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REVIEW OPEN ACCESS

Corn Husk Leather as an Innovative Alternative to Plastic Based PVC and PU Leather in Fashion

Sampada Patil, Tonu Pasare, Pooja Choudhary and Shital Thorat
Department of Fashion Technology, Dr. D. Y. Patil Arts, Commerce & Science College, Pimpri, Pune, Maharashtra,India
*Correspondence for materials should be addressed to SP (email: psampada2799@gmail.com)

Abstract
The fashion industry's increasing reliance on plastic-based synthetic leathers such as polyvinyl chloride (PVC) and polyurethane (PU) has caused serious environmental problems, including microplastic pollution, high carbon emissions and poor biodegradability. In response to these challenges, plant-based materials and waste are gaining increasing attention as susta1inable alternatives. Among these, cornhusk leather, which is obtained from corn agricultural waste, is expected to be an environmentally friendly fashion material. This study examines the potential of corn leather as an environmentally friendly alternative to petroleum-based artificial leather by investigating its material properties, manufacturing process, environmental impact, and suitability for fashion products. This study focuses on the extraction and processing of corn husk fibres with optimized alkaline and bleaching treatments to improve cellulose content and fibre strength. The processed fibres are characterized by a high cellulose content of up to 76%, which contributes to good mechanical properties such as tensile strength and flexibility. These fibres are combined with a bio-based binder and a fibrous support to form a leather-like composite material. The obtained corn husk leather exhibits promising functional properties such as flexibility, breathability, and durability, making it suitable for use in shoes, accessories, and other fashion products. When compared to traditional PU and PVC based imitation leathers, corn husk leather has a substantially lower carbon footprint and resource usage, according to a comparative environmental study. The product aids waste valorisation and adheres to circular economy principles by using agricultural trash. Early acceptance of corn husk leather is indicated by case studies from up-and-coming fashion firms, especially in the vegan and sustainable fashion sectors. Although the results show that corn husk leather is a novel and ecologically friendly material, a number of obstacles still prevent it from being widely used. Long-term durability, consistency in coating formulations, and large-scale production are issues that require more research and technological development. Improving performance and guaranteeing commercial viability will require addressing these issues through ongoing research and material development. All things considered, maize husk leather exhibits great promise as a sustainable substitute for faux leather made of plastic and can significantly contribute to the fashion industry's circular and environmentally responsible practices.

Keywords: Biobased materials; Biodegradable textiles; Corn husk leather; Circular economy; Sustainable fashion; Plastic alternatives

Introduction

The overwhelming reliance of the global fashion industry on resource-intensive materials, especially animal leather and plastic-based imitation leathers like polyurethane (PU) and polyvinyl chloride (PVC), has drawn increasing criticism. Despite being marketed as a cruelty-free substitute, imitation leather presents significant environmental problems due to its petrochemical origin, microplastic shedding, harmful chemicals, and resistance to degradation. Large amounts of agricultural residues, such as corn husks, are produced every year and are frequently burned, dumped in landfills, or allowed to degrade, which adds to trash buildup and greenhouse gas emissions. In this regard, corn husk leather, which is made from corn husk stalks, and cobs is a viable option to transform underutilized agricultural waste into materials that are ready for fashion.

Abundant, annually renewable, and rich in cellulose, corn husk fibres are highly suitable for engineering into textile and composite materials. Recent breakthroughs in fibre extraction, micro-fibrillation, and bio-based coating formulations have allowed for the transformation of corn husk fibres into leather-like sheets. These sheets possess adequate strength, flexibility, and surface quality for applications in footwear, bags, and fashion accessories,

positioning corn husk leather as a viable option within the expanding market of vegan and bio-based leather alternatives.

Due to its affordability, adaptability, and resemblance to animal leather, plastic-based faux leather has long dominated the fashion industry. However, research into sustainable material alternatives has accelerated due to growing awareness of its negative effects on the environment and human health, including high carbon footprints and persistent microplastics. Processed corn husk fibres are combined with natural binders to create corn husk leather, a bio-composite material with a flexible and long-lasting structure. In contrast to traditional PU and PVC faux leathers, this study evaluates the technical feasibility of corn husk leather and explores its potential contribution to the advancement of sustainable and circular fashion practices.

