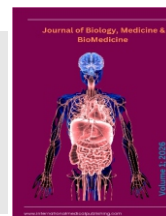




JBMB

Journal of Biology, Medicine & Biomedicine

www.internationalmedicalpublishing.com



Review

Section: Biochemistry

Catalytic Hydrolysis of Ester Linkage in Starch-derived Polylactic Acid (PLA): A Sustainable Approach toward Bioplastics

Sunil Kumar*

¹Department of Zoology, PMCOE Government (Autonomous) Post Graduate College, Satna, Madhya Pradesh, India

HIGHLIGHTS

- Renewable and biodegradable polymer
- Derived from starch-based feedstocks
- Degrades through ester-bond cleavage
- Crystallinity affects degradation rate
- Diverse applications across industries

Key Words:

Polylactic acid
Starch
Ester hydrolysis
Bioplastics
Catalytic mechanism

ABSTRACT

Introduction: Polylactic acid (PLA) is an economically important bio-based and biodegradable polyester increasingly used as an alternative to conventional petroleum-derived plastics. Its renewability, biocompatibility, biodegradability, and mechanical properties comparable to conventional plastics make it valuable for sustainable material development. PLA can be produced from renewable agricultural resources, including starch and cellulose, through physical, chemical, and biological processing. Its environmental degradation is influenced by several intrinsic and extrinsic factors, including crystallinity, pH, temperature, and hydrophilicity. **Aim & Objective:** This review aimed to summarize the chemical composition and physicochemical characteristics of PLA, describe its production from starch-based renewable feedstocks, evaluate its degradation mechanisms, and highlight its major applications in different sectors. **Materials & Methods:** A narrative review approach was adopted to examine available scientific literature concerning PLA production, properties, biodegradation, degradation mechanisms, and applications. Relevant information on renewable feedstocks, processing methods, ester-bond cleavage, catalytic and hydrolytic degradation, and environmental factors affecting degradation was synthesized. **Results:** PLA is primarily produced from renewable carbohydrate-rich materials such as starch and cellulose. Its degradation occurs through both biotic and abiotic pathways. Biotic degradation involves microbial and enzymatic activity, whereas hydrolytic degradation involves cleavage of ester bonds in the polymer backbone. Abiotic processes can facilitate subsequent mineralization under suitable environmental conditions. The degradation rate is strongly influenced by polymer crystallinity, molecular structure, hydrophilicity, pH, temperature, and environmental conditions. PLA demonstrates diverse applications in packaging, agriculture, biomedical materials, food-related products, and other industrial sectors. **Conclusion:** PLA represents a promising sustainable alternative to conventional plastics because of its renewable origin, biodegradability, biocompatibility, and favorable mechanical properties. Understanding its production and degradation mechanisms is essential for optimizing performance, improving environmental degradation, and expanding its applications across various sectors.

* Corresponding Author: Dr. Sunil Kumar, e-mail: sunilbt13@gmail.com

Article History: Received 07 August 2026; Received in Revised form 24 September 2026; Accepted 01 October 2026

How To Cite: Sunil Kumar. Catalytic Hydrolysis of Ester Linkage in Starch-derived Polylactic Acid (PLA): A Sustainable Approach toward Bioplastics.

JBMB: Journal of Biology, Medicine & Biomedicine. 2026;1(1):1-8. DOI: <https://doi.org/10.71393/vy940g92>

This publication is licensed under CC-BY 4.0. Copyright © 2026 The Authors. Published by International Medical Publishing Group.

INTRODUCTION

Poly(lactic acid) (PLA) is an aliphatic homopolymer of lactic acid has emerged as one of the most economically and commercially successful bioplastics explored because of its renewable origin, excellent mechanical properties, biocompatibility, and industrial processability [1]. PLA is primarily synthesized from renewable agricultural biomass and agro-industrial waste feedstocks, especially starch-rich crop residues. The starch-based resources are hydrolyzed to produce fermentable sugars, which are subsequently converted into lactic acid through microbial fermentation. This biopolymer has a spectrum of applications in the field of packaging, biomedical devices, textiles, and consumer products due to its biodegradability [2]. Despite its biodegradable nature and renewable origin, the degradation of PLA under natural environmental conditions is relatively slow compared with other biodegradable polymers due to its both intrinsic and extrinsic factors. Intrinsic factors include the degree of crystallinity, molecular weight, stereochemical composition, and hydrophobicity, which render the water penetration and the accessibility of ester bonds to hydrolytic attack [3]. While, extrinsic factors include environmental conditions such as temperature, pH, photo-oxidation and moisture content (**Figure 1**). The crystalline part of the polymers is more resistant than the amorphous region. The rate of degradation of PLA decreases with an increase in crystallinity of the polymer [4]. Highly ordered crystalline domains influence the polymer's thermal stability, mechanical strength, rigidity, and resistance to degradation. Neat PLA generally exhibits a glass transition temperature (T_g) of approximately 55–65 °C and a melting temperature (T_m) of about 130–170 °C. These thermal characteristics, together with its relatively high tensile strength of up to 50 MPa, contribute to PLA's transparency, rigidity, and suitability for various applications, including food packaging [5]. The composites containing thermoplastic starch (TPS) and incorporation of nanofillers enhanced mechanical performance, making them promising materials for biodegradable packaging applications. The starch serves as an inexpensive, renewable, and widely available natural filler, making starch-based PLA composites economically attractive [6]. Consequently, these composites have significant potential to serve as cost-effective, biodegradable replacements

