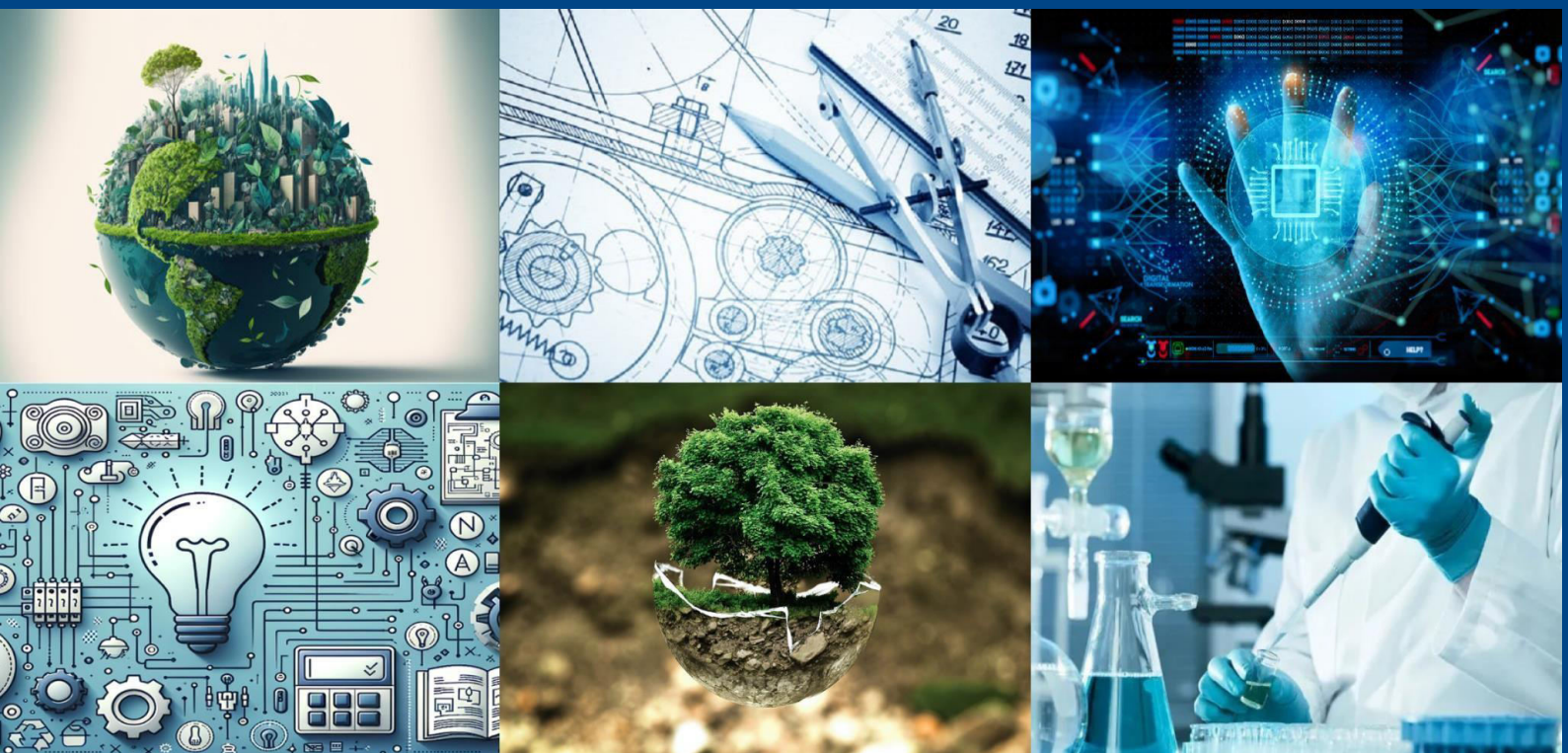




International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 8, Issue 9, September 2025



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

A Study on the Phytochemical Composition of Various Parts of *Achyranthes Aspera* and *Cenchrus Ciliaris*

