Phytochemical Profiling of Ten Different Leafy Wild Vegetables from Bhandara District

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ABSTRACT

Wild vegetables have been an integral part of traditional diets and medicine in various regions due to their rich nutritional and medicinal properties. In rural communities, these plants are not only consumed for their sustenance but are also used as remedies for various ailments such as diabetes, cancer, and heart conditions. Beyond their macronutrient content, wild vegetables are particularly valued for their bioactive compounds, including phenols, tannins, saponins, alkaloids, flavonoids, and steroids. These secondary metabolites have been widely studied for their potential health benefits. The present study focuses on the phytochemical analysis of 10 different species (*Bauhinia purpurea , Chenopodium album, Portula quadrifolia, Celosia argente, Oxalis corniculata, Launaea procumbens, Commelina benghalensis, Amranthus cruentus, Hibiscus cannabinus* and *Olax scandens*) of uncultivated, wild and traditional vegetables available in certain areas of Bhandara district (Maharashtra) during the rainy season. These wild vegetables are a cheap and excellent source of nutrients such as proteins, carbohydrates, iron, essential minerals and other secondary metabolites and used to treat various diseases such as diabetes, constipation, urinary tract diseases, heart diseases and cancer. The phytochemical analysis of extracts from these ten vegetables reveals the presence of phytochemicals such as phenols, tannins, saponins, alkaloids, flavonoids and steroids. Such analysis is commercially very important and is of great interest to pharmaceutical companies for the production of new drugs for treatment of various diseases.

Keywords: Wild Vegetables, Bhandara District, Phytochemicals, Health Benefits

INTRODUCTION

Bhandara district is located in the state of Maharashtra and is part of the Vidarbha region. It lies on the eastern side of Maharashtra and is bordered by Nagpur district to the west and Gondia district to the east. Geographically, Bhandara is situated at approximately 21°09′ N latitude and 79°42′ E

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longitude. The district is positioned at an average altitude of around 244 m above sea level.

Bhandara is known for its diverse terrain, which includes fertile plains, forests, and several water bodies such as lakes and rivers, contributing to its rich agricultural landscape. The district experiences a tropical climate, with a distinct rainy season, where temperatures range from 16 °C to 38 °C. Bhandara's proximity to the Wainganga River and the dense forests of the adjoining regions enhances its natural beauty and provides a habitat for various wildlife species [1].

Wild vegetables are an essential part of the traditional diet of indigenous communities around the world, including India [2]. These plants are vital to rural populations, who often rely on locally available flora for food, medicine and protection. Even in the most remote regions, people continue to rely on these natural resources [3]. Many edible wild vegetables have medicinal properties and can help with common health problems thanks to their rich phytochemical content [4]. The phytochemical compounds were studied using aqueous and methanolic extracts of ten different leafy vegetables collected during the rainy season from different areas of Bhandara district (Maharashtra). The phytochemical compounds such as phenol, tannins, saponin, alkaloid, flavonoids and steroids were studied in these vegetables using standard methods.

Figure 1. Wild vegetables, 1) *Bauhinia purpurea* 2) *Chenopodium album* 3) *Portula quadrifolia* 4) *Celosia argentea* 5) *Oxalis corniculata* 6) *Launaea procumbens* 7) *Commelina benghalensis* 8) *Amranthus cruentus* 9) *Hibiscus cannabinus* 10) *Olax scandens*

In this study, the following leafy wild vegetables were analyzed for the screening of phytochemical compounds: 1) *Bauhinia purpurea* (Caesalpiniaceae) Koilari, 2) *Chenopodium album* (Amaranthaceae) Awali dhawli, 3) *Portula quadrifolia* (Portulacaceae) Cheur bhaji 4) *Celosia argentea* (Amaranthaceae) kurdu, tandulka 5) *Oxalis corniculata* (Oxalidaceae) Ambatchuka 6) *Launaea procumbens* (Asteraceae) Pathari 7) *Commelina benghalensis* (Commelinaceae) Kena 8) *Amranthus cruentus* (amaranthaceae) Red Amaranth 9) *Hibiscus cannabinus* (Malvaceae) Ambadi 10) *Olax scandens* (Olaceae) Aratfari.

MATERIALS AND METHODS

All plant samples (Table 1) were collected from the local fields of Sodipur, Khapa, Chikhali, Mohadi, Bapera, and Tumsar, in Bhandara district (Maharashtra) in a single round of sampling between August 2022 and October 2023.

Chemicals

Folin-Ciocalteu's Phenol reagent (LOBA Chem), Sodium carbonate (LOBA Chem), Gallic acid (LOBA Chem), Aluminium chloride (LOBA Chem), Ethanol (KR), Quercitin (TCI), potassium acetate (LOBA Chem), Sodium Chloride (LOBA Chem), Biuret reagent, Tannic acid (Oxford lab), Folin-Denis reagent (LOBA Chem), Distilled water, Rutin, Bromocresol green, Hydrochloric acid (Somar chem), Ammonium hydroxide (LOBA Chem), Chloroform (LOBA Chem), Methyl orange (Oxford lab), Fehling A and Fehling B reagents (LOBA Chem), Benedict's reagent (LOBA Chem), Molisch's reagent (LOBA Chem), Millon's reagent (LOBA Chem), Ferric chloride (LOBA Chem), and Sodium Hydroxide (LOBA Chem).