for conventional synthetic plastics, reducing dependence on finite fossil resources, minimizing plastic waste accumulation, lowering greenhouse gas emissions, and supporting the transition toward a sustainable circular bioeconomy. The starch was modified using vinyl benzoate through a base-catalyzed transesterification process revealing an overall improved thermal stability and hydrophilicity. The hydrophobicity of modified starch was measured by calculating the contact angle 99° was much larger value compares to typical for unmodified starch 40–60° indicates a considerable increase in water resistance. Whereas for thermal stability of benzoylated starches stand at 361°C was much higher as compared to 315°C for native starch. The measured biodegradation for native starch after 28 days was 81±6% while benzoylated starch was remarkably found to be degraded 86±2%, suggesting benzoylated starches maintain the comparable biodegradability potential of native starch [7]. Starch-based bioplastics, derived from corn, potatoes, or other starch-rich plants are marking a significant material in the packaging industry [8]. These bioplastics are often used to create films, bags, and containers. Their biodegradable nature allows them to decompose more easily than conventional plastics, making them versatile for various packaging needs [9]. A well-established two-stage abiotic-biotic process typically governs the breakdown of bioplastics. During the biotic process, water molecules diffuse into the polymer matrix hydrolyzing the ester bonds and causing chain scission and a gradual decrease in molecular weight. This process produces lactic acid, low-molecular-weight oligomers, and other soluble breakdown products [10]. Microorganisms, such as bacteria and fungi, metabolized these hydrolysed products ensuing biotic stage. Ultimately, the breakdown products are converted into end products carbon dioxide, water, and biomass [3, 11].

Chemical Structure of Starch

Starch ($C_6H_{10}O_5$)_n is the primary storage polysaccharide in plants and one of the most abundant renewable natural polymers. Chemically, it is composed of α-D-glucose monomeric units linked through glycosidic bonds [12]. Depending on the arrangement of these glucose residues, starch is categorized into two structurally and functionally distinct polysaccharides:

