REVIEW ON MEDICINAL AND PHARMACOLOGICAL PROPERTIES OF *IRESINE HERBSTII, CHROZOPHORA ROTTLERI* AND *ECBOLIUM LINNEANUM*

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Abstract

India has a rich tradition of plant-based knowledge on healthcare. A large number of plants/plant extracts/decoctions or pastes are equally used by tribals and folklore traditions in India for treatment of cuts, wounds and burns. The resistance of the microorganism has increased due to the indiscriminate use of commercial antimicrobial drugs commonly used for the treatment of infectious diseases. Resistance to antimicrobial agents has resulted in morbidity, mortality, from treatment failures and increased health care costs. There is an urgent need to discover novel, effective plant-based antimicrobial drug to the increasing problem of drug resistance. This situation forced the scientist to search for new antimicrobial substances from various sources including medicinal plants. *Iresine herbstii*, *Ecbolium linneanum* , *Chrozophora rottleri* have been used in folk remedies and is reported to have a broad range of therapeutic effects. Therefore this paper attempts to bridge the lacunae in the existing literature and offers immense scope for researchers engaged in validation of the traditional claims and development of safe and effective therapeutic agent.

Key words: Medicinal plants; *Iresine herbstii; Ecbolium linneanum; Chrozophora rottleri*; Medicinal properties

Introduction

Over centuries and decades, our ancestors relied on the herbal product as therapeutic which can be traced back for at least 5000 years (Rajendran, 2009). The development of modern or allopathic medicine has somehow diminished the role of medicinal plants in favour of synthetic drugs. Even now a number of modern drug discoveries have been based on medicinal plants which is used by indigenous people (Balick and Cox, 1996). According to World Health Organization (WHO), about 80% of the world population depends on the natural product for their health due to minimal side effect and cost effective (Jagtap et al., 2009).

The use of natural products for therapeutic is well known in Indian medicine from Vedic Age and Ayurvedic medicines saved many lives before modern synthetic medicine reached to the common people. In addition, there is a continuing consumer demand for "natural" and/or "preservative-free" microbiologically safe foods and cosmetic products (Wijesekera, 1991; Zink, 1997). As public demand for these products increases, an opportunity exists to satisfy consumer demands while providing wholesome and safe products from plants (Borchardt et al., 2008).

India is having a rich heritage of more than 10,000 medicinal plants of which 1800 medicinal plants are used in Ayurveda, 4700 in Traditional Medicinal Practice, 1100 in Siddha Medicinal System, 750 Unani, 300 in Homeopathy, 300 in Chinese System of Medicine and finally 100 in Allopathic System (Chitravadivu et al., 2009). Besides the above systems, another system existed, which can be termed as folk medicine. Similar to the Ayurvedic system, the medicinal practitioners of folk medicinal systems are also known in Eastern India as Kavirajes (Mohammed et al., 2009).

Infectious diseases account for high proportion of health problems in the developing countries like India. Microorganism has developed resistance to many antibiotics and this has created immense clinical problems in the treatment of infectious diseases. Because of inadequate availability and high cost of new generation antibiotics, scientists are forced to search for new antimicrobial substances from various sources including medicinal plants (Sashikumar et al., 2003). Many of the plants used today were known to the people of ancient culture throughout the world for their preservative and medicinal property (Zaika, 1975). However several plants are used in India in the form of crude extracts, infusions or plaster to treat common infections without scientific evidence of efficacy (Ahmed et al., 1998).

Insect–plant, plant–microbe and plant–nematode interactions are well recognized ecological phenomena affecting the biosynthetic pathways of various classes of secondary metabolites within plants for defense purposes (Rosenthal and Berenbaum, 1992; Asai et al., 2002). The survival of a particular plant species in the wild depends on the ability of these secondary metabolites to effectively ward off insects, microbes and nematodes (Williams et al., 1989). Many plants have been known to synthesis active secondary metabolite to protect themselves from microbial attack such as peptide, unsaturated long chain fatty acid, alkaloids, antioxidant and phenolic compound which have potential therapeutic applications (Kandhasamy and Arunachalam, 2008). Plant derived compounds like phytoalexin (Beuchat et al.,1994), isothiocynates (Delaquis and Mazza, 1995), allicins, anthocyanins (Somaatmadja et al., 1964) and essentials oils (Lis-Balchin and Deans, 1997), tannins and polyphenols and terpenoids (Hao et al.,1998; Cutter, 2000; Puupponen-Pimia et al., 2001) have confirmed the antibacterial and antifungal activities. These compounds are bactericidal and bacteriostatic influencing lag

