DEVELOPMENT OF READY TO RECONSTITUTE CHOCOLATE DRINK MIX

A Dissertation submitted by

Ms. AYSHA JINAN M.S

(REG NO: VM20FPT006)

St. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

Affiliated to Mahatma Gandhi University, Kottayam, Kerala

In partial fulfilment of the degree of

MASTER OF VOCATIONAL STUDIES

in

FOOD PROCESSING TECHNOLOGY

Under the guidance of

Dr. CHETANA RAMAKRISHNA

Principal Technical Officer

DEPARTMENT OF TRADITIONAL FOODS AND APPLIED NUTRITION

CSIR-Central Food Technological Research Institute

Mysore-570020

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CERTIFICATE

This is to certify that the project entitled "Development of Ready to Reconstitute Chocolate Drink Mix", submitted by **Ms. AYSHA JINAN M.S**., (Reg no: **VM20FPT006**) during February 2022 – July 2022, in the partial fulfilment for award of the degree of **Master of Vocational Studies** in **Food Processing Technology**, Kerala, is the result of study carried out by her in department of **Traditional Foods and Applied Nutrition**, at CSIR- Central Food Technology Research Institute, Mysore, under the guidance of **Dr. CHETANA RAMAKRISHNA.**

Dr Chetana Ramakrishna
Principal Technical Officer

Place: Mysuru

Date:

TFSS Department
CSIR- CFTRI,

DECLARATION

I Aysha Jinan M.S. (Reg no:VM20FPT006), hereby declare that the project work entitled “Development of Ready to Reconstitute Chocolate Drink Mix”, submitted to Mahatma Gandhi University, Kottayam in partial fulfilment of the requirements for the award of the degree of **Master of Vocational Studies** in **Food Processing Technology**, an authentic record of the original research work carried out by me during the period from February 25 to July 17, 2022 under the supervision and guidance of Dr. Chetana Ramakrishna., Principal Technical Officer, Department of Traditional Foods and Applied Nutrition, CSIR-Central Food Technology Research Institute, Mysore. I also declare that this project has not been submitted to any other universities or institutions for the award of any degree.

Place: Mysore Aysha Jinan

Date:

ACKNOWLEDGEMENT

This project would not have been possible without the guidance of number of loving people. First of all, I thank God almighty for his shower of blessing on me for completion of this project.

I express my deep sense of gratitude and sincere salutation to St. Teresa's college (Autonomous) Ernakulam Affiliated to Mahatma Gandhi University Kottayam and Central Food Technological Research Institute, Mysore which gave me the opportunity to complete this project successfully.

I would like to express my gratitude and sincere obligation to my advisor and guide, ***Dr. Chetana.R****, Principal Technical Officer, Department of Traditional Food and Applied Nutrition, Central Food Technological Research, Mysore, for her efficient guidance precious advice and constant encouragement throughout my work.*

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Aysha Jinan

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ABSTRACT

Ready to reconstitute products are those which require less effort to reconstitute or cook. An attempt was made to develop ready to reconstitute chocolate drink mix powder that has rich chocolate flavour and taste. The chocolate drink can be instantly prepared by just adding water to the mix. Five variations of the blends were prepared using ingredients like cocoa powder, chocolate, sugar/ jaggery, dairy whitener, khoa and coconut milk powder. Food additives were added to increase the body on reconstitution which in turn enhances the mouthfeel and consistency of the chocolate drink.

Physico-chemical and sensory evaluation of all the formulated samples was carried out. The prepared samples were estimated for DPPH and flavonoid testing. Quality parameters of the reconstituted chocolate drink like viscosity, pH and total soluble solids were carried out. The Chocolate drink mix was formulated using sugar and dairy whitener and the other jaggery based beverage was marginally higher in consumer acceptance compared to that of the other formulated products. Trials were carried out to develop chocolate drink tablets with the formulated chocolate drink mix powder using tablet making machine.

The results obtained indicate that the formulated chocolate drink mix has a great potential to provide rich chocolate flavour along with health benefits. This product offers convenience as it can be easily reconstituted with water when required and tastes richer than that of commercially available powders.

1.INTRODUCTION

1.1 Cocoa

In the globalisation era, instant drinks are already a necessity to satisfy human consumption. Consumers are increasingly looking for food that tastes good, can be prepared quickly, is simple to consume, and healthy. People who want specific health benefits from their foods have recently become more interested in beverages with functional qualities.

Cocoa (*Theobroma cacao L.*) is acknowledged to play a significant role in the socio-economic sector of many countries in the world, because global demand for this commodity is high particularly for producing various food products (Kindangen et al., 2017). Many years ago, humanity has benefitted from cocoa, the food of the gods. Products made from cocoa are becoming more and more popular. In fact, from a nutritional and health perspective, cocoa is particularly interesting due to its high polyphenol content and widespread use in many foods. Around 40 to 50 million people depend on the income from cocoa farming, which contributes to an annual global production of 4.2 million tonnes of cocoa valued at $11.8 billion and increasing at a rate of 3% per year since the last ten years (Beg et.al., 2017). The third-highest earner of foreign exchange after oil palm and rubber, cocoa is one of the major national commodities, producing the fifth-largest volume of goods after oil palm, coconut, rubber, and sugar cane. Polyphenols from cocoa are a source of health-promoting compounds. According to some studies, polyphenols have advantages such as fighting inflammation, acting as antioxidants to combat free radicals, and preventing the growth of cancer cells.

Colour, appearance, odour, taste and texture contribute to the acceptance of the beverage and are decisive for consumer preference. The cocoa in the beverage formulations plays an outstanding role for the general sensation. The cocoa type strongly determines the intensity of sensory attributes such as colour, flavour, mouthfeel and consistency, and bitterness. Cocoa powder is frequently combined with other ingredients to create a suspension system, which is then used to make cocoa drinks. Cocoa-based products are very popular among various groups of people because of their distinctive taste, aroma, and colour. Today, consumers of chocolate food and drinks are not only dominated by certain groups, but all levels of society. It indicates an encouraging development on the prospects for the chocolate food and beverage market. Chocolate drinks are among the most well-liked food items. It becomes a new

favourite and has been transformed into straightforward products like "instant hot chocolate" and "ready to drink chocolate." In small amounts, catechins, procyanidin B1 and procyanidin B2 are among the active substances found in chocolate drinks; their concentrations range from 0.01 to 0.12% (w/w). Cocoa products can be developed into healthy beverage products because cocoa beans contain polyphenolic compounds and have antioxidant properties (Tyas et.al., 2022).

1.2 Other Ingredients

Tea, coffee, cocoa, and drinking chocolate can all be made using dairy whitener instead of fresh milk, cream, or evaporated milk. Additionally, it goes well with foods like cereal dishes, sauces, puddings, and soups. Dairy whitener's main advantages are that it is simple to handle, has a longer shelf life, and can be tailored to specific needs, such as those of restaurants, railroads, airports, and waterways. Dairy whiteners have good whitening ability, feathering resistance, and emulsion stability to produce smoother, milder, or mellower drinks. Additionally, it makes coffee softer and less acidic (Oldfield and Singh, 2005). The solubility, wettability, and dispersibility requirements typically needed when adding fat-containing powders to water are met by dairy whiteners, which have "instant" solubility properties.

In the tropical region of the world, coconut is one of the most significant tree crops, providing food and shelter for millions of people. On an area of 11.95 million ha, coconut is grown in more than 93 different nations. producing 57,510 million coconuts annually as well. The provision of food, drink, fibre, wood, medicine, energy, shelter, and a variety of other uses for humankind makes it economically significant as well as culturally significant and useful. It is an amazing tree that produces more than 300 items. Coconut powder, which is high in fibre, protein, and calcium, is referred to as a "functional food" because of its many health advantages, including lowering bad cholesterol, preserving the health of the digestive system, and maintaining blood sugar levels (Ramaswamy, 2014).

