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ETHNOBOTANICAL EXPLORATION, PHYTOCHEMICAL SCREENING, AND ANTIMICROBIAL ACTIVITY OF *CHENOPODIUM ALBUM* LINN.: A CASE STUDY FROM BARGARH DISTRICT, ODISHA, INDIA

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Abstract:

Chenopodium album Linn. (Bathua), a member of the family Chenopodiaceae originating from Western Asia, is widely cultivated in India as a food crop and animal fodder. The present study investigated the ethnobotanical significance, phytochemical composition, and antimicrobial potential of C. album collected from Bargarh district, Odisha. Ethnobotanical surveys documented its traditional medicinal uses among local communities. Phytochemical screening of leaf extracts revealed the presence of carbohydrates, proteins, phenolic compounds, terpenoids, reducing sugars, saponins, flavonoids, and amino acids in both aqueous and ethanol extracts. Alkaloids were detected only in ethanol extracts using Dragendorff's and Wagner's reagents, while steroids were identified exclusively in ethanol extracts through the Liebermann–Burchard test. Antibacterial activity was evaluated using the agar well diffusion method against Escherichia coli, Bacillus subtilis, and Pseudomonas aeruginosa. Ethanol extracts exhibited stronger antibacterial activity than aqueous extracts. The highest inhibition zone was observed against E. coli (12 mm), followed by B. subtilis (10 mm) and P. aeruginosa (8 mm), indicating promising antimicrobial properties.

Keywords: *Chenopodium album, Ethnomedicinal, Phytochemical, Antimicrobial Activity.*

Introduction

Plants and their compounds have had a variety of effects on humans. Man has utilized plants for food and shelter since the beginning of civilization, and some of them are utilized to treat a wide range of medical illnesses (1, 2). In the past, humans used medicinal herbs without knowing what their active constituents were. The active components and therapeutic effects of medicinal plants have been studied in the modern era using a variety of

scientific techniques (3). It has been noted that over 80% of people on the planet rely on plants for their basic medical needs. It has been discovered that more than 2000 plants and 8000 distinct species have various therapeutic uses (4). Due to rising numbers of antibiotic-resistant strains and a surge in the population with lowered immunity, the severity of bacterial infections has increased even after the discovery of numerous medications (5). Overcoming antibiotic resistance is the main challenge for the future millennium, according to the 2014 WHO report on antimicrobial resistance. As the World Health Organization encourages and promotes the development and use of medicinal plant resources for traditional systems of medicine, screening plants for antimicrobial activity has become increasingly important (6).

Chenopodium album (L.) is a member of the genus *Chenopodium* of the family Chenopodiaceae, also known as the Goosefoot family. It may be referred to by its Hindi name Bathua in the English texts (7). Other names for it include Bathua, Vastukah, Chakvit, and fat-hen. *C. album* is an annual vegetable weedy plant that grows quickly. In India, *C. album* is grown and eaten as a food crop, also fed to animals. There are several medical uses for this weedy shrub. It is an upright, polymorphous herb. It was discovered at an altitude of 4,700 meters and stands 3.5 meters tall. The herb frequently grows in fields of wheat, barley, mustard, and gram and decreases their yield. It is a prevalent weed in waste areas in both summer and winter. The tender shoots can be eaten fresh in a salad or with gravy, cooked as a vegetable, or added to breakfast food. In general, the leaves have 3.9% proteins, 0.76% lipids, 8.93% carbohydrates, 3% ash, calcium, phosphorus, vitamin A, and a few other elements (8). Because of its high oxalic acid content, the leaves are consumed as a vegetable when steamed or cooked like spinach. However, in North America and Europe, they are typically considered a weed in areas like potato fields (9). According to Singh *et al.* (10), the dried-out leaves of *Chenopodium* can also be incorporated into a variety of traditional foods to increase the dietetic value of the artwork and add variety to the diet. Because of its excellent nutritional value and therapeutic qualities, *C. album* is utilized in the preparation of numerous well-known medications. It is also a very good source of healthful nutrients and minerals. Bathua is used in India to make a variety of edible dishes, including shake, chapati, and sag. Since ancient times, traditional medicinal plants have been known to offer a wide range of biological activity, including antibacterial, analgesic, anticancer, and antihypertensive properties. They are also a significant source of several biologically active chemicals (11). Since the dawn of human civilization, the abundant antifungal compounds found in plants have been used as biopesticides. Every day, it is obvious that plants and plant products have antifungal properties. Antifungal compounds derived from plants have no negative effects on the environment, which is a huge benefit. These days, a commercial pesticide that is used to combat plant illnesses has been developed to seriously harm both human health and the environment. The *C. quinoa* leaves' nutraceutical potential was evaluated by measuring their antioxidant activity, analyzing their phenolic content, and determining how phenolic chemicals affected the characteristics of cancer cells. The findings demonstrated the anticarcinogenic and chemo-preventive properties of phenolic chemicals (12). When combined with traditional antimicrobials, essential oil from *Chenopodium ambrosioides* var. *ambrosioides* showed synergistic antibacterial activity against tested bacterial strains. Significant antioxidant activity was also demonstrated (13). *C. album* is a rich source of anthelmintic compounds; the plant is utilised medicinally in many nations as a source of numerous strong and effective medications. All Gram (+) and Gram (-) microorganisms were shown to be susceptible to the antibacterial activity of *C. album* ethanol leaf extract, with *B. subtilis* exhibiting the greatest activity with a 13 mm zone of inhibition at a concentration of 1000 µg/ml (14). According to a review of the