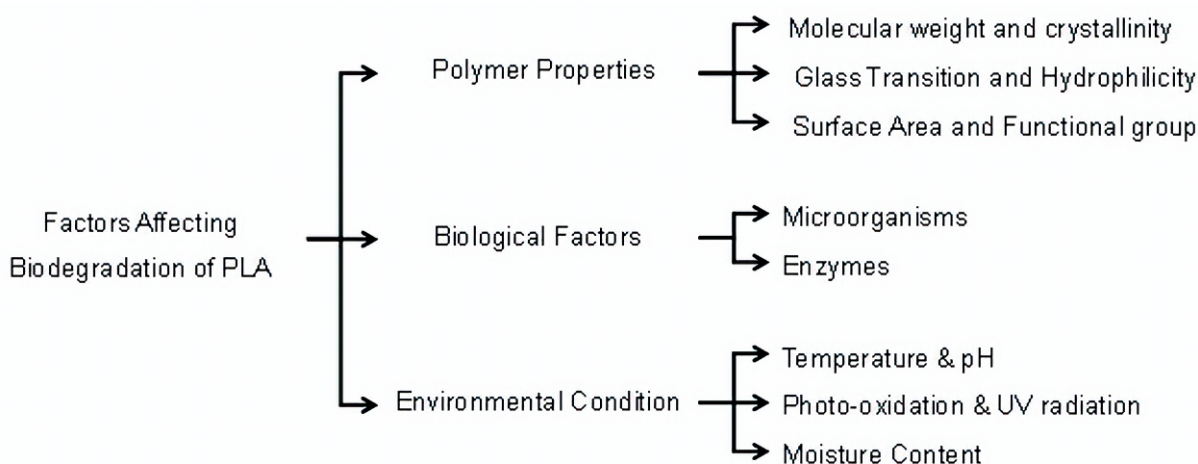


Figure 1: Factors affecting the biodegradation of biopolymer

amylose and amylopectin. Typically, starch contains 20–30% amylose and 70–80% amylopectin, although the ratio varies among botanical sources [13, 14]. Amylopectin consists of α -D-glucose molecules linked by α -(1 $\rightarrow$ 4) and α -(1 $\rightarrow$ 6) glycosidic bonds (**Figure 2A**), with branching occurring approximately every 6 to 100 monomers. In contrast, amylose comprises glucosyl units linked to α -D-glucose units linked by α -(1 $\rightarrow$ 4) glycosidic bonds (**Figure 2B**). The length of these chains typically ranges from about 600 to as many as about 18,000 glucose units [15]. The internal organization of starch is characterized by a hierarchical radial structure consisting of alternating concentric rings of amylose and amylopectin. Within these rings, amylopectin forms two-fold helices, known as crystalline lamellae, while amylose forms tightly packed single helices, forming amorphous lamellae [16, 17].

Chemical Structure of PLA

Lactic acid ($C_3H_6O_3$), also known as 2-hydroxypropanoic acid, is the fundamental monomeric unit used for the synthesis of polylactic acid (PLA), one of the most widely studied biodegradable and bio-based polymers. The molecule contains one asymmetric (chiral) carbon atom, giving rise to two optically active stereoisomers: L-(+)-lactic acid and D-(–)-lactic acid. These stereoisomers possess identical molecular formulas but

differ in the spatial arrangement of the hydroxyl (–OH) group around the chiral carbon (**Figure 3A**) [18]. The stereochemical composition of lactic acid plays a crucial role in determining the crystallinity, thermal stability, mechanical properties, biodegradation behaviour, and processing characteristics of the resulting PLA. L-(+)-lactic acid is the naturally predominant isomer produced through microbial fermentation and is commonly employed for the manufacture of poly(L-lactic acid) (PLLA), a highly crystalline polymer exhibiting excellent mechanical strength and thermal resistance. In contrast, D-(–)-lactic acid forms poly(D-lactic acid) (PDLA). The mixture of both stereoisomers yields poly(D,L-lactic acid) (PDLLA), an amorphous polymer with lower crystallinity, which is associated with a faster biodegradation rate [19]. The purified lactic acid undergoes polymerisation through two main pathways: direct condensation polymerization or ring-opening polymerization of lactide. The industry prefers the latter method to achieve a higher degree of polymerisation, thereby yielding greater molecular weight and superior mechanical properties [9]. The lactic acid is converted into lactide ($C_6H_8O_4$), a cyclic diester consisting of two lactic acid molecules, which undergoes catalytic ring-opening polymerization (ROP) at approximately 180–220°C under vacuum to remove volatiles, commonly using stannous octoate as a catalyst to improve efficiency and limit racemization (**Figure 3B**) [5, 18].

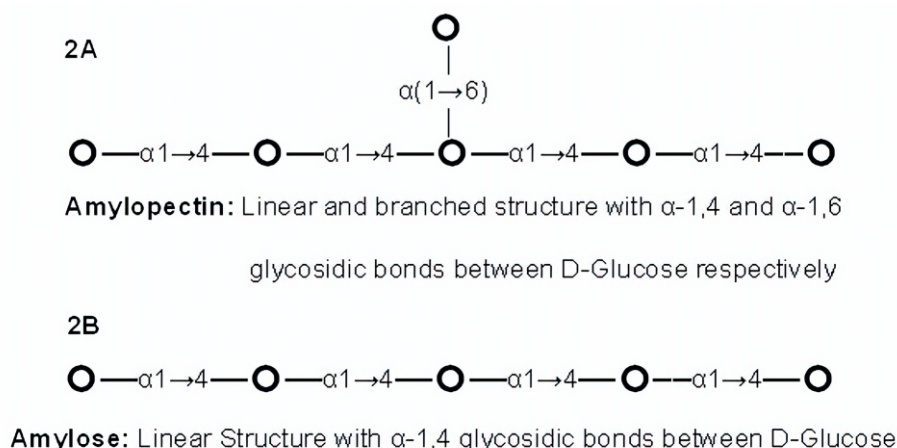


Figure 2. (A, B) Two structurally distinct starch molecules: amylopectin and amylose. Circular units represent glucose molecules linked to glycosidic bond.

