**Phytochemical Profiling and Antioxidant Potential of *Pseudognaphalium luteoalbum* (Phunil) A Wild Edible Plant Found in Manipur**

**Abstract**

The present study investigates the phytochemical composition and antioxidant properties of *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt, commonly known as Phunil in Manipur. The aerial parts of the plant, including stems, leaves, pre-mature and mature seeds, and fruits, were assessed for their biochemical constituents, moisture content, antioxidant activity, and phytochemical composition using standard analytical techniques. The study revealed significant amounts of alkaloids (4.8 mg/g fresh weight), total soluble sugars (12.996 ± 0.179 µg/g fresh weight), total flavonoids (17.310 ± 0.0918 mg/g dry weight), total soluble proteins (140.97 ± 23.98 µg/g fresh weight), and total phenolics (49.926 ± 3.627 µg/g fresh weight). Antioxidant analysis indicated an inhibition concentration (IC50) of 11.579 µg/g dry weight, suggesting strong radical scavenging potential. The high antioxidant content and presence of bioactive compounds suggest that *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt could serve as a valuable natural source of antioxidants with potential applications in both the food and pharmaceutical industries.

**Keywords**

Antioxidant activity, Phytochemical composition, *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt, Traditional medicine, Manipur, Free radical scavenging.

**1. Introduction**

**1.1 Background and Importance of the Study**

Medicinal plants have been an integral part of traditional healthcare systems across various cultures. In biodiversity-rich regions like Manipur, numerous plant species are widely used for their therapeutic properties. *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt (Phunil), a perennial herb belonging to the Asteraceae family, has garnered attention for its medicinal benefits (Hussain et al., 2012; Kang et al., 2020).

The plant is used in ethnomedicine to treat wounds, infections, digestive disorders, and respiratory ailments (Tumen et al., 2010). It is particularly valued for its high antioxidant content, which plays a crucial role in neutralizing free radicals responsible for oxidative stress, one of the primary contributors to chronic diseases, including cancer, cardiovascular disorders, and neurodegenerative conditions (Prior et al., 2005).

The presence of bioactive compounds such as flavonoids, alkaloids, phenolics, and terpenoids in *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt has been associated with significant anti-inflammatory, antimicrobial, and anticancer activities (Gupta et al., 2020; Rani et al., 2022). Given these attributes, investigating its phytochemical composition and antioxidant activity is crucial for validating its medicinal potential and exploring its applications in pharmaceuticals and nutraceuticals.

**1.2 Distribution and Habitat**

*Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burttthrives in cold climatic conditions, typically at altitudes ranging from 1,500 to 3,500 meters above sea level. The plant is commonly found in the Himalayan foothills and grows in well-drained, nutrient-rich soils. It is well adapted to seasonal variations, including prolonged periods of low temperatures and moderate precipitation (Talapatra and Roy, 1980).

In Manipur, the plant is found in hilly terrains and semi-forested areas, where it is used extensively by indigenous communities for its medicinal benefits. The fresh leaves are often consumed as a vegetable to enhance appetite and aid digestion, while crushed plant material is applied externally to treat wounds and inflammation (Tanaka and Ke, 2007; Sharma and Devi, 2015).

The primary objectives of this study are to analyze the phytochemical composition and total antioxidant capacity of *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt are using standard analytical techniques.

**2. Materials and Methods**

**2.1 Study Area**

This study was conducted at the Plant Physiology Laboratory, Department of Life Sciences (Botany), Manipur University, India (23º.80′ N to 25º.68′ N and 93º.03′ E to 94º.78′ E). The plant samples were collected in March 2024 from the University Campus, Canchipur, in Imphal West District, Manipur.

**2.2 Sample Collection and Processing**

Fresh aerial parts of *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt(leaves, stems, pre-mature and mature seeds, and fruits) were collected, cleaned with distilled water, and air-dried at room temperature. The dried plant material was ground into a fine powder and stored for biochemical and antioxidant analysis.

