

# The Chemical Composition and Pharmaceutical Effect of *Celosia cristata*: A Review on Nutritional Aspect

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**Abstract:-** Prehistoric man is known to utilize the plant as medicine for period millenary. A large number of plants are using in medicinal practice not only in Chinese Traditional Medicine but also in Ayurvedic and Unani Medicine. This review focus on chemical composition and pharmaceutical effect based on nutrient present in *Celosia cristata*. *Celosia cristata* are the ornamental as well as medicinal, herbaceous, annual dicotyledon plant. It belongs to the family-Amaranthaceae. It is well known as cockscomb, crested Celosia, laal murga (in local), and jataadhaari (in Ayurveda). It is mostly found in southern China and tropical and subtropical regions around the world like Africa, India, and Southern America. The plant contains attractive and conspicuous inflorescence, with numerous tiny seeds. The plant has been used in several clinical conditions like dysentery, extreme menstruation, intestinal bleeding, mouth sores, and eye disease. To estimate nutritional component physiochemical, fluorescence, and physiochemical assessment method done. Physiochemical analysis of *Celosia cristata* shows the carbohydrates, proteins, alkaloids, saponin, flavonoids, phenolic compounds, tannins, and triterpenoids are present. The said plant illustrates many different pharmacological activities like antihepatotoxic, adipogenic, antioxidant, anthelmintic, antiviral, antimicrobial, cytotoxic, antidiabetic, and hemostatic effects.

**Keywords:-** DPPH, *Celosia*, Chemical Composition, Pharmaceutical Effect, Antioxidant, Antiviral, Cytotoxic, Betalain.

## I. INTRODUCTION

Prehistoric man is known to utilize the plant as medicine for period millenary. A large number of plants are using in medical practice not only in Chinese Traditional medicine but also in Ayurvedic and Unani Medicine, to exert therapeutic effects. The mechanism of a medicinal plant can be understood if we collect more knowledge of its pharmacology and phytochemistry. This review focus on chemical composition and pharmaceutical effect based on the nutrient present.

*Celosia cristata* are an ornamental as well as a medicinal plant, an annual dicotyledon, herbaceous, 5-2 feet in height. The plant belongs to the class-Magnoliopsid, family-Amaranthaceae, and genus-Celosia. It well known as cockscomb, crested Celosia, laal murgaa (in

local), jataadhaari (in Ayurveda) [1,6]. It is mostly found in southern China and also tropical and subtropical regions around the world like Africa, India, and Southern America [2]. There are about 60 species of celosia, among them, *C. argentea*, *C. cristata*, *C. isertii* and *C. spicata* are the most important due to their dietary leafy vegetable [3]. *Celosia* is a Greek term that refers "burned" because the head of the flower looks like a flame. The flower is also known by its various name such as flame head, velvet flower, flamingo, and brain comb [4]. Celosia has two types of inflorescence, *Celosia cristata* and plume or plumosa type. In the plumosa group, the flowers are fluffy, feathery head basically consists of tiny flowers. It is basically red and yellow in color. Whereas in the cristata group the flowers are tight, the velvety texture resembles as brain tissue to some people, and the flower head has various colours such as deep red, dark pink, and golden yellow [1,5]. The leaf of *Celosia* is simple, the shape is saggitate (arrow), the venation is pinnate, length varies from 2-4 inches and the color of leaves are purple or red or bright green and leaf arrangement is alternate [1]. The *Semen Cristata* is a flamboyant flattened seed, tiny and kidney-shaped, having a diameter of 1 to 1.5 mm, it is mostly shiny and black color, and the seed coat is thin and crumbly. The seed contains starch and aleurone layer in the albuminous cell and also contains fat and oxalates [2].

## TRADITIONAL USES

*Celosia cristata* is an herbaceous annual plant used medicinally as well as an in diet from the ancient time not only from one part of the world but across it. The young leaves and stems included in the diet due to the same taste as spinach have. It is also used as salad and served with salt, pepper, fresh lime, and oil [7].

The plant has been used in several clinical conditions of the body like in GI-tract problems, dysentery, in extreme menstruation, intestinal bleeding, hemorrhoids, blood disease, urinary tract infection (UTI), mouth sores, several eye diseases, and also in liver problems, in diabetes also and also helpful in lowering blood pressure, amenorrhea and also in several lungs disease [8]. The young shoot of the plant and leafy stalk is shown effective in mouth sores, wounds, and infectious swelling.

