1. Original Research Article

**Physicochemical Properties of Biscuits produced from Wheat, Basil and Lemon Grass flour blends**

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ABSTRACT

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| **Aims:** To determine thephysico-chemical properties of biscuit produced from wheat, Basil and Lemon grass flour blends. Additionally, it is an effort to create herbal biscuits with extra value and health benefits. The investigation of the literature shows that there is a complete lack of technological knowledge regarding the manufacturing, packing, and preservation of herbal biscuits. Using lemon grass and "Basil" to make biscuits is a sustainable way to fight food malnutrition and poverty.  **Study Design:** The data was statistically analyzed by using complete randomized design (CRD) with ten treatments; the significance of study was tested at 5 per cent level  **Results:** The treatment (T10) Whole wheat flour (85.00%) + basil leaves powder (7.50%) + with lemongrass leaves powder (7.50%) provided the significant and maximum protein (7.82 g/100g), fat (11.81 g/100g), ash (3.33 g/100g), and crude fibre (4.95 g/100g). Moreover, carbohydrate (73.65 g/100g) was found in treatment (T1) Whole wheat flour (100%) during analysis. In the case of physical parameters, treatment (T10) Whole wheat flour (85.00 %) + basil leave powder (7.50 %) + with lemongrass leaves powder (7.50 %), the diameter (6.34 cm), thickness (0.79 cm), and weight (4.03 cm) were reported as significant and maximum, respectively.  **Conclusion:** According to the above study, adding basil leaf powder (7.50%) and lemongrass leaf powder (7.50%) to treatment T10 boosts the product's physical and nutritional value. |

*Keywords:* Lemongrass, basil, flour, biscuits and lab

1. INTRODUCTION

Give a factual backdrop, a precise description of the issue, a suggested fix, a synopsis of the relevant literature, and the extent and rationale of the work completed.]India's growing urbanization has led to a sharp rise in the demand for processed foods. When it comes to processed meals, bakery goods, especially biscuits, are quite popular across all age groups in both rural and urban locations. Longer shelf life, especially when made in nearby bakeries, simple marketing, affordability, and a variety of flavors and textures are the reasons behind this. Unleavened dough is used to make biscuits, which are little, thin, crispy cakes.

Because of their ready-to-eat form, widespread consumption, comparatively long shelf life, and high eating quality, biscuits have been proposed as a better use of composite wheat than bread (Okpala and Chinyelu, 2011). One could think of it as a type of candy that has been dried to a very low moisture level. One of the main limitations in the creation of biscuits is the reliance on wheat flour. Due to its excellent nutritional value and practical use, wheat (*Triticum aestivum* L.) is a cereal grain that is grown all over the world. Together with rice and corn, it ranks among the top three crops produced worldwide.

Okaka (2005) asserts that only wheat has significant amounts of the unique proteins gliadin and glutenin, which, when combined with water, produce gluten, the elastic substance necessary for yeast or aerated baked foods. It is currently the second most important crop for human consumption, after rice, in terms of total production tons used for food (Curtis et al., 2002). Starch makes up a large portion of wheat's carbohydrate percentage. Although wheat starch is a significant commercial product, wheat gluten has a higher economic worth. The two main components of wheat flour are carbohydrate and gluten. The nutritional content, palatability, compactness, and convenience of biscuits make them perfect. Biscuits have a longer shelf life and are often less susceptible to microbial deterioration due to their lower moisture content than cakes and bread (Akubor, 2003).

The goal of the current study was to create a product with a low calorie count and a high fiber content. Because of their excellent nutritional, sensory, and textural qualities, ready-to-eat convenience, and affordability, biscuits have long been one of the most well-liked and alluring food items (Pratima & Yadava, 2000). Healthy biscuits with a low glycemic index, higher protein content, increased dietary fiber consumption, high resistant starch, and lower calorie and carbohydrate content are the focus these days. Whole wheat flour, wheat flours, sugar powder, vegetable oil (soybean), dalda, baking powder, skim milk powder, egg white, iodized salt, and other common ingredients are combined with tulshi, lemongrass, and moringa leaves to make herbal biscuits.