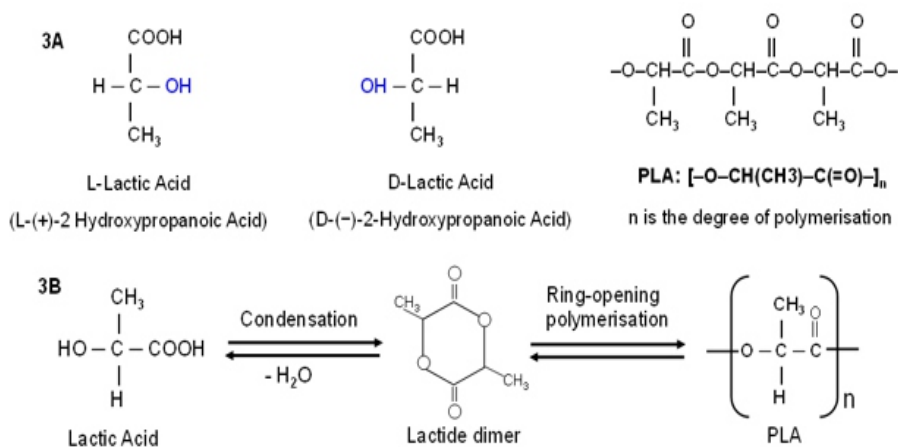


Figure 3. (A, B) Optically active stereoisomers of lactic acid that are condensed into cyclic dimer lactide, further polymerized into high-molecular-weight polymers through ring-opening polymerization.

Synthesis of Starch-Based Polylactic Acid (PLA)

Starch is one of the most abundant, renewable, biodegradable, and cost-effective natural biopolymers, synthesized through photosynthesis and stored as the primary energy reserve in the tissues of plants such as corn, potato, cassava, wheat, and rice. Because of their widespread availability, low cost, and environmentally friendly characteristics, starch has become an attractive feedstock for the production of biodegradable plastics [6]. After surplus starch consumption, the remaining starch-rich biomass residues and agro-industrial wastes can be efficiently utilized as renewable raw materials for the production of polylactic acid (PLA). These biomass wastes are first hydrolyzed into fermentable sugars, which are subsequently converted into lactic acid through microbial fermentation. The lactic acid is then purified and polymerized to produce PLA. Further, it converts into thermoplastic starch (TPS) through addition of plasticizers using the blending techniques under controlled thermo-pressure conditions (**Figure 4**) [20]. The unmodified starch-PLA blends often display weak interfacial adhesion and diminished mechanical strength because of their reconciling the hydrophilic-hydrophobic mismatch [21].

The addition of standard industrial processing techniques such as extrusion, injection molding, and thermoforming improves the structural and functional properties of thermoplastic starch, allowing it to meet the performance of conventional synthetic polymers. Thereby, biodegradable polyester performs excellent mechanical properties, dimensional stability, and product quality, enabling the performance of broad industrial applications [20]. Thus, utilization of starch-derived biomass waste for PLA production not only reduces agricultural waste accumulation but also promotes a circular bioeconomy by converting renewable biomass into high-value biodegradable plastics, thereby reducing dependence on fossil fuel-based polymers and minimizing environmental pollution [22].

Catalytic Hydrolysis of ester bond

The principal functional group in PLA is the ester bonds ($-\text{CO}-\text{O}-$), which are derived from polymerization of carboxylic acid and hydroxyl groups. The ester linkage in PLA is prone to both biotic and abiotic cleavage due to the availability of moisture in the atmosphere. The nucleophilic attack of water molecules cleaves the ester linkage and generates hydroxyl and carboxyl chain ends, resulting in polymer chain scission,

