International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating: 5.29
IJABR 2025; 9(3): 295-299
www.biochemjournal.com
Received: 05-01-2025
Accepted: 10-02-2025

Charu Mendiratta
Associate Professor, School of Allied Health Sciences, Jaipur National University, Rajasthan, India

Poonam Jethwani
Associate Professor, School of Allied Health Sciences, Jaipur National University, Rajasthan, India

Shilpi Sharma
Associate Professor, School of Allied Health Sciences, Jaipur National University, Rajasthan, India

Neha Tak
Assistant Professor, School of Allied Health Sciences, Jaipur National University, Rajasthan, India

Deepika Sharma
Assistant Professor, School of Allied Health Sciences, Jaipur National University, Rajasthan, India

Jyoti Rani
Assistant Professor, School of Allied Health Sciences, Jaipur National University, Rajasthan, India

Corresponding Author:
Charu Mendiratta
Associate Professor, School of Allied Health Sciences, Jaipur National University, Rajasthan, India

Formulation of calcium-enriched powder from dried cauliflower leaves and lotus stem for value added product

Charu Mendiratta, Poonam Jethwani, Shilpi Sharma, Neha Tak, Deepika Sharma and Jyoti Rani

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i3d.3951

Abstract
This study investigates the calcium content, sensory evaluation, and physicochemical characteristics of chilla premix developed from composite flours of rice flour, semolina, and calcium-rich powders, including cauliflower leaf powder, lotus stem powder, and mushroom powder. The calcium content varied significantly across treatments, with the highest concentration of 1970±1.7 mg/100 g found in Treatment R_4 (60% cauliflower leaf powder, 30% lotus stem powder, 10% mushroom powder) and the lowest in Treatment R_3 (50% cauliflower leaf powder, 40% lotus stem powder, 10% mushroom powder) at 1070±2.0 mg/100 g. Due to its superior calcium content, R_4 was selected for further product development. Sensory evaluation of the chilla premix showed that increasing the proportion of cauliflower leaf powder led to a decline in sensory scores, with the highest scores for appearance, taste, and overall acceptability observed in the control and Treatment T_2. The analysis revealed significant differences ($p<0.05$) in appearance, taste, texture, and overall acceptability among the treatments. The physicochemical composition of T_2 chilla premix indicated improved nutritional qualities, with increased protein, fat, crude fiber, and calcium (423.3±5.63 mg/100 g) compared to the control (9.67±0.105 mg/100 g). Statistical analysis further confirmed significant differences ($p<0.05$) in various proximate parameters, including moisture, ash, protein, and energy content. The results suggest that the incorporation of calcium-rich powders can enhance the nutritional profile of chilla premix, making it a promising product for health-conscious consumers seeking to boost their calcium intake.

Keywords: Calcium-enriched powder, Chilla premix, nutritional enhancement, sensory evaluation, composite flours

Introduction

Calcium is crucial for maintaining various physiological functions. Many health benefits of appropriate calcium intake have been demonstrated, including a decrease in hypertensive disorders during pregnancy, a reduction in blood pressure, especially in young people, a prevention of osteoporosis and colorectal adenomas, a reduction in cholesterol, and a reduction in blood pressure in the offspring of mothers who took adequate calcium during pregnancy (Cormick and Belizán, 2019) [4]. Yet a significant portion of the Indian population consumes a calcium-deficient diet. This deficiency has been linked to the prevalence of osteoporosis and decreased bone density, particularly in postmenopausal individuals (Chakraborty *et al.,* 2015) [3]. Inadequate calcium consumption has also been linked to a number of other health problems, including as heart disease, several malignancies, and difficulties during pregnancy (Shlisky *et al.,* 2022) [8]. To combat this deficiency, it's crucial to explore diverse food sources rich in calcium. Among these sources, certain often-overlooked vegetables specifically, cauliflower leaves and lotus stem hold great potential. Both of these foods are typically classified as waste products, yet they are rich in calcium and other vital nutrients. Cauliflower is a popular and widely produced vegetable in India. Cauliflower leaves belong to the *Brassicaceae* family. Cauliflower leaves are a rich source of calcium, iron, and beta-carotene. In India, cauliflower (*Brassica oleraceae* var. Botrytis) is one of the most popular vegetables, yet the average person hardly ever eats the leaves. Fresh cauliflower leaf is a seasonal vegetable that is tasty, nutritious, and rich in calcium (626 mg/100 g). However, because it contains around 80% moisture, it is highly perishable.

