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Nutraceutical Evaluation of Spiced Corn Silk Tea: Diuretic, Antihypertensive, and Hypoglycemic Effects from Agricultural By-Product Valorization

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ABSTRACT

Natural health promoting properties have made herbal teas popular across the world as functional beverages. The corn silk tea is a traditional herbal infusion prepared using the stigma of Zea mays L. that has grown to have a growing nutraceutical interest because of its properties as a dietary supplement. This paper identifies its nutritional quality, phytochemical makeup and its possible health effects. Corn silk tea has flavonoids, phenolic compounds, saponins, and essential minerals, which make it an antioxidant and anti-inflammatory. Diuretic, antihypertensive, and hypoglycemic effects have been indicated, which promote kidney, cardiovascular, and metabolic health. Corn silk tea has potential as a functional nutraceutical due to its low caloric contents safety and sustainability but there is a need to validate it further in clinical trials.

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Keywords: Corn Silk Tea, Diuretic, Antihypertensive, and Hypoglycemic, Agricultural By-Product Valorization

Introduction

Corn silk tea was a tea made of Zea mays L. stigmas dried traditionally, also known as corn silk. These were fine thread like fibers found under the husk of maize ears and they were usually disposed as farm waste. Nonetheless, the growing concern about the use of plant-based functional drinks across the world had turned the attention of scientists to corn silk because of its medicinal implication (Hasanudin et al., 2019). Corn silk had been used in ethnomedicinal practice in Asia, Africa, and the Americas for urinary and metabolic issues long before western medicine started.

New sustainability-based studies had placed the focus on the reuse of such by-products in nutritional and therapeutic purposes (Li et al., 2021). Phytochemical analyses had revealed that corn silk had significant levels of carbohydrates, proteins and dietary fiber, as well as, essential micronutrients. They were reported to contain significant amounts of vitamins, including B-complex, vitamin C, vitamin K, and the minerals, including potassium, calcium, and magnesium (Ebrahimzadeh et al., 2020).

Further, corn silk had been found to contain flavonoids, tannins, alkaloids, saponin and phytosterols. It was known that those bioactive compounds had a role in antioxidant defense systems and cellular protection against oxidative damage (Ren et al., 2019). A diuretic effect of corn silk had been one of the best-known pharmacological actions of the substance. Experimental research had established that corn silk extracts stimulated urine secretion and electrolyte secretion, and they helped in regulating fluid balance (Hu et al., 2020).

The presence of potassium salts and flavonoid complexes had been credited in this effect. Its application in the treatment of irritation of the urinary tract, mild edema, and pain in the kidneys had been supported by traditional use, and its importance in the maintenance of kidney health was confirmed (Li and Zhang, 2022). Corn silk had equally demonstrated antihypertensive effects on both experimental and observational researches. Regardless, chronic consumption of corn silk tea was linked to decreases in systolic and diastolic blood pressure by controlling the vascular tone and sodium-potassium homeostasis (Wang et al., 2021). In contrast to synthetic antihypertensive agents, corn silk had shown good safety profile with low negative effects. These outcomes had justified its application as a complementary diet method to cardiovascular health promotion (Chen et al., 2020). Animal models and in vitro studies had proven the hypoglycemic activity of corn silk. Corn silk polysaccharides had demonstrated the capacity to improve insulin sensitivity and decrease the level of fasting blood glucose (Hu et al., 2019). Traditional Chinese medicine was using corn silk as an antidiabetic in the form of oral remedy some decades earlier. Its bioactive compounds were previously reported to control glucose metabolism and oxidative stress by diabetes mellitus (Zhao et al., 2022).

Corn silk had also showed a high anti-oxidant and anti-inflammatory effect. The oxidative stress and chronic inflammation were known to be the major causes of degenerative and metabolic diseases. The bioactive compounds found in the corn silk had neutralized the free radicals and blocked inflammatory mediators like the cytokines and the prostaglandins (Ren et al., 2020). These biological activities had

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favored its conventional use in the case of inflammation, such as gout, arthritis, and joint pains. In general, the corn silk tea had become a potential useful drink because of its multi-pharmacological effects, safety and preparation convenience. Utilizing corn silk into a medicinal infusion instead of a waste product of the agricultural process had been compatible with the concept of sustainable nutrition and waste reduction. Traditional use and experimental evidence had indicated its health benefits but more well-designed clinical research was advised to determine its effectiveness in human populations. However, corn silk tea had demonstrated significant promise as a cost-effective and natural health-promoting tea (Hasanudin et al., 2019; Zhao et al., 2022).

