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Development and Quality Evaluation of Functional Hard Candy Enriched with *Cymbopogon Citratus* (Lemon Grass) Extract

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ABSTRACT

The growing demand for functional confectionery products has encouraged the incorporation of natural plant-based ingredients with health-promoting properties into conventional sugar-based foods. The present study aimed to develop and evaluate a functional hard candy enriched with *Cymbopogon citratus* (lemongrass) extract. Fresh lemongrass leaves were processed using thermal and non-thermal extraction methods, and the extracts were incorporated into a standard hard candy formulation containing sucrose, liquid glucose, citric acid, and water. The developed candies were evaluated for their physicochemical characteristics, including moisture, total sugars, reducing sugars, ash, and titratable acidity, using standard AOAC methods. Sensory quality was assessed by twenty semi-trained panellists using a nine-point hedonic scale.

The developed lemongrass candy exhibited desirable physicochemical properties, with moisture (2.05%), total sugars (93.2%), reducing sugars (23.8%), ash (0.28%), and titratable acidity (0.52%), all of which were within the acceptable range for hard-boiled confectionery. Sensory evaluation revealed that both formulations were well accepted. The candy prepared using thermally extracted lemongrass showed higher scores for appearance, texture, and overall acceptability, whereas the non-thermally extracted formulation received higher scores for colour, aroma, and taste, indicating better retention of natural volatile compounds. These findings demonstrate that the extraction method significantly influences the sensory characteristics of lemongrass candy while maintaining desirable physicochemical quality.

The study concludes that *Cymbopogon citratus* can be successfully incorporated into hard candy to produce a functional confectionery with good storage stability, favourable sensory properties, and potential health benefits. The developed product offers a promising value-added herbal confectionery with potential for commercial application.

Keywords: *Cymbopogon citratus;* Functional hard candy; Lemongrass extract; Herbal confectionery; Physicochemical properties; Sensory evaluation; Hard-boiled confectionery; Functional foods; Consumer acceptability; Value-added product.

INTRODUCTION

Lemongrass (*Cymbopogon citratus*) is a perennial aromatic herb belonging to the family Poaceae. Native to tropical Asia, it is now widely cultivated in tropical and subtropical regions because of its characteristic lemon-like aroma and diverse medicinal properties (Avoseh et al., 2015). The distinctive citrus fragrance of lemongrass is primarily attributed to citral, the major constituent of its essential oil. Besides its use in herbal teas, beverages, confectionery, and culinary preparations, lemongrass has been extensively utilized in traditional medicine for its therapeutic potential (Shah et al., 2011).

Lemongrass contains a wide range of bioactive compounds, including essential oils, flavonoids, phenolic compounds, tannins, and terpenoids, which contribute to its antioxidant, antimicrobial, anti-inflammatory, and antifungal activities (Avoseh et al., 2015; Shah et al., 2011). These phytochemicals have been associated with

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several health-promoting effects, such as protection against oxidative stress and support for digestive health, making lemongrass a promising functional ingredient in food and pharmaceutical applications (Shah et al., 2011).

The physicochemical properties of lemongrass are largely determined by its essential oil composition. Citral, comprising geranial and neral, is the predominant constituent, followed by myrcene and limonene (Avoseh et al., 2015; Pereira et al., 2022). In addition to its phytochemical richness, lemongrass contains dietary fibre, carbohydrates, small amounts of protein and fat, vitamins (A, C, and B-complex), and essential minerals such as potassium, calcium, magnesium, iron, and phosphorus (Pereira et al., 2022). These nutritional and phytochemical characteristics make lemongrass an excellent natural ingredient for the development of value-added functional foods and confectionery products.

Hard candy is one of the most widely consumed sugar confectionery products because of its pleasant sweetness, attractive appearance, long shelf life, and availability in a wide range of flavours, colours, and shapes (Hartel et al., 2018). It is produced by heating a mixture of sucrose and glucose (corn) syrup to approximately 150–160°C, resulting in a glassy, amorphous structure upon cooling. The high sugar concentration and low moisture content reduce water activity, thereby inhibiting microbial growth and extending the shelf life of the product (Ergun et al., 2010; Hartel et al., 2018).

