

Corn Silk- A Natural Therapy for Curing Diseases and Its Benefits.

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Abstract. Corn is one of the most grown crop in asian countries. Corn silk(CS) is the part of the corn that is proved to be beneficial and therapeutic. Though it is considered as a waste product but it has great value to cure many disorders like kidney, UTI, hypertension, diabetes, anti-depressant, neurological disorders and dysbiosis. CS also acts as a great anti-inflammatory and antioxidant. It is not only used as medicinal herb but also it is used in cosmetics as whitening agent and in food industries because of its nutritional benefits. It is filled with secondary metabolites like flavonoids, proteins ,Vitmain K and Ca, Mg, volatile oils and tanins. Most households in India doesn't have the knowledge of using CS in right way and it is often discarded but if it is studied more deeply it can be used as different products like corn silk tea, corn silk powder and corn silk water.

Keywords- Diuresis, dysbiosis, bioactive compounds, functional food, nutraceutical.

Introduction:

Corn silk (CS) is the most under-rated byproduct of the yellow or green maize (*Zea mays*. L), that people considered it as a waste but it is one of the essential herb that is used to treat various diseases. Corn silk extract products is not so much common in India although it has a beneficial role to treat some diseases, it's product majorly available in US and china. CS (*Stigma maydis*) is the third most and oldest cultivated crop in the world. The annual global production of corn is about 780 million metric tons, of which the United States and China produce more than 40% and 20%, respectively⁽¹⁾. The silks are elongated stigmas which look like a tuft of hairs which are soft and flexible. The colors of the CS, lighter green and then into red, yellow or light brown. The function of CS is to trap the pollen for pollination. Each silk may be pollinated to produce one kernel of corn. The CS can be 30 cm long and have a faintly sweetish taste. When used for medicinal purpose CS is harvested just before pollination happens and can be used in fresh or dried form⁽²⁾.

CS is a natural product and it may be created as functional food ingredients or nutraceuticals. The chemical makeup of CS and the action mechanisms of its bioactive constituents such as volatile oils, steroids, alkaloids and natural antioxidants such as flavonoids, phenolics, terpenoids, etc have favourable effects on human health. CS is an excellent source of vitamin k and contains protein, carbohydrate, fibres, sugars, resin, maizeric acid, mucilage that are essential for a diet and minerals such as k, Ca, Mg, Zn and Mn^(3,4). CS is also used in cyno industry and food industry as a food additive and flavoring agent. For example, corn silk powder is used as food additive to improve the content and physical characteristics of beef patties. Currently, products from CS such as tea, powder and cosmetics are commercial in China, Korea, Japan, USA and UK⁽⁵⁾.

If a natural food product is used as a functional food,

quantity is matter that it should not cause toxicity. CS extracts are beneficial for everyone including cancer, hyperglycemic patients, malaria, inflammation, nocturnal enuresis anxiety, pregnant and lactating women when taken in controlled amount (500mg/kg body weight)⁽⁶⁾. CS is anti-hypertensive, anti-lithiasis, anti-allergic, anti-diarrhoeal, effective against jaundice, fluid retention, dysuria, cystitis, urethritis, biliousness (excess secretion of bile that cause vomiting & nausea) and also used in cosmetics. CS contains maysin , a type of flavonoid that act as a functional food^(7,8). Maysin is a flavone glycoside contining luteolin, a biologically active substance known to have high antioxidant and anticancer activities⁽⁹⁾. Therefore, this review article helps you to know about the nutritional composition of CS, application of CS in pharmaceutical and cosmetic industry and the products of corn silk extract that is available in the market specially in US, China.

Nutritional Composition

Corn silk does not only have pharmlogical uses but it also has many nutritional benefits like it is rich in Vitamin C, Vitamin K, carbohydrates, fibre, volatile oil, gums, resins, sterols, potassium and calcium as depicted in table-1.

