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Chenopodium album Linn.: A REVIEW ON VARIOUS PHARMACOLOGICAL ACTIVITIES

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AUTHORS' CONTRIBUTIONS

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ABSTRACT

Chenopodium album is widely distributed across the globe and is not only being used in the traditional system of medicine but also in modern medicine. Traditionally, the plant has been used as a hepatoprotective, sedative, diuretic, blood purifier, antiscorbutic laxative and as an anthelmintic against round and hookworms. It is also claimed that the leaves of this plant has a long traditional use in the treatment of digestive, peptic ulcer and hepatic disorder. A comprehensive account on various pharmacological activities like Antioxidant, Antimicrobial, Anti-diabetic, Antipruritic, Antinociceptive, Anti-inflammatory, Anthelmintic and Hepatoprotective activities of *C. album* reported are discussed in this review to explore its immense medicinal properties.

Keywords: Pharmacological activities; *Chenopodium album*; antioxidant; antimicrobial; anti-diabetic; antipruritic; antinociceptive; anti-inflammatory; anthelmintic and hepatoprotective activities.

1. INTRODUCTION

Since the dawn of medicine, diverse groups of people are using medicinal plants to treat various diseases. As the medicinal plants are a reservoir of biologically active compounds with therapeutic properties and minimum side effects, it has drawn the attention of scientists across the globe to use them in the modern medicine system so that the harmful use of chemicals and drugs can be minimized.

Many medicinal plants are used for the treatment of various diseases and one such plant is *Chenopodium album* which is a fast growing annual plant. It falls

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under the genus Chenopodium which is distributed in most parts of the world and contains 250 species [1]. About 21 species of this plant are found in India of which some are cultivated to use as a vegetable and a few for the grains obtained from the plant [2]. Naturally, it grows as a weed in the fields of wheat, barley, mustard, gram and other crops [3,4]. The tender shoots are eaten raw and are also cooked as a vegetable. The leaf of this plant is incorporated in various conventional food items to improve the product's nutritional quality and adds variety to the diet [5].

Various studies indicate that *C. album* is an important dietary element rich in nutrients and antioxidants [6,7]. It is an important source of vitamins like vitamin C and β-carotene which occurs in the young shoots and mature plants of *C. album* [8]. It is reported that the leaves of this plant have anti-pruritic, antinociceptive activity [9], sperm immobilizing agent [10], cryptomeridiol and 8-alpha-acetoxycyryptomeridiol as growth promoting activity [11]. It is also claimed that *C. album* contains flavonoid as phenolic amide [12] and has hypotensive activity [13]. Moreover, it is rich in iron [14] and other constituents like saponin [15], cinnamic acid amide [16], alkaloid chinoalbicin [17], apocarotenoids [18], xyloside [19], phenols and ligands [20]. Because of its high nutritional value and medicinal properties, the plant has been used to treat various ailments which occur due to nutritional deficiency. Therefore, for dietary awareness and also to explore the immense medicinal potential of this plant, various pharmacological activities are discussed in this review.

2. PHARMACOLOGICAL ACTIVITIES OF *Chenopodium album*

2.1 Anti-Oxidant Potential

Medical science has given much emphasis to naturally occurring antioxidants like phenolic acids, polyphenols and flavonoids which inhibits both free radicals and oxidative chain reactions within the tissues and membranes. It is reported that polyphenols are the major plant compounds with antioxidant activity that plays an important role in quenching reactive oxygen species [21]. In 2016, Nowak et al. reported that *C. album* extracts can be used as a readily accessible source of natural antioxidants and also for food supplement production [22]. In 2017, Lone et al. evaluated the antioxidant activity of *C. album* by DPPH, riboflavin photo-oxidation, deoxyribose and lipid peroxidation assays. They reported that the extracts exhibited scavenging effect in concentration dependent manner on superoxide anion radicals and hydroxyl radicals [23]. In 2019, Saini et al. studied the antioxidant activity of *C. album* by DPPH free radical scavenging activity, total phenolics content and ascorbic acid estimation. Their results justified the nutritional and biological significance of *C. album* [24]. In 2020, Arora et al. carried out a phytochemical screening of *C. album* and reported the presence of flavonoids, tannins, carbohydrates, saponins, proteins and alkaloids [25]. Similar results were also reported by Choudhary et al., [26] and Suleman et al. [27].