literature, streptomycin, ampicillin, chloramphenicol, ciprofloxacin, gentamycin, tetracycline, and ofloxacin all showed antibacterial activity against *C. album* (15).

The phytochemical screening of medicinal plants, such as *Justicia adhatoda* L. (16), *Tinospora cordifolia* (Willd.) Miers. (17), *Murraya koenigii* (Linn.) Spreng. (18), *Tridax procumbence* (19), *Moringa oleifera* Lam. (20), *Drimia indica* (21), *Ottochloa nodosa* (22), *Achyranthes aspera* L. (23), and *Marsilea minuta* L. (24), *Boerhavia diffusa* L. (25), *Hibiscus* (26), *Basella* (27). The goal of the current research was to examine the phytochemical screening and antibacterial properties of both aqueous and ethanol extracts from the leaves of *Chenopodium album*.

Materials and Methods

Plant collection, identification and extract preparation

The plant materials used in this study were gathered from several rural areas of Bargarh district. The author completed the taxonomic identification of these plants. Photographs of the various plant parts were taken for the preparation of a digital herbarium. The plant samples were brought to the Botany Laboratory of Vikash Degree College, Bargarh for phytochemical screening and antibacterial activity.

The gathered plants were shade-dried for three weeks at room temperature after being cleaned of dust using running tape water. Using an electric grinder, the dried plants were ground into a powder. The powder was then placed in an airtight bottle and weighed in specific quantities for additional phytochemical screening and antimicrobial activity. The preparation of the ethanol and aqueous extracts followed the guidelines provided by several authors (16-27).

Determination of antimicrobial activity

The antibacterial activity of those extracts was investigated using the Agar well diffusion method (19). Using a spreader, lawn cultures of *Escherichia coli*, *Pseudomonas aeruginosa*, and *Bacillus subtilis* were applied on Muller-Hinton agar. A cork-borer was used to cut the wells from the agar plates. Using a sterile micropipette, the extracts were added to the well. A sterile micropipette was used to pour streptomycin solution into a separate well of each plate, while the pure solvents in equal volume served as the negative control. When ethanol extracts were utilized as the solvent extracts, 100% ethanol was likewise utilized for the positive control. The plates were incubated at 37^{O}C for 24 hrs. After incubation the diameter of the zone of inhibition was measured by using scale.

Results and Discussion

The results of phytochemical screening are summarized in Table 1. Molisch's test conforms to the presence of carbohydrates in both the aqueous and ethanol extract from the leaves of *Chenopodium album.* Both the Biuret test and Xanthoproteic test indicate the presence of protein in both the extracts. Ferric chloride test and Lead acetate test shows the presence of Phenolic compounds in both the extracts. Salkowski's test, Molisch's test, and Foam test show presence of Terpenoids, Reducing sugars, and Saponins in both the extracts, respectively. Shinoda test and Ninhydrin test shows the presence of Flavonoids and Amino acids, respectively. Both the Dragendorff's reagent and Wagner's reagent show the presence of Alkaloids on ethanol extracts while absent in aqueous extracts. Liebermann-Burchard test shows the presence of Steroids on ethanol extracts while absent in aqueous extracts.

