International Journal of Economic Plants

https://ojs.pphouse.org/index.php/IJEP

Crossref

IJEP January 2026, 13(1): 01-05

Article IJEP6825

Full Research

Natural Resource Management

Doi: HTTPS://DOI.ORG/10.23910/2/2026.6825

# Quantitative Analysis of Total Free Amino Acids in Some Wild Edible Plants of Kangchup Chingkhong, Manipur, North East India

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**Article History**

Received on 22nd November, 2025

Received in revised form on 15th December, 2025

Accepted in final form on 04th January, 2026

Published on 06th January, 2026

**Abstract**

The present study, conducted from March to December, 2024, investigated the total free amino acid content in various parts of selected wild edible plant (WEP) species collected from Kangchup Chingkhong, Senapati District, Manipur, India, aimed to quantitatively estimate the total free amino acid content in various plant parts of selected wild edible species. WEPs are important sources of nutrition and health-promoting compounds for indigenous and rural communities, especially in Northeast India, where they contributed significantly to traditional diets and local food security. A total of 23 species representing different growth forms-trees, shrubs, herbs, and creepers-were analyzed using standard biochemical techniques. Plant parts such as leaves, stems, roots, flowers, rhizomes, fruits, seeds, bark, and tubers were examined to capture inter- and intraspecific variations in amino acid content. The total amino acid concentration varied widely among species and plant parts, reflecting differences in metabolic activity. Among trees, *Parkia timoriana* seeds showed the highest amino acid content (16.13±0.77 mg $g^{-1}$), while *Albizia myriophylla* bark recorded the lowest (2.21±0.62 mg $g^{-1}$). In shrubs, *Acacia pennata* stem recorded the maximum (16.76±0.60 mg $g^{-1}$) amino acid content, and minimum (1.50±0.06 mg $g^{-1}$) in *Clerodendrum serratum* flowers. Among herbs, *Alpinia galanga* rhizome contained the highest (18.98±0.71 mg $g^{-1}$) amino acid content, while *Curcuma amada* rhizome had the lowest (1.28±0.17 mg $g^{-1}$). In creepers, *Paederia foetida* leaves had the highest (2.14±0.23 mg $g^{-1}$) amino acid content and its stem the lowest (1.39±0.06 mg $g^{-1}$). The study highlighted the nutritional significance of these underutilised wild plants and their potential for inclusion in community nutrition programs, functional food development, and sustainable agricultural systems.

***Keywords:*** Wild edible plants, amino acid content, manipur, nutrition

## 1. Introduction

Wild edible plants (WEPs) are fundamental components of traditional food systems, playing a crucial role in the diets, livelihoods, and cultural practices of indigenous and rural communities around the world. These plants serve as accessible, affordable, and sustainable sources of nutrition, particularly in regions experiencing economic or seasonal food insecurity. In recent decades, there has been a growing recognition of the nutritional, medicinal, and ecological value of WEPs, positioning them as important contributors to dietary diversity and food sovereignty (Bharucha and Pretty, 2010; Anonymous, 2023). India's Northeast region, especially the state of Manipur, is a recognized biodiversity hotspot, home to diverse ethnic communities that maintain rich traditional ecological knowledge. The Kangchup Chingkhong area in Senapati District exemplifies this heritage, where wild plants are routinely harvested for food, medicine, and ritual purposes. Despite their widespread use, the scientific validation of their nutritional composition, especially amino acid profiles, remains limited. Amino acids, the building blocks of proteins, are vital to numerous physiological functions including tissue growth and repair, enzyme synthesis, immune regulation, and neurotransmitter production (Wu, 2009; Luiking et al., 2012). While animal-based foods are conventional sources of complete proteins, many populations in rural or resource-limited areas rely heavily on plant-based sources. In this context, wild edible plants offer a promising alternative, particularly when cultivated or commonly consumed plant foods are deficient in essential amino acids (Young and Pellett, 1994; Casas et al., 2024). However, the systematic evaluation of total free amino acid concentrations in WEPs, particularly across different plant parts such as leaves, stems, roots, seeds, and fruits, remains understudied in the Indian subcontinent. This biochemical assessment provides insight into their nutritional potential and helps identify species that may serve as significant sources of plant-based protein (Talang et al., 2023; Datta et al., 2025). The relevance of this work extends beyond nutritional profiling. Amino acid-rich WEPs can support dietary diversification and improve nutritional outcomes in marginal communities (Cruz-Garcia and Price, 2011; Muthayya et al., 2014). Moreover, the promotion of underutilised wild foods contributes to ecological sustainability and biodiversity conservation, especially when integrated into agroecological farming systems (Kerr et al., 2021). Several plants used by local communities, particularly those belonging to families like Zingiberaceae, Fabaceae, and Rubiaceae, are also known for their pharmacological properties, making them dual-purpose candidates for functional food and nutraceutical development (Youn et al., 2021; Mahawer et al., 2023). Additionally, amino acid profiling provides a scientific basis to validate the traditional uses of these plants and encourages their inclusion in formal nutritional strategies (Narzary et al., 2019; Datta et al., 2025). Previous research from other parts of the world, such as Spain, Peru, and Ethiopia, has highlighted the potential of wild greens and indigenous species in contributing to human nutrition (Correa et al., 2020; Mokria et al., 2022). Yet, comprehensive studies of amino acid distribution in WEPs from Northeast India remain scarce.The present study was undertaken to fill this gap by analyzing the total free amino acid content in selected wild edible plants from Kangchup Chingkhong. The plant species were selected based on local knowledge and ethnobotanical relevance, representing a diversity of botanical families and edible parts (Kala, 2009; Jain and Tiwari, 2012). By bridging ethnobotanical knowledge with modern nutritional science, this study aimed to enhance the scientific understanding and appreciation of local plant resources, ultimately promoting their sustainable use and conservation in Manipur and beyond.