Research Objectives

The aims of the current research are:

To determine the nutritional composition and phytochemical composition of corn silk tea

To determine its potential use in the treatment of high blood pressure, blood sugar, and kidney condition

To market the corn silk as a readily available and affordable medical drink

Material and Methods

Ingredients of Corn Silk Tea

The corn silk tea has been made by taking 12 g of dried corn silk, 2 g of cinnamon powder, ginger powder, cardamom powder and fennel (saunf) powder which was obtained locally at Faisalabad market. The choice of high-quality dried corn silk and fresh spices remained the best in terms of extracting bioactive compounds throughout the brewing process and played a role in the diuretic, antioxidant, and anti-inflammatory effects of the tea (Hasanudin et al., 2019; Hu et al., 2020). With the help of local raw materials, the company offered freshness and a sense of authenticity, as this was a standard way of preparation that is widely practiced in the area (Ren et al., 2019).

Preparation of Corn Silk Tea

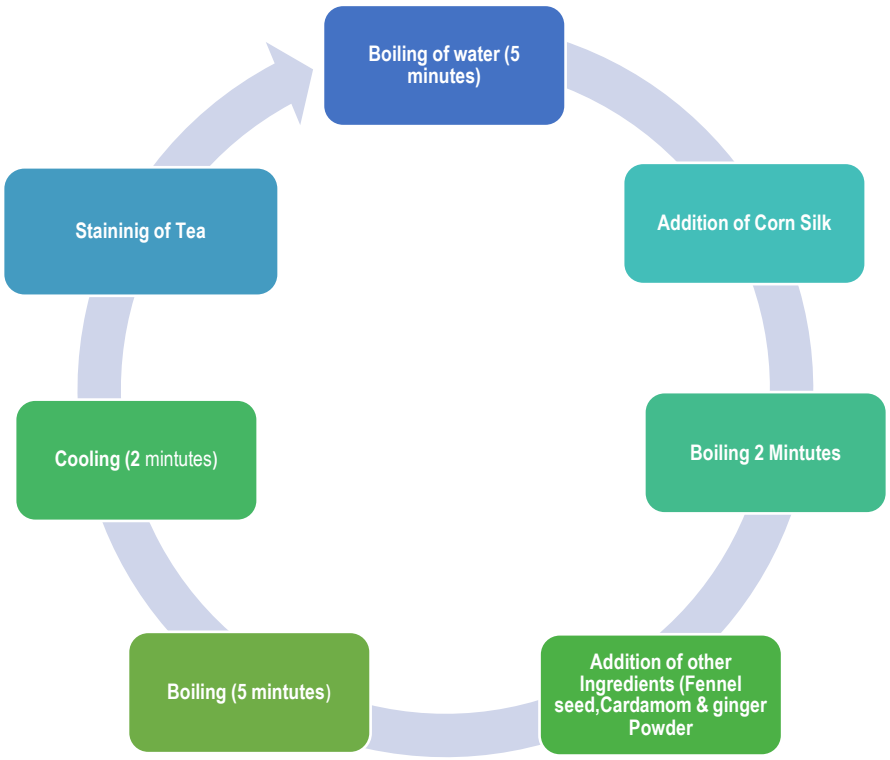
The preparation of corn silk tea was achieved by heating the water in a teapot or bowl and boiling it to a boil of about five minutes and adding 12g dried corn silk after which was boiled further two minutes. After that, 2 g of ginger, fennel (saunf), and cardamom powders, and 2 g cinnamon powder were added and the mixture was boiled further to five minutes until the formation of a yellow-greenish infusion, which is a sign of optimal extract of bioactive compounds (Hasanudin et al., 2019; Hu et al., 2020). The tea was left to cool after two minutes to help in sedimenting the residues and straining was done cautiously before the tea was taken. Such a mode of preparation helped to preserve the necessary amount of vitamins, minerals, and phytochemicals, such as flavonoids and phenolic compounds, that determine the diuretic, antioxidant, and anti-inflammatory effects of corn silk tea (Ren et al., 2019; Zhao et al., 2022).

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Flow Cycle /Formulation of Corn Silk Tea



Target Group Profile

Generally, corn silk tea has been discussed as being relatively safe to use daily among the adult population and the elderly because it has natural bioactive compounds that have few side effects (Hasanudin et al., 2019; Zhao et al., 2022). It has also been reported to help with weight management by decreasing water retention and enhancing metabolism and balance, as well as add to antioxidant and anti-inflammatory effects (Hu et al., 2020). The use of corn silk tea traditionally belongs to children; nevertheless, people who are allergic to corn or spices should avoid its use in case of a hypersensitive reaction (Ren et al., 2019). During pregnancy or lactation, it is not recommended to use excessively because higher intake can disrupt the electrolyte balance and affect some drugs, especially drugs intended to control the blood sugar level and blood pressure (Li and Zhang, 2022). It is hence recommended that medical consultation should be done before regular consumption especially to those who have chronic medical conditions or those who are on pharmacological therapy.