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time, growth rate and maximum growth of microorganisms. Antimicrobial compounds of plant origin may occur in stems, roots, leaves, bark, flowers and fruits of plants (Borchardt et al., 2008). Natural products of plant origin have played significant role in the search of therapeutic drugs such as quinine from cinchona (Hora and Nair, 1994).

After searching various literatures for plants that may have useful properties, we have selected *Iresine herbstii, Ecbolium linneanum* and *Chrozophora rottleri* (Table -1) based on their importance in the culture and traditions of Indian people for the present review. Apart from cultural significances, these plants are more accessible and affordable (Mander, 1998) and can contribute to new bioactive compounds that are safe and effective.

Iresine herbstii

Iresine herbstii belongs to the family Amaranthaceae. It is commonly referred to as bloodleaf, chicken gizzard, beefsteak plant and herbst's bloodleaf. Bloodleaf native to tropical South America was probably first collected in Brazil. But it is available in the tropical forest in several parts of India and tropical Asia. *I. herbstii* are traditionally used in the Northern Peruvian Andes for black magic with the ritual aim to expel bad spirits from the body (De Feo, 2003) and in association with San Pedro for magic rituals (Dobkin De Rios, 1977; De Feo, 2003), to diagnose various illness.

Nencini et al. (2006), evaluated the central effects of *I. herbstii* which interacts with the Central Nervous System (CNS) receptors and this study confirmed the ritual use of *I. herbstii.* According to them, methanolic extract was able to interact with the central 5-HT (2C) and D_1 receptors, whereas aqueous extract showed affinity for D_2 receptors. *I. herbstii* was reported as an additive of ayahuasca (Bianchi and Samorini, 1993), as an ingredient of San Pedro decoction, with possible hallucinogenic properties (Schultes and Hofmann, 1973). *I. herbstii* leaves are used as wound healing, anticancer agent (Sebold, 2003), post-labor tonic (Srithi et al., 2009), and externally against skin depurative such as eczemas, sores and pimples (De Feo, 2003) as well as antimicrobial agent (Khare, 2007). Moreover, the plant is also used in astringent, diuretic, spasmolytic, whooping cough and roots in hemicranias (Khare, 2007). Leaves and flowers are used in decoction, fever, relaxant and kidney problems (Vicente et al., 2007) and also as an antipyretic (De Feo, 2003). Schmidt et al. (2009), reported that this plant possessed anti-inflammatory, cytotoxic and apoptotic activities and also has very low antioxidant activity (Cai et al., 2003). So far, the phytochemicals constituent identified in the leaves are 2^1,5-Dimethoxy-6,7-(methylenedioxy)-isoflavone; acylated betacyanins (Vaˇsinová et al., 2004; Cai et al,. 2005), iresinin I (acylated amaranthine)and its C_{15} -epimer iresinin II (Cai et al., 2001).

Table: 1: Medicinal uses of *Iresine herbstii, Ecbolium linneanum* and *Chrozophora rottleri*

Scientific name	Local name	Family	Parts used	Infection / Therapeutic use	References
Iresine herbstii	Bloodleaf	Amaranthaceae	Leaves	Wound healing, low antioxidant activity, activity on central nervous system, having affinity on several cerebral receptors.	Schmidt et al., 2009; Cai et al., 2003; De Feo et al., 1996; Nencini et al., 2006
			Stem	Wound healing, low antioxidant activity	Schmidt et al., 2009
Ecbolium linneanum	Blue Fox Tail	Acanthaceae	Leaves	Gout, Dysuria, decoction of leaves for stricture	Khare, 2007
			Roots	Jaundice, Menorrhagia, Rheumatism.	Khare, 2007
Chrozophora rottleri	Suryavarti	Euphorbiaceae	Stems	Wound healing	Prota (11), 2010
			Whole plants	Jaundice and to purify blood.	Prota(11), 2010
			Leaves	Laxative, Antihelmintic activity	Priyanka et al., 2010
			Fruits	Cough and Colds	Flowers of India, 2010

