

# Chenopodium album: Exploring the Therapeutic Values of the Magical Medicinal Herb

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## Abstract

Medicinal plants have been used in health care since several decades. It would not be incorrect to say that the medicinal plants can be game changers in medical care. These are widely used because of their easy availability, affordability, efficacy, and having minimal or no side effects. A plant can be labeled as a medicinal plant whose parts such as flowers, leaves, roots, stems, fruits, or seeds can be directly or indirectly used in medicinal preparations. Knowledge of the beneficial properties of medicinal plants is of great significance to both health care professionals as well as patients. The medicinal plants, in specific, produce chemical compounds called phytochemicals, which have the potential to be used as drugs. The pharmacological activity of these phytochemicals in medicinal plants forms the scientific basis for their use in modern medicine. *Chenopodium album* is a wonder plant with significant functional potential that remains underutilized till date. The plant is added to food to improve its sensory and functional qualities, in addition to providing vitamins, minerals, fiber, and important fatty acids. Traditionally, the plant has been utilized as an anthelmintic against round- and hookworms, as well as a blood purifier, diuretic, hepatoprotective, and antiscorbutic laxative. Additionally, it is also known to possess anticancer properties. Thus, there is a lot of promise for a thorough biological assessment of *C. album*. Regarding processing parameters, not much investigation has ever been done on this potentially beneficial plant. This review covers the importance of *C. album* in terms of its beneficial effects for several medical conditions, highlighting its anticancer activity.

## Keywords

- *Chenopodium album*
- anticancer
- antioxidant
- antimicrobial
- anti-inflammatory
- medicinal values

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## Introduction

Cancer is an illness that has a serious impact on people all around the world. New treatments are constantly needed to cure and prevent this deadly illness. Natural substances are attracting scientific and academic interest since they are thought to have fewer harmful side effects than existing treatments like chemotherapy. New therapeutic medications are being developed as a result of research in “naturally occurring secondary metabolites” produced by the plant kingdom that has anticancer properties.<sup>1</sup>

The second leading cause of death worldwide is cancer, a disease that may be treated. There is an urgent need to develop more potent anticancer drugs given the rising risks of drug-resistant malignancies. A highly sensible substitute for contemporary cancer treatment is herbal therapy. One useful technique for identifying and expanding on more biologically dynamic molecules is the study of natural products.<sup>2</sup>

Eighty percent of rural residents rely on medicinal plants as their main source of health care, according to the World Health Organization. The knowledge of the traditional use of local herbs forms the basis of these practices. Biologically active substances found in medicinal plants often target tumor cells by a variety of processes, which can lead to the activation of cell cycle arrest, extrinsic and intrinsic apoptosis, autophagy, etc.<sup>3,4</sup>

*Chenopodium album* is a widespread species, which may thrive in groves, hedgerows, and roadsides, as well as in nearly any kind of organic soil that is rich in nitrogen and at elevations of up to 1,000 m. Being a facultative halophyte, this species is widely found in temperate and subtropical regions and exhibits a notable ability to withstand environments with high salt. Total phenols, saponins, alkaloids, flavonoids, glycosides, essential oils (EOs), trigonelline, chenopodine, potassium, and vitamin C are among its many phytochemicals. In addition to its traditional usage as a purgative, helminthic, and a blood purifier, the plant possesses a variety of pharmacological potentials, including antioxidation, anticancer, antipruritic, antinociceptive, anti-inflammatory, antiviral, antibacterial, and antifungal properties.

Numerous karyotypic investigations have documented significant genotypic variation among various *C. album* species. There has been significant variation in the protein profile of the seeds and the deoxyribonucleic acid markers of the *C. album* complex, primarily based on the region of origin.<sup>5,6</sup>

## Vernacular Names

*C. album* has been known world over by different names, as per the local languages. The vernacular names of *C. album* have been described in ►Table 1.<sup>7</sup>

## Taxonomy

The taxonomy details of *C. album* have been described in ►Table 2.

**Table 1** Vernacular names of *Chenopodium album*

Hindi	Bathua sag
Sanskrit	Vastuka
English	White goose foot
Bengali	Chandan betu
Tamil	Parupukkirai
Telugu	Pappukura
Malayalam	Katu ayamoddakam
Gujarati	Chel and Tanko
Kannada	Hancike
Marathi	Chakvat

**Table 2** Taxonomy of *Chenopodium album*

Kingdom	Plantae
Subkingdom	Tracheobiont
Superdivision	Spermatophyte
Division	Magnoliop
Class	Magnoliopsida
Subclass	Caryophyllidae
Order	Caryophyllales
Family	Amaranthaceae
Genus	Chenopodium
Species	<i>Chenopodium album</i> Linn.