Mahendra Regar¹, Dr. Ravi Parihar²

Research Scholar, Department of Botany, Govt. Dungar College, Bikaner, Rajasthan, India¹

Assistant Professor, Department of Botany, Govt. Dungar College, Bikaner, Rajasthan, India²

ABSTRACT: Plants have long served as an important source of food, medicine, and fodder, with their biochemical and phytochemical constituents playing a vital role in human health and livestock nutrition. Scientific evaluation of these constituents not only validates traditional knowledge but also provides a foundation for their sustainable application in medicine and agriculture. In this context, the present study focuses on two species of ecological and economic importance: *Achyranthes aspera*, a medicinal herb widely used in indigenous healthcare practices, and *Cenchrus ciliaris*, a nutritious fodder grass valued in livestock management. The study aims to analyze the phytochemical composition of different parts of these plants by quantifying carbohydrates, crude fibre, crude protein, total protein, fats, and chlorophyll content.

KEYWORDS: Plants; Phytochemical Analysis; Root; Stem; Leaf.

I. INTRODUCTION

Phytochemical analysis is an essential approach as it provides insights into the biochemical composition of plants and their potential medicinal, nutritional and ecological significance. Plants produce a wide array of primary and secondary metabolites, which not only support their growth and development but also serve as a defense against environmental stress, herbivory and pathogens. These phytochemicals include carbohydrates, proteins, fats, fibres, chlorophylls and other bioactive compounds, many of which have been recognized for their therapeutic and nutraceutical value. The study of carbohydrates, proteins and fats in plants highlights their role as major constituents of food and energy storage, while crude fibre contributes to structural integrity and has nutritional relevance for both humans and animals. Similarly, chlorophyll content reflects the photosynthetic capacity and metabolic activity of plant tissues. Variations in the distribution of these constituents across different plant parts such as root, stem and leaves provide valuable information on the functional roles of each organ and their potential applications. In the present study, two plant species, *Achyranthes aspera* and *Cenchrus ciliaris*, were selected for phytochemical analysis owing to their ecological importance and traditional uses.

Achyranthes aspera L. – Description

Achyranthes aspera L. is a widely distributed herbaceous plant found across tropical and subtropical regions. It is well known for its nutritional and ethnomedicinal applications and is commonly consumed by ruminants, horses and rabbits. The plant is also utilized in traditional food preparations and as a valuable forage species. The plant has a broad distribution across tropical and subtropical regions of Europe, Africa, Asia, Australia, and the Americas, with its origin believed to lie in the Old World. It thrives in open and dry environments at elevations up to 2000–3000 m and is frequently found in secondary growth, forest margins, thickets, open grasslands, sandy soils, and disturbed habitats. While in countries like Mexico it is considered a weed, in Tanzania it has been reported as invasive, and in East Java it often dominates the understorey vegetation of *Acacia nilotica*. Morphologically, *Achyranthes aspera* occurs either as an annual or perennial shrubby herb, typically reaching a height of 60–80 cm, though in favorable conditions it may grow up to 200 cm. At maturity, it develops a woody base supported by a strong taproot system. The leaves are opposite, simple, and variable in shape, size, and color, often up to 15 cm long, usually ovate, and may bear soft hairs on one or both surfaces. The inflorescence appears as terminal or axillary spikes, ranging in color from silvery green to pinkish-red, and bears small flowers (3–7 mm) that usually bend downward upon maturity. The fruits are tiny capsules measuring 1.6–2.5 mm and contain a few seeds, which are mainly dispersed through animal fur and human clothing.

