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PHARMACOLOGICAL ACTIVITIES OF *CHENOPODIUM ALBUM* LINN.- A REVIEW

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ABSTRACT

India has a great variety of medicinal plants and is one of the richest countries in the world in terms to genetic resources of natural resources since time commercial. Ayurveda and Siddha systems of medicine are the traditional heritage of India where different plants have been used. The medicinal value of these plants lies in some chemical active substances that produce a physiological action. *Chenopodium album* is one of the most widely distributed species of weeds in the world. Commonly found in India, South Africa, Australia and the Americas. In India, the plant is commonly called Bathua and found usually in the winter season. The plant contains various phytochemicals like saponins, flavonoids, glycosides, fixed oils, gums and tannins, etc. Pharmacological studies reported that the plant possess various activities such as anticancer, hepatoprotective, antioxidant, antibacterial, anti-inflammatory, etc. The extensive survey of the literature revealed that *Chenopodium album* is an important medicinal plant with diverse pharmacological spectrum.

KEYWORDS: Herbal medicine, traditional uses, pharmacological properties, *Chenopodium album*, bathua.

INTRODUCTION

Herbal medicine or phytomedicine is a medical system based on the use of plants or plant extracts for medical treatment and traditional medicine is still widely practiced today. Herbalism has a great scope in the form of medicine, as herbs may be used for any condition

that is medically treatable. This statement does not mean that herbs are a panacea for the ills of humanity.[1]

Chenopodium album L. (family: Chenopodiaceae) is herbaceous plant which is commonly known as Bathua and also used as vegetable. It is native of Western Asia. It is a fast growing, upright, summer annual weed of goosefoot species and attains a height upto 1 meter. The plant is light green in appearance because entire plant is covered with different amounts of a waxy substance. It is commonly used for food and medicinal values. The plant and their parts are useful in curing cough, anorexia, piles, dysentery and diarrhea and kills small worms.[2]
It is an invasive weed, very common in temperate countries, growing everywhere in soils which is rich in nitrogen, especially on wasteland. The stems are glabrous, angled greenish, and somewhat succulent. The opposite leaves can be varied in appearance, with a whitish coat on the underside. Its pollen can contribute to hay-fever like allergies.[3]

The plant has its medicinal property mainly in seeds and leaves. Leaves are rich in important oil mineral matters, particularly in nitrogen, a considerable amount of albuminoids and potash salts. The plant is recommended by Hindu physicians for correction of splenic enlargement and hepatic disorders.[4]

Taxonomical Hierarchy

Kingdom	:	Plantae
Sub kingdom	:	Tracheobiont
Super division	:	Spermatophyta
Division	:	Magnoliop
Class	:	Magnliopsida
Sub class	:	Caryophyllidae
Order	:	Caryophllales
Family	:	Chenopodiaceae
Genus	:	Chenopodium L.
Specie	:	*Chenopodium album*
Botanical name:		*Chenopodium album*

Vernacular Names

Sanskrit	:	Vastuka
Hindi	:	Bathua sag

Bengali	:	Chandan betu
Tamil	:	parupukkirai
Telgu	:	Pappukura
Malyalam	:	Katu ayamoddakam
English	:	White Goose foot
Gujrati	:	Chel, Tanko
Kannad	:	Hancike
Marathi	:	Chakvat[4]

HABITAT

Chenopodium album Linn (family: Chenopodiaceae) is cultivated in agricultural land and gardens; it is distributed all over South East Asia. It is found in areas around Kashmir, Mumbai, Sikkim and throughout Pakistan.[5] Its leaves and tender twigs are used as vegetable and fodder.[6]

CULTIVATION

The seed is broadcast during April at higher elevations and in June-August at lower elevations. If wide- spaced, the plants grow vigorously. The crop matures in 135-146 days. The plants are harvested, dried, threshed and the grain is winnowed. The yield varies greatly. The growth of this plant is highly simulated by magnesium and may be an indicator for this element. As a weed, its infestation of wheat is severe. It can be controlled through clean cultivation. When the main crop is young, weedicides give promising results in controlling the weed. At the seedling stage, application of Diuron proved useful to control this weed in orchards. The species produces aeroallergens.[7]