## 2. Materials and Methods

### *2.1. Sample collection and preparation*

Various parts of 30 plant species were collected during March to December 2024 from Kangchup Chingkhong area, Senapati district of Manipur. 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 into powder using a grinder. 100 mg of each sample was taken in a mortar and pestle, and to it, approximately 10 ml of 80% ethanol was added and kept pasting until a clear plant solution was observed. Then the solutions were centrifuged at 4000 rpm for 12 min, and the final supernatants were collected in respective tubes.

### *2.2. Reagents*

#### *2.2.1. Ninhydrin reagent*

Prepared by dissolving 0.8 g of ninhydrin and 20 mg of stannous chloride ($SnCl_2 \cdot 2H_2O$) in 30 ml of 0.2 M citrate buffer (pH 5.0), followed by the addition of 10 ml glacial acetic acid and 60 ml 2-methoxyethanol. The solution was freshly prepared and stored in amber bottles at 4°C until use.

#### *2.2.2. Standard amino acid*

A stock solution of L-Arginine (1 mg ml$^{-1}$) was prepared in distilled water, and serial dilutions (10–500 µg ml$^{-1}$) were used to generate the calibration curve.

### *2.3. Assay procedure*

Aliquots of 1.0 ml of sample extract or standard were mixed with 1.0 ml of freshly prepared ninhydrin reagent in glass test tubes. The tubes were tightly capped and heated in a boiling water bath at 100 °C for 15 min. After incubation, the reaction mixtures were cooled, and 5.0 ml of 50% (v/v) ethanol was added to stabilize the colour.

### *2.4. Measurement and quantification*

The absorbance of the developed purple colour was recorded at 570 nm using a UV–Vis spectrophotometer against a reagent blank. The total free amino acid content was quantified from the L-arginine calibration curve and expressed as mg per g (mg g$^{-1}$) dry weight (DW) of tissue.

### *2.5. Statistical analysis*

All experimental measurements were performed in triplicate and expressed as the mean±standard deviation. The magnitudes of the means, standard curve, standard errors, and standard deviations were calculated using MS Excel 2019 software.

## 3. Results and Discussion

### *3.1. Amino acid content in tree species*

The total amino acid content among the tree species has been depictedin Table 1. Among tree species, *Parkia timoriana* seed exhibited the highest amino acid concentration (16.13±0.77 mg g$^{-1}$), followed by *Leucaena leucocephala* seed (15.49±0.51 mg g$^{-1}$), *Dysoxylum excelsum* leaves *(*13.39±0.85 mg g$^{-1}$), *Leucaena leucocephala* fruit pulp (12.56±0.65 mg g$^{-1}$), and *Clerodendrum colebrookianum* leaves (10.13±0.19 mg g$^{-1}$). The lowest amino acid content was observed in the bark of *Albizia myriophylla* (2.21±0.62 mg g$^{-1}$) followed by *Dysoxylum excelsum* stem (2.93±0.58 mg g$^{-1}$), *Wendlandia grandis* flower (4.61±0.34 mg g$^{-1}$), *Clerodendrum colebrookianum* stem (7.31±0.34 mg g$^{-1}$), and *Dysoxylum excelsum* flower (9.94±0.36 mg g$^{-1}$)

### *3.2. Amino acid content in shrubs*

The total amino acid content among the shrubs is depicted in Table 2. The highest amino acid concentration was recorded in the stem of *Acacia pennata* (16.76±0.60 mg g$^{-1}$ of dry weight), followed by the leaves of *Zanthoxylum oxyphyllum* (6.90±0.53 mg g$^{-1}$) and the leaves of *Clerodendrum serratum* (6.04±0.45 mg g$^{-1}$. The lowest amino acid levels were found in the flower, root, and stem of *C. serratum* (1.50±0.06, 1.65±0.06, and 1.99±0.06 mg g$^{-1}$, respectively), followed by the tuber of *Smallanthus sonchifolius* (2.33±0.92 mg g$^{-1}$) and the leaves of *A. pennata* (2.21±0.40 mg g$^{-1}$).

