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Review Article

ZEA MAIZE: A MODERN CRAZE
Parle Milind* and Dhamija Isha
Pharmacology Division, Dept. Pharm. Sciences, Guru Jambheshwar University of Science and Technology, Hisar, Haryana, India
*Corresponding Author Email: mparle@rediffmail.com

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ABSTRACT
Zea stands for ‘sustaining life’ and Mays stands for ‘life giver’. Zea mays is one of the oldest and most dynamic crop species, which has gained popularity in modern world too, due to its applications in diverse dishes. Corn is produced in every continent of the world with the exception of Antarctica. It is an annual monococious sunny plant, surviving perfectly in nutrient rich, well-drained soil. Each and every part of the corn, from husk to corn silk is beneficial for the society. There are more than 3,500 different uses for corn products. Corn does much more than feed people and livestock. The plant contains alkaloids, flavonoids, saponins, maizeenic acid, vitamins B1, K and minerals like potassium, phosphorous and zinc. Traditionally, Maize is used as an analgesic, anti-diarrheal, anti-prostatic, anti-lihiasis, anti-tumor, anti-hypertensive, anti-diabetic, anti-hyperlipidemic, anti-inflammatory and anti-oxidant. In this review article, we have narrated miscellaneous uses of corn varieties and described the pharmacological activities, phytoconstituents, nutritional value and traditional uses of maize. The maize has assorted uses like culinary, medicinal and industrial. Corn dishes like corn-meat, corn-flakes, popcorn, “makki ki roti” and corn soup highlight its dominance all over the world. Therefore, maize has become a craze among modern youth.

KEY WORDS: Zea mays, Anti-inflammatory, Anti-oxidant, Diuretic, Hypoglycemic.

INTRODUCTION
The word Zea mays comes from two languages. Zea comes from ancient Greek and is a generic name for cereal and grains. Some scientists believe that Zea stands for "sustaining life". Mays comes from the language Taino, meaning "life giver." Maize or corn (Zea mays L.) is the world’s third leading cereal crop, after wheat and rice. It probably originated in Central America, specifically Mexico. Maize belongs to family Poaceae and is a tall annual herb with an extensive fibrous root system. It is a cross-pollinating species with female and male flowers at separate places on the plant. The United States is the largest producer of Zea mays, accounting nearly for 40% of the total world’s production, followed by China and Brazil. Maize provides nutrients for humans and animals; and serve as a basic raw material for the production of starch, oil, protein, alcoholic beverages, food sweetener and more recently fuel. Corn has diverse culinary applications all over the world. Mostly the sweet corn variety is used in making corn dishes. Corn or maize is considered a staple food in many parts of world. The most commonly made corn recipe is popcorn. The sweet corn is commonly eaten as raw and fondly used in soups, salads, as a garnish. Corn is widely used in making corn-meal. Corn-meal, ‘makki ki roti’ and the most common breakfast cereal, corn-flakes are the most popular corn recipes. In traditional medicine, corn is used for relieving diarrhea, dysentery, urinary tract disorders, prostatitis, lithiasis, angina, hypertension and tumor. The plant is pharmacologically exploited for hypoglycemiac, anti-inflammatory, antioxidant and diuretic properties. The major maize growing states are Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Punjab, Haryana, Maharashtra, Andhra Pradesh, Himachal Pradesh, West Bengal, Karnataka and Jammu & Kashmir, jointly accounting for over 95% of the national maize production. The green plant has been used in the dairy and beef industries, as fodder.

Botanical Description

Kingdom: Plantae
Subkingdom: Tracheobionta
Superdivision: Spermatophyta
Division: Magnoliophyta
Class: Liliopsida
Subclass: Commelinidae
Order: Cyperales
Family: Poaceae
Subfamily: Panicoideae
Tribe: Andropogoneae
Genus: Zea
Species: Zea mays

