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Pharmaceutical properties of Indian species of *Ficus* Linn.

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Abstract

The paper deals with the review of pharmaceutical properties of species of *Ficus* L. occurring in India.

Key-Words: Pharmaceutical, *Ficus*, Extract.

Introduction

Plants have been used for treating ailments for thousands of years through the empirical knowledge gathered about the useful and harmful properties of different plants and also by intuition. In India, the *Charak Samhita* and *Sushrut Samhita* described the medicinal properties of 500 and 700 plants respectively under 37 classes or "*Ganas*" (Saxena, 2003). The oldest record of medicinal use of plants is found in the *Rig Veda*, which is approximately 8000 years old. In *Atharva Veda* remarkable description of Indian medicinal plants were provided by ancient Indian scholars. *Ayurveda,* an *Upaveda,* composed around 2500 BC deals with medicine, healthcare and treatment of disease from indigenous drugs. From *Vedas* it is learnt that Indo-Aryans used the *'Soma'* (a plant product) as a revitalizing agent, which exhibits an amazing stimulating effect (Satyavati *et al.,* 1976). More than 90% of the formulations under the Indian Systems of Medicine i.e. Ayurveda, Siddha, Unani and Homoeopathy (AYUSH), predominantly contain plant-based raw materials (Anonymous, 2008).

The genus *Ficus* L. (Moraceae) was first published in Systema Naturae by Carolus Linnaeus in 1735. *Ficus* is one of the largest genus among angiosperms. Among the genera of seed plants it ranked as the twenty-first (Frodin 2004). It comprises of about 800 species distributed in tropical and subtropical regions of the world (Adebayo *et al.* 2009). in India, 115 species are distributed throughout the country with the maximum diversity of the species lies in the North-East region having about 43 species in Meghalaya alone and may be considered as the hotspot region in India (Chaudhary *et al* ,2012).

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Members of the genus have been used as food, fodder, medicine, as source of rubber and several other uses. Studies on pharmaceutical activities of *Ficus* have been carried out by several workers (Sehgal, 2003; Patil & Patil, 2010; Lalla, 2005; Joseph & Raj, 2011; Mousa *et al.,* 1994; Zahra *et al.,* 2009; Khan *et al.,* 2007; Shukla *et al.*, 2004; Vohra & Parasar, 1970; Singh *et al.,* 2009; Aref *et al.,* 2010; Kuete *et al.,* 2011; Shukla, 1995; Daniel *et al*, 2003; Morton & McManus, 1986; Aswar *et al.*, 2008; Mahalingam,2008; Sharma *et al.,* 2010; Gabhe, 2006; Abdulla *et al.,* 2010; Mukherjee *et al.,*1998; Taur, 2007 and several others). These works have provided information on medicinal properties of several members of *Ficus*.

Pharmaceutical activities of *Ficus* species

Analgesic (pain reliever): Analgesic activity of the leaf extract of *Ficus glomerata* Roxb. and stem bark of *Ficus bengalensis* Linn. have been confirmed respectively by Sehgal (2003) and Patil & Patil (2010). Kumar *et al.* (2012) also published a review paper on analgesic property of *Ficus carica* Linn.

Treatment of cancer: Medicinal plant products exhibiting anticancer activity continue to be the subject of extensive research aimed at the development of new or alternative drugs for the treatment of different human tumors. Lalla (2005) reported *F. glomerata* and *F. racemosa* Linn. for the treatment of skin cancer. Both the natural and compounds synthesised from *F. carica* showed in vitro inhibitory effects on proliferation of various cancer cell lines (Joseph & Raj, 2011). Fruit extracts of *F. benjamina* Linn., *F. bengalensis* , *F. religiosa* Linn. and *Ficus sycomorus* Linn., an African species, exhibited anti-tumor activity in the potato disc bioassay (Mousa *et al.*, 1994).

Treatment against ulcer: The healing activity of whole plant extract of *F. deltoidea* Jack. was studied in gastric ulcer induced by ethanol in rats, the extract

promoted ulcer protection as ascertained by the comparative significant decreases in ulcer areas and inhibition of sub mucosal edema and leucocytes infiltration of sub mucosal layer (Zahra *et al.,* 2009). Sivaraman & Muralidharan (2010) reported *F. hispida* as a potent anti-ulcerogenic as well as ulcerhealing properties and could act as a potent therapeutic agent against peptic ulcer disease. Anti-ulcerogenic potential of *F. bengalensis* is also reported by Kulshreshtha *et al.* (2011).