"Food for specified health use" is the term used to describe functional foods. The Chinese proverb "Food and medicine are isogenic" is essentially where the term first appeared. Because of their benign nature and health benefits, functional foods are receiving a lot of attention. Apart from their nutritional advantages, functional foods have been shown to be useful against some health issues because of their antibacterial, anti-inflammatory, and anti-cancerous qualities. Numerous functional food products, including dairy products, functional drinks, and functional baked goods, are being produced and have established a significant market share. Lemongrass (*Cymbopogon citratus*) is a significant herb with over 500 varieties, broad growth potential, and special functional qualities that make it helpful in many everyday food items.

All parts of lemongrass-leaves, stalks, oil, and flavor-are used because they contain the highest levels of nutrients and antioxidants. Much effort is required to investigate the functional qualities of this herb by testing it under various settings and using it in a variety of human food products, including community-level functional drinks. In addition to functional foods made from different sources, the review aimed to succinctly describe the nutritional and functional significance of lemongrass (Ranjah et al., 2018).

Products from bakeries are a significant source of nutrition. Bread, biscuits, pastries, cakes, buns, rusks, and other items are examples of various bakery products. The least expensive processed food is biscuits. With basil helping to boost immunity, heal infections, purify the blood, cure insect bites, lower blood pressure, treat respiratory disorders, and maintain blood sugar levels, and lemongrass relieving anxiety, lowering cholesterol, preventing infection, boosting oral health, relieving pain, boosting red blood cell levels, and relieving bloating, among other benefits, the current research project focuses on producing herbal biscuits using basil and lemongrass leaves. Additionally, it is an effort to create herbal biscuits with extra value and health benefits. The review of the literature shows that there is a complete lack of technological knowledge regarding the manufacturing, packing, and preservation of herbal biscuits.

All things considered, adding basil and lemongrass to biscuits has several advantages, such as better nutrition, dietary variety, allergy friendliness, sustainability, and taste enhancement. It adds a distinctive twist to the classic snack and provides a healthier and more inclusive choice for people with particular dietary requirements.

2. material and methods

**2.1 Study Place**

The Department of Processing and Food Engineering Laboratory at the Vaugh Institute of Agricultural Engineering and Technology, Sam Higginbottom University of Agriculture Technology & Sciences, Prayagraj, is where the experimental study was carried out.

**Table 1.** Experimental plan related wheat flour, basil and lemongrass leaves powder incorporated biscuit

|  |  |  |  |
| --- | --- | --- | --- |
| Sr. No. | Parameter | Level | Description |
| 1. | Product | 1 | Biscuit |
| 2. | Ingredients | 4 | Sugar powder, Amul Butter, Baking soda and Amul milk powder |
| 3. | Treatments | 10 |  |
| 4. | Storage conditions | 1 | Ambient temperature |
| 5. | Packaging material | 1 | Flexible pouch (Airtight Pouch) |
| 6. | Analysis of output (Biscuit) |  | Physico-Chemical analysis-diameter, thickness, weight, spread ratio, moisture, protein, ash, fat, crude fiber and carbohydrate |
| 7. | Statistical Analysis | 1 | Completely randomized design (CRD) |
| 8. | Replications | 3 | R-I, R-II, R-III |

**2.2 Physical properties**

Diameter: Four biscuits were arranged edge to edge to measure the biscuit's diameter. Vernier callipers were used to measure the overall diameter in centimeters. To get duplicate readings, the biscuits were rotated at a 90° angle. To obtain an average value, this procedure was carried out three times, and the results were expressed in centimeters.   
Thickness: Four biscuits were stacked on top of each other to determine the biscuit's thickness. With the use of a vernier caliper, the thickness was measured in centimeters.With the use of a vernier caliper, the thickness was measured in centimeters.

