WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 14, Issue 9, 261-268. Review Article ISSN 2277–7105

MAIZE STARCH – PROPERTIES, APPLICATIONS AND FUTURE PERSPECTIVE

Kishan R. Prajapati*, Nargis F. Pathan and Muskan S. Mansuri

Department of Pharmacy, B.Pharmacy College, Rampura, Kakanpur, Godhra, Gujarat, India.

Article Received on
05 March 2025,

Revised on 25 March 2025,
Accepted on 15 April 2025

DOI: 10.20959/wjpr20259-36391

***Corresponding Author**
Kishan R. Prajapati
Department of Pharmacy,
B.Pharmacy College,
Rampura, Kakanpur,
Godhra, Gujarat, India.

ABSTRACT

Maize starch is one of the most widely used polysaccharides, derived from corn (Zea mays). It has unique properties like its neutral taste, good film forming ability and excellent stability. It is primarily composed of two polymers: amylose and amylopectin. It is extensively utilized in the food, pharmaceutical, and industrial sectors due to its versatile properties. In the food industry, it serves as a thickening agent, stabilizer and gelling agent in product like sauces, gravies and desserts. In pharmaceutical it is used as a filler, disintegrant and binder in tablet and capsule. In the paper industry, it is used as a coating agent and adhesive. This review explores the physicochemical characteristics of maize starch, its applications in different industries, and ongoing research on enhancing its functionality.

INTRODUCTION

Maize starch is a fine, white powder. Maize starch derived from corn (Maize) grain and is obtained from the endosperm of maize kernels. Itis primarily composed of amylose and amylopectin. Its widespread use is attributed to its availability, low cost, cost-effectiveness, and unique functional properties. The purpose of this review is to examine the characteristics of maize starch and its multifaceted applications, particularly in food and pharmaceuticals.

Granule structure: The starch granules' size and morphology vary according to the source, and this affects their functionality in different applications.

Gelatinization: Maize starch undergoes gelatinization when heated in water, which makes it useful as a thickening agent in food and pharmaceutical formulations.

Viscosity and Gel Formation: The viscosity profile and gel-forming ability of maize starch are crucial factors in determining its suitability for various formulations.

Discovery and Further history

The primary source of maize starch discovered in Mesoamerica around 9000 years ago. Thomas Kingsford discovered maize starch in 1842 from corn kernels by using an existing process for extracting wheat starch .Kingsford's method involved soaking process of kernels in a basic solution, then grinding them and separate out maize starch. Nowadays that method become modern wet milling.

Before 1851, maize starch was largly used to industrial application like laundry starch. In 1854, John Polson of Brown and Polson in Paisely, Scotland patented a method to create pure culinary maize starch. This innovation, marked as; "Patented Cornflour", revolutionized the use of maize starch transforming is from an industrial product into a ingredient used in kitchens. Brown and Polson initially renowned for there muslin production for the Paisley Shawl industry, evolved into becoming the leading starch manufactures in United Kingdom.

Synonyms

Corn Starch Corn Flour Maize Flour Cornmeal Starch.

Types

1. **Native maize starch:** It is naturally extracted from corn.

2. **Modified maize starch:** In this, the chemical and physical properties of starch is modified.

A. Pre gelatinized maize
B. Cross-linked maize starch
C. Acid-modified maize

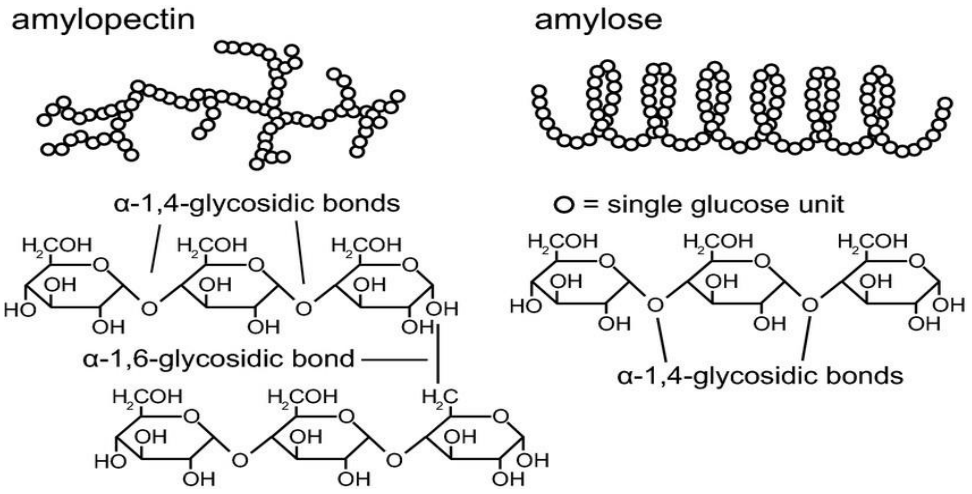
3. **High amylose maize starch:** It is containing high amount of amylose (Which gives higher gel strength).