Fresh cauliflower leaves are easily obtained for free because they are typically regarded as waste in the vegetable market. If the fresh leaves can be dried and made into cauliflower leaf powder (CLP), this can be utilized as an inexpensive, high-calcium supplement that can be added to a variety of daily menu items. Thus, in order to take use of the cauliflower greens' high calcium potential, it is needed to be dried and processed (Chakraborty *et al.*, 2015) [3]. Adding value to products is possible because cauliflower leaves are under the category of waste products [4].Nelumbonucifera, the lotus stem, belongs to the Nelumbonaceae family (Yadav, 2023) [10]. Lotus stem is rich in calcium, making it valuable for bone health and preventing conditions like osteoporosis. Its antioxidant and anti-inflammatory properties enhance its role in calcium-enriched product formulations (Begum and Punia, 2021) [2]. In the study conducted by Shamim *et al.*, 2020, lotus stem powder (LSP) was incorporated into cookies, resulting in a significant enhancement of their calcium content. The calcium levels in these LSP-incorporated cookies ranged from 23 mg to an impressive 455.625 mg per 100 g, highlighting the potential of lotus stem as a valuable source of calcium[7]. For optimal calcium absorption, adequate vitamin D intake is essential. Mushrooms could provide a valid way to achieve this goal, as they are one of the few sources of vitamin D. When commonly consumed mushroom species are exposed to a source of ultraviolet (UV) radiation, such as sunlight or a UV lamp, they can generate nutritionally relevant amounts of vitamin D. Vitamin D from irradiated mushrooms could be a viable alternative for meeting vitamin D requirements, as these mushrooms serve as an excellent source of this essential nutrient, significantly enhancing the bioavailability of calcium and thereby contributing to overall bone health (Rondanelli *et al.*, 2023) [7]. Calcium is essential for maintaining strong bones and teeth, as well as supporting proper muscle function, nerve transmission, and blood clotting. These calcium-rich powders provide a natural, plant-based source of calcium, making them an excellent alternative for individuals who may have dietary restrictions or are looking to reduce their intake of animal-based products. Additionally, the chilla premix, enriched with these powders, offers a convenient and nutritious food option, especially for health-conscious consumers. With improved levels of protein, fat, fiber, and calcium, the chilla premix not only supports bone health but also contributes to overall nutritional well-being. Consuming such fortified products regularly can be particularly beneficial for individuals at risk of calcium deficiency, such as postmenopausal women, older adults, and those with certain health conditions, helping to promote better bone density and prevent osteoporosis.

Materials and Methods

Preparation of cauliflower leaf powder

Cauliflower leaf powder was made using the roasting process described by Chakraborty *et al.* (2015) [3]. Fresh leaves were obtained from the local vegetable market and thoroughly cleaned with flowing water before being properly rinsed. The washed and rinsed leaves were then weighed and the value was recorded. The cauliflower leaves were then blanched, which involved immersing them in boiling water for 3-5 minutes before placing them under a stream of cold water. The blanched greens were then sliced into small pieces and dry roasted on a skillet (tawa) for five minutes on medium heat, followed by another five minutes on low heat until the leaves were crispy. The crispy leaves were then ground into a fine powder. The resulting cauliflower leaf powder (CLP) was weighed and stored in a labeled, airtight container.

Preparation of loctus stem powder

Lotus stem powder will be made in the same way as Manju *et al.* (2021) [2]. Two kilograms of fresh lotus stems were purchased from a nearby vegetable store, and they were thoroughly cleaned and washed to remove any dust or dirt on the surface. The next step was to remove the outer peel of the lotus stem with a sharp knife, then cut and slice the peeled lotus stem into little pieces. The little pieces were then transferred to a big bowl for blanching and blanched in boiling water for three to four minutes. In the boiling water, two percent salt was added. The blanched pieces were put on a clean tray and sun dried until thoroughly dry and firm. The dry pieces of lotus stem were then transferred to a grinding jar and ground into fine white powder with the grinder. The produced powder was then transferred to a labeled, airtight container.

