FORMULATION AND DEVELOPMENT OF HERBAL COCONUT CANDY ENRICHED WITH *ASPARAGUS RACEMOSUS* (SHATAMUL) STARCH

A PROJECT REPORT

BY

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Submitted to the Department of Nutrition and Food Engineering in the partial fulfillment of B.Sc. in Nutrition and Food Engineering.

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APPROVAL

This Project titled "**Formulation and Development of Herbal Coconut Candy Enriched with *Asparagus racemosus* (Shatamul) Starch**", submitted by **Shahin Alam** to the Department of Nutrition and Food Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Nutrition and Food Engineering and approved as to its style and contents.

EXAMINING COMMITTEE

Chairman of the Board _____ _____

External Member _____ _____

Internal Member-1 _____ _____

Internal Member-2 _____ _____

DECLARATION

I declare that I have completed this project under the supervision of ‘‘**Dr. Md. Bellal Hossain, Dean & Professor,”** Faculty of Health and Life Sciences (FHLS), Department of Nutrition and Food Engineering, Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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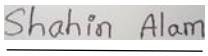

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ABSTRACT

This research project focuses on formulating and evaluating an herbal candy using *Asparagus racemosus* (Shatamul) root starch and coconut powder as major ingredients. Herbal functional and nutraceutical food is strong support for maintaining health and promoting optimal healthcare, longevity, vitality, and quality of life. Shatamul is traditionally used for its health benefits, including hormone regulation, immune support, and antioxidant properties, while coconut powder is rich in healthy protein and dietary fiber—the research aimed to develop an innovative functional candy that delivers these health benefits in a convenient form. Experiments were conducted to determine the ideal balance between active ingredient efficacy and consumer acceptability. In the Nutrition and Food Engineering's departmental laboratories for baking confections and processing of foods, the nutritional value and sensory characteristics of herbal candy have been evaluated. This herbal candy has a balanced nutritional formulation, containing 3.50% moisture, 1% ash, 4.2% protein, and 0.17% fat. It contains 91.13% carbohydrates, making it an excellent source of energy. It has a superb sweetness level, with a Brix of 82%. Its acidic nature impacts its flavor quality, as evidenced by its pH of 4.20. Color, texture, flavor, and overall acceptability were all rated favorably by the sensory evaluation, with "Liked Very Much" being the most often given response in every single category. Analyses suggested that the most suitable combination preserved the bioactive components of the herb while providing an excellent taste. Feedback from consumers indicated a high level of acceptability, indicating that Shatamul herbal candy might be marketed as a healthy and wellness-promoting treat.

Keywords: Herbal candy, functional food, sensory evaluation, health care.

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CHAPTER 1

INTRODUCTION

1.1 Introduction:

Candy is a semisolid medicinal formulation. Candy is a delightful, delicate treat that everyone enjoys. Compared to synthetic products, herbal ones have fewer adverse effects. It is a well-liked product that is consumed by both young and old. The main component, sugar, provides an immediate energy boost and is typically combined with various flavors and multi-therapeutic herbs. Products that originate from herbs are more beneficial to health and have more therapeutic effects. Herbs used in candy production have the following benefits: they are safe, effective, have fewer side effects, are compatible with the human body, and are widely accepted across cultures. Herbal candies are an effective way to supply vitamins, minerals, and a variety of bioactive substances, such as ascorbic acid, lycopene, and anthocyanin. (Kailey, Rasane, & Singh, 24 October, 2023) Several types of candies and toffees have been developed using different fruits singly or combined. These are called fruit candies or toffees. Fruits, which are commonly used for the preparation of candies, are bananas, apples, pears coconut, etc. (Bhise, March 2019) In India and Persia, hard candies called nabaat and mishri were popular. The very first sugary confections were made in the early ninth century. (Gholamhosseinpour, Varidi, & M, 2008) For the reason of their high-calorie content, flavor, and palatability, candies are regarded as immediate energy sources. They are simple to prepare, pack, move, and store. (A & T. C., 2006)

Plants always played a significant role in medication, and since the nineteenth century, when scientific research on drugs first began, herbs have served as an essential resource for the identification of compounds with biological activity. (al. H. W., 2009) Plants significantly influence medication development and play a vital role in human health as they provide herbal remedies, commonly referred to as phytopharmaceuticals or botanicals. (al. J. W., 2014) The functional qualities of an ingredient define how it behaves during cooking and prepping and affect the final food items' look, flavor, and perceptual experience. They affect how food molecules behave throughout manufacturing, preservation, getting ready, and absorption. (Kinsella, 1982) Nutritional foods and nutraceuticals are a superior option for improving human health, reducing diseases, and assisting rural communities in their overall development. Functional food items and dietary supplements are a rapidly increasing notion in the market because people are becoming more mindful of their health, which has raised their market share. It has biologically active components that could improve the nutritional value of meals. Customers know the critical role nutritional products play throughout medical care and illness treatment. (SA., 2012)

The main bioactive elements of asparagus are steroidal saponins and terpentene saponins. This plant also contains vitamins A, B1, B2, C, E, magnesium, phosphorus, calcium, iron, and folic acid, as well as other primary chemical components of Asparagus contain essential oils,

asparagines, arginine, tyrosine, flavonoids (Kaempferol, Quercetin, and Rutin), resin, and tannic steroidal glycosides (asparagosides), bitter glycosides, asparagines, and flavonoids. The majority of the phenolic chemicals found in A. racemosus are phytoestrogens and flavonoids with oestrogenic action, such as isoflavones, couestans, and prenylated flavonoids. The roots of A. racemosus are utilized to create Ayurvedic Rasayana, which enhances longevity, boosts immunity, prevents aging, and increases vitality. The root extract has antidiabetic, antiulcer, antioxidant, and antidiarrheal properties. (Suse, Sahoo, Patil, & Suse, 2019)

In the Indian subcontinent, the medical benefits of coconuts have long been recognized. (Joshi S, Kaushik V, & Mhaskar S., 2020) The coconut's water, milk, and oil are all healthful & nourishing. Given its medicinal properties along with its nutrient content, coconut is also known as a "functional food". (Biswas K, Mohanta YK, & Kumar VB, 2020) Compared with various food items, coconut copra has a significant amount of potassium. (Appaiah, P., Sunil, L., & Prasanth Kumar, P., 2014) Coconuts play a significant part in the human diet due to the presence of key functional components. Coconut has more fatty acids, which provide increased health benefits. Coconut natural fat in the human diet helps to improve the anti-inflammatory function of the human immune system. (JH, AK, LM, & PS, 2014) Coconut-based snacks and confectionary goods, in which coconut is the major component, are widely popular.

1.2 Objective of the Study:

Developing coconut candy with herbal Shatamul starch introduces a unique twist by incorporating medicinal herbs into a sweet treat. Here are some potential objectives for producing coconut candy with herbal Shatamul starch:

1. **Nutritional Enhancement:** Enhance the nutritional profile of traditional herbal candy by incorporating coconut, which provides healthy fats, and Shatamul herbal powders, known for their potential health-promoting properties.

