

## Extraction and Evaluation of Leaf Protein Concentrate from Four Selected Grass Species.

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### KEYWORDS

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*Dichanthium annulatum*,  
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### Abstract

Leaf protein concentrate (LPC) represents a sustainable and economical source of plant protein with growing importance in nutrition and feed research. The present study investigated the extraction and protein potential of LPC obtained from four selected grass species: *Cynodon dactylon*, *Dichanthium annulatum*, *Eragrostis uniolooides*, and *Setaria glauca*. Fresh leaves were processed to obtain green juice, followed by heat-induced coagulation and centrifugation for LPC recovery. The extracted LPC was analysed for yield, moisture content, and protein concentration using standard analytical procedures. Significant variations were observed among the grass species with respect to LPC yield and protein content. *Cynodon dactylon* and *Dichanthium annulatum* showed comparatively higher LPC recovery and protein levels than the other species studied. The results demonstrate that selected grasses can serve as viable alternative sources of plant protein. This study highlights the potential of utilizing underexploited grass resources for LPC production, contributing to sustainable protein supplementation and improved feed and nutritional security.

### Introduction

Protein deficiency continues to be a major nutritional concern, particularly in developing countries where access to conventional protein sources is limited by cost and availability (Temba *et al.*, 2016; Nadathur *et al.*, 2017; Kumar *et al.*, 2025). This has led to growing interest in alternative, sustainable, and plant-based protein resources that can support both human nutrition and animal feeding systems (Ferrari *et al.*, 2022; Sobczak *et al.*, 2023). Among these alternatives, leaf protein concentrate (LPC) has gained attention due to its high protein content

and the widespread availability of green leafy biomass (Biswas & Purohit, 2024; Furia *et al.*, 2025).

Leaf protein concentrate is obtained by processing fresh green leaves to extract juice, followed by coagulation and separation of the protein fraction (Anoop *et al.*, 2023). LPC is known to contain a considerable amount of crude protein along with essential amino acids, minerals, and bioactive compounds (Fatima *et al.*, 2024). The production of LPC offers several advantages, including efficient

utilization of plant biomass, low production cost, and suitability for regions with limited agricultural inputs (Yue *et al.*, 2025). As a result, LPC has been explored as a supplementary protein source in food and feed formulations (Mota *et al.*, 2022; Domokos-Szabolcsy *et al.*, 2023).

Grasses represent an abundant and underexploited source of leaf biomass, especially in tropical and subtropical regions (Singh *et al.*, 2018). Species such as *Cynodon dactylon*, *Dichanthium annulatum*, *Eragrostis uniolooides*, and *Setaria glauca* are widely distributed and commonly used as fodder due to their high adaptability, rapid growth, and biomass yield (Waheed *et al.*, 2022). Despite their extensive availability, their potential for LPC extraction and protein recovery has not been sufficiently explored (Fatima *et al.*, 2024).

Evaluating these grass species for LPC production could contribute to improved utilization of local plant resources and help address protein scarcity (Pirie, 1987; Fasuyi & Aletor, 2005). The protein yield and quality of LPC are influenced by factors such as plant species, leaf maturity, and extraction conditions (Perez-Vila *et al.*, 2024). Therefore, systematic assessment of LPC derived from different grass species is essential to identify

suitable candidates for sustainable protein production. The present study focuses on the extraction and evaluation of LPC from selected grass species with the aim of assessing their protein potential and suitability as alternative plant protein sources for nutritional and feed applications.

## Materials and Method

Fresh leaves of *Cynodon dactylon*, *Dichanthium annulatum*, *Eragrostis uniolooides*, and *Setaria glauca* were collected at the vegetative growth stage from local grasslands. The samples were washed thoroughly with tap water followed by distilled water to remove extraneous matter and were processed immediately after collection.

### Extraction of Leaf Protein Concentrate

Leaf protein concentrate (LPC) was prepared using a green biomass fractionation method. Cleaned leaves were mechanically macerated with a minimal volume of distilled water, and the resulting pulp was filtered through muslin cloth to obtain green juice. The juice was heated at 80–85°C for 10-15 min to induce protein coagulation. After cooling, the coagulated protein was separated by centrifugation at 5,000 rpm for 10 min. The precipitated LPC was washed with distilled water and dried in a hot-air oven at 60° C until constant weight.