**Table 2.** Formulation table of wheat flour, basil and lemongrass leaves powder for biscuit

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr. No. | Whole wheat flour (g) | Basil leave powder (g) | Lemongrass leaves powder (g) | Treatment total (g) | Row material used for all treatment | | | | Total (Treatment +Raw material) (g) |
| Sugar powder (gm) | Amul Butter (g) | Baking Soda (g) | Amul milk powder(g) |
| T1 | 100.00 | 0.00 | 0.00 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |
| T2 | 97.50 | 2.50 | 0.00 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |
| T3 | 97.50 | 0.00 | 2.50 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |
| T4 | 95.00 | 2.50 | 2.50 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |
| T5 | 95.00 | 5.00 | 0.00 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |
| T6 | 95.00 | 0.00 | 5.00 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |
| T7 | 90.00 | 5.00 | 5.00 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |
| T8 | 92.50 | 7.50 | 0.00 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |
| T9 | 92.50 | 0.00 | 7.50 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |
| T10 | 85.00 | 7.50 | 7.50 | 100.00 | 30.00 | 40.00 | 1.00 | 18.00 | 189.00 |

*Weight:* Five pieces of control and sensory accepted biscuits were weight by using weighing balance and average weight of both samples were recorded (Jauharah *et al*., 2014).

*Spread ratio:* Spread ratio was calculated as diameter (length) to thickness ratio.

Spread ratio = diameter/ thickness

**2.3 Chemical properties**

*Determination of moisture content of biscuit:* The method was used to assess the sample's moisture content. Procedure: A hot air oven (HLO-30 Model) was utilized as the instrument for determining the moisture content. The moisture dish was filled with approximately 5 g of the sample, which had been air dried in the oven and weighed before being placed in an oven set at 120 °C for one hour. It was weighed after cooling in the desiccator. In order to determine the lowest weight, the drying procedure was repeated, cooled, and weighed every 30 minutes until the difference between the two subsequent weigh-ins was less than 1 mg. The formula was used to determine the moisture content.

Moisture content (%):

Where, W: the empty dish's weight, expressed in grams. W1: weigh the dish containing the material in grams prior to drying. W2: the dish's weight in grams once the stuff has dried.

*Determination of protein content of biscuit:* The protein content was ascertained using the micro Kkjeldahl method as described . In a heating tube, two grams of each sample were combined with ten milliliters of concentrated H2SO4. After adding two to three grams of catalyst mixture to the tube, the mixture was heated in a fume cupboard. Distilled water was used to hold the digest. An equal volume of 40% NaOH solution was combined with 10 milliliters of the digest and then transferred into a micro Kjeldahl distillation unit. After the combination was distilled, the distillate was collected and placed in a 2% boric acid solution with a 1:5 ratio of methyl red and bromocresol green indicators. 50 milliliters of distillate were gathered and titrated in total. The average value was calculated after the sample was replicated. The protein content was estimated by multiplying the nitrogen content by 6.25. The following formula was used to calculate the protein content:

)

Protein (%)= Nitrogen (%) x 6.25 (correction factor)

Where, N: Normality of the titrate (0.1N), VF: Total volume of the digest= 100ml

T: Titre Value, VA: Aliquot Volume distilled

*Determination of biscuit fat content: Soxhlet's apparatus was used to extract the ether and determine the biscuit's fat content. The Reagent The petroleum ether utilized had a boiling point between 40 and 60 °C. Five grams of the powdered, dehydrated material were precisely weighed in a thimble and defatted with petroleum ether in Soxhlet's apparatus for six to eight hours at 60 degrees Celsius. After evaporating the resulting ether extract, the lipid content was determined using equation.*

Where, W1: weight of the empty extraction flask. W2: weight of the flask and oil extracted. W3: weight of the sample

*Determination of ash content of biscuit*:

Method: A pre-weighed silica crucible was filled with precisely 5 g of the powder sample. After carbonizing it in a silica crucible on a burner, it was heated for six hours at roughly 600 °C. It was cooled in the muffle furnace to achieve a pure white. To stop the crucible from absorbing moisture, it was then moved to desiccators and weighed as precisely as possible. The formula was used to determine the amount of ash.