Jaggery, a traditional sweetener made by concentrating sugarcane juice, is totally natural and serves as rich source of minerals especially iron. Without the use of chemicals, sugarcane juice is concentrated to create jaggery, a natural sweetener. Both solid blocks and a semi-liquid version are available. Additionally, the sap from some palm trees, including the sagopalm (*Caryota urens L*.), coconut palm (*Cocos nucifera L*.), wild date palm (*Phoenix sylvestris Roxb*.), and palmyra palm (*Borassus flabellifer L.),* is used to make jaggery. It is one of the most wholesome and healthy sugars in the world and contains the natural sources

of minerals and vitamins that are naturally present in sugarcane juice. Jaggery is one of the world's most wholesome and healthy sugars because it naturally contains a vast amount of the minerals, proteins, and vitamins found in sugarcane juice. More importantly, jaggery has great nutritional and therapeutic value because regular consumption may lengthen human life. It is known for being a medicinal sugar and is recommended as an ayurvedic treatment for conditions like dry cough, sputum-producing cough, indigestion, constipation, etc. Jaggery contains magnesium, which supports the nervous system, and potassium, which protects the cells' acid-alkaline balance and fights acids and acetones. Iron is abundant in jaggery, which prevents anaemia (Walhekar et.al., 2018).

1.3 Ready to Reconstitute Powders (RTR)

Instant foods are convenience products that require less effort to reconstitute or cook before consumption. They range from liquids or semisolids to those that form a thin slurry or porridge after due reconstitution (Shittu & Lawal, 2007). Beverage consumption is an important component of regular diet and is recommended for children and population engaged in physical fitness for energy and nutrition (Mee, 2016).

The market for powders that dissolve right away in cold water has been expanding over the past few years. Due to their wide variety and superior effects after reconstitution, instant items are growing in popularity among customers today. Food items like milk, coffee, cocoa drinks, desserts, soups, and health supplements are just a few examples of what you may get in the grocery store that fit into our contemporary lifestyles. Indian cuisine has a long history and a wide range of traditional preparations, making it the birthplace of this timeless art.

These are prepared mixtures used in the production of goods. They contain all the components and additives that can be stable in a single, homogeneous mixture and serve a specific function in the production of the product. All-inclusive dry powder blends of this kind are used to create products and only require the end user to add water. The fundamental premise is to make product production more streamlined and reliable. This category of food is referred to as convenience foods because it requires little to no significant processing or cooking prior to consumption, providing convenience to consumers. It only needs to be handled minimally, such as mild heating or warming and rehydrating in hot or cold.

1.4 Chocolate Drinks

The most popular foods include chocolate drinks. It has developed into a simple product that is now a new favourite, such as "instant hot chocolate" and "ready to drink chocolate."

Typically, cocoa powder is combined with other ingredients like sugar, milk, and stabiliser in hot water to create chocolate-flavoured beverages. Both adults and children frequently choose chocolate milk as a beverage. Its flavour, colour, and texture can differ widely, and it is prepared from a mixture of whey, milk, chocolate, and other components. Chocolate milk's sensory and nutritional benefits, as well as its usefulness and use, attest to the product's popularity with customers. The overall benefits of the beverage compositions are greatly increased by the addition of cocoa.

An attempt was undertaken for the development of ready to reconstitute chocolate drink mix to provide rich chocolate taste and flavour.

The main objectives of the present study are as follows:

1) To formulate rich chocolate beverage mixes by varying sweeteners and milk powders.
2) To study their physico chemical and sensory quality.

2.LITERATURE RIVIEW

2.1 Ready to Reconstitute products

The market for powders that dissolve rapidly in cold water has grown in recent years. Instant goods are becoming increasingly popular among consumers due to their wide variety and great effects after reconstitution. Milk, coffee, cocoa drinks, desserts, soups, and health supplements are examples of store foods that complement our modern lifestyle. RTR powders are prepared mixtures used to create products. They include all ingredients and additives that are stable in a single, uniform mixture and have a specific function in the production of the product. This kind of mix is an all-inclusive, dry powder blend that just needs water to be added by the consumer for the production of products. The main goal is to make product production more streamlined and reliable. This food category, also known as convenience foods, provides consumers with convenience by requiring little or no significant processing or cooking prior to consumption. It only needs a minimal amount of handling, such as gentle heating or warming and rehydration in hot or cold water (Kadbhane and Giram, 2019).

2.2 Chocolate Drinks

Chocolate drinks are among the most well-liked food items. It has evolved into a straightforward product, such as "instant hot chocolate" and "ready to drink chocolate," and has become a new favourite (Tyas et. al., 2020). In general, chocolate beverages are made by combining cocoa powder with other components like as sugar, milk, and stabiliser in hot water. (Muhammad, 2020). Chocolate milk is a common beverage choice for both children and adults. It is made from a combination of whey, milk, cocoa, and other ingredients, and its flavour, colour, and texture can vary greatly. (Thompson et al. 2004). The sensory and nutritional qualities of chocolate milk, as well as its practicality and ease of use, attest to consumers' acceptance of this product. (Varnam and Sutherland, 1997).

The inclusion of cocoa in the beverage formulations significantly contributes to the overall experience. The intensity of sensory characteristics like colour, flavour, mouthfeel, consistency, and bitterness is strongly influenced by the type of cocoa; in particular, the cocoa polyphenols have been linked to astringency and bitter flavour. The fat in the drinks that are ready to drink primarily affects how they look and feel (such as their creaminess and mouthfeel), and it also acts as an aroma carrier and flavour intensifier. In dairy drinks, sugar

contributes to more than just sweetness, it also enhances smell, helps to develop flavour, and gives the beverage body, which directly affects mouthfeel by altering flow behaviour. Studies that linked sensory qualities to the physicochemical characteristics of hot chocolate drinks mainly concentrated on instant cocoa powder without taking into account other preparations that are now accessible, like block chocolate or cocoa mixtures that include milk powder, which are considered just-add-water instant products. Both of the aforementioned product categories are currently important to take into account when thinking about convenience and tradition. (Rivas et.al., 2018).

2.3 Cocoa

Cocoa (*Theobroma cacao L.*) is widely recognised to play an important role in the socioeconomic sectors of many countries throughout the world, because global demand for this commodity is considerable, notably for the production of various food goods. (Kindangen et al., 2017). People are drawn to cocoa derivative products because of its sensory qualities, such as their distinct colour and flavour. (Aprotosoaie et al., 2016). Cocoa beverage is one of the favourite cocoa-derived products in the global market since it was introduced in Europe in the mid of 18th century (Cidell and Alberts, 2006).

One of the main national exports, cocoa ranks fifth in terms of volume behind sugar cane, rubber, oil palm, and coconut. It also earns the third-highest amount of foreign exchange after these two commodities. Polyphenols found in cocoa have positive effects on human health. According to some studies, polyphenols have advantages such as their ability to combat free radicals, reduce inflammation, and stop the growth of cancer cells (Tyas et.al., 2022)

Moreover, nowadays, cocoa has been proven to contain polyphenol compounds that have the potential to act as antioxidants (Counet, 2017). Due to its high flavonoid content, which benefits human health, chocolate is a functional food product (Wollgast and Anklam, 2000). Latif (2013) reviewed the effects of chocolate on human health and showed how cocoa, which has high concentrations of flavonoids like epicatechin and catechin and procyanidins, is a rich source of antioxidants with radical scavenging activity

Cocoa ready-to-drink' is currently gaining popularity as an alternative beverage due to its convenience and usefulness for consumers (Rossi et.al., 2014). Manufacturers of ready-to-drink beverages face some challenges, particularly in achieving a desirable mouthfeel and a good suspension of ingredients in milk or other base liquids. A variety of other qualities, in

addition to colour and flavour, help to define cocoa powder and have a significant functional impact on the final product that uses it (Ana et. al., 2010).