formation of low-molecular-weight oligomers, lactide, and lactic acid (**Figure 5**) [23]. This mechanism is accelerated in the presence of depolymerase enzymes. The esterase-type enzymes like proteinase K and lipase correspond to serine-dependent hydrolase activity. The catalytic serine residue acts as a nucleophile, attacking the carbonyl carbon of the ester bond and forming a transient enzyme-substrate intermediate, resulting in cleavage of the ester linkage and release of oligomeric and monomeric units (**Figure 6**). Similarly, lipase-type PLA-degrading enzymes possess substrate-binding regions that facilitate interaction with the ester linkage appropriately within the active site. These structural and catalytic features enable enzymatic chain scission of PLA and contribute to its subsequent biodegradation [11]. Serine-mediated hydrolytic cleavage by the enzyme has been reported elsewhere, highlighting alteration of enzyme configuration under varying pH conditions [24]. Functional stability of the enzyme corresponds to conformational changes of the active sites of the enzyme at multiple pH values, influencing the rate of hydrolysis. The result was further confirmed by high-performance liquid chromatography indicate intense peaks at a lower retention time in the degraded specimen after 6 days, while the peak at higher retention time disappeared completely after 9 days, indicating the absence of longer PLA chains [25]. Moreover, the catalytic efficiency of enzymes is influenced by pH of medium that changes the conformation of the enzyme and influencing the rate of biodegradation. More degradation was observed in alkaline range and vice versa. Hydrolytic degradation of D, L-lactic acid oligomers under alkaline conditions predominantly occurs through random cleavage of ester bonds along the polymer backbone. The overall degradation rate is governed by several interrelated factors, including the hydrolysis rate constant, amount of water absorbed by the polymer matrix, diffusion coefficient of the resulting chain fragments, and solubility of the degradation products [23]. Thus, the catalytic process of PLLA degradation involves four stages: (a) substrate binding, (b) nucleophilic attack, (c) protonation, and (d) ester hydrolysis [11].

Applications of PLA

Polylactic acid (PLA) composites have emerged as promising biodegradable materials due to their renewable origin, excellent biocompatibility, biodegradability, and low environmental impact. PLA composites have found widespread applications in

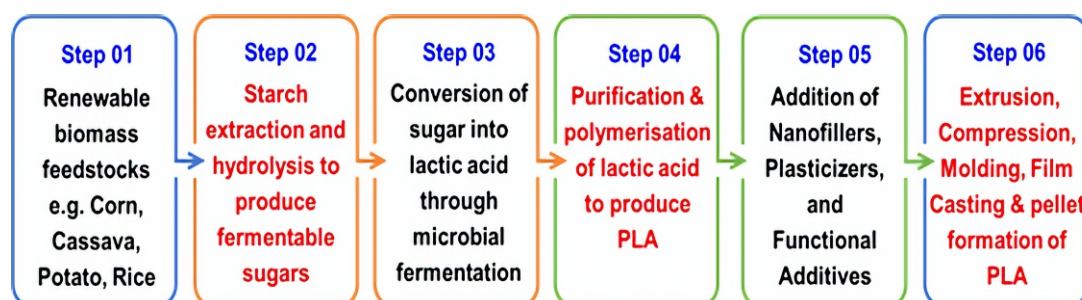


Figure 4. Conversion of renewable biomass into bioplastics.

food packaging, agriculture, biomedical engineering, pharmaceuticals, and tissue regeneration [26]. PLA has been approved for its intended use in food packaging by the Food and Drug Administration (FDA). Ghasemlou et al. [27] explored that PLA derived from fermented plant sugars is commonly utilized in products such as food containers, drink bottles, and disposable cutlery. PLA is gradually moving towards becoming a 'green' food packaging material for goods under the trade name Biota™ [18]. Due to their non-toxicity and bioresorbable nature, PLA composites are extensively investigated for surgical sutures, scaffolds and wound dressings. The resorbable graft is hydrolyzed into lactic acid and metabolized in the form of water and CO₂ without toxic tissue accumulation. PLA polymers are widely employed as biodegradable carriers for controlled and targeted drug delivery. Polylactide membrane (OrthoMesh; DePuy Synthes) shows promising results for treatment of segmental bone defects [28]. A PLA nanoparticle-based drug delivery system was developed in which the active pharmaceutical ingredients were associated with the polymer through ionic

interactions, enabling their incorporation and controlled delivery [29]. Preparation of modified polylactic acid melt-coated urea enables slow and sustainable release of urea in the agricultural sector [30].

CONCLUSION

Starch-based polylactic acid (PLA) composites represent a scientifically robust and environmentally sustainable approach to developing biodegradable alternatives to conventional petroleum-based plastics. Their biodegradability is primarily attributed to the hydrolytic susceptibility of the ester bonds present in the PLA backbone. The incorporation of starch not only reduces the overall production cost but also enhances the hydrophilicity of the composite, facilitating water uptake into the polymer matrix. The water diffusion accelerates the nucleophilic attack of water molecules on the ester linkages, thereby promoting the catalytic hydrolysis of the polymer chains. The starch-based PLA composites could be cost-competitive replacements for conventional synthetic plastics and reduce the dependence on fossil resources.