International Synonyms
Synonym: Zea vulgaris Mill., Zea mays L. subsp. mays L., Zea macroperma Klotzsch
Arabic: Dharah, Surratul makkah
Chinese: Yu mi xu , Yu shu shu, Pao mi
Croatian: Kukuruz
Danish: Majs
Dutch: Mais, Korrelmaïs, Turks tarwe, Turkse koren
English: Maize (UK), Turkish wheat, Field corn, Corn (USA), Indian corn
Estonian: Mais
Finnish: Maissi
French: Mais, Blé des Indes, Blé de Turquie.
German: Körnermais, Echter Mais, Türkisches Korn, Türkischer Mais,
Italian: Granturco, Granoturco, Formentone, Grano di Turchia, Mais
Japanese: Toumorokoshi, Fiirudo koon.
Korean: Ok soo soo.
Malay: Jagong, Jagung (Indonesia).
Persian: Gaudume makka.
Portuguese: Milho, Milho forrageiro
Russian: Kukuruza obykonvennaiha.
Spanish: Maíz, Maíz comun, Mijo turquesco, Mazorca de maíz
The origin for *Zea mays* has been recognized as the Mesoamerican region, now Mexico and Central America. Domestication of maize commenced at least 7000 years ago, as determined through paleohistorical records. In the 16th century, Portuguese imported maize to Southeast-Asia from America. The maize was familiarized to Spain by Columbus and from Spain it extended to France, Italy and Turkey. During the 17th century maize was introduced in India. From India it went to China, Philippines and the East Indies. Now-a-days corn is being grown in USA, China, Brazil, Argentina, Mexico, South Africa, Rumania, Yugoslavia and India.

**Climate and soil requirements**

Maize is basically a sunny crop, so it requires warm and moist climate. Annual rainfall of 60 cm is required, throughout its growing stage. It cannot withstand frost at any stage. Prolonged cloudy period is harmful for the crop but, an intermittent sunlight and cloud of rain is the most ideal for its growth. It needs full sunlight for its accelerated photosynthetic activity. In India, maize is traditionally grown in monsoon season, which is accompanied by high temperature (<35°C) and rains. However, with the development of new cultivars and appropriate production technology, winter cultivation of maize has emerged as a viable alternative. It needs fertile soil and thrives best in deep, loamy soil along with abundant moisture. The ideal soil for maize should be rich in organic matter and well-drained. Soil pH should be in the range of 7.5 to 8.5 for good crop growth.

**Botanical Features**

Maize is a tall, determinate annual plant varying in height from 1 to 4 metres. The plant produces large, narrow, opposing leaves, borne alternately along the length of a solid stem. Maize is a monoecious plant, that is, the sexes are partitioned into separate pistillate (ear), the female flower and staminate (tassel), the male flower. The main shoot terminates in a staminate tassel. Maize is generally protracted, means the male flower matures earlier than the female flower. The botanical features of various plant parts are as follows:

**Flower:** The apex of the stem ends in the tassel, an inflorescence of male flowers and the female inflorescences (cobs or ears) are borne at the apex of condensed, lateral branches known as shanks protruding from leaf axils. The male (staminate) inflorescence, a loose panicle, produces pairs of free spikelets each enclosing a fertile and a sterile floret. The female (pistillate) inflorescence, a spike, produces pairs of spikelets on the surface of a highly condensed rachis (central axis, or “cob”). The female flower is tightly covered over by several layers of leaves, and so closed in by them to the stem that they don’t show themselves easily until emergence of the pale yellow silks from the leaf whorl at the end of the ear. The silks are the elongated stigmas that look like tufts of hair initially and later turn green or purple in color. Each of the female spikelets encloses two fertile florets, one of whose ovaries will mature into a maize kernel once sexually fertilized by wind-blown pollen.

**Root:** Normally maize plants have three types of roots: i) seminal roots - persist for long period, ii) adventitious roots, fibrous roots developing from the lower nodes of stem below ground level which are the effective and active roots of plant and iii) brace or prop roots, produced by lower two nodes. The roots grow very rapidly and almost equally outwards and downwards. Favorable soils may allow corn root growth up to 60 cm laterally and in depth.

**Stem:** The stem is 3-4 cm thick. The inter nodes are short and fairly thick at the base of the plant; become longer and thicker higher up the stem, and then taper again. The ear bearing inter node is longitudinally grooved, to allow proper positioning of the ear head (cob). The upper leaves in corn are more responsible for light interception and are major contributors of photosynthate to grain.

