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RESEARCH ARTICLE

ANTIOXIDANT EFFICACY OF LEAF PART OF SOME TRADITIONAL MEDICINAL PLANTS

Komal Sudan[1] and Vikas Sharma[1]*

[1]*Natural Products Laboratory, Division of Biochemistry, Faculty of Basic Sciences, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Main Campus Chatha, Jammu-180 009, J&K, India*
Email: vikas.skuast@gmail.com

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Abstract: The traditional medicinal plants have been an integral part of human health care system since ancient times as these plants exhibit pharmacological activities such as antioxidant, anti-inflammatory, antimicrobial and anticancer. The present research work was carried out to examine the phytochemical composition and antioxidant efficiency of four traditional medicinal plants of Jammu region, *viz*., *Bacopa monnieri* (brahmi), *Cannabis sativa* (bhang), *Cordia dichotoma* (lasoda) and *Murraya koenigii* (kadipatta). Methanolic extract of leaf part of the above mentioned plants was used as test material and antioxidant efficiency was assessed *via* three different assays namely DPPH radical scavenging, ferric reducing antioxidant power and metal ion chelation. Results revealed that *Cordia dichotoma* showed maximum phenolic (138.88 ± 0.54 mg GAE/g), flavonoid content (62.91 ± 0.47 mg QE/g) and antioxidant activity *via* FRAP and metal ion chelation assay whereas Brahmi showed highest antioxidant activity *via* DPPH assay followed by lasoda, kadipatta and bhang.

Keywords: Brahmi, Bhang, Lasoda, Kadipatta, Phenolics, Flavonoids, IC_{50}, DPPH, FRAP

INTRODUCTION

Bacopa monnieri, locally known as neer brahmi, jalabuti, jalanima, is a soft-stemmed, semi-succulent perennial herb and the most prominent healing plant recognized in ayurvedic traditions. It is indigenous to countries like India, Bangladesh, Burma and typically grows in wet, marsh-like regions across nations including India, Nepal, Sri Lanka, Vietnam, Taiwan and China. The chemical composition of the plant includes multiple alkaloids such as brahmin, nicotine, herpestine; various saponins like bacosides, hersaponin, betulic acid and compounds like betasitosterol, stigmasterol, stigmastanol. The most recognized neuropharmacological component of the plant is bacoside A, a triterpenoid saponin of the dammarane type (Tamboli *et al*., 2018; Anand *et al*., 2014). The plant possesses antioxidant, antidiarrheal, anti-inflammatory, antibacterial, antifungal, anticancer, anticonvulsant, hepatoprotective, antidepressant, antiulcer, antihyperglycemic, immune-strengthening benefits as well as wound healing activity (Tomar, 2012; Pandey *et al*., 2022).

Cannabis sativa, commonly referred to as bhangi, cheras, jia, is a fast-growing annual herb, originated in central Asia and extensively cultivated across Asia, China and parts of Europe for centuries. The plant is renowned for its cultural / medicinal significance, has been a source of food, fiber, medicine and is even used in religious / recreational contexts. In India, Cannabis has strong spiritual roots as the leaves, often, offered to the Lord Shiva during rituals and continues to hold sacred value (Kuddus *et al*., 2013). It also serves roles as analgesics, antiepileptics, antiemetics and for easing neurological pain (Singh *et al*., 2020). The leaves are used as poultice for treating skin conditions like eczema and are part of traditional medicine for treating hypertension, rheumatoid arthritis, skin itching, severe conditions like cancer, venom-related ailments such as snake, scorpion bites and leaf powder is used for dressing of wounds and sores (Tomar, 2006; Rahmatullah *et al*., 2010; El Khomsi *et al*., 2022). Bhang is known to produce a wide range of bioactive compounds over an estimation of over 550 molecules (Lowe *et al*., 2021). These active components are found in groups such as terpenoids, flavonoids, alkaloids, lignanamides, carotenoids and stilbenoids. Among the flavonoids, luteolin-7-O-glucuronide and apigenin glucuronide are particularly notable flavone glycosides found in bhang (Andre *et al*., 2016; Bautista *et al*., 2021).

