mixture of chalta and tamarind in 1:2 ratio respectively.
- To provide higher antioxidants and anti-cholesterol components and will be a sustainable beneficial drink for human.
- To develop a value added product for the local available raw materials and to improve the financial status of farmers in Bangladesh.
- This study highlights the importance of tamarind in traditional diets of rural communities in Bangladesh.

1.1 Origin of the report

Internship Program of daffodil International University is a Graduation requirement for the NFE students. This study is a partial requirement of the Internship program of NFE curriculum at the Daffodil International University. The main purpose of internship is to get the student

the job world. Being an intern the main challenge was to translate the theoretical concepts into real life experience.

The internship program and the study have following purposes:

- To have an idea of activities of the IFST, BCSIR
- To view the processing of Fruits and Vegetable in the plant
- To know the factories of milk union;
- To identify different problem Beverage product
- To compare the real scenario with the lessons learned in DIU University
- To fulfill the requirement of NFE Program.

This report is the result of two months long internship program conducted in Institute of Food Science and Technology and is prepared as a requirement for the completion of the NFE program of Daffodil International University. As a result I need to submit this report based on the “Formulation and Sensory Evaluation of Mixed Fruit Juice of Chalta and Tamarind at Institute of Food Science and Technology”. This report also includes information on the products and services of Bangladesh.

1.2 Objective of the report

The objective of the report can be viewed in two forms:

- General Objective
- Specific Objective

General Objective:

This internship report is prepared primarily to fulfill the Bachelor of Nutrition and Food Engineering (NFE) degree requirement under the Faculty of Allied Health Science in daffodil International University.

Specific Objective:

More specifically, this study entails the following aspects:

- To give an overview of Institute of Food Science and Technology IFST, BCSIR, Dhaka.

- To focus on the beverage product quality, Institute of Food Science and Technology IFST(BCSIR).
- To discuss the Standards of Juice composition and Juice quality of IFST, BCSIR, Dhaka.

1.3 Scope of the study

The main intention of this study is the Juice compositional standard and quality and processing of Juice products carried by the IFST, BCSIR, Dhaka.

The report covers details about the product quality and processing overview and also. However the study is only related to the quality control department (Laboratory) and production division as I was provided an opportunity to only work in this area.

Sources of data

Primary Sources:

Primary Data was derived from the practical deskwork. Moreover, the survey also helped me to get information directly from the employees of IFST in BCSIR.

Secondary Sources:

- ❖ Internal sources- Different documents provided by concerned officers and different circulars, manuals and files of the organization.
- ❖ External source- Different websites related to the beverage and online resources.

Collection of Data:

Conducting a survey of thirty employees helped me to collect primary data. The questionnaire is applied on the staff and employee. The survey helped me in both deriving the information and also explaining the condition of Juice quality both raw and processed of the beverage products of the concerned division. Secondary data was collected from BCSIR websites and other related websites and documents.

Chapter-2

Overview of the BCSIR Organization

2.1 Historical background of Bangladesh Scientific & Industrial Research

BCSIR Laboratories, Dhaka was established in 1955 bearing the name of East Regional Laboratories under the erstwhile PCSIR as a multidisciplinary research establishment. It has seven research divisions viz. Chemical, Biological, Fibre and Polymer, Pulp and Paper, Analytical, Industrial Physics and Physical Instrument. Current areas and major fields of research and development activities of the laboratories are-(a) Analytical chemistry, (b) Tissue culture, (c) Biotechnology, (d) Pulp and paper, (e) Fibre and polymer chemistry, (f) Arsenic Mitigation, (g) Aromatic and medicinal plants, (h) Industrial physics, (I) Physical instrument, (j) Production of chemical and allied products and so on. Scientists of these divisions are engaged in research and development activities with the aim and objective to develop Technology and to achieve self reliance in Industrial development. In addition to R&D activities the scientists are also engaged in improving analytical and testing service to various GO & NGO bodies, entrepreneurs and individuals. Recently the BCSIR Laboratories, Dhaka has been entrusted with the responsibility of verification of Arsenic removal technology. Recently analytical research division has been renovated and strengthened with the financial assistance of Bangladesh Arsenic Mitigation and Water supply project (BAMWSP) of DPHE.

2.2 Objective of the Institution

Institute of Food Science and Technology, BCSIR, started its operation for the poverty alleviation and to enhance the beverage production in the country. Other hand to provide the city dwellers with a regular supply of fresh and hygienic beverage & beverage

reasonable price. The aim and objective of the council were first formulated during the establishment of the council in 1973, which was rewritten in 1978 during the promulgation of the Ordinance No. V of 1978 and states as follows.

- ✓ To initiate , promote and guide scientific industrial and technological research having bearing on problem connected with the establishment and development of industries and such other allied matters as the Government may refer to it
- ✓ To established maintain and develop laboratories workshops, institutes , centers and organization for furtherance of scientific and industrial research with the object of utilizing and exploiting the natural resources of the country in the best possible manner
- ✓ To give grants-in aid for scientific, industrial and technological research schemes and project of the universities established by law and other institute.
- ✓ To adopt measures for the commercial utilization of the discoveries and invention resulting from the research carried out by the council, universities or by any other research organization.
- ✓ To maintain contact with scientific, industrial and technological research organization of other countries .
- ✓ To take out patents and make arrangement for the industrial utilization of the research processes developed in the institute and laboratories s established by the council
- ✓ To established libraries ,museum, experimental plantation and herbaria as the board may consider appropriate
- ✓ To do such other act and thing as may be necessary for carrying out the purpose of the Ordinance
- ✓ To established and award fellows in areas of research covered by the council
- ✓ To collect and disseminate information of scientific papers, reports and periodicals on such matters.
- ✓ To encourage establishment of industrial research organization.
- ✓ Improved household nutrition and increased purchasing power.
- ✓ Increased Juice yield and productivity of the plant.
- ✓ Community empowerment to the poor through direct participation in organized co-operatives.

- ✓ Management skill developed through accountability of the IFST board members taken from Juice producers.
- ✓ Increased quantity and quality of safe beverage and beverage products affordable for consumers which enhanced health awareness.
- ✓ Off farm employment generation created.

