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Chemical Composition of Corn and Maize and Their Applications in Medical Sector as Well as in Domestic Sector: A Brief Study

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Abstract: Corn (Zea mays), commonly referred to as maize, is one of the most cultivated cereal crops worldwide. This study presents a comprehensive overview of the chemical composition of corn and its various applications in the medical and domestic sectors. Corn is composed of significant macronutrients including carbohydrates, proteins, and fats, along with essential micronutrients such as B-complex vitamins, magnesium, and phosphorus. It is also rich in phytochemicals like lutein, zeaxanthin, and ferulic acid, which contribute to its antioxidant and anti-inflammatory properties. In the medical sector, corn is utilized in the development of nutraceuticals, anti-diabetic formulations, cardiovascular therapies, and as a dietary supplement. Domestically, corn and its derivatives (flour, starch, oil) are employed in cooking, baking, biodegradable household products, and personal care items. This paper integrates chemical insights with practical applications, highlighting corn's role as a sustainable resource in both health care and home management. Further research is recommended to explore advanced therapeutic uses and environmentally friendly domestic innovations.

Keywords: Corn, Maize, Nutraceuticals, Phytochemicals, Domestic Applications, Antioxidants, Functional Foods.

Introduction : Corn (Zea mays) is one of the most significant cereal grains globally, contributing not only to food security but also to industrial, domestic, and medicinal innovations. Originating from Central America and now cultivated in over 160 countries, corn serves as a staple food, livestock feed, biofuel source, and a raw material for various industrial applications. While the primary role of corn in food systems is well recognized, its chemical richness and multifunctionality are lesser known to the general public and even to some scientific sectors.This paper seeks to explore corn and maize from two perspectives: chemical composition and utility. In particular, the study focuses on how corn's unique combination of macronutrients, micronutrients, and phytochemicals makes it suitable for diverse applications. From corn oil used for cardiovascular health to corn starch in eco-friendly cleaning agents, the crop serves as a bridge between traditional domestic practices and modern scientific advancements.By reviewing the core components of corn and their interactions with human health and household systems, this research aims to create a knowledge platform for future exploration in food science, pharmacology, and sustainable home economics.

Chemical Composition of Corn and Maize : Corn (Zea mays), known commonly as maize, is chemically rich in both macro- and micronutrients and also contains several health-promoting phytochemicals. This composition underpins its widespread use in nutritional therapy, functional foods, pharmaceuticals, and even domestic applications. Understanding the complete chemical makeup of corn is essential to explore its multifaceted roles in modern and traditional contexts.

Macronutrients: Corn is primarily composed of carbohydrates, making up approximately 72–74% of its dry weight, largely in the form of starch. This starch is stored in the endosperm and is a vital energy source in both human and animal diets. Corn starch is also an industrial base for bioplastics and thickeners.

The protein content of corn ranges between 8–11%, with zein being the major protein fraction. Although zein is not a complete protein due to its low lysine and tryptophan levels, corn can be complemented with legumes to form a nutritionally adequate amino acid profile. Corn gluten meal, a by-product of corn processing, is protein-rich and often used in dietary supplements and animal feed.

Lipids constitute approximately 4–5% of whole corn, with corn germ containing up to 45% oil. Corn oil is largely composed of unsaturated fatty acids, particularly linoleic acid (omega-6) and oleic acid (omega-9), which are beneficial for heart health. It also contains phytosterols that may reduce LDL cholesterol levels. These macronutrients not only serve nutritional needs but also enable corn's role

in food processing, soap making, and emulsifier production.

Dietary fiber content in whole corn is about 7–9%. This includes both insoluble fibers such as cellulose and soluble fibers like pectin, aiding in digestive regulation and blood sugar stabilization. The bran and pericarp layers of the corn kernel are rich in fiber, contributing to satiety and gut health.

Micronutrients: Corn provides an array of essential vitamins and minerals, particularly from the B-vitamin group. These include:

1. Thiamine (B1) – Supports nervous system function and carbohydrate metabolism.
2. Niacin (B3) – Important for skin health and enzymatic activity; however, in untreated corn, niacin is bound and requires alkaline processing (nixtamalization) to become bioavailable.
3. Folate (B9) – Crucial for DNA synthesis and fetal development.
4. Pantothenic acid (B5) and pyridoxine (B6) – Aid in energy metabolism and red blood cell production.

