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Harnessing Corn Silk Syrup For Liver And Kidney Health: A Natural Cure

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ABSTRACT

Traditional herbal remedy Zea mays L. (commonly known as corn silk) is now scientifically proven to benefit liver and kidney health. This analysis investigates both the chemical identities present in corn silk syrup and its clinical effects together with its multiple therapeutic usage possibilities as an eco-friendly natural medicine. The bioactive contents in corn silk include flavonoids, saponins, alkaloids, phenolic compounds that generate its strong hepatoprotective along with anti-inflammatory and diuretic effects and antioxidant potential. These properties make corn silk particularly promising in managing renal and hepatic disorders such as nephrotoxicity, kidney stones, and liver fibrosis. Preclinical and limited clinical studies suggest that corn silk syrup may reduce elevated serum creatinine and urea levels, enhance urine output, and protect against drug- or toxin-induced hepatic damage. Its antioxidant activity contributes to the reduction of oxidative stress and liver and kidney tissue lipid peroxidative damage. In addition, the preparation of the syrup using green and simple extraction techniques underpins its incorporation into functional food and nutriticum capsules. Further standardization of dosage, long-term evaluation of safety, and clinical trials are needed to confirm its efficacy and optimize its use. This review brings the potential of the use of corn silk syrup as a cheap, natural alternative or addendum to the liver and kidney health management process

Keywords: Corn silk syrup, Hepatoprotective, Nephroprotective, Antioxidant activity, Phytochemicals

1. INTRODUCTION

The mention of corn silk in the Chinese medical literature marked its appearance when the Sichuan Journal of Traditional Chinese Medicine and Lingnan Pharmacopoeia first quoted it after its mention in Southern Yunnan Materia Medica in 1476. The 1997 version of the Chinese Pharmacopoeia included corn silk as an official Chinese herb. Research shows that corn silk has found widespread application in food products and healthcare formulations thus indicating possible usage of the herb in diverse edible and medicinal applications. (1). Corn silk resources have grown especially plentiful as a result of Zea mays L.'s widespread production and processing in China and other nations. Traditional Chinese medicine's (TCM) sustainable growth has garnered a lot of attention lately, and corn silk extraction has emerged as a research hotspot. In contemporary study, TCM exhibits the typical multicomponent and multitarget properties. Different macromolecules can be identified from its phytochemistry, such as flavonoids, saponins, alkaloids, organic acids, etc., and macromolecules as proteins & polysaccharides. As a result, a single component may be crucial to a pharmaceutical action, and different classes of elements may combine to produce a specific effect. Furthermore, TCM typically has a wide range of pharmacological actions and associated processes (2). Stigma maydis is another name for the long stigmas of the female flowers of the maize plant these stigmas resemble a tuft of hairs. It is derived from corn production and a generation of excess waste. Light green is mostly first and later it becomes red, yellow or light brown. It is used to catch pollen that is used for pollination and is harvested at the same time the corn cob is picked. One can pollinate each silk and obtain one kernel of maize. The CS has a rather furnished taste; and it is capable of being from 30 cm and up. It contains a lot of vitamins, carbs, fixed and volatile oils and protein. Also, the substances, including calcium, potassium, magnesium, sodium salts, steroids, phenol and flavonoids, are

believed to fixate their pharmacological potential (3). When maize silk was used to make wine and vinegar, several volatile chemicals

were realized; they included 1-butanol, 3-methyl-acetone, 1-butanol, chemical nomenclatures: 3-methyl-hexanoic acid. In testing, almost all of these substances had some sorts of antibacterial properties (4). By comparing the effects of 10% corn silk extract mouth gargles with mouth gargles available on the market, an in vitro study demonstrated a remarkable decrease in the bacterium that causes decay (S. mutans) (5). Various countries such as China, the US, and France have in the past utilized corn silk as a medication to disease kidney stones, obesity, bedwetting, UTIs, liver issues, and prostate issues. The corn silk extract is useful in reversing some of the serious effects of diabetes, hypertension and high blood pressure. (6). Additionally, maize silk is a mild cleansing agent for the body. Corn silk extracts have been utilized by naturopaths to treat gonorrhea and other severe urinary tract disorders. It is frequently a key ingredient in skin and hair products and has been shown to condition the skin and hair (7). Prior toxicological research on maize silk crude aqueous extract has demonstrated that it has no harmful effects on Wistar rats' hematological systems. It has been found to be safe for human ingestion and non-toxic. In Asia, it is used in tea as a medicinal and healthful beverage (8). Additionally, it was noted that the synthesis and migration of specialized white blood cells known as macrophages which have the ability to absorb foreign particles were both boosted. Additionally, laboratory studies have shown that maize silk can decrease some cancer-causing chemicals and prevent some germs from adhering to the cell lining. When used in big or regular doses, corn silk is a perfectly safe plant. Corn silk extracts have a number of advantages for both young and old, as well as for expectant and nursing mothers. In order to realize its phytoconstituents to perform specific and desired bioactivities or healings, Silk of Corn could be utilized in a tincture, decoction or as a capsule of the plant (9). The most important hormone that specifies the skin tone of an individual is melanin. An enzyme, Tyrosinase oxidizes tyrosine to increase the amount of melanin produced by Melan-A cells. Cornsilk extract evoked a decline in Tyrosinase action in Melan-A cells (10). In the absence of any unusual side effects, applying corn silk to faces with hyperpigmentation significantly reduced pigmentation of the skin. There is a high probability that corn silk will lower skin pigmentation (11). The rise of triglycerides, cholesterol, and phospholipids is defined as hyperlipidemia. This makes the body prone to cardiovascular illnesses and develops atherosclerosis. The flavonoids in corn silk are anti-atherogenic and alters triglyceride, cholesterol, and low-density lipoprotein in any experimental study(12).

Phytochemical composition of corn silk:

The non-nutritional bioactive substances found in various parts of the plants are referred to as phytochemicals. These compounds are critical forms that play vital roles in plants, more so in defending against predators and unfavorable situations in the environment. These substances are of particular significance in the pharmaceutical and medical industries because of the presence of biological properties in them such as antibacterial and antioxidant properties. Phytochemicals present in corn silk are phenols, polyphenols, phenolic acids, flavonoids, Flavone glycosides, anthocyanins, carotenoids, terpenoids, alkaloids, steroids, tannins, saponins, volatile oils (13) these which have been investigated biologically and pharmacologically for activity, characterization, and isolation.