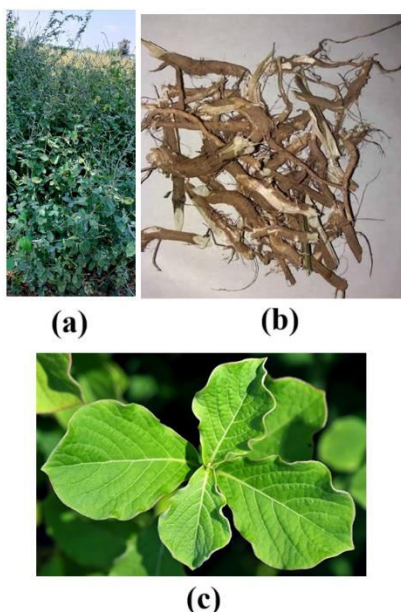


International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

The seeds are minute and are occasionally used as emergency food. The species is valued for its diverse applications in food, forage, and traditional medicine. In parts of Tanzania, the leaves are consumed as a leafy vegetable similar to spinach, often cooked with sesame seeds, peanuts, or sunflower seeds to enhance flavor. In East Java, it serves as an important forage source for buffaloes and is grazed by other livestock, while in India, its leaf protein concentrate has been investigated as a potential dietary supplement during scarcity. Furthermore, various plant parts, including leaves, stems, roots, and seeds, are utilized in African and Indian ethnomedicinal systems for their therapeutic properties. Beyond its nutritional and medicinal roles, *Achyranthes aspera* is also recognized as a bio-indicator of soil fertility, further emphasizing its ecological and economic significance (Dinakarkumar et al., 2025; Nargatti et al., 2021; Mandefro et al., 2023; Talreja and Tiwari 2023).

Fig 1: *Achyranthes aspera*: (a) whole plant; (b) root; (c) leaves



***Cenchrus ciliaris* – Description**

Cenchrus ciliaris L., commonly known as Buffel grass, is a perennial tropical grass of significant economic importance, widely cultivated in Africa, Australia and India for its high forage value. It is considered one of the most resilient pasture grasses in arid and semi-arid regions. The grass is native to Africa, Arabia, the Middle East, and India, but it was introduced into Australia in the late 19th century, where it has since naturalized extensively. Today, it is distributed across tropical, subtropical, and warm temperate regions worldwide, thriving in diverse habitats including open bushlands, woodlands, grasslands, sandy and rocky soils, calcareous areas, and dry riverbeds. It grows from sea level to elevations up to 2000 m and can tolerate rainfall as low as 100 mm, performing best in well-drained soils with a pH between 7 and 8. While it is highly drought-tolerant and fire-resistant, it does not withstand prolonged waterlogging. Morphologically, Buffel grass is a variable, tufted, tussock-forming species with a deep and robust root system extending up to 2 m below the surface, which enables survival under severe drought conditions; certain varieties also exhibit rhizomatous growth. Its culms are erect or decumbent, often reaching 2 m in height, and its linear leaves, measuring 3–30 cm in length and 4–10 mm in width, are green to bluish-green in color and slightly hairy. The species bears a spike-like panicle inflorescence with bristled spikelets that detach readily, while its seeds are small ovoid caryopses, about 1.4–2 mm in size. Owing to these adaptive features, *C. ciliaris* is primarily cultivated as pasture and forage, as it establishes readily, withstands heavy grazing, and remains palatable to livestock even under harsh conditions. Forage yields range between 2–18 t DM/ha without fertilizer, but may reach up to 24 t/ha with fertilizer application. It produces good quality hay when harvested at early flowering, though its utility for silage is limited due to low moisture content in semi-arid areas. During droughts, old stands continue to provide roughage, especially when supplemented, ensuring its role as an important fodder resource. In addition to livestock feeding, the seeds of Buffel grass are sometimes consumed by humans in India, either directly or ground into flour for bread. Furthermore,



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

numerous cultivars, particularly developed in Australia, have been selectively bred for adaptability to saline and arid conditions, enhancing the value of this grass as a sustainable fodder species (Wasim et al., 2021; Hemavathy et al., 2023; Aslam et al., 2024; Siller-Clavel et al., 2022; Singh et al., 2023; Singh et al., 2024).