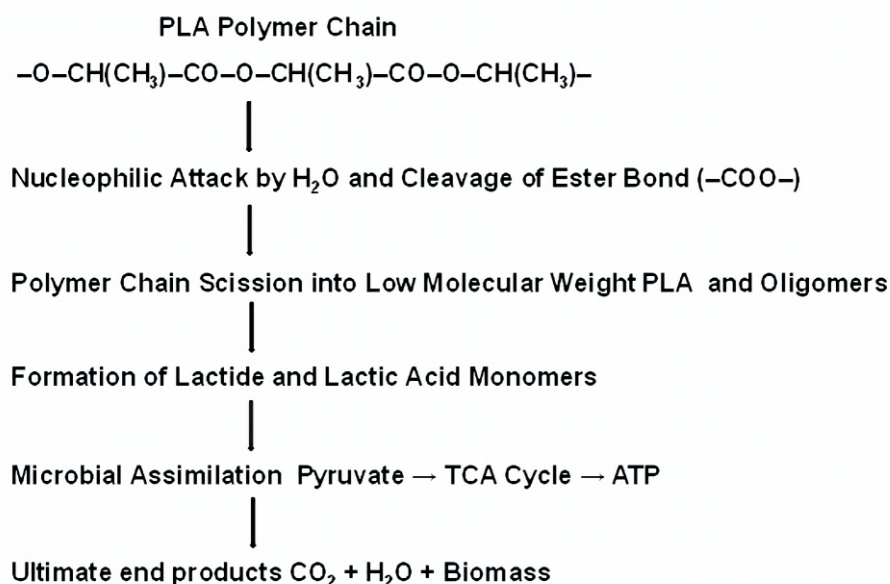


Figure 5. Catalytic process of PLA degradation and microbial assimilation.

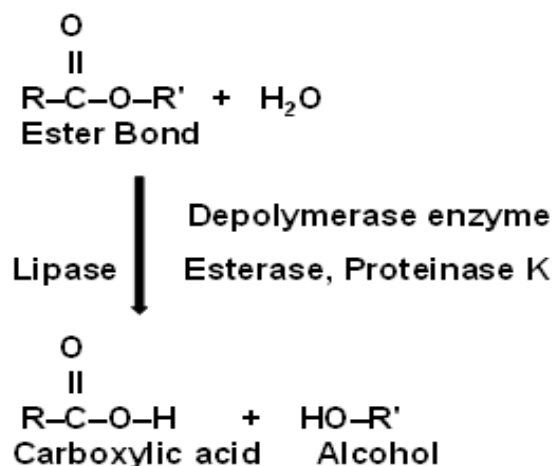


Figure 6. Catalytic hydrolysis of ester linkage in presence of enzymes

CLINICAL SIGNIFICANCE

The clinical significance of this study lies in its potential to bridge the gap between research findings and practical health-care, diagnosis, and treatment outcomes. By highlighting real-care applications. It emphasizes the importance of translating scientific observations into meaningful improvements in patient world relevance, the study contributes to evidence based medical practice and supports informed clinical decision making. Ultimately, the findings aim to enhance patient quality of life, optimize therapeutic strategies, and promote better disease management in clinical settings.

ABBREVIATIONS

PLA: Polylactic Acid

TPS: Thermoplastic Starch

T_g: Glass Transition Temperature

T_m: Melting Temperature

CO₂: Carbon Dioxide

AUTHOR INFORMATION

Dr. Sunil Kumar: Assistant Professor,

<https://orcid.org/0000-0003-4497-9815>

AUTHOR CONTRIBUTIONS

All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteria outlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

ACKNOWLEDGEMENT

The authors sincerely acknowledge the seniors of the Department of Zoology, PMCOE Government (Autonomous) Post Graduate College, Satna, Madhya Pradesh, India. We are grateful to our college for providing the necessary resources to carry out this work. We also extend our heartfelt thanks to our colleagues and technical staff for their valuable assistance during the study.

CONFLICT OF INTEREST

Authors declared that there is no conflict of interest.

FUNDING

None

ETHICAL APPROVAL & CONSENT TO PARTICIPATE

All necessary consent & approval was obtained by authors.

CONSENT FOR PUBLICATION

All necessary consent for publication was obtained by authors.

DATA AVAILABILITY

All data generated and analyzed are included within this research article. The datasets utilized and/or analyzed in this study can be obtained from the corresponding author upon a reasonable request.

