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VALORISATION OF *Solanum tuberosum* AND *Musa paradisiaca* PEEL WASTE INTO FUNCTIONAL BIOPLASTIC

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Partial Fulfilment of the Requirements for the

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in

BIOTECHNOLOGY

by

JYOTISNA

24/MSCBIO/24

Under the supervision of

PROF. JAI GOPAL SHARMA

Department of Biotechnology

Delhi Technological University

To the

Department of Biotechnology

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College og Engineering)

Bawana Road, Delhi- 110042

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DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

Shahbad Daulatpur, Main, Bawana Road, Delhi-42

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I, Jyotisna, 24/MSCBIO/24 of MSc. Biotechnology, hereby certify that the work which is presented in the thesis entitled "**Valorisation of *Solanum tuberosum* and *Musa paradisiaca* peel waste into Functional Bioplastic**" which is submitted by me to the Department of Biotechnology, Delhi Technological University, Delhi in partial fulfilment of the requirements for the award of the degree of Master of Science in the Department of Biotechnology, Delhi Technological University is an authentic record of my own work carried out during the period from January to April under the supervision of Prof. Jai Gopal Sharma.

The matter presented in the thesis has not been submitted by me for the award of any other degree of this or any other Institute. The work has been accepted in SCOPUS conference with the following details.

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Certified that Jyotisna (24/MSCBIO/24) has carried out their search work presented in this thesis "**Valorisation of *Solanum tuberosum* and *Musa paradisiaca* peel waste into Functional Bioplastic**" for the award of Master of Science from Department of Biotechnology, Delhi Technological University, Delhi, under my supervision. The thesis embodies results of original work, and studies are carried out by the student herself and the contents of the thesis do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

Date:

Signature	Signature
Prof. Jai Gopal Sharma	Prof. Yasha Hasija
Supervisor	Head of the Department
Department of Biotechnology	Department of Biotechnology
Delhi Technological University	Delhi Technological University

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JYOTISNA

24/MSCBIO/24

ABSTRACT

The aim of this study is to synthesize high intensity, flexible bioplastic by upcycling commercial chip industry waste peels of *Musa paradisica* and *Solanum tuberosum* as a eco-friendly alternative to petroleum based plastics. The chips-industrial waste, banana peels, and potato peel waste generated in huge amounts, every year and are rich in starch.

Firstly, the peels from raw *Musa paradisica* and *Solanum tuberosum* are chopped and dried, ground into fine powdered form, and dissolved them into an alkaline solution used bio-based binding agents for casting. Allow dried our sheets in oven for overnight at 50-70°C. This experiment used glycerol as a plasticiser to increase its flexibility and Sodium Hydroxide (NaOH) for degrading lignin, hemicellulose, cellulose, and other complex polymers in plant biomass.

Further, addition of Sodium alginate along with glycerol and carboxymethyl cellulose (CMC) as a binding agent enhances the overall flexibility of the material . It showed heat resistance, water resistance and microbial growth resistance properties to a greater extent. The blending and nanostructure is investigated and confirmed by FTIR Spectroscopy.

The study proves that a combination of Raw Banana peels, which are rich in cellulose, hemicellulose, lignin, polyphenol and pectin, leads to high flexibility and elongation. Whereas potato peels, which contain starch like amylose and amylopectin contribute towards high tensile strength and elasticity. This project is support the India's Mission 2047 by promoting the waste valorisation and sustainable materials development under the framework of green technology as it recycling food waste into a valuable product biodegradable bioplastic.

TABLE OF CONTENT

LIST OF FIGURES

LISTS OF ABBREVIATIONS

CMC- Carboxymethyl Cellulose

PHB- polyhydroxybutyrate

FTIR-Fourier-Transform Infrared

NaOH- Sodium hydroxide

HCl- Hydrochloric Acid

RT- Room Temperature

PLA- Poly Lactic Acid

CHAPTER 1
Introduction

Plastic pollution has become a huge environmental problem today, motivating the whole world to attention toward sustainablity and circular bio economy (Vatieri, 2025). Ever since 1950s, petroleum-based plastics have been predominantly, adapted due to their cheap prices and longivity. As they are non-biodegradable, there is a huge demand for greener and cleaner alternatives (Pandey, 2026). The idea of bioplastics came into picture in the early 1920s, when French scientist Maurice Lemoigne discovered polyhydroxybutyrate (PHB) from bacterial fermentation but bioplastic breakthrough innovation w ere not considered much, due to boom of cheap petrochemical polymers.