Antiageing agent / antioxidant: Cell membranes are especially vulnerable to the aggression of free radicals. When the nucleus is damaged, the cell loses its ability to replicate itself. The impaired cell replication results in the weakened immune system, skin ageing and many age related disorders. Various antioxidants deactivate the free radicals and prevent oxidation on a cellular level. Some commonly used plants as antiageing agents includes *F. bengalensis* (Khan *et al.,* 2007; Patil & Patil, 2010). The antioxident effect of species of *Ficus* may be attributed to the polyphenolic compounds they posses. The antioxidant effect of aqueous extract of the bark of *F. bengalensis* has been evaluated in hypercholesterolemia rabbits by Shukla *et al.* (2004) and confirmed its significant antioxidant effect. The potential health-promoting constituents of fig fruits were studied with six commercial fig varieties differing in color (black, red, yellow and green) for total polyphenols, total flavonoids, antioxidant capacity and profile of anthocyanins. In the dark-colored mission and the red Brown-Turkey varieties, the anthocyanin fraction contributed 36 and 28% of the total antioxidant capacity, C3R (cyanidin- 3-*O*-rutinoside) contributed 92% of the total antioxidant capacity of the anthocyanin fraction. Fruits of the mission variety contained the highest levels of polyphenols, flavonoids, and anthocyanins and exhibited the highest antioxidant capacity (Joseph & Raj, 2011).

Anti diabetic: Diabetes mellitus is the most common endocrine disorder that impairs glucose homeostasis resulting in severe diabetic complications including retinopathy, angiopathy, nephropathy, neuropathy and causing neurological disorders due to perturbation in utilization of glucose. According to Ayurvedic system of medicine *F. bengalensis* is well known in the treatment of diabetes (Rashid, 2008). This attracted the attention of many earlier workers who studied the hypoglycemic effect of extracts from its bark and tried to isolate active compounds. Bark of this plant has anti-diabetic properties. The hypoglycemic effect of extract of bark was demonstrated in alloxan diabetic rabbits, rats and in humans. Potent hypoglycemic water insoluble principle was isolated from the bark and a water soluble hypoglycemic principle was also isolated from the bark which was effective at a low dose of 10 mg/kg, bw/day (Patil & Patil, 2010). Both the banyan bark principles were effective in mild as well as severe alloxan induced diabetes in rabbits, and improved lipid profile (Vohra & Parasar, 1970). The aqueous leaf extract of *F. carica* induced a significant hypoglycemic effect in oral or intraperitoneal administration in streptozotocin - diabetic rats. Weight loss was prevented in treated diabetic rats and the survival index was significantly altered by plasma insulin levels (Joseph and Raj, 2011). Singh *et al.* (2009) reported that *F. bengalensis, F. carica* and *F. glomerata* are effective in the treatment of diabetes. The hypoglycemic activity of ethanol extracts of leaves of *F.glomerata* has significant antihyperglycemic effect in experimental albino rat model of diabetes mellitus (Sharma *et al.,* 2010). Hypolipidemic effect of the water extract of the bark of *F. bengalensis* was investigated in alloxan induced diabetes mellitus in rabbits showing a good glycemic control also corrects the abnormalities in serum lipid profile associated with diabetes mellitus in view of the ability of the water extract of *F. bengalensis* to improve carbohydrate and lipid metabolism (Shukla, 1995). The fruits of *F. glomerata*, locally known as Gular have been used since ancient times in the ethno-medicine including as a remedy of diabetes mellitus (Chopra *et al.*,1976). The aqueous extract of *F. bengalensis* at a dose of 500mg/kg/day exhibits significant antidiabetic and amelioferative activity as evidenced by histological studies in normal and *F. bengalensis* treated streptozotocin induced diabetic rats. On the basis of the findings, it could be used as an Antidiabetic and Ameliorative agent for better management of diabetes mellitus (Mahalingam,2008). *F. exasperate* Vahl and *F. arnottiana* Miq. are also reported to have anti-diabetic activity by Sonibare *et al.* (2006) and Mazumdar *et al.* (2009) respectively.