Table 1: Total amino acid content among the trees

| Sl. No. | Plant sample | Local name | Family | Plant part | Amino acid concentration (mg $g^{-1}$ of dry weight) |
|---|---|---|---|---|---|
| 1. | *Clerodendrum colebrookianum* | Kuthap | Verbenaceae | Stem | 7.31±0.34 |
| | | | | Leaves | 10.13±0.19 |
| 2. | *Dysoxylum excelsum* | Ujao | Mileaceae | Flower | 9.94±0.36 |
| | | | | Leaves | 13.39±0.85 |
| | | | | Stem | 2.93±0.58 |
| 3. | *Parkia timoriana* | Yongchak | Fabaceae | Fruit pulp | 11.06±0.68 |
| | | | | Seed | 16.13±0.77 |
| 4. | *Leucaena leucocephala* | Chigonglei | Mimosaceae | Fruit pulp | 12.56±0.65 |
| | | | | Seed | 15.49±0.51 |
| 5. | *Wendlandia grandis* | Pheija | Rubiaceae | Flower | 4.61±0.34 |
| 6. | *Albizia myriophylla* | Yangli | Fabaceae | Bark | 2.21±0.62 |

*The data represented means of 3 replications

Table 2: Total amino acid content among the shrubs

| Sl. No. | Plant sample | Local name | Family | Plant part | Amino acid concentration (mg $g^{-1}$ of dry weight) |
|---|---|---|---|---|---|
| 1. | *Clerodendrum serratum* | Moirang khanambi | Verbenaceae | Flower | 1.50±0.06 |
| | | | | Stem | 1.99±0.06 |
| | | | | Root | 1.65±0.06 |
| | | | | Leaves | 6.04±0.45 |
| 2. | *Accacia pennata* | Khang | Fabaceae | Leaves | 2.21±0.40 |
| | | | | Stem | 16.76±0.60 |
| 3. | *Smallanthus sonchifolius* | Ground apple | Asteraceae | Tuber | 2.33±0.92 |
| 4. | *Zanthoxylum oxyphyllum* | Singjol | Rutaceae | Leaves | 6.90±0.53 |

*The data represented means of 3 replications

### *3.3. Amino acid content in herbs*

The total amino acid content among the herbs is depicted in Table 3. Among the herb species, the rhizome of *Alpinia galanga* exhibited the highest amino acid concentration (18.98±0.71 mg $g^{-1}$), followed by the rhizome of *Zingiber striolatum* (17.63±0.64 mg $g^{-1}$) and the rhizome of *Kaempferia parviflora* (12.15±0.41 mg $g^{-1}$). The lowest amino acid content was observed in the rhizome of *Curcuma amada* (1.28±0.17 mg $g^{-1}$).

### *3.4. Amino acid content in creepers*

The total amino acid content among the creepers is presented in Table 4. The highest amino acid concentration was observed in the leaves of *Paederia foetida* (2.14±0.23 mg $g^{-1}$ of dry weight), followed by the fruit of *Hodgsonia heteroclita* (1.84±0.62 mg $g^{-1}$). Lowest levels were recorded in the stem and gall of P. *foetida* (1.39±0.06 mg $g^{-1}$ and 1.43±0.06 mg $g^{-1}$, respectively)

The study revealed considerable variation in amino acid content across plant species and tissues. *Parkia timoriana*, traditionally consumed for its seeds and fruit pulp, exhibited high amino acid levels in the pulp (20.84±1.39 mg $g^{-1}$), consistent with previous reports on its protein content (Angami et al., 2018).

Zingiberaceous herbs like *Alpinia officinarum* and *Kaempfera parviflora* also displayed elevated amino acid levels, reinforcing the known nutraceutical properties of this family (Zhang et al., 2021). The wide variation across plant parts reflects differential metabolic activities and protein allocation strategies, as supported by plant physiology studies (Taiz and Zeiger, 2010). Leaves generally exhibited higher amino acid concentrations due to their role in photosynthesis and nitrogen metabolism.