## Origin and Geographical Distribution

Known mostly as a noxious weed, *C. album* is found throughout the world, primarily at higher elevations in the tropics, from 70°N to 50°S, including all of Africa. As a grain crop, it has been domesticated and cultivated throughout northern India's Himalayan area and Nepal.<sup>8</sup> It is also grown as a traditional leafy vegetable in India. Due to widespread cultivation, its native range is unknown; however, it spans the majority of Europe. Archaeological evidence also points to its prehistoric cultivation as a pseudocereal in Europe. Although they fall under the *C. album*, plants endemic to eastern Asia frequently differ from European examples. It can be found practically anywhere in nitrogen-rich soils, particularly on wasteland.<sup>9</sup>

## Botanical Description

*C. album* is a green plant that grows between 20 cm and 1.5 m in height. White-mealy below, or occasionally green on both sides, and irregularly dentate are its typical characteristics. Hermaphrodite, tiny (3 mm in diameter), assile, green, and unnoticeable, the blooms have five sepals and five stamens but no petals. The seed is tiny, nearly round, oval in cross-section, and glossy black. The fruit is an achene, or seed covered by the thin, papery pericarp.

## Chemical Constituents

Glycosides, alkaloids, volatile oils, resins, gums, and tannins are some of the unique compounds that give plants their therapeutic value.<sup>10</sup> Typically, these active particles stay concentrated in the plant's storage organs, which include the seeds, roots, leaves, and bark. According to the phytochemical analysis, the plant's aerial portions contain 0.02% glycosides. Alkaloids, saponins, glycosides, fixed oils, and tannins are all found in *C. album* seeds.

Three grams of protein, 1.6% reducing sugar, 3.7% total sugar, 3.5 to 5.8% fat content, 17.9 to 25.9 mg of sodium, 471 to 550.8 mg of potassium, 135.3 to 175.8 mg of magnesium, 67.4 to 152.3 mg of calcium, and 0.8 to 1.1 mg of manganese are all present in *C. album* seeds.<sup>11</sup> EOs, minerals, especially potash salts, a significant quantity of albuminoids, and other nitrogenous substances are all abundant in leaves. P-cymene (40.9%), ascaridole (15.5%), pinane-2-ol (9.9%),  $\alpha$ -pinene (7.0%),  $\beta$ -pinene (6.2%), and  $\alpha$ -terpineol (6.2%) are the components of the leaf oil.

## Evidence of Use of *C. album* as Medicine

Folk medicine frequently uses *C. album*, a natural cure, to treat a variety of illnesses. Indeed, the traditional benefit of this plant has been revealed by a number of ethno-botanical reports. The leaves are used to cure intestinal worms, constipation, skin conditions like jaundice, and as a laxative and aphrodisiac. Additionally, the entire plant is suggested for the treatment of hepatic problems, headaches, diarrhea, dysentery, and stomach pain. Evidence supports its use as an antihelminthic, diuretic, and laxative.<sup>12</sup>

Traditional medicine has also utilized the seeds of *C. album* to fortify the wall of the urinary system. Additionally, *C. album* has been used to treat influenza and fever in traditional Indian medicine. Hemorrhoids and gastroenteritis have been treated using the entire plant, either cooked by itself or in combination with other herbs. Additionally, it has been employed as a diuretic, depurative, and antianemic.<sup>12</sup> Furthermore, the roots are utilized to treat colic.<sup>13</sup>

When combined, these results demonstrate *C. album*'s historical significance in international traditional pharmacopoeia. However, it is crucial to remember that its traditional use varies depending on a number of factors, such as preparation techniques, ethnic group, and geographic location. Indeed, each population's cultural level influences the traditional use of *C. album* as a medicinal plant.<sup>14</sup> Let us examine this wonder plant's many nutritional and therapeutic qualities in more detail.