**Fruit/Grain:** The individual maize grain is botanically a caryopsis, a dry fruit containing a single seed fused to the inner tissues of the fruit case. The seed contains two sister structures. One is a germ which includes the plumule and an endosperm, which provides nutrients for that germinating seedling until the seedling establishes sufficient leaf area to become an autotroph.

**Pollination and Fertilization**

In maize, the pollen shedding is not a continuous process and usually begins two to three days prior to silk emergence and continues for five to eight days. The silks are covered with fine, sticky hairs which serve to catch and anchor the pollen grains. Pollen shedding stops, when the tassel is too wet or too dry and begins again, when temperature conditions are favorable. Pollen grain remains viable for 18 to 24 hours, under favorable conditions. Cool temperatures and high humidity favor pollen longevity. Fertilization occurs after the pollen grain is caught by the silk and germinates by growth of the pollen tube down the silk channel within minutes of coming in contact with a silk and the pollen tube grows the length of the silk and enters the embryo sac in 12 to 28 hours.
**Corn** has numerous varieties, some of which are described as under:

**Dent corn** derives it’s name from the dent or depression on dried, matured kernel. Shrinkage of the soft, floury starch within the hard starch to one side of the kernel evokes dent. Dent corn is yellow or white in color. It is primarily used as a feed for livestock. White dent corn is a preferred food in Mexico, Central America, the Caribbean, and Southern Africa. Therefore, it is the most produced type of corn and accounts for about 95% of all maize produced.

**Flint corn** has a smooth kernel due to a limited to non-existent amount of soft starch contained within the hard endosperm. The color varies from white to deep red. Flint corn thrives in cool climate with wet soil at higher altitudes. It matures earlier than other varieties of maize. Flints are more resistant to fungi and insects, due to less moisture absorbing capacity. Thus, it can be stored more durably than other varieties.

**Flour corn** resembles flint corn in size and shape. The color is mostly white or blue in color. The endosperm contains soft, mealy starch, thereby smoothly pulverized into flour. Flour corn is mainly cultivated in the Southwestern United States and Andean highlands of South America. In South America it is used for making beer and special food preparations.

**Sweet corn** comprises of wrinkled kernels, which are typically white or yellow. The sweetness is a result of a genetic mutation in metabolism that prevents the sugars from being completely transformed into starch. It has a soft, sugary endosperm and thus is bred especially for consumption in an immature state, like corn on the cob. It is grown mainly in the United States.

**Pod corn** is grown almost exclusively for scientific research in an effort to trace the genetic roots of corn. Each kernel of pod corn is enclosed in a glumes, or husk.

**Phytoconstituents**

Sweet corn is a variety in the *Zea mays* species, namely var. rugosa, convar. Saccharata. ‘Corn sweet factor’ is a glucoside of 2,4-dihydroxy-7-methoxy-1,4-bezoxazin-3-one. The corn silk contains galactan, xylan, dextrine and other compounds. The seeds contain much sugar, zeaxanthin, protein, inositol, hexaphosphoric acid, maizenic acid, resins and a fixed oil. Kernel contains esters of indole-3-acetic acid and d-glucose-hydroxy-2-indolione-3-acetic acid. *Zea mays* contains cytokine zeatin, a biologically active purine derivative, flavonoids, alkaloids, allantoin, saponins, volatile oil (about 0.2%), mucilage, vitamins C, E and K, minerals especially potassium, starch, sugar, fat, maizenic acid, gluten, dextrin, glucose, cellulose, silica, phosphates of lime and magnesia. It also contains isouceretin, chrysanthemim, cyanogenic material, 6-methoxybenzoazoline, dicarboxylic acids such as oxalic acid, polysaccharide, essential fatty acids, anthocyanin and flavonoids glycosides and a triterpene cyclosadef. Maize kernel contains carbohydrates 66.2%, protein 11.1%, fat 3.6%, minerals 1.5% and fibres 2.7%. It was found to have β-carotene, biotin, choline, pantothenic acid, folic acid, pyridoxine, thiamine, riboflavin, niacin, vitamin E, minor amount of vitamin C, N-((3-coumaryl)tryptamine and N-ferulyltryptamine. It also contains cinnamoyl hydroxyacetic acid derivatives, sixty one volatile compounds, out of which, geosmin was a highly odorous compound. Corn silk (CS) is rich in phenolic compounds, such as anthocyanins, p-coumaric acid, vanillic acid, protocatechuic acid, derivatives of hesperidin and quercetin, and hydroxycinnamic acid derivatives composed of p-coumaric and ferulic acid. It also contains maizenic acid, flavonoid maysin, rutin, flavon-4-ols, chlorogenic acid, saponins, volatile oils (alpha terpinol, menthol, carvacrol, thymol, citronellol, eugenol), fixed oil, resin, sugars, phytosterols, mucilage, tannin and c-glycosylflavones. In addition, CS also contained derivatives of cinnamic acid, glucose, rhamnose and minerals, including sodium (0.05%), potassium (15%), iron (0.0082%), zinc (0.016%) and chloride (0.25%). The proximate compositions of corn silk consists of 9.65% moisture, 3.91% ash, 0.29% crude fat, 17.6% crude protein and 40% crude fiber. Corn silk comprises of style and stigma. Style of *Zea mays* contains constituents such as as lumichrome, chrysoeriol, genistein, adenosine, guanosine, uracil, acetovanillone, vanillin, vanillic acid, 6-methoxybenzoazolinone, stigmast-4-en-3-one, β-sitosterol, stigmasterol, stigmastanone, 7alpha-hydroxyisostigmasterol. Pollen contains flavonol glycosides of quercetin, isorhamnetin and kaempferol. Roots contain 2-(2-hydroxy-7-methoxy-1.4-benzoxazin-3-one)-β-D-glucoside.