Alkaloids, tannins, terpenoids, and flavonoids were identified in the aqueous extract of *Tridax procumbens* leaves (19). The morphological description of the *Hibiscus* plant, as well as its phytochemical and different bioactive chemical content and their structures, ethno-medical and botanical benefits for human health, and toxicity studies

(26). Sharma *et al.* (24) investigated the phytochemical components of *Marsilea minuta* leaves, which are responsible for several known pharmacological features. The phytochemical screening revealed a number of bioactive chemicals in aqueous, methanol, and ethanol extracts; including tannin, saponin, flavonoids, phenolic compounds, and reducing sugars. These secondary metabolites showed antibacterial, anti-inflammatory, antidiabetic, and antioxidant properties.

Table 1: Preliminary phytochemical screening of *Chenopodium album*

Test Parameters	Test/ Reagent	Aqueous Extract	Ethanol Extract
Carbohydrate	Molish's test	+	+
Protein	Biuret test	+	+
	Xanthoproteic test	+	+
Phenolic compound	Ferric chloride test	+	+
	Lead acetate test	+	+
Terpenoids	Salkowski's test	+	+
Reducing sugars	Molisch's test	+	+
Saponins	Foam test	+	+
Flavonoids	Shinoda test	+	+
Alkaloids	Dragendorff"s reagent	-	+
	Wagner's reagent	-	+
Amino acids	Ninhydrin test	+	+
Steroids	Liebermann-Burchard test	-	+

Table 2: Antibacterial activity of *Chenopodium album* by agar well diffusion method

Organisms	Diameter of Inhibition zone (mm)		
	Streptomycin	Aqueous	Ethanol
E. coli	18	9	12
P. aeruginosa	14	6	8
B. subtilis	16	7	10

The ethanol extract of *Justicia adhatoda* L. contained phytochemicals such as alkaloids, steroids, terpenoids, saponins, phenols, and tannins, but it lacked flavonoids, cardiac glycosides, amino acids, proteins, and reducing sugar. Alkaloids, flavonoids, terpenoids, saponins, tannins, phenols, amino acids, and proteins demonstrated positive results in the aqueous extracts, but steroids, tannins, cardiac glycosides, carbohydrates, and reducing sugars demonstrated negative results (16). According to Rani *et al.* (21), tannins, saponins, flavonoids, phenolic compounds, reducing sugars, and steroids were found in the hydroethanolic extract of *Drimia indica* bulbs, according to a qualitative phytochemical study. According to Sahu *et al.* (23) aqueous, methanol, and ethanol extracts of leaf, shoot, inflorescence and root from *Achyranthes aspera* made by shaking and boiling were used for phytochemical screening, and the results were recorded. All components of the plant lack terpenoids. Both methods' methanolic, ethanolic, and aqueous extracts contain alkaloids. 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. Dash *et al.* (17) reported the ethnobotanical exploration and phytochemical screening of *Tinospora cordifolia* (Willd.) Miers. belongs to the family Menispermaceae, a climbing shrub from Bargarh district, Odisha India. For phytochemical screening both the aqueous and ethanol extracts of leaves and stems were done 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, flavonoids, saponins, glycosides, steroids, terpenoids, phenolics and tannins. Mallik *et al.* (18) reported 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. Padhan *et al.* (20) reported that for both aqueous extracts of *Moringa oleifera* leaves revealed the presence of the following phytochemical constituents saponins, flavonoids, terpenoids, cardiac glycosides and alkaloids (aqueous extract), while ethanolic extract showed the presence of tannins, saponins, flavonoid, steroids, cardiac glycosides, anthraquinones and alkaloids. Sahu *et al.* (28) reported that for phytochemical analysis ten selected fresh parts of species. Phenolic compounds, flavonoids, and saponins were also quite abundant in most species. The ethanol extract from the bulb of *Allium sativum* showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, glycosides, saponins, steroids and carbohydrates. The ethanol extract from seeds of *Brassica juncea* 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 from the seeds of *Cuminum cyminum* showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, terpenoids and triterpenoids, glycosides, saponins and steroids. The ethanol extract from the rhizome of *Curcuma longa* showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, terpenoids and triterpenoids, glycosides, saponins and carbohydrates. The ethanol extract of both seeds and leaves of *Coriander sativum* showed positive results for alkaloids, flavonoids, phenolic compounds, terpenoids and triterpenoids, saponins, steroids and carbohydrates. The ethanol extract of both the fruits and seeds of *Elettaria cardamomum* showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, terpenoids and triterpenoids, saponins, carbohydrates and proteins. The ethanol extract from the flower buds of *Syzygium aromaticum* showed positive results for alkaloids, flavonoids, phenolic compounds, tannins, terpenoids & triterpenoids, steroids, carbohydrates, and proteins. The ethanol extract from the leaves of *Trigonella foenum-graceum* showed alkaloids, phenolic compounds, tannins, saponins, and proteins. The ethanol extract from the rhizome of *Zingiber officinale* showed positive results for alkaloids, flavonoids, tannins, glycosides, saponins, and carbohydrates. Sahu (27) reported the morphological characterization, phytochemical screening and nutritional contents of *Basella alba* L. and *Basella rubra* L. belonging to family Basellaceae were analyzed. 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 valuable leafy vegetables should be part of our diet and consumed in order to enhance better health.