Cordia dichotoma, locally referred to as lasura, bhokar, sleshmataka, is a tree species, thriving in tropical and subtropical climates. It is native to regions like India and Nepal. Traditionally, lasoda is often used to address a variety of respiratory and

*Corresponding Author

pulmonary conditions like congestion, colds, hemorrhoids, severe breathing disorders (Jamkhande *et al*., 2013). Lasoda contains various secondary metabolites including alkaloids, flavonoids, tannins, proteins, carbohydrates and phenolic substances. Among these, flavonoids and phenolic compounds are the most prevalent and play a major role in offering strong antioxidant benefits. These phytochemicals are well regarded for their effectiveness in dealing with long-term health issues due to their therapeutic and pharmacological potency (Raghuvanshi *et al*., 2022). The plant is rich in bioactive elements including pyrrolizidine alkaloids, coumarins, terpenes, saponins and sterols. The leaves, fruit, bark, seeds show various therapeutic actions such as anti-inflammatory, antiulcer, analgesic, antidiabetic and immune boosting effects (Jamkhande *et al*.,2013).

Murraya koenigii, commonly known as kari patta, kathnim, kari bevu, is a tropical and sub-tropical tree, native to India, Sri Lanka and several other Asian countries. This plant is well regarded for its distinctive aroma and medicinal value, due to its rich content of bioactive compounds. The plant is used as a calcium supplement for those with deficiencies and also provides essential nutrients like Vitamin A, B, B2, C, iron (Nalli *et al*., 2016). Kadipatta plant contains beneficial phytochemicals such as flavonoids, phenols, saponins, alkaloids, tannins, glycosides, along with essential minerals like calcium, magnesium, sodium, potassium and zinc (Igara *et al*., 2016). The plant also contains phytocompounds such as koenimbine, koenine, mahanimbine, murrayazolidine, murrayazoline, murrayacine, girinimbine and mukoeic acid. The curry leaves are particularly rich in carbazole alkaloids (Tomar, 2024). The different parts of the plant, especially the leaves and roots, offer significant therapeutic benefits and are traditionally used to manage conditions like night blindness, dysentery, diarrhea, vomiting, bites from venomous animals. Due to their aromatic qualities, the leaves are frequently used in curries for seasoning and flavour enhancement (Gahlawat *et al*., 2014). This plant exhibits a broad spectrum of medicinal activities, including phagocytic, neuroprotective, hepatoprotective, antioxidant, antibacterial, antidiabetic, anti-inflammatory, antihypertensive, antifungal, antiprotozoal, antihypercholesterolemic, antiulcer, antidiarrheal and antitumor (Patil *et al*., 2024). In the current investigation, the above mentioned four traditional medicinal plants were evaluated for their antioxidant potential.

MATERIALS AND METHODS

Collection plant material: The plants namely *Bacopa monnieri* (brahmi), *Cannabis sativa* (bhang), *Cordia dichotoma* (lasoda) and *Murraya koenigii* (kadipatta) were authenticated at site and enough quantity of fresh leaves were collected, then the leaf material was shade dried at room temperature and grounded into fine powdered form.

Extract preparation: Powdered dried leaf material of the above mentioned traditional medicinal plants was placed in a percolator of appropriate size. The material was then submerged in 99% (v/v) methanol depending on the need. Standard protocol (Kandil *et al*., 1994) was followed for the extraction of single plant which can easily be employed for each plant. Dried plant material (50 g) was placed in a conical glass flask. Sufficient quantity of solvent was added so as to submerge the plant material. After standing for about overnight, the percolate was collected and filtered if required. The process was repeated four times, which was generally sufficient for exhaustive extraction of the plant material. The methanolic extract was evaporated to dryness under reduced pressure at 60°C using vacuum rotary evaporator and round bottom flask (RBF). The final drying was done in a vacuum desiccator. The dried extract was scrapped off from the RBF and transferred to a tared wide mouth glass container of appropriate size. The container was weighed to calculate the quantity of the extract obtained. This formed the "stock extract" of the plant. Generally, 4 to 5 g crude extract was obtained from 50 g of the dried plant material.

