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Research Article

Assessment of the proximate and nutritional composition of *Clerodendrum indicum* (L.) Kuntze leaves

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Abstract

Wild edible plants play a significant role in enhancing dietary diversity and providing essential nutrients, particularly in rural and tribal communities. This study focuses on the nutritional and proximate composition of *Clerodendrum indicum* (L.) Kuntze leaves, a lesser-known wild leafy vegetable by using standard methods of analysis. Proximate analysis revealed a moisture content of 11.24 ± 0.05 g/100 g, crude protein (23.59 ± 0.67 g/100 g), crude fiber (14.88 ± 0.66 g/100 g), crude fat (0.68 ± 0.02 g/100 g), total ash (9.28 ± 0.21 g/100 g), and carbohydrate content of 55.20 ± 0.39 g/100 g. The energy value was calculated to be 320.92 ± 3.36 kcal/100 g. The leaves also contained notable levels of ascorbic acid (154.42 mg/100 g) and sugars, including total sugars (13.90 g/100 g) and reducing sugars (7.34 g/100 g). These findings highlight the nutritional potential of *C. indicum* leaves and their role in promoting dietary diversity, nutritional security. Integrating this underutilized plant into regular diets can contribute to improved nutrition and the development of sustainable agricultural practices.

Keywords: *Clerodendrum indicum*; Proximate Composition; Nutritional Assessment; Food Security.

1. Introduction

The growing global population and increasing food demand have intensified the need for sustainable and diverse food sources (Tilman et al., 2011). Wild edible plants have long been a vital component of traditional diets, particularly among the rural and tribal communities, where they serve as essential sources of nutrition and medicinal benefits. Among these, wild leafy vegetables are gaining attention for their nutritional richness and potential health promoting properties (Van der Hoeven., 2013). *Clerodendrum indicum* (L.) Kuntze (Family: Lamiaceae), commonly known as "Wild Jasmine" or "Jungle Glory," and Okorbirik in Mishing, is an underutilised leafy vegetable consumed by the Mishing tribe of Assam in the North East India. *C. indicum* is widely distributed in tropical and subtropical regions including Assam and the tender leaves and shoot are reported to be used to cook and it is bitter in test (Somwong and Suttisri, 2018).

Clerodendrum indicum holds the cultural and traditional significance among the various cultural groups of India. In traditional medicine systems, especially in Ayurveda, different parts of the plant, such as leaves, roots, and flowers, are used for their therapeutic properties. The root and leaf extracts of *Clerodendrum indicum* have been traditionally utilized for the treatment of rheumatism, asthma, and various inflammatory diseases, underscoring its medicinal significance in managing chronic health conditions. *Clerodendrum indicum* has been traditionally used to treat a variety of ailments, including coughs, scrofulous infections, buboes, venereal infections, and skin diseases. It has also been employed as a vermifuge, febrifuge, and in the treatment of beriberi disease, highlighting its importance in traditional medicine systems (Shrivastava and patel, 2007; Wang et al., 2018). *C. indicum* is not only valued for its medicinal properties but is also cultivated and used as an ornamental plant due to its attractive flowers and vibrant appearance, making it a popular choice for landscaping and decorative purposes (Somwong and Suttisri, 2018). It is reported to have antimicrobial (Pal et al., 2012), anti-diarrheal (Sidde et al., 2018) and antioxidant (Majumder et al., 2019) anti-inflammatory (Sushma et al., 2021) properties. However limited scientific literature exists on the detailed nutritional profile of *Clerodendrum indicum*. This study aims to assess the proximate and nutritional potential of *Clerodendrum indicum* leaves, highlighting their potential as a sustainable and nutrient-rich food source. By addressing this gap, the research seeks to promote the inclusion of such wild edible plants in regular diets and their role in enhancing food diversity.

2. Materials and methods

2.1. Sample preparation

The samples of *Clerodendrum indicum* were collected from Patharkandi of Karimganj district, Assam. The collected leaves were thoroughly washed under running tap water to eliminate dirt and impurities. Following this, the leaves were air-dried in shade at room temperature to preserve their nutritional properties. Once dried, the leaves were grounded into powdered and stored in airtight containers at room temperature for further analysis. Thereafter, the prepared samples were analysed for their proximate and nutritional properties using various analytical methods.