Table- 1: Nutritional information of fresh corn silk⁽¹⁰⁾

Nutrients	Fresh CS Nutritional Value
Moisture	57.50 g
Carbohydrates	27.80g
Proteins	5.78g
Fats	0.36g
Crude Fibre	6.00g
Sodium	720.27mg
Potassium	107.08mg

Medicinal Uses of Corn Silk

Treatment of Diabetes Milletus

Diabetes Milletus is the most common metabolic disorder in which hormone, insulin functions abnormally or insufficient/ no production of insulin and it results in increase in the blood glucose level (hyperglycemic). Insulin is secreted by the Beta cells of pancreas. CS can be used as an oral antidiabetic agent in china for decades⁽¹⁾. The experimental studies shows the positive result of CS on the reduced hyperglycemia in alloxan-induced diabetic mice. The action of CS extract on glycemic metabolism is not via increasing glycogen and inhibiting gluconeogenesis but through increasing insulin level as well as recovering the injured β -cells⁽¹¹⁾.

The treatment with CS extract raised the level of hepatic glycogen storage this helps to maintain blood glucose levels as glycogen synthesis in the liver induces decreased hepatic glucose production. CS extract may be used as a hypoglycemic food or medicine for hyperglycemic people⁽¹¹⁾.

Relationship of CS to treat kidney and UTI

Corn silk has been used since ancient times to treat various disorder among which kidney and UTI remains common .As corn silk is diuretic it helps to increase the the contraction of smooth muscles that leads to increase urine output.Various medicinal properties related to kidney and its disorder is explained below.

To treat Urinary tract infection.

UTI is as a common disorder which is caused due to poor sanitation, pregnancy, kidney stones etc. When corn silk extract is taken it relieves and soothes the inflamed tissue therefore decreasing the burning sensation during urination⁽¹⁾. Consumption of CS for 5-20 days can give relief from symptoms. The reason why it is considered to be useful in such conditions due to its secondary metabolites which consists of flavonoids, tanins, terpenoids, alkaloids⁽³⁾. Instead of extract when corn silk tea is also consumed relief from symptoms could be seen.

To treat Kidney stones

Kidney stone is condition where there are calculi formed that makes passing urine difficult and painful.

Corn silk can used to increases the diuresis so it will increase the contractions which will help to pass urine it also helps to decompose the stones⁽¹⁾.

To treat chronic kidney disorders

Kidney is very important organ as it is used to eliminate waste from our bodies. Accumulation of waste in our body can be toxic and lead disbalance in our body. CS has been proved to provide beneficial role in treating Chronic kidney When CS is taken in the form of tea it has resulted in decreases fluid retention and also low serum creatinine levels. It is also helpful in reducing the swelling in body caused due to water retention. CS has also been found helpful for reducing potassium when it is consumed with other medicines. High blood pressure, being the most prominent symptom, is reduced with the help of corn silk tea⁽¹²⁾.

To treat Nephrotoxicity

Nephrotoxicity is a condition in which there is build of toxins. When the rat model of kidney failure were given the extracts of binhong leaves and CS it showed increased kidney functions and also helped in intoxicification of kidney⁽¹³⁾. Removal of toxins like urea, potassium, creatinine was seen. Therefore better functioning of kidney.

Antioxidant Property

Aerobic cells have developed antioxidant defence systems to counteract the harmful/damaging effects of free radicals. Antioxidants are the substances that delay or inhibit the oxidation of the substrate caused by the free radicals. They act as scavengers for free radicals. A free radical is a molecule or chemical species that contains one or more unpaired electrons and can exist independently and may initiate the degenerative diseases.

CS has been used traditionally as a medicine for its antioxidant properties as it can decrease the level of lipid peroxidation. According to experimental studies, antioxidant shows free radical scavenging activity, total antioxidant activity and phytochemical constituents. Phytochemicals are the plant chemicals and non-nutrient bioactive compound, found in fruits, vegetables and plant based foods and shows positive result to reduce various major chronic diseases⁽¹⁴⁾.

Phytochemicals in CS are flavinoids, phenols, tannins, anthocyanin, saponins, steroids, alkaloids and terpenoids and also contains α -terpineol, citronellol and eugenol that are some of the main compounds involved in antioxidant activity of CS⁽¹⁵⁾⁽¹⁶⁾. CS effectively increase the antioxidant enzyme levels such as sodiumdismutase and glutathionine peroxidase⁽¹⁷⁾. The high antioxidant activity for CS is affected by the levels of total phenols and flavonoids (myricetin, fisetin, quercetin, naringin and luteolin). The antioxidant activity increases with increasing levels of total phenols and flavonoids⁽¹⁸⁾⁽¹⁹⁾. CS also has tannins (have astringent properties) that can cause protein precipitation in the cell membrane and stop the attack of free radicals on the cell. Thus, CS has protective against free radicals and oxidative stress.