 

(a) (b)

Figure1. (a) Vegetative stage (b) Flowering stage of *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt (Phunil).

**2.4 Biochemical Analysis**

A series of biochemical assays were performed to evaluate the nutrient and bioactive compound composition of *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt. Each analysis was conducted in triplicate, and the mean values were used for interpretation. The results provide insights into the plant’s phytochemical profile, antioxidant potential, and nutritional importance.

**2.4.1 Total Soluble Sugars**

Total soluble sugars were estimated using the anthrone method (Hedge & Hofreiter, 1962). The presence of soluble sugars is an essential factor in assessing the plant’s metabolic activities, as sugars serve as energy reservoirs and precursors for secondary metabolite synthesis. The assay involved treating the plant extract with anthrone reagent under acidic conditions, leading to the formation of a green-colored complex, which was quantified spectrophotometrically at 620 nm.

**2.4.2 Soluble Proteins**

Protein estimation was performed using Lowry’s method (Lowry et al., 1951). Proteins are vital macromolecules that participate in enzymatic reactions, structural functions, and metabolic pathways. The total soluble protein content in the plant extracts was determined by reacting the sample with the Folin–Ciocalteu reagent, leading to a colorimetric reaction that was read at 750 nm.

**2.4.3 Total Phenolic Content (TPC)**

Phenolic compounds are potent antioxidants known to protect cells from oxidative damage by scavenging free radicals. Total phenolic content (TPC) was determined using the Folin-Ciocalteu reagent (Bray & Thorpe, 1954). The plant extract was mixed with the reagent, and sodium carbonate was added to initiate the reaction. The absorbance was measured at 765 nm using gallic acid as the standard.

**2.4.4 Total Alkaloid Content**

Alkaloids, a diverse group of nitrogen-containing compounds, have significant pharmacological properties, including antimicrobial, anti-inflammatory, and anticancer activities. Alkaloid content was estimated using the gravimetric method (Obadoni & Ochuko, 2001), where the sample was treated with dilute hydrochloric acid and precipitated using ammonium hydroxide. The dried precipitate weight was recorded to determine the alkaloid content.

**2.4.5 Total Flavonoid Content (TFC)**

Flavonoids are polyphenolic compounds that contribute to antioxidant activity, UV protection, and plant pigmentation. The total flavonoid content was assessed using the aluminum chloride colorimetric method (Chang et al., 2002). The absorbance of the reaction mixture was measured at 415 nm, and the results were expressed in terms of quercetin equivalents.

**2.4.6 Antioxidant Activity (DPPH Assay)**

Antioxidant activity was determined using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay (Brand-William et al., 1995; Kulisic et al., 2004). The ability of the plant extract to donate electrons and neutralize DPPH radicals was measured spectrophotometrically at 517 nm. The percentage of DPPH inhibition was calculated, and the IC50 value (the concentration required to inhibit 50% of free radicals) was determined. A lower IC50 value indicates stronger antioxidant potential.

**3. Statistical analysis**

The experimental data were analysed statistically by followingthe standard procedure outlined by Gomez and Gomez (1984), and the values were furnished in the form of standard error and standard deviations.

**4. Results and Discussion**

The phytochemical and antioxidant analysis of *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt (Phunil) provided insights into the plant’s biochemical profile and its potential medicinal value.

**4.1 Moisture Content**

Table 1: Results of percentage water content in *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. BurttHook. based on fresh weight and dry weight.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl.no.** | **Content** | **% water content** | **Standard error** | **Standard deviation** |
| 1. | % Water content (fresh weight basis) | 83.48 | 0.79 | 1.58 |
| 2. | % Water content (dry weight basis) | 507.62 | 60.035 | 30.018 |

Moisture content is a crucial indicator of a plant’s metabolic state and shelf life. Studies have reported that *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt exhibits high moisture levels (Table.1), suggesting substantial water retention, which may influence its enzymatic activities and shelf stability. High moisture content is a characteristic of many medicinal plants, as noted by Kader (2005), who emphasized that water content plays a crucial role in the post-harvest physiology of medicinal plants, affecting their longevity and biochemical composition. Additionally, Ghasemzadeh et al. (2016) highlighted that moisture levels significantly impact the concentration of bioactive compounds, influencing both antioxidant potential and pharmacological efficacy.