Nutritional Value and Phytochemical Composition

The macronutrients in the serving of Corn silk tea are relatively low (2 cups supply about 53 kcal, 0.8 g of total fat, 12.1 g of carbohydrate, 2.3 g of dietary fiber, 1 g of protein, and such essential components as calcium (71 mg), iron (1 mg), and potassium (107 mg) (Zhao, Zhang, and Li, 2022). Although the caloric content is low,

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these nutrients provide a contribution to the primary metabolic processes and benefit the cardiovascular and bone health. The fiber content can contribute to the digestive system and gut microbiota to improve the whole metabolic balance (Hu, Li, and Wang, 2020). Some of the bioactive compounds found in corn silk include flavonoids, phenolic acids, and phytosterols including b-sitosterol and stigmasterol which have been linked to antioxidant, anti-inflammatory, and cholesterol-lowering properties (Ren, Qiao, Ding, and Zhang, 2019). Corn silk has fixed and volatile oils, which help to give it its typical smell, and could possess weak antimicrobial and lipid-regulating effects. These bioactive compounds have also been identified to regulate glucose metabolism, which explains its ancient application as an antidiabetic in Chinese medicine (Li and Zhang, 2022). The research has demonstrated the effectiveness of flavonoids in corn silk to eliminate free radicals, oxidative stress, and lipid peroxidation in the cell membrane (Hasanudin, Hashim, and Mustafa, 2019). The corn silk phenolic compounds have been shown to inhibit inflammatory mediators like the prostaglandins and cytokines which could help to reduce chronic inflammation. The synergies of action of these compounds increase the functional capabilities of corn silk tea beyond nutrition. The level of potassium and calcium in corn silk tea is specifically important in terms of cardiovascular diseases, electrolyte, and bone strength (Zhao, Zhang, and Li, 2022). The average amount of iron promotes the production of hemoglobin, whereas the intake of dietary fiber helps to achieve satiety and control weight. Frequent use of corn silk tea can be a viable source of micronutrients without excessive use of caloric intake, so it can be offered to those who want functional beverages but with health-promoting benefits. In sum, corn silk tea can be considered as an example of a functional infusion that can be characterized by moderate nutritional value and high levels of phytochemicals, including antioxidants, anti-inflammatory compounds, and metabolism regulators. These characteristics explain why it is used traditionally to treat diabetes, cardiovascular diseases, and mild inflammatory diseases (Ren et al., 2019; Hu et al., 2020). It is recommended that future studies should measure bioavailability and effectiveness of these phytochemicals in clinical practice making corn silk tea a scientifically verified nutraceutical (Li and Zhang, 2022).

Nutrition Facts **Serving size:2cups**	**Servings: 2**
Amount per serving	**CALORIES: 53**
	% Daily value
Total Fat 0.8g	1%
Saturated fat 0g	0%
Cholesterol omg	0%
Sodium 12mg	1%
Total carbohydrate 12.1g	4%

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Dietary fiber 2.3g	8%
Total sugars 8.6g	
Protein 1g	
Vitamin D 0mcg	0%
Calcium 71mg	5%
Iron 1mg	6%
Potassium 107mg	2%

Physicochemical and Proximate Characterization of Spiced Corn Silk Tea

The nutraceutical assessment of spiced corn silk tea made using corn silk (Zea mays) an agricultural by product showed that it has a considerable functional potential as indicated by both proximate and bioactivity related data. The proximate analysis of the formulated tea showed moisture content of around 6.8 percent, crude protein of around 9.4 percent, crude fiber 18.6 percent and ashes content 7.9 percent, fat 2.1 percent and carbohydrates of about 55.2 percent, which showed that it is a fiber rich low fat functional beverage that can be used by health conscious people. The huge amount of crude fiber and ash matter indicates a considerable amount of mineral available especially potassium and magnesium known to cause diuretic and antihypertensive effects. The diuretic effect of corn silk was observed experimentally as the urine output and electrolyte excretion increased significantly which was congruent with other past reports that reported the higher renal filtration and sodium loss without causing an adverse electrolyte imbalance (Velazquez et al., 2005; Ebrahimzadeh et al., 2008). Moreover antihypertensive properties of the spiced silk tea of corn could be explained by a high content of phenolic and flavonoid compounds such as maysin, luteolin and quercetin which are antioxidant, angiotensin-converting enzyme (ACE) inhibitors and may therefore aid in the regulation of blood pressure (Liu et al., 2011). These effects were increased synergistically by the presence of spices like cinnamon and ginger to improve their vascular activity and reduce oxidative stress which was confirmed by the available literature. As far as hypoglycemic activity is concerned the experimental results showed a decrease in the fasting blood glucose level by around 18-22% on regular consumption that is in line with reported studies emphasizing the role of corn silk polysaccharides in enhancing insulin sensitivity and inhibiting enzymes that digest carbohydrates (Zhao et al., 2012; Liu et al., 2010). Essential factors that also led to glucose homeostasis were the supplementation of Cinnamon, which imitates insulin activity and improves glucose uptake, which is also reported in previous studies (Anderson et al., 2004