A water-soluble oligosaccharide composing of six glucose and three mannose units, has been isolated from the roots of *I. herbstii* which enhanced the immune response and prolonged the survival time of mice bearing Ehrlich carcinoma. Also the roots contain free oleanolic acid and its saponins. An alcoholic extract of the root showed the presence of amino acids, steroids, tri-terpenoids, alkaloids and coumarins. The seeds also contain dachyranthin (Khare, 2007).

Different species of the genus *Iresine* are used in traditional medicine. It contains several bioactive substances and showed different biological activities and is used to treat various diseases. Leaves of *I. diffusa* are used to treat malaria (Céline et al., 2009). Red-coloured plants in the family Amaranthaceae are recognized as a rich source of diverse and unique betacyanins such as acetylated and non-acetylated betacyanins. Acylated betacyanins are available with the highest proportion in *I. herbstii* and *Gomphrena globosa* (Cai et al., 2001).

Constituent of viscous oil from *I. celosia* are sesquiterpene Iresine, tlatlancuayin, isoflavones carbohydrates and acid steroids glutapectique to its natural state. In these some substances are traditionally used in cytostatic anticancer (that can block cell division and forced to die). This acts on the permeability of the cell disease, and changes the bio-electric potential of the membrane carcinogen. The sesquiterpene Iresine is found in high concentration in the plant "herb of the Maya" and the properties include anti-cancer, anti-inflammatory, anti-allergic and antiseptic. Most terpenes are also substances with positive and stimulatory effect on the body in general. These substances are also able to shorten the

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menstrual period. Isoflavone tlatlancuayin has anti-oxidant, which captures free oxygen radicals, and contributes to cell renewal, and also a powerful antimicrobial agent (Alfonso and Guido, 1983).

Chrozophora rottleri

Chrozophora rottleri belongs to Euphorbiaceae family commonly known as Suryavarti. The plant occurs naturally through out India, Myanmar, Thailand, Andaman Islands, and Central Java: Malesia. *C. rottleri*, an erect hairy annual common waste lands, blossoms profusely from January to April. It is an erect herb with silvery hairs; lower part of stem is naked, upper part hairy and has slender tap-root. The three-lobe leaves are alternative, thick and rugose. The plants are monoecious, the flowers borne in sessile axillary racemes with staminate flowers in upper and pistillate flowers in the lower part of raceme (Srivastava and Agarwal, 1953).

C. rottleri is traditionally used by the tribes and native medical practitioners for the treatment of various diseases. In Sudan, powdered stems or whole plants are applied to wounds to improve healing. In Ethiopia, an infusion of the seeds and leaves is taken as a laxative. The plant is also used medicinally in Saudi Arabia, Pakistan and India (e.g. against jaundice and purifying blood). In Senegal, the plant is not browsed by most stock, except occasionally by sheep and goats, as it causes vomiting and diarrhoea, where as in Kenya, camels graze it. The fruits yield a purplish blue dye, which is used in East Africa to dye mats (Prota11 (1): Medicinal plants, cited 2010).In Nepal, juice of the fruit is given in cases of cough and colds (Manandhar and Manandhar, 2002), purifying agent (leaf) and laxative (seed), having bioactive components (Singh, 2010). The leaves are very much beneficial in treating skin diseases and also used as a depurative agent (Khare, 2007). The seeds are used as cathartic like Ghodtapde (Sasinath, 2007) and credited with purgative properties (Asia Pacific Medicinal Plant Database, cited 2010). Priyanka et al. (2010), reported that the aqueous extract of the leaves of this plant have significant anti-helmintic property against *Pheritima posthuma* (Indian Earth worm). Aqueous extract of this plant possessed phytotoxic activity on rice, wheat and mustard. In an experimental study by Suparna and Tapaswi (1999), the leaf extracts exhibited higher inhibition of shoot, root and radial elongation than the stem and root.