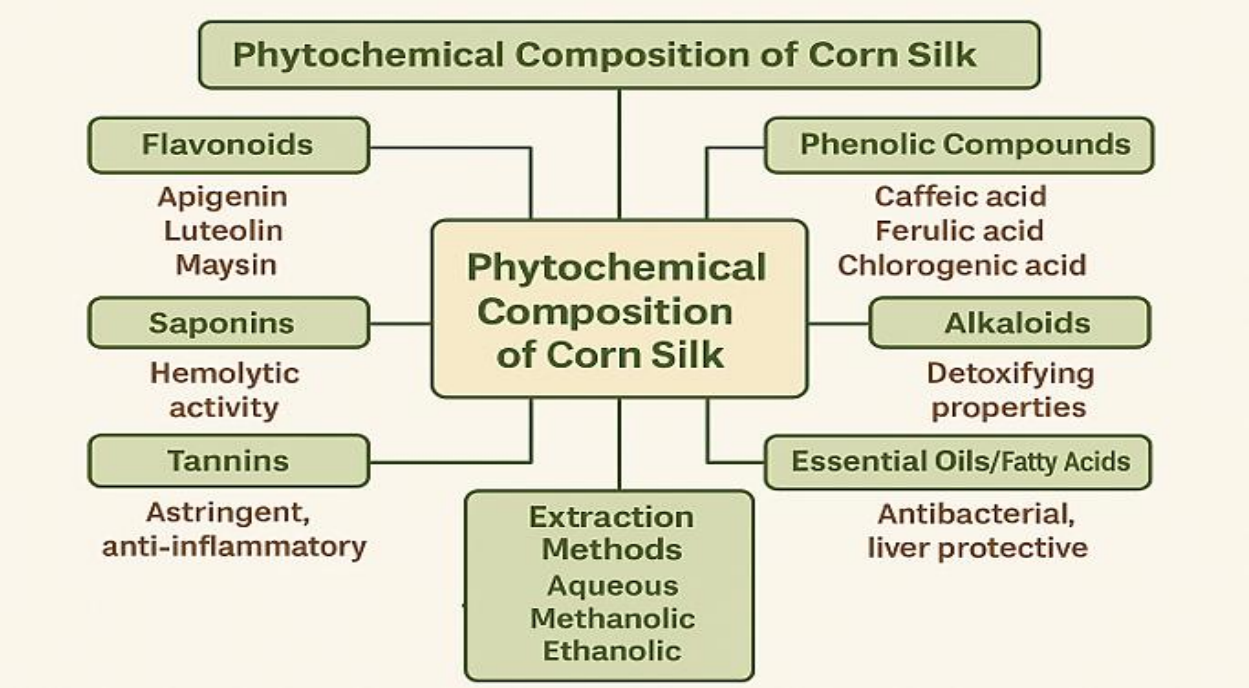

Fig 1. illustrates the phytochemical composition of corn silk

Table 1: Phytochemical Characteristics and Research Findings of Different Types of Corn Silk Extracts

Corn Silk Variety	Type of Extract	Phytochemical Composition	Study Insights / Formulation Prepared	Ref
CV. Mohar	Ethanol, Methanol, Chloroform	Flavonoids, glycosides, steroids, saponins, tannins, alkaloids, balsams, phenols, volatile oil, resin	Methanolic extract evaluated for antimicrobial and free radical scavenging activity	**14,15**
Malaysian Corn Silk	Methanol, Aqueous	Phenols, flavonoids, alkaloids, saponins, carding Glycosides, anthraquinones, terpenes.	Both extracts screened; methanolic showed higher antioxidant potential and antimicrobial activity	**16**
Purple Waxy Corn, White Waxy Corn, Super Sweet Corn	Methanol	Total phenolic content, total flavonoid content, anthocyanins	Focused on quantitative phytochemical analysis; used in colorant and antioxidant-based functional food development	**17**
Baby Corn (Pacific 271 & zebSG 17 hybrid)	Ethanol, Aqueous	Extracts used: alcohol 40%, hot water, dichloromethane, methanol, and methanol with 60% ethyl acetate.ections that could be determined were: flavonoids, tannins, terpenoids, steroids and total phenolic content. Cooma area ecтeRegion: Cooma area. Drink extracts could be used Easily available and less sensitive to texture and colour changes during processing and storage. Require development medicine related book for more details.	Extracts evaluated for skin protection and UV filtering in topical cosmeceutical formulations	**18**

P.1543 Hybrid	Methanol (CECME), Consecutive Extraction	Phenolic acids, flavonoids, ascorbic acid, tannins, cardiac glycosides	Used for in vitro antioxidant assay and formulation of polyherbal antioxidants	**19**
Purple, Green, Pink & Yellow Corn (ZP Exp, ZP 555, ZP 341, ZP366)	Methanol, Hydro-ethanolic, Aqueous	Flavonoids, tannins, anthocyanins, proanthocyanidins, alkaloids, sterols, mucilage, coumarin	Methanolic extract evaluated for neuroprotective and hypolipidemic properties in rats	**20 ,2 1**
Brazilian Corn Silk	Ethanolic Extract	Flavonoids, tannins, phenols, terpenoids	Applied in photoprotective and skin-soothing formulations; antimicrobial assays confirmed efficacy	**22**

These substances regulate the growth and reproduction of plants, as well as their relations with the environment. They are synthesized in conjunction with primary metabolic chemicals. Besides their common use in the dyes, tastes, scents, and pesticides field, phytochemicals are also responsible for the vast majority of the microbiological and nutritional properties of food-based items (23). Secondary metabolites are accumulated entirely in diverse sections of a plant, and their concentration is vital for the treatment of many sick conditions. These are the familiar classifications of plant phytochemicals: alkaloids, tannins, saponins, flavonoids, terpenoids, steroids and glycosides. The properties of their being anti-inflammatory, anti-viral, anti-diabetic, and anticancer are popular (24). For thousands of years, corn silk, a significant plant constituent with a wide range of physiologically active chemicals, has been utilized in a variety of therapeutic applications. It contains organic acids, volatile oils, tannins, terpenoids, alkaloids, steroids, and rich in flavonoids (25,26). It was demonstrated that all three extracts included flavonoids and glycosides, but only the ethanol and methanol-based extracts contained sugars and steroids. However, none of the extracts included tannins, amino acids, carbohydrates, terpenoids, phenols, or saponins. Emmanuel et al. conducted another investigation (27). Fresh matured corn silk sample (FMCSS) and dried matured corn silk sample (DMCSS) methanol extract was used to screen for phenols, alkaloids, cardiac glycosides, flavonoids, terpenes, steroids, glycosides, tannins, anthraquinones, saponins, balsams, triterpenoids, paleobotanies, resins and volatile oils. It was noted that sample fresh was phenol and volatile oil free while sample dried contained two, resin was only found in fresh sample and alkaloids, cardiac type glycosides, saponins, flavonoids, steroids, tannins, glycosides and balsams were in fresh and dried samples on the other hand terpenoids triterpenoids paleobotanies and cardenolides were absent in all samples (28). Solehan et al used an aqueous or a methanol extract to perform the initial screening of the phytochemical content of Malaysian corn silk. The results revealed that the phenols, flavonoids, alkaloids, saponins, phobia tannins, tannins and cardiac glycosides were both present in the extracts whereas, the extract & protein-xanthoprotein were present in the initials (29).