4. **Liquid maize starch:** It is used to produce liquid suspension.

5. **Instant maize starch:** It is a treated starch and it can be used without heating.[8]

Physicochemical properties

Structure: Maize starch consists of two main components-amylose (20-30) and amylopectin (70-80%). Amylose a linear polysaccharide made of alpha-1,4-linked D-glucose unit. Amylopectin a highly branched polysaccharide with alpha-1,4-linked glucose chain and alpha-1,6 branch point. The ratio of these components influences the starch's properties.[14]



IUPAC Name	2-(Hydroxymethyl)-6-{[4,5,6-trihydroxy-2-(hydroxymethyl)oxan-3-yl]oxy}oxane-3,4,5-triol
Chemical Formula	(C6H10O5)n Where n=number of glucose unit
Melting Point	256-258^C
Molecular Weight	Greater than 4,000 g/mol
Solubility	Insoluble in water at room temperature
Taste	Tasteless
Density	Variable

Method of synthesis

1. The maize kernels are soaked in water to make them soften.
2. Then after the soaked maize kernels are milled using wet milling then slurry are formed and release starch from endosperm.
3. The slurry is passed from centrifugation to separate the starch.

4. The slurry is washed to remove any other impurities.
5. Then the cleaned starch is dried to remove moisture and they turn into fine powder.
6. The dried starch are packaged for various application such as industrial, pharmaceutical and food.

Applications of maize starch

1. In the food industry

Thickening agent: Used in soups, sauces, and gravies due to its ability to form viscous solutions.

Sweeteners: Through hydrolysis, maize starch is converted into glucose or high-fructose syrup, widely used as sweeteners in beverages and processed foods.

Texturizer: Employed to improve texture in products like ice cream and baked goods.[2]

2. In the pharmaceutical industry

Excipient in tablet formulation: Maize starch is a common excipient used as a binder, disintegrant, and filler in tablet formulations.

Controlled release systems: Modified maize starch is used in controlled-release drug delivery systems.

Capsule filling: Starch-based capsules are used for encapsulating powdered medicines, providing controlled dissolution.[13]

3. In the Textile and Paper Industries

Sizing agent: Used to improve the surface characteristics of paper and textiles, adding strength and smoothness.

Biodegradable plastic: Maize starch is a key ingredient in the development of biodegradable plastics, reducing the environmental impact of synthetic polymers.

4. In the cosmetic industry

Absorbent and Binding Agent: Maize starch is often included in cosmetic formulations for its absorbent properties, helping to keep products dry and stable.[8]

Handling precaution

1. The starch powder create the dust, so avoid the inhalation of the powder and used the mask.
2. When handling this maize starch use the gloves and protective eyewear.

3. Work surface and equipment are clean to prevent centrifugation.
4. The eating, drinking and smoking are avoid while handling the starch.
5. Store in dry, clean and cool place.
6. Store this starch away from incompatible material and stored in tightly closed container.

Storage

1. Temp: Temp. between 15 c to 25 c. Excess heat can degrade the maize starch.
2. Humidity: Keep the storage in dry place.
3. Light: Avoid the direct from sunlight.

Incompatibilities

1. That interact with cations like magnesium and calcium in the formulation can reduce their absorption and effectiveness.
2. Maize starch absorb moisture from environment, so the drugs that are moisture sensitive can degrade when exposed. Ex. Aspirin
3. Maize starch interact with poorly soluble drugs(griseofulvin) may not distribute uniformly with maize starch.

Adverse effects

Allergic reactions, Blood sugar level increased, GI discomfort, increase metabolic risk.

Evaluation

1. **Colorimetric assay**: This test is determination for starch content.

Procedure: Treated starch sample with a anthrone reagent. They produce blue-green color and measure the absorbance at 680 nm using colorimeter.

2. **pH:** For check pH of starch content.

Procedure: Weight 1 gm of maize starch dissolve starch in 100 ml of distilled water to create suspension and stir the suspension for 1-2min. Calibrate pH meter and then immerse electrode in suspension then record pH. Measure the pH by using pH meter.

Criteria: pH range 6 to 7.5.

3. **Loss on drying:** This test is determine moisture content of maize starch.

Procedure: Weight the 3-5gm maize starch in clean container. Measure initial weight of sample (W1) then place sample in drying in oven at 105 c then cool it. Weight again sample (W2).

Formula: LOD(%)= W1-W2/W1*100

Criteria: Up to 15%

4. **FTIR:** FTIR used to identify the molecular structure of maize starch.

Procedure: Weight 1-2gm of maize starch mix with 500gm KBr solution and make pellet then this pellet place in FTIR. Criteria: Maize starch spectrum is around 1740 cm^{-1}.

