



# International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)





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# Preparation of Tamarind Seed Candy

Sakshi Morey, Tanuja Ghate, Janvi Wanhare, Soni Thakur

Diploma Student, Department of Food Technology, Ballarpur Institute of Technology Bamni, Maharashtra, India

Diploma Student, Department of Food Technology, Ballarpur Institute of Technology Bamni, Maharashtra, India

Diploma Student, Department of Food Technology, Ballarpur Institute of Technology Bamni, Maharashtra, India

Head of Department & Assistant Professor, Polytechnic, Department of Food Technology, Ballarpur Institute of Technology Bamni, Maharashtra, India

**ABSTRACT:** The development of tamarind seed candy presents an innovative approach to utilizing tamarind seeds, a commonly discarded by-product of tamarind fruit processing. Despite being overlooked, tamarind seeds are an abundant source of nutrients, including proteins, dietary fiber, essential amino acids, and polyphenolic compounds known for their antioxidant properties. This research aims to formulate and produce a confectionery product using tamarind seed flour, thereby adding value to tamarind seeds and promoting sustainable food practices.

### I. LITERATURE OF CANDY

Candy, alternatively called sweets or lollies, is a confection that features sugar as a principal ingredient. The category, called sugar confectionery, encompasses any sweet confection, including chocolate, chewing gum, and sugar candy. Vegetables, fruit, or nuts which have been glazed and coated with sugar are said to be candied. The word candy entered the English language from the Old French *çucure candi* ("sugar candy"). The French term probably has earlier roots in the Arabic *qandi*, Persian *qand* and Sanskrit *khandā*, all words for sugar.

Sugarcane is indigenous to tropical South and Southeast Asia. Pieces of sugar were produced by boiling sugarcane juice in ancient India and consumed as *khandā*.

### II. INDUSTRIAL EVOLUTION

In 1847, the invention of the candy press (also known under the surprising name of a toy machine) made it possible to produce multiple shapes and sizes of candy at once. In 1851, confectioners began to use a revolving steam pan to assist in boiling sugar. This transformation meant that the candy maker was no longer required to continuously stir the boiling sugar. The heat from the surface of the pan was also much more evenly distributed and made it less likely the sugar would burn. These innovations made it possible for only one or two people to successfully run a candy business.

In an 1885 cover cartoon for *Puck*, Joseph Keppler satirized the dangers of additives in candy by depicting the "mutual friendship" between striped candy, doctors, and gravediggers. By 1906, research into the dangers of additives, exposés of the food industry, and public pressure led to the passage of the Pure Food and Drug Act, the first federal United States law to regulate food and drugs, including candy.

#### Raw Material

- **Tamarind seed**

A protein found in tamarind seeds has antiviral properties and can potentially be used to develop antiviral medication for chikungunya. Their findings have been published in the Elsevier Journal, *Virology*. Tamarind and its seeds have long been known for their incredible health benefits and now it has been proven. Tamarind is a fruit popularly used in Indian cuisine to add a tangy flavour. Its seeds are shiny black in colour and are said to be used for various medicinal purposes. We list down some more benefits of tamarind seeds:



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### **Benefits of tamarind seeds**

1. Beneficial for teeth
2. Helps in promoting digestion
3. May prevent infections
4. Helps manage diabetes
5. Heart-friendly

### **Nutritional value of tamarind seeds**

Magnesium: 26% of the daily value (DV)

Potassium: 16% of the DV

Iron: 19% of the DV

Calcium: 7% of the DV

Phosphorus: 11% of the DV

Copper: 11% of the DV

Vitamin B1 (thiamin): 43% of the DV

Vitamin B2 (riboflavin): 14% of the DV

Vitamin B3 (niacin): 15% of the DV

It has trace amounts of:

Vitamin C

Vitamin K

Vitamin B6 (pyridoxine)

Folate

Vitamin B5 (pantothenic acid)

Selenium

It also contains 6 grams of fiber, 3 grams of protein, and less than 1 gram of fat. This comes with a total of 287 calories.

### • **Jaggery powder**

Jaggery powder is a traditional, unrefined sweetener made from sugarcane juice or palm sap. It is processed without chemicals, preserving its natural nutrients such as iron, calcium, potassium, and magnesium. The juice or sap is boiled until it thickens and solidifies, then it is granulated into powder form. Jaggery powder has a rich, caramel-like flavor and is used in various cuisines for desserts, beverages, and savory dishes. It is considered healthier than refined sugar due to its higher nutrient content and slower absorption, making it a popular choice for traditional and healthy recipes.





