International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 26-09-2025, Accepted: 25-10-2025, Published: 10-11-2025
Volume 10, Issue 11, 2025, Page No. 11-14

Study on total alkaloid and total glycoside content of some wild edible and cultivated plants of Kangchup Chingkhong, Manipur, North East India

A Kikim*, O Noyon Singh, Ch Niranjan
Institutional Biotech Hub, Lilong Haoreibi College, Lilong, Ushoipokpi, Thoubal, Manipur, India

Abstract
Wild edible plants (WEPs) and their cultivated counterparts serve as vital sources of food, nutrition, and traditional medicine in Northeast India. In Manipur, particularly in Kangchup Chingkhong, rural communities rely on these species for dietary diversity and primary healthcare. Despite their importance, comparative analyses of key secondary metabolites such as alkaloids and glycosides remain limited.

This study quantified total alkaloid and glycoside contents in selected wild and cultivated plants from Kangchup Chingkhong using validated spectrophotometric methods. Alkaloids were estimated by the Bromocresol Green (BCG) method at 470 nm with atropine as the standard, and glycosides were determined by the phenol–sulfuric acid method at 490 nm. All analyses were performed in triplicate, and results were expressed as mg/g dry weight equivalents.

Significant variations ($p < 0.05$) were observed among species. Among cultivated plants, *Curcuma longa* rhizome contained the highest alkaloid content (2.40 ± 0.10 mg/g), whereas *Acacia pennata* leaves recorded the maximum among wild species (1.75 ± 0.08 mg/g). Glycoside levels were comparatively higher in wild plants, with *Solanum melongena* fruit (7.00 ± 0.15 mg/g) and *Clerodendrum serratum* leaves (6.66 ± 0.40 mg/g) showing the highest concentrations. Overall, cultivated species tended to accumulate more alkaloids, while wild plants exhibited higher glycoside levels, reflecting distinct phytochemical adaptations and highlighting their potential for nutraceutical and medicinal applications.

Keywords: Wild edible plants, cultivated plants, Manipur, alkaloids, glycosides

Introduction

Wild edible plants (WEPs) play a vital role in the nutrition, health, and cultural identity of indigenous communities across Northeast India, particularly in Manipur. They supplement staple diets, provide resilience during seasonal food shortages, and contribute a wide range of bioactive compounds with therapeutic potential (Sundriyal & Sundriyal, 2004; Konsam *et al*., 2016; Talang *et al*., 2023) [8, 20]. Secondary metabolites such as alkaloids and glycosides are especially significant: alkaloids are well known for their pharmacological activities including antimicrobial, antimalarial, and anticancer properties (Wink, 2013; Cushnie *et al*., 2014) [4, 21], while glycosides contribute to cardioprotective, antioxidant, and anti-inflammatory effects (Sun *et al*., 2020; Elshafie *et al*., 2023) [5, 18].

Although ethnobotanical surveys of Manipur have documented the diversity of wild food plants (Khumbongmayum *et al*., 2005), systematic phytochemical quantification of bioactive metabolites in wild versus cultivated species remains limited. Comparative analysis is crucial because domestication and cultivation often influence metabolite profiles through changes in soil nutrients, light exposure, and plant defense mechanisms (Ku *et al*., 2020; Nyero *et al*., 2023; Casas *et al*., 2024) [2, 10, 13]. Kangchup Chingkhong represents a biodiversity hotspot where both wild-collected and cultivated edible plants are commonly consumed, yet their phytochemical potential has not been fully characterized.

Among the diverse classes of plant metabolites, alkaloids and glycosides are of particular interest due to their dual role in nutrition and traditional medicine. Standardized quantification of these metabolites provides a baseline for evaluating nutritional and therapeutic values, aids in validating indigenous knowledge, and supports the development of functional foods or nutraceuticals (WHO, 2013; Chinsembu, 2016; Radha *et al*., 2021; Sridonpai *et al*., 2022) [3, 15, 17, 22]. Furthermore, such studies contribute to conservation strategies by highlighting the value of underutilized wild species, thereby promoting both biodiversity preservation and sustainable use.