The zone of inhibition of standard (Streptomycin) is 18 mm for *E. coli,* 16 mm for *B. subtilis,* and 14 mm for *P. aeruginosa* (Table 2). The zone of inhibition in aqueous extract of *C. album* ranges from 6 mm to 9 mm. Highest zone of inhibition in aqueous extract of *C. album* was observed for *E. coli* (9 mm), followed by *B. subtilis* (7 mm), and *P. aeruginosa* (6 mm). While the zone of inhibition in ethanol extract of *C. album* ranges from 8 mm to 12 mm. The height zone of inhibition in ethanol extract of *C. album* was observed as 12 mm for *E. coli,* followed by 10 mm for *B. subtilis,* and 8 mm for *P. aeruginosa*. The antimicrobial activities were reported by various authors from various plants like *Passiflora edulis* (4), *Chenopodium ambrosioide*s var. *ambrosioides* (13), *C. album*'s ethanolic leaf extract (14), aqueous extract of *Tridax procumbence* (19), *Boerhavia diffusa* L. (25).

References

1. 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.
2. 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.
3. Prusti, A., Mishra, S. R., Sahoo, S., & Mishra, S. K. (2008). Antibacterial activity of some Indian medicinal plants. *Ethnobotanical Leaflets, 12*, 227–230.
4. Johnson, M., Maridass, M., & Irudayaraj, V. (2008). Preliminary phytochemical and anti-bacterial studies on *Passiflora edulis*. *Ethnobotanical Leaflets, 12*, 425–432.
5. Raut, J. S., & Karuppayil, S. M. (2014). A status review on the medicinal properties of essential oils. *Industrial Crops and Products, 62*, 250–264.
6. Mickymaray, S., Al-Aboody, M. S., Rath, P. K., Annamalai, P., & Nooruddin, T. (2016). Screening and antibacterial efficacy of selected Indian medicinal plants. *Asian Pacific Journal of Tropical Biomedicine, 6*(3), 185–191.
7. Duraipandiyan, V., Ayyanar, M., & Ignacimuthu, S. (2006). Antimicrobial activity of some ethnomedicinal plants used by Paliyar tribe from Tamil Nadu, India. *BMC Complementary and Alternative Medicine, 6*, 35–41.
8. Parekh, J., & Chanda, S. V. (2007). In vitro antimicrobial activity and phytochemical analysis of some Indian medicinal plants. *Turkish Journal of Biology, 31*, 53–58.
9. Grubben, G. J., & Denton, O. A. (2004). *Plant resources of tropical Africa 2: Vegetables*. PROTA Foundation, Wageningen, Netherlands; Backhuys Publishers, Leiden; CTA.
10. Singh, L., Yadav, N., Kumar, A. R., Gupta, A. K., Chacko, J., Parvin, K., & Tripathi, U. (2007). Preparation of value-added products from dehydrated bathua leaves (*Chenopodium album* L.). *Natural Product Radiance, 6*, 6–10.
11. Webster, D., Taschereau, P., Belland, R. J., Sand, C., & Rennie, R. P. (2008). Antifungal activity of medicinal plant extracts: Preliminary screening studies. *Journal of Ethnopharmacology, 115*, 140–146.
12. Gawlik-Dziki, U., Swieca, M., Sulkowski, M., Dziki, D., Baraniak, B., & Czyz, J. (2013). Antioxidant and anticancer activities of *Chenopodium quinoa* leaves extracts: In vitro study. *Food and Chemical Toxicology, 57*, 154–160.