2.2 Anti-Microbial Activity

Antibiotics, antifungals, antiprotozoals and antivirals are a group of drugs used to treat microbial infections. Kumar and Kumar [28] studied the antimicrobial activity of methanol and ethyl acetate extracts of *C. album* against common human pathogens like *Klebsicella*, *P. acne*, *E. coli*, *P. aeruginosa*, *C. albicans* and *S. cerevisiae*. They reported significant antimicrobial activity of methanol extract of *C. album* against *P. acne* and *S. cerevisiae* and mild antimicrobial activity of ethyl acetate extract [28]. To describe the antibacterial activities, Kaur et al. [29] used well plate method where he used three different solvent extracts (methanol, acetone and chloroform) of leaves of *C. album* against the test organisms namely, *Lactobacillus*, *Bacillus subtilis* and *Escherichia coli* and examined the size of zone of inhibition. The maximum zone of inhibition for 100% concentration was observed as *E. coli* (19 mm) and *Lactobacillus* (19 mm) in diameter respectively, while no antibacterial activity was shown against *B. subtilis.* Compared with standard Amoxicillin, it was found to be 23 mm in diameter for *Lactobacillus* and 25 mm for both *E. coli* and *B. subtilis* in terms of zone of inhibition [29]. Saini et al. [30] mentioned that the antimicrobial effect of methanolic leaf extract of *C. album* when tested by well diffusion method, proved that the plant possesses considerable inhibitory activity against *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Candida albicans* and *Candida glabrata* [24]. Choudhary et al. [26] also reported antimicrobial activity of *C. album* during phytochemistry and pharmacological exploration of *C. album* [26]. Recently, Suleman et al., 2021 also reported the antibacterial activity of *C. album* against *Staphylococcus auerus* and *S. typhi* [27]. A similar report on the antibacterial activity of *C. album* against Rhizobacteria was also reported by Maria et al., [30].

2.3 Anti-Diabetic Effect

Kant et al. [31] investigated the antidiabetic effect of methanolic extract of *C. album* roots against STZ-induced male Wistar albino rat models. Their results

showed a significant decline in fasting blood glucose levels and a high dose (HD) of *C. album* extract significantly normalized insulin levels. They further revealed that the methanol extract of *C. album* roots was effective in normalizing plasma lipid status and decreased cholesterol, triglyceride and LDL levels. Also, a significant decrease in the liver enzymes like SGPT and SGOT was reported [31]. Choudhary et al. [32] evaluated the *in vitro* and *in vivo* antidiabetic potential of the flavonoid fraction of *C. album* and reported potent antidiabetic activity in a dose-dependent manner in both *in vitro* and *in vivo* diabetic models without any sign of severe toxicity [32]. In a recent review study, Nepal and Chakraborty [33] reported anti-diabetic activity of the plant *C. album* [33].

2.4 Anti-pruritic and Antinociceptive Activity

To evaluate the crude leaf extract of *C. album* for central antinociceptive activity in albino mice, Magama and Asita, [34] used Eddy's hot plate test. For antinociception, they used 0, 50, 100 and 150 mg/kg body weight and standard drug Aspirin (150 mg/kg body weight) and found that both Aspirin and the extract at 100 and 150 mg/kg body weight exhibited significant ($p<0.05$) dose-dependent antinociception compared with the negative control at the seven time intervals; 30, 60, 120, 180, 240, 300, 360 minutes. They found that the maximum antinociception (71.47%) for the 150mg/kg body weight group being at 30 minutes after administration and statistically not different from that of Aspirin (67.44%) at the same time interval. Between 30 and 180 minutes after oral administration of test substances, antinociception due to *C. album* extract (150 mg/kg body weight) was statistically not different from that due to Aspirin which remained more efficacious than the extract till the end of experiment at 360 minutes; a parallel shift from 240 minutes suggesting a similar mechanism of antinociception [34]. Similar findings on the antinociceptive activity of *C. album* were also reported by Mushtaq et al., [35]. Choudhary et al. [26] also reported the antinociceptive activity of *C. album* during phytochemistry and pharmacological exploration of *C. album*.