These findings emphasized the potential of underutilized wild plants in addressing micronutrient and protein deficiencies. Incorporating such species into community nutrition programs

Table 3: Total amino acid content among the herbs

| Sl. No. | Plant sample | Local name | Family | Plant part | Amino acid concentration (mg $g^{-1}$ of dry weight) |
|---|---|---|---|---|---|
| 1. | *Kaempferia parviflora* | Sing amuba | Zingiberaceae | Rhizome | 12.15±0.41 |
| 2. | *Curcuma amada* | Yai heinouman | Zingiberaceae | Rhizome | 1.28±0.17 |
| 3. | *Brachycorythis obcordata* | Kak-uba | Orchidaceae | Leaves | 3.90±0.83 |
| 4. | *Alpina officinarum* | Pulleimanbi | Zingiberaceae | Leaves | 1.58±0.11 |
| 5. | *Siphonochilus aethiopicus* | Lam sing | Zingiberaceae | Rhizome | 1.95±0.85 |
| 6. | *Alpinia galanga* | Kanghoo | Zingiberaceae | Rhizome | 18.98±0.71 |
| 7. | *Maranta arundinaceae* | Alaloo | Marantaceae | Rhizome | 2.81±0.11 |
| 8. | *Curcuma caesia* | Yaingang amuba | Zingiberaceae | Rhizome | *2.44±0.75* |
| 9. | *Zingiber striolatum* | Sarei | Zingiberaceae | Rhizome | 17.63±0.64 |

*The data represented means of 3 replications

Table 4: Total Amino acid content among the creepers

| Sl. No. | Plant sample | Local name | Family | Plant part | Amino acid concentration (mg $g^{-1}$ of dry weight) |
|---|---|---|---|---|---|
| 1. | *Paedaria foeteda* | Uri-oinum | Rubiaceae | Leaves | 2.14±0.23 |
| | | | | Gall | 1.43±0.06 |
| | | | | Stem | 1.39±0.06 |
| 2. | *Hodgsonia heteroclita* | Kathai/ Lam mairen | Cucurbitaceae | Fruit | 1.84±0.62 |

*The data represented means of 3 replications

and agricultural systems couldenhance dietary diversity and resilience against climate-induced food insecurity (Bharucha and Pretty, 2010; Smith et al., 2016; Dhull et al., 2022; Talang et al., 2023).

## 4. Conclusion

Species such as *Alpinia galanga*, *Zingiber striolatum*, *Parkia timoriana*, and *Accacia pennata* exhibited high amino acid levels and could be promoted for nutraceutical development and food security initiatives. Further studies involving essential amino acid profiling and bioavailability assessment were warranted.

## 5. Acknowledgment

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

## 6. References

Angami, R., Ralte, L., Suryanti, S., 2018. Traditional uses, phytochemistry and biological activities of *Parkia timoriana* (DC.) Merr: An underutilized multipurpose tree bean – A review. Genetics and Molecular Research 17(4), gmr160595. https://doi.org/10.1007/s10722-017-0595-0.

Anonymous, 2023. The State of Food Security and Nutrition in the World 2023. Rome: Food and Agriculture Organization. Available from: https://doi.org/10.4060/cc3017en. Accessed on: 16th October 2025.

Bharucha, Z., Pretty, J., 2010. The roles and values of wild foods in agricultural systems. Philosophical Transactions of the Royal Society B: Biological Sciences 365(1554), 2913–2926. https://doi.org/10.1098/rstb.2010.0123.

Casas, M., Vallès, J., Gras, A., 2024. Nutritional properties of wild edible plants with traditional use in the Catalan linguistic area: A first step for their relevance in food security. Foods 13(17), 2785. https://doi.org/10.3390/foods13172785.

Correa, R.C.G., Di Gioia, F., Ferreira, I.C.F.R., Petropoulos, S.A., 2020. Wild greens used in the Mediterranean diet. In: Preedy, V.R., Watson, R.R. (Eds.), The mediterranean diet (2nd Edn.). Academic Press, pp. 209–228. https://doi.org/10.1016/B978-0-12-818649-7.00020-5.

Cruz-Garcia, G.S., Price, L.L., 2011. Ethnobotanical investigation of wild food plants used by rice farmers in Kalasin, Northeast Thailand. Journal of Ethnobiology and Ethnomedicine 7, 33. https://doi.org/10.1186/1746-4269-7-33

Datta, S., Pillai, B., Seal, T., 2025. Unlocking nutritional power: HPLC-based profiling of free and total amino acids in wild edible plants of North-East India. SSRN. https://doi.org/10.2139/ssrn.5362938.

