

## Development of Value Added Laddu by using Green Gram and Barnyard Millet

<sup>1</sup> Karuna Singh; <sup>2</sup> Jeetendra Singh; <sup>3</sup> Sharma Ishika

<sup>1</sup> Assistant Professor, Department of Home Science, Dayalbagh Educational Institute, Agra-5, India

<sup>2</sup> Department of Home Science, Faculty of Arts, Dayalbagh Educational Institute, Dayalbagh, Agra-5, India

<sup>3</sup> PhD Scholar, Department of Botany, Dayalbagh Educational Institute, Agra-5, India

Corresponding Author: **Karuna Singh**

**Abstract:** The purpose of the current project, "Development of Value-Added Laddu Using Green Gramme and Barnyard Millet," was to standardise and develop a product that includes dates, barnyard millet, and green gram. This study focused on enhancing the processing method, evaluating the chemical and physical characteristics of the value-added laddu, and conducting microbiological testing. The developers combined barnyard millet and germinated green gram with dates, which serve as a natural sweetener, to produce a gluten-free dish. Moong bean, is also referred to as Green gram, is valued for its great fibre content, simple digestion properties, and rich protein proportion. It is known to lower the risk of certain common diseases nowadays, like obesity, diabetes, cancer, and, to some extent, cardiovascular diseases. It is frequently reported to have health advantages. In this study, for the control and treatment groups (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub>), various laddu formulations were prepared by standardising the amount of moong dal and barnyard millet at 100%, 90%, 80%, 70%, and 60% while adding 40% dates consistently in every sample. For sensory evaluation of developed samples, a 9-point hedonic scale was used, which assessed the product's sensory qualities, including colour and appearance, flavour, texture, taste, and general acceptance. Out of all the developed samples, the highest average sensory score ( $6.73 \pm 1.21$ ) was formulation T<sub>4</sub>, it was prepared using 60% germinated moong dal and barnyard millet flour.

### Introduction

India produces a large number of moong and ranks sixth in terms of production, consumption, and exports, making its food processing industry one of the biggest

expanding in the world. There is demand for nutrient-rich, ready-to-eat foods which has rapidly increased as people become more conscious of the gut brain connection and focusing between diet and health. Consequently, a large number of functional foods have been developed to improve health and well being by reducing the risk of so many medical conditions (Gautam, 2018). Laddu's enticing flavour and taste which has cultural significance and widespread acceptance makes it one of the most well-liked ready-to-eat dishes everywhere. There are so many efforts, which have been made to improve the nutritional composition, better palatability and functional qualities of laddu in response to expanding marketplace concurrence and consumer demand for healthier options (Tyagi et al., 2006).

Moong scientifically known as *Vigna radiata*, is a great source of high-quality protein. It is consumed in various forms in India. Few common forms are including split dal, moong sprouts, and sometimes as whole grains. Moong is planted not only as a food crop but also as a green manure crop and as animal feed (Naik et al., 2020). Moong is a popular vegetarian super food that is easy to digest. It is high in vital nutrients, and promotes tissue healing and muscular growth (Momaya, 2022). Moong is grown in India in the summer, rabi, and kharif seasons, frequently following the harvest of other crops. Of the 30.41 lakh hectares of moong that were cultivated, Rajasthan topped in both area (29.68%) and production (25.51%), producing 14.24 lakh tonnes. Maharashtra and Andhra Pradesh rank second and third, respectively, in terms of area and output. Roy et al. (2017) reported that Punjab had the highest yield at 838 kg/ha, while Karnataka had the lowest at 247 kg/ha. Moong dal supports the activity of the hormone cholecystokinin, which plays a role in weight management by increasing feelings of fullness and boosting metabolism, thereby helping to reduce overeating. Its high potassium and iron content contributes to maintaining a regular heartbeat, preventing muscle cramps, and lowering blood pressure. Owing to its easy digestibility, moong dal is especially suitable for individuals with hypertension or heart-related conditions (Shahrajabian et al., 2019).