MORPHOLOGY

A summer annual, an upright, branched that grows 4 inches to 6 feet tall. Branches generally arch upward and stems are erect, grooved, striped with bluish green to greyish and red. Leaves are simple, green, arranged alternately along branches, and are covered with white, tiny, granular scales. Leaf margins and undersides are sometimes purplish. Lower leaves are borne on stalks, have shallow lobes or coarsely toothed margins, and often resemble a goose's foot. Upper leaves do not have stalks and are linear and narrow. Leaves are 1/2 - 3 inches long and up to 1 1/4 inches wide. Petal-less, tiny, gray-green flowers occur at the ends of branches in tightly clustered spikes. Flowers are globular and are enveloped almost entirely by a cup of five green sepals. Flowers produce smooth, minute, circular black or

brown seeds, covered with a thin, papery casing. Seeds are papillate, granular, elliptical, irregularly pentagonal-hexagonal, seed coat black, glossy, edge fairly acute evenly wide along its entire length.[8-10]

CHEMICAL CONSTITUENTS

The medicinal importance of a plant is due to the presence of some special substances like glycosides, alkaloids, volatile oils, resins, gums and tannins etc. These active principles usually remain concentrated in the storage organs of the plants viz., seeds, roots, leaves, bark, etc.[5] The phytochemical analysis revealed presence of 0.02% glycosides in aerial parts of the plant.[11]

Seeds of *Chenopodium album* includes alkaloids, Saponins, glycosides, fixed oils and tannins.[12] The seeds of *Chenopodium album* contains 3.3g/100g of protein, 1.6% reducing sugar, 3.7% of total sugar, 3.5 to 5.8% lipid content, 17.9 to 25.9 mg/100g Na, 471 to 550.8 mg/100g K, 135.3 to 175.8 mg/100g Mg, 67.4 to 152.3 mg/100g Ca, 0.8 to 1.1 mg/100g Mn were reported.[13]

Leaf of *Chenopodium album* contains β-sitosterol, lupeol, 3-hydroxynonadecyl henicosanoate.[14] Leaves are rich in an essential oil, mineral matters particularly in potash salts; a considerable amount of albuminoids and other compounds of nitrogen.[4] The abundant constituents of the leaf oil were: p- cymene (40.9%), ascaridole (15.5%), pinane-2-ol (9.9%), α-pinene (7.0%), β-pinene (6.2%) and α-terpineol (6.2 %).[15]

The mature plant is reported to be poisonous to sheep and swine when ingested in large quantities over a prolonged period, probably due to oxalic acid. The leaves contain considerable amount of soluble oxalates, found maximum in leaves followed by flowers and stem.[7]

TRADITIONAL USES

In traditional system of medicine, Lamb's-quarter tea was used to treat stomachache, scurvey and diarrhea and the leaves were used as a poultice over wounds and bites. In Mexico the cooked leaves and seed heads are believed to keep the digestive system clean and healthy. Leaves are also used for arthritis and rheumatism by washing the joints and limbs with decoction. A warm poultice of the leaves is used to treat headache.[16] Leaves are also used in constipation.[14]

These are also used as laxative, anthelmintic against round-and hookworms, blood-purifier, antiscorbutic. An infusion is used for spleen enlargement, hepatic disorders, intestinal ulcers, biliousness. Used for treating burns. The leaves have ascaridole which is used for treating round-and hookworms. The oil also contains traces of ascaridole. Seeds isolated cryptomeridiol which showed significant growth promoting activity.[6]

PHARMACOLOGICAL ACTIVITIES

Anticancer

The methanolic, ethanolic and aqueous extract of the leaves of *Chenopodium album* were screened for their anti cancer properties in BHK-21 cell line. Both the extracts showed positive results with successful control of cell's growth.[17]