Where,

W2: Final weight of dish + Ash. W1: weight of dish. W: Weight of sample

*Statistical analysis:* In order to identify significant differences (p<0.05) between samples, analysis of variance (ANOVA) was employed in every analysis. ten treatments were used in the complete randomized design (CRD) for statistical analysis of the data; the study's significance was assessed at the five percent level (Panse and Sukhatme, 1967).

3. results and discussion

**3.1 Physical properties**

Based on the diameter (6.34 cm) physical property analysis of the biscuit, the treatment (T10) using whole wheat flour (85.00%) plus basil leaves powder (7.50%) and lemongrass leaves powder (7.50%) had a significantly greater diameter physical property result than the other treatments (Table-3). This increase in the diameter of biscuit could be to increase in fiber contents of biscuit with dietary fiber content in basil and lemongrass leaves powder (Kulthe *et al.,* 2018). The significant increase in diameter decrease in thickness with increase in basil and lemongrass leaves powder could be due to the reduction in gluten content (elasticity) with increase in basil and lemongrass leaves powder. Too little elasticity may cause dough to flow after molding, resulting in thin biscuit with larger diameter (Gernah and Anyam, 2014). The treatment (T10) applied whole wheat flour (85.00%) plus basil leaves powder (7.50%) and lemongrass leaves powder (7.50%) showed a significantly higher thickness (0.79 cm) physical property result than the other treatments of the biscuit.

There is a relationship between the biscuit breaking strength and the height or thickness of the spreadable layer. As a biscuit gets thinner, its capacity to tolerate stress or an impact load declines (Oke *et al.,* 2022). Dietary fiber of the biscuit formulations also affected the thickness development during cooking (Mridula *et al.,* 2007). Too much elasticity (gluten) in the dough will spring back to give thicker biscuit with smaller diameter (Gernah and Anyam, 2014).

The greater water holding capacity of fibers may be the reason of this (Ayoub *et al.,* 2022). According to the weight (4.03 g) physical property analysis of the biscuit, treatment (T10) using whole wheat flour (85.00%) plus basil leaves powder (7.50%) and lemongrass leaves powder (7.50%) produced a significantly higher weight physical property result than the other treatments. The gradual rise in the biscuit's moisture content from the blends Gernah and Anyam (2014) suggests that the increased weight of the biscuit may be the result of water imbibitions caused by the higher water absorption/retention capacity of the basil and lemongrass leaf powder. Due to the fibrous material found in the wheat flour, basil and lemongrass leaves powder, the weight of the biscuit may have risen due to the dough’s higher water demand (Ayoub *et al.,* 2022).

According to the spread ratio (4.03) of the biscuit, treatment (T10) using Whole wheat flour (85.00 %) + basil leave powder (7.50 %) + with lemongrass leaves powder (7.50 %) basil produced a non significant and maximum spread ratio physical property result than the other treatments.

**3.2 Chemical properties**

After the analytical study it was seen that the chemical analysis of moisture, the treatment (T10) Whole wheat flour (85.00%) + basil leave powder (7.50%) + with lemongrass leaves powder (7.50%) had the non significant and maximum moisture content (4.86 %) when compared to other treatments (Table-4). The result of basil and lemongrass leaves powder prepared biscuit significantly higher data of protein content (7.82 g/100g) noticed under the treatment (T10) Whole wheat flour (85.00 %) + basil leave powder (7.50 %) + with lemongrass leaves powder (7.50 %) compared to other treatments. The high protein contribution from basil, and lemongrass as compared to other treatments used in the biscuit preparation might be the reason for high protein content of T10 biscuit. It might be due to after incorporating of basil and lemongrass leaves powder, the nutritive value was improved Alam *et al.,* 2013).