2.5 Anti-Inflammatory Activity

Kim et al. studied free radical scavenging activity and enzyme-linked immunosorbent assay (ELISA) experiments on *C. album* extracts to evaluate their anti-oxidative and anti-inflammatory effects. In the free radical (1, 1-diphenyl-2-picrylhydrazyl, DPPH) scavenging activity, EC50 of *C. album* was measured at 0.524 mg/ml. The IL-6 and TNF-α ELISA assay showed that IL-6 in mouse spleen cells treated with 1 mg/ml of sample decreased the production of IL-6 concentration by 72.30%. In the case of TNF-α, *C. album* decreased 77.85% of TNF-α production. Their results confirmed antioxidant and anti-inflammatory effects of *C. album* which can be applied to natural medicine cosmetics having anti-inflammatory effects [36]. Similar findings on the anti-inflammatory activity of *C. album* were also reported by Mushtaq et al., [35]. Amodeo et al. studied the *in vitro* anti-inflammatory activity of *C. album*. They reported a significant inhibitory activity on nitric oxide production in lipopolysaccharide-stimulated cells by *C. album* extract [37]. Choudhary et al. [26] also reported the anti-inflammatory activity of *C. album* during phytochemistry and pharmacological exploration of *C. album*.

2.6 Anthelmintic Activity

Anthelmintic or antihelminthic is the substance capable of eliminating parasitic worms (helminths) from the body. It has been reported that helminth infection causes stunted growth, cognitive impairment, anemia and increased susceptibility to other diseases in both human and domestic animals which adds to the economic burden of developing countries [21]. Certain medicinal plants having anthelmintic action has attained great interest for their capability to treat the disease. Lone et al. [23] evaluated the anthelmintic activities of *C. album* against gastrointestinal nematodes of sheep where they used faecal egg count reduction assay for *in vivo* study. They reported that the extracts exhibited dose- and time- dependent anthelmintic effects on *Haemonchus contortus* as compared to the standard anthelmintic agent, levamisole. Choudhary et al. [26] also reported the anthelmintic activity of *C. album* during phytochemistry and pharmacological exploration of *C. album*. Recently, Choudhary et al., studied the in vitro anthelmintic activity of *C. album* on earthworms and reported that *C. album* exhibits two major compounds by LC-MS, i.e., NG and DG, that are mainly accountable for its anthelmintic activity [38].

2.7 Hepatoprotective Activity

Das and Borthakur, 2020 studied the hepatoprotective activity of methanolic leaves extract of *C. album* against paracetamol induced liver damage in albino rats using the biochemical parameters like SGOT, SGPT, ALP, direct bilirubin, total bilirubin and albumin. They reported significant alterations in the increased level of the parameters due to the treatment with the methanolic leaves extract of *C. album* and the results were also supported by histopathological

studies [39]. Some findings on hepatoprotective activity of *C. album* were reported by Parkash and Patel [40]; Aman et al. [41]; Choudhary et al. [26].

3. CONCLUSION

From this review, it can be concluded that the plant *C. album* possesses important pharmacological activities viz. anti-oxidant, anti-microbial, anti-diabetic, anti-pruritic, antinociceptive, anti-inflammatory, anthelmintic and hepatoprotective which is of great medicinal value. Also, isolation of pure phytopharmaceuticals and determining their mode of action may lead to the synthesis of novel therapeutic agents. However, there is an evident literature gap regarding the anticancer effect of *C. album* and phyto-analytical properties of this plant. Therefore, further research on this therapeutically potent herb and its potent toxicity is recommended.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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