### LPC Yield

LPC yield was calculated on a dry weight basis and expressed as grams per 100 g of fresh leaf material.

### Moisture Content

Moisture content of LPC samples was determined by oven-drying at 105 °C to constant weight and expressed as percentage moisture.

### Crude Protein Analysis

Crude protein content of LPC was determined using the Kjeldahl method. Total nitrogen was quantified after acid digestion, distillation, and titration, and crude protein was calculated by applying a nitrogen-to-protein conversion factor of 6.25. Results were expressed on a dry matter basis.

The LPC yield varied significantly among the selected grass species when processed on a fresh weight basis (Table 1). *Cynodon dactylon* exhibited the highest LPC recovery (7.5 g/100 g fresh leaves), indicating superior extra ability and protein recovery efficiency. This may be attributed to its favourable leaf morphology and higher soluble protein fraction. *Setaria glauca* showed a moderate LPC yield, while *Dichanthium annulatum* and *Eragrostis uniolooides* recorded comparatively lower but statistically similar yields.

### Results and Discussion

Table no.1 Leaf Protein Concentrate (LPC) from selected grasses

Species	Fresh Leaf Used (g)	LPC Yield (g)
<i>Cynodon dactylon</i>	100	7.5
<i>Dichanthium annulatum</i>	100	4.5
<i>Eragrostis uniolooides</i>	100	4.3
<i>Setaria glauca</i>	100	5.7

Crude protein content of the extracted LPC also differed significantly among species (Table 2). LPC from *Cynodon dactylon* showed the highest crude protein content (38.8%), confirming its potential as a nutritionally rich leaf protein source. Moderate protein levels were observed in *Eragrostis uniolooides* and *Dichanthium annulatum*, whereas *Setaria glauca* exhibited the lowest crude protein percentage.

Table No.2 Crude protein content from LPC

Species	Crude Protein
<i>Cynodon dactylon</i>	38 .8
<i>Dichanthium annulatum</i>	35.3
<i>Eragrostis uniolooides</i>	36 .4
<i>Setaria glauca</i>	33 .6

The low SD ranges recorded for LPC yield, crude protein, and moisture content (Table 3) indicate good repeatability and reliability of the extraction and analytical procedures. Overall, the results clearly demonstrate that *Cynodon dactylon* is the most promising species for LPC production in terms of both yield and nutritional quality, followed by *Setaria glauca*, while the other grasses show scope for improvement through optimized processing conditions.

Table No.3 Parameters and SD Range

Parameter	SD Range
LPC Yield	0.12 – 0.24
Crude Protein of LPC	0.18 – 0.30
Moisture content of LPC	0.10 – 0.15

### Conclusion

The present study concluded that the selected grass species differ significantly in their potential for leaf protein concentrate (LPC) production in terms of yield and crude protein content. Among the four grasses evaluated, *Cynodon dactylon* emerged as the most promising species, exhibiting the highest LPC yield and superior crude protein concentration. This highlights its strong suitability as an efficient and nutritionally rich source of leaf-derived protein.

*Setaria glauca* showed a moderate LPC yield but comparatively lower crude protein content, indicating that higher concentrate recovery does not always correspond to improved protein quality. *Dichanthium annulatum* and *Eragrostis uniolooides* produced lower LPC yields with intermediate protein levels, suggesting limited protein extractability under the applied processing conditions.

The narrow standard deviation ranges observed for LPC yield, crude protein, and moisture content confirm the reliability and reproducibility of the extraction and analytical methods. Overall, the findings emphasize the importance of species selection for optimizing LPC production and quality. *Cynodon dactylon* can be recommended as a suitable candidate for sustainable LPC production, while the other grasses may be further explored through improved extraction

techniques to enhance their protein recovery and nutritional value.

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### References:

- Anoop, A. A., Pillai, P. K., Nickerson, M., & Ragavan, K. V. (2023). Plant leaf proteins for food applications: Opportunities and challenges. *Comprehensive Reviews in Food Science and Food Safety*, 22(1), 473-501.
- Biswas, D., & Purohit, S. R. (2024). Nutritional profile, antinutritional factors, and digestibility of proteins in non-conventional leaf protein sources. *ACS*

*Food Science & Technology*, 4(5), 1017-1029.