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### Health benefits of Jagger powder

1. Rich in Nutrients
2. Improves Digestion
3. Detoxifies the Body
4. Boosts Immunity
5. Prevents Anemia
6. Regulates Blood Pressure
7. Relieves Menstrual Pain
8. Provides Instant Energy
9. Helps with Respiratory Issues

### III. MATERIAL

#### Equipments

Weighing balance



Pan

Mixer



Bowl

Gas stove



Spatula

Strainer



Spoon

### INTRODUCTION

Tamarind (*Tamarindus indica*) is a widely used fruit, known for its unique sweet and tangy flavor, which makes it a popular ingredient in culinary and medicinal applications. The tamarind tree, primarily grown in tropical and subtropical regions, produces pods containing the edible pulp and hard seeds. While the pulp is highly valued and extensively used in cooking, beverages, and traditional medicine, tamarind seeds are often regarded as waste and discarded during fruit processing. This leads to a significant amount of seed by-product that remains largely underutilized despite its rich nutritional profile.

Tamarind seeds have been found to contain essential nutrients such as protein, dietary fiber, carbohydrates, and beneficial phytochemicals like tannins, flavonoids, and antioxidants. These components offer various health benefits, including anti-inflammatory, antioxidant, and cholesterol-lowering effects.

### IV. METHODOLOGY

#### Production process of tamarind seed candy

##### Preparation of Powder

- First, take the tamarind and jujube seeds, wash them with water to remove all the dirt and any foreign material. Now sort them to remove damage, rotten or injured seeds. The seed we are using should be healthy for further processing



- Now soak the seeds in water in a different containers And keep it soaked until it becomes slightly soft. It takes



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almost 2 to 3 hours.

- After soaking remove the seeds from water and roast them on pan, after successfully roasting them remove the black covering of tamarind seeds.



- Then grind tamarind seeds and jujube seeds and then roast the powder for few minutes.
- After delightfully roasting it, the is now ready for further Candy Processing.

### Preparation of candy:

- In a high sided pan, add 60 parts jaggery powder, Switch on the hob and stir immediately to prevent the jaggery powder from settling at the bottom of the pan. Continue until all the sugar dissolves, making it stir.
- As the mixture starts to boil, froth will rise in the pan and then subside – this is known as breaking the boil. You can hold the mix at this point if your preparing batches in advance, but the water content must be correct otherwise it might invert. Turn off the heat and add liquid glucose, stirring it in before switching the heat back on.



- (The easiest way to get glucose out of your bucket is with wet hands. The water helps prevent it from sticking but you must move quickly!)
- To avoid crystals forming on the sides of the pan, place a lid on the top for a minute or 2. Next, take off the lid and insert a thermometer to keep an eye on the temperature of the candy mixture.
- Heat the mixture to 146°C (295°F), and then turn off the heat. Bear in mind that this mix is extremely hot. Wearing gloves is crucial, as any liquid candy on your skin could result in a severe burn.
- After this we will add ingredients such as Tamarind seeds and Jujube seeds powder in jaggery concentrate.

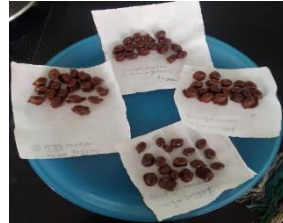


- When all the ingredients are mixed well, pour it into a silicon mold carefully.
- Dust top with confectioners' sugar. Let cool until hardened, about 15 minutes. Then remove all the candy from the mold.
- Finally, if the candy forms hard, brittle strands that easily break, the candy is at the hard crack stage, between 300° — 310°F.



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- Your candy is now ready and enjoy these delicious candies.

### V. RESULT AND DISCUSSION

#### 5.1 Results and Discussion of Tamarind Jaggery Candy

##### 1. Product Development and Optimization:

**Formulation:** The ideal formulation of tamarind jaggery candy was determined through a series of trials, balancing the ratio of tamarind pulp and jaggery to achieve a pleasant sweet-tangy taste. The consistency, flavor, and texture were key parameters evaluated.

**Processing Conditions:** The cooking temperature and time were optimized to ensure proper caramelization of jaggery while preserving the natural flavor and color of tamarind. This step was critical in achieving a candy with the desired firmness and reduced stickiness.

##### 2. Sensory Evaluation:

A sensory panel evaluated the candy for parameters such as taste, aroma, texture, appearance, and overall acceptability. The results indicated high consumer preference for the candy with a balanced flavor profile and smooth, chewy texture.