In recent years, the definition of sustainable materials has shift from just bio-degradability to entire life cycle of the feedstock, to ensure that the production of bioplastics does not compete with food security or farmland (Kakadellis & Harris, 2020). Modern research is contributing in converting use of agricultural and food processing by-products, industrial waste into valuable polymeric matrices (Vatieri, 2025). Structural polysaccharides can be extracted from tuber and fruit processing industries (Caliskan, 2025).

Large amounts of organic waste is produces from commercial chip and snack food industry, which usual kept in landfills. This thesis focuses on the valorisation of commercial chip industry waste, specifically from *Solanum tuberosum* and *Musa paradisiaca* peels, and make a highly functional, eco-friendly biofilm as an end product, which can be used as bioplastic. Amylose-rich (starch) from Potato peels (Rani, 2026), and lignocellulosic fibres and flours from banana peels, can be readily cast into structural films (Alcivar-Gavilanes et al., 2022). The blending of these two waste products together created a highly functional biofilm In which the banana peels contributed toward elastic flexibility , potato peels increase the overall tensile strength of biofilm .

The refinement of these bio-composites is done, the raw peels are chopped and dried, then converted into powder and treated with alkaline Sodium hydroxide (NaOH), which degrade the rigid lignin and cellulose components and washed with distilled water to remove extra NaOH. The extracted polymers are then plasticized with glycerol and stabilised by carboxymethyl cellulose (CMC) to retain structural integrity and flexibility. The resulting material oven dried between 50–70°C followed by casting in order to get a dark unbleached biofilm material. Which can be used as a bioplastic as it has resistance toward heat, water and microbial attack. The molecular structure of the bioplastic was confirmed by Fourier-Transform Infrared (FTIR) spectroscopy. The present research is a direct linked with sustainable growth and contributes to India under Mission 2047 by promoting waste valorization and green material development.

CHAPTER 2

Literature Review

2.1 Bioplastic

Today's modern industrial world is built upon Petrochemical synthetics. For nearly a century, we have been stuck on that choice between microplastics, absolute environmental permanence, and finite fossil fuels (Kakadellis & Harris, 2020). These biomass-derived, biodegradable bioplastics work around the circular economy (Vatieri, 2025).

Maurice Lemoigne isolated polyhydroxybutyrate (PHB) from bacterial lipids for the very first time in 1926. But the market is more inclined toward cheap oil-based polymers boom the market and escaped bio-based research for fifty years due to their expensive downstream steps . Even now, A few pure microbial variants like polyhydroxyalkanoates still face a downfall because expensive extraction.(Danial et al., 2021).

So, now researchers focus entirely on low-impact, zero-burden carbon (Pandey, 2026). This means intercepting waste streams from manufacturing lines rather than burning up fertile farmland meant for feeding people (Kakadellis & Harris, 2020). It's a massive shift. Yet, global checks on single-use packaging will force rapid commercial scaling (Rodriguez et al., 2024).

2.2 Sources of Bioplastics

Feedstocks can be classified into three generations based on Origin. First-generation sources: They are straight from food supplies like corn, cane, and cassava. They are not good for long-term sustainability as raising up food prices and taking arable land.

Second-generation processing shifts to non-food biomass, agricultural leftovers, and municipal food waste (Vatieri, 2025). This category feeds on materials like tuber skins, fruit epicarp discards, and processing effluents waste, and agricultural waste (Caliskan, 2025). It avoids the food-versus-fuel trap completely and utilises tons of organic wastes (Ebrahimian et al., 2022).Our work focuses strictly on second-generation materials. The raw Starch rich chips industry, discarded peels of potato and banana chip production are processed further in order to synthesise a biofilm out of it.

Third-generation lines bypass land entirely by cultivating algae and specialized wastewater microbes.

