Journal of Science Research International (JSRI)
ISSN: 2456-6365 (Online)

ORIGINAL RESEARCH PAPER

OPEN ACCESS

ASSESSMENT OF MORPHOLOGICAL, PHYTOCHEMICAL, AND NUTRITIONAL PROFILING OF TWO UNDERUTILIZED LEAFY VEGETABLES *BASELLA SP.*

Alok Ranjan Sahu

Department of Botany, Vikash Degree College, Barahaguda, Canal Chowk, Bargarh, Odisha

**Correspondence author E-mail: alok.btgene@gmail.com*

Received: 07 November 2025	Revised: 03 January 2026	Accepted: 25 January 2026	Published: 30 January 2026

DOI: **https://doi.org/10.5281/zenodo.18466544**

Abstract:

Green leafy vegetables are recognised to be a great source of several vital nutrients. Basella belongs to the family Basellaceae, commonly referred to as Indian spinach, and commonly known as Poi in Odia. It is native to Africa and Asia and it is widely cultivated in tropical and sub-tropical areas where it is used as vegetables. In the present study, morphological characterisation, phytochemical screening and nutritional contents of Basella alba L. and Basella rubra L. were analysed. The preliminary phytochemical screening of methanolic leaf extracts confirms the presence of carbohydrate, protein, glycosides, alkaloids, and tannin. Compared to popular green vegetables, several plants have a higher nutritional and vitamin content. Such beneficial veggies should be part of our diet and should be grown and consumed in order to enhance health.

Keywords: *Morphological, Phytochemical, Nutritional, Underutilized, Basella alba L., and Basella rubra L..*

Introduction

Man is incredibly knowledgeable about edible plants, and green leafy vegetables have overlapping nutritional and therapeutic properties that improve human well-being. They have the highest nutritional value yet are the last expensive veggies that impoverished men can afford. They should be given more credit because of their additional nutritional worth. The primary cause of these green leafy vegetables' reduced consumption is ignorance, particularly regarding their nutritional worth. The critical micronutrient content of leafy vegetables and a few wild plant species in India has been examined in previous research [1]. Medicinal plants are defined as plants with one or more of their parts containing properties that can be used for therapeutic purposes or used as precursors for the synthesis of various drugs [2]. Due to their low toxicity, pharmacological activity, and economic viability, plant's therapeutic qualities have drawn a lot of attention in light of scientific advancements. A significant share of meals with therapeutic benefits are green leafy vegetables [3, 4]. Global crops like cauliflowers and cabbage

may be available to tribal communities, but they are expensive to buy, and seasonal. Since the crops are not included in traditional meals, there is little interest in eating veggies from throughout the world. Several traditional leafy vegetables require processing as they contain anti-nutritional factors like glucosinolates, nitrate, oxalate, phytate, saponin, and tannins [5]. Tribal cultures employ traditional processing techniques to detoxify vegetables with antinutrients and make them suitable for human consumption, like soaking, adding tamarind, and prolonged cooking [6]. Phytochemicals are naturally occurring chemical compounds that are physiologically active and have a greater positive impact on human health than macronutrients and micronutrients [7]. When consumed in large quantities, these phytoconstituents play a crucial role in human health. Given that 2.8% of people worldwide suffer from diabetes mellitus, one of the commonly found metabolic disease, plants with antidiabetic properties are crucial in contemporary environment. Numerous plant species are found around the world and have been utilized for these advantageous purposes.

Linnaeus obtained the generic name *Basella* from Malayalam. Subsequently, he used *Hortus malabaricum* as a synonym for *Basella rubra* L. = *Basella alba* L. [8]. Due to various contradictory findings from classical taxonomists, *Basella* has received a lot of attention [9]. The genus has five species, four of which are widely spread throughout East and Southeast Africa as well as Madagascar, and one of which is pantropical [10]. Two *Basella* L. species were initially described by Linnaeus in Species. In accordance with article 11.5 of the code, initially treated *Basella alba*, *B. rubra*, and *B. lucida* as synonyms and modified *Basella alba* as the proper name [11]. The fact that there are very few structural differences between these two taxa has further reinforced these conclusions [12]. The majority of authors concurred that the two-colour variations of Basella are not distinct species, according to the Echo plant information sheet [13] Cytological, pollen morphology, and protein profile analyses of *Basella's* red and green stem forms demonstrated that they are all members of the same species, which is *Basella alba* [14]. According to Almeida [15] in "Flora of Maharashtra," *Basella alba* L. has a green stem and green petiole, while *B. alba* L. var. *cordifolia* (Lamk.) Almeida has a red stem and red petiole.