BCSIR R&D Overview :

The glorious journey of Bangladesh Council of Scientific & Industrial Research (BCSIR) 1st largest R&D organization in the country was commenced in the year of 1995 as the multidisciplinary research unit named as East Regional Laboratories of PCSIR. Since its inception it is marching forward performing brilliant R&D activities. Now in this 21 st Century it has expanded its domain to nine research laboratories ,institute and centre and different field of science and technology ,comprising 48 research division to meet up the demand of time . Now a day's R&D is of great importance and plays a vital role in the economic development of the country – keeping this view in mind a total of about 425 skilled and dedicated scientist and engineers of the council are actively performing R&D project to make a significant contribution of both the national and international levels.

CHAPTER-3

Design of the study

3.1 Short description of the study

The experiment was carried out at the Fruit Technology Research Section under the Institute of Food Science and Technology (IFST) , Bangladesh Council of Scientific and Industrial Research (BCSIR),Dr.Kudrat-I-Khuda Road , Dhanmondi, Dhaka- 1205.

Laboratory- A laboratory is essential to enable the management of the plant to guarantee products of approved quality. The following test is routinely performed by the plant laboratory and accurate control over all the plant operational Tests:

- I. Organoleptic test: The plant provides one or more graders to examine Fruits, Vegetable and beverage products for odor and appearance.
- II. Biochemical test
 - Total sugar
 - Titratable acidity
 - Reducing sugar
 - Vitamin C
 - Mineral
 - Brix
 - pH
 - Ash.
- III. Microbiology test :
 - Total plate count
 - Detection of Pathogenic Bacteria count
 - Detection of Yeast ,Mold count.

3.2. Raw fruits collection

Raw fruits were collected from the Kaoran bazar (Tamarind, Dillenia indica).

3.2.1. Washing the raw fruits

Raw fruits were washed under tap water.

3.2.2. Peeling the raw fruits

The fruits were sliced by using SS (Stainless steel) knife and chopping board .

3.3. Preparation of mixed juice

3.3.1 .Equipment for juice production

Equipment for processing of Fruits Products

- pH meter
- Refractometer
- Digital Balance
- Ordinary Balance
- Stainless Steel Tank
- Funnel
- Stainless Steel Table
- Stainless Steel Spoon
- Wood Paddle
- Thermometer
- Homogenizer
- Filter

Table-2 List of Equipment Necessary for Product Development

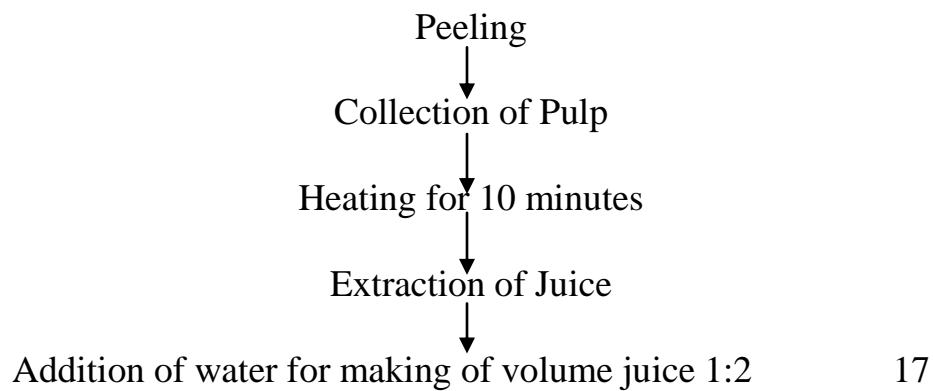
3.3.2. *Ingredients*

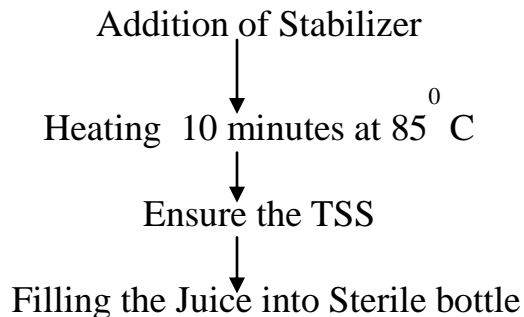
- (1) Tamarind juice= 1 litre
- (2)Chalta juice=1litre
- (3)Xenthen gam=5gm
- (4)Sodium Benjoid =5 gm
- (5)Sugar=2 kg
- (6)Salt=5gm

The fruits slices were boiled with 4-5liters of water for one hour. The juice were extracted by using a commercial blender .The juice were mixed with the following ingredients such as xanthenes gum 0.2%,NaCl 2%,sugar 15%,citric acid 0.3%,preservative 0.1%,fruit pulp 20%, diluted with water 1:3 and mixed thoroughly. The mixed juice were boiled at 85-90⁰C for 1 hour and cooled at 60

3.3.3. **Manufacturing Procedure**

Follow Diagram for the production of Juices





3.3.4. Filling the mixed juice

The mixed juice immediately filled into sterile glass bottle and sealed by using a food grade cap. The product was labeled as per BSTI standard.

Production area: Production area is the part of plant in where raw Juice processed or pasteurized to provide quality products consumer. Here production area is divided into two section such as Biochemical section and Microbiological section.

Biochemical section:

Biochemical section is part within production area and Juice also a type of Beverage products. In Biochemical section, 30 to 40 workers and 10 stuffs are involved in this section during Juice production. Juice is produced several times a week.

3.4. SAMPLING PROCEDURE (Juice)

3.4.1. Apparatus & Sampling Equipment Treatment

There are Many kinds of experimental techniques, were employed throughout the analytical research work. They are as follows:

1.AAS (Thermo-scientific Ice 3000 series Atomic Absorption Spectrometer) Flame photometer, AAS (Thermo-scientific Ice 3000 series Atomic Absorption Spectrometer) is used to determine minerals.

2.Oven

3.Muffle Furnace Muffle Furnace of type Gallen kamp, Model-S90 NC/NA was used for the determination of minerals present in ash and the fiber ash.

4. pH meter pH meter of type HI 98106 by HANNA was used for the determination of pH.

5. Hand Refractometer Hand Refractometer of type ATAGO, MODEL-9099; 0-90% was used for the determination of total soluble solids (TSS) or Brix.

6.Moisture analyzer

Chemicals (Analytical grade quality) and distilled deionized water were used in the analysis.