2.3 Physical, Mechanical and Thermal Characteristics of Bioplastics

A bioplastic synthesis is completely based upon its raw material thresholds. Whereas the performance depends entirely on physical, mechanical, thermal, and barrier properties.

2.3.1 Mechanical Properties

Mechanical performance relies on two parameters: tensile strength, which is the maximum stretch a material tolerates, and elongation at rupture, a measure of raw toughness before failure. If only starch rich material used it make the matres is brittle and fails under tension.

Because of this, cross-linking agents, plasticisers, and structural fibres are added to it to make it viable (Rani, 2026).

2.3.2 Hydrophilicity or Hydrophobicity of Starch-Based Bioplastics

Starches and celluloses are packed with free hydroxyl (-OH) groups. Consequently, raw, unmodified bioplastics love water. This hydrophilic nature means they absorb moisture rapidly and swell up in wet conditions (Shafqat et al., 2021). But this hydrophilic nature can be neutralised by blending in hydrophobic bio-binders and mineral fillers.

2.3.3 Biodegradability

Petroleum plastics are highly non perishable. Instead bio-based polymers are biodegradable in nature, microbes break them down naturally into carbon dioxide, water, and stable biomass (Danial et al., 2021). The degradation clock depends mostly on the polymer's internal crystallinity and the microbial density of the surrounding soil.

2.3.4 Chemical Structure Confirmation

Fourier-Transform Infrared (FTIR) spectroscopy verifies the chemical structure. We use this technique to check the carbohydrate retention, trace cross-linking, and monitor shifts in hydrogen bonding (Rani, 2026).

2.4 Properties of Banana Peel

Banana peel waste specifically from Musa paradisiaca, contains massive reserves of cellulose, hemicellulose, pectin, and starch (Sultan & Johari, 2021). Quality of Resulting product depend on processing steps . The dried peels into a coarse, fibrous flour (Alcivar-Gavilanes et al., 2022) , boil and blend them into a thick, gelatinized paste (Al-Qadri, 2025). Lignocellulosic fibres are major component of the banana , their dense fibre network yields high mechanical flexibility and excellent elongation characteristics. Adding the alkali solutions like sodium hydroxide (NaOH) strips away the outer defences and breaks down the rigid lignin and hemicellulose seals, making the raw cellulose fibres for film casting (Kossalbayev et al., 2025).

2.5 Properties of Potato Peel

Industrial chip manufacturing lines dump potato peel waste, Solanum tuberosum, in landfills by tons. It's a massive processing byproduct, but it serves as a cheap, incredibly rich reservoir of high-grade starch (Ebrahimian et al., 2022).

Starch Extraction Process: Isolating starch from industrial potato peel waste requires a modified wet sedimentation process. It yields a highly consistent, pure product (Rani, 2026). This recovered starch contains 21.2% amylose and 78.8% amylopectin, which creates a highly crystalline, semi-continuous matrix (Rani, 2026).

Structural Functions: The tightly packed amylose chains give pure potato peel starch excellent tensile strength and rigidity. So it molds easily into firm, structured shapes.

Performance Limitations: But strength isn't everything. Raw potato starch is brittle a. It suffers from high water vapor permeability and rots almost immediately in soil. In fact, it often loses over 86% of its initial weight in days because soil bacteria devour the exposed starch particles (Jinnah et al., 2022; Al-Qadri, 2025).

2.6 Factors Influencing the Production of Bioplastics

2.6.1 Concentration of Plasticizer and its Type

Raw starch and cellulose molecules are together in a rigid grip by internal hydrogen bonds. These intractions are breaked by introducing small, hydrophilic plasticizer molecules between the polymer chains forces them apart (Othman et al., 2021). Polyol plasticizers like liquid glycerol carry multiple hydroxyl groups which easily bind with starch and let the molecular chains slide past one another (Shafqat et al., 2021).

Ye too much glycerol ruins the material. High concentrations of Glycerol make rapid water absorption and ruins the material (Shafqat et al., 2021). whereas If solid polyols like sorbitol are added, the resulting film gains structural strength but drops significantly in flexibility (Rani, 2026).