The leaves of *B. alba* have been reported for the treatment of urticaria, constipation by the native of Bargarh district, Odisha [16, 17]. Peoples of Bargarh District of western Odisha cultivated the *Basella* sp. in their traditional home garden because they used both the leaf and tender stems are cooked with edible oil and eaten as a curry, further they used leaves and tender stems for the treatment of skin diseases and as laxative in children and pregnant women [18]. *B. alba* L. is reported as leafy vegetables by various parts of Odisha like Bargarh [19], Jharigaon block of Nabarangpur district [20], Balangir [21], Hemgir block of the Sundargarh district [22], Barpali NAC of Bargarh district [23], Dunguripali block of Subarnapur district [24]. Sahu and Mishra [25] reported that the paste prepared from root (10 gm) of *Basella* with rice washed water taken in the morning time in empty stomach for nearly one month to cure irregular periods by the native of Bargarh district, Western Odisha. The leaves and shoot of *B. alba* were used as food by cooing and also used to treat dysentery, diarrhea, anemia, cancer by the native of Balangir district, Western Odisha, India [21].

Several authors were reported regarding the phytochemical screening of medicinal plants like *Justicia adhatoda* L. [26], *Tinospora cordifolia* (Willd.) Miers. [27], *Murraya koenigii* (Linn.) Spreng. [28], *Tridax procumbence* [29], *Moringa oleifera* Lam. [30], *Drimia indica* [31], *Hibiscus* [32], *Ottochloa nodosa* [33], *Achyranthes aspera* L. [34], *Marsilea minuta* L. [35] form various parts of the Odisha. Here, the present study emphasizes morphological variation, phytochemical screening and nutritional assessment of two such under-utilized plants, *B. alba* L. and *B. rubra* L., which are commonly used by tribal communities.

Materials and methods

Plant Materials

Both the *B. alba* L. and *B. rubra* L. were identified from home gardens of various villages of Bargarh district, Odisha. The plant parts were collected, and photographed for their morphological identification, phytochemical screening and nutritional profiling.

Phytochemical analysis

Leaves of *B. alba* L. and *B. rubra* L. were dried under shade separately. The dried materials were made to powdered by using mixer grinder, and stored in ait tight containers. The powdered leaves were subjected to solvent extraction using methanol. Five gram of powdered plant materials were subjected to Soxhlet extraction for 6-7 hours 150 ml of solvents. The extracts obtained were kept in an oven at 50°C for evaporation to remove the excess solvent. The extracts were stored in a cool, dry place for the preliminary analysis of phytochemicals.

Phytochemical Screening

The qualitative phytochemical screening of the components like glycosides, saponin, flavonoids, tannins, alkaloids, phenolic compounds, terpenoids and steroids were carried out using the modified methods of various authors [26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37].

Nutritional investigation

Fresh leaves from *B. alba* L. and *B. rubra* L. were collected and subjected to various tests according to standard procedures in order to estimate nutritional (carbohydrate, protein, chlorophylls, carotenoids, lipids, amino acids, reducing sugar, vitamins) parameters.

Results and Discussion

Morphological analysis

Both plants are Perennial, herbaceous, twinning; Plant height at flower bud initiation is 86.9 ± 3.8 (cm) in *Basella alba* L. and 119.7 ± 1.50 cm in *Basella rubra* L.; No. of primary branches are 5.3 ± 0.6 and 4.3 ± 0.6 in *B. alba* L. and *B. rubra* L. respectively. The stem of both plants has Glabrous texture, while the stem colour is green in *B. alba* L. and red in in *B. rubra* L. the leaf shapes are cordate, pinnate venation and alternate leaf arrangement are found in both the plants. The leaf length is 7.7 ± 0.6 cm and 6.6 ± 0.2 cm in *B. alba* L. and *B. rubra* L., respectively. Leaf width 6.7 ± 0.3cm and 5.2 ± 0.2 cm; while Petiole length is 1.8 ± 0.6 cm and 1.7 ± 0.3 cm in *B. alba* L. and *B. rubra* L., respectively.