Fig 2: *Cenchrus ciliaris*: (a) whole plant; (b) inflorescence (long green flat parts in the background are the true leaves)



II. RESEARCH METHODOLOGY

Phytochemical analyses were conducted on two medicinal plant species i.e., *Achyranthes aspera* and *Cenchrus ciliaris* to evaluate the presence and quantity of key biochemical constituents (Titus et al., 2024). *Achyranthes aspera* is a well-known medicinal herb widely employed in indigenous systems of medicine, whereas *Cenchrus ciliaris* is an important fodder grass species valued for its nutritional contribution to livestock. By analyzing parameters such as carbohydrates, crude fibre, crude protein, total protein, fats and chlorophyll content in different plant parts, this study aims to generate a comparative biochemical profile of these species. Chlorophyll content was measured following Arnon's (1949) method. Quantitative analysis of carbohydrates, proteins, fats, and crude fiber was performed using the standard protocols outlined by the Association of Official Analytical Chemists (AOAC, 1995). Lipid content was determined using Folch's method (Folch et al., 1957), and total protein content was estimated by Lowry's method (Lowry et al., 1951).

Result and Discussion: -

The chemical composition of *Achyranthes aspera* and *Cenchrus ciliaris* reveals notable variations in nutrient content.

Table 1: Chemical composition of *Achyranthes aspera* and *Cenchrus ciliaris*

Plant Species	Plant Part	Carbohydrates (g/100 g)	Crude Fibre (%)	Crude Protein (%)	Chlorophyll (µg/g)	Total Protein Content (%)	Fats (%)
<i>Achyranthes aspera</i>	Root	45.2	14.3	3.5	ND	3.5	1.2
	Stem	47.9	12.2	4.2	Trace	4.0	1.8
	Leaf	51.4	16.9	5.4	Chl a: 390.7 Chl b: 271.9	0.8	2.6
<i>Cenchrus ciliaris</i>	Root	30.1	27.7	3.6	ND	2.5	1.5
	Stem	28.2	32.3	5.1	Trace	5.1	2.8
	Leaf	29.1	37.3	7.9	Chl a: 258.1 Chl b: 93.2	3.7	3.2