2.6.2 Bio-Binder Concentration and Efficiency

To keep the matrix uniform and stable, it is important to add structural bio-binders like sodium alginate or carboxymethyl cellulose (CMC). These binders forge cross-linked networks between the potato starch particles and banana fibers and the resulting composite film ends up flexible, smooth, and highly resistant to moisture transmission.

2.6.3 Bio-Pre-treatment Conditions (Alkali Digestion)

The mild alkali like Sodium hydroxide treatment is important to break apart those stiff lignocellulosic segments (Kossalbayev et al., 2025). The process strips away non-cellulosic clutter like lignin, freeing up the structural polymers so they cast evenly. But it is important to keep it in right concentration and rinse the properly with distilled water twice or thrice to remove it nicely after degradgation is complete. Excessive alkalinity triggers a fast depolymerization of the carbohydrate backbone, destroying the tensile strength of final material.

2.6.4 Temperature and Drying Cycle Profiles

Drying temperatures is important to make biopolymer matrix gelatinizes and sheds water. Keeping oven temperature steadily between 50 and 70°C ensures constant evaporation. It prevent thermal breakdown and structural cracking before they start. Straying outside this window ruins the batch, causing warped films or trapping excess moisture inside the polymer network.

2.6.5 Feedstock Proportions

Quality and behaviour of the resulting Product is depends upon the ratio of banana peel fibres and potato peel starch. By blending this specific hybrid setup, banana peels provide elasticity and potato starch provide rigidity and raw tensile strength. The combination of these waste streams makes a balanced bio-composite film with high thermal, hydrological, and biological shelf life.

CHAPTER 3

Material required and Methodology

3.1 Experimental apparatus:

- laboratory blender or motor and pastel
- beaker 100mL and 250mL
- Hot plate with a magnetic stirrer or manual glass steering rod.
- Analytical balance.
- PH meter or indicator strip .
- thermometer
- Non-stick casting surface (silicon mat Teflon sheet or glass Petri dishes)
- laboratory drying oven

3.2 Reagent and raw materials;

- Biopolymer matrix : 15.0g banana peels and 5.0g potato peels.
- Hydrolysing Agent: 1.8 mL Hydrochloric Acid HCl (0.1 M -0.5 M)
- Neutralizing Agent: 1.8 mL Sodium Hydroxide NaOH 0.1 M 20.5 M
- plasticiser 1.2 ML glycerol
- Reinforcing polymer : 1.8 ML carboxymethyl cellulose solution
- Solvent distilled water

3.3 Sample Extraction and Preparation

Figure 3.1 Dried *Solanum tuberosum* (Potato) Peels.

Figure 3.2 Powder of dried *Musa paradisiaca* (banana) peels.

Figure 3.3 Powder of Dried *Solanum tuberosum* (Potato) peels

Figure 3.4 The picture shows a beaker containing a powdered mixture of dried potato and banana peels dissolved in water.

Figure 3.5 After heating, mixture of dried potato and banana peels dissolved in water.

Pre-treatment:

- **Washing:** Wash the raw banana and potato peels thoroughly using distilled water. This basic step strips away residual soil, field pesticides, and external surface muck.
- **Cutting:** Cut the clean peels into small, uniform pieces of roughly 5 mm. It's a simple surface- area game. Splitting the material into smaller chunks maximizes exposure for the subsequent heat treatment.
- **Heating:** Dump the chopped pieces into a beaker. Pour in just enough distilled water to submerge the material entirely. Now, boil the mixture at 100°C for 20 to 30 minutes. But don't rush it. Keep heating until the structural tissue breaks down completely, leaving the peels soft and pliable.
- **Decantation:** Carefully pour off the excess water from the beaker.
- **Mechanical Extraction:** Transfer the softened tissue into a blender or a standard mortar and pestle, slightly in a heterogenous.

3.4 Steps:

Figure 3.6: Illustrates the methodology of the synthesis of bioplastic from *Solanum tuberosum* and *Musa paradisiaca* peel.