Moong dal provides approximately 40.5 to 71% of the recommended dietary fibre intake, which helps prevent nutritional deficiencies and reduce blood cholesterol levels. Its sprouts are an excellent protein source for vegetarians, as they contain more than 85% of essential amino acids (Naik et al., 2020). Additionally, its low glycaemic index helps regulate insulin and blood glucose levels, thereby lowering the risk of diabetes.

Additionally, its iron content encourages the production of red blood cells, preventing anaemia and improving circulation (Shahrajabian et al., 2019).

**Barnyard Millet:** *Echinochloa frumentacea*, a self-pollinating crop in the Poaceae family, was the first small millet to be domesticated. It is grown in several Indian states, including Odisha, Maharashtra, Madhya Pradesh, Tamil Nadu, Bihar, Punjab, Gujarat, and the highlands of Uttarakhand. It is a nutrient-rich food source with about 10.5% protein and a high dietary fibre content. This little kharif crop thrives in rain-fed

conditions and has a moisture content of 8.7–9.63%. Because of its low, slowly digested carbohydrate content, it is suitable for diabetics. Because barnyard millet is more nutritious than grains, it has a lot of potential to promote health (Kaur and Sharma, 2020).

Barnyard millet is a low-calorie grain because a 25g portion has 75 calories and 1.5g of protein. Its high dietary fibre content (12.6%) makes digestion easier and helps prevent constipation and bloating. Because its carbohydrates promote the synthesis of resistant starch, barnyard millet is beneficial for those with diabetes and cardiovascular disease. Additionally, it is free of gluten, making it an excellent option for those who have coeliac disease or avoid gluten. Barnyard millet has the highest iron concentration (18.6 mg per 100g) among millets and cereals (Shriley et al., 2017). Obesity, smoking, poor diet, and inactivity all raise the risk of heart disease and stroke. Barnyard millet has lower blood sugar and cholesterol levels than rice (Kaur and Sharma, 2020).

### Dates

Dates, formally known as *Phoenix dactylifera*, are one of the healthiest fruits and an important part of West Asian culture. The dry variant provides more calories than the fresh because of its high natural sugar content and designation as a dry fruit. Their high calorie content contributes to their popularity as an energy source (Kumari et al., 2021). While wrinkled skin is a sign of dryness, smooth skin indicates freshness. Numerous polyphenols, including alkaloids, flavonoid glycosides, and phenolic acids, are abundant in date fruits. The hue, shape, and flavour of desert dates and date palms vary, primarily due to differences in sugar concentration (Idowu, 2020).

Dates are rich in antioxidants and anti-inflammatory qualities linked to cancer prevention; they provide potassium, which supports cardiovascular health; they have low sodium and some fibre for heart health; they are the fruit with the highest concentration of isoflavones, which are phytoestrogens that may alleviate menopausal symptoms; they are a natural sweetener alternative to syrups and refined sugars, providing sweetness without significant blood sugar spikes. Laddu is a sweet Indian treat that is made using a mixture of flour and sugar, boiled, and then moulded into balls. A range of grains, legumes, or seeds can be used to make it; toasted wheat is commonly utilised. They often contain items like chopped almonds and dried raisins. Since its inception in India, Laddu has spread throughout the Indian subcontinent. (Kumari et al., 2021).

### Emergence & Justification of the problem

Boondi, coconut, gramme flour, clarified butter, and sugars—all of which are high in calories and saturated fats—are the ingredients of Laddu. Varieties like besan laddu and motichoor are especially heavy in calories. Additionally, the high sugar content may result in inflammation and blood sugar surges, which can hinder fat burning and perhaps impair children's growth and development. This study aims to create a

healthier, gluten-free laddu that provides nutritional fibre and plant-based protein using germinated green gramme, barnyard millet, and dates as a natural sweetener.