##### 3. Nutritional Analysis:

The nutritional analysis of tamarind jaggery candy highlighted its richness in minerals like iron, calcium, and magnesium from jaggery. It also showed the presence of dietary fiber and antioxidants from tamarind.

##### 4. Textural Properties:

Texture analysis revealed that the candy had a desirable chewy consistency, which was influenced by the concentration of jaggery and the method of cooking. Excessive cooking led to hardening, while undercooking resulted in a sticky product.

##### 5. Shelf Life and Stability:

The stability of tamarind jaggery candy was tested over a storage period. Packaging in moisture-resistant materials was necessary to maintain product quality by preventing moisture absorption and microbial contamination.

#### 5.2 Sensory Evaluation

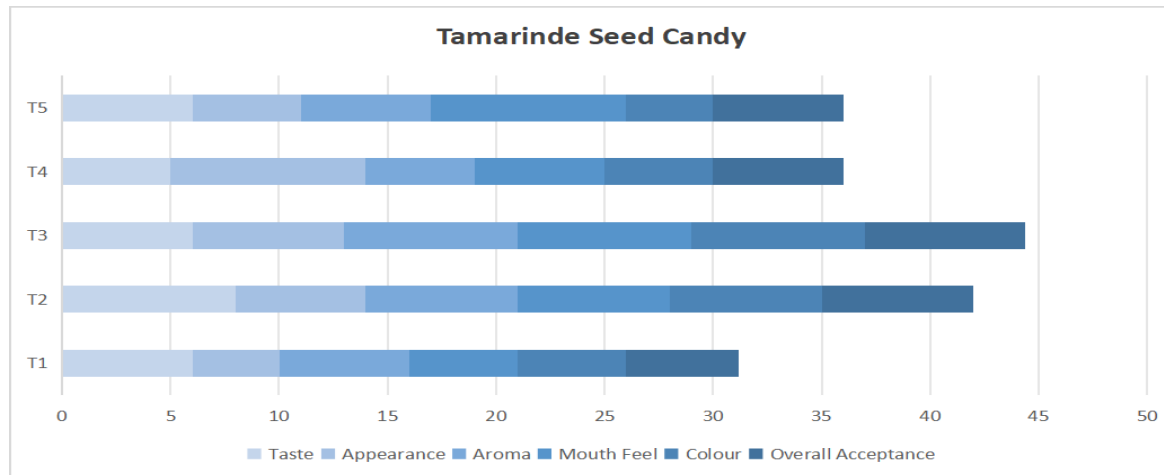
A brief summary of the sensory evaluation of tamarind seed products would include the assessment of key sensory attributes such as taste, texture, aroma, and overall acceptability. Tamarind seeds, when processed (e.g., roasted or ground into flour), have a subtle nutty or earthy flavor. The texture can vary depending on the form; for instance, roasted seeds have a crunchy texture, while tamarind seed flour can have a smooth, fine texture when used in food products. The aroma of processed tamarind seeds is mild and nutty. Sensory evaluation helps determine the palatability of tamarind seed-based products, guiding potential applications in food formulations, like snacks or as a flour alternative.

| Trials (Avg. rating) | Taste | Appearance | Aroma | Mouth Feel | Colour | Overall Acceptance |
|----------------------|-------|------------|-------|------------|--------|--------------------|
| T1                   | 6     | 4          | 6     | 5          | 5      | 5.2                |
| T2                   | 8     | 6          | 7     | 7          | 7      | 7                  |
| T3                   | 6     | 7          | 8     | 8          | 8      | 7.4                |
| T4                   | 5     | 9          | 5     | 6          | 5      | 6                  |
| T5                   | 6     | 5          | 6     | 9          | 4      | 6                  |



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### 5.3 CHEMICAL ANALYSIS

#### Analysis of Product

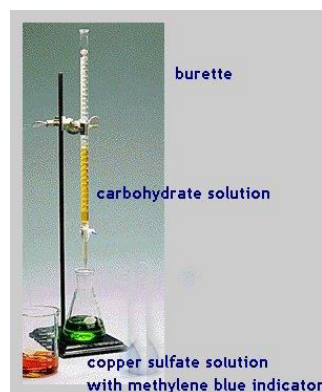
##### • Analysis of carbohydrates

Carbohydrates are one of the most important components in many foods. Carbohydrates may be present as isolated molecules or they may be physically associated or chemically bound to other molecules. Carbohydrates digestible by humans and therefore provide an important source of energy

- The Lane Eynon method is an example of a titration method of determining the concentration of reducing sugar in a sample.
- The burette is used to add the carbohydrate solutions being analysed to a flask containing a known amount of boiling copper sulphate solution and Methylene blue indicator. Copper sulphate solution is also known as Fehling solution or reagent.
- The reducing sugar in the carbohydrate solution react with copper sulphate in the flask. Once all the copper sulphate in solution has reacted, any further addition of reducing sugar causes the indicator to change from blue to white (indicating end point is reached).

