ABSTRACT

India is well known for its rich biological diversity. It is endowed with the rich wealth of flora and fauna. Many plants contain medicinal properties, which help to cure the diseases which have a severe impact on mankind. Nearly, 3000 medicinal plants were recognized commercially in India. In the present study, the phytochemical properties and the medicinal values of important plants and trees available in India are compared. The significant presence of compounds such as flavonoids, tannins, saponins, alkaloids, glycosides etc present in various sources of aqueous and methanolic extracts like Boerhaavia diffusa, Emblica officinalis, Terminalia chebula, Terminalia bellirica and, Withania sominifera were found by phytochemical screening, which accounts for its various medicinal properties.

KEYWORDS: Boerhaavia diffusa, Emblica officinalis, Terminalia chebula, Terminalia bellirica, Withania sominifera.

INTRODUCTION

Plants that are rich in secondary metabolites, called medicinal plants, are widely used in traditional medicine to combat and cure various ailments.[1] Medicinal plants are a source of naturally active compounds used extensively by tribal people worldwide for many ailments. Phytochemicals are biologically active, naturally occurring organic chemical compounds present in plants and has health benefits for humans than those attributed to macronutrients and micronutrients.[2] Since ancient times, people have been exploring nature particularly plants, in search of new drugs, and this has resulted in the use of a large number of medicinal
plants with curative properties to treat various diseases.\cite{3} Nearly 80% of the world’s population relies on traditional medicines for primary health care, most of which involve the use of plant extracts.\cite{4} In India, almost 95% of the prescriptions have been reported to be plant based in the traditional systems of Unani, Ayurveda, Homeopathy and Siddha.\cite{5}

**Vernacular names**

<table>
<thead>
<tr>
<th>Language</th>
<th><strong>Boerhaavia diffusa</strong></th>
<th><strong>Terminalia chebula</strong></th>
<th><strong>Emblica officinalis</strong></th>
<th><strong>Terminalia bellerica</strong></th>
<th><strong>Whitania sominifera</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>Hogweed</td>
<td>Chebulic myrobalan</td>
<td>Emblica myrobalan</td>
<td>Beleric myrobalan</td>
<td>Winter cherry</td>
</tr>
<tr>
<td>Tamil</td>
<td>Mukkurittaikkoti</td>
<td>Kadukkai</td>
<td>Nellikkai</td>
<td>Tandrikkai</td>
<td>Ammukuram</td>
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<tr>
<td>Hindi</td>
<td>Snathikari</td>
<td>Harara</td>
<td>Amla</td>
<td>Bahera</td>
<td>Ashwagandha</td>
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<tr>
<td>Sanskrit</td>
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<td>Haritaki</td>
<td>Amalaki</td>
<td>Bibhitaki</td>
<td>Ashwagandha</td>
</tr>
<tr>
<td>Telugu</td>
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<td>Amlakamu</td>
<td>Tadi</td>
<td>Vajigandha</td>
</tr>
<tr>
<td>Bengali</td>
<td>Punarnova</td>
<td>Haritaki</td>
<td>Amlaki</td>
<td>Bohera</td>
<td>Kalmegh</td>
</tr>
</tbody>
</table>

**Boerhaavia diffusa**

*Boerhaavia diffusa* is a wild perennial medicinal herb, which belongs to the family *Nyctaginaceae*. It is widely distributed in tropics and subtropics.\cite{6} It is encountered in different terrestrial habitats, ranging from grasslands, wastelands, agro-ecosystems to large forest gaps. It has a thick deep penetrating taproot system which bears few rootlets, brown occasionally. It contains fusiform roots, which are stout, and contains a woody root stock. Stems are often purple in color.

These are creeping, swollen at the nodes and some arises from the root stock. It has a long history of uses by the tribes and in Ayurveda / natural herbal medicine. This plant contains a compound called rotenoids, which are the main constituent of the plant that helps curing of various autoimmune diseases. Diseases like Alzheimer’s disease, Colon cancer, Rheumatic arthritis\cite{7} can be effectively treated using this plant.

