

Phytochemical and Phytotherapeutic Properties of *Celosia* species- A Review

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ABSTRACT

Medicinal plants have been used basically in all cultures as a source of medicine. Medicinal plants play an important role in public health, especially in developed and developing countries and leads to examination for therapeutic and pharmacological applications. Medicinal Plants have been used for thousands of years to flavor and conserve food, to treat different health issues and to prevent diseases including epidemics. Active compounds produced during secondary metabolism are usually possess the biological properties of plant species used throughout the globe for various purposes, including treatment of infectious diseases. Based on the medicinal values, the *Celosia* species has been chosen for this study. *Celosia* species plays an important role in traditional medicine to cure several disorders such as fever, diarrhoea, mouth sores, itching, wounds, jaundice, gonorrhoea, and inflammation. A variety of phytoconstituents are isolated from the *Celosia* species which includes triterpenoids, saponins, alkaloids, phenols, tannins, flavonoids, cardiac glycosides, steroids, phytosterols, and phlobatannins. The plant having potential pharmacological values screened for its various pharmacological activities, namely, anti-inflammatory, immune-stimulating, anticancer, hepatoprotective, antioxidant, wound healing, antidiabetic, antinociceptive effect and antibacterial activities which are reported in the extracts of different parts of the plant. The objective of this study was to provide an overview of the ecology, phytoconstituents, pharmacology of *Celosia* species and to assess their therapeutic potentials and secure an evidence base for further research works on *Celosia*.

Keywords: Medicinal plants, *Celosia*, Phytoconstituents, Pharmacological applications.

INTRODUCTION

Medicinal plant is an important element of endemic medical systems in all over the world. The ethno botany provides a wealthy means for natural drug research and development¹. Traditional use of herbal medicines involves generous need, and this is absolutely true for many products that are accessible as “traditional herbal medicines”. Herbal traditional methods have been refined through many skills of many generations. Herbal medicines are easily available, intact, reasonable and without any adverse effects. Natural products have played an important role throughout the world in evaluating and averting various human diseases.

Medicinal plants contain organic compounds, known as phytochemicals (phyto means plant in Greek) and are responsible for the defensive strength of the body. These bioactive substances encompass alkaloids, carbohydrates, flavonoids, steroids, tannins and terpenoids. Today, a millions of drugs are refined from medicinal plants. The World Health Organization (WHO) estimates that 80% of the world people presently use herbal medicine for primary health care.

Many researchers have found that phytochemicals have the potential to trigger the immune system, constrain toxic substances in the diet from becoming malignant, reduce

inflammation, prevent DNA damage and induce DNA repair, reduce oxidative damage to cells, slow the growth rate of cancer cells, stimulate damaged cells to self-destroy (apoptosis) before they can reproduce, helps in controlling the intracellular signaling of hormones and gene expression, and activate insulin receptors. Templates for lead optimization programs are phytochemicals, which are intended to be safe and effective drugs². Currently there is a growing interest in investigating the phytochemical constituents of a medicinal plant and its pharmacological activity³.

The family Amaranthaceae constitutes nearly 165 genera and 2,040 species and is treated to be the most species-rich lineage among the flowering plant order of Caryophyllales⁴. The Amaranthaceae consists of annual or perennial plants, herbs, also shrubs, small trees and vines. It is a sophisticated family that can be identified from the tropics to cool temperate regions. Nativity of the Amaranthaceae are tropical and subtropical areas of Central America, Africa and Australia, whereas Chenopodiaceae occur mostly in arid to semiarid, saline, disturbed, and agricultural habitats of temperate and subtropical regions⁵.

Native people in the tropical and subtropical countries as well as temperate climate used Amaranthaceae species as



Figure 1: *Celosia argentea*.



Figure 2: *Celosia cristata*.



Figure 3: *Celosia isertii*

medicinal plants for their numerous activities accepted in the present day biological tests. Extracts from Amaranthaceae plants exhibits pharmacological activities such as antioxidant, antidiabetic, tonic, immune stimulatory, antitumor, antibacterial, anti-inflammatory, antiosteoporosis, antiulcer, hypolipidemic, diuretic, larvicidal, antihypertensive, hypoglycemic and analgesic activity.

Amaranthaceae family is analyzed by its diverse chemistry, including betalains, flavonoids, phenolic acids, essential oils, sesquiterpenes, diterpenes and triterpenes.

Triterpene saponins are found to be present generously in Amaranthaceae species.

