



BIOCHEMICAL PROPERTIES OF MAIZE PLANT AND METHODS OF ITS DETERMINATION

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Abstract:

The article examines the main biochemical composition of maize and the methods for its determination. Information is provided on spectrophotometry, chromatography, and chemical analysis methods for determining carbohydrate, protein, fat, and vitamin content. These analyses are essential for assessing the nutritional value and quality control of maize.

Keywords: Maize, grain, fat, carbohydrate, amylose, Kjeldahl method, spectrophotometry, gas chromatography, chlorophyll content, vitamin.

Introduction

MAKKAJO‘XORI O‘SIMLIKINING BIOKIMYOVIY XUSUSIYATLARI VA UNI ANIQLASH METODLARI

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Annotatsiya

Maqolada makkajo‘xorining asosiy biokimyoviy tarkibi va uni aniqlash usullari ko‘rib chiqilgan. Uglevod, protein, yog‘ va vitamin miqdorini aniqlashda



spektrofotometriya, xromatografiya va kimyoviy tahlil metodlari haqida ma'lumot berilgan. Ushbu tahlillar makkajo'xoring oziqaviy qiymatini aniqlash va sifat nazorati uchun muhim ahamiyatga ega.

Kalit so'zlari: makkajo'xori, don, yog', uglevod, amiloz, kjeldalh usuli, spektrofotometriya, gaz xromatografiyasi, xlorafil miqdori, vitamin.

Introduction

Currently, one of the main objectives of agriculture is to expand the cultivation areas of crops to meet the growing global demand for food and increase the production of high-quality products. In this regard, grain crops hold a leading position, and maize (*Zea mays* L.) plays a crucial role among them. Maize is widely used in food production, livestock farming, and industrial sectors.

Maize (*Zea mays* L.) is an annual plant in the Western Hemisphere. It is a monoecious plant, with male flowers located on the tassel and female flowers forming on the ear shoots. Maize contains essential vitamins such as B1, B2, PP, C, D, and K, as well as minerals including calcium, phosphorus, iron, and sodium. The grain composition consists of 9–10% protein, 4–6% fat, and 65–70% carbohydrates. Yellow maize varieties also contain provitamin A, nicotinic and pantothenic acids, flavonoids, and other bioactive compounds.

The biochemical composition of maize determines its nutritional value and industrial significance. This article explores the main biochemical properties of maize and the methods used for their determination.

Carbohydrates

Carbohydrates are the most abundant biochemical component in maize, with starch being the primary constituent, accounting for 60–75% of the total composition. Maize contains approximately 1–3% sugar, with fresh maize having a higher sugar content, which decreases upon drying.

Maize is rich in complex carbohydrates, making it a long-term energy source. Including maize in the diet contributes to improved digestive function.

To determine the starch content in maize, the following methods are used:

- **Iodine test** – a simple qualitative method to detect the presence of starch.

- **High-Performance Liquid Chromatography (HPLC)** – an advanced analytical method used to quantify specific carbohydrate components.
- **Spectrophotometric methods** – used for precise carbohydrate quantification based on light absorption.

Protein and Amino Acids

Maize grains contain an average of 8–12% protein, with zein being the predominant protein. The amino acid composition of maize includes:

- **Leucine** – essential for protein synthesis and muscle growth.
- **Isoleucine** – involved in immune function and energy production.
- **Valine** – aids in muscle recovery and energy balance.
- **Phenylalanine** – plays a key role in neurotransmitter production.
- **Tyrosine** – enhances brain function.
- **Tryptophan** – helps in serotonin production, regulating mood and sleep.

Maize has low levels of lysine and tryptophan, indicating a lower protein quality. Therefore, it is recommended to consume maize with other protein sources such as legumes or animal-based products.

For a complete protein intake, maize should be combined with foods like beans, peas, or meat, which enhance its overall protein quality.

Methods for Determining Protein Content

- **Kjeldahl Method** – Measures total nitrogen content to determine the overall protein amount.
- **Bradford Assay** – Uses spectrophotometry to measure protein concentration.
- **Electrophoresis** – Separates proteins and amino acids to analyze their composition.

Fats and Lipids

Maize contains **3–5% fat**, which is slightly higher than in other cereal grains. The primary source of fat in maize is the germ (embryo) of the grain.