**4.2 Chlorophyll Content**

Chlorophyll is essential for photosynthesis, and its concentration provides insights into the plant’s photosynthetic efficiency.

Table 2: Results of Chlorophyll a, Chlorophyll b, and total chlorophyll in µg/g fr. wt. for *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt*.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl.no.** | **Component** | **Concentration (µg/g fresh weight)** | **Standard deviation (mean)** |
| 1. | Chlorophyll a | 0.393 ± 0.005 | 0.009 |
| 2. | Chlorophyll b | 0.159 ± 0.005 | 0.009 |
| 3. | Total Chlorophyll | 0.549 ± 0.009 | 0.016 |

The relatively low chlorophyll content (Table 2) suggests that the plant may not be highly photosynthetically active or may undergo seasonal variations in chlorophyll synthesis. The ratio of chlorophyll a to chlorophyll b (approximately 2.47:1) indicates a predominance of photosystem II, which is crucial for light absorption and energy transfer. Studies on other medicinal plants have reported varying chlorophyll contents. For instance, Kadam et al. (2013) found that *Sesbania exaltata* exhibited chlorophyll a levels ranging from 2.98 to 3.36 mg/g fresh weight and chlorophyll b levels from 2.61 to 3.08 mg/g fresh weight, depending on the season. Similarly, Kulkarni and Gaherwar (2018) reported that *Azadirachta indica* had a total chlorophyll content of 3.206 mg/g fresh weight. These comparisons highlight the variability in chlorophyll content among different species and underscore the need for further research on *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt.

**4.3 Biochemical Composition**

The plant demonstrates a rich biochemical profile, confirming its potential as a nutraceutical and medicinal plant.

Table 3: Results of the quantitative value for soluble protein, total soluble sugar, and total phenols in µg/g fr. wt. for *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt.

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl.no.** | **Component** | **Concentration (µg/g fresh wt.)** | **Standard deviation (mean)** |
| 1. | Soluble Protein | 140.97 ± 23.98 | 41.54 |
| 2. | Total Soluble Sugar | 12.996 ± 0.179 | 0.311 |
| 3. | Total Phenolics | 49.926 ± 3.627 | 6.282 |

High protein levels (140.97 ± 23.98 µg/g fresh wt.) suggest that the plant may have enzymatic or structural functions contributing to its growth and defence mechanisms. Phenolic compounds, known for their antioxidant properties, were found to be significantly high, further supporting the plant’s medicinal value. According to Al-Snafi (2019), the phytochemical screening of *Gnaphalium luteoalbum* revealed the presence of alkaloids, carbohydrates, phenols, flavonoids, saponins, tannins, glucoside resins, phytosterols, terpenoids, and fixed oils.

**4.4 Alkaloids and Flavonoids**

Table 4: Results of the quantitative value for total alkaloids and total flavonoids for *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burttin mg/g fr.wt.

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl.no.** | **Component** | **Concentration (mg/g fresh wt.)** | **Standard deviation (mean)** |
| 1. | Total Alkaloids | 4.8 | 0.311 |
| 2. | Total Flavonoids | 17.310 ± 0.0918 | 6.282 |

The substantial alkaloid content aligns with traditional medicinal uses of *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt, as alkaloids are known for their antimicrobial and neuroprotective effects. Flavonoids, which contribute to UV protection and antioxidant activity, were found in significant amounts, reinforcing the plant’s potential for pharmaceutical applications. Wang et al. (2024) highlighted that plants in the genus *Gnaphalium* have been used for treating various diseases, including pain and rheumatism, and possess bioactive compounds such as flavonoids and phenolic acids.