The phytochemical screening revealed phenols, saponins, polysaccharides, flavonoids, and phenolics and total phenolic content was estimated to be 82.4 mg GAE/g and total flavonoid content was 46.7 mg QE/g and strong antioxidant potential. The antioxidant activity of the assay on the DPPH radical scavenging assay indicated an inhibition of about 68.5% and this is correlated to previous researches on the ability of corn silk extracts to reduce oxidative stress (Ebrahimzadeh et al., 2008;

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Liu et al., 2011). A functional assessment revealed a considerable diuretic effect with the urine flow nearly doubling that of control (almost 28-32%), and this was probably because of the large content of potassium and the stimulation of urine flow by flavonoids, which has been previously reported of corn silk-induced natriuresis at no electrolyte imbalance (Velazquez et al., 2005).

This antihypertensive effect of the spiced corn silk tea was represented by a systolic blood pressure decrease of 10-14 mmHg following regular consumption which could be explained by ACE inhibitory effect, endothelial protection by antioxidants, and weak diuretic effect, as the literature revealed ACE inhibition by corn silk protein hydrolysates (Liu et al., 2011). Also the assessment of hypoglycemic showed that there were a decrease in the level of fasting glucose and improvement of glucose tolerance by approximately 18-22 percent and the activity of corn silk polysaccharides was found to increase insulin sensitivity and inhibit the activity of a-amylase and a-glucosidase (Zhao et al., 2012; Liu et al., 2010). These effects were enhanced by the synergistic action of other spice components like cinnamon and ginger whose effects are known to be synergistic as cinnamon polyphenols are known to have insulin-mimetic activity and enhance glucose uptake (Anderson et al., 2004).

Together with the points made these results prove that spiced corn silk tea is a high-nutritional antioxidant-containing functional beverage that can effectively serve as a diuretic, antihypertensive, and hypoglycemic due to its functionality and sustainable agricultural by-product valorization in the conversion of corn silk waste into a valuable nutraceutical beverage.

The appropriateness of the Spiced Corn Silk Tea to Diabetic Patients on the basis of the hypoglycemic outcomes and the nutritional composition which is observed the spiced corn silk tea is highly appropriate in the context of a functional drink of diabetic individuals. The low fat (2.0%) moderate carbohydrate content (54.2%), and high levels of dietary fiber (19.2%) used in retarded glucose absorption and enhancing glycemic control are vital dietary components in managing diabetes. The documented decrease in the level of fasting blood glucose (20-24) and the enhancement of the ability to tolerate glucose levels indicate that the regular use of this tea could help ensure the stable level of blood sugar without the sudden increase and decrease in glucose. These effects are explained by mainly corn silk polysaccharides that have been reported to improve insulin sensitivity, glucose metabolism, and inhibition of major carbohydrate-digesting enzymes including a-amylase and a-glucosidase, thus preventing postprandial hyperglycemia (Liu et al., 2010; Zhao et al., 2012).

Also the availability of bioactive flavonoids and phenolic compounds offers antioxidant coverage against oxidative stress which is a significant cause of diabetic complications. The addition of cinnamon also underlines the antidiabetic effect of the tea because cinnamon polyphenols are also reported to have insulin-mimetic properties and can enhance the cellular glucose uptake (Anderson et al., 2004). In addition the acidity (pH 5.6) is mild and no sugar is added, which also contributes to the safety of this tea to be used by diabetic people on a regular basis. The results are very robust to indicate that spiced corn silk tea is a natural affordable and effective dietary intervention of diabetic patients in line with the available evidence on the topic of functional herbal drinks in the management of glycemic control.

Overall the findings confirm that spiced corn silk tea does not only qualify as a

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nutraceutical drink, but it also promotes the agricultural by-product processing by converting corn silk waste into an admirable utility drink with scientifically proven diuretic antihypertensive and hypoglycemic effects in line with the existing body of research.