Therefore, the present study was undertaken to quantify the total alkaloid and total glycoside contents of selected wild edible and cultivated plants of Kangchup Chingkhong, Manipur. By employing validated spectrophotometric methods—Bromocresol Green (BCG) assay for total alkaloids and phenol–sulfuric acid method for total glycosides—this work aims to provide comparative insights into the phytochemical richness of these plants and their potential roles in nutrition and health security.

Materials and Methods

Sample collection and preparation Wild edible and cultivated plant species were collected from Kangchup Chingkhong area, Senapati district of Manipur. After collecting, the plant samples were cleaned by using tap water followed by double distilled water to remove all the dust and oven dried at 60 °C. The dried samples were ground to powder by using a grinder. 200 mg of each sample was taken for extraction of alkaloid and glycoside content

Alkaloid Estimation (BCG Method)

Alkaloids were estimated following the bromocresol green (BCG) method described by Harborne (1998) [7] and Obadoni & Ochuko (2002) [14].

Reagents and Standards
A 0.1% bromocresol green (BCG) solution was prepared by dissolving 100 mg of BCG in 100 ml distilled water and stored in an amber bottle at room temperature. Phosphate buffer (pH 4.7) was prepared by dissolving 6.8 g sodium dihydrogen phosphate (NaH_2PO_4) and 8.72 g disodium hydrogen phosphate (Na_2HPO_4) in 1 l of distilled water, and the pH was adjusted with HCl. A standard alkaloid stock solution (1 mg/ml) of quinine sulphate was prepared in distilled water, from which working concentrations (10–50 µg/ml) were obtained by serial dilution.

Extraction of Alkaloids
0.2g of dried plant sample was extracted with 10% acetic acid in ethanol. The mixture was kept for 4 h with intermittent shaking, filtered through Whatman No.1 filter paper, and concentrated to one-fourth of the original volume at 55–60 °C in a water bath. The extract was adjusted to a final volume of 10 ml with distilled water.

BCG Assay Procedure
Five millilitres of extract (or standard solution) were mixed with 5 ml phosphate buffer (pH 4.7) and 5 ml BCG solution in a separatory funnel. After vigorous shaking for 3–5 min, 5 ml chloroform was added, and the mixture was shaken again for 3 min. The phases were allowed to separate, and the lower chloroform layer containing the alkaloid–BCG complex was collected. Absorbance was recorded at 470 nm using a UV–Vis spectrophotometer, with chloroform as the blank.

Glycoside Estimation
Extraction and Purification
0.2g of each dried plant sample was extracted for glycoside by maceration using 70% ethanol at room temperature for 24–48 h with occasional shaking, followed by filtration and concentration under reduced pressure below 50 °C. Extracts were treated with 10% lead acetate to remove phenolics, filtered, and excess lead was removed with sodium sulfate (Harborne, 1998; Evans, 2009) [6, 7].

Hydrolysis
The purified extract was hydrolysed with 2N HCl by refluxing in a water bath for 1–2 h. After cooling, the hydrolysate was neutralized with NaOH, filtered, and collected for analysis.

Estimation Methods
Total glycosides were quantified using the reducing sugar method, in which hydrolysates were reacted with Nelson and Somogy's method, heated and cool. The absorbance dark blue-green colour developed was measured at 640 nm using glucose as a standard.

Statistical Analysis
All experiments were conducted in triplicate, and results were expressed as mean ± standard deviation. Statistical analysis was performed using Microsoft Excel 2019. Analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) was used to determine significant differences ($p < 0.05$).