Anti-inflammatory activity

Inflammation is the reflective marker against harmful pathogens, irritants that disturbs body's immune system. The signs of inflammation are pain, red, heat and swelling in infected or injured area. Steroidal and non-steroidal anti-inflammatory drugs are used to treat inflammation effects⁽²⁰⁾.

CS is well known for its anti-inflammatory properties as it has property to inhibit the production of antigen IgE due to presence of non-starch polysaccharides in CS extract⁽²¹⁾. CS extract was suggested as clinically suitable to treat type 1 allergy diseases. Type 1 allergy is an immunological disorder related to hypersensitivity and causes an active activation of white blood cells to produce IgE and results in inflammatory responses⁽²²⁾.

Thus, CS shows positive responses against inflammatory markers.

Neuroprotective Effect

Neuroprotection refers to the protection of central nervous system function against the neuronal injury. According to in-vitro study by Natural Medicine database, CS inhibits acetylcholinesterase and butyrylcholinesterase that shows protective effects for Alzheimer's disease⁽²³⁾⁽³⁾.

CS has myasin (flavone glycoside) that shows neuroprotective effect against oxidative stress induced apoptotic death of human brain SK-N-MC cells through its antioxidant action⁽²⁴⁾.

Treatment for Hyperlipidemia

Hyperlipidemia is the increase in the level of triglycerides, cholesterol and phospholipids. This results in the development of atherosclerosis and leads to increase the risk of cardiovascular diseases.

The experimental studies shows that, flavonoids in CS has protective properties against atherogenesis and results in the reduction of triglycerides, cholesterol and low density lipoproteins levels⁽²⁾.

Prevent Gut- Dysbiosis

Dysbiosis is the condition in which there is the increase of bad microbes that harm our gut and health. CS has bioactive component flavonoid that alter the bile acid secretion and digestive enzyme activity, which in turn change the nutrient availability for gut microbes in large intestine and this effects the composition of gut microbes. The CS prevents gut dysbiosis by increasing the good & beneficial bacteria in the gut majorly lactobacillus and bifidobacterium⁽²⁵⁾.

Anti-Depressant, anti-fatigue and anti-anxiety activity

CS polysacchrides has positive effects towards the decreasing the depression and fatigue and also have anxiolytic properties.

Use in Cosmetic

Melanin is the most important hormone for deciding the skin colour of the human body. Melanin production by Melan-A cell increases by the oxidation of the tyrosine by enzyme tyrosinase.

CS extract reduced the activity of tyrosinase in Melan-A cell⁽¹⁾. The application of CS on faces with hyperpigmentation significantly reduced the skin pigmentation without abnormal reactions. CS has good prospects for suppressing the skin pigmentation⁽²⁶⁾.

CS is also have traditional use in soften the skin tissues (Emollient) and helps to overcome skin rashes.

Product Formation by using Corn Silk/ Corn Silk Extract

CORN SILK TEA (CST)

One of the product that can be formed using corn silk is Corn silk Tea it has bioactive compounds like flavonoids ,it also has antioxidant properties.CST has has shown positive impact for edema, decrease prostate inflammation,hypertension diabetes, kidney disorders, anti-depressant and diuretic effect and neurological problems⁽²⁷⁾.

CS has different advantages like it is easily available, affordable and good in taste.The amount in which CST should be used is 30 grams in boiling water and consumed as tea. The powdered can be stored and used for further use⁽³⁾.

CORN SILK WATER (CSW)-

CSW contains luteolin derivatives that can change into luteolin aglycones and also includes maysin glycones, methoxymaysin and isoorietins that are known to reduce oxidative stress, inflammation, hyperglycemia^(28,29) , protect neuronal cell death, increase blood flow, β -cell mass, promote gut microbiome-brain axis. CSW contains bioactive compound flavonoids that helps to prevent platelete aggregation and ischemic stroke⁽²⁵⁾.

CORN SILK POWDER-

During processing Corn Silk Powder chemical characteristic changes, it depends on the drying methods and temperature. The high antioxidant activity for corn silk powder is affected by the levels of total phenols and flavonoids⁽¹⁸⁾. Corn silk powder (2%) is also used to produce functional yeast bread with its desirable texture and sensory acceptability. The protein, ash and total dietary fibre contents of yeast breads were increased and moisture content was decreased with corn silk powder⁽¹⁾.