The *Celosia* species is a genus of edible and ornamental plants of the family Amaranthaceae. The generic name is derived from the Greek word kelos, meaning "burned," and refers to the flame-like flower heads. Wool-flowers, brain celosia or cockscombs are the common name used for the flowers of the species if the flower heads are crested by fasciation or Velvet flower (in Mexico). In East Africa's highlands the plants are very famous and are used under their Swahili name, mfungu⁴.

The most important species with economical importance of Amaranthaceae family named *celosia argentea*, *celosia cristata* and *celosia isertii* were selected for the review.

Distribution and Description

Celosia argentea

C. argentea is a smooth annual herb type. It grows upto 0.5 to 1.5 meters high. Leaves are alternate, linear to lanceolate, entire and are about 4 to 14 centimeters in long. It is an erect, coarse, simple or branched. The flowers are small in size and they are dense erect spikes, 8 to 12 millimeters in length, borne in solitary, erect, stout, dense, white, purple, or pink, glistening spikes. They are about 3 to 30 centimeters long and 1.5 to 2 centimeters in thick, without petals. Sepals are 6 millimeters long, and so longer than the bracts. It contains membranaceous fruits. Seeds are shining and black and they are 1.5 millimeters in diameter. The plant of *Celosia argentea* is shown in Figure 1.

The plant is most commonly seen in West Africa, from Sierra Leone to Nigeria. *Celosia argentea* is also present in Ethiopia, Somalia, and Kenya, other parts of East Africa, Mexico and Central Africa. *C. argentea* is an important cultivated vegetable in the rainforest zone of Nigeria, Benin, Cameroon, Gabon, and Togo. It grows as a weed during rainy season throughout India and other tropical regions of the world mainly Sri Lanka, Yeman, Indonesia, America and West Indies⁶.

Celosia cristata

It is non-woody plant. It is widely seen in Africa, South America, India and some parts of Asia⁷. The plant reaches a height from 5 to 2 feet. Leaves are arranged in alternate, simple and saggitate or arrow shaped. Margin and pinnate venation is seen in leaf. They grow upto 2-4 inches in length and greenish purple or red in colour. Flowers are mostly red in colour. *Celosia cristata* was found to be having the capability of producing purplish or reddish pigment in tissue culture system. Cyanidin, a kind of anthocyanin was found to be present⁸. The flower of *Celosia cristata* is shown in Figure 2.

The geographic origins of *Celosia* are unknown, although speculations include the dry slopes of Africa and India as well as dry stony regions of both North and South America. First they are found in North America from the 18th century. Although reportedly Chinese herbalists used to stop bleeding, treat diseases of the blood, and infections of the urinary tract, there are no references to its use in any western herbals - modern or centuries old, European or Native American.

Celosia isertii

Taxonomic classification.

Binomial Name	<i>C.argentea</i>	<i>C.cristata</i>	<i>C.isertii</i>
Superdivision	Spermatophyte	Spermatophyte	Spermatophyte
Division	Magnoliophyta	Magnoliophyta	Magnoliophyta
Class	Magnoliopsida	Magnoliopsida	Magnoliopsida
Order	Caryophyllales	Caryophyllales	Caryophyllales
Family	Amaranthaceae	Amaranthaceae	Amaranthaceae
Genus	<i>Celosia</i>	<i>Celosia</i>	<i>Celosia</i>
Species	<i>C.argentea</i>	<i>C.cristata</i>	<i>C.isertii</i>

Table 1: Phytochemical Analysis Using Aqueous Extract.

Phytochemicals	<i>C.argentea</i>	<i>C.cristata</i>	<i>C.isertii</i>
Alkaloids	+	+	+
Saponins	+	+	+
Tannins	+	+	+
Flavonoids	+	-	+
Phenols	+	+	+

It is a straggling herb, reaches upto 3.0 m height. It is generally seen in stream-banks, damp sites, clearings and rarely in savanna. The leaves are boiled and applied hot for rheumatism in Sierra Leone⁹. Traces of flavones have been found to be present in the entire plant from the Congo area. Recorded from Senegal to South Nigeria and Fernando and in Cameroun across central Africa to Tanganyika, Zambia and Angola. In West Africa the plant is often eaten as a vegetable or prepared in soups and sauces. The flower of *Celosia isertii* is shown in Figure 3