Phytochemical analysis

Phytochemicals are not essential nutrients and are not required by the human body for sustaining life, but they have important properties to prevent or to fight some common diseases. Many of these benefits suggested a possible role for phytochemicals in the prevention and treatment of disease. Preliminary analyses of phytochemical constituents in methanolic leaf extracts are carried out using a standard protocol. The results of phytochemical screening are summarized in Table 1. The preliminary phytochemical analysis of methanolic leaf extract of both plants showed the presence of carbohydrates, proteins, glycosides, alkaloids, tannins, flavonoids, steroids and saponins. The presence of alkaloids, tannins, terpenoids and flavonoids were reported from the *Tridax procumbens* leaf aqueous [29]. Sahu *et al.* [32] reported the distribution and morphological description of the *Hibiscus* plant, along with its phytochemical as well as various bioactive chemical composition and their structures, the ethno-medicinal and botanical benefits on human health, and toxicity research. The phytochemical components of *Marsilea minuta* leaves, which are in charge of a number of documented pharmacological

characteristics, were examined by Sharma *et al.* [35]. Several bioactive substances, including tannin, saponin, flavonoids, phenolic compounds, and reducing sugars, were found in three distinct extracts (aqueous, methanol, and ethanol) according to the phytochemical screening. These secondary metabolites exhibited antioxidant, anti-inflammatory, antidiabetic, and antimicrobial properties. The residents of the Bargarh district utilized the leaves of *Justicia adhatoda* L. as a uterine tonic and to cure rheumatism, asthma, arthritis, colds, coughs, eczema, malaria, and TB. The phytochemical screening revealed presence of phytochemicals like alkaloids, steroids, terpenoids, saponins, phenols and tannins in the ethanol extract, while flavonoids, cardiac glycosides, amino acids, proteins, carbohydrates and reducing sugar were found to be absent. Meanwhile, In the aqueous extracts, alkaloids, flavonoids, terpenoids, saponins, tannins, phenols, amino acids and proteins showed positive result, but steroids, tannins, cardiac glycosides, carbohydrates and reducing sugars showed negative result [26]. The qualitative phytochemical analysis of the hydroethanolic extract of *Drimia indica* bulbs revealed the presence of tannins, saponins, flavonoids, phenolic compounds, reducing sugars, and steroids [31]. The phytochemicals screening was carried out by using various extracts of *Achyranthes aspera* prepared by shaking and boiling method and documented. Steroid was found to be absent in all extracts prepared by using solvents (methanol, ethanol and water) by both methods. Tannin is present in the shoot and root of several extracts isolated by different solvent using shaking as well as boiling method. Terpenoids are absent in all parts of the plant. Alkaloid is present in methanolic, ethanolic and water extracts of both methods. Phenol was absent in all extract made by shaking method and present in extract using methanol, ethanol and water as solvent and using boiling method. Leaf and inflorescence contain flavonoid. Saponin was present in root and stem parts by shaking method whereas it was found in leaf and inflorescence extract by boiling method. Coumarin was found in all the three extracts [34]. The ethnobotanical exploration and phytochemical screening of *Tinospora cordifolia* (Willd.) Miers. belongs to the family Menispermaceae, a climbing shrub from Bargarh district, Odisha India. Both the water and ethanol solvents were used to obtain extracts of leaves and stems *i.e.* used for qualitative phytochemical screening by using standard methods. In this finding alcohol shows a higher solubility rate as compared to water. Present finding shows the presence of carbohydrates, proteins, alkaloids, flavanoids, saponins, glycosides, steroids, terpenoids, phenolics and tannins [27]. The various phytochemical tests of *Murraya koenigii* (Linn.) Spreng., including the Wagner's test for alkaloids, Lead acetate test for flavonoids, Ferric chloride test for phenols and tannins, Foam test for saponins, and the Keller-Killiani test for glycosides, confirm the presence of these bioactive compounds in *M. koenigii*. Additionally, tests for carbohydrates, proteins, and steroids also reveal the plant's diverse chemical makeup. These findings support the plant's medicinal use in local and traditional healing practices, particularly in regions like Odisha, where it plays an integral role in managing health conditions [28]. For both aqueous and ethanolic extracts revealed the presence of the following phytochemical constituents saponins, flavonoids, terpenoids, cardiac glycosides and alkaloids (aqueous extract) and tannins, saponins, flavonoid, steroids, cardiac glycosides, anthroquinones and alkaloids (ethanolic extract) in *Moringa oleifera* leaves. This is an indication that the *M. oleifera* leaves contained tannins, saponins, flavonoid, steroids, terpenoids, cardiac glycosides, anthroquinones and alkaloids as secondary metabolites [30]. Sahu *et al.* [36] reported that for phytochemical analysis ten selected fresh parts of species were collected. Phenolic compounds, flavonoids, and saponins were also quite abundant in most species. The ethanol extract of *Allium sativum* (bulb) showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, glycosides, saponins, steroids and carbohydrates. The ethanol extract of *Brassica juncea* (seeds) showed positive results for alkaloids, flavonoids, phenolic compounds, tannins,