Anti fungal activity: Methanolic extracts of *F. carica* latex had a total inhibition against *Candida albicans* (100%) at a concentration of 500µg/ml and a negative effect against *Cryptococcus neoformans* whereas *Microsporum canis* was strongly inhibited (75%) and totally with ethyl acetate extract at a concentration of 750µg/ml (Joseph & Raj, 2011). Aref *et al*. (2010) also reported that the methanolic, hexanoïc, chloroformic and ethyl acetate extracts of *F. carica* latex posseses anti-fungal activity. Antifungal activities have also been reported for *F. exasperate* (Sonibare *et al*., 2006).

Anti bacterial activity: The methanol extract of *F. carica* showed a strong antibacterial activity against oral bacteria while the combined effects of methanol

extract with ampicillin or gentamicin were synergistic against oral bacteria (Joseph & Raj, 2011). The fruit extracts of *F. sycomorus*, an African species, *F. benjamina*, *F. bengalensis* and *F. religiosa* had significant antibacterial activity (Mousa *et al.*, 1994). Aref *et al*. (2010) also reported that the methanolic, hexanoïc, chloroformic and ethyl acetate extracts of *F. carica* latex posseses anti-bacterial activity. *F. exasperata* leaf, stem bark and root contained bioactive substances with the highest inhibitory activities against some human bacterial pathogenic organisms (Adebayo *et al*., 2009).

Anti pyretic: The ethanol extract of *F. carica*, at doses of 100, 200 and 300 mg/kg showed significant dose-dependent reduction in normal body temperature and yeast provoked elevated temperature. The effect extended up to five hours after drug administration when compared to that of Paracetamol (150 mg/kg.), a standard antipyretic agent. This shows the anti pyretic effect of ethanol extract of *F. carica* (Joseph and Raj, 2011). *F. bengalensis* also shows antipyretic activity (Patil & Patil, 2010).

Scavenging & immune response: The water extract (WE) and crude hot-water soluble polysaccharide (PS) from *F. carica* fruit were investigated for scavenging abilities on DPPH, superoxide and hydroxyl radicals and reducing power. The immune activities of PS were evaluated using the carbon clearance test and serum hemolysin analysis in mice. Both WE and PS have scavenging activities on DPPH with the EC50 (0.72, 0.61) mg/ml, respectively. The PS showed higher scavenging activity than WE on superoxide radical (EC50, 0.95 mg/ml) and hydroxyl anion radical (scavenging rate 43.4% at 4 mg/ml). The PS (500 mg/kg) also has a significant increase in the clearance rate of carbon particles and serum hemolysin level of normal mice. This indicates the scavenging activity and immune responses of the extract (Joseph and Raj, 2011)

Hepatoprotective: Shade dried leaves of *Ficus carica* were extracted using petroleum ether (60-80°) and tested for antihepatotoxic activity on rats treated with 50 mg/kg of rifampicin orally. The result indicated promising hepatoprotective activity (Gond and Khadabadi, 2008). The ethanolic extract of *F. benjamina* possesses hepatoprotective activity against CCl4 induced hepatotoxicity in rats (Kanaujia *et al*., 2011)

Antiatherogenic: One month treatment of alloxan diabetic dogs with glycoside, viz. leucopelargonin derivative (100mg/kg/day) isolated from the bark of *F. bengalensis* decreased fasting blood sugar and *F. benghalensis* glycosylated haemoglobin by 34% and 28% respectively. Body weight was maintained in both the treated groups while the same was decreased significantly by 10% in the control group. In cholesterol diet fed rats, as the atherogenic index and the hepatil bile acid level and the faecal excretion of bile acids and neutral sterols increased, the HMGCOA reductase and lipogenic enzyme activities in liver and lipoprotein lipase activity in heart and adipose tissue and plasma LCAT activity and the incorporation of labeled acetate in to free and ester cholesterol in liver decreased significantly (Daniel *et al.*, 2003).