Vernacular Names

Celosia argentea

Common names are Kadayohan (Tag.), Cock's comb, silver cock's comb, Wool flower in English, indivara, survali, safedmurga in Hindi, sitivara, vitunnaka, sunishannaka in Sanskrit, Bairihong, Ye ji guan huo, Gou weicao, Ji guan huo in Chinese, Amarantecrète de coq, Célosieargentée, Célosiecrète de coq in French, No-geitou in Japanese, Gaemaendurami in Korean, Chesechil a malk, Esehilamalk in Palauan, Māmoe in Samoan, Orlón, Cresta de gallo, Rabo de conejo in Spanish, Repe moa in Tahitian and Lisi in Tongan

Celosia cristata

Common names are Cockscumb, redfox, red spinach, katifaorfeldeek in Arabic, ji guan hua, qingxiangzi, ye chi kuan in Chinese, crete de coq, celosia in French, silberbrandschopf, silberhahnenkamm in German, lalmurghka, kokan, pilemurghka in Hindi, boroty, jenggarayam in Indonesian, crestadigallo in Italian, nogetoikeito in Japanese and balungayam in Malayalam.

Celosia isertii

Common name are Fula-fulfulde.

Phytochemical Constituents

Celosia argentea

Phytochemical compounds present in *C.argentea* are betalains, nicotinic acid, celogenamide A, celogentin A–D, Celogentin-H, celogentin-J and celogentin -K, moroidin. Flavonoid acts as a defense and signaling compounds in reproduction, pathogenesis and symbiosis. Isoflavones such as 5-Methoxy-6,7-methylenedioxy-2'-hydroxyisoflavone and its 2'-methoxy derivative: tlatlancauyin were obtained from aerial parts of *C.*

*argentea*¹⁰. The six compounds including Eugenyl O- β -D-glucopyranoside (citrusin C) which is obtained from the leaves of *C. argentea* shows Tyrosinase inhibitory and superoxide scavenging activity. A phenolic glycoside, 4-O- β -D-glucopyranosyl-2-hydroxy-6-methoxyacetophenone along with ten known compounds were isolated from the plant *C. argentea*¹¹. Diterpenes, C₂₀ are a group of compounds that consists of 4 five carbon (C₅) units called isoprene. *C. argentea* contains numerous kinds of amino acids, and their constituents were determined by using a Hitachi 835-50 automatic amino acid analyzer. The result reveals that the total amino acid content was 131.87 mg/g, and the essential amino acid contents attain 42.85% of the total amino acids¹². Non-essential amino acids like aspartic acid and glutamic acid contents were higher than others, reaching 10.95 mg/g and 15.75 mg/g, respectively.

Minerals are essential in plant growth and development, and in managing human health. Some necessary trace elements for bio-system such as Fe, Mn, Cu, and Zn, involved in metabolism, and are closely related to immune function. *C. argentea* subsists of over eighteen minerals¹³ in which the contents of Al, Fe, Ni, Mn, Cu, K, Ti, and Se were far higher than those in *C. cristata*. A study on minerals of *C.argentea* showed that the content of Fe, Mn, Cu, and Zn were 197, 56, 30, and 160 g/g, respectively¹². Apart from the above mentioned compositions, other compounds like Lutein and β -carotene¹⁴ were also isolated from *C. argentea*. These compounds are well known for their pharmacological, toxicological activities and bitter taste. There is a promising interest in the *C. argentea* for its effective phytochemical constituents and also its potential pharmacological activities.

Celosia cristata

Celosia cristata contains an essential phytochemical compound namely flavonoids. Total flavonoid contents were determined using the aluminum colorimetric method with slight modification¹⁵. Cochliophilin A (5-hydroxy-6,7-methylenedioxyflavone) and an isoflavone, cristatein (5-hydroxy-6-hydroxymethyl-7,2'-dimethoxyisoflavone) are present in *Celosia cristata*. Glycoproteins obtained from the plant leaves are CCP-25 and CCP-27 at the

Table 2: Phytochemical analysis using methanol and ethanol Extracts.

Phytochemicals	Methanol Extract		Ethanol Extract
	<i>C.argentea</i>	<i>C.cristata</i>	<i>C.isertii</i>
Alkaloids	+	+	+
Saponins	+	-	+
Tannins	+	+	+
Flavonoids	+	+	+
Phenols	+	+	+

Table 3: Pharmacological And Therapeutic Applications Of *Celosia* Genus.