Antioxidant, anti-inflammatory and hepatoprotective properties:

Antioxidants are used by aerobic organisms to avoid oxidation that can cause harm in the body cells as it consumes oxygen. Oxidation has all the potential to cause various ailes like Atherosclerosis, neurological disorder, cancer, diabetes, inflammation and aging. A lot of the research has focused on the natural antioxidants that are found in fruits, teas, vegetables, cereals and even medicinal plants because they are effective in getting rid of free radicals and are reported to be more benevolent than such synthetic antioxidants as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) etc (30, 31, 32). There are many types of natural antioxidants such as vitamins such as tocopherols and Vitamin C, while phytochemicals such as Flavonoid and Phenolic acids are present among all the plant sources. In other recent results obtained, extracts from maize silk are said to yield on the basis of the antioxidants. Five corn silk fractions: Ethanol extract (EF), Petroleum ether fraction (PF), Acetic ether fraction (AF), Green soybean; N-butanol (BF), Water (AF) were tested in averse in vitro antioxidant models (33, 34). It was shown that the highest DPPH scavenging, and total antioxidant activities were detected in the methanolic extract of maize silk. Approximately 70% of the flavonoids that occur in corn silk have a C6-C3 skeleton that increases Maysin stigma secretion, which regulates the synthesis of intracellular antioxidant enzymes in SK-N-MC cells but confirms the reduction of intracellular reactive oxygen species (ROS) stimulated by H2O 2 (35). Through a test for Cu2+-induced oxidation of liposomes, it was also identified that corn silk flavonoid luteolin could act as an extremely potent antioxidant. It was found to be a great component with lipid peroxidation test. Combined with flavonoids, chlorogenic acids (CGAs) have been shown to be interesting phenolics and powerful antioxidants. Therefore, antioxidant regulation is

very important in preventing stress from oxidation and uses of maize silk indicate that it has antioxidant potential (36). Thus, regulation of antioxidants is important to avoid oxidative stress, and the maize silk uses demonstrate an antioxidant capacity. A number of factors, including ischemia, pathogenic microbes, thermal or physical damage and antigen-antibody interactions, can trigger inflammatory processes. It is the release of analgesia mediators that causes inflammation related pain (37). Tumor necrosis factor- α (TNF) and E. Coli lipopolysaccharide (LPS) are essential types of inflammatory mediators that sustain physiological sort of responses. The ability of TNF or LPS to induce expression of adhesion molecules such as ICAM-1, ELAM-2, and VCAM-1 (EAhy 926) will promote leukocytes adhesion to endothelial cells as well as indirectly lead to inflammation. Interference with leukocyte adherence or adhesion molecules is required for the therapeutic intervention of inflammation of diverse kind. One of the important TNF antagonistic properties identified was of crude ethanolic extract of corn silk in herbal anti-inflammatory medication Tumor necrosis factor-α (TNF) and E. Coli lipopolysaccharide (LPS) are essential inflammatory mediators that regulate physiological responses of different types. The ability of TNF or LPS to trigger ICAM-1, ELAM-2 and VCAM-1 (EAhy 926) adhesion molecules' expression will increase the adherence of leukocytes to endothelium cell that will lead to inflammation. Therapy of many types of inflammatory diseases in both children and young adults requires interruption of leukocyte adherence or adhesion molecules. The crude ethanolic extract of corn silk has one of the notable TNF antagonistic properties in herbal anti-inflammatory medications (38, 39). The ethanolic extract was able to prevent EAhy 926 endothelial cells from adhering to monocytic U937 cells at dosages of 9 to 250 µg/mL when it was used to block the effect of TNF and LPS that causes cells to stick to one another. Also, the impact made by corn silk extract on PMA induced generation of TNF, LPS and ICAM-1 was analyzed. ICAM-1 expression reduced five fold (50% and 65% adhesion) two hours (4h) and six hours (18h) post corn silk extract administration. In addition it also inhibited the induction of ICAM-1 mediated by LPS (1 and 10 µg/mL) during the 18 hours treatment period. Given that use of it's ethanolic extract was found to suppress expression of ICAM-1 and the adhesiveness of the endothelial cells by two of the most famous pro-inflammatory agents: TNF and LPS, corn silk as a traditional remedy for inflammatory diseases received a scientific justification. The additional determinants of anti-inflammatory potency of corn silk extract in the rat carrageenin (Cg)-induced pleurisy model were code-cellular infiltration, exudate formation, TNF, interleukin-1 beta (IL-1β), IL-17, vascular endothelial growth factor alpha (VEGF-α), C3 and C4 complement protein levels, ICAM-1 and inducible nitric oxide synthase (iNOS) levels, nuclear factor kappa B (NF-κB) activation, and total antioxidant activity respectively. Inflammatory reactions of fillers of pleural cavities in rats to Cg were due to cell migration and exudate production. Corn silk extract at doses of 2 and 4g/kg body weight reduced the amount of exudate by 28.6% and 54%, and reduced cell migration by 60.8% and 82.4% respectively (40). Due to its anti-inflammatory analgesic action, the corn silk has been used in the treatment of complaints like gout and arthritis. Owing to its diuretic nature, it helps maintain the joints of the body from accumulating more uric acid than necessary which may aggravate the condition of gout (41The anti-inflammatory attributes of maize silk extracts are responsible for preventing INOS levels, IL-17, tumor necrosis factor alpha, C3 and C4 complement protein levels, adhesion molecule (ICAM-1), cellular infiltration, exudates, and Cg induced pleurisy. It can restrain tumor necrosis factor-I (TNF-I) with pre-treatment using its extract. IL-1I2 and inhibit inflammatory process (ICTM-1 and INOS) also. The corn silk supplements' treatment was effective in cases of oxidative stress and other inflammatory diseases (42). The thread-like fibers from maize (Zea mays L.), known as corn silk, have long been utilized in herbal medicine and are currently receiving more attention due to their hepatoprotective (liver-protecting) qualities. Numerous investigations have examined its possible advantages in preserving liver health: Protective Effects on Liver Injury: Studies show that polysaccharides derived from maize silk can lessen the severity of acute liver damage. In one study, for example, it was shown that in animal models, highly branched polysaccharides from maize silk fermented by Lactobacillus plantarum might prevent acute liver damage (43). Decrease in Liver Enzyme Levels: A study examining the effects of infusing male Wistar rats with corn silk revealed a reduction in liver enzyme levels, indicating a hepatoprotective effect. The study demonstrated how corn silk may lower indicators of liver damage (44). Reduction of Hepatic Steatosis: In albino rats, doxorubicin-induced hepatic steatosis (fatty liver) has been investigated in relation to corn silk extracts. According to the research, corn silk may help prevent the buildup of liver fat and the harm that goes along with it (45). Protection Against Toxin-Induced Hepatotoxicity: In a different investigation, adult Wistar rats' liver damage from carbonated alcoholic herbal beverages was assessed in order to determine the hepatoprotective efficacy of corn silk extract. According to the findings, maize silk extract may enhance liver histology and lower liver toxicity indicators (46). Hepatoprotective and Hypolipidemic Effects: In rats given nicotine, corn silk extract has also been shown to have hepatoprotective and hypolipidemic (lipid-lowering) effects, indicating that it may be used to control lipid profiles and liver health (47). All of these studies point to the presence of chemicals with strong hepatoprotective qualities in maize silk, which may provide a natural way to promote liver health. However, further study is required to completely comprehend its safety and effectiveness, especially in human clinical trials.