### Material and methods

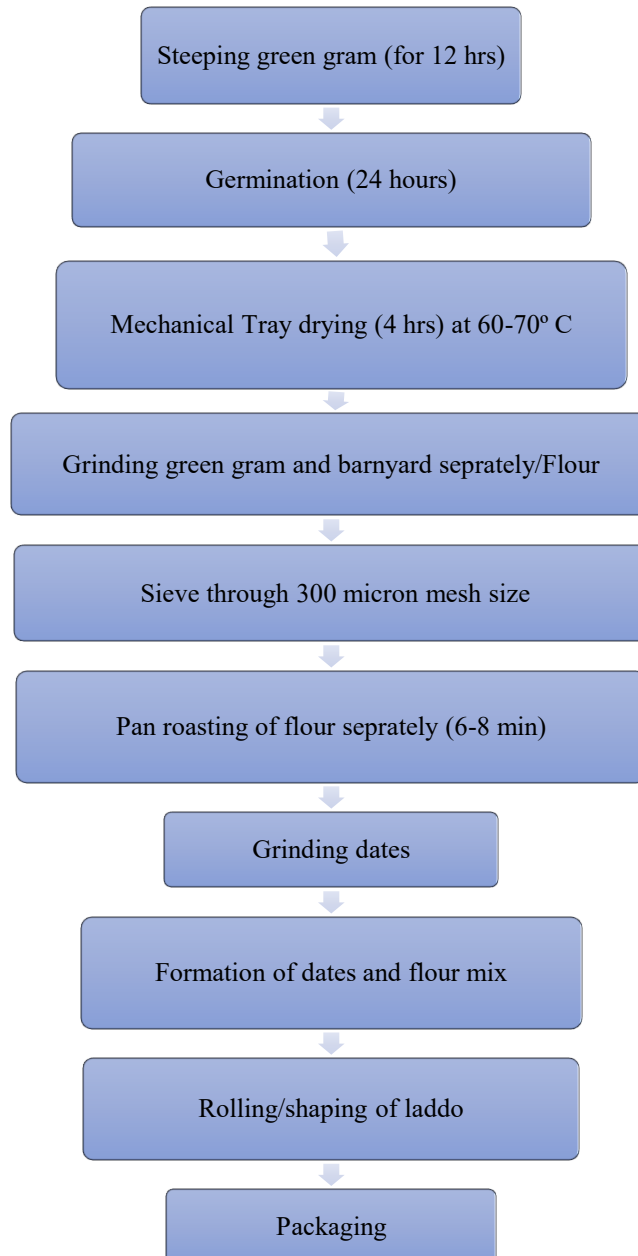
The purpose of this study was to standardise the production of value-added laddus utilising dates, barnyard millet, and green gramme. Using items from the local market, it was carried out at the Dayalbagh Educational Institute's Department of Home Science in Agra. A control of 100% non-germinated flour was used in addition to four treatments (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub>) of germinated green gramme and barnyard millet flour. The best combination employed 40% of each of grinded dates and clarified ghee for binding, but earlier formulations using dates and clarified butter were ineffective.

**Table- 1 Sample formulations**

Ratio (%)		Amount					
		Green gram (g)	Barnyard Millet (g)	Sugar (g)	Dates (g)	Clarified butter (ml)	Cardamom powder
<b>C</b>	100:00	100 g	–	35 g	–	40 ml	1.5 g
<b>T<sub>1</sub></b>	90:10	90 g	10 g	–	40 g	40 ml	1.5 g
<b>T<sub>2</sub></b>	80:20	80 g	20 g	–	40 g	40 ml	1.5 g
<b>T<sub>3</sub></b>	70:30	70 g	30 g	–	40 g	40 ml	1.5 g
<b>T<sub>4</sub></b>	60:40	60 g	40 g	–	40 g	40 ml	1.5 g

Green Gramme (100g), Sugar Powder (35g), Clarified Butter (40ml), and Cardamom Powder (1.5g) were used to produce the control. Green gramme and barnyard millet flour were used in the following ratios for gluten-free laddu: 90:10, 80:20, 70:30, and 60:40. Cardamom powder was added for flavour. First, soak the green gramme for 12 hours in RO water. Rinse the lentils after draining, then place them on a muslin cloth to sprout at room temperature—ideally for 24 hours to get 1-2 cm sprouts. For optimal results, mist the cloth with water as it germinates. The tray drier was employed for four hours at 60 to 70 degrees Celsius after the components had been germinated and dried. Dates, barnyard millet, and green grammes were weighed, pulverised separately, and sieved through a 300-micron mesh screen. For six to eight minutes, the barnyard and germinated gramme flours were toasted in a pan while being constantly stirred. Following roasting, 40 g of ground dates and 40 ml of clarified butter were combined with the flours. The mixture was moulded into 20 g laddu-shaped balls after being allowed to rest at room temperature. Low-density polyethylene (LDPE) bags were used to contain the prepared laddu.