In terms of minerals, corn contains:

1. Magnesium – Essential for bone health and enzyme activity.
2. Phosphorus – Supports skeletal structure and cellular energy transfer.
3. Potassium – Helps regulate blood pressure and nerve function.
4. Iron – Though present in small amounts, it contributes to hemoglobin synthesis.

Yellow maize is also a rich source of provitamin A carotenoids, particularly beta-carotene, which can be converted into vitamin A in the human body. This is especially significant in biofortified varieties (e.g., Golden Maize), used in combating vitamin A deficiency in developing countries.

Phytochemicals and Bioactive Compounds: Corn is particularly noted for its diverse range of phytochemicals, which offer health-protective effects beyond basic nutrition.

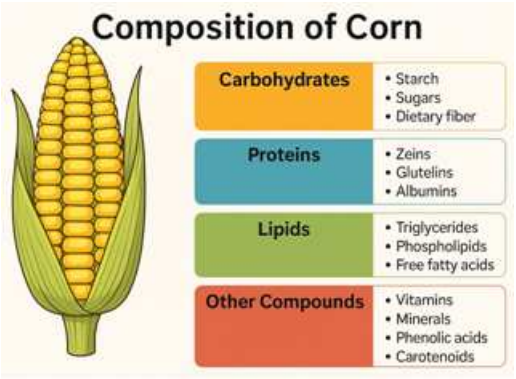
Lutein and Zeaxanthin: These carotenoids are concentrated in yellow maize varieties and are renowned for promoting eye health by protecting against age-related macular degeneration (AMD). Both compounds filter harmful blue light and act as antioxidants in the retina.

Ferulic Acid: A potent phenolic antioxidant, ferulic acid is abundant in the bran of corn. It neutralizes free radicals, reduces inflammation, and may protect against cardiovascular disease and certain cancers. It also contributes to corn's anti-aging and anti-wrinkle potential in cosmetic formulations.

Anthocyanins: Found primarily in purple and blue maize, anthocyanins exhibit strong antioxidant and anti-inflammatory properties. These pigments may support vascular health and glucose regulation, making them beneficial in anti-diabetic dietary interventions.

Flavonoids: Flavonoids such as apigenin, luteolin, and quercetin have been identified in corn husks and kernels. These compounds exhibit antimicrobial, anti-allergic, and cardioprotective activities, supporting corn's role in preventive medicine and immune modulation.

Phytosterols: Corn germ oil is rich in plant sterols, which structurally resemble cholesterol but help lower serum LDL cholesterol levels by inhibiting its absorption in the intestine. Their inclusion in functional foods and cholesterol-lowering spreads is now commonplace.



Summary of Composition

Nutrient Type	Main Compounds /Elements	Role/Function
Carbohydrates	Starch	Energy, food Processing
Proteins	Zein, glutelin	Body repair, animal feed
Lipids	Linoleic acid, oleic acid	Heart health, food oils
Vitamins	B1, B3, B6, Folate, Provitamin A	Metabolism, fetal health
Minerals	Mg, P, K, Fe	Enzymatic activity, blood pressure
Phytochemicals	Lutein, zeaxanthin, ferulic acid, phytosterols	Eye health, antioxidant, cholesterol control

This comprehensive chemical profile demonstrates that corn and maize are not just energy-rich crops but also reservoirs of therapeutic and functional molecules. Their composition supports a wide range of applications in health care systems, nutrition therapy, and even eco-conscious household practices.

Applications in the Medical Sector : The increasing interest in plant-based health interventions has underscored the significance of corn (*Zea mays*) not only as a dietary staple but also as a source of functional components with therapeutic potential. Corn and maize-derived products, particularly from kernels, bran, and germ, have been incorporated into a variety of medical and nutraceutical formulations due to their rich phytochemical and nutritional profile. This section discusses their diverse uses in the medical sector, focusing on nutraceutical applications, antioxidant and anti-inflammatory roles, and pharmaceutical potential.