Species	Folk Medicines	Research & Development
<i>C.argentea</i>	Abnormal vaginal discharge, Asthma, Redness photophobia, Gonorrhoea, Eczema, Antipyretic,	Anti bacterial activity, Anticancer activity, Antidiarrhoeal activity, Antiinflammatory, Anti- mitotic.
<i>C.cristata</i>	Liver heat, Improving eye sight, Fatigue, Lowering blood pressure, Atherosclerosis	Anti helminthic, Anti diabetic, Anti- inflammatory, Hepatoprotective activity.
<i>C.isertii</i>	Lowering blood pressure, Anti atherosclerosis, Cardio vascular protection.	Anti inflammatory, Analgesic action, Anti- aging, Anti apoptotic

flowering stage¹⁶. Pure Celosianins like Celosianin I, Celosianin II and their C-15 epimers are isolated from *Celosia cristata* inflorescence¹⁷. 4-hydroxy phenethylalcohol, kaempferol, quercetin, β -sitosteol, 2-hydroxy octadecenoic acid, stigmasterol were also identified. Saponins such as cristatin, celosin A, celosin B, celosin C and celosin D are present in plant seeds. The total phenolic content (TPC) was determined using Folin–Ciocalteu’s reagent¹⁸. Antiviral protein CCP-27 isolated from leaves of *Celosia cristata*. Ammonium sulphate fractionation method is used for isolation purpose. Gel filtration chromatography method is used for further purification of proteins¹⁹.

Celosia isertii

Analysis of the plant extraction of *C.isertii* proved the presence of phytochemical constituents which are known to exhibit medicinal as well as physiological activities. The phytochemical studies were performed on aqueous and ethanol extract of *C. isertii* leaves reveals the presence of alkaloids, cardiac glycosides, flavonoids, phenols, phlobatannins, phytosterols, saponins, steroids, tannins and triterpenoids²⁰. The phytochemical analysis of celosia genus using different aqueous, ethanol and methanol extracts are tabulated in table 1 and 2.

Pharmacological activities

Celosia argentea

A wide range of pharmacological activities are done in *C.argentea*. Immuno-stimulating activity is done by celosian which is a significant chemical constituent of *C.argentea* and also it is found to be a potent antihepatotoxic agent for chemical and immunological liver injury models in animals. Celosian is a strong immune stimulating agent which induces the production of tumor necrosis factor-alpha (TNF-alpha), interleukin-1 beta (IL-1 beta), nitric oxide (NO) and gamma interferon (IFN-gamma) on various in-vitro experimental methods²¹. Intra-gastric administration of celosin A and B with doses 1, 2 and 4 mg/kg per day to Kunming mice for three days significantly interrupted the rise of AST, ALT, and ALP

caused by CCl₄ effectively²². Celosin C and D also significantly stopped the increase of AST, ALT, and ALP caused by CCl₄ effectively within a concentration of 1–4 mg/kg compared with the control group.

Some other compounds isolated and identified from the plants of *C. argentea* are phenolics, steroids, diterpenes, and flavonoids. The recent investigations shows that, three novel triterpenoid saponins, celosin E, celosin F and celosin G together with a noted compound cristatain, were confined from the seeds and characterized using extensive nuclear magnetic resonance (NMR) and mass spectroscopy (MS) technique. These three novel triterpenoid saponins and cristatain exhibits the antitumor and anti-inflammatory activities by in vitro screenings²³. Many studies demonstrated that *C.argentea* has significant Anti-inflammatory, anticancer, hepatoprotective, antioxidant, wound healing, antidiabetic and antibacterial activities. *C. argentea* was reported to exhibit antibacterial activity against *Bacillus subtilis*, *S. aureus*, *Salmonella typhi*, *Escherichia coli*, *Agrobacterium tumefaciens*, and *Mycobacterium tuberculosis*²⁴.

C.argentea could definitely suppress the castor oil induced diarrhea and charcoal meal induced diarrhea. Results suggested that the extract of *C. argentea* leaves prevents the diarrhea within a dose of 100 to 200 mg/kg and that it may act centrally and may inhibit PGE to give anti-diarrhoeal effects²⁵. Anti-oxidant activity of the extract may be credited to the phenolic and flavonoid components of the extract. The induction of anti-oxidant enzymes and scavenging of free radicals may account for the mechanism of action of the extract as an anti-oxidant.

C.argentea is a high nutritional valued vegetable crop. *C.argentea* is being used traditionally, due to their tremendous therapeutic potential to treat/cure various diseases. *C. argentea* is well known for its usage in the treatment of piles, bleeding nose, disinfectant, inflammation, haematological and gynaecologic disorders. The plant is also used for treatment of mouth sores, blood diseases and used as an aphrodisiac which is familiar in

India. The seed paste of *C. argentea* used to cure ovarian and uterine diseases and it is very well used in Indian folk medicine to cure diabetes mellitus.