**Terminalia chebula**

*Terminalia chebula* medicinal herbs belongs to the family *Combretaceae*, it is found in greater parts of India chiefly in deciduous forest and area of light rainfall – West Bengal, Assam, Bihar, Orrisa, Madhya Pradesh, Maharashtra, Deccan, South India. It is a tree of 15-24 m high and the leaves of these plants are ovate or elliptic with a pair of large glands at the top of the petiole. Flowers are yellowish white in terminal spikes and the seeds are hard pale yellow. It is used as a natural cleanser of the digestive system and for anti-aging activity. It improves the functioning of liver, spleen, colon and the immunity of the body.\cite{8}
**Embilica officinalis**

*Embilica officinalis* is a deciduous tree of the family *Phyllanthaceae*. It is commonly called as Indian Gooseberry. It is found mostly in the parts of the sea-coast districts and on hill slopes upto 200 meters, and is also cultivated in plains.\(^9\) It is abundant in deciduous forests of Madhya Pradesh also grows in tropical and subtropical parts of Ceylon, Malay Peninsula and China.\(^10\) The tree with a crooked trunk is small to medium in size (8 to 18m in height) and spreading branches. The branchlets are glabrous or finely pubescent, 10–20 cm long. The leaves are simple, subsessile and closely set along branchlets, light green, resembling pinnate leaves. The flowers are greenish-yellow. The fruit is nearly spherical, light greenish yellow, quite smooth and hard on appearance, with six vertical stripes or furrows. It possess antiviral and antibacterial properties.

**Terminalia bellirica**

*Terminalia bellirica* is also a deciduous tree, which is grown as an avenue tree which belongs to the family *Noctuidae*. It is found commonly on the plains and lower hills of Southeast Asia. The leaves are crowded towards the end of the branches and it is about 15 cm long. They are large, glabrous, alternate and elliptic. Flowers are solitary, small and greenish white in color. Fruit is ellipsoid and light-yellow in color. It is considered as astringent and laxative.\(^11\)

**Withania somnifera**

*Withania somnifera*, is a xerophytic plant which belongs to the *Solanaceae* or night-shade family.\(^12\) It is cultivated in many parts India, especially in drier areas such as Madhya pradesh, Punjab, Sindh, Gujarat, Rajasthan and Nepal. It is a short shrub growing 35 to 75 centimeters tall and the branches extend radially from a central stem. Small, green flowers are seen. The ripe fruit is orange-red in color. In Unani system of medicine, roots of *Withania somnifera* commonly known as Asgand are used for the medicinal properties. However, leaves of the plant are also reported to be used medicinally. This herb is termed as rasayana in Ayurvedic practice, which means it acts as a tonic for vitality and longevity.

**MATERIALS AND METHODS**

**PLANT SOURCES**

The plants like *Boerhavia diffusa* and *Withania somnifera* were grown in college premises after purchasing seeds from nursery in New Delhi. Leaves and roots were used for examination for estimation of phytochemicals. Whereas, fruits of trees like *Embilica*
officinalis, Terminalia chebula and Terminalia bellirica were collected from the nursery in Bangalore.

**PREPARATION OF PLANT EXTRACT**
The Boerhaavia diffusa, Emblica officinalis, Terminalia chebula, Terminalia bellirica and Withania somnifera grounded plant powder were washed thoroughly and shade dried for a certain period of time. Then, these plants were grounded and made into a powder separately using a blender. 20g of the root powder of each plant was dissolved in 100ml of aqueous and methanol medium separately. After 24 hours, it was filtered using a Whatman no: 1 filter paper. And the extracts were stored separately for the later use.

**PHYTOCHEMICAL TESTING**
The phytochemical analysis for the above 5 plant and tree extracts (aqueous and methanol) were carried out using the standard methods.[13]

1. **Flavonoids**
   a) *Alkaline reagent test*
   2ml of the extract was taken and treated with sodium hydroxide solution. Immediately the appearance of yellow or red color confirms the presence of flavonoids.

2. **Saponins**
   a) *Froth test*
   1ml extract was taken and 20ml of distilled water was added to it. The mixture was shaken for a minute. Presence on the top confirms the presence of saponins.