**4.5 Antioxidant Activity**

Table 5: Results of the quantitative value for antioxidant activity for *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burtt in µg/g dry wt.

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| IC50 (DPPH Assay) | 11.579 µg/g dry wt. |

Antioxidant assays revealed significant free radical scavenging properties. The low IC50 value (11.579 µg/g dry wt.) suggests strong antioxidant activity, comparable to well-known medicinal plants. This indicates that *Pseudognaphalium luteoalbum* can be an effective natural antioxidant source, potentially useful in preventing oxidative stress-related diseases such as cancer, cardiovascular disorders, and neurodegenerative conditions. A study by Aderogba et al. (2014) demonstrated the antifungal activity of *Pseudognaphalium luteoalbum* leaf acetone extracts and purified compounds, indicating its potential as a source of biologically active compounds.

Figure 2: Graphical representation of % inhibition for *Pseudognaphalium luteoalbum* (L.) Hilliard and B.L. Burtt

**4.6 Comparative Analysis with Other Medicinal Plants**

To further assess the significance of the obtained results, a comparison was made with other medicinal plants known for their antioxidant properties.

Table 6: Comparative Analysis of *Pseudognaphalium luteoalbum* (L.) Hilliard and B.L. Burtt

with Other Medicinal Plants for total phenolics, total flavonoids, and antioxidant activity.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl. no** | **Plant Species** | **Total Phenolics (µg/g)** | **Total Flavonoids (mg/g)** | **IC50 (DPPH)** |
| 1. | *Pseudognaphalium luteoalbum* (L.) Hilliard and B.L. Burtt  | 49.926 ± 3.627 | 17.310 ± 0.0918 | 11.579 µg/g |
| 2. | Curcuma longa (Turmeric) | 45.62 ± 2.91 | 15.75 ± 0.82 | 14.3 µg/g |
| 3. | Azadirachta indica (Neem) | 52.38 ± 4.12 | 18.62 ± 0.76 | 10.95 µg/g |

The data indicate that *Pseudognaphalium luteoalbum* (L.) Hilliard and B.L. Burt exhibit antioxidant activity comparable to that of turmeric and neem, two widely recognized medicinal plants. The findings align with previous studies by Ghasemzadeh et al. (2016), who analyzed the phytochemical composition of *Curcuma longa*, and Hussain et al. (2012), who reported the antioxidant potential of *Azadirachta indica*. These comparisons further validate the medicinal significance of *Pseudognaphalium luteoalbum* (L.) Hilliard and B.L. Burtt as a potent natural antioxidant source. Additionally, according to Wang et al. (2024), the *Gnaphalium* genus possesses various therapeutic properties, including antioxidant activity, which supports the findings of this study.

**4.7 Significance of the Findings**

The high levels of phenolics, flavonoids, and alkaloids, along with potent antioxidant activity, support the traditional uses of *Pseudognaphalium luteoalbum* (L.) Hilliard and B.L. Burtt (Phunil). These findings suggest that the plant could be further investigated for developing herbal medicines, dietary supplements, and functional foods. The presence of bioactive compounds such as flavonoids and phenolic acids, as highlighted by Wang et al. (2024), underscores the plant’s potential in pharmaceutical applications.

**5. Conclusion**

The present study highlights the phytochemical and antioxidant potential of *Pseudognaphalium luteoalbum* (L.) Hilliard and B.L. Burtt (Phunil)confirm its value as a medicinal and nutraceutical plant. The high levels of phenolics, flavonoids, and alkaloids, combined with strong antioxidant activity, support its traditional medicinal uses and suggest its potential application in herbal medicines, dietary supplements, and functional foods. Given the increasing demand for plant-based antioxidants in the pharmaceutical and food industries, this study provides a strong foundation for further exploration of *Pseudognaphalium luteoalbum* (L.) Hilliard and B.L. Burtt are valuable medicinal resources.

**Disclaimer (Artificial intelligence)**

NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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