Results and Discussion
Total Alkaloid Content (mg/g)
The total alkaloid content (Table 1) varied significantly among the studied wild and cultivated plant samples. In general, wild plants exhibited moderate alkaloid levels, whereas cultivated plants showed a wider range with both very high and low values.
Among the wild plants, *Accacia pinnata* leaves recorded the highest alkaloid content (1.75 ± 0.08 mg/g), followed by *Clerodendrum colebrookianum* leaves (1.36 ± 0.06 mg/g) and *Zingiber striolatum* (1.11 ± 0.05 mg/g). Moderate levels were observed in *Accacia pennata* stem (1.08 ± 0.07 mg/g), *Zanthoxylum oxyphyllum* leaves (1.07 ± 0.06 mg/g), and *Parkia timoriana* seed (0.88 ± 0.04 mg/g).
Lower alkaloid contents were found in *Curcuma caesia* (0.54 ± 0.04 mg/g), *Curcuma amada* (0.56 ± 0.09 mg/g), *Leucaena leucocephala* pulp (0.56 ± 0.06 mg/g), *Paedaria foeteda* stem (0.58 ± 0.04 mg/g), and *Brachycorythis obcordata* leaves (0.60 ± 0.09 mg/g). The least alkaloid concentration was recorded in *Maranta arundinaceae* rhizome (0.22 ± 0.06 mg/g).
Among the cultivated plants, *Curcuma longa* rhizome exhibited the highest alkaloid content (2.40 ± 0.10 mg/g), followed by *Solanum melongena* fruit (0.54 ± 0.08 mg/g) and *Pisum sativum* seed (0.46 ± 0.04 mg/g). The lowest alkaloid values were observed in *Oryza sativa* grains (0.36 ± 0.06 mg/g for local and 0.39 ± 0.09 mg/g for black rice) and *Zingiber officinale* rhizome (0.53 ± 0.09 mg/g).
Overall, cultivated plants, particularly *Curcuma longa*, contained higher alkaloid levels than most wild species, indicating possible domestication-related enhancement or varietal selection for bioactive compounds.
The critical difference (CD) at 5% level was 0.04, and the standard error of difference [SE(d)] was 0.09, indicating significant variations among the tested plant samples.

Total Glycoside Content (mg/g)
The total glycoside content (Table 1) also showed notable differences between wild and cultivated species. In general, wild plants exhibited a broader and higher range of glycoside concentration compared to the cultivated ones.
Among wild plants, *Solanum melongena* fruit recorded the highest glycoside content (7.00 ± 0.15 mg/g), followed closely by *Clerodendrum serratum* leaves (6.66 ± 0.40 mg/g), *Smallanthus sonchifolius* tuber (6.46 ± 0.20 mg/g), *Clerodendrum colebrookianum* leaves (6.42 ± 0.08 mg/g), and *Clerodendrum serratum* root (6.38 ± 0.11 mg/g).
Moderate glycoside levels were recorded in *Siphonochilus aethiopicus* rhizome (5.39 ± 0.12 mg/g), *Alpinia galanga* rhizome (5.49 ± 0.11 mg/g), *Clerodendrum serratum* flower (5.21 ± 0.09 mg/g), and *Clerodendrum colebrookianum* stem (5.11 ± 0.09 mg/g). Lower concentrations were observed in *Dysoxylum excelsum* parts, *Alpinia officinarum* leaves (1.00 ± 0.03 mg/g), and *Maranta arundinaceae* rhizome (0.18 ± 0.05 mg/g).
Among cultivated species, the highest glycoside content was found in *Solanum melongena* fruit (7.00 ± 0.15 mg/g), whereas *Oryza sativa* grains (local and black rice) and *Zingiber officinale* rhizome showed the lowest glycoside levels (ranging from 0.03 ± 0.03 mg/g to 0.14 ± 0.04 mg/g).
Hence, wild species such as *Clerodendrum* and *Smallanthus*, and the cultivated *Solanum melongena*, were particularly rich in glycosides. The critical difference (CD) at 5% level was 0.09, and SE(d) was 0.19, confirming statistically significant variation in glycoside content among the samples studied.
Alkaloid content was generally higher in cultivated plants, especially *Curcuma longa*, while glycoside content tended to be higher in wild species, except for *Solanum melongena,* which surpassed all. The results indicate that both wild and cultivated species possess considerable phytochemical potential, suggesting their possible use in nutraceutical or medicinal applications.

The present study revealed significant variations in total alkaloid and glycoside contents among the examined wild and cultivated plant species, indicating diverse phytochemical potential across taxa. Such differences can arise from genetic factors, ecological conditions, plant part used, and ontogenetic stage—factors known to shape secondary-metabolite profiles (Song, *et al*. 2022) [16].