USE OF ARTIFICIAL INTELLIGENCE (AI) & LARGE LANGUAGE MODEL (LLM)

The authors confirm that no AI & LLM tools were used in the writing or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

AUTHOR'S NOTE

This article serves as an important educational tool for the scientific community, offering insights that may inspire future research directions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

PUBLISHER'S NOTE

All statements made in this article are the sole responsibility of the authors and do not necessarily reflect the views of the publisher, editors, or reviewers. The journal maintains a neutral stance regarding jurisdictional claims in institutional affiliations presented in published work.

ARCHIVING INFORMATION

- 
- Self-archiving on Google and Amazon Web Services (AWS) cloud servers, as well as on three dedicated in-house servers.
- PKP Preservation Network

MANAGING & PUBLISHING EDITOR

Dr. Pooja Gaur^{1,2}

Ph.D. & National Post-Doctoral Fellow in Medicinal Chemistry

¹CSIR-Central Institute of Medicinal & Aromatic Plants, Lucknow, India

²CSIR-National Botanical Research Institute, Lucknow, India

HANDLING EDITOR

Dr. Dinesh Kumar Verma

Research Assistant Professor, School of Allied Health Sciences, Boise State University, Boise, Indiana, USA

e-mail: dineshkumarverma@boisestate.edu

REFERENCE

1. Dutta D, Sit N. A comprehensive review on types and properties of biopolymers as sustainable bio-based alternatives for packaging. Food Biomacromolecules. 2024;1(2):58-87. <https://doi.org/10.1002/fob2.12019>

2. Baranwal J, Barse B, Fais A, Delogu GL, Kumar A. Biopolymer: a sustainable material for food and medical applications. *Polymers*. 2022;14(5):1-22. <https://doi.org/10.3390/polym14050983>
3. Dallaev R, Papež N, Allaham MM, Holcman V. Bio-degradable polymers: properties, applications, and environmental impact. *Polymers*. 2025;17(14):1-61. <https://doi.org/10.3390/polym17141981>
4. Shrestha S, Snowdon M, Levin DB. Enzymatic degradation of PLA: preferential degradation of the amorphous fraction. *Polymers*. 2025;17(22):1-16. <https://doi.org/10.3390/polym17223042>
5. Jasrotia S, Gupta S, Puttaiahgowda YM, Baborski A. Recent advances in polylactic acid (PLA)-based sustainable food packaging: a comprehensive review. *Appl Food Res*. 2026;6(2):1-11. <https://doi.org/10.1016/j.afres.2026.102111>
6. Zhao Z, Li Y, Xu Y, et al. PLA/starch composites: new applications as control release materials. *Foods*. 2026;15(3):1-25.
7. Lenti M, Parisi D, Raffa P. Starch benzylation in super-critical CO₂: a novel sustainable route towards biodegradable hydrophobic polymeric materials. *Carbohydr Polym Technol Appl*. 2024;7:1-13. <https://doi.org/10.1016/j.carpta.2024.100483>
8. Anitha R, Jayakumar K, Samuel GV, Joice ME, Sneha M, Seeli DS. Synthesis and characterization of starch-based bioplastics: a promising alternative for a sustainable future. *Eng Proc*. 2024;61(1):1-5. <https://doi.org/10.3390/engproc2024061030>
9. Shahar FS, Balakrishnan TS, Hameed Sultan MT. The evolution and environmental prospects of renewable bioplastics: types, production methods, and sustainability. *J Renew Mater*. 2025;13(6):1071-1101. <https://doi.org/10.32604/jrm.2024.02024-0011>
10. Feng P, Jia J, Liu M, Peng S, Zhao Z, Shuai C. Degradation mechanisms and acceleration strategies of poly(lactic acid) scaffold for bone regeneration. *Mater Des*. 2021;210:1-16.
11. Xu Y, Peng W, Poli V, et al. A review of the degradation mechanisms of biodegradable PLA/PBAT films: biological, chemical, and biochemical perspectives. *Energy Environ Sustain*. 2026;1-11. <https://doi.org/10.1016/j.eesus.2026.100071>
12. Chauhan K, Kaur R, Chauhan I. Sustainable bioplastic: a comprehensive review on sources, methods, advantages, and applications of bioplastics. *Polym Plast Technol Mater*. 2024;63(8):913-938. <https://doi.org/10.1080/25740881.2024.2307369>
13. Svihus B, Uhlen AK, Harstad OM. Effect of starch granule structure, associated components and processing on nutritive value of cereal starch: a review. *Anim Feed Sci Technol*. 2005;122(3-4):303-320. <https://doi.org/10.1016/j.anifeedsci.2005.02.025>
14. Cornejo-Ramírez YI, Martínez-Cruz O, Del Toro-Sánchez CL, Wong-Corral FJ, Borboa-Flores J, Cinco-Moroyoqui FJ. The structural characteristics of starches and their functional properties. *CyTA J Food*. 2018;16(1):1003-1017. <https://doi.org/10.1080/19476337.2018.1518343>
15. Khatami MH, Barber W, De Haan HW. Using geometric criteria to study helix-like structures produced in molecular dynamics simulations of single amylose chains in water. *RSC Adv*. 2021;11(20):11992-12002. <https://doi.org/10.1039/d1ra00071c>
16. Gamage A, Liyanapathirana A, Manamperi A, et al. Applications of starch biopolymers for a sustainable modern agriculture. *Sustainability*. 2022;14(10):1-33. <https://doi.org/10.3390/su14106085>
17. Wang Y, Ou X, Al-Maqtari QA, He HJ, Othman N. Evaluation of amylose content: structural and functional properties, analytical techniques, and future prospects. *Food Chem X*. 2024;24:1-24. <https://doi.org/10.1016/j.fochx.2024.101830>
18. Ahmed J, Varshney SK. Polylactides-chemistry, properties and green packaging technology: a review. *Int J Food Prop*. 2011;14(1):37-58. <https://doi.org/10.1080/10942910903125284>
19. Capuana E, Lopresti F, Ceraulo M, La Carrubba V. Poly-L-lactic acid (PLLA)-based biomaterials for regenerative medicine: a review on processing and applications. *Polymers*. 2022;14(6):1-29. <https://doi.org/10.3390/polym14061153>
20. Jayarathna S, Andersson M, Andersson R. Recent advances in starch-based blends and composites for bioplastics applications. *Polymers*. 2022;14(21):1-24. <https://doi.org/10.3390/polym14214557>
21. Yu L, Petinakis E, Dean K, Liu H, Yuan Q. Enhancing compatibilizer function by controlled distribution in hydrophobic polylactic acid/hydrophilic starch blends. *J Appl Polym Sci*. 2011;119(4):2189-2195. <https://doi.org/10.1002/app.32949>
22. Nofar M, Sacligil D, Carreau PJ, Kamal MR, Heuzey MC. Poly(lactic acid) blends: processing, properties and applications. *Int J Biol Macromol*. 2019;125:307-360. <https://doi.org/10.1016/j.ijbiomac.2018.12.002>
23. Teixeira S, Eblagon KM, Miranda F, Pereira MFR, Figueiredo JL. Towards controlled degradation of poly (lactic) acid in technical applications. *C*. 2021; 7(2):1-43. <https://doi.org/10.3390/c7020042>
24. Kumar S, Maiti P. Understanding the controlled biodegradation of polymers using nanoclays. *Polymer*. 2015;76:25-33. <https://doi.org/10.1016/j.polymer.2015.08.044>
25. Kumar S, Singh S, Senapati S, Singh AP, Ray B, Maiti P. Controlled drug release through regulated biodegradation of poly(lactic acid) using inorganic salts. *Int J Biol Macromol*. 2017;104:487-497. <https://doi.org/10.1016/j.ijbiomac.2017.06.033>