As antibreast cancer bioagent

This study was aimed to investigate the effects of *Chenopodium album* (leaves) on the growth of estrogen independent (MDA-MB-468) and estrogen dependent (MCF-7) human breast cancer cell lines. Their cytotoxicity were assessed by different solvent extracts (ethyl acetate, petroleum ether and methanol) using MTT [3-(4, 5-dimethyl thiazol-2-yl)-2, 5-diphenyl tetrazolium] and TBE (Trypan blue exclusion) bioassay. Methanolic extract of *Chenopodium album* (leaves) possessed maximum antibreast cancer activity having IC (50) value 27.31 mg/ml against MCF-7 cell line. The MeOH extract of *C. album* (leaves) against MCF-7 breast cancer cell line had significant percent inhibition (94.06%) at 48 h of exposure and concentration 100 mg/ml ($p < 0.05$) indicated the presence of some structural moiety which was responsible for this observed antiproliferative effect.[18]

Antiulcer

The effects of alcoholic extract of aerial parts of *Chenopodium album* Linn. (Chenopodiaceae) was investigated in rats to evaluate the antiulcer activity by using three models, i.e., ethanol, pyloric ligation and cold restraint stress induced ulcers. The study indicated that the free acidity, volume of gastric acid secretion, ulcer index and total acidity with respect to control was significantly reduced using alcoholic extract.[19]

Antibacterial activity

The antibacterial activity of *Chenopodium album* against various pathogenic bacteria viz. *Salmonella typhimurium, Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, Proteus vulgaris, Bacillus subtilis* and *Pseudomonas aueruginosa* was

evaluated. The aqueous and methanol leaf extract revealed strongest antibacterial activity against *P. aeruginosa* and *S. aureus* respectively.[20] The methanol leaf extract inhibited *Bacillus subtilis, Staphylococcus epidermidis*, *Escherichia coli* and *Staphylococcus aureus*.[21] The methanol leaf extract at different concentration show inhibition against *S. aureus, B. subtilis, E. coli* and *P.aueruginosa*.[22] The flowers and leaves ethanolic and methanolic extracts of *Chenopodium album* L. don't have any activity against the selected bacterial strains [*Pseudomonas aeruginosa* (ATCC 27853), *Bacillus cereus* (ATCC 1274), *Staphylococcus aureus* (ATCC25923) and *Escherichia coli* (ATCC 25922)].[23]

Spasmolytic and Analgesic

The plant was extracted in ethanol and fractionated in water, chloroform, *n*-butanol and ethyl acetate. The crude extract exhibited a dose-dependent increase in relaxation of smooth muscles. The ethyl acetate and chloroform fractions exhibited relaxation of the intestinal muscles whereas, *n*-butanol fraction produced strong relaxant effect. Overall, the activity produced by *n*-butanol fraction was found to be highly significant. Tail flick method in mice was carried out for the analgesic effect of the crude extract.[5]

Hepatoprotective activity

The effect of aqueous and alcoholic extracts of the aerial parts of *Chenopodium album* was investigated at the doses of 200 and 400 mg/Kg for hepatoprotective activity against paracetamol and alcohol induced hepatotoxicity using histopathological method and biochemical markers. Significant hepatoprotective activity was showed by both the extracts as clearly seen by restoration of alkaline phosphatase, blilrubin and serum transaminases content.[24-25] The effect of methanol and acetone extracts, in ratio of (50:50) of dried whole plant of *Chenopodium album* Linn, was investigated hepatoprotective activity against paracetamol induced hepatic injury, was achieved by injecting paracetamol 2.5 ml/Kg orally in equal proportion with dimethylsulfoxide (DMSO). Acetone and methanol extract at (400 mg/Kg, oral) showed significant hepatoprotective activity identical to that of standard drug, silymarin.[26] In the in vitro studies, the effect of ethanol extract against carbon tetrachloride CCl_4 induced hepatotoxicity of *Chenopodium album* leaves was found to be most active whereas in the in vivo studies, the ethanol extract exhibited significant protection against CCl_4 induced hepatotoxicity.[27]