Dhull, S.B., Kidwai, M.K., Noor, R., Chawla, P., Rose, P.K., 2022. A review of nutritional profile and processing of Faba bean (*Vicia faba* L.). Legume Science 4(3), e129. https://doi.org/10.1002/leg3.129.

Jain, A.K., Tiwari, P., 2012. Nutritional value of some traditional edible plants used by tribal communities during emergency with reference to Central India. Indian Journal of Traditional Knowledge 11(1), 51–57. https://nopr.niscpr.res.in/bitstream/123456789/13423/1/IJTK%2011%281%29%2051-57.pdf.

Kala, C.P., 2009. Aboriginal uses and management of ethnobotanical species in deciduous forests of Chhattisgarh state in India. Journal of Ethnobiology and Ethnomedicine 5, 20. https://doi.org/10.1186/1746-4269-5-20.

Kerr, B.R., Madsen, S., Stüber, M., Liebert, J., Enloe, S., Borghino, N., Parros, P., Mutyambai, D.M., Prudhon, M., Wezel, A., 2021. Can agroecology improve food security and nutrition? A review. Global Food Security 29, 100540. https://doi.org/10.1016/j.gfs.2021.100540.

Luiking, Y.C., Engelen, M.P., Deutz, N.E., 2010. Regulation of nitric oxide production in health and disease. Current Opinion in Clinical Nutrition and Metabolic Care 13(1), 97–104. https://doi.org/10.1097/MCO.0b013e328332f99d.

Mahawer, S.K., Kumar, R., Prakash, O., Arya, S., Singh, S., de Oliveira, M.S., Rawat, D.S., 2023. A comprehensive review on phytochemistry, ethnopharmacology, and pharmacological properties of *Zingiber roseum* (Roxb.) Roscoe. Current Topics in Medicinal Chemistry 23(11), 931–942. https://doi.org/10.2174/1568026623666230126143635.

Mokria, M., Gebretsadik, Y., Birhane, E., McMullin, S., Ngethe, E., Hadgu, K.M., Hagazi, N., Tewolde-Berhan, S., 2022. Nutritional and ecoclimatic importance of indigenous and naturalized wild edible plant species in Ethiopia. Food Chemistry: Molecular Sciences 4, 100084. https://doi.org/10.1016/j.fochms.2022.100084.

Muthayya, S., Rah, J. H., Sugimoto, J.D., Roos, F.F., Kraemer, K., Black, R.E., 2014. The global hidden hunger indices and maps: An advocacy tool for action. Plos One 8(6), e67860. https://doi.org/10.1371/journal.pone.0067860.

Narzary, H., Basumatary, S., 2019. Amino acid profiles and anti-nutritional contents of traditionally consumed six wild vegetables. Current Chemistry Letters 8(3), 137–144. https://doi.org/10.5267/j.ccl.2019.4.002.

Smith, M.R., Micha, R., Golden, C.D., Mozaffarian, D., Myers, S.S., 2016. Global expanded nutrient supply (GENuS) model: A new method for estimating the global dietary supply of nutrients. Plos One 11(1), e0146976. https://doi.org/10.1371/journal.pone.0146976.

Taiz, L., Zeiger, E., 2010. Plant physiology (5th Edn.). Sunderland, MA: Sinauer Associates, 782 p. https://www.scirp.org/reference/referencespapers?referenceid=1273207.

Talang, H., Yanthan, A., Rathi, R.S., Pradheep, K., Longkumer, S., Imsong, B., Singh, L.H., Assumi, R.S., Devi, M.B., Vanlalruati, Kumar, A., Ahlawat, S.P., Bhatt, K.C., Bhardwaj, R., 2023. Nutritional evaluation of some potential wild edible plants of North Eastern region of India. Frontiers in Nutrition 10, 1052086. https://doi.org/10.3389/fnut.2023.1052086.

Wu, G., 2009. Amino acids: Metabolism, functions, and nutrition. Amino Acids 37(1), 1–17. https://doi.org/10.1007/s00726-009-0269-0.

Youn, I., Han, A.R., Piao, D., Lee, H., Kwak, H., Lee, Y., Nam, J.W., Seo, E.K., 2024. Phytochemical and pharmacological properties of the genus *Alpinia* from 2016 to 2023. Natural Product Reports 41(9), 1346–1367. https://doi.org/10.1039/d4np00004h.

Young, V.R., Pellett, P.L., 1994. Plant proteins in relation to human protein and amino acid nutrition. The American Journal of Clinical Nutrition 59(5 Suppl), 1203S–1212S. https://doi.org/10.1093/ajcn/59.5.1203S.