Sugar confectionery encompasses a variety of products, including hard candies, soft candies, caramels, toffees, marshmallows, taffy, and lollipops. Among these, hard candy is particularly popular due to its desirable texture, storage stability, and ability to incorporate a wide range of flavouring agents, colourants, and functional ingredients (Hartel et al., 2018). In recent years, increasing consumer awareness regarding health and nutrition has driven the demand for confectionery products enriched with natural bioactive ingredients. Consequently, herbs, fruit extracts, spices, and other plant-derived compounds are increasingly being incorporated into confectionery formulations to improve their sensory attributes while enhancing their nutritional and functional value.

Lemongrass, owing to its pleasant citrus flavour, bioactive phytochemicals, and recognised health-promoting properties, represents a promising ingredient for the development of functional confectionery products. However, studies investigating its incorporation into hard candy formulations remain limited. Therefore, the present study was undertaken to develop a functional hard candy enriched with *Cymbopogon citratus* extract and to evaluate its quality characteristics and potential as a value-added herbal confectionery product.

Kingdom	**Plantae**
Order	Poales
Family	Poaceae
Subfamily	Panicoideae
Genus	Cymbopogon (also known as Lemongrass)

Table No:1.1 Botanical Classification of Lemon grass

S.no	**Nutritional Component**	**Quantity**
1	Carbohydrate	55.0%
2	Crude fat	5.10%
3	Crude fiber	4.56%
4	Energy	360 g/100 g

Table No: 1.2 Nutritional Content of Lemon grass

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REVIEW OF LITERATURE

Species of Cymbopogon

The genus *Cymbopogon* (family Poaceae) comprises approximately 140–180 species of aromatic grasses distributed throughout tropical and subtropical regions of Asia, Africa, and Australia (Avoseh et al., 2015). These species are economically important because of their high essential oil content, which is extensively utilized in the food, pharmaceutical, cosmetic, perfumery, and aromatherapy industries. Although several *Cymbopogon* species possess medicinal and industrial significance, *Cymbopogon citratus* is the most widely cultivated and investigated owing to its pleasant citrus aroma, high citral content, and broad spectrum of biological activities (Shah et al., 2011).

The biological properties of *Cymbopogon* species are largely attributed to their essential oils, which contain varying concentrations of citral, citronellal, citronellol, geraniol, limonene, myrcene, and other terpenoid compounds. Variations in phytochemical composition among species influence their aroma, therapeutic properties, and industrial applications (Avoseh et al., 2015; Pereira et al., 2022).

Major Species of *Cymbopogon* and Their Characteristics

Species	Common Name	Major Phytochemicals	Major Applications
Cymbopogon citratus	West Indian lemongrass	Citral (geranial and neral), myrcene, limonene, flavonoids	Widely used in herbal teas, beverages, confectionery, essential oils, and traditional medicine. Exhibits antioxidant, antimicrobial, anti-inflammatory, and digestive health-promoting properties (Shah et al., 2011; Avoseh et al., 2015).
Cymbopogon flexuosus	East Indian lemongrass	Citral, geraniol, limonene	Commercial source of essential oil for flavouring agents, pharmaceuticals, cosmetics, and aromatherapy. Reported to possess antimicrobial, antioxidant, antifungal, and anti-inflammatory activities (Avoseh et al., 2015).
Cymbopogon nardus	Citronella grass	Citronellal, citronellol, geraniol	Extensively used in perfumes, soaps, insect repellents, and aromatherapy products. Also exhibits antimicrobial and anti-inflammatory properties (Avoseh et al., 2015).
Cymbopogon martinii	Palmarosa	Geraniol, geranyl acetate	Used in perfumery, cosmetics, pharmaceuticals, and skin-care products because of its antimicrobial and antioxidant properties (Avoseh et al., 2015).
Cymbopogon pendulus	Jammu grass	Elemicin, citral	Used in traditional medicine and pharmaceutical preparations owing to its antiseptic and antifungal activities (Avoseh et al., 2015).
Cymbopogon ambiguus	Australian lemongrass	Citral, phenolic compounds, flavonoids	Traditionally used for relief of headaches, muscle discomfort, and respiratory ailments. Reported to possess antioxidant and anti-inflammatory properties (Avoseh et al., 2015).