Method of extraction and preparation of corn silk syrup:

Ethanol Reflux Removal:

One of the practiced methods of extraction of flavonoids, which is often used, is ethanol reflux extraction. In general, flavonoid aglycones are soluble in all the organic solvents viz, ether, methanol, ethanol and ethyl acetate but they are insoluble in water. As a result, flavonoids are extracted from corn silk by using the refluxing ethanol method, as it makes use

of the nontoxicity of ethanol and its relatively low cost (48). The ethanol concentration, material-liquid ratio, extraction duration, and extraction temperature are the main factors affecting the extraction of maize flavonoids. Rates of corn flavonoid extraction are comparatively stable, and the best extraction procedure is rather simple. While ethanol reflux extraction method would be easier to use compare to hot water extraction method, there is a good amount of extraction liquid needed and also the process takes longer time to finish. Because it doesn't save money and energy, it is not constructive for large-scale production. At optimal conditions of extraction. Corn silk, more than 60% ethanol, ratio of the solvent to corn-silk 1:30, and 80o C for 3 h (49) high extraction yield (5.32mg-1) was achieved of total flavonoids.

Extraction in water.

Aqueous extracts from maize silk demonstrated a wide range of antibacterial activity of the microorganisms on display in the study/ These compounds may offer a substitute of traditional methods of food storage fungus controlling and controlling the bacterium (50). 50g of air-dried powder was boiled for six hours in distilled water in order to mediate aqueous extraction. The solvent was extracted under vacuum every three hours. A set of supernatants was prepared. The supernatant was then concentrated in 100 milliliters final volume after six hours. At the end, an extraction of 50g from the material was carried out in 100ml of the distilled water to receive a concentration of 500mg/ml (51).

Extraction Assisted by Microwave.

Microwaves are wavelengths in the electromagnetic frequencies span which is from 300 Mhz to 300 GHZ and 1mm to 1m. Polar structures in living plant cells absorb microwaves and generate masses of heat to instantly increase internal temperature, thus pressure (52). As soon as the pressure will break the cell wall and the membrane, an intracellular material will dissolve and enter the extract. Traditional solvent extraction techniques are superior to or inferior to microwave extraction techniques (53,54). The total flavonoids extracted from the maize silk using a microwave-assisted method and in vitro defatted rat liver causes hypolipidemia were examined. Orthogonal tests were performed after the effects of solvent concentration, extraction time, microwave power, and the dosage of solvent were analyzed. Animals with the result of hyperlipidemia after being put on high-fat diet served the overall model of hyperlipidemia. The best extraction conditions include ethanol concentration of 60%, power of 600W, extraction time that is 16min long, plant material to solvent ratio of 1:20 and extract yield of 4.55%. Corn silk total flavonoids inhibited the levels of serum TC, TG and LDL-c significantly. Also, in animal hyperlipidemia model, CSTF decreased the serum lipid in a stimulation-dependent fashion (55).

Extraction with ultrasonic assistance.

A type of sound wave with a frequency greater than 20,000 hertz is called an ultrasonic wave. The medium may interact as a result of the mechanical vibrations that ultrasonic waves create in the material medium (56). The primary impacts of ultrasonic waves in a liquid are cavitation and thermal effects. Increasing the solubility of flavonoids is advantageous. The ultrasonic-assisted extraction process could be viewed as an adequate supplementary extraction procedure as it doesn't require additional chemical reagents and doesn't violate the structure of flavonoids (57). The optimum level of the below conditions was worked out from a three-level three variable box-Behnken design of response surface methodology (RSM) where the response is yield for same batch size. 30 percent ethanol, the 1:20 obtained between the mixture and its solvent and 500 W of ultrasonic power as well as 20 minutes duration of extraction time. Under favorable conditions total yield of flavonoids extracted was 1.13% (58).

Supercritical fluid extraction:

Mineral properties of maize silk to prefer to remove the release of flavonoids and nitrite and denature using supercritical fluid carbon dioxide (SF-CO2) is examined. The first procedure was to fine-tune for the influence of particle size, time of extraction and the composition of the cosolvent on the water content of ethanol. Then the Box–Behnken design and response surface methodology (RSM) were utilized to examine the effects of three independent variables (temperature, pressure and cosolvent amount) on yield of flavonoid with the help of extraction. SFE using optimum parameters (50.88°C; 41.80 MPa cosolvent; 2;488 mL/g; 0.4mm particle-size; 20% of aqueous ethanol as the cosolvent; and 120 min of extraction) was able to extract 4.24 mg/g of corn silk flavonoids. a percentage yield. There was also evaluation of the scavenging of nitrite using the Gries reagent on the flavonoid enriched SFE extracts. The flavonoid-enriched SFE extracts exposed the highest nitrite-a-stanching-capacity (88.1±3.04%) at pH 3.0 and 500 g/ml. While it was concentration dependent, the peculiarities of the ability of extractions to scavenge nitrite were negatively correlated with the pH (59).