Treatment:

- a) The sampling equipment for chemical purposes should be dry and clean
- b) Sampling equipment has to be clean and sterilization is required for microbiological testing. Disposable plastic equipment also needs to be sterile.
- a) Exposure to hot air at 170-75 °C for not less than 2 hours.
- b) Exposure to steam at 121 ± 1 °C for not less than 20 minutes in an autoclave.:

Chemical, Solvents And Ingredients:

Chemical and solvent used in the study were at AR grade, and water was distilled, deionized. Other chemicals e.g NaOH, conc.HCl, H₂SO₄, 5% Meta phosphoric acid and 2,6 Dichlorophenol indophenols , Fehling solution 1,2 etc. were used from BCSIR laboratory store. 19

3.4.2. Procedure: Biochemical Analysis

3.4.2.1. Determination of pH:

Principle: The pH means the negative logarithm of hydrogen ion concentration in a solution. The pH of the selected samples was determined by the conventional procedure by a pH meter (Ibrahim, 2002).

Materials: A pH meter (Hanna instruments-ORPP), salinity-sodium tester, ISO-9001 certified company; Woonsocket, RI 02895), the supplied pH 4.0 buffer solution, distilled water and 50 ml beakers.

Using standard buffer solution of pH 4.0 for calibration: The pH buffer solution was used to calibrate the pH meter.

Procedure: The electrode assembled of the pH meter was dipped into the standard buffer solution of pH 4.0 taken in a clean and dry beaker. The fine asymmetry potential knob was adjusted to pH 4.0. The electrode assembled pH meter was dipped into the selected fruit and vegetables samples; the pH was then readout washed twice with distilled water. Again it was dipped into another sample to determine the pH. The pH of all samples was determined by the procedure.

3.4.2.2. Determination of ° Brix or TSS:

Standard processes are followed for determination of TSS (Gofur *et al.*, 1998). The Brix is defined as a unit of measurement of Total soluble solids (TSS) present in any sugary solution either prepared or in natural state such as fruit juices, vegetable pest, pulp etc. It is the measurement of the refractive indices of the said substances at 20°C. The Brix of all the tropical fruit samples was determined by a hand refractometer ranges from (0⁰ to 99⁰ ATAGO 9099, Japan).

3.4.2.3. Determination of Vitamin C (Ascorbic acid) content:

Principle:

Ascorbic acid was determined by using the official method of analysis (AOAC, 1984).

Reagents:

Reagents used to determine Ascorbic acid content were:

- a. Metaphosphoric acid solution (3%) in H₂O.
- b. Standard ascorbic acid solution: 100mg was taken in 100ml of 3% metaphosphoric acid (H₃PO₃) and then diluted to 0.1mg/ml (dilute 10ml of 1mg/ml to 100ml) with 3% H₃PO₃ immediately before use.
- c. Dye solution: 50mg of 2, 6 dichlorophenol indophenols was dissolved in hot water and then added 42mg of NAHCO₃. The solution was cooled after dissolving the bicarbonate and then diluted to 200ml with water. It was stored in a refrigerator and standardized every day before use.

Standardization of Dye:

- a. Take 5ml std. ascorbic acid solution or 1ml std. ascorbic acid solution.
- b. Add 5ml of metaphosphoric acid.
- c. Titrate the solution to a pink colour which should persist 15 seconds.

$$\text{Dye factor} = \frac{\text{ml of std. ascorbic acid taken} \times \text{concentration}}{\text{ml of dye consumed}}$$

Procedure:

5 mg of sample was taken and transferred to a 100ml volumetric flask and the volume was made up to mark with metaphosphoric acid. Then it was filtered with whatmanpaper 40. 10ml of metaphosphoric acid extracted sample was taken in an aliquot and titrated with

solution, using phenolphthalein as indicator to a pink coloured end point which persist at least for 15 seconds.

Calculation:

$$\text{Ascorbic acid content (\%)} = \frac{T \times D \times V1}{V2 \times W} \times 100$$

Where,

T = Titration reading

D = Dye factor

V1 = Volume made up

V2 = Volume of extract taken for estimation

W = weight of sample.

3.4.2.4. Determination of Total Sugar:

Method: Lane and Eyanon method 1, 2.

Invert sugar reduces the copper solution of red, insoluble, cuprous oxide. The sugar content in a food sample is estimated by determining the volume of the unknown sugar solution required to completely reduce a measured volume of Fehling's solution.

Reagents:

1. Fehling solution (A): 69.29gm to copper sulphite ($\text{CuSO}_4 \cdot 2\text{H}_2\text{O}$) was dissolved in water dilute to 1000 mL if necessary filter through No.40 whatman paper.
2. Fehling solution (B): 346 of Rochelle salt (Potassium sodium tartarate, $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$) was dissolved and 100gm NaOH in water and made up to 1000 mL. 22
3. Methylene blue indicator: 1mg of methylene blue was dissolved in 100 mL of water.

4. 45% Neutral lead acetate solution: 225gm of neutral lead acetate was dissolved in water and dilute to 500 mL.

5. 22% Potassium oxalate solution: An amount of 110gm Potassium oxalate ($K_2C_2O_4 \cdot H_2O$) was dissolved in water and diluted to 500 mL. An excess of lead acetate in the sugar solution will result in an error in the filtration. The exact amount of $K_2C_2O_4$ necessary to precipitate the lead from the lead acetate solution was determined. To obtain this value, 2 mL aliquots of the lead acetate solution was pipetted into each of 6 mL, 50 mL beaker containing 25 mL water. In the beaker 1.6, 1.7, 1.8, 1.9, 2.0 and 2.1 mL of $K_2C_2O_4$ solution was added respectively. Each solution was collected in a 50 mL conical flask. To each of the filtrates, add a few drops of $K_2C_2O_2$ solution were added. The correct amount of potassium oxalate required is the smallest amount which, when added to 2 mL of lead acetate solution, gave a negative test for lead in the filtrate. In the presence of lead, the filtrate gave white precipitate with HCl or yellow precipitate with potassium chromate solution. The equivalent volume was marked on the bottle and was used then the solution was required in sugar determination.

6. Standard invert sugar solution: An accurately weighed amount of 9.5gm of AR sucrose was taken into a 1 liter volumetric flask. 100 mL water and 5 mL concentrate HCl was added and allowed to stand for 3 days at 20-25⁰C or 7days at 15⁰C for inversion to take place and then made up to mark with water. This solution was stable for several months.