Methanol extracts of CS showed an antioxidant activity on the level of lipid peroxidation⁽³⁰⁾. Ethanol extract from CS exhibited a good reducing power and has a good bioactive source of natural antioxidants⁽³¹⁾⁽³²⁾.

Conclusion

Therefore this review article focused on the uses of the corn silk which is considered as a waste material in most of the households. It's nutritional components like high fibre, vitamin K, bioactive components and phytochemicals like flavonoids, phenolic compounds makes it very beneficial for people suffering from diabetes, high cholesterol, UTI, kidney stones, CKD, neurological disorders and dysbiosis and it acts as antioxidant and diuretic. Currently there are very less products of corn silk available in the Indian market. If more studies are done on corn silk in future it can be a high quality functional food.

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Reference

1. Deokar, A.M.; Deokar, G.S. and Kshirsagar, S.J.; Corn silk (*Stigma Maydis*) as a herbal remedie: an overview. International Journal of Institutional Pharmacy and Life sciences. 2016, 6(3): 2249-6807.
2. Hasanudin, K.; Hashim, P. and Mustafa, S.; Corn silk (*Stigma Maydis*) in healthcare: A phytochemical and pharmacological review. *Molecules*. 2012, 17: 9697-9715.
3. Vijitha, T.P. and Saranya, D.; Corn silk- A medical boon. International Journal of Chemtech Research. 2017, 10(10): 129-137.
4. Wan, R.; Nurhanan, W.I.; Farid, A.R.; Ghazali, C. and Moshin, S.S.J.; Effect of sodium hydroxide(NaOH) and sodium hypochlorite (NaHClO) on morphology and mineral concentration of *Zea mays* hairs (corn silk). *Annals of Microscopy*. 2010, 10: 1-10.
5. Wan Rosli, W.I.; Nurhanan, A.R.; Solihah, M.A. and Mohsin, S.S.J; Corn silk improves nutrient content and physical characteristics of beef patties. *Sains Malaysiana*. 2010, 40: 155-161.
6. Ha, A.W.; Kang, H.J.; Kim, S.L.; Kim, S.L.; et al.; Acute and subacute toxicity evaluation of corn silk extract. *Preventive Nutrition and Food science*. 2018, 23(1): 70-76.
7. Fossen, T.; Slimestad, R. and Andersen, O.M.; Anthocyanins from maize (*Zea mays*) and reed canarygrass (*Phalaris arundinacea*). *J Agric Food Chem*. 2001,49: 2318-2321.
8. Kim, S.L. and Jung, T.W.; Maysin and other flavonoid contents in corn silk. *Korean J Breed*. 2001,33: 338-343.