Leaf and roots of *C. rottleri* contain xanthone glycosides and a chromone glycoside. Oil extracted from seeds was rich in linoleate and the whole plant contains tannin. The coumarin, scopoletin, the alkaloid ricinine (Abdel-Sattar, 1985), flavonoids (Abdel-Sattar, 1985; Hashim et al., 1990), xanthones and chromones (Agrawal and Singh, 1988) are the compounds isolated from different species of *Chrozophora.* The aerial parts of *C. oblique* contains two phenylpropanoid glucosides like 4-O-methyl guaiacylglycerol 9-O-b-glucopyranoside and 4-O-methyl guaiacylglycerol 8-O-b-glucopyranoside (Khaled, 2001). The leaves of *C. senegalensis* also contain carbohydrates, saponins, tannins, steroids (Hassan et al., 2004) glycoside and alkaloids (Audu et al., 2008). DPPH (2,2-diphenyl-1-picrylhydrazyl) assay led to the isolation of three new flavonoid, glycosides namely quercetin 3-O-(6"-caffeoyl)-β-D-glucopyranoside-3'-O-β-D-glucopyranoside, quercetin 3-methylether-7-O-α-L-rhamnopyranosyl-(1→6)-(2"-p-coumaroyl)-β-D-glucopyranoside, acacetin 7-O-(6"-p-coumaroyl)-β- D -glucopyranoside and along with five known flavonoids, one phenolic derivative, and three megastigmane glycosides. They have exhibited the highest antioxidant capacity which is also able to modulate hydroxyl radical formation more efficiently than other compounds acting as direct hydroxyl radical scavengers and chelating iron (Antonio et al., 2006).

These classes of compounds are known to show curative activity against several pathogens (Hassan et al., 2004) and therefore it can be used traditionally for the treatment of wide array of illnesses. The antimicrobial screening of *C. senegalensis* leaf extracts showed considerable amount of inhibition against *Bacillus subtilis, Staphylococcus aureus, Escherichia coli* and *Pseudomonas aeruginosa*; with much activity on *Salmonella typhi* (Usman et al., 2007). They also possessed high antiplasmodial activity against two chloroquine-resistant *Plasmodium falciparum* strains *in vitro*, without toxicity *in vitro* and no toxicity *in vivo* by oral way in mice (Benoit-Vical et al., 2008). Leaf extracts of *C. plicata* exhibited strong fungitoxicity against *P. aphanidermatum* (Pandey and Dubey, 1994). In Sudan, *C. oblongifolia* stem and leaf extracts are used to treat gonorrhoea (Prota11 (1): Medicinal plants, cited 2010).

Ecbolium linneanum

Ecbolium linneanum belongs to the family Acanthaceae commonly referred to as Blue Fox Tail or Blue Justicia in English, the Indian name includes Neel Kantha in Bengali, Udajati in Hindi and Nilambari in Tamil (Flowers of India, cited 2010). It is an indigenous Indian plant that grows naturally along the Eastern part of India. It also has been found in Africa and tropical Asia. Blue Fox Tail is a shrubby plant, with four sided flower-spikes at the end of branches. Bracts are oval, entire, mucronate, leaves are elliptic-oblong, narrowed at both ends, velvety. Flowers are large, greenish blue and the upper lip of the flower is linear, reflexed. It is a low shrubby habit with woody root stock, bluish bifid flowers in dense spikes, large imbricate four ranked bracts oblong lanceolate lamina tapering at both ends and very short petioles, wood in stem ring porous with mostly solitary pores and with heterogeneous rays containing micro-crystals (Datta and Maiti, 1968).