Procedure: An amount of 25 mL of the standard invert solution was pipette into a 100 mL volumetric flask and about 50 mL of water was added. A few drops of phenolphthalein indicator was added and neutralized with 20% NaOH until the solution turned pink. Then acidity with 1N HCl was added drop wise until one drop caused the pink to mark with water (1 mL = 25mg of invert sugar)

Standardization of the Fehling solution: An equal quantity of fehling's solution (50 mL of A and 50 mL of B) was mixed and pipettes accurately out 10 mL of the mixed solution into a 250 mL conical flask and 25 to 50 mL of water was added.

The standard invert sugar solution prepared by inversion of sucrose was taken in a 50 mL burette. Into the mixed fehling's solution almost the whole of the standard invert sugar solution (18 to 19) required to effect the reduction of all the copper, so that not more than 1 mL will be required later to complete the titration.

The flask containing the cold mixture was heated over a hot plate or burner conversed with asbestos filled wire gauge. When the liquid was removed from the flame, 3 drops of methylene blue indicator solution was added and completed the titration, so that the reduction mixture was boiled altogether for 3 minutes without interruption. The end point was indicated by the depolarization of the sugar solution required for the completely reducing 10 mL of fehling solution. The equivalent volume was 20.37 ± 0.03 mL (A small deviation from the individual procedure or composition of the reagents). When the variation was too wide, the concentration of the fehling's solution was adjusted such that the equivalent volume of neutralize sugar solution for 10 mL of fehling solution was 20.37 ± 0.05 mL.

Preparation of the sample: An amount of 2 mL of sample juice was weighed and transferred to 100 mL volumetric flask and to it 50 mL water was added and neutralized with 1n NaOH, 2 mL of lead acetate solution was added, shake and allowed it to stand for 10minutes. Necessary amount of $K_2C_2O_4$ solution was added to remove the excess of lead. The volume was made up to the mark with water and was filtered the solution by using filter paper (what man NO-4)

Total sugar: An amount of 50 ml of the clarified solution was pipette into a 100 ml conical flask and to it 2gm of citric acid was added and was boiled gently for 10 minutes to complete the inversion of sucrose and was cooled and transferred to a 100 ml volumetric flask. The solution was neutralized with 1n NaOH using phenolphthalein as indicator. For inversion at room temperature ($20^{\circ}C$ or above) for 24 hours and then neutralized with concentrated NaOH solution and volume was made up to 100 ml.

Calculation:

$$\% \text{ of reducing sugar} = \frac{\text{mg of invert sugar} \times \text{dilution} \times 100}{\text{titrate} \times \text{wight or volume of sample} \times 100}$$

$$\% \text{ of total sugar} = \frac{\text{mg of total sugar (after invasion)} \times \text{dilution} \times 100}{\text{titrate} \times \text{weight or volume of sample} \times 100}$$

The pedant non reducing sugar was obtained by the subtraction the percent reducing sugar from the percent total sugar.

3.4.2.5. Determination of Titratable acidity:

Titratable acidity is determined by recommended process (Ranganna S, 1986).

Reagents:

- i) NaOH solution 0.1 N (4g NaOH in one liter distilled water)
- ii) Phenolphthalein indicator with 1% solution in ethanol (acid sample neutralizes NaOH and showed faint pink color at the end point).

Titratable acidity may be expressed as the amount of free acid (mainly as citric acid) in the product (gm/100gm, gm/100 mL, or gm/liter).

Equipments:

- i. Automatic burette reservoir
- ii. 10 mL pipette
- iii. pH
- iv. 250 mL Erlenmeyer flask.
- v. Analytical balance
- vi. 50 mL beaker
- vii. 50 mL volumetric flask.

Procedure: In a 50 mL beaker, 2-4 g or mL pulp or juice was taken and diluted with distilled water up to the mark of 50 mL of volumetric flask. Then the samples

Erlenmeyer flask and 0.1N NaOH drop wise added to the burette until the desired end point faint where pink color was observed. The same procedure was followed in case of all samples.

Calculation:

$$\text{Acidity g\%} = \frac{\text{titre value} \times 0.1 \times 64 \times 100}{\text{Sample volume} \times 1000}$$

3.4.2.6. Determination of Reducing Sugar:

Method: Lane and Eyanon method 1, 2.

Invert sugar reduces the copper solution of red, insoluble, cuprous oxide. The sugar content in a food sample is estimated by determining the volume of the unknown sugar solution required to completely reduce a measured volume of Fehling's solution.

Reagents:

1. Fehling solution (A): 69.29gm to copper sulphite ($\text{CuSO}_4 \cdot 2\text{H}_2\text{O}$) was dissolved in water dilute to 1000 mL if necessary filter through No.40 whatman paper.
2. Fehling solution (B): 346 of Rochelle salt (Potassium sodium tartarate, $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$) was dissolved and 100gm NaOH in water and made up to 1000 mL.
3. Methylene blue indicator: 1mg of methylene blue was dissolved in 100 mL of water.
5. 22% Potassium oxalate solution: An amount of 110gm Potassium oxalate ($\text{K}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$) was dissolved in water and diluted to 500 mL. An excess of lead acetate in the sugar solution will result in an error in the filtration. The exact amount of $\text{K}_2\text{C}_2\text{O}_4$ necessary to precipitate the lead form the lead acetate solution was determined. To obtain this value, 2 mL

acetate solution was pipetted into each of 6 mL, 50 mL beaker containing 25 mL water. In the beaker 1.6, 1.7, 1.8, 1.9, 2.0 and 2.1 mL of $K_2C_2O_4$ solution was added respectively. Each solution was collected in a 50 mL conical flask. To each of the filtrates, add a few drops of $K_2C_2O_2$ solution were added. The correct amount of potassium oxalate required is the smallest amount which, when added to 2 mL of lead acetate solution, gave a negative test for lead in the filtrate. In the presence of lead, the filtrate gave white precipitate with HCl or yellow precipitate with potassium chromate solution. The equivalent volume was marked on the bottle and was used then the solution was required in sugar determination.

6. Standard invert sugar solution: An accurately weighed amount of 9.5gm of AR sucrose was taken into a 1 liter volumetric flask. 100 mL water and 5 mL concentrate HCl was added and allowed to stand for 3 days at 20-25⁰C or 7days at 15⁰C for inversion to take place and then made up to mark with water. This solution was stable for several months.