2.4 Other Ingredients

Drinks with functional qualities have gained popularity recently among those who want specific health benefits from their foods. Dairy whitener is frequently used to make beverages like tea, coffee, cocoa, and drinking chocolate without using fresh milk, cream, or evaporated milk. It is also suitable for adding to foods like soups, sauces, puddings, and cereal dishes. The main benefits of dairy whitener are its ease of handling, longer shelf life, and ability to meet specific needs like those of restaurants, railroads, airports, and waterways (Khatkar et.al., 2012). In order to produce smoother, milder, or mellower drinks, dairy whitener have good whitening ability, feathering resistance, and emulsion stability. It also lightens coffee and neutralises coffee acids (Oldfield and Singh 2005). Dairy whiteners have "instant" solubility properties and meet the solubility, wettability, and dispersibility requirements typically needed when adding fat-containing powders to water. Additionally, milk protein helps dairy whiteners have important quality traits like feathering, mouthfeel, and other organoleptic traits (Sunil et.al., 2012).

One of the most significant tree crops in the tropical areas of the world, coconut provides food and shelter for millions of people. On an area of 11.95 million hectares, coconut is grown in more than 93 nations worldwide. producing 57,510 million coconuts annually as well. A provision of food, drink, fiber, wood, medicine, energy, shelter, and a variety of other uses for humankind makes it economically significant as well as culturally significant. It is a remarkable tree that produces more than 300 items (Jayasekara and Gunathilake, 2007). Coconut powder, which is high in fibre, protein, and calcium, is referred to as a "functional food" because of its many health advantages, including decreasing bad cholesterol, supporting a healthy digestive system, and regulating blood sugar levels.

Jaggery, a traditional sweetener made by concentrating sugarcane juice, is totally natural and serves as rich source of minerals especially iron. (Ramaswamy, 2014). Jaggery is a naturally occurring sweetener made from sugarcane juice that is concentrated without the use of any chemicals. Both solid blocks and semi-liquid versions of it are offered. In addition, the sap from some palm trees, including the sagopalm (*Caryota urens L.*), the wild date palm (*Phoenix sylvestris Roxb.*), the coconut palm (*Cocos nucifera L.*), and the palmyra palm (*Borassus flabellifer L.*), is used to make jaggery. One of the world's healthiest sugars, it

contains the natural sources of vitamins and minerals that are naturally present in sugarcane juice (Singh et.al., 2015).

2.5 Milkshake powders

Based on the physical, nutritional, sensory, and storage characteristics, A study has been made to improve the nutraceutical and functional aspects of the chocolate with butter fruit milkshake powder at the 15–60% level. According to this study, chocolate that had been fortified with butter fruit milkshake powder was both more affordable and had better nutritional value. It also had acceptable sensory qualities. As a result, chocolate manufacturers might be able to create a new type of chocolate that is useful and increase market revenue (Aparna et. al., 2021).

Food with good flavour that is quick to prepare, simple to consume, and nutritious is becoming more and more in demand. Although avocados are fruit, that are difficult to preserve, which presents a problem for food scientists. Avocado is used to create a novel freeze-dried milkshake powder. With high nutritional value and a longer shelf life, this product offers a nutritious combination of dairy and fruit ingredients (Shreya et. al., 2020).

The consumer preference for marketed foods with the flavours of cocoa and coffee. Due to its flavour and high nutritional value, the sapota powder created by standardising the blending of cocoa and coffee has a very wide market and contributed a combination of chocolate and sapota ready to use milkshake powder (Patel et. al., 2015). Since many children do not like the taste of milk as it is, but readily accept it when it has been given a good flavouring, the consumption of flavour-enhanced milk is constantly rising. (Taware, 2002).

3. MATERIALS AND METHODS

This chapter describes the materials that were procured and used for preparation of chocolate drink beverage mix. The methods used in the present study to measure the proximate composition, physico-chemical, sensorial and rheological properties of chocolate drink mix are discussed here.

3.1 Materials

3.1.1 Raw Materials

All the materials like cocoa powder, dark chocolate compound (grated form), pasteurized dairy whitener (Amul), khoa powder, coconut milk powder, jaggery (powder form), sugar and vanillin (flavouring agent) were procured from Loyal World supermarket, Mysore for product development.

Other food additives of beverage mix are guar gum, tri-calcium phosphate and carboxymethyl cellulose were purchased from SD Fine Chemical Ltd, Mumbai.

Fig 3.1 cocoa powder

Fig 3.2 Chocolate (grated)

Fig 3.3 Sugar powder

Fig 3.4 Dairy whitener

Fig 3.5 Coconut Milk powder

Fig 3.6 Khoa powder

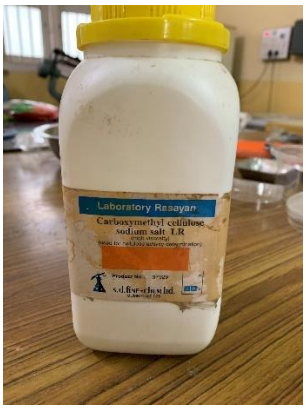


Fig 3.7 Carboxy methyl cellulose

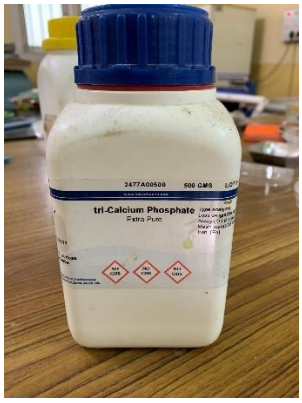


Fig 3.8 Tri calcium phosphate

Fig 3.9 Guar Gum

3.10 Vanillin powder

3.1.2 Chemicals/Reagents

All the chemical used in the experiments and for analysis were of analytical grade. Chemicals are quercetin solution, sodium hydroxide, sodium nitrite, aluminium chloride and gallic acid.

Solvents: methanol, petroleum benzine, toluene and DPPH (3,2-diphenyl-1-picrylhydrazyl).

3.1.3 Instruments used in experiment

Weighing balance, pH meter, water activity meter, moisture analyser, viscometer, Refractometer, Colour measuring system, spectrophotometer, particle size analyser, rheometer and tablet making machine were used whenever required for conducting the experiment.

3.1.3.1 Digital refractometer

A calibrated digital refractor is used to calculate the samples' total suspended solids (Figure) (Model; HI 96801). By calculating a solution's refractive index, the brix value is calculated. A substance's refractive index and the quantity of dissolved particles in it are both optical properties.

Fig 3.11 Digital Refractometer

3.1.3.2 Analytical Weighing Balance

Weighing balance from Infra solutions and Mettler Toledo with capacity ranges of 0.01g to 200g, 1mg to 100g and 1000g to 5000g were used.

Fig 3.12 Weighing Balance

3.1.3.3 pH meter

pH meter from Control Dynamics India Model, APX 175, was used during the project for measurement of pH of the sample.

Fig 3.13 pH meter

3.1.3.4 Muffle Furnace

This is a furnace with an extremely heated chamber the walls of which radiantly heat the content the chamber, so that the material being heated has no contact with flame. The temperature range is 500, in order to estimate ash and mineral contents muffle furnace was used in the ashing of the samples.

Fig 3.14 Muffle Furnace

3.2 METHODS

3.2.1 Formulation of Chocolate Beverage Mixes

The Ready to Reconstitute (RTR) chocolate drinks mix (CDM) were prepared by weighing the respective amount of raw formulation.