terpenoids & triterpenoids, glycosides and proteins. Positive results for alkaloids, phenolic compounds, tannins, saponins and protein were found in the ethanolic extract of *Cinnamomum verum*. The ethanol extract of *Cuminum cyminum* (seeds) showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, terpenoids and triterpenoids, glycosides, saponins and steroids. The ethanol extract of *Curcuma longa* (rhizome) showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, terpenoids and triterpenoids, glycosides, saponins and carbohydrates. The ethanol extract of *Coriander sativum* (seeds and leaves) showed positive results for alkaloids, flavonoids, phenolic compounds, terpenoids and triterpenoids, saponins, steroids and carbohydrates. The ethanol extract of *Elettaria cardamomum* (fruits and seeds) showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, terpenoids and triterpenoids, saponins, carbohydrates and proteins. The ethanol extract of *Syzygium aromaticum* (flower buds) showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, terpenoids % triterpenoids, steroids, carbohydrates, and proteins. The ethanol extract of *Trigonella foenum-graceum* (leaves) showed alkaloids, phenolic compounds, tannins, saponins, and proteins. The ethanol extract of *Zingiber officinale* (rhizome) showed positive results for alkaloids, flavonoids, tannins, glycosides, saponins, and carbohydrates.

Nutritional analysis

The nutritional quality of *B. alba* and *B. rubra* was assessed in this study by analysing the following factors. Protein (mg/g), total chlorophyll (mg/g), carotenoids (mg/g), fat (%), amino acids (mg/g), reducing sugar (mg/g), vitamin C, vitamin B2, vitamin B3, and vitamin B1, and data were evaluated using statistical techniques (Table 2). *B. alba* had higher carbohydrate content (75.5±2.85mg/g) than *B. rubra* (72.45±1.65mg/g). It was reported that *Amaranthus dubius* had a carbohydrate value of 83 mg/g, whereas *B. alba* had a lower value [38]. Because of the high protein concentration, the sample has few carbohydrates. Nutritional content analysis revealed that *B. alba* has a higher protein content (1.25±0.90 mg/g) than *Amaranthus* sps. The protein content of *B. rubra* was 0.35±0.05 mg/g on average. Plant foods can be regarded as good sources of protein if they contain more than 12% of their calories from protein (Ali, 2009). The present study showed that *B. alba* and *B. rubra* are all good sources of protein. Greens are important sources of protective food that are highly beneficial for the maintenance of good health and the prevention of diseases. In this study, the chlorophyll content was higher in the *B. alba* (3.30±0.65mg/g) compared to *B. rubra* (1.70±0.15mg/g). Ferruzzi and Blakeslee [39] claim that chlorophyll suppresses the actions of elements that cause cancer and combats poisons. Iron levels in human blood are raised by chlorophyll, which is particularly beneficial for expectant or nursing mothers. Chlorophyll also helps to purify the liver. Chlorophyll regulates blood sugar levels in the human body, which is good for general health and wellness. Chlorophyll is known to be reported for its antioxidant potential and has promising medicinal and health benefits [40]. *B. rubra* (0.95±0.15 mg/g) and *B. alba* (0.35±0.05 mg/g) had considerably higher amino acid contents. Numerous medical disorders can be treated with amino acids. Carotenoids were present in both plants in good amounts (*B. alba* 0.55±0.03mg/g and *B. rubra* 0.40±0.01mg/g). Carotenoids are abundant in green leafy plants. According to Singh *et al.* [41], green leafy vegetables account for 90% of the 95% of accessible β-carotene from greens in India. Instead of using synthetic vitamin A, one way to improve children's vitamin A status is to increase their daily intake of foods high in β-carotene. *B. rubra* had a greater lipid content (0.33±0.01 mg/g) than *B. alba* (0.31±0.00 mg/g). Leafy vegetables are low in lipids, according to Ejoh *et al.* [42]. *B. alba* had the highest levels of thiamine (0.15±0.00 mg/g) and niacine (0.01±0.00 mg/g). The highest levels of riboflavin (10.95±0.75 mg/g) and ascorbic acid (6.30±0.10 mg/gm) are found in *B. rubra*. By chelating or preserving the iron in its

