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Recent Investigations in Phytopharmacology: An Overview

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In recent times, focus on plant research has increased all over the world and a large body of evidence has been accumulated to highlight the immense potential of medicinal plants used in various traditional systems of medicine. There is a growing interest in correlating phytochemical constituents of a plant with its pharmacological activity. The present review aims to compile data related to recent investigations in phytopharmacology generated through the research activity using modern scientific approaches and innovative scientific tools.

Keyword: Hepatoprotective, Antibacterial Activity, Diabetes, Antipyretic, Anti-HIV-1 Activity.

1. Introduction

Phytopharmacology was invented by the Russian scientist David Macht in the 1930s. The term has since changed its meaning to become an established field of drug research, where the active substances come from plants. Plants have been one of the important sources of medicines since the beginning of human cultivation. The use of plants for healing purposes predates recorded history and forms the origin of much of modern medicine (Examples include aspirin (from willow bark), digoxin (from foxglove), quinine (from cinchona bark), and morphine (from the opium poppy) etc.)^[1]. There is a growing demand for plant based medicines, health products, pharmaceuticals, food supplements, cosmetics etc. Currently 80% of the world population depends on plant-derived medicine for the first line of primary health care for human alleviation because it has no side effects^[2]. In recent times, focus on plant research

has increased all over the world and a large body of evidence has been accumulated to highlight the immense potential of medicinal plants used in various traditional systems of medicine^[3-5]. There is a growing interest in correlating phytochemical constituents of a plant with its pharmacological Activity. Scientists have even started correlating the botanical properties of plants with their pharmacological activity. The present review aims to compile data related to recent developments in phytopharmacology generated through the research activity using modern scientific approaches and innovative scientific tools.

1.1 Recent Investigations Reported in Literatures

1.1.1 Wound Healing Effects of *Ageratum conyzoides*

The methanolic extract of the *Ageratum conyzoides* was studied for wound healing effect

in Wistar rats (n=10). Wounds prepared in excised areas of the skin were packed with gauze soaked by the extracts and were determined histologically after 10 days. The Ageratum sections showed fewer inflammatory cells and more fibrosis than controls^[6,7]. It was concluded that extract of *Ageratum conyzoides* has a better wound healing enhancing action.

1.1.2. Hepatoprotective Potency of *Achyranthes aspera*

Ethanol extract from seeds of *Achyranthes aspera* was studied for its hepatoprotective activity against carbon tetrachloride (CCl₄) induced liver damage model in rats. It has been found that the animal group treated with CCl₄ recorded significant rise in serum markers reflecting hepatic damage and pretreatment of rats with ethanolic extract of *Achyranthes aspera* (100mg/kg p.o) inhibited the increase in serum levels of total bilirubin, total protein, serum alanine transaminase, aspartate transaminase and alkaline phosphatase reflecting the liver protection by crude drug. The results obtained were found comparable with silymarin (100mg/kg p.o) indicating hepatoprotective potential of *Achyranthes aspera*^[8].

1.1.3. Antibacterial activity of *Pedilanthus tithymaloides*

The in vitro antimicrobial activity of methanol, n-butanol, chloroform, ethereal, ethyl acetate extracts of *Pedilanthus tithymaloides* extracts was carried out against various gram positive and gram-negative bacteria using disc plate method. The zone of inhibition formed against these microorganisms was measured for the determination of the antibacterial efficacy of the different plant extracts. Of the selected extracts, n-butanol extracts showed significant antibacterial potential against *Bacillus subtilis*, *Proteus mirabilis*, *Streptococcus pyogenes*, *Aeromonas*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. In addition, petroleum ether extracts showed activity against *Aeromonas* species. The ethyl acetate and chloroform extracts showed

antibacterial activity only against *Klebsiella pneumoniae*^[9].

1.1.4. Effect of Rutin in Diabetes Rat Gastropathy

The antioxidant effect of Rutin was investigated in diabetic rats. The Alloxan monohydrate was used to induce the diabetes in normal rats. The animals were divided into two groups. The first group comprising control group treated with vehicle while in second group Diabetes was induced. The Gastric emptying was evaluated by Phenol red assay method and Intestinal transit by Charcoal meal Method. The results indicated that 20 mg/kg and 40 mg/kg of Rutin improved gastric emptying and intestinal transit significantly and in dose dependent manner. The study revealed the usefulness and beneficial value of rutin in the treatment of disorder of gastric emptying and intestinal transit in diabetes gastropathy^[10].

1.1.5. Antipyretic Activity of Methanolic Extract of *Pterocarpus santalinoides*

Pterocarpus santalinoides was claimed to have antipyretic properties. The leaves of *Pterocarpus santalinoides* family Fabaceae were dried, powdered and extracted by cold maceration with methanol for 48hrs, it was concentrated using rotary evaporator. The anti-pyretic activity was investigated using brewer's yeast to induce pyrexia in rats. *Pterocarpus santalinoides* extract (300 mg/kg) relieved pyrexia in rats (p<0.01) and this effect was comparable to that of aspirin (100 mg/kg)^[11].