Fig- Flow chart of procedure



**Fig- Germination process of green gram:**



**Fig- 3 Processing of Laddo:**



**Analysis of product:**

Developed laddu were evaluated for sensory characteristics (Color and appearance, texture, taste, aroma, and overall acceptability), by using 9-point Hedonic scale with 51

panelists. An electronic hot air oven was used to assess the generated laddu for proximate analysis and determine its moisture content. While lipid content was assessed using a Soxhlet apparatus, carbohydrate content was determined by deducting other elements (AOAC, 1984). The Kjeldahl method (AOAC, 1983) was used to measure total protein using a nitrogen digestion device. The energy value was computed using established techniques, and the total ash content was evaluated in accordance with AOAC guidelines (1995). To guarantee food safety, microbiological testing was carried out (Shekhar et al., 2019). The data was analyzed by using One-way ANOVA to assess significant differences among different trials tried for developed laddu.

## Results and Discussion

The goal of the current study was to create value-added laddus with dates, barnyard millet, and green gramme and evaluate their acceptance. The sensory, physical, and chemical properties of laddus were assessed. The laddus's diameter was measured; a 20 gram sample had the largest diameter, measuring 31.22 mm. Significant variations in the samples' organoleptic characteristics (colour, texture, flavour, and acceptability) were shown by sensory assessments using a 9-point hedonic scale. The acceptance score for the control laddu produced from 100% non-germinated green gramme was  $8.16 \pm 0.94$ . The overall quality was affected by the inclusion of dates and barnyard millet; the 60% ratio had an acceptance score of  $6.73 \pm 1.21$ . This study resulted in development of a product with good organoleptic quality and general acceptability along with good nutritional values.

**Table- 2 Mean score for sensory characteristics of laddo:**

Level incorporation	Color & appearance	Texture	Taste	Aroma	Overall acceptability
100.00	$8.23 \pm 0.99$	$8.07 \pm 1.07$	$8.31 \pm 0.96$	$8.03 \pm 1.16$	$8.16 \pm 0.94$
90.10	$6.76 \pm 1.36$	$6.23 \pm 1.66$	$5.94 \pm 2.04$	$6.52 \pm 1.73$	$6.36 \pm 1.28$
80.20	$6.43 \pm 1.40$	$6.27 \pm 1.34$	$6.43 \pm 1.75$	$6.82 \pm 1.50$	$6.49 \pm 1.12$
70.30	$6.96 \pm 1.28$	$6.66 \pm 1.27$	$6.66 \pm 1.50$	$6.60 \pm 1.61$	$6.72 \pm 1.11$
60.40	$6.94 \pm 1.56$	$6.74 \pm 1.29$	$6.74 \pm 1.43$	$6.74 \pm 1.41$	$6.73 \pm 1.21$

**Values are Mean  $\pm$  SD of 51 panelists**

**(SD= Standard Deviation)**

**Color & appearance:** The f-ratio value is 13.50106. The p-value is  $<.00001$ . The result is significant at  $p <.05$ .

**Texture:** The f-ratio value is 15.8671. The p-value is  $<.00001$ . The result is significant at  $p <.05$ .

**Taste:** The f-ratio value is 16.60458. The p-value is  $< .00001$ . The result is significant at  $p < .05$ .

**Aroma:** The f-ratio value is 8.72679. The p-value is  $< .00001$ . The result is significant at  $p < .05$ .

**Overall acceptability:** The f-ratio value is 20.55567. The p-value is  $< .00001$ . The result is significant at  $p < .05$ .