Preparation of corn silk syrup

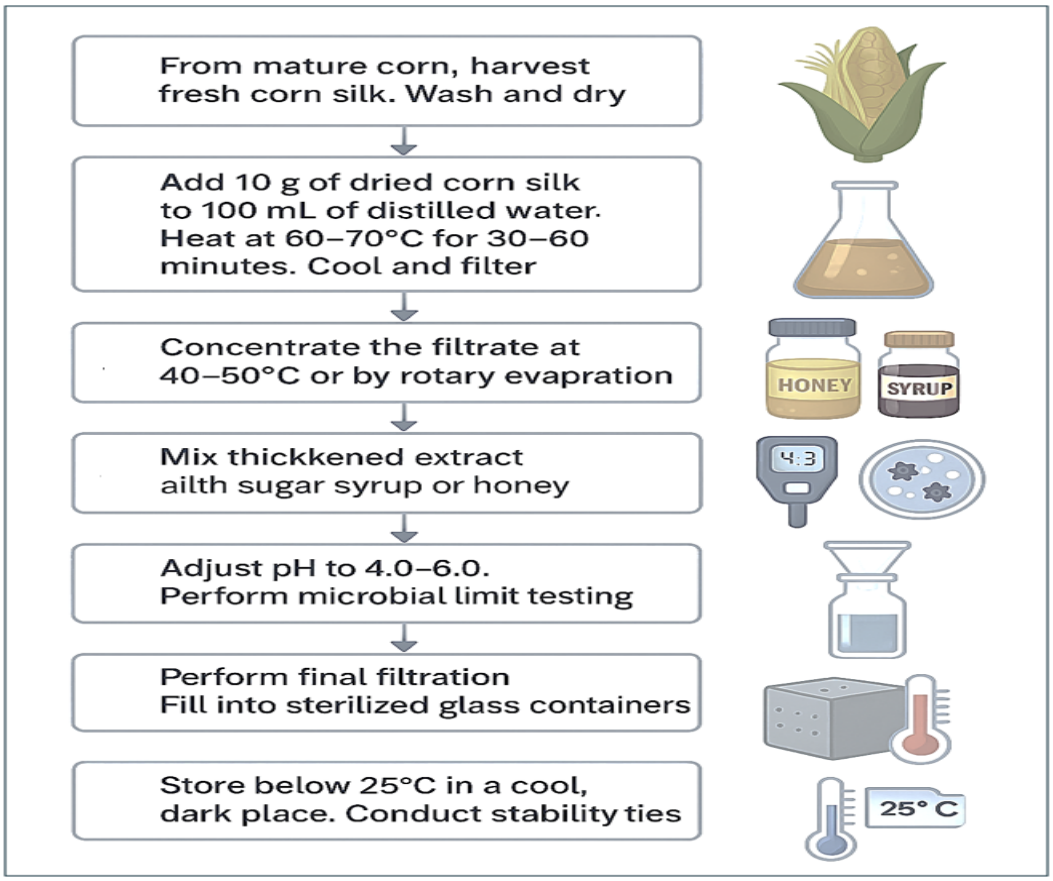

Fig 2. Preparation of corn silk syrup

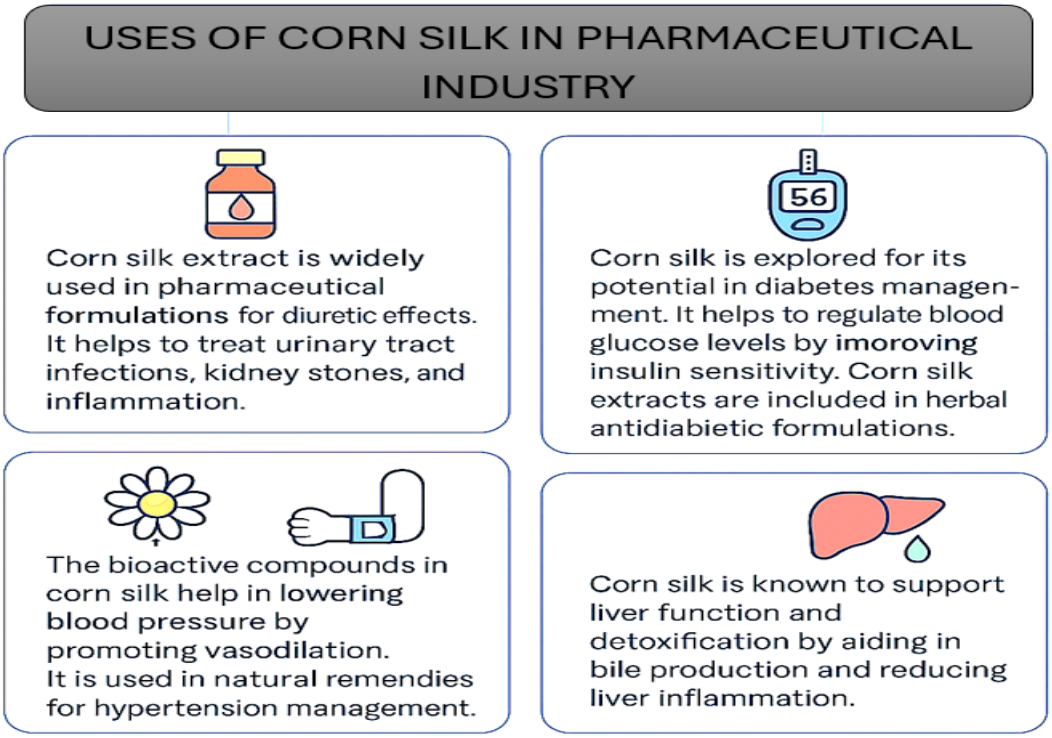

Fig 3. Uses of Corn Silk in the Pharmaceutical Industry

Mechanism of action in liver and kidney protection:

The bioactive substances flavonoids, polysaccharides, and phenolic acids are the main drivers of the mechanism of action (MOA) of maize silk (Stigma maydis), which protects the liver and kidneys through a combination of antioxidant, anti-inflammatory, and metabolic regulatory properties. A thorough explanation of its preventive benefits for these organs may be found below:

Protection of the Liver by Antioxidant Activity: Hepatocyte oxidative stress is decreased by flavonoids and corn silk polysaccharides (CSPs), which scavenge free radicals. In experimental models, for instance, acidic polysaccharides from maize silk dramatically reduced blood ALT and AST levels (indicators of liver injury) by inhibiting lipid peroxidation and boosting antioxidant enzymes such as superoxide dismutase (SOD). Similar to vitamin C, which reduces oxidative damage in liver tissues, the butanol component of corn silk extract showed potent iron-chelating and radical scavenging properties (60) **Anti-Inflammatory Effects:** Pro-inflammatory cytokines including TNF-α and IL-6, which are connected to liver inflammation and fibrosis, are decreased by corn silk polysaccharides. CSPs prevented oxidative stress and inflammation-induced apoptosis in human liver cells (HL-7702). **Regulation of Lipid Metabolism:** Corn silk's flavonoids and polysaccharides control lipid metabolism by lowering the buildup of triglycerides and cholesterol in the liver, hence averting fatty liver disease (60).

CS's role in kidney and urinary tract infections:

Since ancient times, corn silk has been used to treat a variety of illnesses, including kidney and urinary tract infections. Due to its diuretic properties, corn silk aids in the contraction of smooth muscles, which raises urine production. Below is an explanation of the many medicinal qualities associated with renal disease.