The inflorescence is effective in hemoptysis, amenorrhea, hemorrhoids, in diarrhoea, leucorrhoea, and hematuria. It also shows strong action against trich. The flamboyant flattened seeds of *C. cristata* are used mostly in eye-related problems like eye inflammation, light sensitivity

by eyes, conjunctivitis, migraine, helminths, painful urination, cough, dysentery, intestinal problem, antipyretic, astringent, menstrual problem, haemorrhoids, and liver problem [7,8].

## II. METHODS

### Physiochemical assessment

The physiochemical assessment of *C.cristata* was studied on different parameters such as –Total ash value-5.54, sulphated ash-0.8, water-soluble ash-2.78, moisture content (Azeotropic distillation method )-5.4, Acid insoluble ash-1.14, Loss on Drying (LOD)-5.8, stomatal Number-1.72, stomatal index-25 (W/W%) [8].

### Fluorescence Assessment

The fluorescence assessment under visible radiation (254 nm) and UV light radiation (365 nm) was studied for dried powder of *Celosia cristata* with the solvent. It shows different colors in a different solvent. In the visible light with powder ash 1(N) NaOH-aqueous, 1(N) NaOH-alcoholic shows reddish brown and 1(N) HCl, 1% H<sub>2</sub>SO<sub>4</sub> shows dark brown and 1% HNO<sub>3</sub> shows brown color. Where In UV light radiation the powder ash with 1(N) NaOH-aqueous, 1(N) NaOH-alcoholic shows the dark brown color, and 1(N) HCl, 1% H<sub>2</sub>SO<sub>4</sub> and 1% HNO<sub>3</sub> shows greenish color. Without any solvent dried powder shows brown color in visible light and yellowish-brown in UV-light radiation [8].

### Phytochemical estimation

Soxhlet extraction was made by using pet ether, chloroform, ethanol, and water with the whole plant powder to detect the phytoconstituents like carbohydrates, amino acids, fats, saponin, proteins, flavonoids, and phenolic compounds. In pet ether extract only steroids and triterpenoids were detected, In chloroform extract alkaloid, flavonoid, gums, steroid, and triterpenoids were detected, in ethanol and aqueous extract fats, steroids, and triterpenoids were not detected [8].

### CHEMICAL COMPOSITION

Phytochemical analysis of *C.cristata* extract basically shows the presence of nutritive materials like carbohydrates, proteins, amino acids, alkaloids, flavonoids, saponin, gum, phenolic compounds, steroids, tannins and triterpenoids [8]. The plant also contains betanin and other sterols [6].

In aqueous, methanolic and chloroform leaf extract, the phytochemical examination shows the presence of alkaloids, tannin, triterpenoids, flavonoids, phenolic compounds and saponin but there is the absence of fat & oils, sterol, carbohydrates and glycosides as well as protein [9]. At the time of post-flowering stage of *Celosia cristata* the leaves were found to have two antiviral glycoproteins name CCP-27 and CCP-25 have 27 kDa and M<sub>r</sub>-25. It is purified by anion & cation exchange method and then purified by gel filtration chromatography method [10,11].

The inflorescence of *Celosia cristata* contains amarantin, isoamarantin, celosianin and isocelosianin [6]. The antioxidant compounds like polyphenol, tannin and flavonoids were carried by spectrophotometric method in methanolic extract and the solvent fraction of cockscomb flower and found 6.80, 6.23 and 2.34 mg/gm from extract residue [12]. The dashing color of *Celosia cristata* inflorescence is due to betalain and is water-soluble coloring matter found in amaranthaceae. The inflorescence contains amaranthine type betacyanin like C-15, celosianin-I and celosianin-II [8]. Kashmiri *Celosia cristata* flower also contains a variety of vitamins, minerals, amino acids and fatty acids [32].

Several methods were conducted to analyse the chemical composition of extract solution from *Celosia cristata* plant, silica gel column chromatography, recrystallization and sephadex LH-20 methods were carried out for segregation and filtration process. From ethanolic extract, Six compounds were isolated and point out as  $\beta$ -sitosterol, 4-hydroxyphenethyl alcohol, quercetin, 2-hydroxy-octadecanoic acid, kaempferol, and stigmasterol [13]. The *Celosia cristata* also contain choline ester of hyaluronic acid [6].