1.1.6. Anti-inflammatory Activity of Ethanolic Extract of *Ageratum conyzoides* Linn. Leaf

The anti-inflammatory activity of crude ethanolic extract the leaves of *Ageratum conyzoides* Linn. (Family: Asteraceae) was studied using carrageenan and histamine-induced rat paw edema test at different doses (200 and 400 mg/kg body weight). At the dose of 400 mg/kg body weight, the extract showed a significant anti-inflammatory activity both in the carrageenan and histamine-induced oedema test models in rats showing 59.15% and 57.76% reduction in the

paw volume comparable ($P < 0.01$) to that produced by the standard drug indomethacin (61.27% and 63.35%) at 4h respectively. The percentage inhibition of the oedema paw volume by the 400 mg/kg body weight of the extract was also statistically significant ($P < 0.05$; $P < 0.01$) compared favorably with the indomethacin treated animals at 1, 2 and 3 h in both models^[12].

1.1.7. Immunomodulatory Activity of *Quisqualis indica* Linn.

The role of phagocytosis is the removal of microorganisms and foreign bodies, dead or injured cells. The primary target of most of the immunomodulators is believed to be macrophages which play a major role by engulfing pathogens or foreign substances and initiating innate immune response. Hydroalcoholic extract of *Quisqualis indica* Linn. flower extract is a potent immunostimulant, stimulating specific and non-specific immune mechanisms. The immunomodulatory activity of hydroalcoholic extract of *Quisqualis Indica* Linn was evaluated in wistar rats. The *Quisqualis Indica* flower extract was administered orally at a dose of 100 mg/kg and 150 mg/kg. The *Quisqualis Indica* flower extract (150 mg/kg) showed significant ($p < 0.05$) increased in phagocytic index when compared to control group. Higher dose of *Quisqualis Indica* flower extract showed significant immunomodulatory activity^[13,14].

1.1.8. Antipyretic and Analgesic of *Aegle marmelos* (Bael)

Bael extract exhibit antipyretic and analgesic activity, as it has shown a significant inhibition of a carrageenan induced paw edema, cotton pellet granuloma and paw itching in mice and rats. Shankharanath V., (2007), demonstrated that methanolic extract of leaves of *Aegle marmelos* at a dose level of 200 and 300 mg/kg show significant analgesic activity on acetic acid induced writhing and tail flick test in mice^[15-19].

1.1.9. Anti-ulcer Activity and HPTLC Analysis of *Mangifera indica* L. Leaves

Mangifera indica (Family: Anacardiaceae) is being used in Ayurvedic and indigenous medical systems for the treatment of various diseases including gastric ulcer. The antiulcer potential of the petroleum ether and ethanol extracts of leaves of *Mangifera indica* was evaluated by in vivo aspirin-induced gastric ulcer assay. The petroleum ether (250mg/kg) and ethanol extracts (250mg/kg) of leaves of *Mangifera indica* plant significantly reduced the ulcer index in the range of $P < 0.001$ and $P < 0.01$ values. Histopathological findings also confirmed the antiulcer activity of *Mangifera indica* leaves extracts in albino rats. The study provided preliminary data on the antiulcer potential of *Mangifera indica* leaves and support the traditional uses of the plant for the treatment of gastric ulcer^[20].

10. Anticonvulsant Activity of Ethanolic Extract of *Vitex nigundo*

Vitex-negundo Linn (Family: Verbenaceae), a large aromatic shrub with typical five foliolate leaves pattern has found to possess anticonvulsant activity. Maximal electroshock seizures (MES) in albino rats were used to study anticonvulsant activity of *Vitex-negundo* leaf extract. The ethanol leaf extract of *Vitex-negundo* was administered orally in graded doses (500 and 1000 mg/kg and 2000mg/kg p.o) in the experimental model and the effects were compared with Diphenylhydantoin in MES method as standard and normal saline as control. The *Vitex-negundo* in the doses 1000 mg/kg has significant effect and 2000mg/kg p.o showed protection against MES to a highly significant extent. Test drug in the dose (1000 mg/kg, po) showed 60% protection in clonic seizures. It also decreased number and duration of convulsions significantly. These findings suggested that *Vitex-negundo* possesses anticonvulsant activity against MES induced convulsions^[21].