### Proximate composition of laddu:

Table 3 presents the approximate nutritional composition of laddu prepared using germinated moong bean flour and barnyard millet with dates, compared to the control laddu. The protein content ranged from 16.83% to 14.71%, fat from 17.06% to 16.40%, ash from 1.94% to 1.57%, moisture from 1.06% to 2.13%, carbohydrates from 63.09% to 65.17%, and energy values from 473.29 to 467.16 kcal per 100 g. The observed reduction in protein content may be attributed to interactions between proteins and polyphenols (Mauron, 1990). Carbohydrate levels showed noticeable variation, while both formulations contained relatively low fat levels (17.06% and 16.40%). In addition, the process of germination may enhance the bioavailability of minerals (Reema et al., 2004).

**Table- 3 Proximate composition of laddo:**

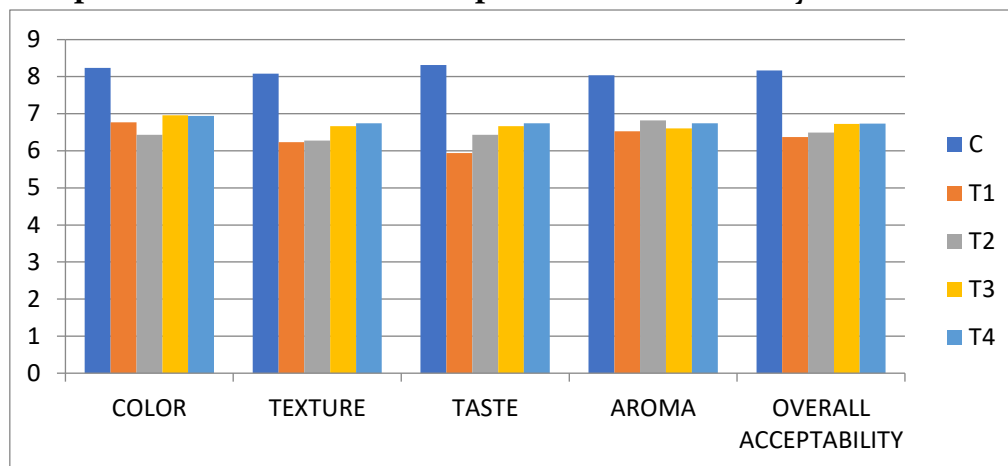
Parameters	Sample	
	C	T <sub>4</sub>
Moisture	1.06±0.30	2.13±0.41
Fat	17.06±0.23	16.4±0.4
Ash	1.94±0.07	1.57±0.01
Protein	16.83±0.32	14.71±0.69
Carbohydrate	63.09±0.67	65.17±1.16
Energy	473.29±1.75	467.16±2.87

Values are written in mean  $\pm$  SD of developed laddo

(SD= Standard Deviation)

C= Control, T<sub>4</sub>= Highest sensory scored sample

The sample (T<sub>4</sub>) and control (C) were analyzed for microbial testing to ensure food safety. The serial dilution and pour plate method were used to check for yeast and mold, helping to assess contamination risk and prevent food processing outbreaks.

**Fig- 4 Comparison between different parameters of sensory**

### Conclusion

The study, "Development of Value-added Laddu using Green Gramme & Barnyard Millet," was conducted at the Department of Home Science at the Dayalbagh Educational Institute in Agra. The study's objective was to create laddu, a natural substitute for sugar, by combining germinated green gramme flour with varying amounts of ground dates and barnyard millet flour. A 9-point hedonic scale was used to assess the prepared laddu's sensory attributes, such as colour, flavour, taste, texture and general acceptability. Since laddu is a typical snack that people of all ages love, improving its nutritional profile provides an inventive way to create functional meals. Green gramme sprouts that have germinated are especially high in vitamins B, C, and K and give the food a unique taste. The sprouts were mechanically dried for four hours at 60–70°C to assure food safety. They were then pan-roasted to increase digestibility, get rid of raw aromas, and lower the chance of microbial contamination. The developed laddu, which were created especially for those with gluten intolerance, including those with coeliac disease, are a reliable source of protein and energy. These laddu are ideal for a gluten-free diet because green gramme and barnyard millet are inherently gluten-free. Several physicochemical properties, including crude protein, fat, ash, moisture, carbohydrates, and energy, were examined in the formulation of laddu T<sub>4</sub> (60%) and control laddu (100%). The created laddu's diameter was measured in order to evaluate its physical properties. Sensory examination revealed that Sample T<sub>4</sub>, which contains a ratio of 40% barnyard millet to 60% germinated green gramme, is the ideal inclusion ratio. Consequently, the research yielded a product of high organoleptic quality, appeal to everyone, and nutritional value.