To cure an infection in the urinary tract: Pregnancy, kidney stones, and inadequate cleanliness are some of the primary causes of urinary tract infections (UTIs). Taking corn silk extract reduces the burning feeling during urination by calming and relieving the irritated tissue (61). For five to twenty days, taking corn silk can help reduce symptoms. Its secondary metabolites, which include flavonoids, tanins, terpenoids, and alkaloids, are the reason it is thought to be helpful in these circumstances (62). Relief from symptoms may be observed when corn silk tea is additionally drunk in place of extract. **Kidney Protection-Anti-Diabetic Nephropathy:** By adjusting the gut-kidney axis, corn silk polysaccharides (CSPs) reduce diabetic nephropathy. CSPs decrease systemic inflammation and the buildup of uremic toxins (such indoxyl sulfate) by restoring the balance of the gut microbiota (e.g., boosting Firmicutes and decreasing Bacteroides). In diabetic rats, this reduces kidney fibrosis and oxidative stress. **Diuretic and Electrolyte Regulation:** Packed with potassium and flavonoids, corn silk encourages diuresis by boosting salt excretion and urine production, which aids in the removal of toxins and guards against kidney stones. Additionally, this diuretic impact lessens hypertension and edema, two conditions that frequently cause kidney injury.

Anti-inflammatory and Antioxidant Effects:

Corn silk extracts shield renal tubular cells from inflammation and death by preventing NF-κB activation and lowering the generation of ROS. For example, in nephropathy models, CSPs decreased proteinuria and increased glomerular filtration rates (63).

Common Liver and Kidney Protection Mechanisms: Modulation of Metabolic Pathways: Glycerophosphate, fatty acid, and bile acid metabolism are all regulated by corn silk and are essential for both organs' energy homeostasis and detoxification. **Interaction with the Gut Microbiota:** Polysaccharides function as prebiotics, supporting good gut microbes that generate short-chain fatty acids (SCFAs). By lowering oxidative stress and systemic inflammation, SCFAs indirectly shield the kidneys and liver.

Table 1. Key Bioactive Compounds in Corn Silk and Their Roles in Liver and Kidney Protection (64)

Bioactive Compound	Role in Liver and Kidney Protection
Flavonoids	Antioxidant, anti-inflammatory, anti-fibrotic; enhance hepatic enzyme activity.
Polysaccharides	Modulate gut microbiota, reduce oxidative stress, support immune response
Phenolic Acids	Scavenge free radicals, inhibit lipid peroxidation, protect against hepatotoxicity.
Sterols	Regulate cholesterol metabolism, reduce lipid accumulation in liver tissues.

Saponins	Anti-inflammatory diuretic effects, reduce nephrotoxicity, and support renal filtration.
Alkaloids	Exhibiting anti-inflammatory and analgesic effects may modulate renal oxidative enzymes.
Tannins	Astringent, antioxidant activity; reduce renal oxidative stress and proteinuria.
Vitamins (A, C, E)	Act as natural antioxidants, prevent hepatic and renal cell damage, support detoxification processes.
Minerals (K, Mg, Zn)	Maintain electrolyte balance, support enzymatic function in liver and kidney tissues.

Regulation of liver enzymes (ALT, AST, ALP) and kidney markers (creatinine, urea, uric acid):

Kidney indicators and liver enzymes are essential for evaluating organ function and general health. Below is a summary of their regulations:

Aspartate aminotransferase (AST) and Alanine Aminotransferase (ALT): These enzymes aid in the metabolism of amino acids and are mostly located in liver cells. **Regulation:** Medication, food, alcohol intake, and liver health can all affect their levels. They can be controlled by eating a balanced diet, abstaining from excessive alcohol, and taking care of liver issues.

Alkaline Phosphatase (ALP): This enzyme aids in the breakdown of proteins and is present in the liver, bones, and bile ducts. **Regulation:** Gallbladder problems, liver illness, and bone abnormalities can all have an impact on ALP levels. The key is managing liver health, consuming vitamin D, and eating a healthy diet.

Due to the potential health benefits, it may have especially its effect on liver and kidney function, Cornsilk – otherwise known as the silky threads found on corn – has long been used in herbal medicine. Corn silk may help regulate renal markers such as creatinine, urea, and uric acid and also regulate liver enzymes such as ALT, AST, and ALP. Repeatedly said to cause these effects are its diuretic, anti-inflammatory and antioxidant characteristics. Flavonoids, alkaloids, and tannins are among the bioactive substances found in cornsilk that may aid in liver detoxification and lessen oxidative stress on the kidneys. Additionally, it is thought to increase urine output, which can support kidney health and aid in the removal of pollutants (65). Though encouraging, these results are frequently predicated on rudimentary research or conventional wisdom. Before taking cornsilk as a supplement, it is imperative that you speak with a healthcare provider, particularly if you are taking medication or already have liver or renal issues (66). **Creatinine:** The kidneys filter this waste product from muscle metabolism. **Regulation:** Kidney function, protein consumption, and hydration all affect creatinine levels. Maintaining proper hydration and renal health might be beneficial. **Urea:** Generated by the metabolism of proteins and eliminated by the kidneys. **Regulation:** Urea levels are influenced by kidney function, protein intake, and hydration. It's crucial to eat a balanced diet and drink enough water. **Uric Acid:** The kidneys eliminate this result of purine biosynthesis. **Regulation:** Uric acid levels are influenced by diet, hydration, and renal function. Reducing foods high in purines, such as seafood and red meat, and drinking enough water can be beneficial. **Diuretic Characteristics:** As a natural diuretic, corn silk encourages the creation of more pee. This lowers blood pressure by flushing out extra fluid and sodium. Promote kidney health by eliminating pollutants and lowering the chance of kidney stones. Encourage urine flow to alleviate urinary tract infection (UTI) symptoms.

Preclinical and Clinical Evidence:

Hepatoprotective effects in liver injury model:

Thirty weight – 25 – 30 grams male NMRI mice were sacrificed for the present investigation. They were purchased from Dezful University of Medical Sciences, Animal Reproduction and Maintenance Center and kept in 12-hour light-dark regime with access to the buyable food and potable water. These groups were impaired below: (n=6): sham (given saline gavage and an intraperitoneal injection of 0.9%), control, nicotine (2.5 mg/kg)≠IP≠0.9%), nicotine (2.5 mg/kg)+400 mg/kg of oral aqueous extract of corn silk (68), and nicotine (2.5 m g/kg)+400 mg/kg of methanolic extract of corn silk (69). For a period of one month, nicotine and extracts were used (70). The animals were also carefully sedated using a combination of ketamine and xylazine (70mg/kg to 10mg/kg) and then their blood sera were collected from their cardiac puncture 24 hours after absorption of their last injection of the extract. The extremely high TG, TC, alkaline phosphatase, alanine aminotransferase, aspartate aminotransferase, and high-density lipoprotein (HDL-C) have subsequently been determined using some commercial kits and biochemical procedures. However, some portion of liver was homogenized with phosphate-buffer