3. **Proteins**
   a) *Ninhydrin’s test*
   2ml of the extract was taken and few drops of ninhydrin reagent was added to the extract solution and the mixture was heated for some time in a water boiling bath. Appearance of blue color reveals the presence of proteins.

   b) *Lowry’s test*
   2ml of the extract was taken and it was added with 1ml of lowry’s reagent (alkaline copper reagent) and incubated at room temperature for 10mins. Then 1ml of folin phenol reagent was added and again the mixtures were incubated for 30mins. Appearance of blue color complex denotes the presence of proteins.
c) **Bradford’s test**

2ml of the bradford’s reagent was added to 1ml of the extract and it was incubated for 5 minutes at room temperature. Formation of blue color confirms the presence of proteins.

4. **Carbohydrate test**

a) **Molisch’s reagent / Napthol test**

2ml of the extract was taken and 1ml of the Molisch’s reagent was added to it. Then 1ml of concentrated sulfuric acid was added along the sides of the test tube. On the appearance on a violet / purple ring at the junction of 2 liquids confirms the presence of carbohydrates.

b) **Fehling’s test**

2ml of the extract was taken and 1ml of Fehling’s solution A and 1ml of Fehling’s solution B was added to the extract. Then the mixture was boiled in a boiling water bath for 2-3 minutes. Formation of brownish red / yellow precipitate confirms the presence of carbohydrates.

c) **Benedict’s test**

2ml of the extract was taken and few drops of Benedict’s reagent was added to the extract and it was boiled for 2 minutes in the water bath. Later it was allowed to cool. Formation of red, yellow or green color precipitate confirms the presence of carbohydrates.

5. **Quinines**

a) **Sulfuric acid test**

2ml of the extract was taken and 1ml of the concentrated sulfuric acid was added and left undisturbed for few minutes. Development of red color shows the presence of quinines.

6. **Phenols**

a) **Ferric chloride test**

A few drops of ferric chloride was added with few drops of the extract. Appearance of blue-green color denotes the presence of phenols.

7. **Alkaloids**

a) **Wagners reagent test**

2ml of the extract was taken and few drops of Wagners reagent was added to it. Formation of red color indicated the presence of alkaloids.
8. Glycoside

a) Keller Killiani test

Few drops of the extract was dissolved in acetic acid containing few amount of ferric chloride. The sulfuric acid was added to the test tube. At the junction formation of reddish brown color, which turns blue gradually, confirms the presence of glycoside.

9. Isoflavanoids

2ml of the extract was taken and treated with sodium hydroxide solution. Immediately the appearance of yellow or red color can be observed. When a few drops of dil. hydrochloric acid was added, the solution turns colourless. This confirms the presence of isoflavinoids.

RESULTS AND DISCUSSION

The flavonoids are a large group of naturally occurring phenolic compounds found in fruits, vegetables, grains, bark, roots, stems, flowers, tea, and wine. Saponins extracted from plants show biological and pharmacological activities such as anti-inflammatory, anti-hepatotonic, wound healing, veinotonic, expectorant, spasmolytic, hypoglycemic, antimicrobial and antiviral. Alkaloids compose more than 6000 basic nitrogen containing organic compounds, which occur in about 15% of all vascular terrestrial plants and in more than 150 different plant families. Polyphenols act as antioxidants, which protect cells and body chemicals against damage, caused by free radicals and reactive atoms that contribute to tissue damage in the body. Glycosides can suppress and soothe irritant dry coughs. They have a helpful sedative and relaxant effect on the heart and muscles when taken in small doses.

The present work aims at preparing aqueous and methanolic leaves and roots extract of *Boerhaavia diffusa* and *Withania somnifera* and similarly aqueous and methanolic fruits extract of *Terminilia chebula*, *Terminilia bellirica* and *Emblica officinalis*. The extracts are then subjected to various biochemical tests for analyzing the phytochemical constituents present in various sources of the plants and trees. These tests reveal the presence of various bioactive secondary metabolites, which might be responsible for their medicinal attributes. The observations and inference made in the phytochemical tests are presented below. The aqueous and methanolic extract of leaves and roots of *Boerhaavia diffusa* shows the presence of flavonoids, saponins, proteins, carbohydrates, phenols, alkaloids, glycosides and isoflavonoids as similar studies performed in *Boerhaavia coccinea*. *Boerhaavia diffusa* contains rotenoids which have found to have anti-inflammatory, diuretic, fibrinolytic, nephritic syndrome and anti-convulsant activities. The *Boerhaavia diffusa* plant roots are
used to effectively cure several diseases including Jaundice, Dyspepsia, enlargement of spleen, abdominal pain, abdominal tumors and cancers.\textsuperscript{[19]} The root juice is used in the curing of Asthma, Urinary Disorders, Leucorrhoea, Rheumatism and Encephalitis.\textsuperscript{[20]} The root powder is used to treat eye disorders, when mixed with \textit{Thalictrum foliolosum}. The flowers and seeds are used as contraceptive.