Five different variations of chocolate drink mix blends were prepared with ingredients as shown in table 3.1. Ingredients are weighed and blended in a mixer grinder to get a uniform mixture. Food additives were added to improve the texture, thickness and viscosity of the sample while mixing in a blender.

A commercial hot chocolate mix was used for comparison. All other formulations were compared to the commercial product. The prepared chocolate drink mixes were packed in aluminium laminate pouches and stored for further analysis. The chocolate drink mixes were reconstituted in hot water and thoroughly mixed to assess the final product's taste and sensory quality.

Table.3.1 Formulation of RTR Chocolate drink mix

Ingredients	Formulations(g)				
	F1	F2	F3	F4	F5
Sugar	200	--	200	--	200
Jaggery	--	200	--	200	--
Dairy Whitener	80	80	--	--	--
Khoa	--	--	--	--	140
Coconut Milk Powder	--	--	160	160	--
Cocoa Powder	80	60	60	60	60
Chocolate	60	80	70	70	90
CMC*	4	4	4	4	4
GG*	4	4	4	4	4
TPC*	4	4	4	4	4
Vanillin	4	4	4	4	4

*CMC= Carboxy Methyl Cellulose, *GG= Guar Gum, *TPC= Tri Calcium Phosphate

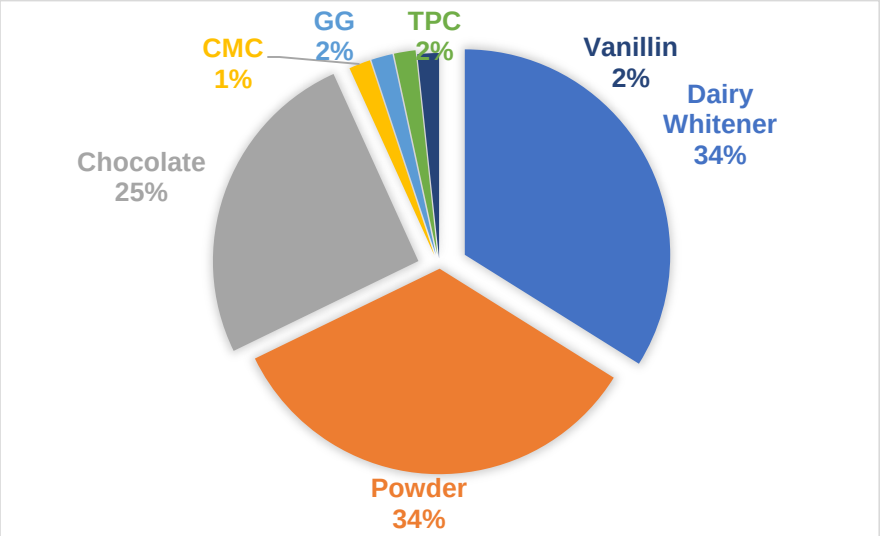


Fig 3.15 Formulation sample F1 = Beverage mix with dairy whitener and sugar

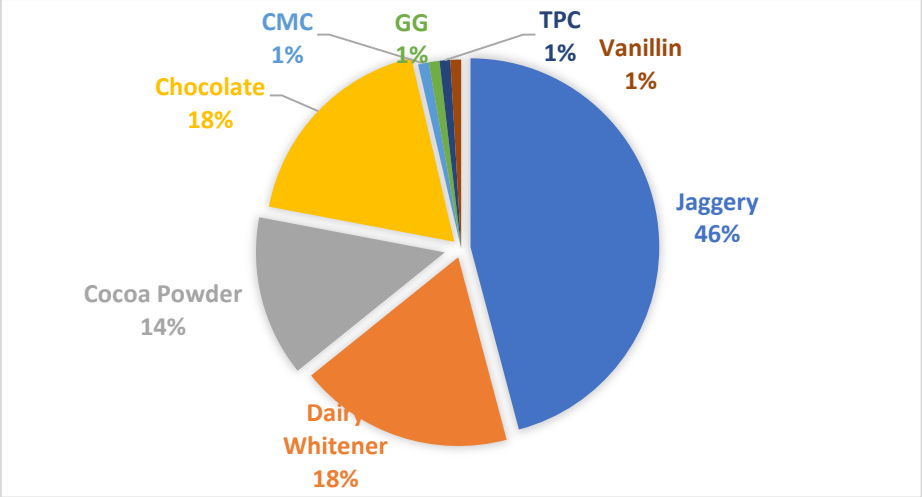


Fig 3.16 Formulation sample F2 = Beverage mix with Jaggery and Dairy whitener

Representative photo of Beverage mix made using sugar and dairy whitener

Fig 3.17. Sample F1

Representative photo of Beverage mix made using jaggery and dairy whitener

Fig 3.18. Sample F2

3.3 Physico Chemical Analysis

3.3.1 Proximate Composition

3.3.1.1 Moisture Content

Moisture content of the samples was determined by using a calibrated digital moisture analyser (Figure 3.19) (Denver instruments Germany, Model-IR 35, Germany) at 110±1ºC. A sample of 10g in triplicates was exposed to the heated infrared coils of the moisture analyser and the analysis was completed in an automatic mode within 20-30 minutes (Rahel et. al., 2015).

Fig 3.19 Moisture Analyzer

3.3.1.2 FAT

The crude fat estimation by Soxhlet method according to AOAC method no.920.85 (AOAC,2000).

Procedure

To determine the amount of fat present in the samples, empty round bottom flasks were weighed. 10g of chocolate drink mix sample was weighed in to the thimbles and the thimbles were plugged with cotton. The thimbles were kept in the extractor of the Soxhlet Apparatus. Petroleum ether were poured into the extractor and whole apparatus was fixed. Fat extraction was continued for 8 hours, it should be 16 cycles. After complete extraction occurs, thimbles

were removed from the extractor and petroleum ether was distilled off from flask by using rotavapor. After removing the solvent completely, the flasks were kept in oven at 100° C to remove traces of petroleum ether left, if any. The flasks were then cooled in a desiccator and weighed.

The percentage fat content is determined by the formula:

$$\% \text{ Fat} = \frac{\text{Difference of the weight of the round bottom flask X 100}}{\text{Sample weight}}$$

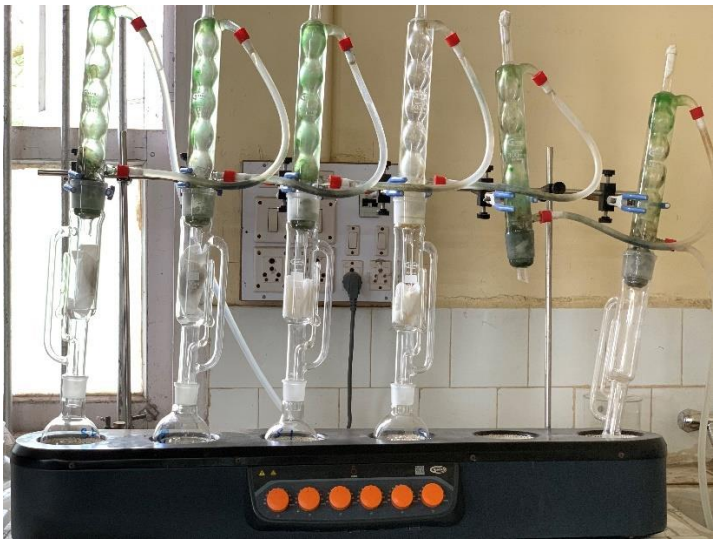


Fig 3.20 Soxhlet Apparatus

3.3.1.3 Protein

Protein was estimated using Thermofisher scientific protein analyser (Flash 2000) by dumas method according to AOAC method number 992.15(AOAC2012).