saline. GSH and MDA were extracted in the supernatant sample, and using suitable commercial kits (Novin Navand Salamat Pishtaz Co., Iran) ; they were tested after 10 min of centrifuging with 5000 rpm. For the calculation of LDL-C and very low-density lipoprotein (VLDL) the following equations were applied. Male mice for the current study were administered with nicotine/distilled water, and shaken for forty-eight hours to determine the hepatoprotection and hypolipidemic potentials of the corn silk extract. It was then centrifuged for 20 minutes at 3500 rpm after passing through the filter (71). Like in the case of making aqueous extract, 250 grams of corn silk powder were dissolved using a quantity of distilled water of 1 liter (20–80%) and methanol for 72 hours. The mixture was then filtered and centrifuged for 20 minutes at 3500 rpm (72). Finally, the resulting powder was placed in the refrigerator at 4°C until it was required after the supernatant solution of both extracts was dried and subjected to incubator at 37°C. Result: The body weights in the various groups were equalized, with no noticeable discrepancy. Nicotine placed group compared to control group showed reduced mean weights of liver and GSH ($P<0.05$). The levels of triglycerides, total cholesterol, HDL-C, LDL-C, liver enzymes, and MDA were also higher for the nicotine group, when compared with the control group, ($P<0.05$). In addition, the numbers of sinusoids|, inflammatory cells and necrotic liver cells were higher in the nicotine group than in the control group. Aqueous and methanolic extracts of maize silk increased the described parameters after mice were given nicotine ($P<0.05$)

Table 3. Summary of Clinical Trials Investigating Pharmacological Effects of Corn Silk

Study	Design & Participants	Intervention	Outcomes	Findings	Limitations
Diuretic Effect in Healthy Adults (2014)	Double-blind, randomized, placebo-controlled; N=50 healthy adults (25 M/25 F), age 18–45	**Group 1:** 500 mg corn silk extract twice daily for 7 days **Group 2:** Placebo	Urine volume (primary); Electrolytes (Na^+, K^+, Cl^-)	↑ 28% urine output ($p<0.05$); Comparable to low-dose hydrochlorothiazide; Electrolytes stable ($p>0.05$)	Short trial (7 days); No pharmacokinetics of actives (e.g., flavonoids, maysin)
Anti-Diabetic Effect on Type 2 Diabetes (2016)	Open-label, randomized controlled trial; N=30 with T2DM (HbA1c: 7–9%)	**Group 1:** Metformin + corn silk tea (2 g twice/day for 8 weeks) **Group 2:** Metformin only	FBG, HbA1c, Lipid profile (HDL, LDL, TG)	FBG ↓ 15% ($p<0.01$); LDL ↓ 9%, HDL ↑ 12% ($p<0.05$); HbA1c: no significant change	Small sample; Open-label design
Uric Acid Reduction in Hyperuricemia (2019)	Randomized, active-controlled; N=40 adults with uric acid >6.0 mg/dL	**Group 1:** Corn silk extract (300 mg/day) **Group 2:** Allopurinol (100 mg/day) for 4 weeks	Serum uric acid, CRP, IL-6, eGFR, Creatinine	Uric acid ↓ 1.2 mg/dL (corn silk), ↓ 2.1 mg/dL (allopurinol); CRP ↓ 18% (corn silk), 22% (allopurinol); Both safe	No mechanistic study (e.g., xanthine oxidase); Short duration
Antihypertensive Effect in Prehypertensive (2021)	Randomized, placebo-controlled pilot; N=60 (BP 130–139/85–89 mmHg)	**Group 1:** 1 g corn silk/day **Group 2:** Placebo for 12 weeks	Systolic/Diastolic BP	↓ SBP/DBP by 6.5/3.2 mmHg ($p<0.05$) vs. placebo (NS); Linked to NO-mediated vasodilation & diuresis	No ambulatory BP monitoring

Nephroprotective effects in kidneys dysfunction models

Animal preparation: Male white rats weighing 150–200g and aged 10–12 weeks were housed in Pioneer University animal cages under standard management settings. Rats received water and normal lab food (73). **Methodology for the experiment**: After acclimatization, the experiment animals were divided into five groups each containing four rats. A total of eight days was used to apply the extract and the gentamicin on the rats. The experimental group was administered with an 80 mg/kgBW gentamicin by intraperitoneal injection, while the negative control group received an oral suspension of 0.5% NaCMC. For

eight days, the group that received treatment regarding corn silk extracts was given oral administration doses of 250, 500, and 1000 mg/KgBW. The extract gave was performed interperitoneally one hour later on day three and it continued till day eight. **Gathering of samples**: On the eighth day, urine was obtained for microscopic investigation, and on the ninth day, it extracted blood from the orbital vein of the eye for urea and creatinine levels which are indicators of renal damage. Additionally, after the death of an animal, both kidneys were removed for analysis of kidney weight ratio and histology. **Histopathological analysis**: The animal was killed, and a kidney tissue sample was also taken for histological examination. It was sectioned to a thickness of 4mm, waxed, sunk in a 10% formalin solution, and treated with hematoxylin and eosin. The tissue is then watched under light microscopy for a diagnosis of healthy tubules and any observation of glomerular cell injury. **Findings and Conversation** The excretory organs, specifically the kidneys, were examined in this study. Reduced urea and creatinine output due to abnormalities in glomerular filtration results in elevated plasma levels of these substances. As a result, one analytical metric for kidney function was the measurement of urea and creatinine levels. Furthermore, microscopic examinations of renal histology were performed to observe the alterations in the kidney tissue.

Table 4. Comprehensive Overview of Dosage, Safety, Synergy, and Therapeutic Potential of Corn Silk Syrup

Category	Details
Recommended Dosage	Aqueous Extract: 500 mg twice daily (7–14 days) – diuretic effect- Dried Corn Silk Tea: 2–3 g daily (up to 8 weeks) – lipid/glucose support- Ethanol Extract: 300 mg/day (4 weeks) – uric acid reduction- Standardized Extract: 1 g/day (12 weeks) – blood pressure control- Tea: 1–3 g dried corn silk, 2–3 times/day- Tincture: 2–4 mL, 2–3 times/day (1:5 strength)- Capsule/Powder: 400–1000 mg/day (standardized to flavonoids)
Safety Profile	Generally safe at recommended doses- Animal studies show no toxicity up to 5 g/kg- Mild and rare side effects: GI upset, allergic skin reactions, increased urination
Contraindications	Pregnancy/Breastfeeding: Avoid due to lack of safety data- Kidney Disorders: Monitor electrolytes if used long-term- Drug Interactions: Potentiates effects of antihypertensives, antidiabetics, and diuretics
Extraction Methods	**Water-based**: Preserves polysaccharides, flavonoids- **Ethanol extraction**: Captures both water/alcohol-soluble compounds- **Ultrasound-Assisted Extraction**: Increases yield and efficiency
Syrup Preparation	**Sweeteners**: Honey, agave (with added therapeutic effects)- **Preservatives**: Citric acid, ascorbic acid for shelf-life- **Bioavailability Enhancers**: Piperine, liposomes
Stability & Quality Control	**pH Range**: 4.5–5.5- **Thermal Stability**: Cold-processed to protect actives- **Microbial Control**: Sterile manufacturing, natural antimicrobials (e.g., rosemary extract)