Anthelmintic/ vermifuge: The latex of *F. glabrata*, has been evaluated clinically and shown to be a potent and well tolerated anthelmintic agent (Morton and McManus, 1986). The methanolic, chloroform, and pet ether extracts of the roots of *F. bengalensis* have potent anthelmintic activity when compared with conventionally used drug and is equipotent to standard anthelmintic drug (Aswar *et al.*, 2008). The aqueous extract of *F. racemosa* possesses wormicidal activity and thus may be used as an anthelmintic (Chandrashekhar *et al*., 2008).

Anti-inflammatory: The anti-inflammatory effect of ethanolic and petroleum ether extracts of the bark of *F. bengalensis* were evaluated in carrageenan-induced hind paw edema in rats and the paw volume was measured plethysmometrically at 0 to 3h after injection. The results indicated the ethanolic extract of *F. bengalensis* exhibited more significant activity than petroleum ether in the treatment of inflammation compared with the standard drug Indomethacin (Patil *et al*., 2009). Kumar *et al.* (2012) also published a review paper on anti-inflammatory activities of *F. carica.*

Immunomodulatory: Gabhe (2006) evaluated the immunomodulatory activity of the aerial roots of *F. bengalensis.* The successive methanol and water extracts exhibited a significant increase in the percentage of phagocytosis versus the control. In the in vivo studies, the successive methanol extract was found to exhibit a dose related increase in the hypersensitivity reaction to the SRBC antigen. It also resulted in a significant increase in the antibody titer value to SRBC.

Wound healing: In Ayurvedic medicine, *F. racemosa* Linn. is used as a wound healing agent (Biswas & Mukherjee, 2003). The aqueous extract of the whole plant of *F. deltoidea* was investigated by Abdulla *et al*. (2010) to evaluate the rate of wound healing enclosure and the histology of healed wounds in rats and results strongly document the beneficial and significant effects to accelerate the rate of wound healing enclosure in the experimentally-induced wounds in rats.

Antidiarrhoeal: Mukherjee *et al*. (1998) evaluated ethanol extracts of *F. bengalensis* (hanging roots), *Eugenia jambolana* Lam. (bark), *F. racemosa* (bark) and *Leucas lavandulaefolia* Rees (aerial parts) and showed significant inhibitory activity against castor oil induced diarrhoea and PGE2 induced enter pooling in rats. These extracts also showed a significant reduction in gastro-intestinal motility in charcoal meal tests in rats. The results obtained establish the efficacy of all these plant materials as anti-diarrhoeal agents. Mandal & Kumar (2002) reported *F. hispida* Linn. leaf extract as an anti-diarrheal agent.

Anti-stress and anti-allergic: Extracts of *F. bengalensis* bark was screened for its antiallergic and antistress potential in asthma by milk-induced leucocytosis and milkinduced eosinophilia. Aqueous, ethanol, and ethyl acetate extracts showed significant decrease in leucocytes and eosinophils in the order given while petroleum ether and chloroform extracts were inactive. This shows the application of polar constituents of *F. bengalensis* bark as antis tress and ant allergic agents in asthma (Taur, 2007).

F. religiosa is also used for the treatment of Bronchial Asthma. Malhotra *et al.* (1960) was the first who investigated the antiasthmatic potential of the alcoholic bark extract of the *F.religiosa*. The exract showed inhibitory effect on both acetylcholine-induced and histamine-induced experimental asthma (Malhotra *et al.,* 1960).

Conclusion

Review of literature shows that out of about 115 species of *Ficus* occuring in India, 11 species have pharmaceutical value. Of the Indian species of *Ficus*, it has been found that *F. bengalensis* have been reported to be beneficial in the treatment of maximum number of diseases (pain reliever, cancer, anti-ulcerogenic, ageing, diabetes, fever, antherogenesis, helminthes infections, inflammation, Immune system, diarrhoea, allergy and stress) followed by *F. carica* (diabetes, fever, scanvenging, immune response, fungal diseases, bacterial diseases and diseases caused by microbes). Species such as *F. racemosa* (syn. *F. glomerata*), *F. deltoidea*, *F. hispida*, *F. benjamina*, *F. exasperate*, *F. religiosa, F. arnottiana* and *F. glabrata* are also reported to contain pharmaceutical properties for the treatment of different diseases.

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