It may be expected that adding basil and lemongrass leaf powder to biscuits has a larger potential to help people overcome protein calorie deficiency because these two plant sources have higher protein contents (Farzana *et al.,* 2017). The outcome was comparable to that attained by (Aswini, 2022; Singh, 2004; Alam *et al.,* 2014; Shukla *et al.,* 2016; Vidhani *et al.,* 2016;Veer *et al.,* 2019; Gaikwad, 2021; Kumari *et al.,* 2022; Jariyah, 2018).

Comparing the treatment (T10) of whole wheat flour (85.00%) + basil leave powder (7.50%) + with lemongrass leaves powder (7.50%) to other treatments, the significantly higher fat content of the biscuit made with basil and lemongrass leaves powder was reported to be (11.81 g/100g). Basil, and lemongrass contained high fat compared to other treatment resulting in higher fat content of T10 biscuit. Eugenol and ursolic acid are two of the essential oils found in Basil leaves, which may be the result of the plant's numerous active ingredients. Nerol, Geraniol, Citral, Citronellal, Myrcene, and Limonene are the primary chemical components of lemongrass essential oil (Anonymous, 2023). The increase in fat content in the present study may be explained as basil and lemongrass leaves powder are globally considered as the various edible oil source, containing a higher percentage of fat than wheat flour (Farzana and Mohajan, 2015). The outcome was comparable to that attained by (Husain *et al.,* 2015 a; Husain *et al.,* 2016).

After the analytical study it was seen that the treatment (T10) Whole wheat flour (85.00%) + basil leave powder (7.50%) + with lemongrass leaves powder (7.50%) significantly higher effect on the ash (3.33 g/100 g) of biscuit when compared to other treatments. The high mineral content of basil, and lemongrass might have resulted in high ash content in T10 of biscuit as compared to other biscuit. It might due to the presence of basil and lemongrass leaves powder in the biscuit preparation as basil and lemongrass leaves are good source of minerals, supported by other studies (Mohajan *et al.,* 2018; Ayo *et al.,* 2014; Sengev & Gernah, 2013). A food substance's ash content reflects the inorganic material that remains after the organic stuff has burned up. The amount of ash in a food item could serve as a gauge for its mineral content (Priya and Lalitha, 2016).

Ariful Alam *et al.* ([2014](https://pmc.ncbi.nlm.nih.gov/articles/PMC9304522/#CR7)) concluded that Tulsi and Moringa leave incorporated cookies showed enhanced nutritional quality compared to control cookies (Sowmya, *et al.,* 2022).

4. Conclusion

Current trends and shifting customer preferences point to an important possibility for innovation in the creation of new value-added herbal and plant-based baking goods. As herbal products are becoming more popular on the global market due to their strong therapeutic potential, lack of side effects, and presence of health-beneficial active pharmacological ingredients, the food sector is preparing to deliver natural medicines that are safe and effective. People of all ages are drawn to biscuits because they are a filling bakery dessert that nourishes while it refreshes. According to the above study, adding basil leaf powder (7.50%) and lemongrass leaf powder (7.50%) to treatment T10 boosts the product's physical and nutritional value.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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**Table 3.** Effect of wheat flour, basil and lemongrass leaves powder on diameter, thickness, weight and spread ratio of biscuit