1.1.11. Anti-diabetic Potential of *Quisqualis indica* Linn in Rats

The methanolic extract of flowers of *Quisqualis indica* Linn. was evaluated for antidiabetic

activity on alloxan induced diabetes in rats. Diabetic rats were treated with methanolic extract of flowers of *Quisqualis indica* Linn. at doses of 100, 200 and 400 mg/kg, p.o. for 43 days. The methanolic extract of flowers of *Quisqualis indica* Linn. at doses of 200 and 400 mg/kg, p.o. showed significant decrease in the biochemical parameters, glucose, triglyceride, total cholesterol, HDL-cholesterol, LDL-cholesterol levels as compared to diabetic control group. The methanolic extract of flowers of *Quisqualis indica* Linn. at doses of 200 and 400 mg/kg, also proved to be effective in normalizing the levels of triglyceride and cholesterol levels in heart homogenates as compared with diabetic control. Hence, it may be concluded, that the methanolic extract of flowers of *Quisqualis indica* Linn. may be beneficial in the treatment of diabetes^[22].

1.1.12. Antinociceptive and Antioxidant Potential from the Leaves of *Spilanthes paniculata*:

The crude ethanolic extract of the leaves of *Spilanthes paniculata* Wall.ex DC (Family: Asteraceae) was evaluated for its possible antinociceptive and antioxidant activities abundantly growing in northeast part of Bangladesh. At the dose 500 mg/kg body weight, the extract showed a significant analgesic activity in acetic acid induced writhing in mice showing 37.61% inhibition ($P < 0.001$) comparable to that produced by Diclofenac sodium (45.02%) used as standard drug. Five complementary test systems, namely DPPH free radical scavenging, nitric oxide scavenging, reducing power, Fe^{++} ion chelating ability and total phenolic content were used for determining antioxidant activities of the leaf extract. The total phenolic amount was found quite high in ethanolic crude extract (278.47 mg/g of gallic acid equivalent). The results suggested the antinociceptive and antioxidant activities of the crude ethanolic extract of the leaves of *Spilanthes paniculata*^[23].

1.1.13. Anthelmintic activity of *Ficus carica* Linn.

Stepak et al. reported the anthelmintic efficacy of cysteine proteinases from fig (*Ficus carica* Linn.)

in vitro using the rodent gastrointestinal nematode *Heligmosomoides polygyrus* (*H. polygyrus*). Within a 2h incubation period, cysteine proteinases, caused marked damage to the cuticle of *H. polygyrus* adult male and female worms, reflected in the loss of surface cuticular layers^[24]. The efficacy and mode of action make plant as potential candidates for a novel class of anthelmintics^[25].

1.1.14. Anti-hypertensive Activity of *Silybum marianum*

Jadhav GB, et al. evaluated the effect of silymarin (300 mg/kg and 500 mg/kg, p.o, for 4 weeks) in Deoxycorticosteroneacetate (DOCA) salt induced hypertensive rats. It was reported that silymarin (300,500 mg/kg/day, p.o) significantly ($p < 0.05$) reduced systolic blood pressure, heart rate, basal arterial blood pressure and pressor responses to nor-adrenaline, adrenaline, phenylephrine and serotonin (5-HT) in animals treated with DOCA salt as compared with DOCA-salt hypertensive rats^[26,27].

1.1.15. Hepatoprotective activity of leaves of *Cassia occidentalis*

Hepatoprotective activity of leaves of *Cassia occidentalis* against paracetamol and ethyl alcohol intoxication was evaluated in rats. The aqueous-ethanolic extract of leaves of *Cassia occidentalis* was studied against rat liver damage induced by paracetamol and ethyl alcohol by monitoring serum transaminase, alkaline phosphates, serum cholesterol, serum total lipids and histopathological alterations. The extract of leaves of the plant produced significant hepatoprotection^[28].

1.1.16. Anti-HIV-1 activity of Phenolic Compounds Isolated from *Diospyros lotus* fruits

Phenolic compounds represent an important natural source of antiretrovirals for AIDS therapy due to their significant anti-HIV-1 activity and low toxicity. The phenolic compounds isolated from methanol extract (70%) of *Diospyros lotus* fruits were tested for anti-HIV-1 activity. Seven compounds, ellagic acid, methyl gallate, gallic

acid, myricetin-3-O- β -glucuronide, myricetin-3-O- α -rhamnoside, myricetin and quercetin were isolated and identified from *Diospyros lotus* fruits. Gallic acid was found to be most active compound against HIV-1 with Therapeutic Index (TI) value of >32.84 and the other compounds were less potent active. *Diospyros lotus* fruits could provide a chemical reservoir of anti-HIV agents^[29].

2. Conclusion

From the literature review, it is clear that the medicinal plants play a vital role against various diseases. There is a pertinent need to renew scientific enthusiasm toward natural products for inclusion in drug discovery program. Development of quality control methods of plant drugs with adoption of good manufacturing practices and validation of the claims of their therapeutic efficacy are the challenges in the years ahead, if the resurgence of global interest in these drugs is to be further strengthened. Documented clinical experience with botanical medicines as codified in traditional systems of medicine might simplify the issues associated with poor predictability. New functional leads picked up from the traditional knowledge and experiential database may help to reduce time, money, and toxicity, which are the three specific hurdles in the drug development.

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