2. **Health benefits:** Numerous health advantages of *asparagus racemosus*, such as immunological aid, intestinal wellness, regulation of hormones, and general vigor, are attributed to its active ingredients and nutritional makeup.

3. **Functional Ingredient Fortification**: Integrate Shatamul herbal starch as functional ingredients to add medicinal and nutritional value, promoting overall well-being.

4. **Taste and Texture:** Herbal candy offers health benefits and meets high taste and texture standards to ensure consumers' satisfaction and acceptance.

CHAPTER 2

LITERATURE REVIEW

2.1 Herbal Candy

Herbal candy is a type of confectionery made especially for soothing sore throats. In contrast to regular sweets, herbal candy is made using natural components derived from medicinal plants and herbs, which are well-known for their calming and restorative capabilities. These candies are frequently used to treat coughs, sore throats, and other respiratory conditions. They have the purpose of providing immediate relief by reducing sore throats and improving overall comfort. (Patricia & Monteiro, 2005) Herbal candies contain a variety of botanical substances with expectorant and anti-inflammatory properties, such as clove, ginger, honey, and other herbal extracts. By relieving congestion, opening up the airways, and decreasing inflammation, these herbs are believed to help lessen the symptoms of coughing. In addition to their potential health benefits, herbal candies are well-liked for their tasty flavor and ease of usage. (Prerana M., Ravina B., Gopal S., & Deshmukh, 17 Feb. 2024) Herbal candies are growing in popularity as consumers prefer natural options over conventional medicine. Companies are creating unique combinations like lavender-mint and turmeric-ginger to appeal to modern tastes. Many businesses are adopting eco-friendly packaging to attract environmentally-conscious consumers.

2.2 Coconut powder: Coconut is considered a healthy food and hence there is a high demand for shifting the market towards value-added products such as coconut milk, coconut cream, coconut vinegar, etc as mentioned above. Coconut has great culinary, medicinal, cosmetic, and industrial applications; therefore, all efforts should be made to promote the value-added products of coconut at the national and global level. (A, Gabriela John, Prema R, & Chandrasekar , December 2013)

Coconut Nutritional and Health Benefits: The coconut provides a wholesome and nutritious source of meat, water, milk, and oil. Coconut is also considered a 'functional food' because it provides additional health benefits apart from its nutritional constituents. (A, Gabriela John, Prema R, & Chandrasekar , December 2013) The essential minerals in desiccated coconut powder support overall wellness. It is rich in dietary fiber, aiding in the regulation of bowel movements and digestion, both of which benefit gut health.

2.3 *Asparagus racemosus* (Shatamul): In Ayurveda, this amazing herb is known as the "Queen of herbs", because it promotes love and devotion. Shatavari is women's primary Ayurvedic rejuvenation tonic, while Withania is for men. Asparagus racemosus (family Asparagaceae), popularly known as Shatamul, is one of the well-known medications in Ayurveda, effective in treating Madhur rasam, Madhur vipakam, seet-veeryam, som rogam, chronic fever, and internal heat. (VM., 2000)

Scientific classification of *Asparagus racemosus* (Shatamul)

Kingdom: Plantae

Clade: Angiosperms

Clade: Monocots

Order: Asparagales

Family: Asparagaceae

Subfamily: Asparagoideae

Genus: Asparagus

Species: A. racemos

Figure 1: A. racemosus

It was botanically described in 1799. (United States: Department of Agriculture, 2009) A combination of destructive harvesting, habitat damage, and deforestation, the plant is currently considered endangered in its natural environment. *A. racemosus* is used in Ayurvedic scriptures to prevent and treat gastrointestinal ulcers, dyspepsia, and as a galactagogue. Some Ayurvedic practitioners have effectively employed *A. racemosus* to treat neurological problems. (Goyal , Singh , & Lal , 2003)

Shatamul Starch Nutritional and Health Benefits: Asparagus is a well-known source of asparagine, a non-essential amino acid for humans. Asparagine, a beta-amino derivative of aspartic acid, is essential for producing glycoproteins and other proteins. (Bishnoi, Gehlot, & Kaushik, 10 March 2018). In Ayurveda, dyspepsia is treated using powdered dried root of *A. racemosus*. It has been observed that giving healthy volunteers powdered dried *A. racemosus* root orally improves stomach emptying. According to reports, it functions similarly to the synthetic dopamithene antagonist metoclopramide. (Dalvi , Nadkarni , & Gupta , 1990)

CHAPTER 3

MATERIALS AND METHODS

3.1 Collection of Raw Materials

Desiccated coconut powder and *Asparagus racemosus* (Shatamul) were purchased from the local market under quality standards.

3.1.1 Preparation of *Asparagus racemosus* (Shatamul) root powder

Shatamul's roots were first cut off from their limbs, then afterward watered, chopped into little pieces, and dried at 60°C over six hours. After that, it was carefully filtered and ground into a powder. The substance was kept cool and dry after being put in a Plastic container.

3.2 Preparation of Herbal Candy

Materials:

- *Asparagus racemosus* (Shatamul) root powder
- Desiccated Coconut powder
- Sugar
- Corn Syrup
- Water
- Citric Acid
- Raspberry Red Color
- Raspberry Flavor

Table 1: Formulation of Herbal Candies

Ingredient	Amounts				
	T0	**T1**	**T2**	**T3**	**T4**
Sugar (gm)	100	100	100	100	100
Corn syrup (ml)	50	50	50	50	50
Water (ml)	18	18	18	18	18
Citric acid (gm)	0.25	0.25	0.25	0.25	0.25
Coconut powder (gm)	5	5	5	5	5
Shatamul powder (gm)	0	1	2	3	4