Procedure:

Duma's method determines the protein content by estimating nitrogen in the sample. This method is based upon the fact that nitrogenous compound when heated with cupric oxide in an atmosphere of carbon dioxide yields free nitrogen. Traces of oxide of nitrogen, which may be formed in some cases, are reduced to elemental nitrogen by passing over heated copper spiral. Then the mixture is passed through potassium hydroxide to remove carbon dioxide. The nitrogen is then quantified using a universal detector.

Fig 3.21 Protein Analyzer

3.3.1.4 Ash Content

The ash content of any food sample is an index of minor constituents of food. The AOAC method no. 923.03 (AOAC, 2000) was used to determine the ash content.

Principle

Muffle furnace is used for ash and mineral estimation of samples .it consists of an extremely heated chamber the walls of which heat the content in the crucible without the flame directly coming in contact with the sample. The sample is ignited at 550° C to burn off all organic material. The inorganic material which does not volatilize at that temperature is called ash.

Procedure

Silica dishes were weighed and marked with heat resistant pencil. Two gram of each sample was weighed and added to the respective dishes with proper labelling. The samples were charred in low flame to char all carbonaceous matter and smoke, which affects the lining and coils of muffle furnace. After the smoke stopped, the silica dishes were placed in the muffle furnace and the sample were ignited for 12 to 14hrs at 500-550˚C. In case the ash appears black even after 12 hrs of ignition, 2-3 drops of concentrated Nitric acid were added to ash and then ignited again, After the sample turned white, the silica dishes were removed from the furnace and cooled in desiccators and weighed. The loss in weight was reported as ash.

Calculations:

The percentage of ash content is determined by the formula:

$$\text{Ash content (\%)} = (W2\text{-}W1/\ W) *100$$

W: Weight of sample,

W1: Weight of the empty crucible,

W2: Weight of the crucible and ash after ashing

Fig 3.22 Muffle Furnace

3.3.2 pH Measurement

pH of the beverage samples was determined using calibrated (buffers pH 4.0 & 7.0) digital pH meter (Figure 3.23) (Model; Cyber scan 510). The glass electrode was dipped in the sample solution to record the potential difference between the glass electrode and the reference electrodes. The potential difference is used to measure the hydrogen ion concentration indicating the pH of given solution using the Nernst equation.

Fig 3.23 pH meter

3.3.3 Bulk density:

The food was taken in a measuring cylinder and filled up to 100 ml mark and the weight was taken. The weight obtained per volume (g/ml) gives apparent bulk density. To obtained compact bulk density, the same amount of food was tapped gently on a wooden/rubber flank until a constant volume is obtained and the weight per unit volume (g/ml) gives the "Compact bulk density". The exercise was carried out for 5 times and the average was taken to minimise the error.

3.3.4 Colour Measurement

Colour of the food product is the first important attribute that impress the consumer. Samples of final product was evaluated using colour measuring instrument (Model-Konica Minolta, C/3500D). Colour values were recorded in terms of lightness value (L*), greenness/redness value (a*) and yellowness/ blueness values (b*).

Fig 3.24 Digital Colourimeter

3.3.5 Viscosity Measurement.

The viscosities of samples were determined using a calibrated digital Viscosity Meter (Brookfield DV- II +Pro) (Fig). The operations were done in triplicates at 100 rpm with spindle number 4.

Fig 3.25 Viscometer

3.3.6 Water Holding Capacity (WHC)

Water Holding Capacity was determined using the method described by RA Anderson – 1982. One gram of the sample was added 10 ml of distilled water in a pre-weighed centrifuge tube. The tube with its content was agitated on a magnetic stirrer for 2 min and centrifuged at 4,000 rpm for 20 min on a VWR centrifuge (Model Micro Star R30, USA). The clear supernatant was discarded, and the centrifuge tube was weighed with the sediment. The amount of water bound by the sample was determined by difference and expressed as the weight of water bound by sample.

Fig 3.26 Centrifuge

3.3.7 Particle Size Analysis

Particle size analysis was determined using Microtrac Particle Size Analyzer 3500 (Nikkiso group, USA) (Figure 3.27) working on laser diffraction principle. Particle size is a fundamental property of sedimentary materials that may tell us much about their origins and history. In particular, the dynamical conditions of transport and deposition of the constituent particles of rocks is usually inferred from their size. The size distribution is also an essential property for assessing the likely behaviour of granular material under applied fluid or gravitational forces, and gauging the economic utility of bulk materials ranging from foundry sands to China clay.

Fig 3.27 Particle Size Analyzer

3.3.8 Total Soluble Solids Measurement (˚Brix)

The Total Suspended Solids of the samples were determined using calibrated digital Refractometer (Figure 3.28) (Model; HI 96801). Brix determination is made by measuring the refractive index of a solution. Refractive Index is an optical characteristic of a substance and the number of dissolved particles in it. The samples of 2-3 drops each were taken in triplicates to measure the magnitude of degree Brix of the sample.

Fig 3.28 Digital Refractometer

3.3.9 Total Flavonoid Content Determination:

Total flavonoid content was determined by Aluminium chloride method using quercetin as a standard.1 ml of test sample and 4 ml of water was added to a volumetric flask (10 ml volume). Add 0.3 ml of 5 % Sodium nitrite, 0.3 ml of 10% Aluminium chloride was added after 5 minutes. After 6 minutes incubation at room temperature, 1ml of 1 M Sodium hydroxide was added to the reaction mixture. Immediately the final volume was to make up to 10 ml with distilled water. Absorbance of sample was measured against the blank at 510 nm using a spectrophotometer. All the experiment was repeated three times for precision and values were expressed in mean standard deviation in terms flavonoid content (Quercetin equivalent, QE) per g of dry weight (Faiqoh et.al.,2020).

3.3.10 DPPH Radical Scavenging Activity

The process outlined by Blois et al.,1998 was carried out with a modified volume. A total of 100 litres of fresh and powder extracts were combined with 1 ml of DPPH methanolic solution (0.3 mm). The control was an equal quantity of methanol and DPPH without the sample. For 20 minutes, the solutions were incubated at room temperature in the dark. The absorbance was then measured at 517 nm against a blank of methanol. The proportion of free radical scavenging activity was estimated using the formula below.

((Ac-As)/Ac)100 = percent inhibition

Ac is the control absorbance and

As is the sample absorbance.

Fig 3.29 Methanol Extraction of Samples

Fig 3.30 Spectrophotometer

3.3.11 Water Activity Measurement

Water activity is one of the most critical elements in determining how quickly food deteriorates due to microbial or non-microbial effects. Food preservation is aided by water action. Water activity of the samples were determined using calibrated digital water activity meter (Figure 3.31) (Model; Lab touch-aw, Novasina) at 32±2ºC. The cuvette inside the meter is filled with the sample in triplicate with an approximate run time of 10 to 15 minutes per test.

Fig 3.31 Water Activity Meter

3.4 Sensory Evaluation

The sensory qualities of the finished product were assessed using the hedonic rating test. It was organised in a calm environment with well light, humid-free, and ventilated rooms while upholding hygiene standards.

The test provides an indication of consumer preference and acceptance of the final product. For each participant in the sensory exam, a separate score sheet card is used. Instead of identifying differences, this test is better suited to identifying preferences.

Hedonic Test was employed for this purpose. A 9-point scale ranging from 'Like Very Much' to 'Dislike Very Much' with Neither Like nor Dislike' as midpoint was used for this purpose. Respondents included staff and students from other departments at CFTRI whose age ranged between 21 to 50 years. Judges were asked to mark the product based on the degree of preference. Each panellist evaluated 20 mL per sample of the warm beverage in cups coded with random 3-digit number. Water was served for palate cleansing.

Fig 3.32 Sensory booth

4.RESULTS AND DISCUSSIONS

4.1 Physico Chemical Analysis of Formulated beverage mixes

4.1.1 Proximate Analysis

The proximate analysis was carried out and the composition results are depicted in the table 4.1. All the samples possessed a good quantity of protein, fat and ash and low moisture.