2.2. Proximate and nutrient analysis

The dried powdered samples were prepared in triplicate to ensure consistency and accuracy, and were then used for the analysis. Ash content was determined following the IS 1011 method by incinerating the samples in silica crucibles using a muffle furnace (Labtech, LEF-103S) at 550°C for 5 hours. Moisture content was measured by heating the samples in an air oven at a temperature range of 100–110°C until a constant weight was achieved. Crude fat content was determined using the methods describe in IS: 10226. Crude fibre was estimated using the Pelican Fibre Plus FES-06 instrument, following the methods described in IS 1011. Nitrogen content was determined by the Kjeldahl method, using the Pelican CLASSIC-DX VATS (B) system with steam distillation, and titrated with a standard 0.01 M HCl solution. Crude protein content was calculated by multiplying the crude nitrogen content by a conversion factor of 6.25, as per the formula: (%Protein =

%Nitrogen × 6.25). The carbohydrate content of the samples was determined using the anthrone method, a widely used colorimetric technique for carbohydrate estimation (Hedge and Hofreiter, 1962). The energy content of the samples was calculated by multiplying the values of protein, fat, and available carbohydrate by their respective caloric conversion factors (4.00, 9.00, and 4.00 kcal/g) and summing up the results (AOAC, 2000).
Titrable acidity was determined according to IS 13845. Ascorbic acid content was determined using the method describe in FSSAI Lab Manual for Fruits and Vegetable Products. Total sugar and reducing sugar contents were determined according to IS 15279. The presence of benzoic acid was determined using the FSSAI Lab Manual for Food Additives. The detection limit was noted. All the procedure was carried out in the Food Engineering and Technology, Tezpur University, Assam, India.

2.3. Statistical analysis

All the experiments were conducted in triplicates to ensure reliability and consistency of the results. The data were then expressed as mean ± standard deviation.

Table 1. The proximate composition of *Clerodendrum indicum* on dry matter basis.

Component	Value	Unit
Moisture	11.24 ± 0.05	g/100 g
Crude protein	23.59 ± 0.67	g/100 g
Crude fibre	14.88 ± 0.66	g/100 g
Crude fat	0.68 ± 0.02	g/100 g
Total ash	9.28 ± 0.21	g/100 g
Carbohydrate	55.20 ± 0.39	g/100 g
Energy	320.92 ± 3.36	(kcal/100g)

Values were expressed as mean of 3 replicates ± standard deviation

Table 2. The nutritional composition of *Clerodendrum indicum*.

Component	Value	Unit
Titratable acidity	2.29	g/100 g
Ascorbic acid	154.42	mg/100 g
Total sugar	13.90	g/100 g
Reducing sugar	7.34	g/100 g

Values were expressed as mean of 3 replicates ± standard deviation

3. Results

3.1. Proximate composition

The proximate analysis (Table 1) revealed that the leaves of *Clerodendrum indicum* contained a higher concentration of carbohydrates (55.20 ± 0.54 g/100 g) and crude protein (23.59 ± 0.67 g/100 g), making it a valuable source of macronutrients. Moisture content was recorded at 11.24 ± 0.05 g/100 g, ensuring good shelf stability when dried. The crude fibre content was recorded at 14.88 ± 0.66 g/100 g, emphasizing its potential as a dietary fibre source. Fat content was relatively low (0.68 ± 0.02 g/100 g), while the ash content, indicative of mineral composition, was 9.28 ± 0.21 g/100 g. The calculated energy content was 320.92 ± 3.36 kcal/100 g, indicating that *C. indicum* can serve as an energy-rich food source.

3.2. Nutritional composition

The nutritional composition of the leaves, including titratable acidity, ascorbic acid content, total sugar, and reducing sugar, is reported in Table 2. The titratable acidity of the leaves was measured as 2.29 g/100g, contributing to their characteristic tangy flavour. Ascorbic acid (Vitamin C) content was significant, recorded at 154.42 mg/100g, suggesting potential antioxidant benefits. The total sugar content was 13.90 g/100g, with reducing sugars accounting for 7.34 g/100g, indicating a moderate sweetness profile.

4. Discussion

Present study reveals *Clerodendrum indicum* (L.) Kuntze leaves to have significant potential as a nutritious food source. The study indicates that the leaves are particularly rich in carbohydrates (55.20 ± 0.54 g/100 g) and protein (23.59 ± 0.67 g/100 g), showing a remarkable similarity to *Chenopodium album* as reported in some earlier investigations (Pradhan et al., 2015). This makes them an excellent energy source and a valuable addition to diets, especially in regions where protein deficiency is high. The high crude fibre content obtained (Table 1) reported in this study is comparable to that of *Urtica dioica* (13.2 g/100 g) and *P. latifolia* (15.30 g/100 g) (Pradhan et al., 2015; Arasaretnam et al., 2018), further enhances their dietary value. Dietary fibre is crucial for maintaining digestive health as it helps regulate bowel movements and prevent constipation. Additionally, it has been linked to a reduced risk of chronic diseases, including diabetes, heart disease, and obesity. A high-fibre diet can help manage blood sugar levels, lower cholesterol, and promote a healthy weight, making it an important component of a balanced diet (Waddell and Orfila, 2023; Li and Sen, 2024).