Sample preparation

The reflux method of extraction is one the efficient conventional techniques. In this process, there is no loss of solvent. The reflux method involves the condensation of vapours, followed by transferring the resulting condensate back into the original system. The extraction process for these dried and crushed samples was carried as follows: A mixture of 100 mL of each solvent (methanol (LOBA Chem), and water was added to 10 g of dried sample in a round bottom flask. The mixture was stirred carefully. The extraction mixture was refluxed for 90 mins. Each extraction was repeated 2 times with both solvents to get an approximate value. The above procedures were carried out in the flasks covered with platinum foil and kept away from sunlight. The extracts were filtered using Whatman filter paper No. 1. Then, the resultant filtrate was fractionated with petroleum ether by simply shaking it with solvents in a separating funnel. Two immiscible layer were formed, namely, upper petroleum ether and lower methanol layer. Methanol layer was collected and kept for drying in a water bath at temperatures below 60 °C. The dried material were then measured and stored in a desiccator for further analyses.

Phytochemical analysis

The phytochemical tests were carried out as follows [5]:

1. Alkaloids: the crude extract was mixed with 2 mL of 1% HCl and slightly heated. Mayer's and Wagner's reagents (LOBA Chem) were then added to the mixture. The turbidity of the resulting precipitate confirmed the presence of alkaloids.

2. Flavonoids: To the aqueous or methanolic extract, 5 mL of 95% ethanol (LOBA Chem), a few drops of conc. HCl (LOBA Chem) and 0.5 g of magnesium filings were added. A pink to red colour was observed.

3. Saponin: The crude extract was mixed with 5 mL of distilled water in a test tube and shaken vigorously. The formation of a stable foam indicated the presence of saponin.

4. Phenols: The extract was mixed with 2 mL of a 2% solution of FeCl3 (LOBA Chem). A blue-green or black coloration indicates the presence of phenols.

5. Steroids: The sample was extracted with 2 mL of chloroform (LOBA Chem). Subsequently, 2 mL each of concentrated H2SO4 and acetic acid (LOBA Chem) were poured into the mixture. After vigorous shaking, the chloroform layer (LOBA Chem) shows a fluorescent green colour, indicating the presence of steroids.

6. Tannin: One gram of fruit extract was mixed with 100 mL of distilled water, boiled, cooled and filtered. 1% ferric chloride was then added dropwise to the filtrate. The green-black precipitate indicates the presence of tannin.

RESULTS AND DISCUSSION

Phytochemical analysis of extracts from ten wild leafy vegetables shows the presence of bioactive compounds with known medicinal properties and physiological activities [5]. The aim of the screening was to identify the most important phytochemicals, including phenols, tannins, saponins, alkaloids and flavonoids. The results of the six phytochemical tests are summarized in Table 1 and show both positive and negative results for all ten plant extracts.

Table 1. Phytochemical analysis of secondary metabolites

Name of the Species	Steroid		Phenol		Saponin		Alkaloid		Flavonoid		Tanin	
	A	M	A	M	A	M	A	M	A	M	A	M
Bauhinia purpurea	-	+	+	+	+	+	+	+	+	+	+	+
Chenopodium album	-	+	+	+	+	+	+	+	+	+	+	+
Portula quadrifolia	-	+	+	+	+	+	+	+	+	+	-	+
Celosia argentea	-	+	+	+	+	+	+	+	+	+	+	+
Oxalis corniculata	-	+	+	+	+	+	+	+	+	+	-	+
Launaea procumbens	-	+	+	+	-	+	+	+	+	+	+	+
Commelina benghalensis	-	+	-	+	+	+	+	+	+	+	+	+
Amranthus cruentus	-	+	+	+	+	+	+	+	+	+	+	+
Hibiscus cannabinus	-	+	+	+	-	+	+	+	+	+	+	+
Olax scandens	-	+	+	+	+	+	+	+	+	+	+	+

A. Aqueous extract, M. Methanol extract, + Present, - Absent

The inclusion of plants in drug development is becoming increasingly important due to the wealth of bioactive compounds they offer [6]. Phytochemicals such as phytosterols, phenols, saponins, alkaloids, flavonoids, and tannins found in wild leafy vegetables have shown significant pharmacological potential. These compounds, often extracted from plants using solvents such as methanol and water, exhibit diverse health benefits that make them valuable in the development of future pharmaceuticals.

Phytosterols are steroid compounds found in plants that are similar in structure and function to cholesterol. Plant sterols are an essential component of various animal and human organisms [7]. Phytosterols may have health benefits in animals and humans, such as heart disease, colon cancer, breast cancer [8], stomach cancer [9], obesity [10] and heart attack [11]. In this study, the selected leaf vegetable extracts contain steroids in the methanol extract, while they are not present in the aqueous extract. Steroids are generally non-polar or only slightly polar molecules and they tend to dissolve better in non-polar or less polar solvents such as methanol. Aqueous extracts, being polar due to the water content, are less effective at dissolving non-polar compounds such as steroids [12].