The seed of *Celosia cristata* contains five types of saponins –celosin-A, celosin-B, celosin-C, celosin-D and cristatain and their chemical structures were examined spectroscopically [14]. And also semenoside-A a new triterpenoid saponin compound has been found from semen *Celosia cristata* [15]. The semen cristata contains protein (10.1-12.8%) and fats (7.2-7.9%) [6].

The seedling of *Celosia cristata* contains cochliophilin-A (5-hydroxy-6,7-methylenedioxyflavone, 1) is specific attractant toward the host zoospores (*Aphanomyces cochlioides*) which is responsible for damping-off disease and root and stem rot of chenopodiaceae. The *Celosia cristata* found to susceptible to these pathogens and contain 1.4  $\mu$ g/g in fresh weight. Cristatein (5-hydroxy-6-hydroxymethyl-7, 2'-dimethoxy isoflavone, 2) a new isoflavon along with five known flavonoid identified from *Celosia cristata* [16].

## III. PHARMACEUTICAL EFFECT

### Antihepatotoxic Effect

A chemical substance can prevent damage to the liver. The seed of *Celosia cristata* contains five types of saponin-celosin A, celosin B, celosin C, celosin D and cristatain, Among which saponin cristatain shows strong hepatoprotective effect against hepatotoxins like tetrachloro carbon (CCl<sub>4</sub>) and dimethylformamide (DMF) when inserted in mice. There found to reduce the hepatotoxicity in mice by decreasing aspartate aminotransaminases (AST), alanine aminotransferases (ALT) and alkaline transferases (ALP) in plasma and serum level [14].

Semen *Celosia cristata* contains other new triterpenoid saponin semenoside-A. Semenose-A was given to mice in different oral dosages 1.0, 2.0 and 4.0 mg/kg. Then it was

examined that it has hepatoprotective effect against CCl<sub>4</sub> [15].

The *Celosia cristata* flower (CCF) extract has antioxidant and protective effects on hepatocytic Chang cell and rat liver against tert-butyl-hydroperoxide (t-BHP), due to its radical scavenging ability and prevent reactive oxygen species (ROS). CCF is given to rats in 100 mg and 500 mg/kg for five days, just prior to t-BHP single dose. It shows that after consumption of the CCF serum glutamate pyruvate transaminase (GPT) and glutamate oxaloacetate transaminase (GOT) goes down. The extract decreases triglycerides and lipid peroxidation against t-BHP induced oxidation stress [17].

Red flower extract of *Celosia cristata* was found to have high cholesterol adhesion effect, which inhibits the replication process of Hepatitis-C virus (HCV)-2a RNA. It reduces high cholesterolemia and treats HCV infection [18].

#### Adipogenic Effect

*Celosia cristata* flowering extract was found to decrease adipogenesis. The experiment was conducted on human adipose tissue progenitor cell (CD34<sup>+</sup>/CD31<sup>-</sup>) In-Vitro. The progenitor cell was segregated by immunoselection approach. On commitment and differentiation of progenitor cell two different cell cultures were used to assess the effect of *Celosia cristata* extract. Two experiments were conducted, In differentiation medium the cells were cultured for ten days in the presence and absence of extract to understand their impact. In other experiments, Firstly the cells were cultured for 48 hours in the presence and absence of extract and then cultured for ten days in a differentiation medium for their effect [19].

It was concluded that extract was completely capable to reduce the lipid content of progenitor cells under differentiation. And when progenitor cells in commitment inducing conditions were placed, were found that extract influences potent reduction in fat content. This is due to a decreased level of the master gene (PRAR<sub>γ</sub>2,C/EBP<sub>α</sub>) and marker cell (LPL and GPDH) [19].

#### Antioxidant Effect

The leaves of *Celosia cristata* contain two N-terminally blocked glycoproteins known as CCP-25 and CCP-27 are antiviral proteins, analyzed by reverse-phase HPLC. In vitro using ferric reducing antioxidant power, it reveals that these proteins are strong antioxidants. CCP-25 reduces the activity of redox enzymes (such as peroxidase, polyphenol oxidase and catalase) on tobacco mosaic virus a sample plant. The action of phenylalanine ammonia lyase (a biosynthetic antioxidant compound) is also inhibited [20].