1. Take of banana peels and potato peels in 2 separate beakers.
2. Boil these beakers of distilled water for around 30 minutes, until they completely soften, then decant the water.
3. Then use a laboratory blender or mortar and a pestle to grind or soften the peels into a completely smoothen uniform paste.
3. Weigh the15gm of Green banana peels paste and 5gm of Potato peel paste in a beaker and mix them . Add 1.8 mL of HCL to the it. Stir thoroughly with glass road for one to two minutes this acid disrupt the branches in structures. Then wash it with water 2-3 times.
4. Add 1.2 mL of glycerol and 1.8 mL of Carboxymethyl cellulose (CMC) or Sodium Alginate to the mixture stir vigorously until the mixture looks completely homogeneous.
5. Then check the PH and if required, set it at 7.0 with NaOH, and then wash the mixture with distilled water.
6. Place the beaker on a hot plate heat the mixture roughly from 85 to 95 degree while stirring constantly watch the texture change it will transform from brainy paste into thick, uniform semi-translucent glue-like mixture this is usually take 10 to 15 minutes.
7. While the mixture is still hot, pour it into a nonstick surface like a glass Petri dish. Use the spatula to spread as thin as evenly possible then dry it in a laboratory at 55ºC for about four to six hour completely until it becomes solid.
8. Remove the biofilm from the nonstick surface at room temperature (RT).

3.5 Preliminary screenings

These quick baseline checks evaluate the quality of the biofilm .

- Visual inspection and texture scan is done by holding the dried film up to a light source check the uniformity, bubbles or cracks. It should also feel flexible and smooth.
- Thickness is consistently checked by digital micrometre or capillary to measure the thickness of film across different points and then check the average to ensure the uniform.

CHAPTER 4

Results and discussion

Figure 4.1 Bioplastic synthesised from powder of Green banana peels and Potato Peel

4.1 Morphology and Physical Properties

In this research, At the end an Opaque, dark-coloured biofilm matrix. The dark colour of this matrix is due to the presence of the enzymatic browning products like polyphenols and tannins that are native to the epicarp of the raw *Musa paradisiaca* (Alcivar-Gavilanes et al., 2022) and *Solanum tuberosum*.

The unbleached biofilm matrix carrying highly uniform structural integrity, slight textured surface, and high macroscopic continuity. The Prime reason leading to such properties is bioplastic matrix is the structural integration of the bio-based binders with the CMC, which inhibit the phase separation between the hydrophobic constituents banana fibres, and hydrophilic parts of potato starches.

They provided microstructural advantages where the banana peel cellulose fibrils contributed toward the reinforcing network and the potato starch served as the continuous filling matrix (Kumar & Nair, 2023).

4.2 Chemical Structure Verification (FTIR Analysis)

Molecular interaction, degree of cross-linking, and functionality of the composite network (my research) are determined by Fourier-Transform Infrared Spectroscopy (FTIR). Which revealed successful blending and no phase segregation between the components, thus leading to the development of an effective hybrid structure (my research).The wide and high-intensity band appearing at the 3200 { cm}^{-1} to 3450 { cm}^{-1} range depicts the presence of -OH stretching vibrations. The results also show a strong hydrogen bonding between the potato starch amylose chain, banana cellulose, glycerol, and the CMC binder network (Rani, 2026; my research). A clear peak detected at 2920 { cm}^{-1} suggests that there were C-H stretching vibrations, which are indicative of the aliphatic chains of the plasticizer and carbohydrates (Shafqat et al., 2021).Additionally, the intense peaks observed at the range of 1600 { cm}^{-1} and 1650 { cm}^{-1} can be attributed to the carbonyl (C=O) stretching vibrations from the carboxylate groups of the CMC and sodium alginate binder components (my research). The efficiency of alkaline digestion method involving Sodium hydroxide (NaOH) was efficient in breaking is Proved by significant C-O-C ether linkage stretching vibration at the fingerprint region of 1000{ cm}^{-1} and 1150{ cm}^{-1

4.3 Mechanical Properties

The mechanical properties of the biofilm is depend greatly on the ratio and composition of the industrial waste materials used. If only unmodified potato starch are taken, then films usually shows a high tensile strength, which can easily break due to brittleness and low elongation strain (Jinnah et al., 2022). On the other hand, the raw biofilm made of banana peels solely, shows high flexibility but insufficient stiffness and mechanical resistance (Al-Qadri, 2025).