Objectives

- To compare corn husk leather's mechanical, physical, and visual qualities to those of PVC / PU leather.
- To assess how corn husk leather and plastic-based imitation leather affect the environment, with an emphasis on waste, emissions, and resource consumption.
- To determine the present and future uses of corn husk leather in clothing, accessories, and footwear.
- To make suggestions for upcoming studies and industry implementation.

Literature Review

An Experimental Study on Agro-Waste Corn Husk and Its Application in Textiles

The feasibility of maize husk fibre as a sustainable substitute in the textile sector is examined by Hemlata and Zala (2025). The paper investigates two extraction techniques using a comparative experimental approach: a purely chemical procedure and water retting in conjunction with chemical treatment. Although their inherently abrasive texture renders them unsuitable for direct garment application, the authors discover that water retting yields better, stronger fibers. In order to get around this, the study investigates making needle-punched non-woven fabrics by combining corn husk with viscose in different ratios (70:30, 30:70, and 100%). The optimum thermal insulation qualities are found in a 70:30 corn-husk-to-viscose combination. The study comes to the conclusion that maize husk fibers have substantial eco-friendly potential for useful product creation in a circular economy, despite ongoing technological obstacles.

Knowledge of Leather Alternatives: An Exploratory Study

Ashley (2021) discusses the lack of public awareness of leather and its sustainable substitutes, particularly "Vegan Leather" and "Eco-Friendly Leather". According to a questionnaire-based survey of fashion design students, there is a notable dearth of knowledge about the environmental effects of other alternatives and the procedures involved in the production of leather. One important conclusion is that many participants were unable to discern between vegan leathers made of plastic and really sustainable plant-based substitutes, frequently as a result of marketing rhetoric that is identical. In order to assist consumers in making knowledgeable, sustainable purchase decisions, the study emphasizes the urgent need for improved education within fashion programs and more open communication from producers.

Quality Improvement of Corn Husk as Raw Material for Textile Products

In order to achieve textile quality standards, Hasdiana and Ayuddin (2017) investigate the technical processing of maize husk waste in Gorontalo, Indonesia. In order to identify chemical structures and then process the husk through coloring, sorting, and weaving, the researchers used a two-stage experimental approach. Because of its flexibility, cleanliness, and light color, the study finds that the middle layer of the husk is the best raw material. Results from post-processing demonstrate a significant improvement in color brightness and fiber strength, demonstrating that treated maize husk may be successfully woven into textile products. This study emphasizes how agricultural waste can support regional economic development while offering a sustainable source of fiber.

Valorization of Corn Husk Waste for Textile Applications

A thorough technical investigation of the extraction, processing, and natural dyeing of corn husk fibers is given by Patil and Athalye (2023). The study successfully raises the cellulose content to 79% and greatly enhances water absorption by using water retting, scouring, and bleaching with hydrogen peroxide. This work's main contribution is the optimization of a natural dyeing method that uses Sappan wood to achieve great color strength and fastness without the use of metallic mordants. The authors show that maize husk fiber is a technically feasible, high-performance biomass for sustainable textile applications by using response surface methods and spectroscopic characterisation, opening the door for its industrial usage.

Waste Becomes Economic Value: Corn Leather Craft Training

Putri et al. (2025) concentrate on turning maize husk waste into marketable handicrafts in order to empower young mothers in West Sumatra on a socioeconomic level. This community service program employs a methodical approach that includes training, mentoring, and needs assessment in digital marketing and production. According

to the study, participants' technical proficiency and motivation significantly increased, leading to the production of goods like tissue boxes and ornamental flowers. Local agricultural waste can be successfully "valorized" to improve household incomes and lower environmental pollution through community-driven efforts, as demonstrated by the formation of a successful community-based business organization.

Methodology

In order to assess corn husk leather as a sustainable substitute for plastic-based PVC and PU faux leather for fashion applications, this study uses an experimental and comparative material research methodology.
Corn Husk Leather production transforms an agricultural waste into a functional, leather-like material, which is a sustainable, plant-based, and biodegradable material.

Collecting & Harvesting

The process begins with collecting and harvesting the unused or discarded part of corn(leafy outer husk, stalks, and cobs).