Procedure: An amount of 25 mL of the standard invert solution was pipette into a 100 mL volumetric flask and about 50 mL of water was added. A few drops of phenolphthalein indicator was added and neutralized with 20% NaOH until the solution turned pink. Then acidity with 1N HCl was added drop wise until one drop caused the pink to mark with water (1 mL = 25mg of invert sugar)

Standardization of the Fehling solution: An equal quantity of fehling's solution (50 mL of A and 50 mL of B) was mixed and pipettes accurately out 10 mL of the mixed solution into a 250 mL conical flask and 25 to 50 mL of water was added.

The standard invert sugar solution prepared by inversion of sucrose was taken in a 50 mL burette. Into the mixed fehling's solution almost the whole of the standard invert sugar solution (18 to 19) required to effect the reduction of all the copper, so that not more than 1 mL will be required later to complete the titration.

The flask containing the cold mixture was heated over a hot plate or burner conversed with asbestos filled wire gauge. When the liquid was removed from the flame, 3 drops of methylene blue indicator solution was added and completed the titration, so that the reduction mixture was boiled altogether for 3 minutes without interruption. The end point was indicated

depolarization of the sugar solution required for the completely reducing 10 mL of fehling solution. The equivalent volume was 20.37 ± 0.03 mL (A small deviation from the individual procedure or composition of the reagents). When the variation was too wide, the concentration of the fehling's solution was adjusted such that the equivalent volume of neutralize sugar solution for 10 mL of fehling solution was 20.37 ± 0.05 mL.

Preparation of the sample: An amount of 2 mL of sample juice was weighed and transferred to 100 mL volumetric flask and to it 50 mL water was added and neutralized with 1N NaOH, 2 mL of lead acetate solution was added, shake and allowed it to stand for 10minutes. Necessary amount of $K_2C_2O_4$ solution was added to remove the excess of lead. The volume was made up to the mark with water and was filtered the solution by using filter paper (what man NO-4)

Reducing sugar: An amount of 50 ml of the clarified solution was pipette into a 100 ml conical flask and to it 2gm of citric acid was added and was boiled gently for 10 minutes to complete the inversion of sucrose and was cooled and transferred to a 100 ml volumetric flask. The solution in NaOH using phenolphthalein as indicator. For inversion at room temperature ($20^{\circ}C$ or above) for 24 hours and then neutralized with concentrated NaOH solution and volume was made up to 100 ml.

Calculation:

$$\% \text{ of reducing sugar} = \frac{\text{mg of invert sugar} \times \text{dilution} \times 100}{\text{titrate} \times \text{wight or volume of sample} \times 100}$$

The reducing sugar was obtained by the subtraction the percent reducing sugar from the percent total sugar.

3.4.2.7. Determination of Total Mineral (Ashing):

Principle: The ash content is determined by ignition of a known weight of the food at 600°C until all carbon has been removed. The residue is the ash and is taken to represent the inorganic constituents of the food (AOAC, 1995).

Apparatus: Porcelain crucible, Analytical balance, Desiccators, Muffle furnace.

Procedure: 1.5-2.0gm sample was taken in a crucible. The crucible was placed on a burner and heated first over a low flame till all the material charred. Then the crucible was put in a Muffle furnace for about 3-5 hours at about 600°C. Crucible was then cooled in desiccators and weighed. To assure the completion of ashing, the crucible was again heated in Muffle furnace for 0.5 hour and weighed. This procedure was repeated until two consecutive weights were same and the ash was almost white/ grayish in color.

Calculation:

$$\% \text{ of Ash} = \frac{\text{weight of ash}}{\text{weight of sample taken}} \times 100$$

3.4.2.8. Sample Solution Preparation For Determination Of Mineral

Solution preparation of samples for determination of minerals

After being accurately weighed, the sample was put in the oven to dry at 80⁰ C temperature for overnight and then the sample was heated in the muffle furnace to ash at 600⁰ C temperature for 6 hours. When the ash appears white then the ash was put in desiccator. After the ash was weighed to determine the percentage of ash. During the analysis of minerals extensive caution was taken to avoid contamination of glassware, reagents and other materials. Distilled deionized water was used for the analysis of minerals through the conventional procedure. The ash was taken in a beaker and 40-50 mL of concentrated HCl was added gently with the help of pipette. The solution was stirred with a glass rod. Then solution was heated on the burner. When all the ash was dissolved in HCl acid then the beaker was taken away from the burner.

The acid solution was filtered in a 100 ml volumetric flask using whatman no. 40 filter paper. Then the volumetric flask was filled with distilled water up to the mark. This stock solution was used for mineral analysis. All glassware was dipped in 2% nitric acid solution overnight followed by washing with deionized water and finally dried.

Atomic Absorption Spectrometry Method:

All the minerals and heavy metals except Arsenic (As) and Mercury (Hg) are estimated by Flame Atomic Absorption Spectrometric method (Thermo-scientific Ice 3000 series Atomic Absorption Spectrometer), here Air-acetylene or nitrous oxide-acetylene gas is used. AOAC method is followed for AAS.

Method (for all minerals and heavy metals except As and Hg): Flame Atomic Absorption Spectrometric

Machine: AAS (Thermo-scientific Ice 3000 series Atomic Absorption Spectrometer)

Procedure: Ash a suitable quantity of sample. Moisten with water and carefully add 10ml diluted hydrochloric acid (1+1). Evaporate to dryness on a water bath and continue the heating for a further hour. Cool, add 20ml water and 10ml of the diluted hydrochloric acid, boil and filter into a 250ml volumetric flask. Wash through with hot water. Then cool and make up to volume (C). Set up the atomic absorption spectrophotometer with a hollow cathode lamp using the light at 472nm and a fuel rich flame (air-acetylene or nitrous oxide-acetylene). To a suitable volume of C add releasing agent and water to produce a standard volume of solution to contain 5-10microgram Ca per ml and 10percent of releasing agent. Also prepare a similar blank solution, but omitting C. Spray water into the flame and zero the instrument. Spray successively the standard solutions, sample and blank, washing the instrument through with water between each spraying. Plot the mean of 3 reading for each std. solution against the calcium content. Assess the calcium content (allowing for that of the

blank) of the sample from the std. curve. Sodium equivalent to that in the sample solution should be added to the calcium standard (Kirk and Sawyer, 1991).