The aqueous fruits extract of \textit{Terminilia chebula} shows the presence of flavonoids, saponins, proteins, carbohydrates, phenols, alkaloids, glycosides, isoflavonoids.\textsuperscript{[21]} The methanolic fruits extract contains flavonoids, proteins, carbohydrates, phenols, alkaloids, glycosides and isoflavonoids.\textsuperscript{[21]} The dry nut's peel is used to cure cold-related nagging cough. The fruit has digestive, anti-inflammatory, anthelmintic, cardiotonic, aphrodisiac and restorative properties and is additionally beneficial in flatulence, constipation, piles, cough and cold.

The aqueous fruits extract of \textit{Embilica officinalis} reveals the presence of flavonoids, proteins, carbohydrates, phenols, alkaloids, glycosides and isoflavonoids.\textsuperscript{[22],[23]} Whereas, the methanolic fruits extract of \textit{Embilica officinalis} shows the presence of flavonoids, saponins, proteins, carbohydrates, phenols, alkaloids, glycosides and, isoflavonoids.\textsuperscript{[22]} \textit{Embilica officinalis} is used to induce apoptosis and modify gene expression in rheumatoid arthritis and osteoporosis. It is also used to reduce severity of acute pancreatitis. It shows a potential efficacy against inflammation, cancer, age-related renal disease and diabetes. It is used in the reduction of blood cholesterol level.

The aqueous and methanolic fruits extract of \textit{Terminilia bellirica} reveals the presence of flavonoids, proteins, carbohydrates, phenols, alkaloids, glycosides and, isoflavonoids.\textsuperscript{[24]} The seeds of \textit{Terminalia bellirica} have an oil content of 40%. The pulp of the fruit is considered to be astringent and laxative, which can cure the throat and chest affections. It is sometimes used as an external application to inflamed parts. It is also considered as a fodder for animal.

The aqueous leaves and roots extract of \textit{Withania somnifera} contains flavonoids, proteins, phenols, alkaloids and isoflavonoids.\textsuperscript{[2]} Whereas, the methanolic leaves and roots extract of \textit{Withania somnifera} reveals the presence of flavonoids, saponins, carbohydrates, phenols, alkaloids, glycosides and isoflavonoids.\textsuperscript{[2]} The roots are considered as the main portions of the whole plant, as they possess wide number of therapeutic agents. It stimulates the immune system cells, such as lymphocytes and phagocytes, which also counteract the effects of stress and generally promote wellness.\textsuperscript{[25]} The berries and leaves are applied externally to tumors, tubercular glands, carbuncles, and ulcers. It exhibits greater clinical benefit than
psychotherapy in mental health (anxiety level), concentration, fatigue, social functioning, 
vitality, and overall quality of life. It is considered as aphrodisiac and rejuvenating, anti-
inflammatory and anti tumour agent.

<table>
<thead>
<tr>
<th>TEST</th>
<th>Boerhaavia diffusa</th>
<th>Terminalia chebula</th>
<th>Emblica officinalis</th>
<th>Terminalia bellirica</th>
<th>Withania somnifera</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aqueous Methanol</td>
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<td>Aqueous Methanol</td>
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<td>Aqueous Methanol</td>
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</table>

CONCLUSION

The use of these plants in folk medicine suggests that they represent an economic and safe 
alternative to treat infectious diseases. The curative properties of medicinal plants and trees 
are perhaps due to the presence of various secondary metabolites such as flavonoids, 
saponins, proteins, carbohydrates, quinines, phenols, alkaloids, glycosides, isoflavonoids. 
Thus, the preliminary screening test may be useful in the detection of the bioactive principles 
and subsequently may lead to the drug discovery and development. Thus, these 
phytochemical tests can be used for qualitative and quantitative estimation of 
pharmacologically active chemical compounds.

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