Alkaloids are a major group of nitrogen-containing secondary metabolites with well-documented pharmacological activities including antimicrobial, analgesic and cytotoxic effects. The biosynthesis and pathway diversity of plant alkaloids are now well characterized at the biochemical and genomic levels, which helps explain interspecific and environmental variation in alkaloid yields (Kopp, *et al* 2020) [9] In this study, *Curcuma longa* rhizome exhibited the highest alkaloid concentration (2.40 ± 0.10 mg/g) among cultivated plants, consistent with reports that domestication and cultivation practices can influence the accumulation of particular secondary metabolites through selection or agronomic management (Ku, *et al*. 2020) [10]. Among wild species, *Acacia* spp., *Clerodendrum* spp., and *Zingiber* taxa showed relatively high alkaloid contents, which is congruent with ethnobotanical records and studies showing wild taxa frequently retain diverse alkaloid profiles used in traditional medicine (Abat, *et al*. 2017) [1].

Glycosides (including cardiac glycosides, saponins and other glycosylated metabolites) play roles in plant defense and contribute important pharmacological properties such as antioxidant and anti-inflammatory effects. The biosynthesis and enzymology of plant glycosides have been recently reviewed and provide mechanistic grounding for why glycoside levels vary with species and stress exposure (Kytidou, *et al*. 2020) [11].The results showing higher glycoside ranges in certain wild species (e.g., *Clerodendrum* spp., *Smallanthus* spp.) fall in line with comparative phytochemical studies that often report richer or more diverse secondary-metabolite pools in wild populations than in closely managed cultivated conspecifics (Mangoale & Afolayan, 2020) [12] Conversely, cultivated *Solanum melongena* displaying relatively high glycoside concentration may reflect species-specific responses to cultivation, soil nutrition, and selection for traits that indirectly affect glycoside metabolism (Ku, *et al*. 2020) [10].

Table 1: Total Alkaloid and Glycoside content of some wild edible and cultivated plant species

Plant Sample	Total Alkaloid Content (mg/g)	Total Glycoside Content (mg/g)
Wild plant		
Accacia pinnata stem	1.08 ± 0.07d	0.03 ± 0.03s
Accacia pinnata leaves	1.75 ± 0.08b	1.39 ± 0.05o
Albizia myriophylla bark	0.88 ± 0.07e	0.60 ± 0.05qr
Alpinia galanga rhizome	0.32 ± 0.05ij	5.49 ± 0.11d
Alpinia officinarum leaves	0.39 ± 0.05ij	1.00 ± 0.03p
Brachycorythis obcordata leaves	0.60 ± 0.09fg	4.64 ± 0.07f
Clerodendrum colebrookianum stem	0.43 ± 0.02ghi	5.11 ± 0.09e
Clerodendrum serratum flower	0.53 ± 0.06ghi	5.21 ± 0.09e
Clerodendrum serratum stem	0.40 ± 0.06i	2.26 ± 0.05m
Clerodendrum colebrookianum leaves	1.36 ± 0.06c	6.42 ± 0.08c
Clerodendrum serratum leavs	0.31 ± 0.06ij	6.66 ± 0.40b
Clerodendrum serratum root	0.32 ± 0.06ij	6.38 ± 0.11c
Curcuma amada rhizome	0.56 ± 0.09gh	1.01 ± 0.04p
Curcuma caesia rhizome	0.54 ± 0.04gh	3.98 ± 0.09h
Dysoxylum. excelsum flower	0.53 ± 0.05ghi	0.53 ± 0.07qr
Dysoxylum excelsum stem	0.31 ± 0.06ij	0.17 ± 0.03s
Dysoxylum excelsum leaves	0.32 ± 0.06ij	0.74 ± 0.05q
Hodgsonia heteroclita fruit	0.61 ± 0.06fg	0.62 ± 0.03q
Kaempfera parviflora rhizome	0.75 ± 0.07f	3.77 ± 0.09i
Leucaena leucocephala pulp	0.56 ± 0.06gh	0.83 ± 0.05pq
Leucaena leucocephala seed	0.67 ± 0.07fg	1.43 ± 0.08o
Maranta arundinaceae rhizome	0.22 ± 0.06k	0.18 ± 0.05s
Parkia timoriana flesh	0.57 ± 0.06gh	4.23 ± 0.08g
Paedaria foeteda leaves	0.44 ± 0.02ghi	4.08 ± 0.07gh
Paedaria foeteda stem	0.58 ± 0.04gh	1.87 ± 0.05n
Paedaria foeteda gall	0.39 ± 0.06ij	0.45 ± 0.09qr
Parkia timoriana seed	0.88 ± 0.04e	5.50 ± 0.03d
Siphonochilus aethiopicus rhizome	0.46 ± 0.04ghi	5.39 ± 0.12de
Smallanthus sonchifolius tuber	0.29 ± 0.04jk	6.46 ± 0.20c
Wendlandia grandis flower	0.51 ± 0.06ghi	3.45 ± 0.07j
Zanthoxylum oxyphyllum leaves	1.07 ± 0.06d	4.72 ± 0.04f
Zinziber striolatum rhizome	1.11 ± 0.05d	2.97 ± 0.39l
Cultivated plant		
Curcuma longa rhizome (local variety)	2.40 ± 0.10a	0.41 ± 0.04r
Oryza sativa grain (black rice)	0.39 ± 0.09ij	0.14 ± 0.04s
Oryza sativa grain (local variety)	0.36 ± 0.06ij	0.05 ± 0.01s
Pisum sativum seed (local variety)	0.46 ± 0.04ghi	3.20 ± 0.08k
Solanum melongena fruit (local variety)	0.54 ± 0.08	7.00 ± 0.15a
Solanum tuberosum tuber (local variety)	0.44 ± 0.09ghi	0.60 ± 0.09qr
Zingiber officinale rhizome (local variety)	0.53 ± 0.09ghi	0.03 ± 0.03s
CD (p=0.05)	0.04	0.09
SE(d)	0.09	0.19