**Pharmacological Uses**

**Diuresis and kaliuretics effect**

Corn silk (CS) aqueous extract exhibited diuretic and kaliuretic effect in water-loaded conscious rats. But no variation was observed in proximal tubular function, Na+, Li+ or uric acid excretion, when studied via creatinine and lithium clearance. Pinheiro reported significant increase in urine flow and Na+ and K+ excretion in anaesthetized Wistar rats.

**Hypoglycemic agent**

CS aqueous extract significantly reduced blood glucose levels in alloxan induced hyperglycemic mice and STZ induced diabetic rats. The mechanism of action of Corn silk for its anti-diabetic effect appears to be related to i) Partial recovery of damaged pancreatic β-cells ii) healing of injured β-cells.
iii) increase in serum insulin levels iv) reduction in glycohemoglobin (HbA1c) concentration v) regeneration of injured β-cells vii) improved glucose tolerance viii) reduction in serum lipid level, total cholesterol and total triglyceride.\cite{11,12}

**Anti-fatigue activity**
Corn silk flavonoids raised swimming time in mice, accompanying diminished levels of blood lactate, blood urea nitrogen (BUN) and elevated hepatic glycogen concentration. These results manifested anti-fatigue and enhanced exercise tolerance property of Corn silk.\cite{13}

**Nephrotoxicity reduction**
CS administration dose dependently prevented GM-induced interstitial nephritis and reduced serum creatinine level.\cite{14}

**Anti-inflflammatory activity**
Corn silk ethanol extract elicited significant TNF-α antagonistic activity. The extract efficiently abolished the TNF-α and LPS-induced adhesiveness of EAhy 926 endothelial cells to monocytic U937 cells. Corn silk possesses important therapeutic potential for TNF-α and LPS-mediated leukocyte adhesion and trafficking.\cite{15} CS extract diminished cell migration, exudate formation, oxidative stress, TNF-α, IL-1β, VEGF-α, and IL-17A and blocked inflammation-related events (ICAM-1 and iNOS), illustrating its anti-inflammatory effect.\cite{16}

**Anti-oxidant activity**
Corn silk was extracted to prepare five fractions viz. ethanol extract, petroleum ether fraction, acetic ether fraction, n-butanol fraction and water fraction. The butanolic fraction exhibited the highest antioxidant and free radical scavenging activity. The two flavone glycosides isolated from butanolic fraction viz., isoorientin-2"-O-α-L-rhamnosc and 3"-methoxymaysin, were also found to possess potent antioxidant moieties.\cite{17} Ethanol extract of the Egyptian corn silk reflected profound free radical scavenging activity.\cite{17} CS ethanol extract inhibited γ-radiation-induced damage in liver, reduced the MDA content in a dose-dependent manner and safeguarded the liver from GSH depletion. CS flavonoids extract provided protection against oxidative stress induced by exhaustive exercise in mice.\cite{18}