Cleaning & Drying

After collecting the husk are thoroughly cleaned by soaking them in hot water for 15-30 minutes to remove dirt, dust, and any remaining impurities, and soften them for pliability(ability to blend, fold arm old without cracking or breaking).After washing, they are partially dried in a warm, dry environment with the help of sunlight and wind to reduce excess moisture. To save energy, this drying is often done using mechanical presses that squeeze out water instead of relying entirely on heat By the end of this step, the husks reach an ideal moisture level, which makes them ready for further processing to create corn husk leather.

Fiber Extraction

Husk are soaked in a mild alkali like 10% Sodium Hydroxide solution often in water at 120 °C for 60 minutes to "degum" them. This separates the cellulose fiber from the linging (the "glue" that hold plant together. This method is used to maintains the natural strength of the husk fiber.

Pulping & Binding

In the production of bio-based leather, these extracted husk fibers are first processed through pulping, where fibers are ground into a fine powder or pulp, which is then blended with bio-based binders or resins (like Natural Polysaccharides, which is Cassava starch &Keratin Hydrolysate). To achieve the necessary flexibility and feel of traditional leather, this mixture is frequently combined with Bio-PU (polyurethane derived from vegetable oils).

Layering

The prepare mixture is poured & spread onto a backing material (usually recycled cotton or hemp) and pressed into sheets of required thickness

Formation and Finishing of Sheets

These sheets are then hot-pressed and cured to make the material strong and evenly textured. After curing, the surface is treated to improve its look and durability. The sheets can be dyed and coated with an eco-friendly, plant-based protective layer that gives them an appearance and feel similar to animal leather. Embossing can also be done to create different surface textures, such as smooth or grainy finishes.

Production

The finished corn husk leather sheets are then ready for use. Manufacturers and designers use these sheets to produce various products, including belts, wallets, handbags, and furniture upholstery.

Result

Mechanical properties (tensile: ~25 MPa, elongation: ~6-19%, tear resistance). Studies on corn husk fibers and related composites show that well-extracted fibers display fine diameters (7–30 μm), moderate to high crystallinity (~65%), and good bundle strength suitable for reinforcement.

Physical traits (breathability, waterproofing, texture). Corn-based vegan leathers currently in commercial use are described as lightweight, flexible, and breathable, with good resistance to cracking under typical fashion usage conditions Brand and technical descriptions highlight comfortable hand feel, adequate water resistance after coating, and dimensional stability suitable for footwear upper sand accessories. Data tables/charts on fiber composition (76% cellulose, low lignin).

Fiber-based bio-textiles produced via green alkali retting strategies have been reported to reach tensile strengths around 139 MPa in aligned configurations, suggesting strong potential for robust sheet materials.
Environmental metrics (CO_2 savings, biodegradation rates).

Biodegradability

Generally biodegradable at the end of its life, unlike petroleum-based synthetics. The cornhusk leather explains its overall environmental impact from raw material sourcing to final biodegradation. It is mainly made from agricultural waste like corn husks and plant oils, reducing farming waste. The material avoids toxic tanning chemicals and uses more eco-friendly processing methods it also Cruelty-Free. It has a lower carbon footprint, uses less water, and is completely animal-free. However, it often includes some synthetic binders like PU, so it is fully biodegradable. Its durability is improving but is still usually lower than traditional animal leather. Requires significantly less water and produces fewer greenhouse gas emissions compared to animal leather.

Table 1. Comparison of PU/PVC Leather and Corn Husk Leather

Property	PU/PVC Leather	Corn husk leather
Carbon footprint	High (Approx 12kg)	Low (3Kg)
Source	Petroleum-based plastic	Natural Agricultural waste
Degradable	Non- degradable	Degradable (Compostable)
Water use	Medium- high (approx. 200 Liters / Sq. mtr)	Low (60 Liters / Sq. mtr)
Chemical Toxicity	High	Low – often Free from toxins
Durability	Fair (with time, it cracks & peel)	Good (resistant to UV & abrasion)
Cost	Low	Currently high
Tensile strength	15.20MPa	24.77 MPa
Breathability	Low (non-porous)	Moderate to High
Lifespan	2-5 years (up to 8 for premium)	5+ years
Feel	Rigid, plastic like	Soft

Discussion

Property comparisons and performance in fashion

The all evidence indicates that the corn husk leather has a significantly lower environmental footprint. It can meet key mechanical and functional requirements for many fashion applications (apparel & home furnishing) over plastic-based faux leather. High cellulose content, high fibre strength, and compatibility with bio-based binders allow the production of flexible, soft, durable sheets that maintain certified vegan and significantly reduce fossil-based material content.