3.3 METHODS

Diagram of Herbal Candy

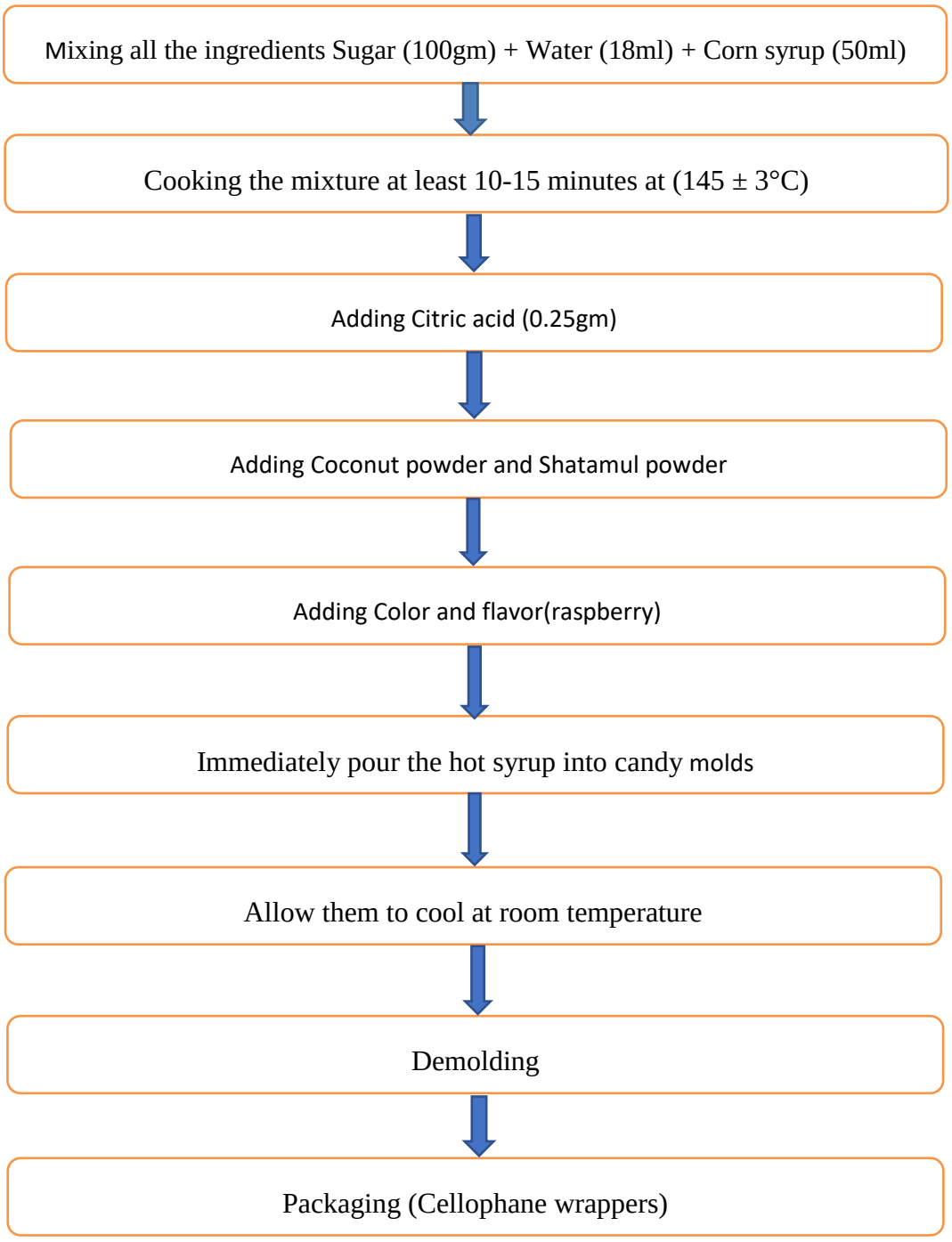

Figure 2: Mix Ingredients cooking

Figure 3: Candy Syrup Pour in Candy Molds

Figure 4: Final Candy Product

3.4 Physiochemical Properties

3.4.1 Determination of pH

Apparatus:

- pH meter
- Beaker

Reagent:

- Buffer pH: 1
- Buffer pH: 2

Procedures:

First, turn on the pH meter. Use buffers 1 and 2 to calibrate the pH meter. Place 2gm of crushed candy sample into a beaker and add 10ml of distilled water to create a solution of candy. Then immerse the electrode in the sample beaker. Finally, check the pH meter's display for the reading. Repeat tests several times to get the average pH value and obtain accurate results.

Figure 5: pH meter (Milwaukee100, Romania)

3.4.2 Determination of Moisture Content

Apparatus:

- Moisture analyzer
- Aluminum foil
- Weight balance
- Sample

Procedures:

For the determination of moisture content, a 2gm candy sample was taken. Then carefully transfer the sample into a digital moisture analyzer and wait for the reading. Then take note of the result.

Figure 6: Aczet Digital Moisture Analyzer (Mb40, India)

3.4.3 Determination of Brix

Apparatus:

- Refractometer
- Dropper

Procedures:

To use the refractometer, clean the prism with distilled water and place a few drops on it. Close the cover plate to spread the water evenly, then adjust the calibration screw to read 0 Brix. Next, add one drop of the candy solution, close the cover plate, and record the Brix reading. Clean the prism with distilled water between samples to prevent cross-contamination. I used a 100-calibrated hand refractometer.

Figure 7: Refractometer (Atago Co Ltd., Japan)

3.4.4 Determination of Ash content

Apparatus:

- Measuring balance
- Muffle furnace
- Porcelain crucible
- Crucible tong
- Desiccator

Procedures:

Preheat a crucible in a hot air oven at 105°C for 30 minutes, cool it in a desiccator, and weigh the blank crucible. Add 2g of candy sample to the crucible and record the combined weight. Heat the crucible with the sample in a muffle furnace at 600-620°C for 6 hours. Finally, calculate the percentage of ash content.

Calculation: %Ash = (weight of sample/weight of dry ash) × 100

Figure 8: Muffle furnace (Thermo Fisher Scientific - United States)

3.4.5 Determination of Acidity

Materials:

- Burette
- Pipette
- NaOH (0.1N)
- Phenolphthalein indicator
- Distilled water
- Weight balance

Procedures:

Firstly, dissolve 10gm of candy sample + 90ml of distilled water in a beaker. Then pipette out 10ml of candy solution in a conical flask and add a few drops of phenolphthalein indicator. After that, Fill the burette with 0.1N NaOH solution. Then slowly add 0.1N NaOH to the candy solution while stirring. Stop when the solution color changes to pink color. Finally, record the burette reading and calculate it.

Calculation: Acidity (mol/L)= $\frac{MNaOH \times VNaOH}{V\ sample}$

Where:

M NaOH is the molarity of NaOH.

V NaOH is the volume of NaOH used (in liters).

V sample is the volume of the acidic sample (in liters).

3.4.6 Determination of Reducing Sugars (Benedict's test method):

Materials:

- Beaker
- Conical flask
- Pipette
- Distilled water
- Test tubes and test tube holders
- Water bath
- Weight scale

Procedures:

Preparation of Benedict's Reagent(100ml):

100 ml of Benedict's reagent can be prepared by mixing 1.73gm of copper sulfate pentahydrate (CuSO4.5H2O), 10 gm of sodium carbonate (Na2CO3), and 17.3 grams of sodium citrate in distilled water (required quantity). Distilled water is used as a solvent.

Testing for Reducing Sugars:

Firstly, dissolve 10gm of candy sample + 90ml of distilled water in a beaker. Then pipette out one (1) ml of candy solution in a test tube. One ml of the analyte sample must be mixed with 2 ml of Benedict's reagent. Place the test tube over a preheated (95°C) water bath and heat for 3-5 minutes. Record the color of the solution.