Types of Fats in Maize:

- **Saturated fatty acids** – 13–15%
- **Monounsaturated fatty acids (Oleic acid, Omega-9)** – 25–30%
- **Polyunsaturated fatty acids (Omega-6, Linoleic acid)** – 50–60%

Essential Fatty Acids in Maize:

- **Linoleic acid (Omega-6)** – Beneficial for heart health and strengthens cell membranes.
- **Oleic acid (Omega-9)** – Protects blood vessels and reduces inflammation.
- **Palmitic acid** – Serves as an energy source and supports cell structure.
- **Stearic acid** – Helps maintain lipid balance in the body.

Corn Oil:

Corn oil, extracted from maize, is rich in **vitamin E** and antioxidants. It contributes to **cardiovascular health** by reducing bad cholesterol levels. Overall, corn oil is considered a **healthy plant-based oil** with beneficial effects on human health.

Methods for Determining Lipid Content:

- **Soxhlet Extraction** – Uses organic solvents to extract fats.
- **Gas Chromatography (GC)** – Analyzes the composition of lipids.

Vitamins and Minerals in Maize

Maize is a rich source of essential vitamins:

B-Complex Vitamins:

- **B1 (Thiamine)** – Important for energy production and nervous system function.
- **B2 (Riboflavin)** – Plays a role in metabolism and cell regeneration.
- **B3 (Niacin)** – Supports digestion, the nervous system, and skin health.
- **B5 (Pantothenic Acid)** – Aids in hormone production and red blood cell formation.
- **B6 (Pyridoxine)** – Regulates protein and carbohydrate metabolism.
- **B9 (Folic Acid)** – Essential for pregnancy, cell growth, and regeneration.

Other Key Vitamins:

- **Vitamin E** – A powerful antioxidant that benefits skin and the immune system.
- **Vitamin K** – Supports blood clotting and bone health.
- **Provitamin A (Beta-carotene)** – Enhances vision and strengthens immunity.



Mineral Content in Maize

Maize contains several essential minerals required for human health, ensuring proper metabolic function and overall well-being.

Potassium (K) – Helps regulate blood pressure and supports heart health.

Magnesium (Mg) – Essential for muscle and nervous system function.

Phosphorus (P) – Necessary for strong bones and teeth.

Iron (Fe) – Plays a key role in red blood cell production and prevents anemia.

Zinc (Zn) – Strengthens the immune system and promotes wound healing.

Copper (Cu) – Assists in the formation of red blood cells.

Selenium (Se) – A powerful antioxidant that protects cells from damage.

Maize is a **moderately rich source of vitamins and minerals**, especially **B vitamins, potassium, and magnesium**. Including maize in the diet can help improve **energy levels and overall health**.

Methods for Determining Vitamins and Minerals:

- **Spectrophotometry** – Measures the concentration of vitamins.
- **Atomic Mass Spectrometry** – Identifies and quantifies mineral content.

Methods for Determining the Biochemical Composition of Maize

Spectrophotometry

This method determines the concentration of substances based on their **light absorption properties**. Examples include:

- **Chlorophyll content** – Measured at **wavelengths of 645 nm and 663 nm**.
- **Protein content** – Analyzed at **280 nm**.

Chromatographic Methods

- **High-Performance Liquid Chromatography (HPLC)** – Used for the separation and analysis of **amino acids and starch fractions**.
- **Gas Chromatography (GC)** – Determines **fatty acid composition and volatile compounds**.



Fluorescence and Fluorometry

These methods measure the presence of **chlorophyll and other biochemical components**:

- **Fluorescence Spectroscopy** – Used for the **identification of chlorophyll and carotenoids**.
- **Fluorometric Methods** – Applied to **evaluate protein and vitamin concentrations**.

Chemical Analysis Methods

- **Titrimetry** – Determines substance concentrations using **specific chemical reagents**.
- **Gravimetry** – Analyzes compounds based on their **mass**.

Conclusion

The **biochemical composition of maize** is a crucial factor in determining its **nutritional value**. The **identification of carbohydrates, proteins, lipids, and vitamins** contributes to **improving agronomic processes and product quality**. Advanced **scientific research and technological innovations** can enhance the accuracy and efficiency of these analyses.

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