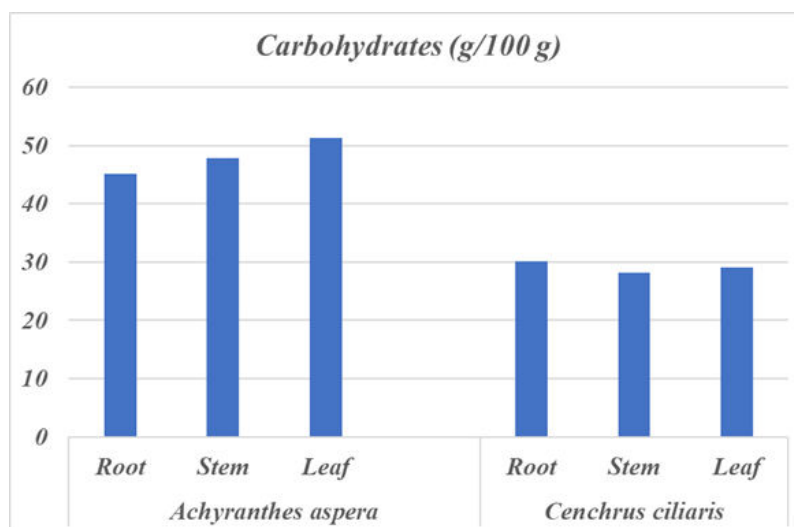


International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

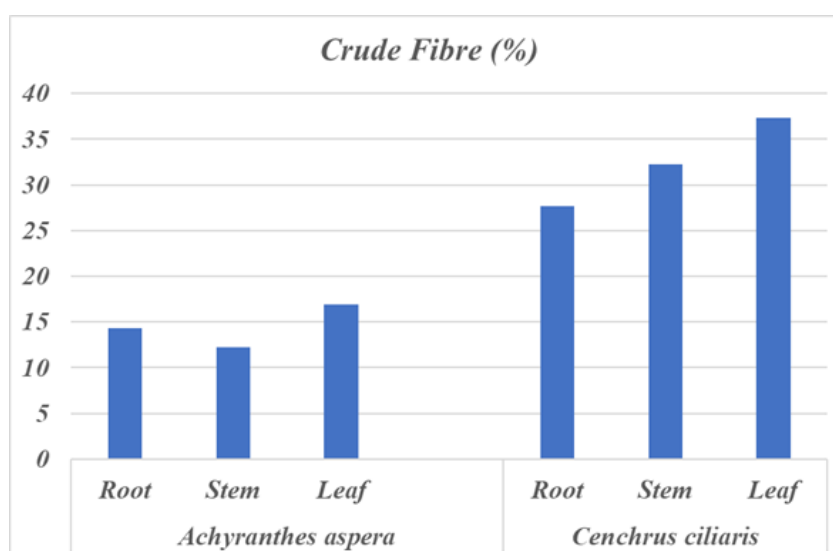
Carbohydrate concentration was found to be higher in *A. aspera* compared to *C. ciliaris*, with the maximum value recorded in the leaves (51.4 g/100 g) of *A. aspera*. In contrast, *C. ciliaris* exhibited comparatively lower carbohydrate levels across all plant parts, with the highest value in root (30.1 g/100 g). This suggests that *A. aspera* may serve as a better source of readily available energy.

Fig 3: Carbohydrate Content (g/100g) of *Achyranthes aspera* and *Cenchrus ciliaris*



Crude fibre content showed an opposite trend, being substantially higher in *C. ciliaris* than in *A. aspera*. The fibre percentage was highest in *C. ciliaris* leaves (37.3%), followed by stems (32.3%) and roots (27.7%), whereas *A. aspera* contained lower fibre values, with the highest in leaves (16.9%). This indicates that *C. ciliaris* contributes more structural biomass and may be more effective as a roughage source in animal feed.

Fig 4: CF (%) Content of *Achyranthes aspera* and *Cenchrus ciliaris*



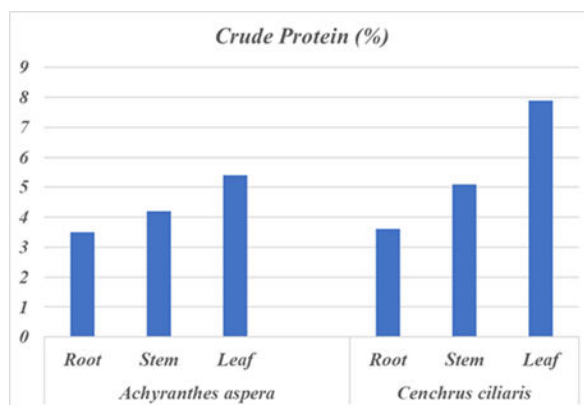
Crude protein and total protein content varied across species and plant parts. *C. ciliaris* generally showed higher protein levels, particularly in leaves (7.9% crude protein, 3.7% total protein), whereas *A. aspera* recorded moderate values with a maximum in leaves (5.4% crude protein). The data indicate that *C. ciliaris* is relatively superior in protein content, making it nutritionally significant for fodder purposes.



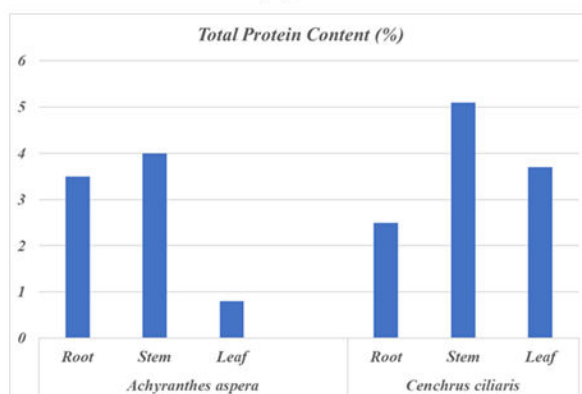
International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Fig 5: (a) CP (%) Content (b) Total Protein (%) Content of *Achyranthes aspera* and *Cenchrus ciliaris*