Interpreting the Results:

Figure 9: Thermostatic Water Bath (Labtek instrument co. ltd., China)

3.4.7 Determination of Fat

Apparatus:

- Weight balance
- Water bath
- Thimble
- n-HEXANE
- Filter Paper
- Soxhlet equipment

Procedure:

Fill the thimble with a 5g sample that has been crushed and dried to remove moisture. Insert the thimble into the 12 Soxhlet extractor. Pour 90 milliliters of n-hexane into a 150 ml flask with a round bottom. Place the entire apparatus on a heating mantle and bring the n-hexane to a boil. Continue the extraction procedure for six hours. Allow the sample to cool after removing the condenser from the extraction unit. Finally, all the fat is removed. After distillation, collect almost all of the solvent droplets. After collecting the samples from the oven, place them in the desiccators. Finally, Determine the weight of the sample.

Calculation:

Total Fat = (W2 – W1 / Ws) * 100
Sample weight = Ws
Before extracting fat, thimble = W1

After the fat is extracted, thimble with fat = W2

3.4.8 Protein determination

Digestion: Four grams of the material were placed on weighing or foil paper to support digestion. The material was transferred to a flask for digestion. After introducing two grams of the digesting mixture, add 10 milliliters of H2SO4 to the flask. Two digestion flasks were used to get an average figure. The flasks were boiled before being used in a Kjeldahl digesting chamber. The temperature at which the experiment began was 400 degrees Celsius. The temperature finally increased to 600 degrees Celsius. It takes three to four hours for the solution to turn colorless. To enhance the results, the procedure requires cooling the flasks and then carefully diluting them with 100 mL of distilled water.

Distillation: Ten milliliters of the solution were transferred from the flask to the distillation flask. The flask had 150 milliliters of distilled water added to it. The distillation flask contained ten milliliters of 40% NaOH. The mixture was colorless. This experiment involved three distillation flasks, one of which contained no material. The third distillation flask had only

chemicals, with no sample present. In comparison, a trapping conical flask contained fifty mL of clean water and ten mL of 0.1N HCl. The trapping conical flask was filled with two drops of methyl red. The solution turned pink. Three sets of the same conical trapping flasks were applied. The distillation process takes thirty minutes to complete using the operation. Conical flasks were used for the NaOH solution titration. To titrate, 0.1N NaOH was put into the burette. After that, conical trapping flasks were employed.

Titration: Placed for titration under the burette. The burette's trapping conical flask was slowly shaken as NaOH was added drop by drop. The color changed once the NaOH was added. The color eventually changed from pink to a bright yellow.

Calculation:

Protein (%) = (B−S)*1.4*10*6.25*0.1 /Sample weight

Where,
B is the volume of base used in titration
S is the volume of standard solution used in titration
1.4 is a factor to accounts for the conversion of nitrogen to protein
10 is a factor in converting the result to a percentage
6.25 is a conversion factor used because protein contains approximately 16% nitrogen

0.1 is the molarity (concentration) of the standard solution used in the titration

3.4.9 Determination of Carbohydrate Content:

The energy value of the hard candy was determined by using the unit calorific value of the basic nutrients, while the carbohydrate content was determined using the differential method.

Total carbohydrate content (%)

= 100 - total values (moisture (%) + ash (%) + fat (%) + fiber (%) + protein (%))

3.4.10 Sensory Evaluation

Sensory Evaluation of Herbal Candy

The field of sensory evaluation has implemented the use of the hedonic rating test. This study will evaluate how participants' hedonic responses are influenced by touch perception (texture), olfactory receptors (aroma), taste receptors (sweetness, sourness, etc.), and visual cues (color). The hedonic scale approach uses discrete stimulus presentation and a 9-point rating system that goes from "like extremely" to "dislike extremely." appropriate for various demographics. Hedonic tests are a useful tool for determining how much a product is liked or disliked. For example, determining consumer acceptance of a new product idea or evaluating the market leaders' favorability with that of standard products.

- A hedonic scale is a definitive method that employs a variety of expressions to accurately represent the degrees of like and dislike.
- To assess preferences, use kid-friendly language, facial expressions, and a 9-point evaluation method.
- Tasters can also provide opinions regarding the product's appearance, smell, taste, and texture.
- In the end, we have to assess the results.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Composition of Proximate Elements:

This herbal candy sample's proximity provides significant details about its overall quality and nutritional content. The sample of herbal candy contains a moisture percentage of almost 3.5%, whereas the available hard candies have a moisture content of around 2-5%. The Brix value of 82% indicates the candy's sweetness, as Brix is commonly used to measure sugar concentration. The protein content is 4.2%, which is an adequate supply of protein for macronutrients. Because of its low profile and low-fat content of 0.17%, it is an excellent option for any individual seeking lower-fat dietary options. Carbohydrate level is 91.13%, It indicates a good source of energy.

The pH value of 4.2 means the herbal candy is slightly acidic, contributing to its possible shelf-life stability. The ash content is 1.20% which represents inorganic mineral content. This gives information on the mineral balance of the herbal candy and how much could add to the total amount of minerals consumed through eating.

Table 2: Proximate composition of Herbal Candy.

Parameter	**Herbal Candy**
Moisture (%)	3.5 ±0.04
Ash (%)	1.0 ±0.04
Protein(g)	4.2 ±0.04
Total Fat(g)	0.17 ±0.03
Brix (%)	82 ±0.01
pH	4.0-4.20
Reducing sugar (%)	1.5-2.0
Acidity	0.65±0.01
Total Carbohydrate (%)	91.13±0.02