## Antimicrobial and Antifungal Activities

Numerous biological properties of *C. album* have been demonstrated by pharmacological studies conducted on its EOs and methanol extracts. In particular, it exhibits antibacterial action against a variety of pathogenic bacteria, including *Salmonella typhimurium*, *Escherichia coli*, *Pseudomonas*

*aeruginosa*, *Bacillus subtilis*, *Staphylococcus aureus*, and *Klebsiella pneumoniae*.<sup>5</sup>

In general, it has been discovered that Gram-positive bacteria are more susceptible to *C. album* than Gram-negative bacteria. Furthermore, *C. album* has antifungal properties against harmful fungus as *Aspergillus flavus*, *Fusarium oxysporum*, *Candida glabrata*, *Ascochyta rabiei*, *Candida albicans*, and *Sclerotium rolfsii* Sacc.

## Anticancer Properties

It has also been observed that *C. album* extracts and isolated molecules have antioxidant action. By inhibiting cell growth and apoptosis, extending mean survival time, reducing tumor weight, reestablishing all metabolic parameters, and boosting host immunity, *C. album* leaf extract has demonstrated strong anticancer action. Ehrlich ascites carcinoma, gastric cancer, and breast cancer have all been demonstrated to be susceptible to the anticancer effects of *C. album*.<sup>15</sup> Consequently, the leaf of *C. album* has been considered as a powerful source of bioactive chemicals for use in cancer chemotherapy.

## Antiulcer Properties

Rats used to test the antiulcer efficacy of an alcoholic extract of the aerial portions of *C. album* Linn. (Chenopodiaceae) demonstrated a substantial decrease in total acidity, ulcer index, volume of stomach acid secretion, and free acidity when compared with control.<sup>16</sup> This study demonstrates the potential of *C. album* as a future antiulcer drug.

## Hepatoprotective Activity

Along with its various therapeutic benefits, *C. album* is also recognized to offer liver-protective actions. Using a histological approach and biochemical markers, one study examined the hepatoprotective effects of aqueous and alcoholic extracts of the aerial portions of *C. album* at doses of 200 and 400 mg/kg against alcohol-induced hepatotoxicity and paracetamol. Both extracts had significant hepatoprotective action, as seen by the restoration of serum transaminases, bilirubin, and alkaline phosphatase levels.<sup>17</sup>

## Antioxidant Activity

Without a doubt, *C. album* has a high level of antioxidant activity.<sup>18</sup> In one study, the 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay was used to evaluate the antioxidant capacity of a novel phenolic glycoside (chenoalbuside) from the methanol extract of *C. album* seeds. The RC50 value was determined to be  $1.4 \times 10^{-4}$  mg/mL.<sup>18</sup> The seeds of *C. album* showed good antioxidant capacity in the aqueous, methanol, and petroleum ether extracts.<sup>19</sup>

Another study identified the phenolic acids in methanolic extracts of *C. album* leaves and fruits and examined antioxidant efficacy. Total free phenolic acids were obtained by acidic hydrolysis of the extracts. Using DPPH tests and hydroxyl radical-scavenging activity, the antioxidant activity was investigated. The findings showed that fruit and leaf methanolic extracts have a lot of potential as a source for natural health products.<sup>17</sup>

### Anti-Inflammatory Activity

The EO (0.64% v/w) obtained by hydrodistillation of *C. album* leaves has been proven to display strong anti-inflammatory activity against 12-o-tetradecanoylphorbol-13-acetate-induced ear edema in mice.<sup>20</sup>

### Nutritional Value

The nutritional worth of these *C. album* seeds has been highlighted in recent years. Due to its high protein content and recommended for people with gluten or wheat sensitivity, it has been described as having very significant nutritional potential. The seeds' distinct benefit is its high total protein content and well-balanced amino acid composition (lysine and methionine).<sup>21</sup>

### Conclusion

Research on medicinal plants has always drawn a lot of scientific interest. All traditional medical systems include herbal treatments, which are a true victory of folk therapeutic diversity.

This literature review has highlighted that *C. album* is an important medicinal plant with diverse pharmacological spectrum. The plant possesses various activities such as antimicrobial, antifungal, anticancer, antiulcer, and antioxidant. In addition, it is hepatoprotective and also has nutritive value. The need of the hour is to translate these properties of this wonder plant to medicines, which can be of immense help to mankind.

### Conflict of Interest

None declared.