Hydride Generation Atomic Absorption Spectrometry Method: For determination of Arsenic (As).

Method: Hydride Generation Atomic Absorption Spectrometric

Machine: AAS (Thermo-scientific Ice 3000 series Atomic Absorption Spectrometer)

Procedure: Ash a suitable quantity of sample. Moisten with water and carefully add 10ml diluted hydrochloric acid (1+1). Evaporate to dryness on a water bath and continue the heating for a further hour. Cool, add 20ml water and 10ml of the diluted hydrochloric acid, boil and filter into a 250ml volumetric flask. Wash through with hot water. Then cool and make up to volume (C). Set up the atomic absorption spectrophotometer with a hollow cathode lamp using the light at 472nm and a fuel rich flame (air-acetylene or nitrous oxide-acetylene). To a suitable volume of C add releasing agent and water to produce a standard volume of solution to contain 5-10microgram Ca per ml and 10percent of releasing agent. Also prepare a similar blank solution, but omitting C. Spray water into the flame and zero the instrument. Spray successively the standard solutions, sample and blank, washing the instrument through with water between each spraying. Plot the mean of 3 reading for each std. solution against the calcium content. Assess the calcium content(allowing for that of the blank) of the sample from the std. curve. Sodium equivalent to that in the sample solution should be added to the calcium standard (Kirk and Sawyer, 1991).

Atomic Absorption Spectrometry Method (Without flame): For determination of Mercury (Hg).

Method: Atomic Absorption Spectrometry method (without flame)

Machine: AAS (Thermo-scientific Ice 3000 series Atomic Absorption Spectrometer)

Procedure: Ash a suitable quantity of sample. Moisten with water and carefully add 10ml diluted hydrochloric acid (1+1). Evaporate to dryness on a water bath and continue the heating for a further hour. Cool, add 20ml water and 10ml of the diluted hydrochloric acid, boil and filter into a 250ml volumetric flask. Wash through with hot water. Then cool and make up to volume (C). Set up the atomic absorption spectrophotometer with a hollow cathode lamp

at 472nm and a fuel rich flame (air-acetylene or nitrous oxide-acetylene). To a suitable volume of C add releasing agent and water to produce a standard volume of solution to contain 5-10microgram Ca per ml and 10percent of releasing agent. Also prepare a similar blank solution, but omitting C. Spry water into the flame and zero the instrument. Spray successively the standard solutions, sample and blank, washing the instrument through with water between each spraying. Plot the mean of 3 reading for each std. solution against the calcium content. Assess the calcium content(allowing for that of the blank) of the sample from the std. curve. Sodium equivalent to that in the sample solution should be added to the calcium standard (Kirk and Sawyer, 1991)

3.5. Microbiological analysis PCA (plate count agar) media were used for TPC (Total plate count).The plates were incubated at 37⁰C for 48 hours. Similarly for the determination of yeast and mold, PDA(Potato dextrose agar) were used and the plates were incubated at 25⁰Cfor 72 hours.

3.5.1 TPC (Total Plate Count): To detect Total Plate Count PCA agar media was used .The plates were incubated at 37⁰c for 48 hours. The total bacterial count was made by adding 1 ml of juice sample into sterile test tube having 9 ml distilled water . After thoroughly mixing the sample was serially diluted up to 1:10. Then I ml sample taken in a sterile petri dish and 15-20 ml plate count agar media were poured figure 2.9. After thoroughly mixing , the plated sample was allowed to solidity and then incubated at 37⁰C for 24 hours . Finally colony counts were made using colony counter. ^[18]



Plate 3.5.1 Total plate Count Analysis in TPC media

3.5.2. Pathogenic bacteria analysis

To detect pathogenic organisms MacConkey agar media was used. The plates were incubated at 37°C for 48 hours.

Coliform Count :

The Coliform count was made by adding 1 ml of juice sample into sterile test tube having 9 ml distilled water. After thoroughly mixing the sample was serially diluted up to 1:10. Then 1 ml sample taken in a sterile petri dish and 15-20 ml plate count agar media were poured figure 2.9. After thoroughly mixing, the plated sample was allowed to solidify and then incubated at 37°C for 24 hours. Finally colony counts were made using colony counter. ^[10]

Salmonella and Shigella Count:

The *Salmonella* and *Shigella* count was made by adding 1 ml of juice sample into sterile test tube having 9 ml distilled water. After thoroughly mixing the sample was serially diluted up to 1:10. Then 1 ml sample taken in a sterile petri dish and 15-20 ml plate count agar media were poured figure 2.9. After thoroughly mixing, the plated sample was allowed to solidify and then incubated at 37°C for 24 hours. Finally colony counts were made using colony counter. ^[19]



Plate 3.5.2 Pathogenic Bacteria Count in Macconky Agar

3.5.3. Yeast Mold count To detect Yeast Molds organisms PDA agar media was used .The plates were incubated at 25⁰c for 24 hours. The Yeast Molds count was made by adding 1 ml of juice sample into sterile test tube having 9 ml distilled water . After thoroughly mixing the sample was serially diluted up to 1:10. Then 1 ml sample taken in a sterile petri dish and 15-20 ml plate count agar media were poured figure 2.9. After thoroughly mixing , the plated sample was allowed to solidify and then incubated at 25⁰C for 72 hours . Finally colony counts were made using colony counter ^[20]



Plate 3.5.3 Yeast Mold Count Analysis in PDA media

3.5.4. Organoleptic test:

Panel Name in cord	Test Parameter	Excellent 5	Very Good 4	Good 3	Fair 2	Not Acceptable	Comment
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The test of the juice quality is judged by the use person senses view, smell, and test. The Organolaptic tests are always used for the first screening of the incoming raw juice. The equipment is not required for this purpose.

Sensory Evaluation

A test panel i.e Sensory Evaluation Test was carried out at IFST, BCSIR, incorporated with 10 members committee to study the Organoleptic test of blended and Dilemma indica mixed fruit juice .The following members were present in the panel and they reported their valuable judgment of the product to the Head of the Sensory Evaluation Committee.