Serial No.	Sample Code	Moisture (%)	Fat (%)	Protein (%)	Ash (%)
1.	F1	1.56±0.08	10.31±0.05	8.41±0.09	3.23±0.10
2.	F2	2.48±0.34	11.43±0.14	8.23±0.08	3.44±0.23
3..	F3	2.67±0.06	12.61±0.13	6.20±0.12	3.45±0.25
4.	F4	1.41±0.07	12.36±0.35	6.40±0.07	3.55±0.21
5.	F5	1.70±0.25	10.24±0.22	10.31±0.05	4.04±0.44

Table 4.1. Proximate composition of chocolate beverage mix

4.1.1.1 Moisture

Water influences the textural stability and shelf life of food products, as well as the growth of microorganisms (Yetim & Kesmen, 2009). An important quality indicator of cocoa powder is its moisture content, because in the presence of an excessive level of moisture, flavour may deteriorate, and the possibility of microbiological spoilage will arise. Generally, the moisture content of cocoa powder must be maintained at up to 5% (Minifie ,1989).

Moisture content has a significant impact on the food quality. The results are shown in table 4.1. It indicates that the samples had a moisture content ranging from 1.41 to 2.67 percentage. Higher values were observed for formulations with jaggery, this could be due to the hygroscopic nature of jaggery. The values of moisture content of the formulated chocolate mixes were in the range of 1-2%. A study by Shreya et.al., 2021 has revealed that had content

of 2.9% which is similar to our study. It was also observed that fat content affects the moisture content of cocoa, because the cocoa drink mixtures prepared from cocoa containing higher fat content exhibited lower moisture percentage (Cvitanovic et.al., 2010).

4.1.1.2 Fat

The formulated samples have high fat content ranging between 10 to 12 percent. Based on the fat contents, cocoa powder can be categorized into high-fat (15-22%), medium-fat (8-14%), and low-fat (2-7%) cocoa powder (Vasela et.al., 2007). High fat content in the sample F5 is due to the addition of khoa powder into the product which itself is a good source of fat.

4.1.1.3 Protein

The formulated mix has highest amount of protein for sample F5 in which khoa powder was incorporated. Samples with coconut milk powder as carrier had lower protein compared to other three samples. Protein is fairly high in the sample and thus it is a protein enriched drink.

4.1.1.4 Ash Content

The ash content was estimated and the results were shown in table 4.1. The values were ranged between 3.23-4.04 percentage. Sample F5 had a slight increase in total ash content when compared to all other four samples.

4.1.2 Colour Measurement

In the appearance of food materials, colours play an essential role. It acts as an indicator of quality which influences the surface, subsurface properties, taste perception, and the product's acceptance. Observed the colour of the Chocolate beverage mix powder in this study. Studied the effect of colour, and discussed the results in the following table 4.2.

Samples F1, F4 and F5 shows high L* (brightness) value as shown in the table 4.2, Addition of Dairy whitener, coconut milk powder and khoa powder to the chocolate drink mix, Lightness values (L*) was significantly increased, when compared to the other samples F2 and F4 with jaggery. Chocolate drink protein content is also linked to colour; the products appear lighter with higher milk or protein content (Rivas et.al.,2018).

The (a*) value of all samples is significantly low due to dark chocolate pigments. There were significant differences in lightness (L*), darkness (a*), and yellowness (b*) of the samples due to different ingredients (Table 4.2). A study by Hough et.al., (1998) and Hough and Sánchez (1997) published that the amount of suspended cocoa had a significant effect on L∗

value of hot chocolate drinks. Values of colour of the formulation was similar to the study by Rivas et.al., (2018).

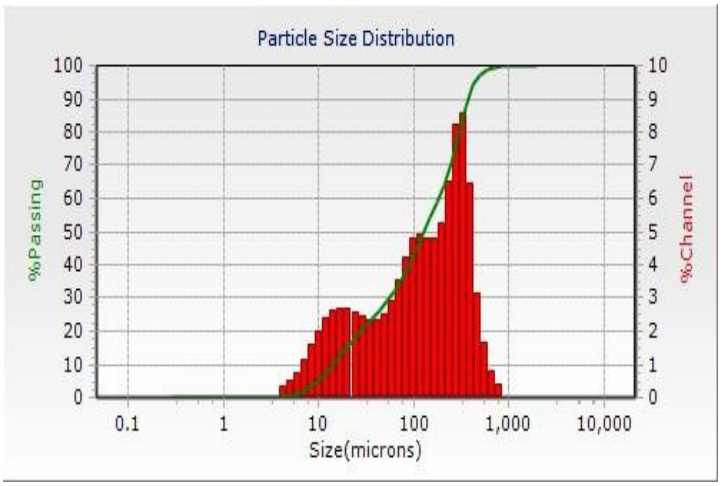
Table 4.2 Colour measurement of formulated chocolate beverage mix

Sample	L*	a*	b*	dE*ab(D65)
F1	52.44	9.38	17.46	49.05
F2	45.03	9.92	18.38	56.29
F3	36.28	10.38	15.71	63.84
F4	50.81	9.28	17.02	50.37
F5	54.48	8.25	15.4	46.25

Table 4.3 Quality parameters of chocolate drink mix powder

Sample	Water Holding Capacity(g/ml)	Bulk Density (g/cm^3)	Particle Size Distribution		
			Dia (um)	Vol (%)	Width
F1	1.17±0.01	0.67± 0.004	172.4	83.2	289.7
F2	1.09±0.04	0.61± 0.002	172.4	83.2	289.7
F3	1.05±0.03	0.62± 0.001	172.4	83.2	289.7
F4	1.27±0.02	0.66± 0.004	172.4	83.2	289.7
F5	1.06±0.03	0.62± 0.004	172.4	83.2	289.7

Fig 4.1. Particle size analysis graph of Chocolate beverage mix



4.1.3 Particle Size Distribution

Droplet size distributions, which can be related to sensory mouthfeel and rheological properties (Rivas et.al., 2018). The results showed that average particle size of the chocolate drink mix had a diameter of 172.4 mm.

4.1.4 Bulk density

It is significant parameter for the powder because it indicates the area cover by the powder, which is vital for packing industry. It is just one physical property of a powder that influences the flowability powder. It depends upon powder properties such as particle shape, size, texture, etc (Shreya et.al.,2020). The Bulk density of formulated drink mixes were evaluated and the results are shown in the table 4.3. All the samples were having similar bulk density values in the range of 0.61-0.67 gcm-3.

4.1.5 Water Holding Capacity (WHC)

WHC of formulated chocolate beverage mix were examined. The results were found to be in the range of 1.05-1.27 g/ml (table 4.3).

4.1.6 Water activity

Water activity (a_w) plays an important role in growth of microorganism cause spoilage of food and loss functional properties of food due to mobility of molecule (Correia et al. 2017). From a safety viewpoint, it has been reported that values below 0.6 can be considered microbiologically or chemically stable because the amount of free water available for biochemical reactions is low (Dantas et al.,2018). From Table 4.4, water activity (a_w) of

chocolate drink mix powders were between 0.578-0.531 after 30 days of storage, which can be considered stable from microbial spoilage. Sample F5 had showed the maximum water activity when compared to other samples. Due to high nutritive value and water activity of khoa, it is conducive to the growth of bacteria. (Sonika et.al., 2019).