4.2 Sensory Quality Attributes

4.2.1 Sensory quality of Herbal candy:

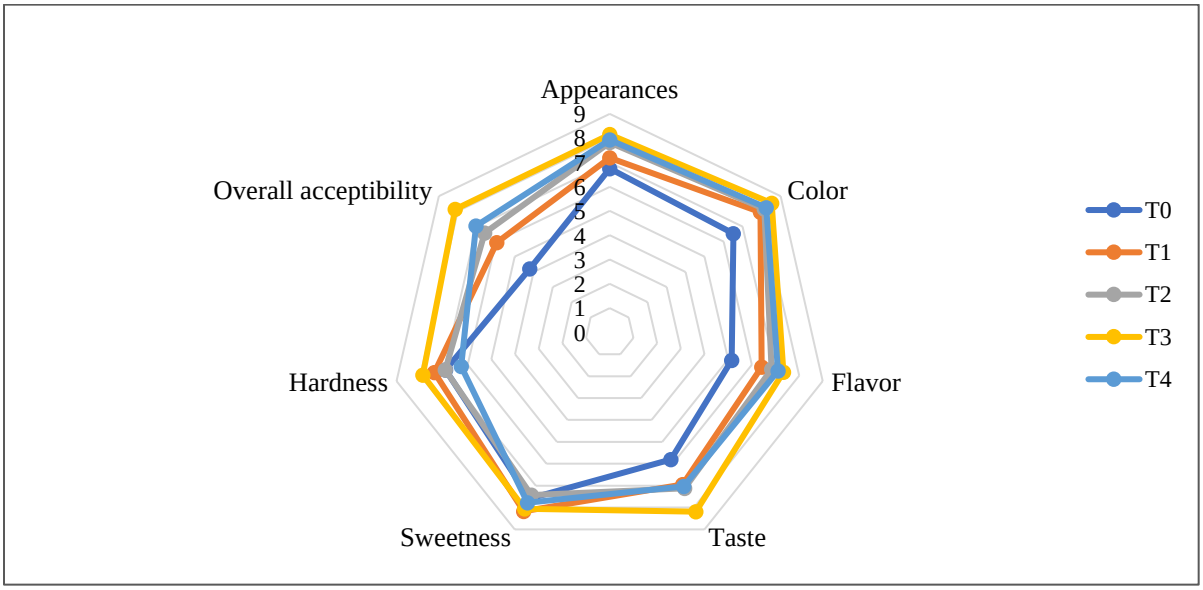

Figure 10: Sensory perception of Herbal candy

Correlation: The chart shows a positive correlation between samples and sensory scores. Sample T3 receives the highest ratings, particularly in Appearance, Overall Acceptability, and Flavor, indicating its strong impact. In contrast, T0 scores the lowest, suggesting beneficial modifications in the samples. Samples T1 and T2 also show slight improvements over the baseline (T0), but T3 is the most preferred option.

Discussion: The radar chart shows that sample T3 excels in Appearance, Overall Acceptability, and Flavor, making it the most preferred option. In contrast, T0, the control sample, received the lowest scores, especially in Overall Acceptability and Flavor. Samples T1 and T2 showed moderate improvements, with T1 slightly better in Sweetness and Color. Overall, T3 was the most effective sample, indicating significant enhancements in the product's sensory qualities.

4.2.2 Appearance: The panelists rated T3 to be more acceptable in terms of color, with a maximum mean value of 8.15 and the lowest mean value of 6.75 for T0.

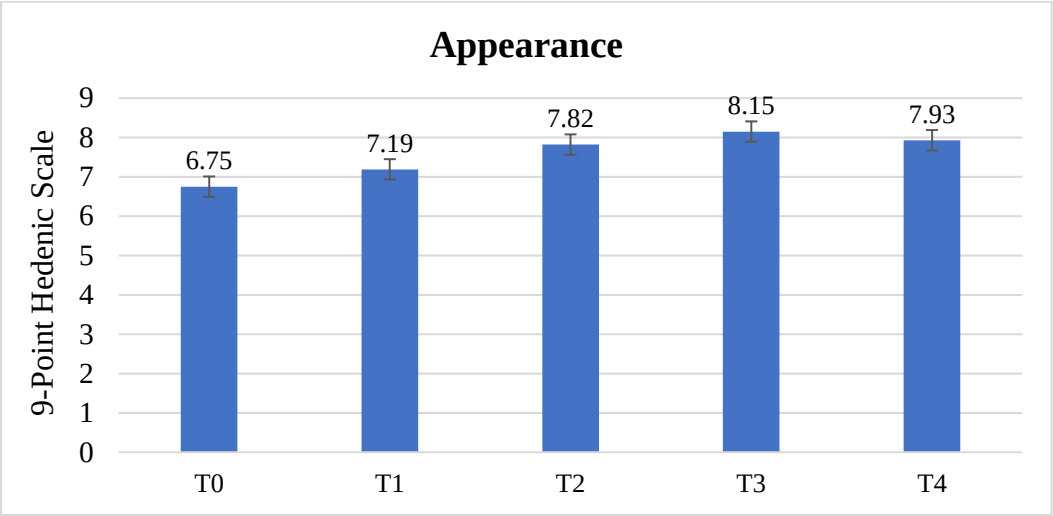

Figure 11: Column displaying appearance variations

Discussion: The graph displays the appearance scores of five samples (T0 to T4) on a 9-point hedonic scale, showing a clear improvement from T0 (6.75) to T3 (8.15). T0, the control sample, had the lowest score, while T3 was the most visually appealing sample. T2 (7.82) and T4 (7.93) also scored well, though lower than T3. Overall, the data indicates that the samples enhanced the product's appearance, with T3 being the most effective. Notably, T3 and T4 had a minimal score difference.

4.2.3 Color: The panelists rated T3 to be more acceptable in terms of color, with a maximum mean value of 8.53 and the lowest mean value of 6.52 for T0.

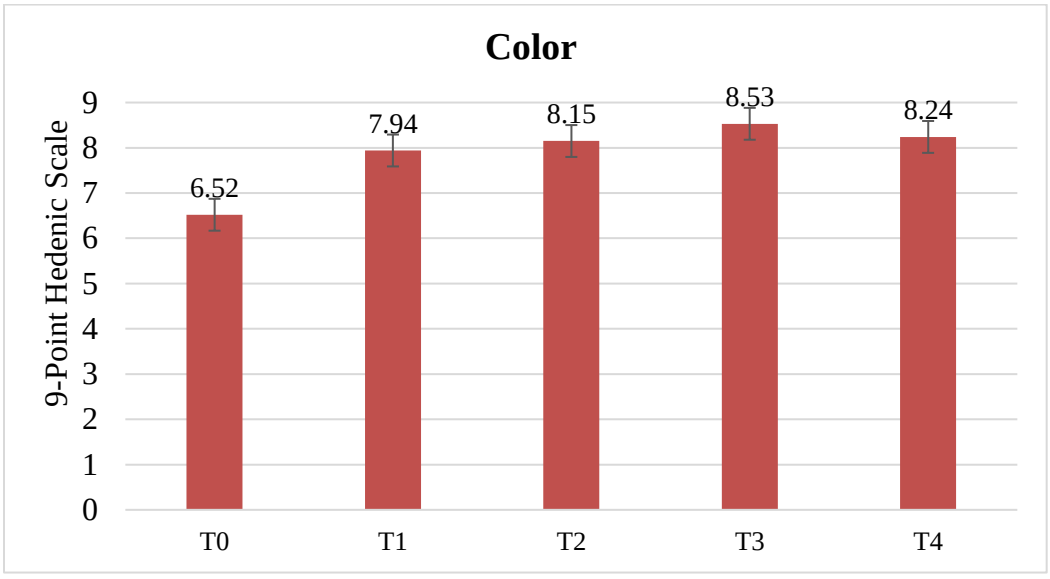

Figure 12: Column displaying Color variations

Discussion: The color scores demonstrate a significant improvement across the samples. Sample T3 had the highest score of 8.53, indicating the most favorable color, while the control sample (T0) scored the lowest at 6.52. Samples T1, T2, and T4 showed moderate improvements, but T3 was the most visually appealing. Overall, these results indicate that the samples effectively enhanced the product's color, with T3 being the most successful.

4.2.4 Flavor: The panelists rated T3 to be more acceptable in terms of flavor, with a maximum mean value of 7.34 and the lowest mean value of 6.15 for T0.