26. Kumar S, Maiti P. Controlled biodegradation of polymers using nanoparticles and its application. *RSC Adv*. 2016;6(72):67449-67480. <https://doi.org/10.1039/c6ra08641a>
27. Ghasemlou M, Barrow CJ, Adhikari B. The future of bioplastics in food packaging: an industrial perspective. *Food Packag Shelf Life*. 2024;43:1-12. <https://doi.org/10.1016/j.fpsl.2024.101279>
28. Nahm NJ, Conway JD. Resorbable polylactide membrane for the treatment of segmental bone defects. *Injury*. 2022;53(2):376-380. <https://doi.org/10.1016/j.injury.2021.11.024>
29. Kost B, Basko M, Bednarek M, et al. The influence of the functional end groups on the properties of polylactide-based materials. *Prog Polym Sci*. 2022;130:1-40. <https://doi.org/10.1016/j.progpolymsci.2022.101556>
30. Tao Y, Xia X, Luo Z, et al. Preparation of modified polylactic acid melt coated urea material and its green coating technique. *Prog Org Coat*. 2022;173:1-10. <https://doi.org/10.1016/j.porgcoat.2022.107214>

Cite this article : Sunil Kumar. Catalytic Hydrolysis of Ester Linkage in Starch -derived Polylactic Acid (PLA): A Sustainable Approach toward Bioplastics. *JBMB: Journal of Biology, Medicine & Biomedicine*. 2026;1(1):1-8.