C. argentea is well known for cold, gastrointestinal diseases, rheumatoid arthritis and as fertility regulating agent in china. The stem, leaf, flower and seed of *C. argentea* is used by the traditional Yao communities of China for the treatment of hemorrhoids, leucorrhoea, profuse uterine bleeding. In Riau province, Sumatra (Indonesia) antibacterial assay of extracts of 114 species were tested and *C. argentea* was found to have activity against cough and jaundice²⁶.

Celosia cristata

Dysentery, coughs, spitting up blood, excessive menstruation, amenorrhoea, intestinal bleeding, bleeding from the lungs, female disorders, hemorrhoids, UTI, blood diseases, mouth sores, retinal hemorrhage, conjunctivitis, eye diseases and to lower blood pressure can be treated by *Celosia cristata*. Cristatain which is isolated from ethanolic extract of seeds of *Celosia cristata* was investigated for hepatoprotective activity. Hepatotoxicity was induced by using chemical factors such as CCL4 and DMF. Oral administration of Cristatain constrained CCL4 and DMF elevates serum transaminase activities based on the dosage levels, exhibits hepatoprotective activity. The antiaging effect of *C. cristata* was evaluated by inhibition of hyaluronidase activity and elastase activity. Aqueous, methanolic and chloroform extracts of *Celosia cristata* leaves were studied for anthelmintic activity. Proteins isolated from *Celosia cristata* leaves are CCP-25 and CCp-27 which are studied for interaction between its antiviral and antioxidant activity²⁷. Increase in activities of redox enzymes such as peroxidase, catalase and polyphenyl oxidase results in strong anti oxidant activity through anti viral proteins and it was evaluated by ferric reducing antioxidant power assay. Promising results were found and can be used for the treatment of obesity²⁸.

Celosia isertii

Anti-apoptosis, anti-aging, anticarcinogen, anti-inflammation, anti-atherosclerosis, cardiovascular protection and improvement of endothelial function, as well as inhibition of angiogenesis and cell proliferation activities are the some biological properties proved in *Celosia isertii*. Several studies have explained about the antioxidant properties of medicinal plants which are rich in phenolic compounds. Natural antioxidants in plants are mainly present in the form of phenolic compounds such as flavonoid, phenolic acids, tocopherols etc. Protein synthesis is interfered due to binding of tannin to proline rich protein. Flavonoids are hydroxylated phenolic substances produced by plants in response to microbial infection and they have been found to possess antimicrobial substances against wide variety of microorganisms in vitro. Their activity is possibly due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell wall. Triterpenoids are terpenoid derivatives of triterpene molecules. They possess anticancer properties. They also are effective antioxidant and show strong anti-cancer activities²⁹.

The plant extracts of *Celosia isertii* were proved to contain saponins which are known to produce inhibitory effect on inflammation³⁰. Saponins has the property of precipitating and coagulating red blood cells. Formation of foams in aqueous solutions, hemolytic activity, cholesterol binding properties and bitterness are some of the characteristics of saponins³¹. Steroids have been proved to have antibacterial properties and they are very important compounds especially due to their relationship with compounds such as sex hormones. Alkaloids have been proved to have cytotoxic properties and associated with medicinal uses for centuries. Several workers have reported the analgesic,³² antiplasmodic and antibacterial,³³ properties of alkaloids. Glycosides have been reported to lower the blood pressure according to many reports³³. The pharmacological and therapeutic applications of *Celosia* genus is tabulated in table 3.

CONCLUSION

A large number of studies suggested that, the *Celosia* species possess antidiabetic, anti-inflammatory, anti-oxidant, anti-bacterial, anti apoptosis, antidiarrhoeal, anthelmintic, antiaging, antimalarial, antiplasmodic, hepatoprotective and immunostimulating activities. However, among all the species of *Celosia*, only a few species including *Celosia argentea*, *Celosia cristata*, and *Celosia isertii* have been explored exhaustively for their chemical constituents and pharmacological activities. Also, this paper reviewed the pharmacological and therapeutical applications of the expressed compounds for numerous disorders. Finally this article reveals that, reported *Celosia* genus consisting species having wide range of phytochemicals and therapeutical applications will be effective for the further research and progression. Thus, there remains a tremendous scope for further scientific exploration of this genus *Celosia* to establish their therapeutic efficacy and commercial exploitation.

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