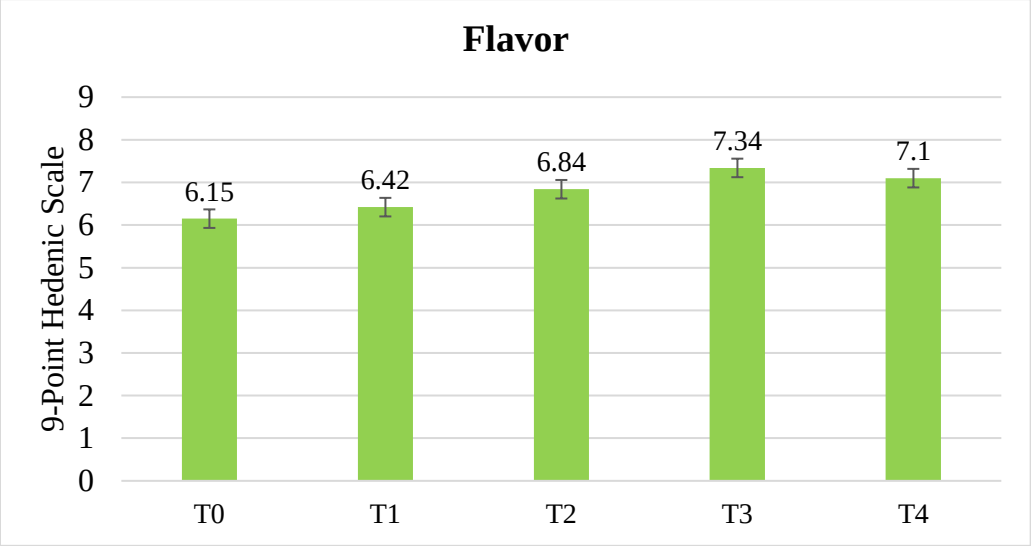

Figure 13: Column displaying Flavor variations

Discussion: The flavor scores demonstrate a clear upward trend from T0 to T3. T0 received the lowest score of 6.15, while T3 achieved the highest score of 7.34. T1, T2, and T4 scored progressively higher than T0, with T3 being the most favored for its flavor. This indicates that the modifications made in the samples were effective in enhancing flavor, with T3 being the most successful in improving this sensory attribute.

4.2.5 Taste: The panelists rated T3 to be more acceptable in terms of taste, with a maximum mean value of 7.38 and the lowest mean value of 5.81 for T0.

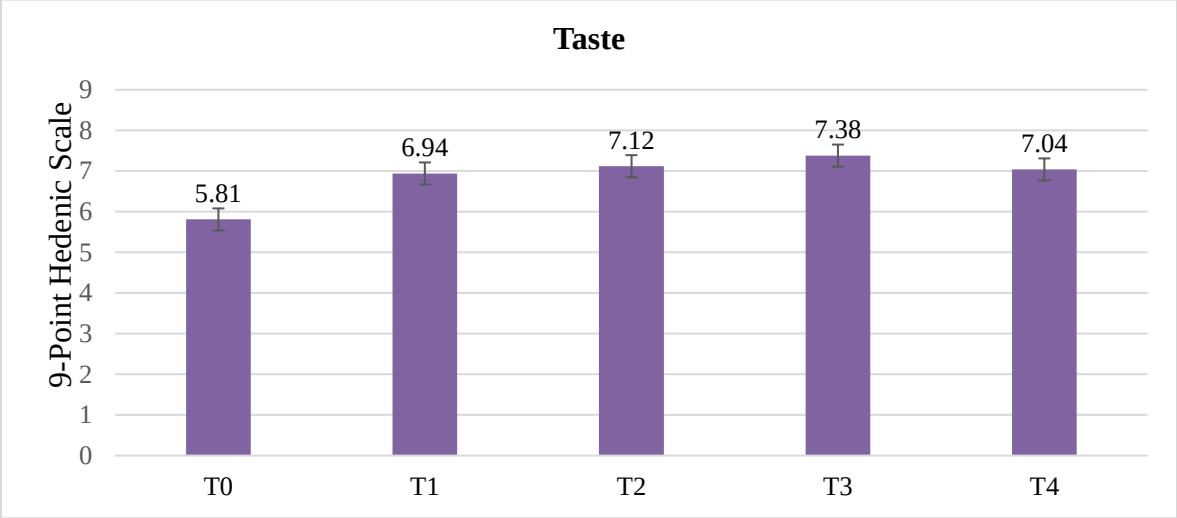

Figure 14: Column displaying Taste variations

Discussion: The taste scores indicate a clear improvement from T0 (5.81) to T3 (7.38), with T3 being the most preferred sample. T1 (6.94) and T2 (7.12) also showed progressive enhancements over T0, while T4 (7.04) experienced a slight decline in comparison to T3. These results suggest that the samples effectively improved the product's taste, with T3 achieving the best overall balance and preference.

4.2.6 Sweetness: The panelists rated T1 as more acceptable regarding taste, with a maximum mean value of 8.17 and the lowest mean value of 7.43 for T2.

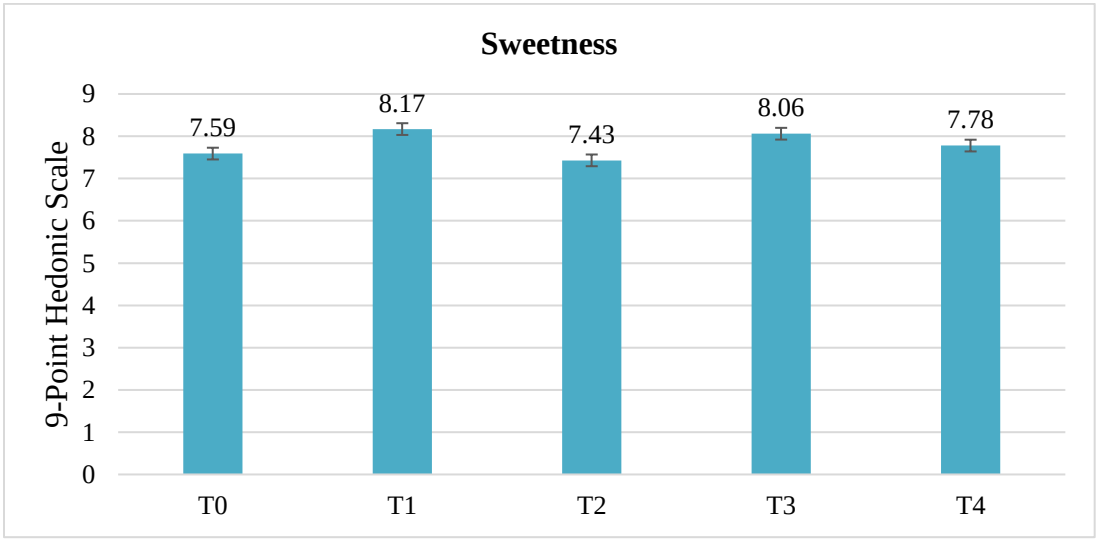

Figure 15: Column displaying Sweetness variations

Discussion: The sweetness ratings indicate that T1 achieved the highest score of 8.17, followed closely by T3 at 8.06 and T4 at 7.78, making these the most preferred samples. In contrast, T0 received a score of 7.59 and T2 scored 7.43, which are comparatively lower. These results highlight how effective the modifications were in enhancing sweetness, with T1 demonstrating the best overall balance. The findings underscore the importance of these samples in improving sweetness perception, thereby contributing to overall sensory satisfaction.