reduced form, ascorbic acid, a water-soluble antioxidant, facilitates the absorption of soluble iron. Humans cannot make or store vitamin C, thus they must get it from their diet. Both plants and animals contain these monosaccharide antioxidants, which have been linked to the prevention of heart disease, the common cold, and several types of cancer.

Table 1: Phytochemical Components of *B. alba* L and *B. rubra* L

Name of compounds	***B. alba* L**	***B. rubra* L**
Carbohydrates	+	+
Proteins	+	+
Alkaloids	+	+
Flavonoids	+	+
Glycosides	+	+
Saponin	+	+
Steroids	+	+
Tannin	+	+

Table 2 Nutritional Analysis of *Basella alba* L. and *Basella rubra* L.

Nutritional Parameters	***Basella alba* L.**	***Basella rubra* L.**
Carbohydrate (mg/g)	75.5±2.85	72.45±1.65
Proteins (mg/g)	1.25±0.90	0.35±0.05
Total chlorophyll (mg/g)	3.30±0.65	1.70±0.15
Amino acids (mg/g)	0.35±0.05	0.95±0.15
Reducing sugar (mg/g)	0.006±0.00	0.002±0.00
Carotenoids (mg/g)	0.55±0.03	0.40±0.01
Thiamine (mg/g)	0.15±0.00	0.11±0.00
Riboflavin (mg/g)	9.10±1.40	10.95±0.77
Ascorbic acid (mg/g)	3.25±0.14	6.30±0.10
Niacin (%)	0.01±0.00	0.00±0.00
Lipids (%)	0.31±0.00	0.33±0.01

Conclusion

Edible green leafy vegetables appear to be underutilized throughout the world and, in some areas, may even be diminished in use. In the present study, *B. alba* and *B. rubra*, two underutilized plants, were used as the study material. Methanolic leaf extract of *B. alba* and *B. rubra* was used for preliminary phytochemical analysis using a standard protocol, which revealed the presence of carbohydrate, protein, glycosides, alkaloids tannin. The nutritional study was carried out in fresh leaves by evaluating several nutritional parameters such as carbohydrate, reducing sugar, total chlorophyll, carotenoids, lipids, proteins, amino acids, and vitamins like thiamine riboflavin, niacin, and ascorbic acid. From the results, it was found that *B. alba* possesses more amount of carbohydrates, reducing sugar, total chlorophyll, carotenoids, proteins, thiamine, and niacin than *B. rubra*. But *B. rubra* has a comparatively higher amount of amino acids, lipid, riboflavin, and ascorbic acid. In comparison with other commonly used leafy vegetables, these plants exhibit more nutritional contents. The present study reveals the potentiality of these inexpensive, easily accessible, but lesser-known leafy vegetables as a source of

unconventional food with nutritive value and many other health benefits. Consumption of such valuable vegetables should be encouraged through awareness and should be propagated. The inclusion of these plants into the diet will add more nutritional benefits to our body in a low cost.