The volume of sugar solution required to reach the end point is recorded. The reaction is not stoichiometric, that means it is necessary to prepare a calibration curve by carrying out the experiment with a series of standard solution of known carbohydrate concentration.

#### Procedure



- 10ml of mix felling reagent is placed in a 250ml flask.
- The sugar solution is transferred into a burette and suspended over the flask.
- 15ml of sugar solution is added to the flask and to boiling.



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- The solution is boil for 15 sec and portions of the sugar solution is added rapidly until only the faintest perceptible blue colour remains.
- 2 to 5 drops of 1% of aqueous solution of methylene blue is added and heating is continue. The sugar solution is added drop wise until the titration is complete which is shown by the reduction of the dye.

Reducing sugar(%) = (mg of invert sugar dilution/Titre weight of sample (g) 1000)\*100

- **Analysis of moisture**

Moisture contain influences the test, texture, appearance and self life of food stuff. Even a slight deviation from definite standard can adversely impact the physical properties of food material. Substance which are too dry could affect the consistency of the end product. Excess moisture may causes food material to agglomerate. Also the rate of microbial growth increases with total water content, possibly resulting in spoilage. Water is also an inexpensive ingredient adding to the weight of the final product.

- Oven drying method is used to determine the percentage of water molecules in a sample.
- In this technique, the moisture content of a food can therefore be determine accurately by measuring the number or mass of water molecules present in a known mass of sample.
- It Is not possible to directly measure the number of water molecules present in a sample because of the huge number of molecules involved.
- An analytical techniques commonly used to determine the moisture content of food are based on Determination of the mass of water present in a known mass of sample.
- In oven drying method the sample is heated under specific condition and the loss of weight is used to calculate the moisture content of the sample.
- The amount of moisture determine is highly dependant on the
  1. Type of oven used
  2. Condition within the oven
  3. Time and temperature of drying
- Vacuum oven:- Drying and the reduced pressure (25-100 mmHg) allows more complete removal of water and volatiles without decomposition within 3-6 hours drying time.
- Microwave oven:- A precise and rapid technique that allow some segment of the food industry to make in process adjustment of moisture content before final packaging in vaccum microwave, drying time at 10 min can yield results equivalent to this 5 hours in standard of vaccum oven.
- The advantages of oven drying method are easy handling and possibility for simultaneous determination.



### procedure

- The sample is weighed, the sample is usually weighed into a flat bottom shallow dish made up of aluminium or similar material which will not react with the food nor pick up water radially
- Weight samples are placed in an oven for a specific time and temperature. The oven temperature is Usually set as 100°C or 105°C and the time varies depending on the sample.
- They are dried until they reach constant evaporated. Mass. The difference in weight is the water which has evaporated

Moisture (%)=((Weight of wet sample- weight of dry sample)/ weight of wet sample)\*100.

Total solid %-100-moisture

Total moisture content present in tamarinde seed candy =1.2%



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### • **Analysis of Ash:**

Ash is an inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidising agent which provides a major part of the total amount of minerals within a food.

Ash is one of the components in the proximate analysis of biological material, consisting mainly of salty, organic constituents. It includes metal salts which are important for processes requiring ions such as sodium ( $\text{Na}^+$ ), potassium ( $\text{K}^+$ ) and calcium ( $\text{Ca}^{2+}$ ).

The analysis of ash content in food is simply the burning away of the organic content, leaving inorganic minerals. This helps determine the amount and type of minerals in food. It is important because the amount of minerals can determine the physicochemical properties of food, as well as retard the growth of micro-organisms.

The analysis of ash in a muffle furnace is used for providing extremely high temperature for determination of ash content in a given sample.



### **Dry Ashing:-**

Dry ashing procedure uses a high temperature muffle furnace capable of maintaining a temperature of between 500 and 600°C. Water and other volatile materials are vaporized and organic substances are burned in the presence of oxygen in air to  $\text{CO}_2$ ,  $\text{H}_2\text{O}$  and  $\text{N}_2$ . Most minerals are converted to oxides, sulphates, phosphates, chlorides or silicates. Although most minerals have fairly low volatility at this high temperature, some are volatile and may be partially lost. Examples are iron, lead and mercury.