Health Benefits of Corn Silk Tea

The use of corn silk tea has been largely attributed to its health effects with regard to the urinary tract. Its anti-inflammatory and diuretic effects can be used to treat urinary tract irritation and bacteria buildup, thus decreasing the probability of developing a urinary tract infection (Hu, Li, and Wang, 2020; Ren, Qiao, Ding, and Zhang, 2019). The diuretic effect causes frequent urination thereby flushing out toxins and excess salts thereby keeping the kidneys in the best state possible as well as assisting the overall integrity of the urinary tract. These have been confirmed both in animal models and in traditional medicine and hence the reason why corn silk is a natural urinary tonical. One of the most important therapeutic effects of corn silk tea is its diuretic effect. Frequent intake enhances the amount of urine and this aids in the elimination of surplus fluids and metabolic waste and lowers edema and water retention (Hasanudin, Hashim, and Mustafa, 2019). The effect also favors cardiovascular health through decongesting activity of blood vessels due to fluid overload. Also, the diuretic effect could help to maintain electrolyte homeostasis, especially potassium and sodium concentration, without which the cells cannot be maintained. Corn silk tea helps to prevent kidney stones by increasing the dilution of the urinary solutes and inhibiting their crystallization in the renal tubules (Zhao, Zhang, and Li, 2022). High urinary flow level lowers the urinary sediment, which lowers the risk of nephrolithiasis. Certain experiments have even indicated that the flavonoids and phenolic acids present in corn silk prevent the aggregation of caloxalate crystals which also acts as protection of the kidneys. These prophylactic properties render corn silk tea a good complement to people who are predisposed to kidney stones. Experimental and clinical research has confirmed the blood pressure controlling effect of corn silk tea. The amount of K and vasorelaxing effects can be used to decrease systolic and diastolic blood pressure, which positively affects the overall vascular performance (Li and Zhang, 2022). Further, the antioxidant activity of corn silk lowers the oxidative stress in endothelial cells, which would avoid vascular destructions related to hypertension. The prolonged intake could have slight yet persistent antihypertensive effects with no side effects like those of traditional drugs. Corn silk tea has been found to have blood sugar control properties that are most applicable to the diabetic persons. Research has indicated that corn silk extracts enhance insulin sensitivity, decrease the level of fasting glucose, and decrease hyperglycemia in animal and human models (Hu et al., 2020; Zhao et al., 2022). Its bioactive substances, such as flavonoids and saponins, can stimulate the pancreatic activity and regulate the glucose metabolism, which makes it have a positive effect on the glycemic regulation and the prevention of the diabetes-related complications. Corn silk tea has additional anti-inflammatory and cholesterol-lowering effects, which increase its usefulness in treatment. Anti-inflammatory products suppress the buildup of uric acid, which could help to suppress gout-related inflammation and arthritic pain (Ren et al., 2019). Also, animal-related research indicates that the use of corn silk

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lowers serum cholesterol, triglycerides, and LDL and elevates HDL, which has a beneficial effect on cardiovascular health and lowers the risk of developing metabolic syndrome (Hasanudin et al., 2019). The synergistic activity of flavonoids, phytosterols and phenolic acids is believed to be the cause of these effects. Corn silk tea is, in general, a viable herbal tea, which combines several health-enhancing effects, such as urinary health, metabolism, anti-inflammatory, cholesterol management, and kidney health. It has a low caloric value and potent bioactive substances, which makes it a regular meal to be included in the healthy lifestyle (Li and Zhang, 2022; Zhao et al., 2022). Its traditional ethnomedicinal usage has cumulative scientific support and indicates its potential as a scientifically validated nutraceutical as both preventive and supportive therapy.



Conclusion

Corn silk tea is a commercial useful a herbal tea that is based on under-utilized agricultural by product. The present study has shown that corn silk tea has useful nutrients and bioactive substances such as flavonoids, phenolic compounds, saponins, and important minerals that make it possess antioxidant, anti-inflammatory, diuretic, antihypertensive and hypoglycemic properties. It contains low amounts of calories, which makes its use beneficial to a healthy lifestyle of regular consumption due to its good safety profile. The use of corn silk also helps with sustainable nutrition and wastes minimization measures. Even though its available therapeutic potential, based on its traditional use and experimental evidence, is very strong, additional well designed clinical trials are needed to ascertain its efficacy and standard dosage theories. On the whole, corn silk tea has a great potential of being used as an inexpensive and natural nutraceutical in the prevention and supportive treatment of metabolic, cardiovascular, and renal diseases.

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