*The data represent are the means of three replications. The data with different letters is significantly different by the Duncan Multiple Range test (DMRT).

Overall, cultivated species may outperform some wild taxa in the accumulation of particular compounds (e.g., certain alkaloids), while wild taxa often maintain higher diversity or levels of other defensive metabolites (e.g., many glycosides). This pattern likely results from the combined effects of domestication, human selection, ecological pressures and genetic background. Such complementary reservoirs of bioactive compounds in wild and cultivated plants underscore their importance for bioprospecting, nutraceutical development, and conservation (Ku, *et al*. 2020) [10].

Conclusion

This study revealed significant variation in total alkaloid and glycoside contents among selected wild and cultivated plants of Kangchup Chingkhong, Manipur. Cultivated species such as *Curcuma longa* exhibited higher alkaloid levels, while wild species including *Clerodendrum serratum*, *C. colebrookianum*, and *Smallanthus sonchifolius* were richer in glycosides. These differences highlight the influence of domestication and ecological factors on metabolite accumulation. The findings provide a valuable baseline for identifying promising nutraceutical and medicinal resources and emphasize the need to conserve both wild and cultivated plant diversity for sustainable utilization.

Acknowledgments

The authors are thankful to the Department of Biotechnology, Ministry of Science and Technology, Government of India, for providing the financial assistance.

Competing interests

The authors have declared that no competing interests exist.

Authors' Contributions

All the authors have given equal contributions. All the authors read and approved the final manuscript