**Traditional Uses**
In the traditional system of medicine, maize is found to be effective as an:
- Analgesic
- Astringent
- Anti-allergic
- Emollient
- Against skin rashes
- Against Sore throat
- Anti-angina
- Anti-hypertensive
- Against Biliousness
- Urinary disorders including dysuria, cystitis, Urethritis, Nocturnal enuresis
- Anti-lithiasis
- Anti-diarrheal
- Anti-dysentery
- Anti-tumor
- Anti-prostatitis

- Anti-gonorroheal

**Therapeutic Uses**
- Corn silk is utilized as a medicine in renal problems for both adults and children, in Mexico. It also helps in genito-urinary complaints.
- Corn silk minimizes edema, gout, cystitis and rheumatism, due to its anti-inflammatory property.
- Chief reputation of corn is its potent anti-prostatitis capability.
- Corn lowers LDL cholesterol and guards against cardiac diseases, diabetes and hypertension.

**Strange Facts**
- Corn silk is placed within a cradle, hung over a mirror for protection and pasted on the door with a belief that it provides good luck.
- Corn is produced in every continent of the world with the exception of Antarctica.
- About 800 kernels are present in 16 rows on each ear of corn.
- The corncob (ear) is actually part of the corn plant’s flower.
- The main ingredient in most dry pet food is corn.
- Corn is America's number one field crop. Corn leads all other crops in value and volume of production.
- The corn plant has both male and female parts. The silk is the female part while the tassel is the male part.
- Our bacon and egg breakfast, glass of milk at lunch, or hamburger for supper were all produced with sweet corn.
- There are more than 3,500 different uses for corn products. Corn does much more than feed people and livestock!
- It is processed and used in baby food, chewing gum, dessert icing, peanut butter, antibiotics, potato chips, ice creams, cakes and marshmallows.
- It's also used in the manufacturing of photographic film, in the production of plastics, alcohol, ink, paint, glue, shoe polish, fireworks, and rust blockading.
- Corn has an incredibly long shelf life? Archeologists have been able to track 1,000-year-old popcorn! (Wonder how that tasted!!!)
- The Indian word maize means "sacred mother" or "life giver."
- Corn-meal was also sprinkled across the doorway to keep enemies out.
- Fabrics used to make your clothing are strengthened by cornstarch.
- The books are bound with corn-starch.
- Corn is also used in such products as soaps, toothpaste and cosmetics.
- The most common breakfast cereal is cornflakes.
- Corn Oil is used as cooking oil.
- Corn Silk reduces blood clotting time.
- *Zea mays* Silk extract provides a smooth texture and helps in skin maintenance due to Zinc Oxide. Corn starch was used for chapped skin and for bee stings.
- Corn is a favorite remedy for the treatment of warts and corns.
- Nosebleeds could be prevented by wearing a necklace of red corn kernels as an amulet.
- The oil of corn was used for treating dandruff.
• Corn meal formed a poultice for headache and when, mixed with onion, for pneumonia.
• Corn contains thiamine, which boosts memory, cognitive functions and neuronal health.
• Folate content of corn is an essential requirement, during pregnancy.
• Corn is rich in phosphorus, which helps to maintain normal growth, kidney function and bone health.

CONCLUSION
Corn is America’s number one field crop. Corn leads all other crops in value and volume of production. Corn is produced in every continent of the world with the exception of Antarctica. There are more than 3,500 different uses for corn products. Corn does much more than feed people and livestock. All three Indian meals include corn in one form or the other. Breakfast consists of corn-flakes mixed with milk, hamburger made up from sweet corn is consumed at lunch or supper becomes special with ‘makki ki roti’ and ice creams. Corn has incredibly long shelf life. Corn contains thiamine, which boosts memory, cognitive functions and neuronal health. Folate content of corn is an essential component, especially during pregnancy. Corn is rich in phosphorus, which helps to maintain normal growth, kidney function. Corn is safe and non-toxic. Pharmacological studies have shown its remarkable medicinal properties such as antioxidant, anti-fatigue, hypoglycemic and effective diuretic agent. Therefore, maize has recently become a craze among modern youth.

REFERENCES

Cite this article as: