



Review Article

Chenopodium album Linn: An outlook on weed cum nutritional vegetable along with medicinal properties

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Abstract

The *Chenopodium album* is a significant nutritious and medicinally beneficial plant. Its fresh leaves and stem are full of nutrients, especially amino acids. The leaves of *C. album* contain various nutrients such as protein, fat, fiber, minerals and vitamins. Moreover, it is also a good source of iron and calcium. *Chenopodium album* has many medicinal properties such as antimicrobial, antihelminthic, antioxidant, antidiarrheal, and hepato-protective. The leaves of this plant are used in traditional medicines to treat digestive, peptic ulcer and hepatic disorder. Therefore, the *Chenopodium album* is a beneficial plant for human beings. However, limited research studies have been conducted by researchers for the processing of this plant. This article mainly discusses different aspects of this plant to enhance the awareness on its nutritional significance.

Keywords bathua, *Chenopodium album*, health benefits, medicinal properties, nutritional composition, phytochemicals

Introduction

Chenopodium album Linn is originating from Western Asia and belongs to the family “Chenopodiaceae”. This plant is categorized under the genus “*Chenopodium*” which is widely distributed all over the world and has about 250 species [1]. It is found throughout the world mainly in India, North America, Northern East and Europe [2]. Generally, about 21 species of *C. album* are found in India mainly in Rajasthan, Himachal, Uttarakhand and Uttar Pradesh [3-4], where some species are cultivated as vegetables and some are grown as a grain crop (*Chenopodium quinoa* and *C. album*) [5-6]. *C. album* has been renewed in Asia in the present time as a valuable food source because of its versatility and its potential to grow under stressed conditions such as low rainfall, high altitude, hot sun, and sub-freezing temperatures.

Generally many thousands of known food plants are ignored by scientific researches and agriculturalists in modern crop production which are treated as a weed according to Ethno-Botanical Survey. *C. album* naturally grows as a weed in the field of winter season crops or Rabi crops (Wheat, Barley, Mustard, and others) in some places of India [7]. It has lower growth as a weed while cultivated crops are leafy and tall plants. The *C. album* is a significant food crop and valuable plant in Ayurveda in tropical and subtropical countries and is abundantly used as food and herbal medicine around the world [2, 5]. The medicinal property of *C. album* is mainly found in its leaves and seeds.

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Botanical Classification

C. album L. is a leafy vegetable plant known as various names throughout the world. It is called 'Bathua sag' in Hindi and named as 'Pigweed' in English


Kingdom: Plantae	
Division: Magnoliophyta	
Class: Magnoliopsida	
Order: Caryophyllales	
Family: Chenopodiaceae	
Genus: <i>Chenopodium</i>	
Species: <i>album</i>	

Figure 1. Botanical classification and whole plant of *C. album* [9].

and it is found all over the world [3]. This plant is a polymorphous, erect, greenish-white herb, up to 3.5 m in length, and grown at an altitude of 4,700 meters [8]. Common Name: Bathua (Hindi), Vastukah (Sanskrit), Fat Hen, Lamb's-quarters, Pigweed (English), Parupukkurai (Tamil), Chandanbethu (Bengali), Bathua (Oriya), Kaduoma (Kannada), Pappukura (Telugu), Vastuccira (Malayalam), Chakvit (Konkani).

Nutritional composition

C. album is nutritional and healthy wild leafy vegetable cultivated in throughout the world [10-11]. Green leaves of *C. album* are very nutritious and rich in essential amino acid, calcium, Vitamin A and C [12]. On the other hand, another study evaluated that the *C. album* having a remarkable quantity of vitamin C and carotenoids in green leaves [13]. It is also a good source of fiber and iron content [14], that is higher as compared to spinach and cabbage, but lower than the amaranth leaves. Pande and Pathak [15] also reported that *C. album* is a good source of amino acids, leucine, isoleucine, lysine and vitamin C (as an active component). *C. album* showed good tolerance to cold, drought and salinity stress. The other attractive feature of *C. album* is that it has high lysine content.

Chemical constituents of *C. album*

The whole plant of *C. album* has various phytochemicals like alkaloids, phenols, saponins, phytosterols, and flavonoids. It mainly has two flavonoids that are kaempferol and quercetin. The leaves of *Chenopodium album* are a potential source of essential oils and mineral matter mainly potash and a good amount of albuminoids. Its root contains saponin. The *C. album* extract has been used for the isolation of 1, 2 and 16 apocarotenoids. The structure of new apocarotenoids determined to be (3R, 6R, 7E, 11E) 3-hydroxy-13 apo-alpha-carotene-13-one (1) and (6S, 7E, 9E, 11E)-3-oxo- 13apo-alpha-carotene-13-one (2) by the spectroscopic NMR and MS analysis [18].

Medicinal properties of *C. album*

Chenopodium album has some medicinal properties such as anthelmintic, antiphlogistic, antirheumatic, antidiarrheal, antioxidant, antimicrobial, contraceptive, laxative, odontalgic, etc. *Chenopodium album* isutilized for the treatment of rheumatism, bug bites, sunstroke, urinary problems, skin problems, etc. It is also known to have sedative and cooling properties, and leaves have been used to treat the burns [19].



Table 1. Physicochemical parameters

S. No.	Nutrients	Quantity
1.	Water	84.3 g
2.	Energy	44 Kcal
3.	Carbohydrates	7.3 g
4.	Fat	0.8 g
5.	Protein	4.3 g
6.	Fibre	4 g
7.	Minerals	
I	Iron	1.2 mg
II	Calcium	309 mg
III	Phosphorous	72 mg
IV	Sodium	43 mg
8.	Vitamins	
I	Vitamin A	580 µg
II	Vitamin B Complex	
(a)	Thiamine	0.16 mg
(b)	Pantothenic acid	0.092 mg
(c)	Riboflavin	0.4 mg
(d)	Niacin	1.3 mg
III	Vitamin C	90 mg

Methanolic and aqueous leaf extracts of *C. album* showed the antilithiatic effects on experimentally induced urolithiasis in rats comparable to a standard antilithiatic agent, cystone [20].

Antimicrobial properties

Methanolic extract and ethyl acetate extract of *C. album* are used for the analysis of antimicrobial activity [21]. The antimicrobial activity is analyzed in the form of zone of inhibition of *Staphylococcus aureus* ATCC 25923 (17.3 mm), *Bacillus subtilis* UC 564 (19.7mm), *Bacillus polymexia* 474 (18.3mm), *Streptococcus faecalis* ATCC 29212 (16.7mm), *Pseudomonas aeruginosa* 25619 (17.7mm), *Salmonella typhi* 57 (16.7mm), *Vibrio cholerae* 824 (17.3mm) and *Shigella dysenteriae* ATCC C3 (17.3mm), *Escherichia coli* NCTC 8196 (18 mm), *Penicillium notatum* ATCC 11625 (15 mm), *Aspergillus niger* AB 41 (16.3), *Candida albicans* ATCC 18804 (18.3 mm) [21]. The antibacterial activity was determined by using the aqueous and methanolic extracts of *C. album* against pathogenic bacteria such as *Escherichia coli*, *Salmonella typhimurium*, *Staphylococcus aureus*, *Proteus vulgaris* and *Pseudomonas aueruginosa* [22]. The studies reported that the aqueous and methanolic extract of the *C. album* leaves was effective on the tested pathogens by using the paper disc diffusion method. While the aqueous extract has been found to have excellent antibacterial activity on *Staphylococcus aureus*, the methanolic leaf extract has been reported to have the strongest antibacterial activity against *Pseudomonas aeruginosa* [22-23].

Two antiviral proteins (AVPs) named CAP-I and CAP-II were used for the isolation from the *C. album* cv Pusa Bathua 1 leaf extract which is purified from the leaves and used to prevent the tobacco mosaic virus (TMV) and sunhemp rosette virus (SRV) infection on their respective host plants. They are different in the amino acid composition and N-terminal sequence. They also vary in IC50 values and the CAP-I had been shown to be 2.5 fold more effective than CAP-II in preventing the viral infection [24].

Hepatoprotective activity

Aqueous and alcoholic extracts of the *Chenopodium album* (aerial parts) showed hepato-protective activity. The aqueous extract (dose of 400 mg/kg) reported to be more potent as compared to Silymarin. The



alcoholic and aqueous extract of *C. album* (200 & 400 mg/Kg dose) has also been found to have significant hepatoprotective activity against paracetamol [25]. The study revealed such extracts restore the physiological integrity of hepatocytes. Both extracts (Aqueous and alcoholic) did not show any sign of toxicity up to the oral dose of 5 g/Kg in mice [25, 26].

Anthelmintic properties

Chenopodium album Linn showed the anthelmintic activity against trichostrongylid nematodes of sheep by causing the mortality of worms and the prevention of egg hatching. It was revealed to have $LC_{50}=0.499$ mg/ml in the egg hatch test. *In vivo* higher rate of reduction (82.2%) in eggs per gram (EPG) of feces was revealed with *Chenopodium album* AME at 3.0 g/kg on day 5 post-treatment [27]. Studies reported that *C. album* possess anthelmintic activity against cyathostomins, an important gastrointestinal nematode infecting equids.

Benefits and losses of *C. album*

Used as a food

C. album or Bathua is a winter season plant that is a popular green leafy vegetable and consumed as a food in India. It has medicinal properties and is very healthy and nutritious. The leaves of this plant are used in various dishes such as soups, curries, and paratha. *C. album* is employed to deal with numerous symptoms attributable to nutritional deficiencies. Many birds and animals like sparrow, chipmunks, and squirrels are eating their seeds and the plants are also used as fodder [19, 28].

Health benefits

Chenopodium fresh leaves have many beneficial medicinal properties. It is used to treat various diseases such as kidney stone, swelling, anemia, heart disease, jaundice and many more. *C. album* or Bathua leaves juice are used as a traditional medicine for intestinal parasites. It also improves the hemoglobin levels and is good for the heart. It is considered as a heart tonic and its leaves are good for liver, spleen and gall bladder [16]. *C. album* is used to treat muscular spasms and pain [29].

Losses from *C. album* of agriculture

C. album grows most vigorously in temperate and sub-temperate regions; however, it is also an important weed in almost all the winter or rabi crops of the tropics and subtropics. It is a most common weed in about 40 crops in almost 47 countries, mainly in cereals, sugarbeet, potatoes and corn. It is one of most common weeds of Canada and Europe, and in India, Mexico, New Zealand, Pakistan and South Africa is ranked amongst the six most serious weeds [30]. It is mostly grown in wheat, barley, chickpea, winter vegetables, horticultural gardens, maize, sunflower and soybean fields. Moreover, it is a

significant weed of tea and upland rice in Japan, citrus orchards and vineyards in Spain, cotton, soyabean and strawberries in the former Soviet Union, cotton, pastures and peanuts in the USA, rice in Mexico and tobacco in Canada [30]. In Europe and America, it is a problematic weed in maize, soybean, wheat, barley, potato and all vegetable crops.

C. album is responsible for the economic losses in agriculture all over the world except in the extreme desert climate [30]. It decreases the crop production by direct competition for light and nutrients. In field, important losses due to *C. album* have been recorded in many crops such as maize, soybeans, tomato, oat, barley, lucerne, and sugarbeet [31-32].

Seed contamination of crops by *Chenopodium* seeds not only affects the weed propagation, but also affects the seed quality and value of the crop. Seeds of *C. album* are very small and frequently contaminate the crop seeds during the harvesting of the weed infested fields [30].

C. album is also responsible for the indirect losses in agriculture as it is responsible for the disease transmission to main crop [33-34]. Several cultural, biological and chemical controls are available to check the *C. album* growth [35].



Conclusion

This review concluded that the *Chenopodium album* is nutritionally important plant that has many health benefits with various medicinal properties. It is mostly grown as a weed in India. As a leafy vegetable, it is the most significant plant for human health because of its higher nutrient content. Its leaves also contained several beneficial properties like antimicrobial, antioxidant, antidiarrheal etc which enhance its importance. Hence, it is utilized in the preparation of many healthy food products by the incorporation of *C. album* leaves extract and powder. It is highly beneficial for human health to cure many diseases and is used in folk medicines for treating various types of diseases from ancient times.

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Conflict of Interests

The authors declare that there is no conflict of interests.

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