Therapeutic Applications	**Urinary Health**: Diuretic and anti-inflammatory effects for UTIs, kidney support, BPH symptom relief- **Inflammation & Antioxidant Support**: Combats oxidative stress and inflammation, potential use in CVD, arthritis- **Fluid Retention**: Effective in managing edema related to PMS, heart failure, and hypertension
Challenges	**Standardization**: Ensuring consistent bioactive content- **Taste**: Bitter flavor may require masking (e.g., mint, chamomile)- **Clinical Validation**: More trials needed to validate combined herbal effi

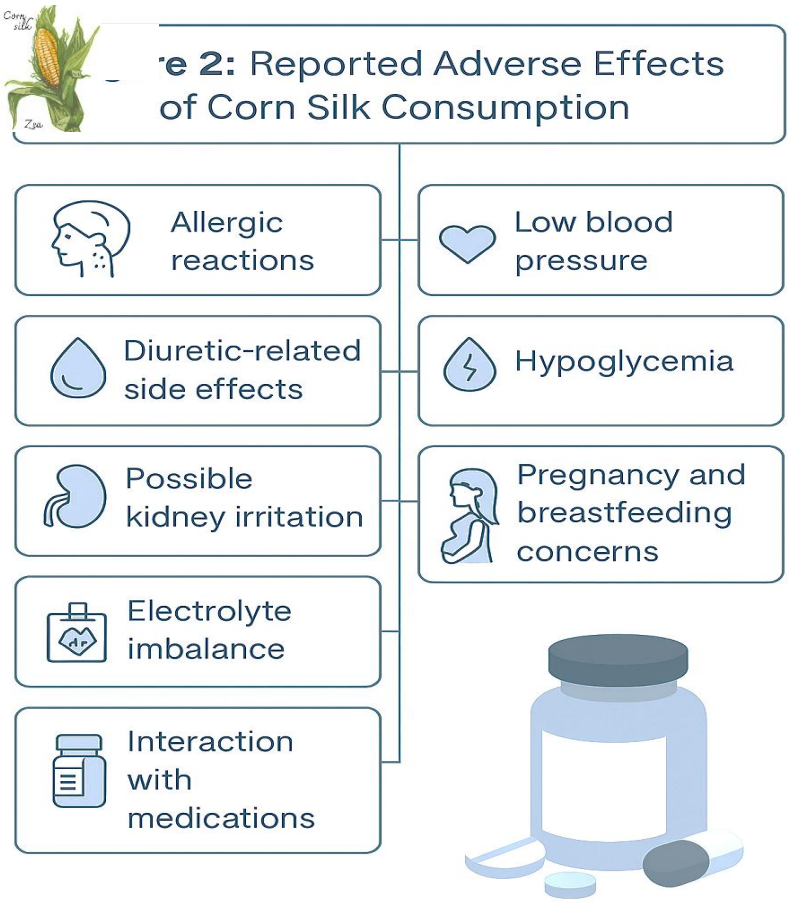

Fig 4. Reported adverse Effects of corn silk consumption

Potential role of cornsilk syrup as natural therapeutic agent:

Effects on Diabetes: According to research, corn silk has diabetics properties. In alloxan diabetes-derived rats, methanol extract of cooked corn silk had a remarkable effect of lowering blood glucose at doses of 500 mg and 750 kg body weight after 72 and 96 hours, respectively (90). **Anti-Inflammatory Activity:** Research has indicated that corn silk extract may help lower inflammation. under rat pleurisy tests, research found that corn silk extract successfully suppressed leukocyte migration and inflammatory exudate under acute inflammatory conditions brought on by carrageenan (91). **Antioxidant Properties:** The abundance of flavonoids including maysin, rutin, and quercetin in maize silk is thought to be responsible for its antioxidant potential. These substances have shown that they can scavenge free radicals, avoiding oxidative stress and the cellular damage that goes along with it. Corn silk extracts, for example, demonstrated potent antioxidant activity and

successfully scavenge free radicals such as DPPH in vitro (92).**Lipid-Lowering Effects:** Positive effects on lipid profiles have been linked to corn silk. Corn silk decoction may lower total cholesterol, triglycerides, and low-density lipoprotein cholesterol (LDL-C) and raise HDL-C levels in angina pectoris patients, according to a comprehensive review and meta-analysis (93). **Possible Anti-Cancer Activity:** According to preliminary research, maize silk could have anti-cancer qualities. For instance, research discovered that the flavonoid may sin, which is abundant in maize silk, greatly increased apoptotic cell death and decreased the viability of prostate cancer cells in a dose-dependent way (94). **Diuretic and Kidney Health Benefits:** Corn silk has long been utilized for its diuretic properties. According to studies, substances found in corn silk may help prevent kidney stones by raising urine volume and reducing concentrations of minerals that cause kidney stones. According to animal research, maize silk extract improved antioxidant activity and decreased calcium oxalate deposition, which in turn decreased the occurrence of kidney stones (95). **Anti-Hypertensive Effects:** Research has shown that corn silk extract can reduce blood pressure. Angiotensin-converting enzyme (ACE) inhibitory peptide CSBp5, a new compound found in corn silk extract, was found to effectively inhibit ACE activity and reduce systolic blood pressure in rats with spontaneous hypertension in a dose-dependent manner (96). **Neuroprotective Potential:** According to certain research, maize silk may have neuroprotective advantages. For example, studies have demonstrated that ethyl acetate extract of maize silk from specific corn types demonstrated substantial suppression of the Alzheimer's disease-associated enzyme acetylcholinesterase, suggesting possible uses in neuroprotection (97).

2. CONCLUSION:

Corn silk syrup, derived from *Zea mays L.*, holds significant therapeutic promise due to its rich phytochemical profile, encompassing flavonoids, polysaccharides, phenolic acids, alkaloids, and essential minerals. This natural remedy exhibits potent antioxidant, anti-inflammatory, hepatoprotective, nephroprotective, and diuretic properties, making it a compelling candidate for liver and kidney health management. Preclinical and emerging clinical studies have demonstrated its capacity to modulate critical biomarkers, such as ALT, AST, creatinine, and urea, while also offering metabolic regulation and immune support. The green extraction methods, along with favorable safety profiles and broad-spectrum pharmacological activities, support its development as a nutraceutical or functional food supplement. However, standardization of bioactive content, dosage optimization, and rigorous clinical validation remain essential to fully translate these findings into evidence-based medical applications. Overall, corn silk syrup exemplifies a sustainable, cost-effective, and natural therapeutic alternative for addressing hepatic and renal dysfunctions.

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