The crude fat content obtained in this study is comparable to the values reported for *Amaranthus viridis* (Nisha et al., 2012). This low-fat composition makes *Clerodendrum indicum* an ideal choice for low-fat diets and provides an excellent alternative to high-fat vegetables. The ash content obtained in this study is almost similar to the value reported *E. foetidum* (Singh et al. 2011) and higher in contrast to that *Amaranthus viridis* (1.85%) and *M. oleifera* (5.13%) reported by (Nisha et al., 2012). Ash content serves as a key indicator of the quality and nutritional value of food products. A high ash content reflects a significant presence of inorganic matter, which is directly associated with the mineral composition of the sample. This makes ash content a reliable parameter for assessing the mineral richness of a food source (Uyoh et al., 2013; Anju et al., 2022). This suggests that *Clerodendrum indicum* leaves are a significant source of minerals. The moisture content (11.24 ± 0.05 g/100 g) is relatively low, suggesting that the leaves have good storage stability, which is important for preservation and reducing spoilage, especially in rural areas where access to refrigeration may be limited.

In addition to its proximate composition, the ascorbic acid in this study was found to be higher compared to previous reports, where the ascorbic acid content ranged from 3 to 44 mg/100g (Pradhan et al., 2015). Vitamin C is vital for immune function, wound healing, and the prevention of scurvy. It also acts as a potent antioxidant, protecting cells from oxidative stress (Chambial et al., 2013). Given its high vitamin C content, *Clerodendrum indicum* can be considered an important contributor to overall health, supporting immune defence, skin health, and general well-being. Its inclusion in the diet can help meet daily vitamin C requirements, particularly in regions where fresh fruits and vegetables rich in this nutrient may be limited. The titratable acidity (2.29 g/100 g) suggests the leaves may also offer a mild acidic taste, which could enhance the flavour profile of various culinary preparations.
The present study reveals that the total sugar content (13.90 g/100 g) and reducing sugars (7.34 g/100 g) in *Clerodendrum indicum* leaves are significantly higher compared to the findings reported by Deb and Khruomo (2021). This elevated sugar content enhances the potential of these leaves to improve the flavour and palatability of various dishes, making them a versatile ingredient in culinary applications. Despite the higher sugar content, the nutritional profile of leaves is balanced by a substantial crude fibre content (14.88%). Dietary fibre is known to slow glucose absorption, reducing the glycaemic response. This balance between sugars and fibre suggests that *Clerodendrum indicum* leaves may be suitable for inclusion in the diets of individuals managing glucose metabolism disorders, such as diabetes.

The combination of a favourable sugar profile, high fibre content, and low fat (0.68%) supports the recommendation of *Clerodendrum indicum* as part of a balanced diet. These attributes indicate its potential to contribute to maintaining healthy blood sugar levels while enhancing the sensory appeal of meals, promoting its role as a functional food in both traditional and modern dietary practices.
However, there is a need for further studies to evaluate the bioavailability of these nutrients and to investigate any potential anti-nutritional factors that could affect the overall health benefits of *Clerodendrum indicum* leaves. Additionally, exploring the medicinal properties could reveal further applications in traditional and modern healthcare practices.

5. Conclusion

The findings of this study highlight the nutritional richness of *Clerodendrum indicum* leaves, a lesser-known wild leafy vegetable used by the tribal communities of North East India. With high protein, carbohydrate, and fibre content, along with substantial amounts of ascorbic acid and minerals, the leaves demonstrate significant potential as a nutrient-dense food resource. The low-fat content and high ash content further reinforce its dietary and mineral value. These attributes suggest that *C. indicum* could be an effective addition to diets, particularly in resource-limited settings, contributing to food security, nutritional enhancement, and dietary diversity. Its integration into sustainable food systems can also support biodiversity conservation and reduce reliance on conventional crops. Further research is recommended to explore its bioactive compounds and potential health benefits, ensuring its broader acceptance and utilization as a functional food.

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Author contribution
Present author is responsible for concept, experimental, data generation and manuscript draft.

Declaration of conflict of interest
Authors have no conflict of interest

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