Standardization of the Calcium Rich Powder

Calcium-rich powder samples were made with varying quantities of cauliflower leaf powder and lotus stems. The amount of oyster mushroom powder is constant in all variations (10 g) given in Table No. 1. The sample having the highest amount of calcium after the calcium estimation test was used as calcium rich powder which was then incorporated in the developed food products

Table 1: Standization of Calcium Rich Powder

Treatments	Ingredients		
	Cauliflower Leaf Powder	Lotus stem powder	Mushroom powder
R_1	30	60	10
R_2	40	50	10
R_3	50	40	10
R_4	60	30	10

Preparation of chilla premix

Chilla premix was made by firstly dry roasting the rice on a pan upon medium flame for few minutes, after the roasting was done the rice was kept aside for cooling. After the rice has cooled down it was transferred to a grinder and converted to fine powder with flour like texture. Afterward ten gram of semolina per hundred gram of chilla premix was added along with 1 tablespoon salt and about half tablespoon of baking soda and all the ingredients were mixed together to form a homogeneous mixture. Finally calculated amount of calcium rich powder (CRP) was added to the above mixture and chilla premix was formed.

Table 2: Preparation of chilla premix by using calcium rich powder

Treatment	Ingredients		
	Rice Flour	Semolina	Calcium Rich Powder
T_0 (Control)			
T_1	90	10	10
T_2	80	10	20
T_3	70	10	30
T_4	60	10	40

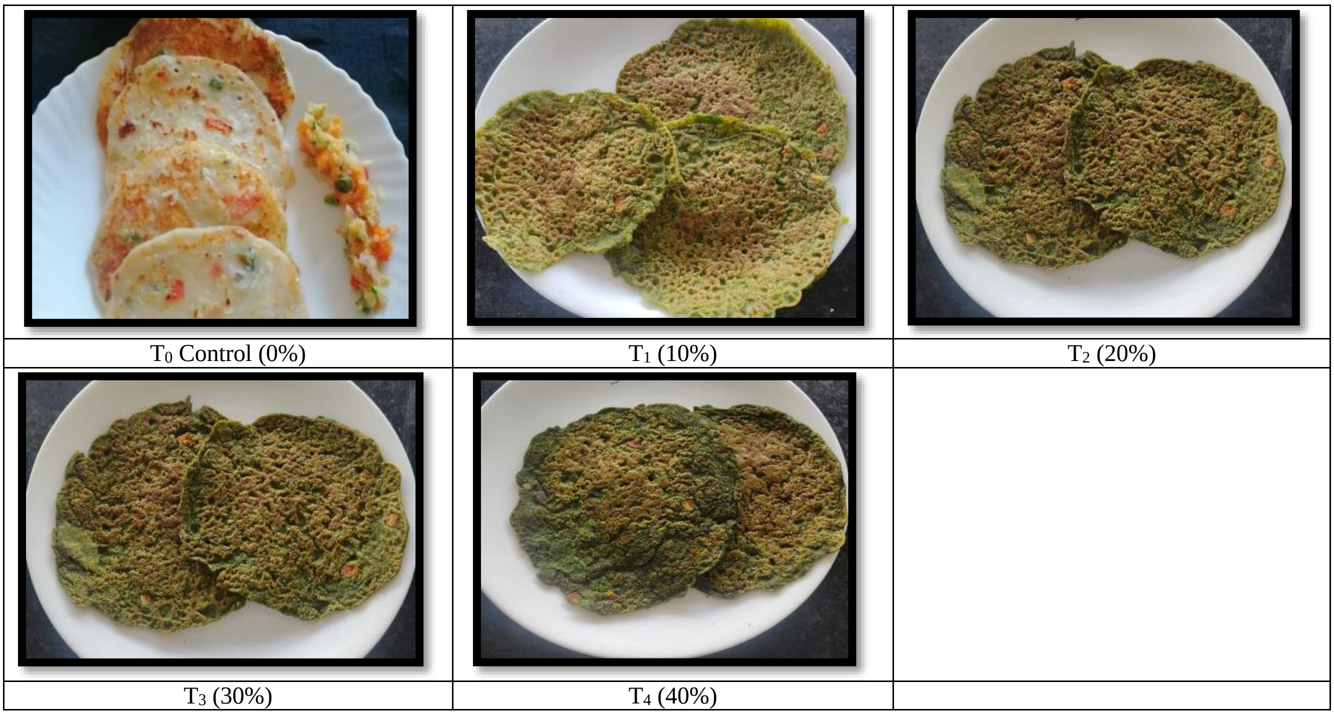

Fig 1: Chilla made from different treatments of chilla premix

Dry roasting rice in a pan till all moisture evaporates.
↓
Cool it
↓
Ground to a fine flour like powder
↓
10 grams of semolina added
↓
Add 1tsp salt and1/2 tsp baking soda together well
↓
Add calcium rich powder to above mixture and mix well.
↓
Store this chilla premix in air tight container.
↓

Flowchart for making of chilla premix

Proximate Analysis of Chilla Premix

Moisture content, crude protein, fiber, fat, total carbohydrate and ash content of premix were determined according to the method of AOAC (2020) [1]. Calcium estimation of the food products was done using the titrimetric method.