The mechanical synergy between these components in the developed biofilm is quite significant as Banana peels have played an important role in eliminating its brittle fracture as opposed to solely tuber are films are used in making the material, it will be more flexible and capable of elongation. Whereas, the role of potato peels are contributed toward increasing the tensile strength and rigidity of the film, enabling it to withstand a greater mechanical stress. So to get appropriate results it is important to make optimal ratio of amylose and amylopectin in the potato-based material (Rani, 2026), as well as the high aspect ratio of the cellulose microfibrils obtained from banana peels (Sultan & Johari, 2021). Additionally, the use of Carboxymethyl cellulose (CMC) as a binding agent resulted in creating a network of that cross-links that make the polymer stress bearable.

4.4 Environmental and Barrier Resistances

Thermal Resistance: The biofilm spread is allowed to Continuous oven-drying at around 50°C to 70°C temperature allowed for constant drying throughout, ensuring the absence of localized heating and thus thermal warping or structural cracking of the resulting films. The obtained unbleached bioplastic shows thermal resistance. Enhanced thermal resistance results from the formation of strong hydrogen bonds between cellulose and starch chains, thus necessitating greater thermal energy to disrupt the polymers' matrix (Othman et al., 2021). When a flame test is also performed, the bioplastic material is converted into ash.

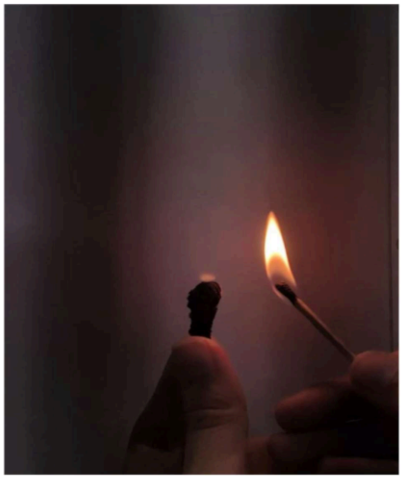

Figure 4.2 Flame Test

4.5 Water Resistance

Naturally, Starch-based materials owing to high amounts of hydroxyl groups in their chemical composition. So they are highly water-soluble and have high moisture absorption properties (Shafqat et al., 2021). To make the bioplastic resistant to water in this study. The steps were followed:

Firstly, pre-treatment with sodium hydroxide made cellulose fractions more crystallised, decreasing the number of potential binding sites to water.

Secondly, bio-based binders like CMC make dense surface layers, which serve as a barrier to moisture vapour permeance.

4.6 Resistance to Microorganisms and Decomposition: The resulted biofilm is resisted to microbial decomposition when used by having strong microbial resistance in standard storage conditions, while being totally degradable when buried in the soil. Pure potato peel starch, however, decomposed quickly if kept inside the soil, resulting in losses of more than 85% within very brief spans because of rapid enzymatic decomposition via amylase activity (Al-Qadri, 2025); the appropriate addition of banana lignocellulose fiber helped in increasing the shelf life of the product. The high density and unbleached nature of the polymeric compound also play a vital role in preventing early microbial growth (Kakadellis & Harris, 2020; my research).

4.7 Sustainability Framework and Relevance to Industry

The utilization of chips industry generated, *Solanum tuberosum* and *Musa paradisiaca* peel waste in the production of extremely resilient bioplastic materials. It aligns with the concepts of the circular bioeconomy of the zero-carbon footprint framework (Vatieri, 2025). Using peels of *Solanum tuberosum* and *Musa paradisiaca* as the primary raw material, the process described here adheres perfectly with a "low-impact, zero-burden" system that does not create food scarcity at all nor waste agricultural land resources (Pandey, 2026; Ebrahimian et al., 2022).

From an economic perspective, the green manufacturing process provides a means for supporting Mission 2047 goals in India through nurturing such domestic innovations in material science, not just reducing waste plastic generation but also moving towards a complete elimination of petroleum-based disposable packaging (Rodriguez et al., 2024; my research).