**Availability of data and materials-** All data are available in Department of Food Science, Faculty of Arts, Dayalbagh Educational Institute, Agra.

## Bibliography

1. Bukya, A., Khedkar, S. B., & Dongare, B. K. (2018). Preparation and standardization of coconut, dry dates and jaggery Ladoo and its storage study. *International Journal of Trend in Scientific Research and Development*, Volume-2(Issue-5), 2462-2466.
2. Chunilal, K., and Sudhakar, R. (2021). Studies on development of process technology for preparation of dry fruit balls incorporated with flaxseed. *Journal of food processing and technology*. ISSN 2157-2440.
3. Food Data Central US Department of Agriculture published (2020).
4. George, J., Kannan, A., & Renitta, R. E. (2019). Development of traditional snack product - Moong DAL Laddo using under-utilized pomegranate peel powder. *International Journal of Engineering and Advanced Technology*, 9(1), 2458-2460.
5. Harrison, J. (2022). Germination botany. Royal Society Research Professor, University College of Wales, Aberystwyth.
6. Jain, M. (2013). Health benefits of dates: Phytochemicals and their functions. Department of Agricultural Sciences, University of Helsinki, PG-27.
7. Kaur, H., and Sharma, S. (2020). An overview of Barnyard millet (*Echinochloa frumentacea*). *Journal of Pharmacognosy and Phytochemistry* 9(4): 819-822.
8. Kumar, I. (2016). Biological transmutation in germination of seeds. *Journal of research*. P-ISSN: 2348-6848, e- ISSN: 2348-795x.
9. Kumari, P and Singh, U. (2005). Nutritional composition and Acceptability testing of laddo developed for pregnant women. Department of Foods and Nutrition.
10. Kumari, N., Sindhu, S. C., Rani, V., & Kumari, V. (2021). Development and evaluation of Indian traditional sweet 'Laddoo' supplemented with germinated pumpkin seed flour. *Asian Food Science Journal*, 48-55.
11. Mamka et, al. (2020). Development of an innovative laddo for lactating women and its shelf-life study. *Journal of creative research thoughts (IJCRT)*. ISSN: 2320-2882.
12. Mohan Naik, G., Abhirami, P., & Venkatachalapathy, N. (2020). Mung bean. *Pulses*, 213-228.
13. PU et, al. (2020). Development and quality evaluation of flaxseed fortified nutra laddo. *The pharma innovative journal*. 9(8): 108-113.
14. Rashid et, al. (2018). Multinutrient Laddo. *International Journal of Food and Nutritional Science*. E-ISSN: 2320-7876 volume 8.
15. Roy, P. D., Lakshman, K., Narwal, R., Malik, R., & Saha, S. (2017). Green Gram (*Vigna radiata* L.) productivity and grain quality enrichment through zinc fertilization. *International Journal of Current Microbiology and Applied Sciences*, 6(6), 643-648.
16. Shekhar, A., Joshi, S., Ambre, S. (2019). Shelf-life study and Acceptability of Calpro Laddo. *Acta Scientific Nutritional Health*. Volume (3).
17. Temitope Idowu, A., Osarumwense Igiehon, O., Ezekiel Adekoya, A., & Idowu, S. (2020). Dates palm fruits: A review of their nutritional components, bioactivities, and functional food applications. *AIMS Agriculture and Food*, 5(4), 734-755.