References

1. Abat JK, Kumar S, Mohanty A. Ethnomedicinal, phytochemical and ethnopharmacological aspects of four medicinal plants of Malvaceae used in Indian traditional medicines, A review. Medicines, Basel,2017:4(4):75. https://doi.org/10.3390/medicines4040075
2. Casas M, Vallès J, Gras A. Nutritional properties of wild edible plants with traditional use in the Catalan linguistic area, A first step for their relevance in food security. Foods,2024:13(17):2785. https://doi.org/10.3390/foods13172785
3. Chinsembu KC. Ethnobotanical study of plants used in the management of HIV/AIDS-related diseases in Livingstone, Southern Province, Zambia. Evidence-Based Complementary and Alternative Medicine,2016:2016:4238625. https://doi.org/10.1155/2016/4238625
4. Cushnie TPT, Cushnie B, Lamb AJ. Alkaloids: An overview of their antibacterial, antibiotic-enhancing and antivirulence activities. International Journal of Antimicrobial Agents,2014:44(5):377–386. https://doi.org/10.1016/j.ijantimicag.2014.06.001
5. Elshafie HS, Abd El-Gawad AM, Smetanska I. A comprehensive review on the biological, agricultural and biotechnological significance of plant secondary metabolites. International Journal of Molecular Sciences,2023:24(4):3266. https://doi.org/10.3390/ijms24043266
6. Evans WC. Trease and Evans' Pharmacognosy. Saunders Elsevier, 2009.
7. Harborne JB. Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. Springer Science and Business Media, 1998. https://doi.org/10.1007/978-94-009-5570-7
8. Konsam S, Thongam B, Handique AK. Assessment of wild leafy vegetables traditionally consumed by the ethnic communities of Manipur, northeast India. Journal of Ethnobiology and Ethnomedicine,2016:12:9. https://doi.org/10.1186/s13002-016-0080-4
9. Kopp T, Abdel-Tawab M, Mizaikoff B. Extracting and analyzing pyrrolizidine alkaloids in medicinal plants: A review. Toxins,2020:12(5):320. https://doi.org/10.3390/toxins12050320
10. Ku YS, Contador CA, Ng MS, Yu J, Chung G, Lam HM. The effects of domestication on secondary metabolite composition in legumes. Frontiers in Genetics,2020:11:581357. https://doi.org/10.3389/fgene.2020.581357
11. Kytidou K, Artola M, Overkleeft HS, Aerts JMFG. Plant glycosides and glycosidases: A treasure-trove for therapeutics. Frontiers in Plant Science,2020:11:357. https://doi.org/10.3389/fpls.2020.00357
12. Mangoale RM, Afolayan AJ. Comparative phytochemical constituents and antioxidant activity of wild and cultivated *Alepidea amatymbica* Eckl and Zeyh. BioMed Research International,2020:2020:5808624. https://doi.org/10.1155/2020/5808624
13. Nyero A, Ocan M, Nabukalu D, Eilu E. Phytochemical composition and antioxidant activities of some wild edible plants locally consumed by rural communities in northern Uganda. Frontiers in Nutrition,2023:10:1070031. https://doi.org/10.3389/fnut.2023.1070031
14. Obadoni BO, Ochuko PO. Phytochemical studies and comparative efficacy of the crude extracts of some haemostatic plants in Edo and Delta States of Nigeria. Global Journal of Pure and Applied Sciences,2002:8(2):203–208. https://doi.org/10.4314/gjpas.v8i2.16033
15. Radha, Kumar M, Puri S, Pundir A, Bangar SP, Changan S, *et al*. Evaluation of nutritional, phytochemical, and mineral composition of selected medicinal plants for therapeutic uses from cold desert of Western Himalaya. Plants,2021:10(7):1429. https://doi.org/10.3390/plants10071429
16. Song C, Ma J, Li G, Pan H, Zhu Y, Jin Q, *et al*. Natural composition and biosynthetic pathways of alkaloids: Insights for discovery and production. Frontiers in Plant Science,2022:13:850949. https://doi.org/10.3389/fpls.2022.850949
17. Sridonpai P, Kongprapun P, Sungayuth N, Sukprasansap M, Chimkerd C, Judprasong K. Nutritive values and phytochemical compositions of edible indigenous plants in Thailand. Frontiers in Sustainable Food Systems,2022:6:870147. https://doi.org/10.3389/fsufs.2022.870147

18. Sun W, Xiong X, Ma Y, Zhang A, Chen J, Shi K. *et al*. Promoting human nutrition and health through plant metabolites, Patterns, challenges and prospects. Frontiers in Nutrition,2020:7:60. https://doi.org/10.3389/fnut.2020.00060
19. Sundriyal M, Sundriyal RC. Wild edible plants of the Sikkim Himalaya: Nutritive values of selected species. Economic Botany,2001:55(3):377–390. https://doi.org/10.1007/BF02866561
20. Talang H, Yanthan A, Rathi RS, Pradheep K, Longkumer S, Imsong B, *et al*. Nutritional evaluation of some potential wild edible plants of North Eastern region of India. Frontiers in Nutrition,2023:10:1052086. https://doi.org/10.3389/fnut.2023.1052086
21. Wink M. Evolution of secondary metabolites in legumes, *Fabaceae*. South African Journal of Botany,2013:89:164–175. https://doi.org/10.1016/j.sajb.2013.06.006
22. World Health Organization. WHO Traditional Medicine Strategy 2014–2023. WHO Press, 2013. ISBN: 9789241506090.