CHAPTER: 5

CONCLUSION

Synthesising bioplastics from a commercial dual-waste blend of Solanum tuberosum and Musa paradisiaca provides a functional, scientifically valid route to sustainable material alternatives. This framework shifts away from simple biomass matrices toward multi-component hybrid bio-composites. It exploits the unique structural benefits of utilizing the commercial chips industry peel waste of Raw Banana Peels and Potato Peels. The potato peel having high amount of Starch matrix, ideal for film formation. Banana peels contribute as lignocellulosic fibres that reinforce the polymer network.

So, this blend hits two environmental benefits at once. It strips organic waste out of the food industry supply chain while cutting reliance on conventional animal leather and petroleum plastics.

From a processing standpoint, careful biochemical optimisation determines whether a bio-based film can outgrow its native physical limitations. Raw starch is brittle and unstable due to rigid internal hydrogen bonds. So it is very important to introduce a plasticiser like glycerol breaks these bonds, turning the matrix into a pliable, workable polymeric film.

Tight process controls dictate the final material thresholds. The thermal gelatinisation should be controlled and hold the neutralisation stage strictly between pH 6.8 and 7.3 to secure thermal stability, mechanical stretch, and a consistent surface finish. Carboxymethyl Cellulose (CMC) fix this network together. It act as a structural binder that anchors the distinct biopolymer fragments into a durable, uniform sheet, which can replace the petroleum-based plastic.

Waste-derived bioplastics are a core component of a functional circular bioeconomy. Repurposing the peel and residues of local tuber crops converts low-value food processing byproducts into high-value alternative textiles. This model mitigates the environmental impact of methane-heavy organic waste disposal. Yet, it can also be used to make bioleather, a circular solution to replace hazardous, chromium-laden leather tanning methods. Producing these dual-waste sheets bridges the gap between lab-scale polymer chemistry and Green manufacturing.

Scaling this banana and potato-peel formulation into a commercially viable bio-leather alternative requires immediate secondary research. Future work must focus on advanced structural reinforcement to mimic the complex, multi-layered fibrous matrix of genuine animal hides. CMC provides the initial baseline support. But incorporating tougher lignocellulosic fibre networks from alternative agricultural residues, specifically sugarcane bagasse, hemp, or pineapple leaves, will significantly enhance tear resistance. Investigating natural plant tannins as cross-linking agents offers a clean biomimetic approach to mimic traditional leather stability without the heavy-metal contamination of chromium processing.

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1) **“International Conference on Nano-materials & Green Technology for Viksit Bharat Mission 2047”**


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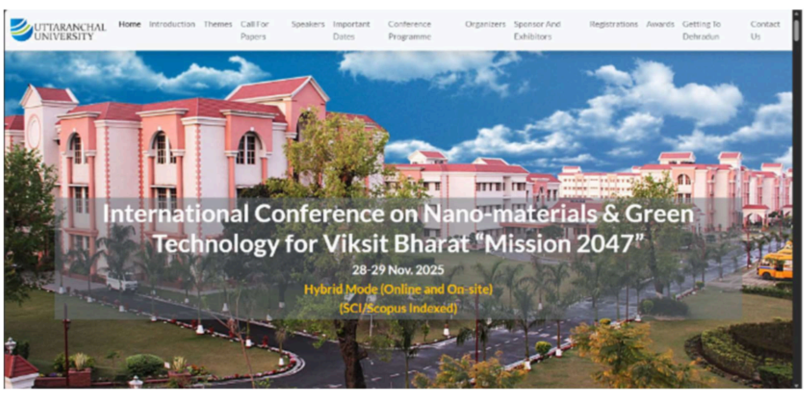

Green Conversion of Chips industry waste into bioplastic: A step toward Green Technology for Viksit Bharat.