Energy value

For estimation of energy value of samples, bomb calorimeter was used. 1500 mL of distilled water was filled in a chamber and attached to central terminal of bomb head through ignition wire. Second wire was attached to the socket provided on the bomb hanger. Sample was ignited in the presence of oxygen and after complete ignition the calorific value was shown on the display screen of instrument as Kcal/g of sample.

Statistical analysis

The results of various physical and chemical measurements of grain quality were analysed. The Analysis of variance was calculated using the standard ANOVA procedure. The analysis of variance revealed significance at a $p<0.05$ level. The standard error (SE) and critical difference (CD) at the 5% level were mentioned where required.

Results and Discussion

The data presented in Table depict the calcium amount in the different proportion. The values for this parameter were highest found to be 1970±1.7 mg/100 g in R_4 Treatment and 1070±2.0 mg/100 g R_3 respectively. Due to high calcium amount in treatment (R_4) used further for the product development.

Table 3: Calcium amount in the different proportion

Treatments	Ingredients			
	Cauliflower Leaf Powder	**Lotus stem powder**	**Mushroom powder**	**Calcium (mg /100 g)**
R_1	30	60	10	1240±2.5
R_2	40	50	10	1450±1.2
R_3	50	40	10	1070±2.0
R_4	60	30	10	1970±1.7

Sensory Evaluation of Chilla premix

The sensory scores are shown on Table 4 with an observable decrease in the scores as cauliflower amount increases. The result showed that the mean scores by the panelists for appearance, taste, texture, crispiness and overall acceptability varied between chilla premix. Appearance and taste are important sensory attributes that affect the acceptability of food products. There was no significant (p>0.05) different in the mean values for appearance of the chilla premix. The taste for chilla premix produced from the composites of 80% rice flour, 10% semolina and 10% calcium rich powder were the most preferred by the panelists and the mean scores were significantly. Control and T_2 got equal scores indicating they were liked equally on the basis of sensory.

Table 4: Sensory Evaluation of Chilla premix

Product	Sensory qualities					
	Appearance	Colour	Texture	Aroma	Taste	Overall acceptability
Control	8.25±0.71	7.59±0.75	8.05±0.66	8.05±0.66	8.32±0.65	8.42±0.43
T_1	8.55±0.51	8.2±0.78	8.12±0.53	8.25±0.60	8.45±0.26	8.67±0.37
T_2	8.25±0.57	8.4±0.50	8.15±0.53	8.30±0.49	8.19±0.58	8.75±0.48
T_3	7.00±1.07	6.9±0.85	6.82±0.99	7.1±0.91	7.07±1.07	7.12±1.22
T_4	6.9±0.12	6.5±0.01	6.44±02	6.90±0.1	7.01±0.31	7.09±0.13
F-value	16.83	16. 42	15.98	12.70	13.92	18.60
Sig.	0.0004*	0.0008*	0.00075*	0.00048*	0.00045*	0.00063*

* = Significance level-0.05** = Non significant

Physicochemical characteristics of Chiila premix

The proximate composition of chilla premix produced from composite flours of rice flour, semolina, calcium rich powder is presented in Table 5. The proximate composition (moisture, ash, protein, fat, crude fiber, carbohydrate, energy and calcium) of chilla premix of T_2 5.47±0.07, 1.2±0.26, 14.02±0.3, 1.83±0.02, 7.06±0.03, 70.42±0.79, 354.23±2.42, 423.3±5.63while that control sample T_0 were 7.01±0.06, 0.58±0.136, 8.54±0.34, 0.56±0.02, 6.24±0.11, 77.07±1.21, 345.6±3.31, 9.67±0.105. Present result of the same are within the range as reported by Vyas, S., & Divedi, D. (2016) [9]; Yadav, R., & Mishra, S. (2017) [11]; Dubey, P., & Mishra, S. (2020) [5] in the chilla premix.