Table -1, Sensory Analysis of Mixed Fruits Juice (Tamarind and Dillenia Indica)

A B C D E F G H I J	Appearance	A,B,C,E, F,H,I	D,G,J				Acceptable
	Color	A,C,D,E, G,H,I,J	B,F				
	Texture	B,D,E,G, H,I,J	A,C		F		

	Flavor	A,B,C,F, G,I	D,E,H,J				
	Test	A,B,C,D, F	E,H,I,J	G			

A: $(5+5+4+5+5)=24$, B: $(5+4+5+5+5)=24$, C: $(5+5+4+5+5)=24$, D: $(4+5+5+4+5)=23$

E: $(5+5+5+4+4)=23$. F: $(5+4+2+5+5)=21$, G: $(4+5+5+5+3)=22$, H: $(5+5+5+4+4)=23$,

I: $(5+5+5+5+4)=24$,J: $(4+5+5+4+4)=22$.

Most of the panel members gave there excellent Judgments .Based on that the quality of the juice could be Acceptable .

(A) .Dr. Tasnim Farzana (SSO) Convener of the Sensory evaluation Committee

(B).Mrs. Konika Mondol (SSO), Members

(C.) Mr Abu Tareq Mohammad (SSO), members

(D).Mr Tanzir Ahmed Khan (SSO), Member

(E).Dr. Konika Mitra (SSO), Member

(F).Dipa Islam (SSO) , Member

(G).Mrs Monira Obaid (SSO), Member

(H).Mr Abhijit Chowdhury (SO), Member

(I).Mr. Md Nur Hossain (SO), Member

(J).Mr.Md Motalab (SO), Member

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After completing the test all the members gave there positive response and excellent marking to accept the test of mixed fruit juice. The organoleptic test of the mixed juice is acceptable.

4.0. Results and Discussion

We have analyzed five samples of blended mixed fruits juice incorporated with *Dillenia indica* and Tamarind .These sample were analyzed and the different chemical results are obtained such as pH= 3.2, TSS = 17%,Titratable acidity = 0.68%, Vitamin C = 75.00 mg, Total sugar = 13.36%, Reducing sugar = 12.3%, Ash = 0.10%, and important minerals such as Na = 4.20 mg%, K = 124.25 mg% , Ca= 0.46mg% ,Fe = 1.56mg% and the Mg = 0.02mg% respectively . Similarly Microbiological result showed that TPC count = 40, Yeast and Mold = 10, and Pathogenic bacteria count re not detected respectively and the report obtained from the Sensory evaluation committee was acceptable for the products .

Table: 2 Biochemical analysis of mixed juice

Sample ID	P^H	Titration acidity %	TSS (Total soluble solid) % mg	Vitamin C % mg	Reducing sugar % mg	Total sugar % mg
A	3.20	0.68	17	75.00	12.3	13.36
B	3.19	0.69	18	74.00	12.4	13.35
C	3.21	0.68	16	73.00	12.5	13.34
D	3.18	0.67	18	76.00	12.2	13.35
E	3.20	0.66	19	75.00	12.6	13.33

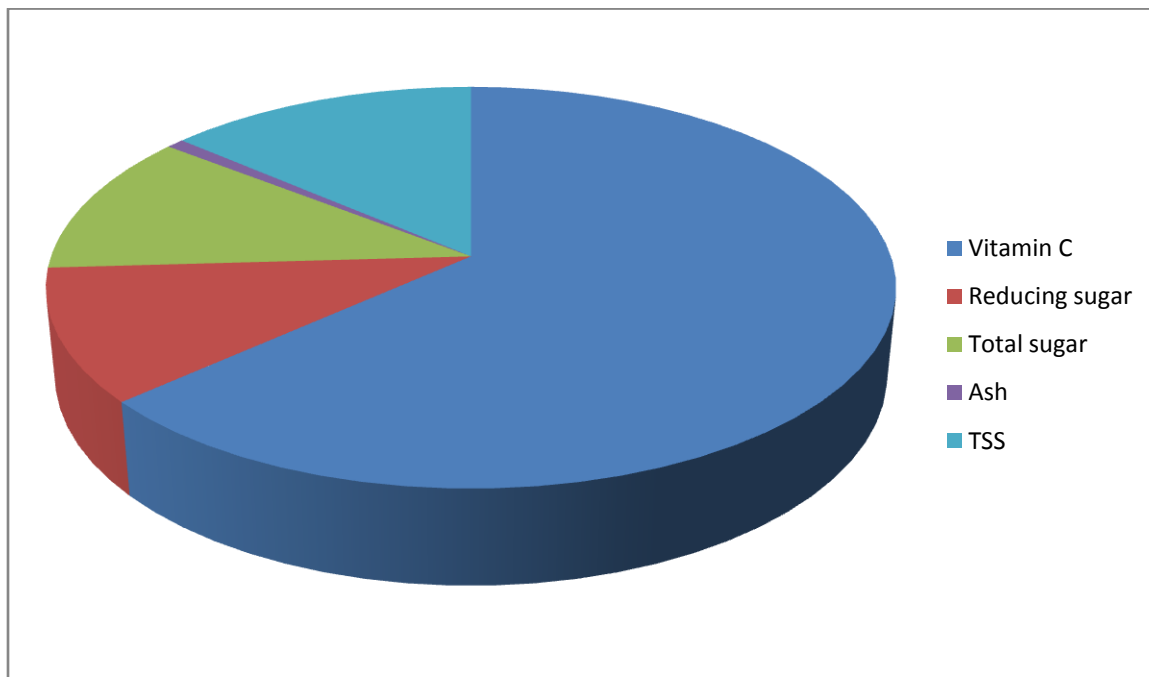


Fig 1: Chemical composition of tamarind juice

Table-2 & Figure 1 shows that Biochemical analysis for five samples such as pH, TSS, Total Sugar, Titratable acidity, Reducing sugar all the parameter are acceptable as per standard level. This results also indicate that huge amount of vitamin C found in the juice sample which is the good source of natural Antioxidant. Presence of higher amount Vitamin C in fruit juice having health beneficial for maintains protein collagens, metabolism of fat protein and amino acids. Similar study was done by Munmee Das et. Al. in 2012 and they found that higher amounts of phenolic compounds and Vitamin C content in *Delenia indica* juice which is good source of Antioxidants compound.^[21]