4.2.7 Hardness: The panelists rated T3 as more acceptable regarding taste, with a maximum mean value of 8.1 and the lowest mean value of 6.27 for T4.

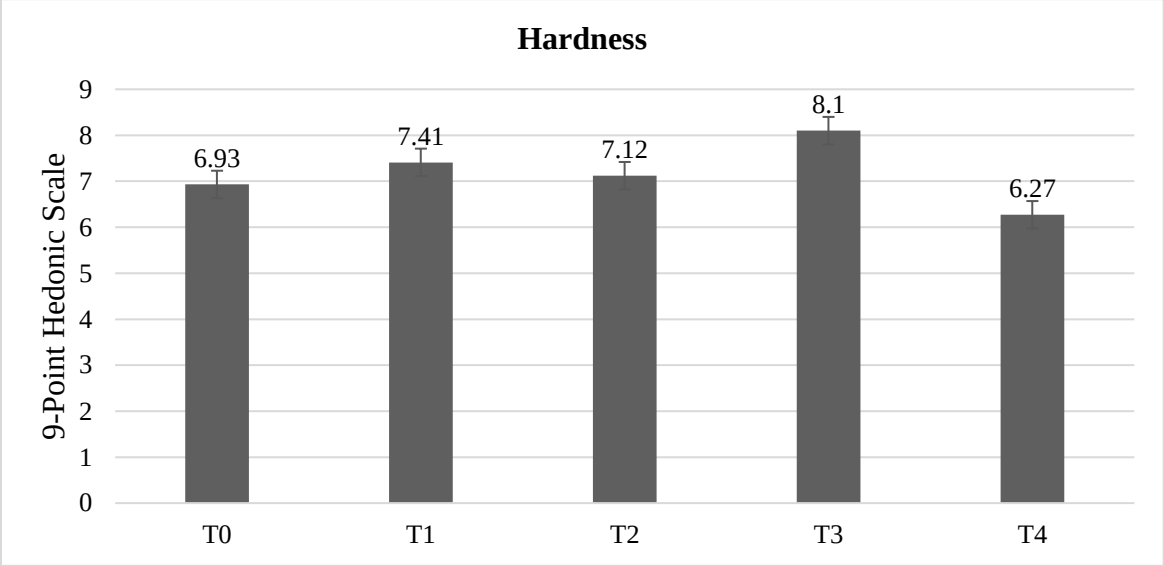

Figure 16: Column displaying Hardness variations

Discussion: The bar chart presents the hardness ratings of various samples (T0, T1, T2, T3, and T4) assessed using a 9-point hedonic scale. Among these samples, T3 achieved the highest hardness rating of 8.1, indicating the most favorable response. In contrast, T4 received the lowest rating of 6.27. T1 and T2 had intermediate hardness ratings of 7.41 and 7.12, respectively, while T0 (the control sample) scored 6.93, slightly above T4.

4.2.9: Overall Acceptability: The sensory evaluation of newly developed herbal candy showed encouraging outcomes in several categories (appearance, color, flavor, taste). In line with consumer expectations for herbal candy products, panelists gave the candy high ratings for taste, sweetness, and hardness. T3 had the greatest mean value of 8.13 in overall acceptability, while T0 had the lowest mean value of 4.1. The serial other candy samples mean value were T1 at 5.94, T2 at 7.6.58, and T4 at 7.04. Therefore, the panelists' overall acceptance of the T3 candy sample was higher.

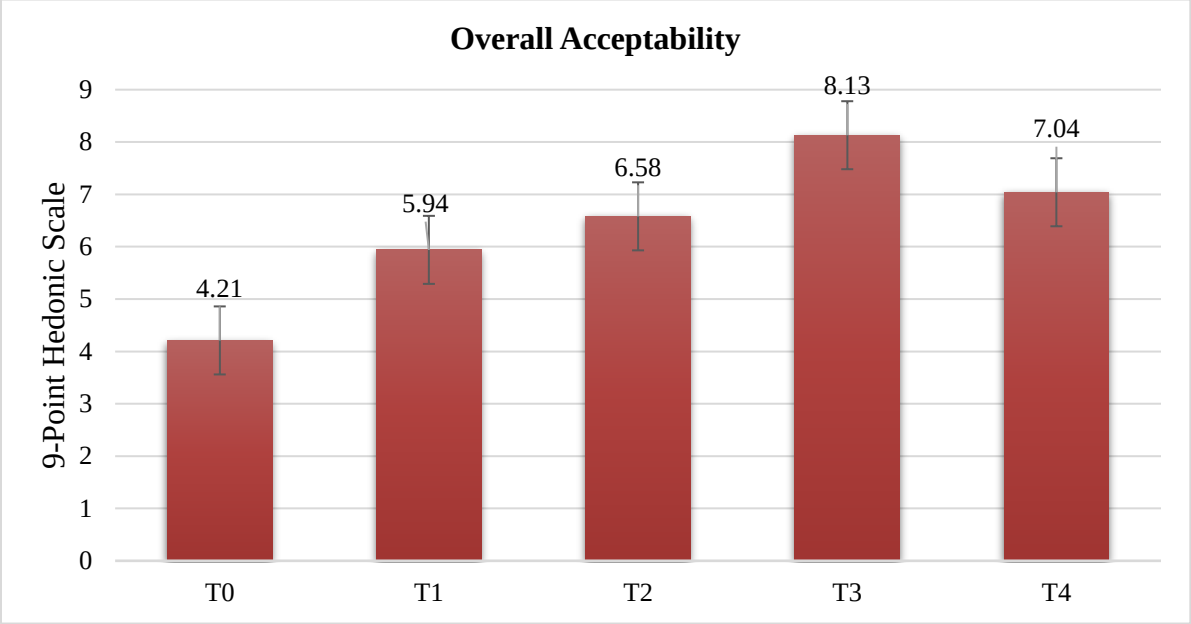

Figure 17: Column displaying Overall Acceptability variations

Discussion: The chart displays the overall acceptability of five samples (T0, T1, T2, T3, and T4) measured on a 9-point hedonic scale. Sample T3 received the highest acceptability rating of 8.13, indicating it was the most preferred option among the samples. In contrast, T0 had the lowest rating of 4.21, reflecting poor acceptability. Samples T1 (5.94) and T2 (6.58) demonstrated moderate improvements over T0 but did not achieve the high level of acceptance seen with T3. Sample T4 scored 7.04, which, while lower than T3, represents a significant improvement compared to T0, T1, and T2. The results show a strong positive correlation between samples and overall acceptability from T0 to T3, with the optimal formulation achieved at T3. The decline in T4 suggests some sensory attributes affecting acceptability may have been compromised, despite its relatively high score. T0's low rating points to the need for improvement, while T3's strong performance highlights its effective balance of attributes. This decline in T4 emphasizes the importance of maintaining optimal conditions. Overall, T3 is the most successful sample and serves as a benchmark for future development.