The ABTS and DPPH radical scavenging activity of methanolic extract on *Celosia cristata* flower per g extract residue were 107.01 and 52.43 mg trolox equivalent antioxidant capacity [12].

*Celosia cristata* shows antioxidant and anti-aging activity. The ethanol extract of the plant was found to inhibit

intracellular superoxide anion generation, H<sub>2</sub>O<sub>2</sub> generation and hydro-peroxide generation. For the anti-aging effect, the extract shows the hyaluronidase and elastase activity inhibition effect. The ethanol extract is used as hydration and as an anti-wrinkle agent [21].

“The inflorescence of *Celosia cristata* contains betalain pigment. It is a strong anti-oxidant, analyzed by using DPPH method. The free radical scavenging activity of betalain increases with a hydroxyl group and also depends upon the position of hydroxyl group and glycosylation of aglycones in the betalain molecule” [22].

#### Anthelmintic Effect

The *C. cristata* leaves were used to make aqueous, methanolic, chloroform and albendazole extract to analyze the anthelmintic effect of adult earthworm (*Pheretima posthuma*). The methanol, chloroform and aqueous leaf extract (100mg and 200mg/ml) were used to learn the paralysis and death time in comparison with albendazole leaf extract (100mg and 200mg/ml). Chloroform extract shows no significant activity, where aqueous extract shows significant activity than the methanolic extract. Anthelmintic activity is observed by the assessment of death and paralysis time [9].

#### Antiviral Effect

*Celosia cristata* leaf contains an antiviral protein known as CCP-27 basically found at post-flowering stage. It activates deoxyribonuclease against supercoiled p BlueScript SK<sup>+</sup> plasmid DNA, it also activates ribonuclease against *Torula* yeast rRNA [10].

Two anti-viral glycoproteins called CCP-27 and CCP-25 have 27 kDa and M(r)25 were collected from dried leaves of *Celosia cristata* during pre and post-flowering stage due to its high availability on that time (20-30 μg/ml). These proteins are effective against citrus ringspot virus and genus tobamovirus (tobacco mosaic virus & sunhemp rosette virus) [11].

#### Antimicrobial Effect

The methanolic, ethanolic and other solvent extracts of *Celosia cristata* shows antimicrobial action against pathogenic microbes like yeast (*Candida albicans*) and bacteria (*Staphylococcus aureus*, *E. coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Salmonella typhimurium*). The minimal inhibitory concentration (MIC) values were examined by the broth microdilution method (M07-A7, M27-A2). The extract of methanolic and ethanolic were effective against *Staphylococcus aureus* (0.125mg/ml), *Bacillus subtilis* (0.5 mg/ml) and *Candida albicans* (1mg/ml) [23].

The antimicrobial activity against the gram+ve bacteria (*Bacillus subtilis*, *Staphylococcus aureus*, *Bacillus megaterium*) and gram-ve bacteria (*Proteus vulgaris*, *E. coli*) were tested from crude extract of *C. cristata* flower. Among the bacteria, only *Bacillus subtilis* showed 8 mm inhibition zone [24].

The flower extract of *C. cristata* was studied against bacteria (*Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aurigenosa* and *Proteus vulgaris*) and filamentous fungi (*Aspergillus*, *Penicillium*, *Fusarium* and *Rhizopus*). The inhibition zone for bacteria were (9±0.5, 8±0.6, 5±0.6, 9±0.4, 7±0.6 and 6±0.8) and for fungi were (12±0.6, 19±0.5, 14±0.7 and 23±0.9) [25].

#### Cytotoxic Effect

The cytotoxic effect of *C. cristata* was examined in fibroblast cell Cos 7 and in cancer cell (HepG2, HeLa, SK-Hep1, LS174T). The IC<sub>50</sub> value for aqueous extract was 200, 263.9, 180 and >200 µg/ml. Where IC<sub>50</sub> values of NaOH extract were 499.8 and 28.4 µg/ml for HeLa and Cos 7. And the IC<sub>50</sub> value of CH<sub>2</sub>Cl<sub>2</sub> extract were 136.0 and 472.0 µg/ml for Cos 7 and HeLa [26].