References

1. Gupta, R., Sharma, A. K., Dobhal, M. P., Sharma, M. C., & Gupta, R. S. (2011). Anti-diabetic and antioxidant potential of β-sitosterol in streptozotocin-induced experimental hyperglycemia. *Journal of diabetes* 3(1):29-37.
2. Kasali, F. M., Mahano, A. O., Nyakabwa, D. S., Kadima, N. J., Misakabu, F. M., Tshibangu, D. S. et al. (2014). Ethnopharmacological survey of medicinal plants used against malaria in Bukavu city (DR Congo). *European J. Med. Plants* 29-44.
3. Anugraha, A. S., Lekshmi, S., & Swapna, T. S. (2020). Nutritional Analysis of Ten Underutilised Wild Edible Plants of Wayanad. *International Journal of Pharmacy and Pharmaceutical research* 20(1):288 301.
4. Pradeesh, S., & Swapna, T. S. (2017). Enzymatic and non-enzymatic antioxidants in tribal leafy vegetable *Bidens biternata* (Lour.) Merr. & Sheriff. *Journal of Medicinal and Aromatic Plant Sciences* 39(2-4):93-100.
5. Makkar, H. P., Becker, K., Sporer, F., & Wink, M. (1997). Studies on nutritive potential and toxic constituents of different provenances of *Jatropha curcas*. *J. Agric. Food Chem.* 45(8):3152-7.
6. Aregheore, E.M. (2012). Nutritive value and inherent anti nutritive factors in four indigenous edible leafy vegetables in human nutrition in Nigeria: a review. *J. Food Res. Sci.* 1:1-4.
7. Hasler, C. M., & Blumberg, J. B. (1999). Phytochemicals: biochemistry and physiology. Introduction. *The Journal of nutrition* 129(3):756S-7S.
8. Cook, A. (2010). Linnaeus and Chinese plants: A test of the linguistic imperialism thesis. *Notes and Records of the Royal Society* 64: 121-138.
9. Ray, T., & Roy, S. C. (2007). Phylogenetic relationships between members of Amaranthaceae and Chenopodiaceae of lower gangetic plains using RAPD and ISSR markers. *Bangladesh J Botany* 36: 21-28.
10. Sperling, C. R. (1987). Systematics of the Basellaceae. Ph. D. Thesis, 279 p. Harvard University, Cambridge.
11. Sidwell, K. 1999. Typification of two Linnaean names in the Basellaceae. *Novon* 9(4): 562-563.
12. Busuioc. G., & Ifrim, C. (2004). Some histo-anatomical aspects concerning the leaf structure of *Basella alba* and *Basella rubra*. *Journal of Plant Development* 12, 95-99.
13. Echo plant information sheet (2006). (Echo, Inc). Malabar Spinach (*Ceylon spinach*. Poi sag) *Basella alba*, *Basella rubra*. pp. 23-24.
14. Roy, S. K., Gangopadhyay, G., & Mukherjee, K. K. (2010). Is stem twinning form of *B. alba* L. a naturally occurring variant. *Curr. Sci.* 98: 1370-1375.
15. Almeida, M. R. (2003). Flora of Maharashtra Vol. 4. Blatter Herbarium, St. Xavier's College, Mumbai.
16. Sahu, A. R., Behera, N., & Mishra, S. P. (2010). Use of Ethnomedicinal Plants by Natives of Bargarh District of Orissa, India. *Ethnobotanical Leaflets* 14: 889-910.
17. Sahu, A. R., Nayak, A. K., & Panigrahi, S. K. (2013). Survey of some important ethno-medicinal plants of Sohela Block, Western Odisha, India. *Life Sciences Leaflets* 11(11): 1-9.
18. Sahu, A. R., & Sahu, M. (2019). A preliminary report on home garden for nutritional and primary health security of rural people of Bargarh District in Western Odisha, India. *World Journal of Pharmacy and Pharmaceutical Sciences* 8(7):1383-1394. (**DOI:** 10.20959/wjpps20197-14174).