Antioxidant

A new phenolic glycoside (chenoalbuside) from the methanol extract of the seeds of *Chenopodium album* was isolated. The new compound was assessed for antioxidant potential by the DPPH assay, and the RC_{50} value was found to be 1.4 x 10^{-4} mg/mL.[28] The aqueous, methanol and petroleum ether extract of seeds of *Chenopodium album* revealed that it possessed good antioxidant potential of FRAP and ABTS which proved them as potent hydrogen and electron donors.[21] The study investigated antioxidant activity as well as determined phenolic acids of methanolic extracts from the leaves and fruits of *Chenopodium album*. Extracts were subjected to acidic hydrolysis in order to obtain total free phenolic acids. The antioxidant activity was examined by using hydroxyl radical-scavenging activity and DPPH assays. From the study it has been revealed that the methanolic extracts of fruits and leaves have great potential as a source for natural health products.[29]

Anthelmintic activity

The water and methanol extract of aerial parts of *Chenopodium album* evaluated for anthelmintic activity. The water extract @ representing 2 g/Kg bw powder is as effective as mornatel at recommended doses. The presence of 0.02% glycosides was revealed by phytochemical analysis.[11] The crude aqueous methanolic extract (AME) of whole plant of *Chenopodium album* evaluated for its anthelmintic activity. Mature Haemonchus contortus and their eggs in adult motility assay was determined in vitro anthelmintic activity. In vivo anthelmintic activity was evaluated by administering AME and crude powder (CP) in increasing doses (1.0-3.0 g/kg) in sheep naturally infected with mixed species of gastrointestinal nematodes. This study showed the use of *Chenopodium album* in the traditional medicine system by justifying that the plant possessed anthelmintic activity in vivo and in vitro.[30]

Antipruritic and antinociceptive

The effects of ethanolic extract from the fruits of *Chenopodium album* L was evaluated for antipruritic and antinociceptive activity. The extract failed to affect hind paw swelling induced by 5-HT and only showed a relatively weak inhibition on the swelling at a higher dose of 400 mg/kg. At a dose of 400 mg/kg, it also reduced the neurogenic pain response of formalin test. In conclusion, it possesses antinociceptive and antipruritic activities.[31]

Anti-inflammatory activity

Chenopodium album leaves yielded 0.64% v/w of essential oil by hydrodistillation. The aromatic compound was contained oil in bulk amount and it was revealed by GC and GC/MS analyses of the oil. The oil displayed strong anti-inflammatory activity against 12-O-tetradecanoylphorbol-13-acetate (TPA) – induced ear edema in mice.[15]

Sperm immobilizing agent

Aqueous decoction of *Chenopodium album* seed extract was assessed for its sperm-immobilizing and contraceptive efficacy both in vitro and in vivo. The minimum effective concentration of seed extract induced instantaneous immobilization of rat spermatozoa in vitro was 2 mg/mL. So, it is reported that it possesses appreciable spermicidal potential.[32]

As allergen for bronchial asthma

The study aimed to evaluate the pharmacological activity of CpG ODN which is used for bronchial asthma treatment which was induced by *Chenopodium album*. Antigen allergenic extract was prepared from *Chenopodium album* pollen. It revealed that both local and systemic levels of IL-10 and IFN-γ was significantly increased by intranasal administration of CpG/Ag, but showed no significant effect on the levels of IgG2a, IgG1 and IgE in serum ($p = 0.06$). This study demonstrated that the therapeutic effects of CpG ODN had not only on nasal lymphocytes but also on splenocytes to produce IFN-γ as a Th1 cytokine and IL-10 as a regulatory cytokine.[33]

CONCLUSION

Medicinal plants have the ability to synthesize a wide variety of chemical compounds due to which important biological functions are performed. The extensive survey of literature revealed that *Chenopodium album* is an important medicinal plant with diverse pharmacological spectrum. The therapeutic value of *Chenopodium album* was confirmed due to the pharmacological studies reported in this review. The plant possess various activities such as antibacterial, anti-inflammatory, anticancer, antiulcer, hepatoprotective, antioxidant, anthelmintic, spasmolytic and analgesic, sperm immobilizing agent, antipruritic and antinociceptive. Hence, this plant provides a significant role in the prevention and treatment of a disease.

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