CHAPTER 5

CONCLUSION

5.1 Conclusion

The findings of the study indicate that shatamul (Asparagus racemosus) and desiccated coconut powder are used to make herbal candy with good sensory qualities and an optimal level of components. Coconut powder and shatamul (Asparagus racemosus) herbal powder both have higher nutritional and functional value. The herbal powder that stops aging, boosts immunity, extends life, and gives the body vigor is also used to treat infertility, impotence, erectile dysfunction, galactagogue, and poor sexual activity. The thesis research has explored the intricate history of herbal candy, offering insights into a range of topics such as commercial dynamics and cultural significance. It is evident from analyzing the survey answers of 60 participants that sample T3 was the most popular option. The majority of people thought it was good, and nobody had any issues with it. They considered sample T3 enjoyable. Following customers' increased inclination for healthier food choices, herbal candy can be seen as an acceptable and nutritious snack option. This study is subject to some constraints.

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APPENDICES

Appendix 1: Sensory Evaluation Data Set

Thesis Title: Development of Herbal Coconut Candy by using Shatamul (Asparagus racemosus) Starch

Sensory Evaluation

Gender **Date:**

- ☐ Male
- ☐ Female

Age Group: **Sample Code:** 122, 233, 344, 455, & 566

- ☐ 18-25
- ☐ 26-30
- ☐ 31-40
- ☐ 40 Above

Evaluation Parameter	9-Liked Extremely	8-Like very much	7- Like moderately	6- Like slightly	5-Neither like or dislike	4-Dislike slightly	3- Dislike moderately	2-Dislike very much	1-Dislike extremely
Appearance									
Color									
Flavor									
Texture									
Taste									
Sweetness									
Hardness									
Overall acceptability									

Signature

Appendix 2: Synopsis

Department of Nutrition and Food Engineering (NFE)
Faculty of Health and Life Sciences (FHLS)
Daffodil International University (DIU)

Daffodil Smart City, Birulia, Savar, Dhaka – 1216, Bangladesh

Synopsis of the thesis

Name: Shahin Alam

ID:193-34-987

Project title: Formulation and Development of Herbal Coconut Candy Enriched with *Asparagus racemosus* (Shatamul) Starch.

1. Introduction:

Candy is a semisolid medicinal formulation. Candy is a delightful, delicate treat that everyone enjoys. Compared to synthetic products, herbal ones have fewer adverse effects. It is a well-liked product that is consumed by both young and old. The main component, sugar, provides an immediate energy boost and is typically combined with various flavors and multi-therapeutic herbs. Products that originate from herbs are more beneficial to health and have more therapeutic effects. Herbs used in candy production have the following benefits: they are safe, effective, have fewer side effects, are compatible with the human body, and are widely accepted across cultures. Herbal candies are an effective way to supply vitamins, minerals, and a variety of bioactive substances, such as ascorbic acid, lycopene, and anthocyanin. (Kailey, Rasane, & Singh, 24 October, 2023) Herbal candy is a type of confectionery made especially for soothing sore throats. In contrast to regular sweets, herbal candy is made using natural components derived from medicinal plants and herbs, which are well-known for their calming and restorative capabilities. These candies are frequently used to treat coughs, sore throats, and other respiratory conditions. They have the purpose of providing immediate relief by reducing sore throats and improving overall comfort. (Patricia & Monteiro, 2005)

2. Objectives:

Developing coconut candy with herbal Shatamul starch introduces a unique twist by incorporating medicinal herbs into a sweet treat. Here are some potential objectives for producing coconut candy with herbal Shatamul starch:

1. **Nutritional Enhancement:** Enhance the nutritional profile of traditional herbal candy by incorporating coconut, which provides healthy fats, and Shatamul herbal powders, known for their potential health-promoting properties.

2. **Functional Ingredient Fortification**: Integrate Shatamul herbal starch as functional ingredients to add medicinal and nutritional value, promoting overall well-being.
3. **Taste and Texture:** Coconut candy offers health benefits and meets high taste and texture standards to ensure consumer satisfaction and acceptance.

3. Materials:

3.1 Ingredients:

- Granulated Sugar
- Corn Syrup
- Water
- Citric Acid
- *Asparagus racemosus* (Shatamul) root powder
- Desiccated Coconut powder
- Raspberry red color
- Raspberry flavor

3.2 Instruments:

- Cooking pot or kettle
- Stirring utensils
- Candy molds
- Weighing scale
- Grinder or food processor
- Packaging materials (wrappers)

4. Methodology:

A. Preparation of *Asparagus racemosus* (Shatamul) root powder and coconut powder: Shatamul's roots were first cut off from their limbs, then afterward watered, chopped into little pieces, and dried at 60°C over six hours. After that, it was carefully filtered and ground into a powder. The substance was kept cool and dry after being put in a Plastic container.

B. Candy mixture: Mixing all the ingredients Sugar + Water + Corn syrup and boil for at least 15 minutes at 145-150°C.

C. Adding *Asparagus racemosus* (Shatamul) root powder and coconut powder:
Once the sugar mixture reaches the correct temperature, add the prepared *Asparagus racemosus* (Shatamul) root powder and coconut powder to the mixture.

D. Adding color and flavor: After that add a few drops of color and flavor to the mixture.

E. Pouring and shaping: Pour the hot syrup into candy molds.

F. Packaging and storage: Allow the herbal candy to cool completely and package it with cellophane paper.

5. Place of the Study: Food Processing Lab, Department of Nutrition and Food Engineering, Daffodil International University

6. Period of the Study: I started my project work on 20 January 2024.

7. Supervisor: Dr. Md. Bellal Hossain, Professor & Dean, Faculty of Health and Life Sciences (FHLS)**,** Daffodil International University.

8. Expected outcomes:

- High Quality
- Extended shelf life
- Successful test
- Satisfied customers
- Consumer demand
- As per as product depends on quality

9. Conclusion: Creating Coconut candy with Shatamul starch can be a delightful and health-conscious treat. This unique combination of flavors brings together the sweetness of chocolate, the tropical essence of coconut, and the herbal goodness of Shatamul. As we look back on this year-long culinary adventure, the Coconut Candy with herbal Shatamul starch stands as a symbol of the endless possibilities within the realm of gastronomy.

10. References:

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Signature of the Supervisor	**Signature of the co-supervisor**

Appendix 3: Plagiarism Report

Formulation and Development of Herbal Coconut Candy Enriched with Asparagus racemosus (Shatamul) Starch

ORIGINALITY REPORT

19%	17%	12%	10%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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3	www.phytojournal.com Internet Source	1%