19. Sahu, A. R., & Ekka, N. J. (2021). A preliminary report on the use of leafy vegetables by the native of Bargarh district, Western Odisha, India. *International Journal of Applied Research,* 7(5), 218-223. (DOI: https://doi.org/10.22271/allresearch.2021.v7.i5d.8567).
20. Sahu, A. R., & Sahu, M. (2022). Green leafy vegetables used by the Tribal Peoples of Jharigaon Block of Nabarangpur District, Odisha, India. In Ecology Research**,** Jachak, et al. Bhumi Publishing, Nigave Khalasa, Kolhapur 416207, Maharashtra, INDIA. Volume V, Chapter 7:52-59. (ISBN: 978-93-91768-57-7).
21. Dash, S., & Sahu, A. R. (2023). A preliminary report on the use of leafy vegetables by the native of Balangir district, Western Odisha, India. In Research Trends in Plant Sience, Bangar, M., Bai, B. P., Dasgupta, S., & Yadav, S. (eds.). Bhumi Publishing, India. Chr. 11, Pp. 83-97. (ISBN: 978-93-88901-68-0).
22. Bhoi, S., & Sahu, A. R. (2025). The use of Green Vegetables by the Residents of Hemgir block in Sundargarh district, Odisha, India: An Initial Report. *Journal of Science Research International (JSRI)* 11(7): 20-28. DOI: https://doi.org/10.5281/zenodo.17186126.
23. Patra, A., Sahu, R., Patra, B., & Sahu, A. R. (2025). Usage of Leafy Vegetables by the Native of Barpali NAC of Bargarh District, Odisha, India. *Journal of Science Research International (JSRI)* 11(5): 77-87. DOI: https://doi.org/10.5281/zenodo.16636486
24. Pradhan, S., & Sahu, A. R. (2025). An investigation on ethnomedicinal uses of native leafy vegetables in Dunguripali Block of Subarnapur, Odisha, India. In Trends in Ethnobotany and Phytochemistry Research, Mishra, S., Agnihotri, N., Iqbal, M.N., and Sahu, A. R. (Eds.), Chapter 8, Pp. 72-85. (ISBN: 978-81-994425-0-4).
25. Sahu, A. R., & Mishra, S. (2022). Plants used for the treatment of Gynecological disorders by the native of Bargarh district, Western Odisha, India. In Recent Trends and Advances in Medicinal Plants Research, Soni, P. K. (eds.) PK Publishers and Distributors, 4thPustakKartarz Nagar, New Delhi, Chapter 6, Pp. 71- 76. (ISBN: 978-81-953735-8-1).
26. Bhoi, K., Sahu, R., Nayak, N. R., Behera, G., & Sahu, A. R. (2025). Ethnobotanical exploration and Phytochemical Screening of *Justicia adhatoda* L: A Case Study from Bargarh district, Odisha, India. *Journal of Science Research International (JSRI)* 11(2): 12-19. DOI: https://doi.org/10.5281/zenodo.15533475.
27. Dash, D, Sahu, R, Barik, J, Nayak, N. R., Behera, G., & Sahu, A. R. (2025). Ethnobotanical exploration and Phytochemical Screening of *Tinospora cordifolia* (Willd.) Miers.: A Case Study from Bargarh district, Odisha, India. *Journal of Science Research International (JSRI)* 11(4): 84-93. DOI: https://doi.org/10.5281/zenodo.15780100
28. Mallik, S., Nayak, N. R., Barik, J., Behera, G., & Sahu, A. R. (2025). Ethnobotanical exploration and Phytochemical Screening of *Murraya koenigii* (Linn.) Spreng.: A Case Study from Bargarh district, Odisha, India. In Multidimensional Research Perspectives in Life Science. Yash Rakholiya, Tarkeshwar Kumar, Biplab Kumar Das, Alok Ranjan Sahu (Eds.), Chapter 11, Pp. 92-102. (ISBN: 978-93-48620-76-7).
29. Nayak, N. R., Pattnayak, A., & Sahu, A. R. (2024). Screening for Phytochemicals, antimicrobial and anticoagulant activity of aqueous extract of *Tridax procumbence.* In Research and Reviews in Plant Sciences, Srivastava, M. P., Bangar, M. A., Chachad, D., & Kumar, A. R. (Ed.). Bhumi Publishing, Nigave Khalasa, Kolhapur 416207, Maharashtra, India. Vol. II, Pp. 115-126.
30. Padhan, E., Nayak, N.R., Barik, J., Behera, G., & Sahu, A.R. (2025) Ethnobotanical exploration and Phytochemical Screening of *Moringa oleifera* Lam.: A Case Study from Bargarh district, Odisha, India. In

Science and Technology for Sustainable Future, Sahu, A. R. (Eds.), Vol. II, Chapter 5, Pp. 73-82. (ISBN: 978-81-979987-8-2).