### References

- Greenwell M, Rahman PK. Medicinal plants: their use in anticancer treatment. *Int J Pharm Sci Res* 2015;6(10):4103–4112
- Chandra S, Gahlot M, Choudhary AN, et al. Scientific evidences of anticancer potential of medicinal plants. *Food Chem Adv* 2023; 2:100239
- Ahmad Khan MS, Ahmad I. Chapter 1-herbal medicine: current trends and future prospects. In: *New Look to Phytomedicine*. Cambridge, MA: Academic; 2019
- Khan T, Ali M, Khan A, et al. Anticancer plants: a review of the active phytochemicals, applications in animal models, and regulatory aspects. *Biomolecules* 2019;10(01):47
- Chamkhi I, Charfi S, El Hachlafi N, et al. Genetic diversity, antimicrobial, nutritional, and phytochemical properties of *Chenopodium album*: a comprehensive review. *Food Res Int* 2022; 154:110979
- Bhargava A, Rana TS, Shukla S, Ohri D. Seed protein electrophoresis of some cultivated and wild species of *Chenopodium*. *Biol Plant* 2005;49:505–511
- Fuentes-Bazan S, Uotila P, Borsch T. A novel phylogeny-based generic classification for *Chenopodium sensu lato*, and a tribal rearrangement of *Chenopodioideae* (*Chenopodiaceae*). *Willdenowia* 2012;42(01):5–24
- Eslami SV, Ward S. *Chenopodium album* and *Chenopodium murale*. In: *Biology and Management of Problematic Crop Weed Species*. Australia: Academic Press; 2021:89–112
- Choudhary SP, Sharma DK. Bioactive constituents, phytochemical and pharmacological properties of *Chenopodium album*: a miracle weed. *IJP* 2014;1(09):545–552
- Yadav P, Kumar A, Mahour K, Vihan VS. Phytochemical analysis of some indigenous plants potent against endoparasite. *J. Adv. Lab. Res. Biol.* 2010;1(01):56–59
- Pachauri T, Lakhani A, Maharaj Kumari K. Analysis of nutrient content of underutilized grain: *Chenopodium album*. In: *Chemistry of Phytopotentials: Health, Energy and Environmental Perspectives*. Berlin, Heidelberg: Springer; 2012:93–96
- Singh S, Singh A, Hallan SS, Brangule A, Kumar B, Bhatia R. A compiled update on nutrition, phytochemicals, processing effects, analytical testing and health effects of *Chenopodium album*: a non-conventional edible plant (NCEP). *Molecules* 2023;28(13):4902
- Bnouham M, Merhfouf FZ, Elachoui M, et al. Toxic effects of some medicinal plants used in Moroccan traditional medicine. *Moroccan Journal of Biology*. 2006;2(03):21–30
- Karunamoorthi K, Jegajeevanram K, Vijayalakshmi J, Mengistie E. Traditional medicinal plants: a source of phytotherapeutic modality in resource-constrained health care settings. *J Evid Based Complementary Altern Med* 2013;18(01):67–74
- Lichota A, Gwozdziński K. Anticancer activity of natural compounds from plant and marine environment. *Int J Mol Sci* 2018;19(11):3533
- Nigam V, Paarakh PM. Anti-ulcer effect of *Chenopodium album* Linn. Against gastric ulcers in rats. *Int J Pharm Sci Drug Res* 2011;3(04):319–322
- Aman S, Mazumder H, Gupta UK, Nayak A. Pharmacological activities of *Chenopodium album* Linn.- a review. *World J Pharm Res* 2016;5(10):361–371
- Nahar L, Sarker SD. Chenoalbuside: an antioxidant phenolic glycoside from the seeds of *Chenopodium album* L. (*Chenopodiaceae*). *Rev Bras Farmacogn* 2005;15(04):279–282
- Pandey S, Gupta RK. Screening of nutritional, phytochemical, antioxidant and antibacterial activity of *Chenopodium album* (Bathua). *J Pharmacogn Phytochem* 2014;3(03):1–9
- Usman LA, Hamid AA, Muhammad NO, Olawore NO, Edewor TI, Saliu BK. Chemical constituents and anti-inflammatory activity of leaf essential oil of Nigerian grown *Chenopodium album* L. *EXCLI J* 2010;9:181–186
- Agarwal A, Rizwana, Tripathi AD, Kumar T, Sharma KP, Patel SKS. Nutritional and functional new perspectives and potential health benefits of quinoa and chia seeds. *Antioxidants* 2023;12(07):1413