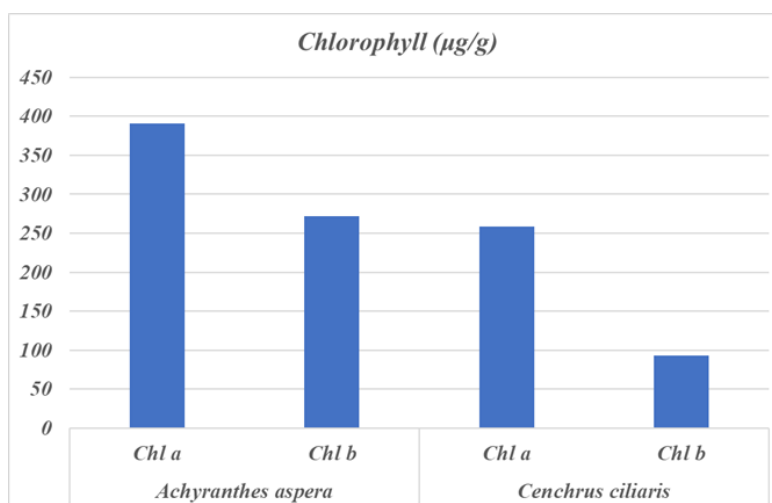
(a)



(b)

Chlorophyll content was measurable in leaves of both species. *A. aspera* leaves exhibited higher chlorophyll a (390.7 µg/g) and chlorophyll b (271.9 µg/g) compared to *C. ciliaris* leaves (258.1 µg/g and 93.2 µg/g, respectively), suggesting stronger photosynthetic potential and pigment richness in *A. aspera*.

Fig 6: Chlorophyll (µg/g) Content of *Achyranthes aspera* and *Cenchrus ciliaris*



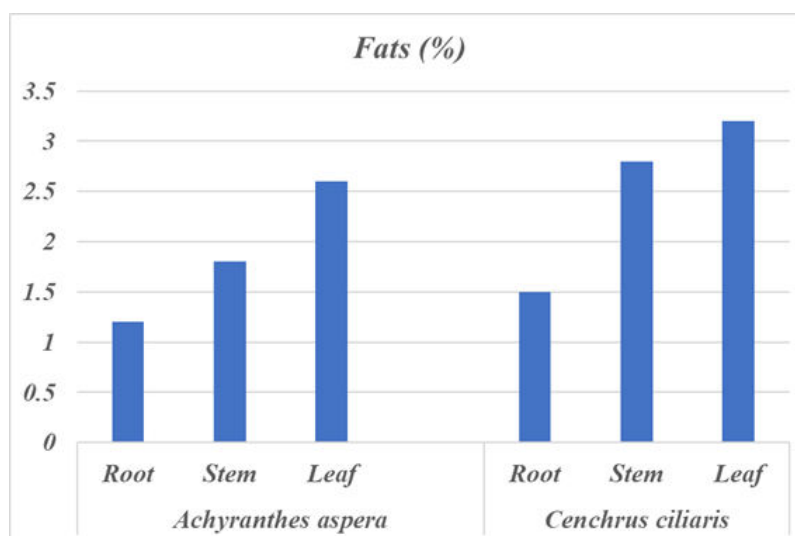


International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Fat content was generally low in both species, ranging between 1.2–2.6% in *A. aspera* and 1.5–3.2% in *C. ciliaris*. However, *C. ciliaris* leaves recorded the highest fat content (3.2%), indicating a slightly better fat reserve compared to *A. aspera*.

Fig 7: Fat (%) Content of *Achyranthes aspera* and *Cenchrus ciliaris*



Overall, the results suggest that *Achyranthes aspera* is richer in carbohydrates and chlorophyll pigments, while *Cenchrus ciliaris* is superior in crude fibre, protein and fat content. These compositional differences highlight the distinct nutritional roles of the two plants, with *A. aspera* showing greater potential as a carbohydrate and pigment source and *C. ciliaris* serving as a valuable forage species due to its high protein and fibre content.