Table 4.4 Measurement of water activity of formulated chocolate drink beverage mix

Sample	Storage Duration (days)	
	0	**30**
F1	0.363	0.531
F2	0.462	0.558
F3	0.421	0.552
F3	0.457	0.466
F4	0.492	0.578

4.2 Flavonoid content and Antioxidant potential

These characteristics are important because they provide details about the bioactive ingredients and associated antioxidant properties of the manufactured product, which are directly related to its health benefits. The consumption of cocoa drinks and beverages contributes to the daily intake of antioxidants in a diet, notably with regard to polyphenolic components. Cocoa powder typically contains 82-90 percent non-fat cocoa solids. (Ana et. al., 2010). Chocolate beverage mix samples were examined for total flavonoid concentration and anti-oxidant activity using the DPPH radical-scavenging technique. Antioxidant concentration in chocolate drink mix samples was determined to be around 93-94 percent in 1ml of extract mention in the table 4.5. The results of flavonoid content of samples were found to be 0.201-0.272 mg/g as shown in table. A study by Faiqoh (2022) has revealed that had anti-oxidant and flavonoid content similar to our study.

Table 4.5. Total flavonoid contents and antioxidant potential of formulated chocolate drink mix

Sample	Antioxidant (%)	TFC (mg/g)
F1	94.64±9.85	0.201
F2	94.36±7.26	0.265
F3	94.0±4.37	0.246
F4	93.40±1.15	0.203
F5	93.04±1.22	0.272

4.3 Reconstitution of formulated chocolate drink mix powder with water

The formulated chocolate drink mixes were reconstituted in to a homogeneous beverage when suspended and stirred in warm water. Freshly prepared beverage was found to be highly soluble and no settling of particles. A commercial hot chocolate mix was employed and other formulations were compared to it. To ensure a rich chocolate taste and thick consistency, the colour, reconstitutability, and sensory quality of the chocolate drink milk were carefully examined. In terms of taste, flavour, and overall quality, 25g of chocolate powder mix diluted in 125 ml water was found to be highly acceptable. Reconstitution of the chocolate drink mix gave rise to a beverage having good body and mouth feel. As there were negligible particles settled at the bottom, the formulation gives excellent suspension and is able to meet the consumer preference.

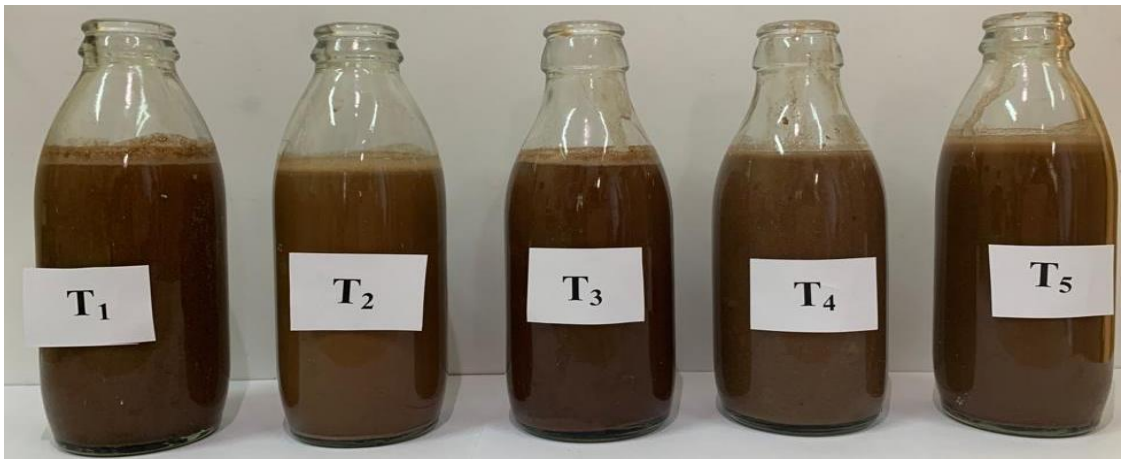


Fig 4.2 Reconstituted chocolate drink mixes

4.4 Studies on beverages after reconstitution

Data in the below table 4.6 shows the quality parameters of the reconstituted chocolate drink mix.

Table 4.6 Quality parameters of reconstituted chocolate drink mix

Samples	pH	Viscosity(cps)	Brix (^{0}B)
F1	6.37±0.04	82.33±1.24	14.43±0.12
F2	6.37±0.03	90.66±0.94	14.8±1.78
F3	6.37±0.01	84.66±1.24	11.26±0.04
F4	6.37±0.04	95.66±0.47	12.3±0.16
F5	6.37±0.01	65.33±0.47	14.7±0.16

4.4.1Total Soluble Solids (˚Brix)

It is the total number of soluble constituents like sugar, organic acid, vitamins, protein, and so on. Samples F3 and F4 had their initial brix adjusted to 11˚ Brix and 12˚Brix, respectively. As a result, the thickness and mouthfeel were found to be uneven. The brix of the reconstituted beverage was adjusted to achieve uniform mouthfeel and texture, as shown in the table 4.6. By adjusting the amount of water added, the value of brix of all the reconstituted samples had been set at 14.5˚ brix.

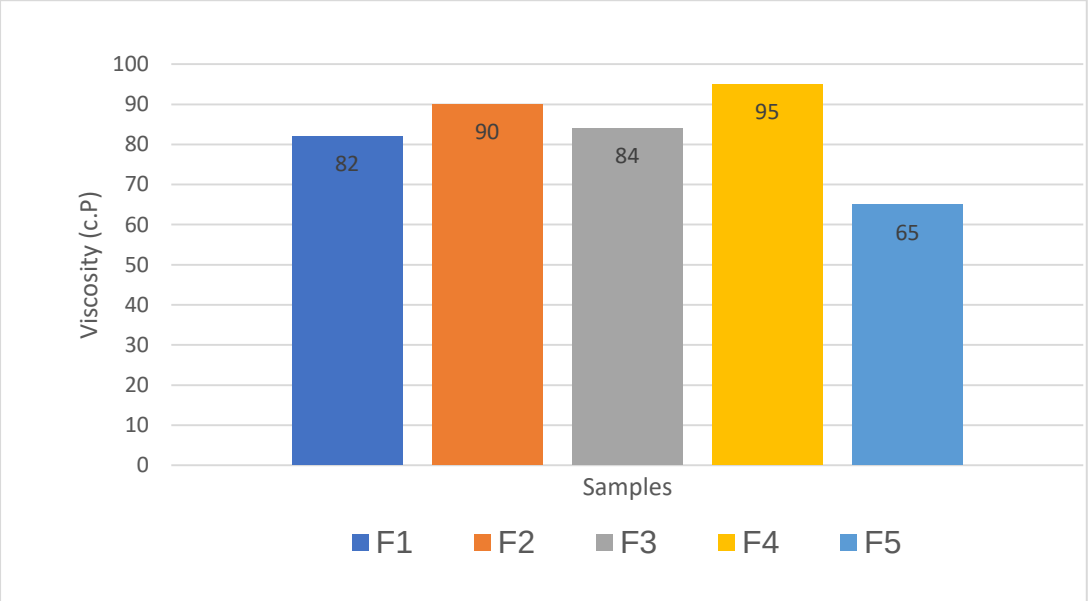
4.4.2 pH

The pH content of the reconstituted formulations is depicted in table 4.6. The results of pH were found to be 6.37, A study by Rivas, (2018) has revealed that 6.19- 7.08 pH in drinking chocolate is similar to our study.

4.4.3 Viscosity

Viscosity of the reconstituted beverages were measured. According to Kristensen et al.,1997 viscosity increases with increasing particle volume and smaller particle size. The estimated value on viscosity (cP) of the chocolate RTR beverage mix is illustrated in table 4.6**.** From the graph illustrated below it can be observed that the lowest viscosity was observed in the sample F5. This may be due to incorporation of high fat khoa powder. The fat of cocoa powder was also proven to have a substantial effect on viscosity. It was shown that higher fat of the cocoa powder results in a lower viscosity. Hence, in the aqueous medium, the powder with high-fat content cocoa powder may flow faster than that with low-fat content cocoa powder when determined in a certain shear rate (Faiqoh et.al., 2021).