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sr. No. | Treatment description | Diameter  (cm) | Thickness  (cm) | Weight (g) | Spread ratio |
| T1 | Whole wheat flour (100 %) | 5.32 b | 0.66 b | 3.24 c | 3.57 |
| T2 | Whole wheat flour (97.50 %) + basil leave powder (2.50 %) | 6.13 a | 0.70 b | 3.69 b | 3.69 |
| T3 | Whole wheat flour (97.50 %) + lemongrass leave powder (2.50 %) | 5.56 b | 0.69 b | 3.78 a | 3.78 |
| T4 | Whole wheat flour (95.00 %) + basil leave powder (2.50 %) + lemongrass leaves powder (2.50 %) | 5.48 b | 0.72 a | 3.64 b | 3.64 |
| T5 | Whole wheat flour (95.00%) + basil leave powder (5.00 %) | 5.69 a | 0.73 a | 3.70 b | 3.70 |
| T6 | Whole wheat flour (95.00%) + lemongrass leave powder (5.00 %) | 6.18 a | 0.69 b | 3.65 b | 3.65 |
| T7 | Whole wheat flour (90.00 %) + basil leave powder (5.00 %) + lemongrass leaves powder (5.00 %) | 6.30 a | 0.78 a | 3.84 a | 3.84 |
| T8 | Whole wheat flour (92.50 %) + basil leave powder (7.50 %) | 6.12 a | 0.71 a | 3.68 b | 3.68 |
| T9 | Whole wheat flour (92.50 %) + with lemongrass leaves powder (7.50 %) | 5.60 b | 0.74 a | 3.78 a | 3.78 |
| T10 | Whole wheat flour (85.00 %) + basil leave powder (7.50 %) + with lemongrass leaves powder (7.50 %) | 6.34 a | 0.79 a | 4.03 a | 4.03 |
|  | F-test | S | S | S | NS |
|  | S.Ed. (±) | 0.33 | 0.04 | 0.15 | 0.17 |
|  | CD (P=0.05) | 0.68 | 0.08 | 0.31 | 0.35 |
|  | CV (%) | 6.79 | 6.58 | 4.95 | 5.50 |

**Table 4.** Effect of wheat flour, basil and lemongrass leaves powder on moisture, protein, fat and ash of biscuit

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sr. No. | Treatment description | Moisture  (g/100g) | Protein  (g/100g) | Fat (g/100g) | Ash  (g/100g) |
| T1 | Whole wheat flour (100 %) | 4.38 | 6.64 b | 10.08 c | 2.22 b |
| T2 | Whole wheat flour (97.50 %) + basil leave powder (2.50 %) | 4.82 | 7.15 a | 10.67 b | 2.71 b |
| T3 | Whole wheat flour (97.50 %) + lemongrass leave powder (2.50 %) | 4.64 | 7.61 a | 10.55 b | 2.75 b |
| T4 | Whole wheat flour (95.00 %) + basil leave powder (2.50 %) + lemongrass leaves powder (2.50 %) | 4.85 | 7.79 a | 11.69 a | 3.02 a |
| T5 | Whole wheat flour (95.00%) + basil leave powder (5.00 %) | 4.60 | 7.36 a | 11.55 a | 2.77 a |
| T6 | Whole wheat flour (95.00%) + lemongrass leave powder (5.00 %) | 4.61 | 7.01 a | 11.31 a | 2.57 b |
| T7 | Whole wheat flour (90.00 %) + basil leave powder (5.00 %) + lemongrass leaves powder (5.00 %) | 4.64 | 6.67 b | 11.29 a | 2.86 a |
| T8 | Whole wheat flour (92.50 %) + basil leave powder (7.50 %) | 4.77 | 6.82 b | 11.51 a | 2.84 a |
| T9 | Whole wheat flour (92.50 %) + with lemongrass leaves powder (7.50 %) | 4.54 | 7.15 a | 11.08 b | 2.47 b |
| T10 | Whole wheat flour (85.00 %) + basil leave powder (7.50 %) + with lemongrass leaves powder (7.50 %) | 4.86 | 7.82 a | 11.81 a | 3.33 a |
|  | F-test | NS | S | S | S |
|  | S.Ed. (±) | 0.25 | 0.36 | 0.32 | 0.27 |
|  | CD (P=0.05) | 0.53 | 0.75 | 0.67 | 0.56 |
|  | CV (%) | 6.62 | 6.14 | 3.51 | 11.90 |