13. Brahima, M. A. S., Fadlib, M., Hassanib, L., Boulayc, B., Markouka, M., Bekkouchea, K., Abbada, A., Alid, M. A., & Larhsinia, M. (2015). *Chenopodium ambrosioides* var. *ambrosioides* used in Moroccan traditional medicine can enhance the antimicrobial activity of conventional antibiotics. *Industrial Crops and Products, 71*, 37–43.
14. Korcan, S. E., Aksoy, O., Erdogmus, S. F., Cigerci, I. H., & Konuk, M. (2013). Evaluation of antibacterial, antioxidant and DNA protective capacity of *C. album* ethanolic leaf extract. *Chemosphere, 90*, 374–379.
15. Jangir, O. P., Kumar, V., Gurnani, C., & Mukhija, S. (2016). Antagonistic effects of *Chenopodium album* against pathogenic microbes in Northern Rajasthan. *World Journal of Pharmacy and Pharmaceutical Sciences, 5*, 833–841.
16. 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, 11*(2), 12–19. https://doi.org/10.5281/zenodo.15533475
17. 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, 11*(4), 84–93. https://doi.org/10.5281/zenodo.15780100
18. 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 Y. Rakholiya, T. Kumar, B. K. Das, & A. R. Sahu (Eds.), *Multidimensional Research Perspectives in Life Science* (Chap. 11, pp. 92–102). ISBN: 978-93-48620-76-7.
19. Nayak, N. R., Pattnayak, A., & Sahu, A. R. (2024). Screening for phytochemicals, antimicrobial and anticoagulant activity of aqueous extract of *Tridax procumbens*. In M. P. Srivastava, M. A. Bangar, D. Chachad, & A. R. Kumar (Eds.), *Research and Reviews in Plant Sciences* (Vol. II, pp. 115–126). Bhumi Publishing.
20. 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 A. R. Sahu (Ed.), *Science and Technology for Sustainable Future* (Vol. II, Chap. 5, pp. 73–82). ISBN: 978-81-979987-8-2.
21. 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 E. Hossain, C. B. Roy, N. Jena, & S. Kumar (Eds.), *Plants and Secondary Metabolites* (Vol. IV, Chap. 6, pp. 52–62). Ambica Prasad Research Foundation.
22. Sahu, A. R., Sahu, B. K., Jogdand, S. K., Singh, G., Kumar, S., & Agrahari, D. (2025). Phytochemical analysis and antioxidant activity of *Ottochloa nodosa* (Poaceae). In *Pharmacologically Important Grass Species* (Vol. 1, pp. 10–17). ISBN: 978-81-989192-8-1. https://doi.org/10.5281/zenodo.17189680
23. 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 A. R. Sahu (Ed.), *Science and Technology for Sustainable Future* (Vol. II, Chap. 10, pp. 140–149). ISBN: 978-81-979987-8-2.
24. 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.

25. 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, 11*(8), 48–58. https://doi.org/10.5281/zenodo.17445853

26. 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 D. Chachad, S. Mishra, P. Mahishi, & A. R. Sahu (Eds.), *Research and Reviews in Plant Sciences* (Vol. IV, pp. 72–80). Bhumi Publishing.

27. Sahu, A. R. (2026). Assessment of morphological, phytochemical, and nutritional profiling of two underutilized leafy vegetables *Basella* sp. *Journal of Science Research International, 12*(1), 7–15. https://doi.org/10.5281/zenodo.18466544

28. Sahu, R., Mahapatra, S., & Sahu, A. R. (2025). Ethnomedicinal exploration and phytochemical screening of selected spices used by the natives of Bargarh district, Western Odisha, India. *Journal of Science Research International, 11*(1), 84–95. https://doi.org/10.5281/zenodo.15119052