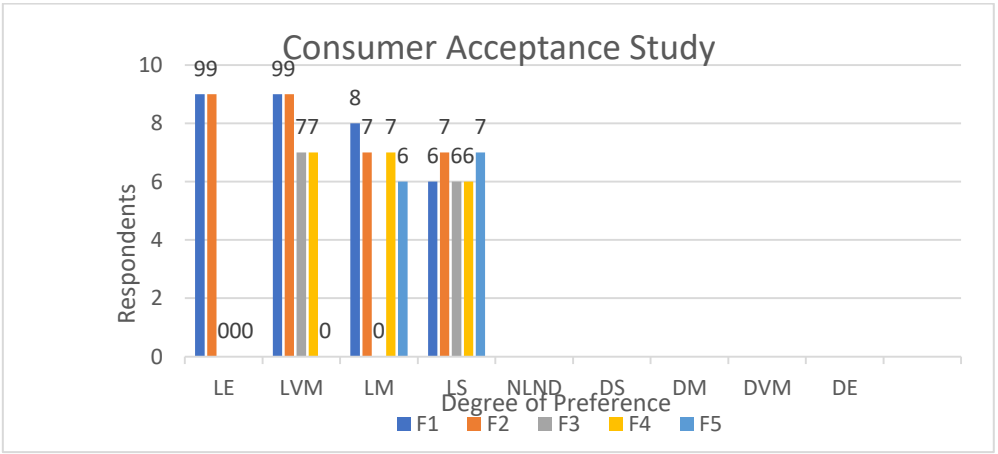
Graph 4.3 Viscosity of the reconstituted chocolate drink mix



4.5 Sensory Evaluation of reconstituted Chocolate drink mixes prepared

A 9-point scale ranging from 'Like Very Much' to 'Dislike Very Much' with Neither Like nor Dislike' as midpoint was used for this purpose. The prepared product was reconstituted using the standardized quantity of boiling water, held for two minutes, and served to the sensory panellist. Judges were asked to mark the product based on the degree of preference. Each panellist evaluated 20 mL per sample of the warm beverages in cups coded with random 3-digit number.

Graph 4.4. Consumer Acceptance study of reconstituted chocolate drink mix



Results of consumer acceptance study indicated that the respondents rated the beverage from "Like" category. There was no marking for the samples under "Dislike" side of the scale (Fig). This showed that beverage samples F1 and F2 scored high and were acceptable.

Table 4.7 Hedonic scale

	Degree of Preference	**Score**
LE	Like Extremely	9
LVM	Like Very Much	8
LM	Like Moderately	7
LS	Like Slightly	6
NLND	Neither Like Nor Dislike	5
DS	Dislike Slightly	4
DM	Dislike Moderately	3
DV	Dislike Very Much	2
DE	Dislike Extremely	1

4.6 Trials on Chocolate Milkshake Tablets

In order to prepare the Ready to Reconstitute (RTR) Chocolate Drink Mix (CDM) into tablets, pilot trials were carried out. Dies of the tablet making machine are filled with a specific amount of chocolate drink mix powder. The punches then apply a predetermined amount of force to these dies. This causes the powder to be compressed into the desired shape and size. Each tablet was made into a 5g small round shaped tablets.

Fig 4.5 Tablet Making Machine

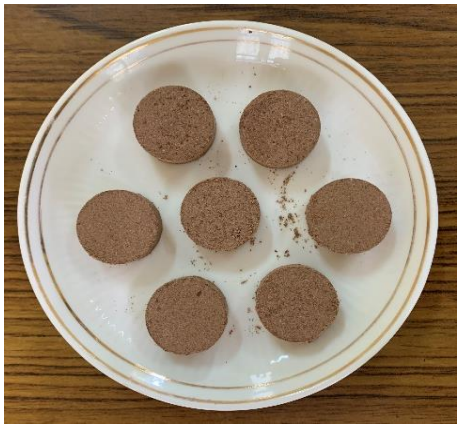


Fig 4.6 Ready to Reconstitute Chocolate Drink Tablets

5. Summary and Conclusion

Ready to Reconstitute Chocolate drink mixes were formulated. Five different blends of chocolate drink mix were optimised by combining ingredients like dairy whitener, khoa powder or coconut milk powder, sugar or jaggery, powdered chocolate along with cocoa powder and food additives.

All the formulated products were evaluated for their physico chemical analysis and evaluation of their sensory profiles. Proximate composition of samples indicates that moisture content of the beverage mix is low (1-2%) and ash content of 3%. The fat content of all the samples were 10-12% and the chocolate beverage mix formulated using coconut milk powder had highest fat content due to its composition. The protein content ranged between 6.20-10.31% with highest protein content in beverage mix incorporated with khoa powder. The chocolate drink mixes were evaluated for their colour value, particle size analysis and water holding capacity. The total flavonoid content of different samples was in the range of 0.201-0.272 mg/g. Antioxidant potential of the samples was in the range of 93-94%. Measurement of water activity was low (0.3-0.6) and is desirable for storage.

The formulated samples of chocolate drink mix were reconstituted with water for sensory quality. Viscosity, pH and brix of the reconstituted drinks were examined. The physico-chemical properties of this beverage mix along with colour, particle size of the mixes and sensory analyses were carried out for all the products. Results indicated that the reconstituted chocolate beverages had a dark chocolatey colour with no settling of particles indicating that the mix was thoroughly dispersible and easily soluble. Body of the sample was perceived to be desirable. The sample had a smooth mouthfeel without any perceptible lumps. Aroma of the sample was perceived to be fresh and desirable. Taste of the drink was perceived to be optimally sweet with a balanced sweetness and thick consistency which gave good mouthfeel. The Chocolate drink mix formulated using sugar and dairy whitener and the other jaggery based beverage was marginally higher in consumer acceptance compared to that of the other formulated products. Based on the consumer acceptance study sample F1 and F2 had the highest score. The results showed that the product was found to be beneficial in health due to its high flavonoid content and antioxidant potential.

Trials were carried out to develop chocolate drink tablets with the formulated chocolate drink mix powder using tablet making machine. Tablets developed were in intact and not easily breakable. The outcomes show that the developed chocolate drink mix has a great potential to deliver a rich chocolate flavour in addition to health advantages. This product is practical because it is quickly reconstitutable with water when needed. However, more research regarding its shelf life needs to be done.

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Annexure

SCORE CARD –HEDONIC RATING SCALE

Product: Chocolate Milk

Name: _____ **Date:** _____

- Taste these given samples and tick (✓) according to how much you like or dislike each one.
- Use the appropriate scale to show your attitude by checking at the point that best
  describe your feelings about the sample.

Degree of Preference		Samples		
		Code	Code	Code
Like Extremely	**9**			
Like Very Much	**8**			
Like Moderately	**7**			
Like Slightly	**6**			
Neither Like Nor Dislike	**5**			
Dislike Slightly	**4**			
Dislike Moderately	**3**			
Dislike Very Much	**2**			
Dislike Extremely	**1**			

Comments:

Signature

SCORE CARD –HEDONIC RATING SCALE

Product: Chocolate Milk

Name: _____ **Date:** _____

- Taste these given samples and tick (✓) according to how much you like or dislike each one.
- Use the appropriate scale to show your attitude by checking at the point that best
  describe your feelings about the sample.

Degree of Preference		Samples		
		Code	Code	Code
Like Extremely	**9**			
Like Very Much	**8**			
Like Moderately	**7**			
Like Slightly	**6**			
Neither Like Nor Dislike	**5**			
Dislike Slightly	**4**			
Dislike Moderately	**3**			
Dislike Very Much	**2**			
Dislike Extremely	**1**			

Comments:

Signature