#### Anti-diabetic Effect

To evaluate the anti-diabetic action of *Celosia argentea* var. *cristata* L methanolic extract, male albino rats were used as diabetic control, normal control, diabetic induced with 250 and 750 mg/kg BW *C. cristata* extract and 5mg/kg BW glibenclamide. The sample was observed for 21 days and found to remarkable reduction to 103.33±17.47, 85.00±5.19 mg/dl for 250, 750mg/kg BW of celosia extract and 104.33±10.40 mg/dl for glibenclamide [27].

#### Antinociceptive Effect

The methanolic extract of *Celosia cristata* plant was used to assess the antinociceptive effect. This effect was accomplished by thermal (tail immersion test and hot plate) and chemical (formalin, glutamate and acetic acid-induced nociception test) pain model in mice with various doses. The interaction of cGMP pathway and ATP-sensitive K<sup>+</sup>-channel were assessed by using methylene blue and glibenclamide. It shows that there is the positive result of *C. cristata* extract on the central and peripheral mechanism of antinociceptive effect [28].

#### Hemostatic Effect

The *C. cristata* also shows a hemostatic effect. The coagulation time in the treated group was comparatively higher than the control group and vitamin-C and calcium content in blood were higher in the treated group [29].

An experiment was done to evaluate the hemostatic effect of *C. cristata* on mice and rabbits. Both animals were treated with plant extract with a dose of 1.7 g/kg BW. The Bleeding Time (BT), Plasma Recovery Time (PRT), Coagulation Time (CT) and Prothrombin Time (PT) were determined. BT reduced in mice and PRT, CT and PT were reduced in rabbits as compared with the control group of mice and rabbits [30].

#### Effect on Endurance

*C. cristata* strengthens the mouse endurance and also increases the glycogen deposition in the liver and muscle [36].

## IV. OTHER ASPECTS

**Supplementary calcium and cristata extract prevent fluoride toxicity:** An experiment was conducted on rats having high fluoride bone mineral density (BMD), fed with cristata extract, high dose of calcium and cristata extract with high calcium dose. The result was found that the food supplemented with calcium and cristata extract with calcium both have better effect to reduce the high fluorine bone on metabolism. Where the water extract of *Celosia cristata* could enhance the homeostasis and immune function [31].

**Prevent micronutrient deficiencies through dietary diversification and modification:** Dietary diversification and modification are done without any change in feeding practice, where fortification is the process of adding micronutrients and bioactive to processed food. The process is done to prevent coexisting micronutrient deficiencies. The use of *Celosia* species can improve in botanical varieties to diet [33].

**Betalain as natural food colorant:** Food color has a greater role to amplify the appeal and acceptability of food items. Natural color has no negative effect on health. *Celosia cristata* flower is the richest source of betalain a natural colorant. It can be used in burgers, bakery items, desserts, cake, pudding and also in ice cream, jam & jellies, drinks, and in many food items [34]. Betalain is not only used as a natural colorant but also attributes biological properties like antioxidant, antiradical, against oxidative damage, antibacterial and cytotoxic [35].

## V. CONCLUSION

Healing with the medicinal plant is the old technique of the human beings themselves. From the very past, there is a connective link established between man and his search for medicine, this is proof from various findings such as from hand written documents and old herbariums collection. Bark, seeds, fruits, leaves and other plant parts are used as medicine for many years due to the experience to cure chronic diseases. Chinese Traditional Medicine, Ayurvedic Medicine and Unani Medicine are agreed that the potent bioactive chemical substances present in *Celosia cristata*.

This review was fully focused on the pharmaceutical effect of *Celosia cristata* and analyze the nutritional aspect of biochemical actives present in it. The said plant illustrates many different pharmacological activities like Antihepatotoxic, Adipogenic, Antioxidant, anthelmintic, eye problems, antiviral, antimicrobial, cytotoxic, antidiabetic, antinociceptive, and hemostatic effects. The pharmacological action is done only due to the presence of several bioactive chemicals present such as alkaloids, flavonoids, saponin, phenolic compounds, steroids, tannins, and triterpenoids. It has commercial importance also due to the presence of showy inflorescence. Further research on the phytochemicals constituent and their pharmacological effect at the molecular level is needed to cure several chronic diseases.

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