31. Rani, J. J., Tripathi, G., Pattanayak, S., Boxi, S., Rout, S., Kumar, S., & Sahu, A. R. (2025). Phytochemical and cytotoxic analysis of bulbs of *Drimia indica* (Jungli piyaz): a medicinal plant of Asparagaceae. In Plants and Secondary Metabolites, Hossain, E., Roy, C. B., Jena, N., & Kumar, S., Ambica Prasad Research foundation, India, Vol. IV, Chapter 6, Pp 52-62.
32. Sahu, A. R., Nayak, N. R., & Ekka, N. J. (2024). A mini-review on phytochemical screening, biological activity, and therapeutic capability of *Hibiscus*: An ornamental plant species. In Research and Reviews in Plant Sciences; Chachad, D., Mishra, S., Mahishi, P., & Sahu, A. R. (Ed.). Bhumi Publishing, Nigave Khalasa, Kolhapur 416207, Maharashtra, INDIA. Vol. IV, Pp. 72-80.
33. Sahu, A.R., Sahu, B. K., Jogdand, S.K., Singh, G., Kumar S. and Agrahari, D. (2025) Phytochemical analysis and antioxidant activity of *Ottochloa nodosa* (Poaceae). Pharmacologically Important Grass Species, Volume 1, 10-17 (ISBN: 978-81-989192-8-1). DOI: https://doi.org/10.5281/zenodo.17189680.
34. Sahu, S., Nayak, N. R., Behera, G., &. Sahu, A. R. (2025). Ethnobotanical exploration and Phytochemical Screening of *Achyranthes aspera* L.: A Case Study from Kalahandi district, Odisha, India. In Science and Technology for Sustainable Future, Sahu AR (Eds.), Vol. II, Chapter 10, Pp. 140-149. (ISBN: 978-81-979987-8-2).
35. Sharma, A., Lal, S., Sharma, B. P., Rathore, S., Sahu, A. R., Jena, N., & Kumar, S. (2024). Phytochemical analysis of *Marsilea minuta* L.: an aquatic medicinal plant. *Medico Bio-wealth of India*. 15(2): 11-20.
36. Sahu, R., Mahapatra, S., & Sahu, A. R. (2025). Ethnomedicinal Exploration and Phytochemical Screening of selected spices used by the Native of Bargarh District, Western Odisha, India. *Journal of Science Research International* 11(1):84-95. (DOI: https://doi.org/10.5281/zenodo.15119052).
37. Sahu, A. R., & Pradhan, S. (2025). Ethnomedicinal exploration, phytochemical screening and antimicrobial activity of *Boerhavia diffusa* L.: A multipotential medicinal plant. *Journal of Science Research International (JSRI)* 11(8): 48-58. DOI: https://doi.org/10.5281/zenodo.17445853.
38. Alegbejo, J. O. (2013). Nutritional value and utilization of Amaranthus (*Amaranthus* spp.)–a review. *Bayero Journal of Pure and Applied Sciences* 6(1):136 43.
39. Ferruzzi, M. G., & Blakeslee, J. (2007). Digestion, absorption, and cancer preventative activity of dietary chlorophyll derivatives. *Nutrition research* 27(1):1-2.
40. İnanç, A. L. (2011). Chlorophyll: Structural Properties, Health Benefits and Its Occurrence in Virgin Olive Oils. *Akademik Gıda* 9(2): 26-32.
41. Singh, A., Dubey, P. K., Chaurasiya, R., Mathur, N., Kumar, G., & Bharati, S. et al. (2018) Indian spinach: an underutilized perennial leafy vegetable for nutritional security in developing world. *Energy, Environment* 3(3):195-205.
42. Ejoh, A. R., Mbiapo, F. T., & Fokou, E. (1996). Nutrient composition of the leaves and flowers of Colocasia esculenta and the fruits of Solanum melongena. *Plant Foods for Human Nutrition* 49(2):107-12.