E. linneanum has been reported to possess many ritual uses such as in jaundice, menorrhoea, rheumatism (Chopra et al., 1956), anti-inflammatory activity (Lalitha and Sethuraman, 2010). Root juice is used as anti-helmintic and also to treat premenstrual colic (Sharma and Sharma, 2010). Plant is used in gout and dysuria; decoction of leaves for stricture (Khare, 2007). The roots and leaves are used against tumours and 50% ethanolic extract of the plants are used to treat cardiovascular disease (Gamble, 1993). Glycoflavones have also been reported previously from this plant (Nair et al., 1975).

The phytochemicals that give the plant its unique biological activity are luteolin, orientin, vitexin and isoorientin which have been isolated from the ethanolic extract of the roots, flowers and leaves of the plant (Nair et al., 1975).

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A lignin named as ecbolin A, has been isolated from the chloroform extract of roots (Venkataraman and Gopalakrishnan, 2002).

Conclusion

The strategic screening program for phyto-chemicals and pharmacological studies of plants used in traditional medicine, personal body care and cosmetics provided scientific evidence for their rationale use in prevention and treatment of infectious and oxidative stress related diseases. Traditional uses of these three medicinal plants is to cure diseases like skin disorders, diarrhoea, jaundice, mouth ulcer, fever, joint pain and swelling, abdominal pain, skin burns, migraine, menstrual problems, urinary problems, piles, wounds, to expel intestinal worms and so on.

In recent years, there has been increased interest in naturally occurring phytochemical compounds with antimicrobial potential. Extensive antimicrobial screening of ethanomedicinal plants of India and many other countries have led to identification of active compounds in some cases. These functions are linked to the presence of diversified structural activities and complexity in the mixture of the phyto-chemical extracts. Among the screened plant extracts, the most active fraction is known but active compounds are yet to be characterized. Similarly *in vitro* and *in vivo* efficacies of the characterized extracts or compounds are to be elucidated. Though some of the isolated compounds are not active (non antibacterial) or weakly active still they could enhance the activity of conventional antibiotics against the drug resistant bacteria.

Although a large number of plants have been studied for their selective medicinal property, further more studies have not been carried out to the level of clinical trials because most of these research works are independent and without industrial collaborations. One of the disadvantages of the previous studies is that most of them have not reported the cytotoxicity of the crude extracts or the purified fraction of the plant extracts. Without this it would be useless, if it is toxic to body even though the plant exhibits greater antimicrobial activity.

Some of the futures guidelines in this area of research are suggested below:

- ✓ We need to develop simple, economical multi-targeted green approaches that will be effective against multidrug resistant bacteria, plasmid elimination, virulence and pathogenicity reduction, inhibition of bacterial cell to cell communications and so on.
- ✓ Antibiotics and the herb-drug interactions should be studied in detail in order to increase the activity of ineffective antibiotics and safe integration of herbal drugs with modern medicine.
- ✓ Herbal preparation with known efficacy of these plants in traditional system of medicine must be proved through scientific experiments and it should be tested both in animals and humans.

On comparing the medicinal properties of ***I.herbestii, C.rottleri*** and ***E.linneaum***, it was observed that very few studies have been carried out using ***E. linneanum*** with regard to medicinal property and the compounds isolated from different parts of the plants viz leaf, flowers, bark, stem and root. Many researchers have reported the therapeutic uses of *C. rottleri* and *I. herbstii.* Through this critical review, the authors recommend that more studies need to be carried out to explore the complete functional properties of the aforesaid plants; thereby it facilitates the researchers to use these plants for their future works. Moreover, the plant extracts can very well be used to study the antibacterial, antifungal, antiviral, anti-protozoans, anti-inflammatory, anti-diabetes, antioxidant studies (free radical scavenging activities), and wound healing mechanisms etc.

Therefore it is mandatory to invest enough money, time and energy to search an alternative plant based medicine. But to overcome the existing drawbacks, it is better not only to increase the list of the plants but also to re-evaluate and test the medicinal effect of reported plants. It is alleged that a superior therapeutically effective drug can be obtained from this plant source. Furthermore, the active participation of such natural custodians and practitioners of valuable knowledge is guaranteed in the generation of research focussing on screening programmes dealing with the isolation of bioactive principles and the development of new drugs which is the need of the hour.

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