Jyotisna, Akanksha
Delhi Technological University, DTU
jyotisna2004@gmail.com

ABSTRACT

The aim of this study is to produce bioplastics from Chips industry waste, as a eco- friendly alternative to petroleum based plastics. The chips-industrial waste, banana peels, and potato peel waste generated in huge amounts. Firstly, we dried raw banana peels and potato peels, grinded them into fine powdered form, and dissolved them into an alkaline solution. And used bio-based binding agents for casting. And we dried our sheets in oven for overnight at 50-70°C. This experiment used glycerol as a plasticizer to increase its flexibility and Sodium Hydroxide (NaOH) for degrading lignin, hemicellulose, micellulose, and other complex polymers in plant biomass. Further, the results can be enhanced by adding sodium alginate along with glycerol and carboxymethyl cellulose (CMC) as a binding agent to enhance the flexibility. Bioplastics were black in color (without adding bleaching agents like H_2O_2 or NaOCl) and showed heat resistance, water resistance and microbial growth resistance properties to a greater extent. Further the blending and nanostructure is investigated and confirmed by FTIR Spectroscopy. The study proves that a combination of Raw Banana peels, which are abundant in cellulose, hemicellulose, lignin, polyphenol and pectin leads to high flexibility and elongation. Whereas potato peels, which contain starch like amylose and amylopectin contribute to high tensile strength and elasticity. This project is support the India's Mission 2047 by promoting the waste valorization and sustainable materials development under the framework of green technology as it recycling food waste into a valuable product —biodegradable bioplastic.

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222. TOWARDS SUSTAINABILITY: INNOVATIONS AND ENVIRONMENTAL IMPACTS IN LEATHER MANUFACTURING FOR THE TEXTILE INDUSTRY

Jyotisna , Akanksha Kushwaha, Jai Gopal Sharma
Department of Biotechnology,
Delhi Technological University,
Delhi, India,

The textile industry can utilise all kinds of resources available in nature, from animals to plants and to microbes. But evolution of textile materials has intensely hampered nature as well. From very ancient times people are attracted by animal leather and fur for their aesthetics and practical qualities, but in recent years, these materials have become a subject of debate due to increasing awareness of ethical rights and concerns surrounding animal welfare and environmental impact. If we talk about eco-friendly, cruelty-free sustainable fashion then plant-based leather, waste-based leather offers stylish alternatives to traditional leather. This review article discusses about the real-world applications of scalability, cost analysis of the products. This also talks about how sustainable approach of making bio-leathers connects to carbon neutrality, SDG12, and SDG13. This article compares productivity, processing, new approaches and environmental impact related to all types of leathers. This article also deals with life cycle assessment (LCA) of leather industry.

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Official Email: arvind@shooliniuniversity.com
Personal Email: sharmaarvind0786@hotmail.com, sharmaarvind00786@gmail.com
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- Paper Submission Due: February 28, 2026
- Decision: March 1, 2026 (onwards)
- Final/Camera-Ready Submission Due: May 20, 2026
- Registration (Open): March 1, 2026
- Registration (Close): June 10, 2026
- Conference Dates: June 22-23, 2026

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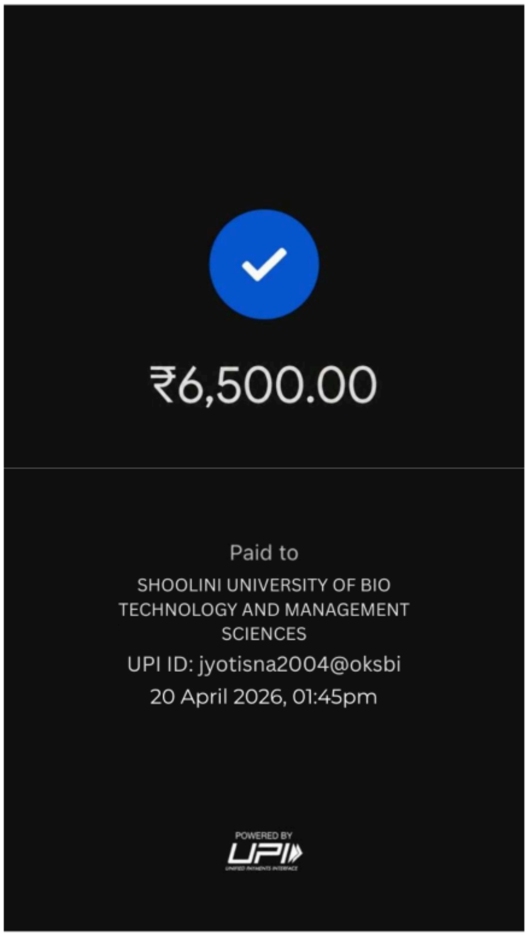
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