Table 4: Nutritional composition of chilla premix (per 100 g)

Treatment	Moisture (%)	Ash (g)	Protein (g)	Fat (g)	Crude fibre (g)	Carbohydrate (g)	Energy (kcal)	Calcium (mg)
T_0 (Control)	7.01±0.068	0.58±0.136	8.54±0.34	0.56±0.02	6.24±0.11	77.07±1.21	345.6±3.31	9.67±0.105
T_2	5.47±0.07	1.2±0.269	14.028±0.3	1.83±0.022	7.06±0.039	70.42±0.79	354.23±2.42	423.3±5.63
t-value	2.54	-3.98	-55.12	-108.5	-9.82	7.37	-3.86	-161.27
Sig.	0.004*	0.0002*	0.00012*	0.00045*	0.00039*	0.00082*	0.00029*	0.00001*

* = Significance level-0.05** = Non significant

Conclusion

In conclusion, the study successfully developed a calcium-enriched chilla premix by incorporating calcium-rich powders derived from cauliflower leaves, lotus stem, and mushroom. The results indicated that the chilla premix with the highest calcium content (1970±1.7 mg/100 g) was obtained from the treatment combining 60% cauliflower leaf powder, 30% lotus stem powder, and 10% mushroom powder (Treatment R_4). Despite the high calcium content of Treatment R_4, sensory evaluation revealed that treatments with a lower proportion of cauliflower leaf powder (such as T_2) were more preferred for their taste, appearance, and overall acceptability. Proximate analysis of the chilla premix showed significant improvements in nutritional content, particularly in protein, fat, crude fiber, and calcium, with Treatment T_2 exhibiting a calcium content of 423.3±5.63 mg/100 g, a considerable increase from the control. Furthermore, the chilla premix had favorable energy, carbohydrate, and crude fiber values, enhancing its overall nutritional profile. These findings suggest that the incorporation of calcium-rich powders from cauliflower leaves, lotus stem, and mushroom can significantly boost the calcium content of food products, making them a valuable dietary option for individuals at risk of calcium deficiency, such as postmenopausal women, older adults, and those with specific health concerns. Thus, the calcium-enriched chilla premix offers a promising and convenient food product for health-conscious consumers seeking to improve their calcium intake and overall nutritional well-being.

References

1. AOAC. Official Methods of Analysis of the Association of Official Analytical Chemists. 19th ed. Association of Official Analytical Chemists, Washington DC; 2020.
2. Begum M, Punia D. Effect of addition of lotus stem powder on nutritional, phytochemical and antioxidant properties of sev. Int J Chem Stud. 2021;9(1):832-836. https://doi.org/10.22271/chemi.2021.v9.i1l.11326.
3. Chakraborty S, Mandal A, Mondal K, Datta S. Preparation of calcium-dense cauliflower leaf powder by different methods & selection of the most suitable method. Int J Curr Res. 2015;7(9):20462-20468.
4. Cormick G, Belizán JM. Calcium intake and health. Nutrients. 2019;11(7):1606. https://doi.org/10.3390/nu11071606.
5. Dubey P, Mishra S. Dietary implication of miracle cereal finger millet (*Eleusine coracana*) and its product development. Aegaeum J. 2020;8(7):1306-1316.
6. Pankar SA, Bornare DT. Studies on cauliflower leaves powder and its waste utilization in traditional product. Int J Agric Eng. 2018;11(Special):95-98. https://doi.org/10.15740/has/ijae/11.sp.issue/95-98.

7. Rondanelli M, Moroni A, Zese M, Gasparri C, Riva A, Petrangolini G, *et al*. Vitamin D from UV-irradiated mushrooms as a way for vitamin D supplementation: A systematic review on classic and nonclassic effects in human and animal models. Antioxidants. 2023;12(3):736. https://doi.org/10.3390/antiox12030736.
8. Shlisky J, Mandlik R, Askari S, Abrams S, Belizán JM, Bourassa MW, *et al*. Calcium deficiency worldwide: prevalence of inadequate intakes and associated health outcomes. Ann N Y Acad Sci. 2022;1512(1):10-28. https://doi.org/10.1111/nyas.14758.
9. Vyas S, Divedi D. Chemical analysis of formulated cereal pulse-based flour and development of value-added products. Chem Anal. 2016;3(3).
10. Yadav S. Formulation and organoleptic evaluation of lotus stem fortified cookies. J Food Process Technol. 2023;14:1026.
11. Yadav R, Mishra S. A study on development of products using nutrigenomics premix powder and its sensory evaluation. Int J Food Sci Technol (IJFST). 2017;7:19-28.
12. Zaidi A, Shamim M, Dixit A, Singh S. Formulation and nutritional analysis of lotus stem incorporated cookies. Int J Sci Dev Res. 2020;5(6). DOI: 10.13140/RG.2.2.16642.71360.