Nutraceuticals and Functional Foods: Nutraceuticals are food-derived products offering health benefits beyond basic nutrition, often contributing to the prevention or management of chronic conditions. Corn plays a vital role in this space, particularly in the form of whole grains, corn oil, and bioactive isolates.

Corn oil is a rich source of phytosterols and unsaturated fatty acids, primarily linoleic and oleic acid, which contribute to lowering serum LDL cholesterol. According to Rios et al. (2020), phytosterol-enriched corn oil consumption resulted in a 10–15% reduction in LDL cholesterol among hyperlipidemic patients. Moreover, lutein and zeaxanthin in yellow maize are commonly used in eye health supplements aimed at delaying the progression of age-related macular degeneration (AMD) (Krinsky & Johnson, 2005).

Ferulic acid, predominantly found in corn bran, has also been incorporated into antioxidant-enriched foods that help in reducing oxidative damage, thus supporting metabolic and cellular health. These nutraceutical compounds position corn as a valuable raw material in the development of functional foods tailored to aging populations and at-risk groups with cardiovascular or visual disorders.

Antioxidant and Anti-inflammatory Properties: Oxidative stress is a common factor in chronic illnesses such as cancer, diabetes, and neurodegenerative disorders. Corn's phytochemicals exhibit significant free radical scavenging activity, contributing to the prevention and management of these diseases.

Anthocyanin-rich varieties, especially purple and blue maize, contain high levels of antioxidant compounds. Studies by Lopez-Martinez et al. (2015) demonstrated that anthocyanin extracts from purple maize significantly reduced reactive oxygen species (ROS) generation in vitro. In addition to anthocyanins, ferulic acid and flavonoids such as quercetin and luteolin from corn husks have been shown to inhibit inflammatory pathways, including cyclooxygenase (COX) and lipoxygenase (LOX) activity.

Clinical trials suggest that diets enriched with whole cornmeal can lead to improved inflammatory markers such as C-reactive protein (CRP) and interleukin-6 (IL-6) levels, thereby supporting corn's role as an anti-inflammatory agent (Gomez-Pinilla, 2017). This renders corn-based diets particularly beneficial for patients suffering from metabolic syndrome, arthritis, and autoimmune disorders.

Pharmaceutical and Clinical Uses: Corn also contributes to pharmaceutical formulations beyond dietary applications. Corn starch, a polysaccharide derived from the endosperm, is extensively used in drug delivery systems as a binder, disintegrant, and filler in tablets and capsules. Due to its biocompatibility and biodegradability, it is favored in the production of microcapsules for controlled drug release, especially in gastrointestinal medications.

Furthermore, genetically engineered varieties of corn have been explored for the production of plant-based vaccines and therapeutic proteins—a field known as **molecular** pharming. For example, corn has been used as a host for producing antigens for hepatitis B and Norwalk virus (Thanavala et al., 2005). These innovations offer a cost-effective and scalable approach to vaccine production in developing regions.

In diabetic care, resistant starch from corn has been found to reduce postprandial glucose levels, improving glycemic control among type 2 diabetes patients (Robertson et al., 2005). It also enhances insulin sensitivity by modulating gut microbiota and promoting short-chain fatty acid (SCFA) production.

Applications in the Domestic Sector : While corn (*Zea mays*) has long been valued as a food staple, its uses in domestic settings extend far beyond nutrition. Corn and its derivatives serve a variety of roles in household products, culinary practices, personal care, and even eco-friendly innovations. These applications leverage corn's biodegradable, non-toxic, and multifunctional chemical properties to create safe, sustainable solutions for everyday life.

Corn Flour and Oil in Cooking and Preservation: Corn flour and cornmeal are foundational ingredients in numerous traditional and modern kitchens. Rich in carbohydrates and gluten-free, corn flour is used in baking, frying, and thickening soups and sauces. Its neutral flavor and fine texture make it suitable for making flatbreads, tortillas, fritters, and porridge.

Corn oil, extracted from corn germ, is a preferred medium for cooking due to its high smoke point and mild flavor. More importantly, it contains essential fatty acids, such as linoleic acid, and plant sterols that promote cardiovascular health. In domestic food preservation, corn oil's antioxidant compounds slow down spoilage and rancidity in stored foods.