Determination of phenols and flavonoids: Phenols were determined by using Folin-Ciocalteu phenol reagent method (Chang *et al*., 2001) and flavonoids were estimated according to the method described by Marinova *et al*., 2005.

Determination of antioxidant activity: DPPH radical scavenging method was determined using the method of Abe *et al*., 1998. This assay is based on spectrophotometric measures of antioxidant capacity to scavenge DPPH radicals. DPPH is a stable radical with a red color. When it receives a proton from a donor like phenolic compounds, it loses its color and turns yellow, which can be detected at 517 nm with a UV-Visible spectrophotometer.

FRAP (Ferric reducing antioxidant power) was determined according to the method of Benzie and Strain, 1996. FRAP assay is used to measure the antioxidant capacity, which is determined by the reduction of ferric-tripyridyltriazine (Fe^{3+} -TPTZ) to an intense blue color ferrous-tripyridyltriazine complex (Fe^{2+} -TPTZ) with an absorption maximum at 593 nm.

Metal Ion Chelation assay was determined by following the method of Decker and Welch, 1990. The antioxidants present in plant extract forms a coordinate complex with the metal ions (chelating activity) and inhibit the transfer of electrons. Thus, oxidation reaction is arrested and no free radicals are produced, can be detected at 562 nm.

Table 1: Antioxidant activity of some traditional medicinal plants along with total phenolic and flavonoid content

S. No.	Scientific name of the plant	Common name	Part used	Total phenolic content (mg GAE/g)	Total flavonoid content (mg QE/g)	DPPH radical scavenging capacity IC_{50} (µg/ml)	Ferric reducing antioxidant power (µM Fe^{2+} eq./g)	Metal ion chelation (%)
1.	***Bacopa monnieri***	Brahmi	Leaves	102.70 ± 0.92	44.16 ± 1.28	**74.97 ± 0.34**	709.98 ± 0.31	33.52 ± 0.85
2.	***Cordia dichotoma***	Lasoda	Leaves	**138.88 ± 0.54**	**62.91 ± 0.47**	97.08 ± 0.44	**1214.08 ± 0.83**	**35.18 ± 0.65**
3.	***Murraya koeingii***	Kadipatta	Leaves	113.80 ± 1.09	55.83 ± 0.90	102.95 ± 0.65	522.80 ± 0.97	30.72 ± 0.57
4.	***Cannabis sativa***	Bhang	Leaves	97.69 ± 0.76	33.25 ± 1.02	124.97 ± 0.61	367.55 ± 0.83	25.21 ± 0.51

*Data presented as Mean ± S.E. of three replications
Highest activity has been indicated in bold numbers

Fig. 1. *Bacopa monnieri* (Brahmi)

Fig. 2. *Cannabis sativa* (Bhang)

Fig. 3. *Cordia dichotoma* (Lasoda)

Fig. 4. *Murraya koeingii* (Kadipatta)

RESULTS AND DISCUSSION

The results revealed that all the selected medicinal plants exhibited phenol and flavonoid content and varying degrees of antioxidant efficacy. The total phenolic content (TPC) of Brahmi leaves was recorded as 102.70 ± 0.92 mg GAE/g dry weight, while the total flavonoid content (TFC) was found 44.16 ± 1.28 mg QE/g, indicating a rich presence of bioactive phytoconstituents. Brahmi also demonstrated highest antioxidant activity in DPPH assay with IC_{50} value of 74.97 ± 0.34 µg/ml, which reflects a strong free radical quenching ability. The FRAP activity of plant was recorded as 709.98 ± 0.31 µM Fe^{2+} eq./g and metal ion chelation was recorded as 33.52 ± 0.85%. The activity can be attributed to its rich content of bioactive compounds such as bacosides, flavonoids and phenolics, which are known for their strong radical scavenging potential.