Table No: 2.1 Major species of *Cymbopogon* and their characteristics

Among these species, *Cymbopogon citratus* is considered the most suitable for food applications because of its desirable flavour profile, Generally Recognized as Safe (GRAS) status in many food applications, and abundance

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of bioactive compounds that enhance both sensory quality and functional value (Shah et al., 2011; Pereira et al., 2022).

Health benefits of *Cymbopogon citratus*

The growing consumer preference for naturally functional foods has increased interest in *Cymbopogon citratus* as a health-promoting ingredient. Lemongrass contains numerous bioactive constituents, including citral, flavonoids, phenolic acids, tannins, alkaloids, saponins, and terpenoids, which collectively contribute to its pharmacological properties (Shah et al., 2011; Ekpenyong et al., 2015). Scientific investigations have demonstrated that these phytochemicals exhibit antioxidant, antimicrobial, anti-inflammatory, antifungal, and immunomodulatory activities, supporting the use of lemongrass in functional food development (Boukhatem et al., 2014).

Health Benefit	Bioactive Compounds	Scientific Evidence
Antioxidant activity	Phenolic compounds, flavonoids, citral	Scavenges reactive oxygen species, reduces oxidative stress, and protects cellular components from oxidative damage (Shah et al., 2011; Ekpenyong et al., 2015).
Antimicrobial activity	Citral, limonene, essential oils	Inhibits the growth of several foodborne bacteria and fungi, making lemongrass a promising natural preservative for food systems (Boukhatem et al., 2014).
Anti-inflammatory activity	Citral, flavonoids, terpenoids	Reduces inflammatory mediators and may contribute to alleviating inflammation-associated disorders (Shah et al., 2011).
Digestive health	Essential oils, terpenoids	Traditionally used to improve digestion, reduce bloating, relieve flatulence, and promote gastrointestinal comfort (Ekpenyong et al., 2015).
Cardiovascular support	Potassium, antioxidants	May contribute to healthy blood pressure regulation and improved cardiovascular function by reducing oxidative stress (Pereira et al., 2022).
Blood glucose regulation	Polyphenols, flavonoids	Experimental studies suggest improved glucose metabolism and enhanced insulin sensitivity; however, further clinical evidence is required (Ekpenyong et al., 2015).
Immune support	Phenolics, flavonoids, vitamin C	Enhances antioxidant defence mechanisms and may strengthen the body's natural immune response (Boukhatem et al., 2014).
Stress relief	Citral and volatile essential oils	Aromatherapy studies indicate calming effects that may help reduce stress and mental fatigue (Ekpenyong et al., 2015).
Skin health	Essential oils, flavonoids	Antimicrobial and antioxidant properties support healthy skin and may reduce microbial contamination (Boukhatem et al., 2014).
Functional food ingredient	Citral, phenolics, flavonoids	Pleasant citrus flavour combined with bioactive compounds makes lemongrass an excellent ingredient for functional beverages, bakery products, confectionery, and nutraceutical formulations (Avoseh et al., 2015; Pereira et al., 2022).

Table No: 2.2 Major Species of *Cymbopogon* and Their Characteristics

The increasing demand for clean-label and health-oriented foods has encouraged the incorporation of lemongrass into various food products, including herbal teas, beverages, bakery products, dairy products, confectionery, and functional snacks. In confectionery applications, lemongrass not only imparts a refreshing citrus flavour and aroma but also enriches products with natural phytochemicals that may enhance antioxidant capacity and

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consumer acceptability. Consequently, *Cymbopogon citratus* has emerged as a promising natural ingredient for the development of innovative value-added confectionery products, including functional hard candy.

Applications of Lemon grass in food industries:

Application Area	Food Product/Industry	Role of Lemongrass	Benefits/Industrial Significance	Key References
Natural flavouring agent	Herbal teas, beverages, soups, sauces, confectionery, bakery products, dairy products	Provides a characteristic citrus aroma and refreshing flavour due to citral	Enhances sensory quality, improves consumer acceptability, and replaces synthetic flavouring agents	Shah et al. (2011); Avoseh et al. (2015)
Natural food preservative	Meat products, fish products, dairy products, beverages, bakery products	Essential oils exhibit antimicrobial activity against foodborne pathogens and spoilage microorganisms	Extends shelf life, improves food safety, and reduces dependence on synthetic preservatives	Boukhatem et al. (2014); Avoseh et al. (2015)
Natural antioxidant	Edible oils, meat products, bakery products, beverages	Phenolic compounds and flavonoids inhibit lipid oxidation and scavenge free radicals	Maintains product quality, delays oxidative deterioration, and preserves nutritional value	Ekpenyong et al. (2015); Shah et al. (2011)
Functional food ingredient	Functional foods, nutraceuticals, fortified foods	Rich source of bioactive compounds including citral, flavonoids, and phenolics	Enhances antioxidant capacity and contributes to health-promoting properties	Pereira et al. (2022); Avoseh et al. (2015)
Beverage industry	Herbal tea, infused water, fruit beverages, ready-to-drink drinks	Improves flavour, aroma, and nutritional quality	Produces refreshing beverages with added antioxidant potential	Shah et al. (2011); Ekpenyong et al. (2015)
Bakery industry	Bread, biscuits, cookies, cakes, muffins	Powder or extract enhances flavour and antioxidant activity	Improves functional value and storage stability of bakery products	Avoseh et al. (2015); Ekpenyong et al. (2015)
Dairy industry	Yoghurt, flavoured milk, cheese, fermented milk products, ice cream	Improves flavour and supplies natural antimicrobial and antioxidant compounds	Enhances shelf life, product stability, and consumer acceptability	Boukhatem et al. (2014); Pereira et al. (2022)
Meat and seafood industry	Fresh meat, processed meat, poultry, fish products	Essential oil inhibits microbial growth and lipid oxidation	Improves microbial safety, colour stability, and storage quality	Boukhatem et al. (2014); Ekpenyong et al. (2015)

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Application Area	Food Product/Industry	Role of Lemongrass	Benefits/Industrial Significance	Key References
Confectionery industry	Hard candy, lozenges, gummies, chewing gum, jellies	Provides citrus flavour and natural bioactive compounds	Produces functional confectionery with enhanced sensory and antioxidant properties	Hartel et al. (2018); Shah et al. (2011); Avoseh et al. (2015)
Food packaging	Edible coatings, biodegradable films, active packaging systems	Essential oil incorporated into packaging materials	Provides antimicrobial and antioxidant protection, extending shelf life of perishable foods	Boukhatem et al. (2014); Avoseh et al. (2015)
Nutraceutical industry	Herbal capsules, powders, dietary supplements, functional beverages	Supplies concentrated phytochemicals with therapeutic potential	Supports development of health-promoting food supplements and functional products	Ekpenyong et al. (2015); Pereira et al. (2022)
Clean-label food formulations	Processed foods requiring natural additives	Replaces synthetic preservatives, flavouring agents, and antioxidants	Meets consumer demand for natural, minimally processed, and clean-label products	Avoseh et al. (2015); Pereira et al. (2022)

Table No: 2.3 Applications of Lemon Grass in Food Industries

MATERIALS AND METHODOLOGY

Plant material: Fresh lemon grass leaves had been collected from the college campus and subjected for cleaning to remove or make free from dust and soil. The stalks have been separated, and the cleaned leaves are prepared for further use in product formulation

Pre-treatment of Lemon grass:

Procedure 1: Preparation of Lemongrass Extract and Its Concentration

Lemongrass (weighed)

↓

Addition of water

↓

Boiling

↓

Extraction of colour and flavour

↓

Filteration

↓

lemon grass extract

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Flowchart No: 3.1.a. Pre-treatment Method Thermal method of Lemongrass juice extraction.

Explanation: The weighed lemongrass (35.5) has been placed in a bowl, and 1000ml of water was added using a volumetric cylinder. The mixture is boiled for 5-10 minutes until a yellowish extract is obtained. The mixture is filtered to separate the plant residue, yielding approximately 720mL of clarified lemongrass extract

Procedure 2:

Lemongrass

↓

finely ground (1:6 ratio 1 part of lemongrass + 6 parts of water)

↓

filtration

↓

lemon grass extract

Flowchart No: 3.1.b. Pre-treatment Method-Non-thermal method of Lemongrass juice extraction.

Explanation: An accurately weighed sample of 40.86 g of lemongrass was taken, and approximately 250 mL of water was added gradually to facilitate grinding. The ground mixture was then filtered through muslin cloth to obtain the concentrated lemongrass extract. A total 235ml of extract was obtained after grinding after filtration

Manufacturing of Candy

Candy is a sugar-based confectionery product in which sugar is the primary ingredient. It is prepared by heating sugar with water and other ingredients such as glucose syrup, flavouring agents, acids, and colourants to obtain products with different textures, including hard, soft, chewy, or gummy candies (Efe & Dawson, 2022).

Candy preparation

Ingredient	Function in Hard Candy	Remarks/Examples
Sucrose (Table Sugar)	Provides sweetness and forms the characteristic hard, glassy texture of the candy.	Main ingredient used in hard candy preparation (Hartel et al., 2018).

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Glucose Syrup	Prevents sugar crystallization and improves clarity, texture, and stability.	Enhances shelf life and maintains smooth consistency (Hartel et al., 2018).
Water	Acts as a solvent during cooking.	Most evaporates during cooking to obtain hard candy consistency (Hartel et al., 2018).
Citric Acid	Regulates pH, enhances flavors, and improves preservation.	Added at 0.1–1.0% (w/w); pleasant fruity taste and high solubility (Bund & Hartel, 2010; Marques et al., 2020).
Functional Ingredients (e.g., Lemongrass Extract, Herbal Extracts, Fruit Concentrates)	Improve nutritional and health-promoting properties.	Used to develop functional confectionery products.

Table No: 3.2.a. Major Ingredients Used in Hard Candy Formulation and Their Function Standard formulation for candy preparation

Ingredient	**Quantity**
Sugar	15.4 g
Liquid glucose	1½ tsp
Citric acid	Pinch
Water	10 mL

Table no: 3.2.b. Ingredients and Quantities Used for the Preparation of Candy

Procedure for Candy Preparation: (standard)

Weigh sugar, glucose syrup, and water

↓

Heat the mixture until the hard-crack stage (145–150°C) is reached

↓

Add citric acid and mix thoroughly for uniform distribution

↓

Pour the hot candy mixture into moulds

↓

Allow the candy to cool completely

↓

Remove candies from the moulds

Flowchart No: 3.3: Procedure for preparation of Candy

1. **Preparation of Candy Syrup:** Sugar, glucose syrup, and a small amount of water were heated together until the syrup reached the **hard-crack stage (145–150°C)**.

2. **Addition of Ingredients:** Citric acid was added to the hot syrup and mixed thoroughly to ensure uniform distribution throughout the candy mass.

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3. **Moulding and Cooling:** The hot candy mixture was poured into greased candy moulds and allowed to cool completely. After cooling, the candies were removed from the moulds and stored in an airtight container until further use.

Preparation of Lemon grass candy

Ingredients used in preparation of Lemon grass candy

Ingredient	**Quantity**
Sugar	15.4 g
Liquid glucose	1½ tsp
Citric acid	A pinch
Water	10 mL
Lemongrass extract	20 mL

Table no: 3.4 Ingredients used for preparation of Lemongrass candy

Manufacturing process of lemongrass Candy:

Preparation of Candy Syrup
↓
Sugar + Glucose Syrup + Small Amount of Water
↓
Heat to Hard-Crack Stage (145–150°C)
↓
Add Prepared Lemongrass Extract + Citric Acid
↓
Mix Thoroughly
↓
Pour into Candy Moulds
↓
Allow to Cool Completely
↓
Remove Candies from Moulds

Flow chart no: 3.5 Processing flowchart of Lemongrass candy

Fig no: 3.5 Lemon grass candy

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Proximate Analysis

Estimation of Moisture Content

The moisture content of the lemongrass candy was determined using the hot air oven method (AOAC, 2019). Approximately 2–5 g of the finely crushed sample was weighed into a pre-weighed moisture dish and dried in a hot air oven at **105 ± 2°C** until a constant weight was obtained. The sample was cooled in a desiccator and reweighed. Moisture content was calculated and expressed as percentage (%).

Estimation of Sulphated Ash Content

Sulphated ash content was determined according to the AOAC (2019) method. About 2 g of the sample was weighed into a silica crucible and carbonized over a low flame. A few drops of concentrated sulphuric acid were added, and the sample was incinerated in a muffle furnace at **550 ± 25°C** until a white or light grey ash was obtained. The crucible was cooled in a desiccator and weighed. The sulphated ash content was expressed as percentage (%).

Estimation of Titratable Acidity

Titratable acidity was determined by the AOAC (2019) titrimetric method. Approximately **10 g** of crushed candy was dissolved in distilled water and filtered. An aliquot of the filtrate was titrated against **0.1 N sodium hydroxide (NaOH)** using phenolphthalein as the indicator until a persistent light pink endpoint was obtained. Titratable acidity was calculated as **citric acid equivalent (%)**.

Estimation of Total Sugars

Total sugar content was estimated by the **Lane and Eynon volumetric method (AOAC, 2019)**. The candy sample was dissolved in distilled water, clarified when necessary, and hydrolysed with dilute hydrochloric acid to convert sucrose into invert sugars.

After neutralization, the solution was titrated against Fehling's solution using methylene blue as the indicator. Total sugar content was calculated and expressed as percentage (%).

Estimation of Reducing Sugars

Reducing sugar content was determined using the **Lane and Eynon method (AOAC, 2019)**. A known quantity of the candy sample was dissolved in distilled water, filtered, and titrated against Fehling's solution using methylene blue as the indicator. The reducing sugar content was calculated from the titre value and expressed as percentage (%).

Sensory Evaluation

The sensory evaluation of the developed lemongrass functional hard candy was carried out to determine its organoleptic acceptability using a **9-point Hedonic Scale**. Two candy formulations prepared from **thermally extracted lemongrass juice (Sample A)** and **non-thermally extracted lemongrass juice (Sample B)** were evaluated.

A panel comprising **20 semi-trained panellists** aged **22–35 years** participated in the sensory evaluation. Prior to evaluation, the panellists were familiarized with the sensory attributes and the use of the hedonic scale to ensure consistency in scoring.

The candy samples were prepared under identical processing conditions except for the extraction method of lemongrass juice. Each sample was coded with random three-digit numbers to eliminate bias and served individually at room temperature under controlled laboratory conditions with adequate lighting and ventilation.

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RESULTS AND DISCUSSIONS

Proximate Analysis of Lemon grass Candy:

The physicochemical properties of the developed lemongrass functional hard candy demonstrated values within the acceptable range for hard-boiled confectionery, indicating good product quality and stability. The candy exhibited a moisture content of 2.05%, which is desirable for maintaining hardness, minimizing stickiness, and enhancing shelf life. The total sugar content (93.2%)reflected the predominance of sucrose in the formulation, while the reducing sugar content (23.8%) indicated an appropriate level of sucrose inversion, contributing to a clear appearance and preventing crystallization. The ash content (0.28%) suggested the presence of small amounts of minerals derived from lemongrass extract without affecting product quality. The titratable acidity (0.52%) provided a desirable balance between sweetness and acidity, enhancing the characteristic flavour of lemongrass. Overall, the obtained physicochemical characteristics confirm that the developed candy possessed desirable compositional quality, storage stability, and suitability as a functional herbal hard confectionery.**:**

Parameter	Obtained Value	Recommended Value
Moisture (%)	2.05	2.10 ± 0.15
Total sugars (%)	93.2	94.5 ± 0.6
Reducing sugars (%)	23.8	24.0 ± 0.8
Ash (%)	0.28	0.24 ± 0.03
Titratable acidity (%)	0.52	0.48 ± 0.04

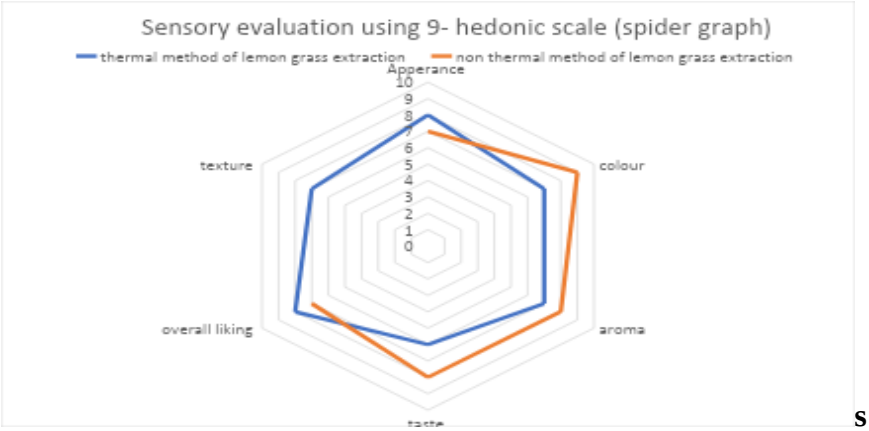
Table No: 4.1 Proximate analysis of Lemon grass candy

Sensory Analysis

The sensory evaluation of the developed lemon grass functional hard candy was carried out to determine its organoleptic acceptability using a 9-point Hedonic Scale. Two candy formulations prepared from thermally extracted lemongrass juice (Sample A) and non-thermally extracted lemongrass juice (Sample B) were evaluated.

A panel comprising 20 semi-trained panellists aged 22–35 years participated in the sensory evaluation. Prior to evaluation, the panellists were familiarized with the sensory attributes and the use of the hedonic scale to ensure consistency in scoring.

The candy samples were prepared under identical processing conditions except for the extraction method of lemongrass juice. Each sample was coded with random three-digit numbers to eliminate bias and served individually at room temperature under controlled laboratory conditions with adequate lighting and ventilation. Drinking water was provided to the panellists for palate cleansing between successive sample evaluations.



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Graph No:4.2 Sensory analysis of Lemon Grass Candy

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Sample a: Candy - from thermally extracted lemongrass juice

Sample b: Candy - from Non-thermally extracted lemon grass juice

The spider graph Figure: The spider graph illustrates the sensory scores of lemon grass candies prepared using thermal and non-thermal extraction methods. The thermal extraction method received higher scores for appearance, texture, and overall liking, indicating better overall acceptability. In contrast, the non-thermal extraction method achieved higher scores for colour, aroma, and taste, reflecting better retention of the natural flavour and aroma of lemongrass. The graph clearly shows that both candy formulations were well accepted by the sensory panel, with only slight differences between the two extraction methods across the evaluated attributes.

SUMMARY AND CONCLUSION

The present study focused on the development and quality evaluation of a functional hard candy fortified with *Cymbopogon citratus* (lemongrass) extract using two extraction methods, namely thermal and non-thermal extraction. The developed candies were assessed for their physicochemical properties, including moisture content, total sugars, reducing sugars, ash content, and titratable acidity, following standard AOAC analytical procedures. Sensory evaluation was conducted using a 9-point hedonic scale with twenty semi-trained panellists to determine consumer acceptability. The results indicated that all physicochemical parameters were within the recommended standards for hard-boiled confectionery, confirming desirable product quality and storage stability. Sensory analysis revealed that the thermally extracted formulation achieved superior scores for appearance, texture, and overall acceptability, while the non-thermally extracted formulation exhibited enhanced colour, aroma, and taste due to better preservation of volatile flavour compounds. Overall, the incorporation of lemongrass extract successfully enhanced the functional and sensory attributes of the candy without compromising its technological quality, demonstrating its potential as a value-added herbal confectionery product.

The study successfully demonstrated the feasibility of incorporating *Cymbopogon citratus* extract into hard candy to produce a functional confectionery with desirable physicochemical characteristics, excellent sensory acceptability, and good storage stability. Both extraction methods produced candies of acceptable quality; however, thermal extraction yielded better overall consumer acceptance, whereas non-thermal extraction preserved the characteristic aroma and flavour of lemongrass more effectively. The findings highlight the potential of lemongrass as a natural functional ingredient capable of enhancing both the nutritional value and sensory quality of confectionery products. The developed product aligns with the growing consumer demand for clean-label, plant-based, and health-promoting foods and offers promising opportunities for commercial production and further development of herbal functional confectionery. Future studies may investigate antioxidant activity, phytochemical retention during storage, shelf-life under different packaging conditions, and consumer acceptance across larger and more diverse populations to further strengthen its commercial applicability.

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