Corn flour is also used as a natural preservative and anti-caking agent. Its hygroscopic nature helps absorb excess moisture, keeping stored food items dry and extending their shelf life.

Corn Starch in Cleaning and Personal Care: Corn starch is one of the most versatile and widely used corn derivatives in the domestic sector. As a fine, absorbent powder, it is commonly employed for:

1. **Stain removal**: Corn starch can be sprinkled on greasy fabric or upholstery stains to absorb oil before washing.
2. **Natural deodorant**: Due to its moisture-absorbing properties, corn starch is used in DIY underarm powders.
3. **Baby care**: Often substituted for talcum powder, corn starch soothes irritated skin and prevents diaper rashes.
4. **Cosmetic products**: Corn starch acts as a binder and thickening agent in lotions, creams, and face powders, offering a soft, matte finish.

In eco-friendly cleaning products, corn starch is combined with vinegar and baking soda to create homemade glass and surface cleaners.

Traditional, Cultural, and Modern Culinary Practices: Corn has a deep-rooted cultural significance in many parts of the world. In India, corn flour is used to make 'makki di roti', a winter delicacy consumed with mustard greens. In Latin American countries, corn masa forms the basis of tamales, tortillas, and pupusas.

Cornmeal is often used as a breading agent in frying recipes, providing crispness and flavor. In baking, corn flour is mixed with other flours to make muffins, cornbread, and cookies, especially in gluten-sensitive diets.

Modern uses have also evolved to include instant mixes and ready-to-cook meals incorporating corn flour due to its easy digestibility and longer shelf life. In recent years, corn has also gained popularity in the form of popcorn-based snacks, energy bars, and extruded breakfast cereals.

Eco-Friendly Innovations and Biodegradable Utilities: Corn starch plays a pivotal role in the creation of biodegradable plastics and packaging materials. With increasing environmental concerns, starch-based films derived from corn are now used as sustainable alternatives to petroleum-based plastic for making carry bags, disposable cutlery, and food containers.

These bioplastics are compostable, reducing the carbon footprint of domestic waste. Corn-based detergents and soaps are also gaining attention due to their minimal skin irritation and environmentally safe decomposition.

Corn's chemical properties make it a remarkably useful resource in the domestic sphere. From its use in culinary traditions and household maintenance to modern biodegradable products, corn contributes significantly to sustainable living. Its ability to provide natural, affordable, and health-conscious alternatives ensures its enduring relevance in households around the world.

Conclusion and Future Scope : Corn (*Zea mays*), beyond its staple food status, represents a multifunctional crop with immense potential across both medical and domestic domains. This study has highlighted the diverse chemical composition of corn—rich in macronutrients, micronutrients, and powerful bioactive compounds such as flavonoids, phytosterols, carotenoids, and phenolic acids. These constituents contribute not only to its nutritional benefits but also to its therapeutic efficacy in managing chronic health conditions like cardiovascular disease, diabetes, oxidative stress, and age-related disorders.

The review also demonstrated how corn is being harnessed for nutraceutical and pharmaceutical development, with components like lutein, zeaxanthin, ferulic acid, and resistant starch contributing to clinical innovations and functional food formulations. In the pharmaceutical industry, corn-derived starches and genetically modified variants offer promising platforms for drug delivery and vaccine development.

Simultaneously, corn's role in domestic life is equally significant. From corn starch in household cleaners and cosmetics to corn flour in traditional recipes and biodegradable packaging, the plant's versatility supports sustainable living practices. As concerns around environmental degradation and synthetic product overuse rise, corn-based materials offer an eco-friendly and affordable alternative.

Future Scope: While the current applications are impressive, future research should focus on:

1. **Bioavailability and clinical validation** of corn-derived compounds through human trials.
2. **Development of fortified corn varieties** with enhanced levels of specific nutrients (e.g., provitamin A, zinc).
3. **Advancement of bioplastic technologies** using corn starch for scalable and compostable alternatives.
4. **Innovation in functional food design**, especially targeting low-income and nutritionally vulnerable populations.

Biotechnological advancements and interdisciplinary collaborations can further optimize corn's therapeutic and household utility, making it a cornerstone of health-promoting and sustainable lifestyles globally.

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