Table: 3 Minerals analysis of mixed juice

Sample ID	Ash % mg	Minerals				
		Fe % mg	Ca % mg	Na % mg	K % mg	Mg % mg
A	0.10	1.56	0.46	4.20	124.25	0.02
B	0.9	1.55	0.45	4.19	124.25	0.02
C	0.8	1.54	0.44	4.18	124.24	0.01
D	0.10	1.56	0.46	4.21	124.23	0.03
E	0.11	1.57	0.47	4.20	124.26	0.03

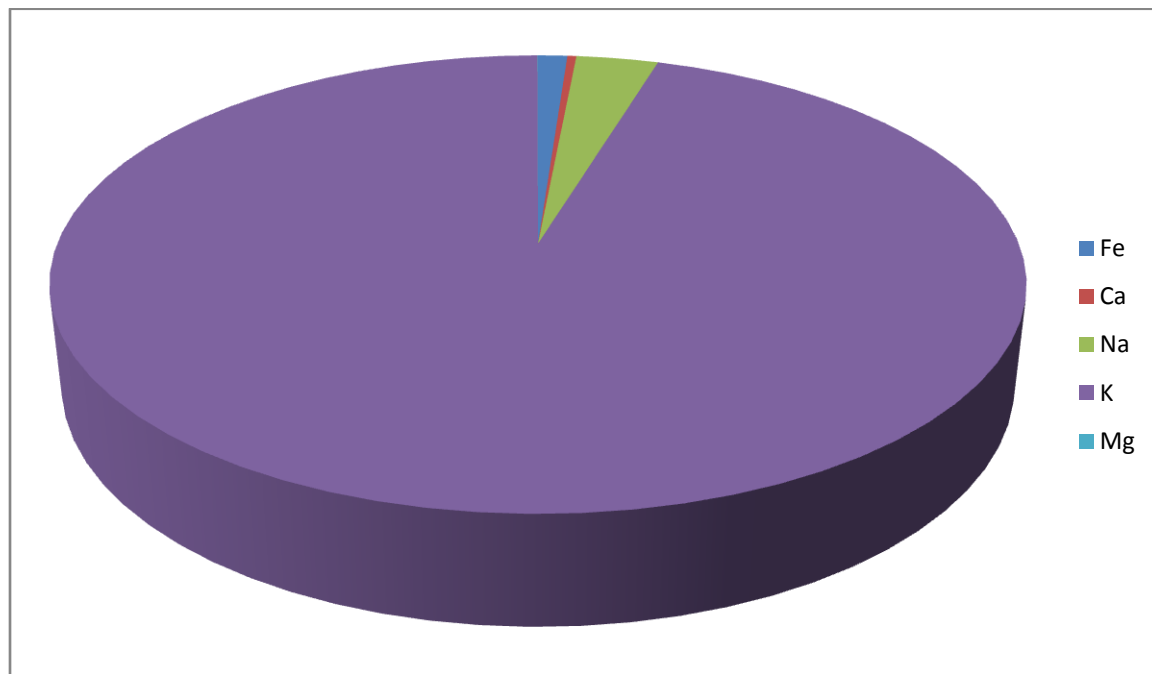


Fig: 2. Mineral composition of tamarind juice

Table -3 & Figure 2 shows that the minerals content of the product was determined by using the Atomic Absorption Spectrophotometer and it was found that presence of Ca, Mg, K, Fe and Na were sufficient amount. From these results it was indicated that the presence of higher amount Minerals content for all the sample are source of Antioxidant compound which is the main source of essential micro nutrient for the growth and development of bones, teeth and also important element for liquefy of blood coagulation. Also higher amount of Fe content is needed for the pregnant women can eradicate anemia and development of human blood Hemoglobin. The function of presence of Sodium is to maintain the fluidity of the body. In humans, sodium is an essential nutrient that regulates blood volume, blood pressure, osmotic equilibrium and pH; the minimum physiological requirement for sodium is 500 milligrams per day.

Table: 4 Microbiological analysis of mixed juice

Sample ID	Total Plate Count cfu/ml	Yeast and mold cfu/ml	Pathogenic bacteria		
			E.Coli Count cfu /ml	Salmonella and Shigella Count cfu/ml	Coliform count cfu/ml
A	40	<10 [*]	ND [*]	ND	<3 ^{**}
B	41	<10 [*]	ND	ND	<3 ^{**}
C	40	<10 [*]	ND	ND	<3 ^{**}
D	39	<9 [*]	ND	ND	<3 ^{**}
E	42	<8 [*]	ND	ND	<3 ^{**}

*ND= Not Detected

*<10 indicates absence of test Organism in 1ml of sample

** As per MPN chart ,the most probable number <3 indicates absence of test Organism in 1ml of sample

Table 4, Microbiological analysis for five samples shows that total Plate count was within 40 cfu and Yeast mold count was found nil . On the other hand, presence of pathogenic bacteria i.e. *E.coli* and *Salmonella* were not detected . From these microbiological results indicates that the juice sample was produce under hygienic condition and safe for human consumption. The internship program has covered both processing and quality of Beverage products. The internship program helped to learn methods for ensuring of juice quality and its identification. The program also helped to learn about the production of Beverage products. For ensuring raw juice quality different types of physical and biochemical tests are carried out in the IFST, BCSIR such as pH, °Brix, Vitamin C, Total sugar, Reducing sugar, Titratable acidity, Ash & Mineral .After processing juice was preserved in to Refrigerator as well as normal room temperature . After that we analysis the preserved juice sample frequently. The above mentioned analyses were carried out for implementing as a routinely daily procedure in the lab. The microbiological test is also carried out such as Total Plate Count (TPC), Coli form Count (CC) Yeast Mold count routinely. Organoleptic test is carried out for judgment of Texture, color and flavor. Actually IFST, BCSIR maintains or regulates its quality parameter according to BSTI standards.

5.0 Conclusion

This product will be value added with the market product. If we can introduce this product in the local market and the consumer will get it low cost with health benefit. That's why our country can earn huge amount money/foreign currency by selling and exporting this product. We can reduce the poverty through employment of new food industry. The analysis showed that the juice sample was suitable and highly acceptable for human consumption. This blended mixed juice can provide higher Antioxidant (Vitamin C) and important minerals and will be a sustainable health beneficial drink for human. So far we know, this type of work has not yet been done in our country. Further analysis like vitamin profile and heavy metal will be required for complete nutritional information of the processed product.

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