Phenols are a widely distributed group of plant metabolites [13]. In this study, most of the selected leafy vegetables contained phenolic compounds in both extracts with the exception of *C. benghalensis*. These solvents are effective in extracting phenol from plant tissues because they break down plant cell walls, releasing the compounds. Some phenolic compounds in *C. benghalensis* might have structural variations that affect their solubility in these solvents, making them harder to extract [14]. Phenolics are known for their pharmacological properties, including anti-apoptosis, anti-carcinogenicity, anti-inflammation, anti-ageing, anti-atherosclerosis, inhibition of angiogenesis, cell proliferation, and protection of the cardiovascular system [15]. Most of the selected leafy vegetables in this study contained phenolic compounds, supporting their potential in drug development for diseases involving oxidative stress and inflammation.

The presence of saponins was detected in both extracts of *Bauhinia purpurea, Chenopodium album, Portula quadrifolia , Celosia argentea, Oxalis corniculata, Commelina benghalensis, Amaranthus cruentus,* and *Olax scandens*. Saponins are known for their therapeutic applications, including stopping bleeding, promoting wound and ulcer healing, and aiding red blood cell clotting [16]. In addition, saponins possess anti-inflammatory properties, bind cholesterol, exhibit hemolytic effect, contribute to bitterness [17,18], and exhibit antibacterial effects [19]. The ability of saponins in wild vegetables to bind cholesterol and exhibit hemolytic activity also positions them as promising candidates in the development of cardiovascular and wound care drugs.

Alkaloids are known for their significant medicinal properties, such as cytotoxicity [20], analgesic activity [21], antispasmodic activity [22], and antibacterial properties [22]. All selected leaf vegetable extracts show the presence of alkaloid compounds, which are chemical substances containing basic nitrogen atoms. These alkaloids are produced by a number of organisms, including bacteria, fungi, plants and animals [23]. Given wild vegetables potent bioactivity, are critical in cancer treatment, pain management, and microbial infection control.

Flavonoids, a group of plant metabolites, play a crucial role in cell signaling pathways and exhibit strong antioxidant activity.

All selected leafy vegetable extracts were found to contain flavonoid compounds, which are a key group of natural antibiotics. These compounds are essential for plant defense mechanisms against various microbes [24]. The presence of flavonoids has been associated with various pharmacological activities, including antimicrobial [25], antioxidant [26] and anticancer properties [17,27]. Flavonoids help in preventing cell damage, making them valuable in drug formulations aimed at reducing oxidative stress and inflammation [28].

In addition, the selected leaf vegetable extracts, with the exception of *Portula quadrifolia*, tested positive for tannins, which are large polyphenolic secondary compounds involved in protein synthesis. Tannins have sufficient hydroxyl and other functional groups to form strong complexes with macromolecules. Their presence has been associated with various medicinal uses, including as an astringent for diarrhoea [29], acting as a diuretic [30,31], and being used in the treatment of duodenal tumors [32]. Additionally, they are known for their anti-inflammatory, antiseptic, and hemostatic purposes [33].

Mokganya et al. [4] noted that the consumption of leafy vegetables is closely linked to the traditions and dietary habits of different ethnic and socioeconomic groups. Agrawal et al. [34] confirmed that the consumption of *Bauhinia purpurea* leaves has been associated with a reduced risk of cancer. On the other hand, pharmacological studies conducted by [35] on this plant showed a number of many bioactive compounds including terpenes, tannins, essential oils amino acids and ascorbic acid that aid in the remedial of antibacterial, antidiabetic, analgesic, anti-inflammatory, anti-diarrheal, anticancerous, nephroprotective and thyroid hormone regulating activity. Similar to *Bauhinia purpurea*, all the mentioned wild vegetables in this study contains bioactive compounds and exhibit pharmacological properties. The results of this study suggest that the phytochemical compounds identified are likely to be bioactive constituents, making these plants an increasingly valuable source of medicinally significant compounds [36,37].

CONCLUSION

The analysis confirms that the ten selected leafy vegetable extracts contain a range of phytochemical compounds with significant bioactive properties. These compounds represent a valuable reservoir of therapeutic potential. Consequently, the extracts from these leafy vegetables could serve as promising sources for developing useful pharmaceuticals. The bioactive phytochemicals found in these wild vegetables highlight their significant potential in future drug development. These plants, which are abundant in diverse phytochemicals, could be a valuable resource for discovering new therapeutic agents to treat a wide range of diseases. The study underscores the importance of further research into the medicinal properties of wild plants to unlock their full potential in pharmaceuticals.

CONFLICT OF INTEREST

The author hereby declares no conflict of interest.

CONSENT FOR PUBLICATION

The author declares that the work has consent for publication.

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