Marketed products

Brand name	Company name	Dose	Price(Rs./kg)
Roquette (Maize Strach Industrial grade)	Roquette India PVT. Ltd.	Depending on formulation	37
Maize starch powder	Gujarat Ambuja Exports LTD.	Depending on formulation	39
Eerest Maize Starch	Everest Starch (India) PVT. LTD.	Depending on formulation	40

Patent

1. **US5954883A -** Waxy maize starch derived from grain of a plant which is heterozygous for the sugary-2 allele Inventor: Calgene, Inc.

Invention Year: 1992

Grant Year: 1999

Expiry: 20 years from the grant date (2019)

Description: Focuses on a specific type of waxy maize starch with improved properties.

2. **US6409840B1 -** High amylose starch and resistant starch fractions Inventor: National Starch and Chemical Investment Holding Corp. Invention Year: 2000

Grant Year: 2002

Expiry: 20 years from the grant date (2022)

Description: Focuses on developing starches with high amylose content and resistant starch properties.

3. **US5712308A -** Process for producing a modified starch Inventor: National Starch and Chemical Investment Holding Corp. Invention Year: 1996

Grant Year: 1998

Expiry: 20 years from the grant date (2018)

Description: Details a method for modifying starch to achieve specific functional properties.

CONCLUSION

Maize starch is remains a fundamental, versatile and widely used raw material. It is widely available biopolymer with significant applications across a variety of industries. Ongoing research into its modifications and improvements will continue to expand its potential uses, new innovation applications especially in environmentally friendly products and more efficient pharmaceutical formulations. Due to its renewable nature make it an increasingly sustainable choice in many industrial processes and also offer promising opportunities for future advancements in traditional sector.

REFERENCES

1. Hoover R. Modified starches: Properties and uses. Comprehensive Reviews in Food Science and Food Safety, 2001; 1(1): 4-19.
2. Wang L., et al. Modification of maize starch for food application: An overview-Starch-Starke, 2019; 71(1-2): 1900143.
3. Billiaderis C.G. Structure and properties of edible starch films: A review-Food Research International, 1991; 24(6): 561-566.
4. Tang X., & Zhang M. Starch-based nanomaterials: Synthesis and applications-Carbohydrate Polymers, 2017; 160: 114-123.
5. Bhattacharya A., & Mukherjee P. Sizing of jute yarn with modified starches. Journal of Applied Polymer Science, 2002; 83(14): 3130-3137.
6. BeMiller J. N. Starch utilization in the food industry. Starch/Stärke, 2001; 53(1): 10-21.
7. Tester R. F., & Karkalas J. Starch: Composition, structure, properties and applications. Journal of Cereal Science, 2005; 41(2): 151-166.
8. Kawaljit Singh Sandhu. Characteristics of the different corn types and their grain fractions: physicochemical, thermal, morphological, and rheological properties of starches. Journal of Food Engineering September, 2004; 1, 64: 19-127.
9. Juliano B.O. “Rice Chemistry and Technology”, American Association of Cereal Chemists, Inc, 1984.
10. Jaspreet Singh, Narpinder Singh. Studies on the morphological, thermal and rheological properties of starch separated from some Indian potato cultivars. Food Chemistry, 2001; 75: 67–77.
11. Pope C.E., Stoica A.L., Elena Barascu, Maria Iordan. 10 January 2010. Morphological and thermal properties of Maize Starch. Viewed, 2025; 23.
12. https://www.researchgate.net/publication/49613894_MORPHOLOGICAL_AND_THERM

AL_PROPERTIES_OF_
MAIZE_STARCH#:~:text=The%20morphological%20and%20physicochemical%20characteristics,chemical%20rea ction%20with%20modifying%20agents.

13. Yan Hong, Yayuan Zhang, Guodong Liu. 24 May 2024. Chapter 10 Maize Starch. Viewed, 2025; 22. January. https://www.sciencedirect.com/science/article/abs/pii/B9780323961028000024
14. Yu J.k., Moon Y.S. 28 December 2021. Corn Starch: Quality and Quantity improvement for industrial uses. Viewed, 2025; 21.
15. https://pmc.ncbi.nlm.nih.gov/articles/PMC8747220/
16. Narpinder Singh, Amritpal Kaur, Khetan Shevkani. November 2013. Maize: Grain structure, composition, milling and starch characteristic. Viewed, 2025; 23.
17. https://www.researchgate.net/publication/286021900_Maize_Grain_Structure_Composition_Milling_and_Starch_C haracteristics
18. Deborah Schwartz and Roy L. Whistler. 20 May 2009. History and future of starch. Viewed, 2025; 25. https://www.sciencedirect.com/science/article/abs/pii/B978012746275200001X