III. CONCLUSION

The phytochemical analysis of *Achyranthes aspera* and *Cenchrus ciliaris* highlighted clear differences in their nutrient profiles. *Achyranthes aspera* was found to be richer in carbohydrates and chlorophyll pigments, particularly in its leaves, indicating its potential as an energy and pigment source. In contrast, *Cenchrus ciliaris* showed higher levels of crude fibre, protein, and fat, especially in the leaves, suggesting its greater suitability as a forage and roughage plant. These variations underline the complementary nutritional roles of the two species, with *A. aspera* contributing more towards carbohydrate-based energy and photosynthetic efficiency, while *C. ciliaris* offers significant fodder value through its high protein and fibre content. These results align with **Devi et al. (2024)**, who also reported high carbohydrate content in the leaves of *A. aspera*, supporting its potential as a natural carbohydrate source. Similarly, **Talreja et al. (2014)** confirmed the nutritional value of *A. aspera* seeds, reporting considerable crude protein and fibre, which resonates with the present findings of its nutritive potential. For *C. ciliaris*, the present results are in agreement with **Ashraf et al. (2013)** and **Mishra et al. (2010)**, who highlighted its nutritional variability, high crude protein, and adaptation potential as a range grass in arid environments, further strengthening its role as a sustainable fodder species. Meanwhile, the broader context provided by **Thattantavide et al. (2024)** underscores the importance of such locally available species in addressing nutritional diversity and food security, a perspective that complements the current study's emphasis on the complementary nutritional roles of *A. aspera* and *C. ciliaris*.

REFERENCES

1. Aron, D. (1949). Copper enzymes in isolated chloroplasts: Polyphenoloxidase in *Beta vulgaris*. *Plant Physiology*, 24(1), 1–15. <https://doi.org/10.1104/pp.24.1.1>
2. Ashraf, M., Mahmood, K., Yusoff, I., & Qureshi, A. K. (2013). Chemical constituents of *Cenchrus ciliaris* L. from the Cholistan Desert, Pakistan. *Archives of Biological Sciences*, 65(4), 1473–1478. <https://doi.org/10.2298/ABS1304473A>