Lasoda leaves exhibited highest phenolic (138.88 ± 0.54 mg GAE/g dw) and highest flavonoid content (62.91 ± 0.47mg QE/g) among all the selected plants. The plant also exhibited notable antioxidant activity with an IC_{50} value of 97.08 ± 0.44 µg/ml in DPPH assay and highest activity in FRAP (1214.08 ± 0.83 µM Fe^{2+} eq./g) and metal ion chelation assay (35.18 ± 0.65%). Kadipatta showed considerable antioxidant activity with an IC_{50} value of 102.95 ± 0.65 µg/ml, FRAP activity was found as 522.80 ± 0.97 µM Fe^{2+} eq./g and metal ion chelation was recorded as 30.72 ± 0.57%. The TPC and TFC of this plant was recorded as 113.80 ± 1.09 mg GAE/g dw and 55.83 ± 0.90 mg QE/g, respectively. *Cannabis sativa* displayed the least activity among the tested plants, although it still exhibited measurable antioxidant effects, possibly due to the presence of cannabinoids and other phytoconstituents with known antioxidant properties. The IC_{50} value measured was 124.97 ± 0.61 µg/ml, the FRAP activity was found as 367.55 ± 0.83 µM Fe^{2+} eq./g and metal ion chelation was recorded as 25.51± 0.51%. The total phenolic and flavonoid content was found 97.69 ± 0.76 mg GAE/g dw and 33.25 ± 1.02 mg QE/g, respectively (Table 1).

The data was compared with literature values and it was found that the data was in good agreement with the published data. The antioxidant properties of brahmi were evaluated using the DPPH assay, revealing that methanolic extracts were notably more effective in reducing DNA damage compared to those made with solvents like chloroform, acetone, hexane, ethyl acetate or water. The methanol-based extracts of brahmi demonstrated a dose-dependent ability to neutralize free radicals and guard DNA from oxidative harm (Russo *et al*., 2003). Lasoda seeds and leaves demonstrate considerable antioxidant activity (Singh *et al*., 2010). The methanol and butanol extract of the bark shows strong free radical scavenging activity in DPPH assay and increased ferric reducing capacity in antioxidant power assays (Nariya *et al*., 2013). Murraya is particularly high in total phenolic and flavonoid content, which correlates with its strong antioxidant and antibacterial properties. The plant also exhibits anticancer potential due to its ability to reduce oxidative stress, a major contributor to cancer progression (Abeysinghe *et al*., 2021; Sachan *et al*., 2025). Bhang is known to produce a wide range of bioactive compounds, cannabidiol and tetrahydrocannabinol are two well-studied cannabinoids recognized for their broad medicinal effects including strong antioxidant abilities. Cannabidiol has shown effectiveness in protecting cells from oxidative stress (Atalay *et al*., 2019).

Medicinal plants have strong antioxidant activity and help in treating conditions such as fever, infections, wounds, digestive disorders, respiratory problems and some chronic diseases like diabetes and hypertension. In the current investigation, the antioxidant profiling of medicinal plants confirms their potential in combating oxidative stress and associated health conditions. *Cordia dichotoma* (lasoda) stands out as the most potent source, supporting its traditional acclaim and justifying further research. These results underscore the value of integrating traditional medicinal knowledge with scientific validation to uncover natural health solutions rooted in biodiversity and cultural heritage. To conclude, these medicinal plants are rich reservoir of bioactive compounds that holds great promise for the development of natural and cost-effective therapeutic agents.

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