If an analysis is being carried out to determine the concentration of one of these substances then it is advisable to use an alternative ashing method that uses a lower temperature. The food sample is weighed before and after ashing to determine the concentration of ash present. The advantages of dry ashing are safe, few reagents are required, many samples can be analysed simultaneously and ash can be analysed for specific mineral content.

### **Procedure:-**

- Weigh the empty crucible and record its weight
- Weigh 5 g of the sample into a crucible.
- Place crucibles in a cool muffle furnace. Use tongs, gloves and protective eyewear if the muffle furnace is warm.
- Ignite 10-12 hours (or overnight) at about 550°C until the sample becomes white or grey.
- Turn off the muffle furnace and wait to open it until the temperature has dropped to at least 250°C, open the door carefully to avoid losing ash that may be fluffy.
- Using safety tongs, quickly transfer crucibles to a desiccator. Cover the crucibles, close the desiccator and allow to cool prior to weighing.

Total ash content present in tamarinde seed candy = 1.03%

### **Protein Analysis:-**

#### **Kjeldahl method :-**

The Kjeldahl method was developed in 1883 by a brewer called Johann Kjeldahl. A food is digested with a strong acid so that it releases nitrogen which can be determined by a suitable titration technique. The amount of protein present is then calculated from the nitrogen concentration of the food. The same basic approach is still used today, although a number of improvements have been made to speed up the process and to obtain more accurate measurements. It is usually considered to be the standard method of determining protein concentration. Because the Kjeldahl method does not measure the protein content directly a conversion factor (F) is needed to convert the measured nitrogen concentration to a protein concentration. A conversion factor of 6.25 (equivalent to 0.16 g nitrogen per gram of protein)



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is used for many applications, however, this is only an average value, and each protein has a different conversion factor depending on its amino-acid composition. The Kjeldahl method can conveniently be divided into three steps: digestion, neutralization and titration.

### Principles:-

The food sample to be analyzed is weighed into a digestion flask and then digested by heating it in the presence of sulfuric acid (an oxidizing agent which digests the food), anhydrous sodium sulfate (to speed up the reaction by raising the boiling point) and a catalyst, such as copper, selenium, titanium, or mercury (to speed up the reaction). Digestion converts any nitrogen in the food (other than that which is in the form of nitrates or nitrites) into ammonia, and other organic matter to CO<sub>2</sub> and H<sub>2</sub>O. Ammonia gas is not liberated in an acid solution because the ammonia is in the form of the ammonium ion (NH<sub>4</sub><sup>+</sup>) which binds to the sulfate ion (SO<sub>4</sub><sup>2-</sup>) and thus remains in solution: N(food) (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> (1)

### Neutralization:-

After the digestion has been completed the digestion flask is connected to a receiving flask by a tube. The solution in the digestion flask is then made alkaline by addition of sodium hydroxide, which converts the ammonium sulfate into ammonia gas:



The ammonia gas that is formed is liberated from the solution and moves out of the digestion flask and into the receiving flask which contains an excess of boric acid. The low pH of the solution in the receiving flask converts the ammonia gas into the ammonium ion, and simultaneously converts the boric acid to the borate ion:



### Titration:-

The nitrogen content is then estimated by titration of the ammonium borate formed with standard sulfuric or hydrochloric acid, using a suitable indicator to determine the end-point of the reaction.



The concentration of hydrogen ions (in moles) required to reach the end-point is equivalent to the concentration of nitrogen that was in the original food (Equation 3). The following equation can be used to determine the nitrogen concentration of a sample that weighs *m* grams using a *x* M HCl acid solution for the titration: (5)

Where *v<sub>s</sub>* and *v<sub>b</sub>* are the titration volumes of the sample and blank, and 14g is the molecular weight of nitrogen *N*. A blank sample is usually run at the same time as the material being analyzed to take into account any residual nitrogen which may be in the reagents used to carry out the analysis. Once the nitrogen content has been determined it is converted to a protein content using the appropriate conversion factor. Protein – F%N.