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

3. Aslam, M. I., Touqeer, S., Jamil, Q., Masood, M. I., Sarfraz, A., Khan, S. Y., Jan, M. S., Alnasser, S. M. A., Ahmad, A., Aslam, F., & Iqbal, S. M. (2024). *Cenchrus ciliaris* L. ameliorates cigarette-smoke-induced acute lung injury by reducing inflammation and oxidative stress. *South African Journal of Botany*, 171, 216–227. <https://doi.org/10.1016/j.sajb.2024.05.057>
4. Association of Official Analytical Chemists. (1995). *Official methods of analysis* (14th ed.). Washington, DC: Author.
5. Devi, S., Nirala, P., Asha, & Maurya, V. (2024). Estimation of total carbohydrate content of *Achyranthes aspera* L. from Kathgodam, Nainital district by anthrone method.
6. Dinakarkumar, Y., Ramakrishnan, G., Marimuthu, P., Priya, S. V., Kumar, S., & Mukkavilli, V. (2025). Diverse bioactivity of traditional herb *Achyranthes aspera* in ethnomedicine. *Pharmacological Research – Natural Products*, 100268. <https://doi.org/10.1016/j.prenap.2025.100268>
7. Folch, J., Lees, M., & Sloane Stanley, G. H. (1957). A simple method for the isolation and purification of total lipides from animal tissues. *Journal of Biological Chemistry*, 226(1), 497–509. [https://doi.org/10.1016/S0021-9258\(18\)64849-5](https://doi.org/10.1016/S0021-9258(18)64849-5)
8. Hemavathy, A. T., Subramanian, A., Anantharaju, P., Sakila, M., & Kavitha, S. (2023). Characterization of Buffel grass (*Cenchrus ciliaris* L.) germplasm using DUS descriptors. *International Journal of Plant & Soil Science*, 35(22), 833–839.
9. Lowry, O. H., Rosebrough, N. J., Farr, A. L., & Randall, R. J. (1951). Protein measurement with the Folin phenol reagent. *Journal of Biological Chemistry*, 193(1), 265–275. [https://doi.org/10.1016/S0021-9258\(19\)52451-6](https://doi.org/10.1016/S0021-9258(19)52451-6)
10. Mandefro, B., Fereja, W. M., Fremichael, D., Mereta, S. T., & Ambelu, A. (2023). Analysis of *Achyranthes aspera* leaf extract and acute toxicity study on fingerlings of Nile tilapia, *Oreochromis niloticus*. *Biochemistry and Biophysics Reports*, 37, 101624. <https://doi.org/10.1016/j.bbrep.2023.101624>
11. Mishra, A., Tiwari, H., & Bhatt, R. (2010). Growth, biomass production and photosynthesis of *Cenchrus ciliaris* L. under *Acacia tortilis* (Forssk.) Hayne based silvopastoral systems in semi-arid tropics. *Journal of Environmental Biology*, 31(6), 987–993.
12. Nargatti, P., Patil, S., & Wadkar, K. (2021). Phytochemical profile and pharmacological aspects of *Achyranthes aspera* Linn: An overview. *Journal of Pharmaceutical Research International*, 33(34B), 187–206. <https://doi.org/10.9734/jpri/2021/v33i34B31860>
13. Siller-Clavel, P., Badano, E. I., Villarreal-Guerrero, F., Prieto-Amparán, J. A., Pinedo-Alvarez, A., Corrales-Lerma, R., Álvarez-Holguín, A., & Hernández-Quiroz, N. S. (2022). Distribution patterns of invasive Buffel grass (*Cenchrus ciliaris*) in Mexico estimated with climate niche models under the current and future climate. *Plants*, 11(9), 1160. <https://doi.org/10.3390/plants11091160>
14. Singh, S., Koli, P., Singh, T., Das, M. M., Maity, S. B., Singh, K. K., Katiyar, R., Misra, A. K., Mahanta, S. K., Srivastava, M. K., Anele, U. Y., Oderinwale, O. A., & Ren, Y. (2024). Assessing genotypes of Buffel grass (*Cenchrus ciliaris*) as an alternative to maize silage for sheep nutrition. *PLOS ONE*, 19(5), e0304328. <https://doi.org/10.1371/journal.pone.0304328>
15. Singh, S., Singh, T., Singh, K. K., Srivastava, M. K., Das, M. M., Mahanta, S. K., Kumar, N., Katiyar, R., Ghosh, P. K., & Misra, A. K. (2023). Evaluation of global *Cenchrus* germplasm for key nutritional and silage quality traits. *Frontiers in Nutrition*, 9, 1094763. <https://doi.org/10.3389/fnut.2022.1094763>
16. Talreja, S., & Tiwari, S. (2023). A comprehensive review of *Achyranthes aspera*: Ethnopharmacology, phytochemistry, and therapeutic potential. *AYUSHDHARA*, 10(5), 270–278.
17. Talreja, T., Sirohi, P., & Sharma, T. (2014). Proximate composition analysis of two medicinally important plants *Achyranthes aspera* and *Cissus quadrangularis*. *International Journal of Pharmaceutical Sciences Review and Research*, 7(2), 416–418.
18. Thattantavide, A., Saritha, G., Ramchiary, N., & Kumar, A. (2024). Assessing the impact of different cooking methods on nutrients, phytochemicals and antioxidant activity of traditional food plants. *Food Chemistry Advances*, 4, 100677. <https://doi.org/10.1016/j.focha.2024.100677>
19. Titus, S. D., Abershi, A. L., Francis, A., Mafe, A. N., Samuel, K. B., Daniel, E. O., & Ojogbene, E. (2024). Effect of processing on nutritional and antinutritional composition of SAMPEA-11 and 20-T cowpea cultivars. *Journal of Multidisciplinary Science MIKAILALSYS*, 2(3), 479–489. <https://doi.org/10.58578/mikailalsys.v2i3.3867>
20. Wasim, M. A., Naz, N., & Zehra, S. S. (2021). Anatomical characteristics, ionic contents and nutritional potential of Buffel grass (*Cenchrus ciliaris* L.) under high salinity. *South African Journal of Botany*, 144, 471–479. <https://doi.org/10.1016/j.sajb.2021.09.015>



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com