Environmental benefits (waste reduction, lower emissions vs. plastics)

It utilizes agricultural waste, requires minimal water, and is largely biodegradable. It uses 60 litres of water per square meter compared to 17,000 lifters for animal leather, and emits far fewer carbon emissions (3 kg CO_2 per sq. m vs. 35 kg for animal leather). Because of its natural plant based fibers, Corn husk leather is more breathable than synthetic PU/PVC leather. Its generally water resistance ,but prolonged exposure to heavy water can damage it, similar to conventional leather.

Economic and scalability factors

Corn husks are a low-value by some specialty bio-materials, corn is grown worldwide, meaning production can be decentralized to reduce logistics costs and carbon footprints. Product of corn production utilizing this waste adds value to agricultural rest, providing potential Farmer Incentives and supporting a circular economy, creating new industry chains, job opportunities. As the corn is second-largest crop globally, corn provides an annually renewable and virtually unlimited supply of raw material (husks account for roughly 14-15% of the plant's biomass).

Limitations (durability inconsistencies) and solutions

However, there are still technical and systemic challenges that constrain wider adoption. These include the optimization of binder systems to minimize residual fossil-derived polymers, ensuring consistent quality across diverse corn varieties and growing conditions, and scaling up fiber extraction and sheet fabrication technologies economically. Additionally, robust, standardized life cycle assessments and long-term wear studies are needed to substantiate environmental claims and performance expectations in real-world fashion use.

Fashion Applications

The market potential for corn husk leather is significant and growing, driven by the booming demand for sustainable, cruelty-free, and plant-based fashion alternatives. Corn leather is positioned as a leading, innovative solution within this space due to its combination of waste up cycling and high performance. The market for leather care is growing, with a strong,, long-term trajectory toward specialized, sustainable, and convenient solutions that protect premium, long-lasting products. Here are some Brand examples of corn husk leather.

VEJA: This major French footwear brand uses a waxed canvas material in its CAMPO sneaker range, which is coated with a resin from corn waste, with the material being made from up to 50% corn waste leftover from the food industry.

ACBC: The brand uses a material called "BioMilan" or "Bioskin" (corn eco-leather) to make sneakers, incorporating agricultural corn waste.

ID Eight: A brand that offers eco shoes, including some sneakers made with corn leather.
Vegan Style: This retailer actively promotes and sells various shoe styles, including boots and sneakers from brands like Zette Shoes that are made using corn leather. Solari Milano: A brand featured on sustainable retail platforms for using high-quality corn leather in its products.
Miomojo: This brand incorporates corn-based materials into its range of accessories, offering stylish options for ethical consumers.
V.GAN: Known for a variety of vegan products, V.GAN utilizes corn leather as one of its core materials.
Agazi and Watson & Wolfe: These brands offer accessories such as belts and other lifestyle products made from corn leather alternatives.
Arture: An Indian brand creating sustainable lifestyle accessories, including some made from corn-based fabrics.
Leafy Leather: An innovator that transforms corn and banana waste into durable, planet-friendly leather

Conclusion

Corn husk leather emerges as a promising sustainable alternative to conventional PVC and PU leather in the fashion industry. It effectively utilizes agricultural waste, reducing environmental burden while supporting circular economy practices. The material demonstrates suitable mechanical strength, elasticity and comfort for applications in apparel, footwear, and accessories. Compared to plastic-based synthetic leather, it requires less water and produces lower carbon emissions, making it environmentally preferable. Its plant-based composition also ensures breathability and maintains vegan material standards. However, further improvements in binder technology, quality consistency, and large-scale production are needed for wider commercial adoption. With continued research and technological development, corn husk leather has strong potential to become a viable eco-friendly material for future fashion products.

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SP, TP, PC and ST conceived the concept, wrote and approved the manuscript.

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