Total protein content present in the tamarind seed candy=13.05%





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### • **Fat/lipid Analysis :-**

#### **Principle-Soxhlet Extraction Method:-**

Lipid in food present in various forms like monoglycerides, diglycerides, triglycerides and sterol and free fatty acid and phospholipid and carotenoids and fat-soluble vitamins. Lipid is soluble in organic solvent and insoluble in water, because of this, organic solvents like hexane, petroleum ether have the ability to solubilize fat and fat is extracted from food in combination with the solvent. Later the fat is collected by evaporating the solvent. Almost all the solvent is distilled off and can be reused.

#### **Solvent Properties**

Primarily solvents like hexane and petroleum ether are in use due to their low boiling point. In addition to it, the solvent possesses following properties:

1. Distribution Coefficient: This is the ratio (at equilibrium) of the concentration of solute in the extract and raffinate phases.
2. Selectivity (Separation Factor): If there are more than one solutes, then we have to for the appropriate solvent due to the chances of intermixing.
3. Insolubility of Solvent: The solvent should have low solubility in the feed solution.
4. Recoverability: The solvent should be thermally stable at the distillation temperature due to its volatility.
5. Density: Density should be lower than water.
6. Interfacial Tension: The larger the interfacial tension, the more difficult the dispersion of one liquid in the other will be.
7. Chemical Reactivity: The solvent should be stable chemically and inert.
8. Non-toxic



#### **Preparing the sample**

First of all, we have to dry the product and remove moisture in order to facilitate entry of the organic solvent, because moisture restricts the entry of organic solvent. Then size reduction is there to increase the surface area and due to it, there is larger exposed surface. After this, we go for acidic hydrolysis which helps in breaking of protein fat emulsion and increases the availability of fat for the solvent. Furthermore, we can collect the solvent by distillation

#### **Requirements**

- Weight balance
- Soxhlet apparatus
- Drying oven
- Thimble
- Heating mantle
- Glass rod
- Desiccator with silica gel
- Petroleum ether (Boiling temperature 60°-80°C)
- Cotton plugs



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### Soxhlet method:

#### Procedure:

- First of all, rinse all the glass apparatus by petroleum ether and dry it in the oven at 102°C and after removing it keep in the desiccator.
- Weigh 5 gram of grounded and dried sample and place it in the thimble.
- Place the thimble in the soxhlet extractor.
- Take a 150ml round bottom flask and clean it and fill the flask with 90 ml petroleum ether.
- Place the whole setting on a heating mantle and allow the petroleum ether to boil.
- Continue the extraction process for several hours, almost 6 hours.
- Remove the condensing unit from extraction unit and allow the sample to cool down. Finally, it removes all the lipid.
- Collect almost all the solvent after distillation.
- Place the sample in the oven and after removing it place in the desiccator.
- Take the weight of the sample.
- As a result, we get a de-fat sample.

#### Calculation:-

Empty thimble =  $w_1$

Thimble with sample =  $w_2$

Weight of sample =  $p$

Then crude fat percentage i.g. =  $(w_2 - w_1) / p \times 100$

This method is an efficient method to extract all the fat present in the food.

## VI. CONCLUSION

A detailed conclusion for tamarind jaggery candy could be as follows:

The development of tamarind jaggery candy demonstrates the potential of using natural, nutrient-rich ingredients to create a healthier and flavorful confectionery product. Tamarind, known for its distinct tangy flavor and high antioxidant content, complements the rich, caramel-like sweetness of jaggery, a traditional unrefined sweetener packed with minerals such as iron, calcium, and magnesium. The combination of these two ingredients not only enhances the sensory properties of the candy, such as taste, aroma, and texture, but also offers significant health benefits, making it an appealing option for health-conscious consumers.

The incorporation of jaggery instead of refined sugar helps to lower the glycemic index of the product, providing a slow release of energy and minimizing the risk of sudden blood sugar spikes. Moreover, the addition of tamarind, which contains organic acids, dietary fiber, and vitamins, supports digestive health and boosts the immune system. Together, these ingredients make tamarind jaggery candy a functional snack that appeals to both traditional and modern consumer preferences.

From a food technology perspective, the formulation and process optimization of tamarind jaggery candy involve careful consideration of ingredient proportions, cooking temperatures, and packaging techniques to ensure a desirable shelf life, consistent quality, and safety. Addressing challenges like stickiness and maintaining product stability is crucial to commercial viability.

Overall, tamarind jaggery candy stands out as a promising innovation in the confectionery sector, aligning with current consumer trends toward natural and healthier food products. It also encourages the use of traditional ingredients, promoting sustainable practices and supporting local agriculture. This product has the potential to diversify confectionery markets while meeting the demand for nutritious and tasty snacks.

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