Fasuyi, A. O., & Aletor, V. A. (2005). Protein replacement value of leaf protein concentrates. *Journal of Food, Agriculture & Environment*, 3(1), 99–104.

Fatima, A., Singh, P., Pandey, V. K., Singh, R., & Rustagi, S. (2024). Exploring the significance of protein concentrate: A review on sources, extraction methods, and applications. *Food Chemistry Advances*, 5, 100771.

Fatima, A., Singh, P., Pandey, V. K., Singh, R., & Rustagi, S. (2024). Exploring the significance of protein concentrate: A review on sources, extraction methods, and applications. *Food Chemistry Advances*, 5, 100771.

Ferrari, L., Panaite, S. A., Bertazzo, A., & Visioli, F. (2022). Animal-and plant-based protein sources: a scoping review of human health outcomes and environmental impact. *Nutrients*, 14(23), 5115.

Furia, K. A., Majzoobi, M., Torley, P. J., & Farahnaky, A. (2025). Innovative approaches in leaf protein extraction: advancements, challenges, and applications in sustainable food formulation and design. *Critical Reviews in Food Science and Nutrition*, 1-33.

Kinsella, J. E. (1979). Functional properties of proteins in foods. *Critical Reviews in Food Science and Nutrition*, 7(3), 219–280.

Kumar, R., Guleria, A., Padwad, Y. S., Srivatsan, V., & Yadav, S. K. (2025). Smart

proteins as a new paradigm for meeting dietary protein sufficiency of India: a critical review on the safety and sustainability of different protein sources. *Critical Reviews in Food Science and Nutrition*, 65(18), 3496-3545.

Mota, J., Casimiro, S., Fernandes, J., Hartmann, R. M., Schemitt, E., Picada, J. & Ferreira, R. B. (2022). Lupin protein concentrate as a novel functional food additive that can reduce colitis-induced inflammation and oxidative stress. *Nutrients*, 14(10), 2102.

Nadathur, S. R., Wanasundara, J. P. D., & Scanlin, L. (2017). Proteins in the diet: Challenges in feeding the global population. In *Sustainable protein sources*, Academic Press. pp. 1-19

Pérez-Vila, S., Fenelon, M., Hennessy, D., O'Mahony, J. A., & Gómez-Mascaraque, L. G. (2024). Impact of the extraction method on the composition and solubility of leaf protein concentrates from perennial ryegrass (*Lolium perenne* L.). *Food Hydrocolloids*, 147, 109372.

Pirie, N. W. (1987). Leaf protein and its by-products in human and animal nutrition. *Advances in Applied Biology*, 12, 1–64.

Singh, K., Awasthi, A., Sharma, S. K., Singh, S., & Tewari, S. K. (2018). Biomass production from neglected and underutilized tall perennial grasses on marginal lands in India: a brief review. *Energy, Ecology and Environment*, (4), 207-215.

Sobczak, P., Grochowicz, J., Łusiak, P., & Żukiewicz-Sobczak, W. (2023). Development of alternative protein sources

in terms of a sustainable system. *Sustainability*, 15(16), 12111.

Temba, M. C., Njobeh, P. B., Adebo, O. A., Olugbile, A. O., & Kayitesi, E. (2016). The role of compositing cereals with legumes to alleviate protein energy malnutrition in Africa. *International Journal of Food Science and Technology*, 51(3), 543-554.

Waheed, M., Haq, S. M., Arshad, F., Bussmann, R. W., Iqbal, M., Bukhari, N. A., & Hatamleh, A. A. (2022). Grasses in semi-arid lowlands—community composition and spatial dynamics with special regard to the influence of edaphic factors. *Sustainability*, 14(22), 14964.

Yue, J., Gao, G., Fan, Y., Liu, Y., & Feng, H. (2025). Estimating crop leaf protein content using hyperspectral remote sensing and pretrained and LCC-assisted LPCNet deep learning model. *Computers and Electronics in Agriculture*, 239, 111064