9. Lee, E.A.; Byrne, P.F.; McMullen, M.D.; Snook, M.E.; Wiseman, B.R.; Widstrom, N.W.; Coe, E.H.; Genetic mechanisms underlying apimaysin and maysin synthesis and corn earworm antibiosis in maize (*Zea mays* L.). *Genetics*. 1998,149: 1997-2006.
10. Bhuvaneshwari, K. and Sivakami Sridevi, P.L.; Analysis of Nutrients and phytochemicals content in Corn Silk (*Zea.Mays*). *International journal of Science and Research*. 2017, 6(1): 2319-7064.
11. Guo, J.; Liu, T.; Han, L. and Liu, Y.; The effects of corn silk on glycaemic metabolism. *Nutrition & Metabolism*. 2009, 6: 47.
12. Sukandar, E.Y.; Sigil,J.I. and Ferdiana, L.; Study of kidney repair mechanisms of cornsilk (*Zea Mays*L.Hair), Binahong(*Anredera Cordifolia* (ten) Steenis) Leaves combination in rat model of kidney failure. *International journal of pharmacology*. 2013, 9(1): 12-23.
13. Sepehri, G.; Derakhshanfar, A.; Zade, F.Y.; Protective effects of corn silk extract administration on gentamicin-induced nephrotoxicity in rat. *Comp.Clinic .Pathol*. 2011, 20: 89-94.
14. Liu, R.H.; Mohmoud and Tanabe, H. J. *Nutri*. 2019, 134: 3479-3485.
15. Harborne, J.B.; *Phytochemical methods: A guide to modern technique of plant analysis*. Chapman and Hall Ltd., London. 1973, 49-188.
16. El-Ghorab, A.; El-Massry, K.;Shibamoto,T.; Chemical composition of the volatile extract and antioxidant activities of the volatile and non-volatile extracts of Egyptian Corn silk (*Zea mays* L.). *J.Agric.Food Chem*. 2007, 55: 9124-9127.
17. Hu, Q.; Deng, Z.; Protective effects of flavonoids from corn silk on oxidative stress induced by exhaustive exercise in mice. *Afr. J. Biotech*. 2011, 10: 3163-3167.
18. Yondra, A.D.; Jose, C.and Teruna, H.Y.; Total fenolik , Flavonoid serta aktivitas antioksidan ekstrak n-heksana, diklometan dan metanol *amaranthus spinosus* 1 em5-bawang merah. *JOM FMIPA*. 2014, 1(2) : 359-369.
19. Catap, E.S.; Jimenez, M.R.R. and Tumbali, M.P.; Immunostimulatory and anti-oxidative properties of corn silk from *zea mays* L. in Nile Tilapia ,*Oreochromis niloticus*. *International journal of fisheries and Aquaculture*. 2015, 7(3): 30-36.
20. Karmakar.S.; *Anti-inflammatory Activity of Zea Mays (corn silk)*. Department of Pharmacy. Reference ID:Pharmatutor-ART-1953.
21. Namba, T.; Xu, Ho.; Kadota, S.; Hattori, M.; et al.; Inhibition of IgE formation in mice by glycoproteins from corn silk. *Phytotherapy Research*. 1993, 7(3): 227-230.
22. Kim, K.A.; Choi,Sk.and Choi,Hs.;Corn silk induces nitric oxide synthase in murine macrophages. *Experimental and molecular medicine*.2004, 36(6): 545-550.
23. Senol, F.S.; Orhan, I.; G.; Cicek, M.; B. Acetylcholinesterase, butyrylcholinesterase and tyrosinase inhibition studies and antioxidant activities of 33 *Scutellaria* L.taxa from turkey . *Food chem.Toxicol*.2009,48:781-788.
24. Choi, D.J.; et al.; Neuroprotective effects of corn silk maysin via inhibition of H2O2-induced apoptotic cell death in SK-N-MC cells. *Life sciences*.2014, 109(1).
25. Ryuk,J.A.; Ko,B.S.;et al.; Protection against Neurological Symptoms by Consuming corn silk water in Artery-Occluded Gerbils with reducing Oxidative stress, Inflammation and Post -Stroke Hyperglycemia through the Gut-Brain Axis.*Antioxidants*.2022,11: 168.

26. Choi, S.Y.; Lee, Y.; Kim, S.S.; et al.; Inhibitory Effect of Corn Silk on Skin Pigmentation. *Molecules*. 2014, 19: 2808-2818.
27. Khairunnisa, H.; Puziah, H.; Shuhaimi, M.; Corn silk (*Stigma Maydis*) in healthcare: A phytochemical and pharmacological review. *Molecules*. 2012, 17: 9697-9715.
28. Choi, D.J.; Kim, S.L.; Choi, J.W.; Park, W.I.; Neuroprotective effects of corn silk maysin via inhibition of H2O₂- induced apoptotic cell death in SK-N-MC cells. *Life Sci*. 2014, 109: 57-64.
29. Guo, J.; Liu, T.; Han, L.; Liu, W.; The effects of corn silk on glycemic metabolism. *Nutr. Metab*. 2019, 6: 47.
30. Maksimovic, Z.A.; Kovacevic, N.; Preliminary assay on the antioxidative activity of *Maydis stigma* extract. *Fitoterapia*. 2003, 74: 144-147.
31. Ebrahimzadeh, M.A.; Poumorad, H. and Hafe, S.; Antioxidant activities of iranian corn silk. *Turkish Journal of Biology*. 2008. 32: 43-49.
32. Liu, J.Wang C.; Wang, Z.; Zhang, C.; et al.; The antioxidant and free radical scavenging activities of extract and fractions from corn silk (*Zea Mays L.*) and related flavone glycosides. *Food Chemistry*. 2011, 126: 261-269.

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