

Sustainable Vegan Leather

Daksha¹, Rupal Babel² and Namrata Kushwah¹

¹PhD Scholar and ² Associate Professor and Head, Department Textile and Apparel Designing, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan

SUMMARY

As ethical consciousness has increased, people have started to critique the unethical elements of using animal resources. The global industrial industry depends heavily on leather, which benefits society and the economy. Its popularity has increased as consumers' awareness of environmental and ethical issues has grown. The need for leather-like materials made without using animals and using biotechnology has grown significantly in recent years. An extensive review of plant sources, their processing, issues, and potential future possibilities for vegan leather is given in this article. By concentrating on the environmental impacts of production methods, this article explores whether vegan leather could be a really sustainable alternative to conventional leather. Many more organic-based materials will be fully biodegradable and utilised in the fashion and textile industries if textile research keeps up its current pace.

INTRODUCTION

Textile stages and processes involve the employment of thousands of chemicals, bleaches, and dyes, and the fashion business is constantly evolving to provide reasonably priced goods in order to draw in customers. Large volumes of trash are produced as a result, or hazardous chemicals are released into the environment throughout the fashion production process, polluting the entire ecosystem. With all, the fashion industry, its always changing styles and trends, aims to attract clients by offering affordable and sustainable market items. The creation of eco-friendly materials and alternative sources is also vital. Two well-known examples of materials made from animals that have generated discussions regarding ethical sourcing and animal rights are leather and fur. To substitute leather generated from animals, a range of synthetic and semi-synthetic materials have been created. Additionally, consumers are searching for and demanding fewer environmentally harmful materials than traditional leather. All industries, including the leather sector, clearly choose non-traditional materials that have shown lower environmental consequences. Additionally, the fashion industry depends on the production of vegan materials since it affects how consumers think and act when they purchase accessories, shoes, purses, and leather coats.

Vegan leather Vegan leather reduces the amount of waste released into the environment during production, it is currently the most sensible substitute that the fashion industry should adopt. Materials that replicate the look and feel of animal leather are made from bio-based alternatives such cacti, pineapple leaves (Piñatex), or mushrooms etc.

Sources of vegan leather

These materials utilise renewable plant resources, which are typically agricultural waste that has been repurposed. A variety of materials are used to make vegan leather, including

Name	Source	Process	Property
Piñatex (Pineapple Leaf Fibers):	Leaves	Leaves collected → stripped of fibers → transformed into a non-woven mesh → processed and treated with a resin to create a leather-like material.	Lightweight, durable, and biodegradable.
Apple Leather:	Skins and cores	Apple waste is dried → powdered, and mixed with a binder → form a leather-like material.	Smooth texture and versatility.

Mushroom Leather (Mycelium):	Root	Grown in a controlled environment using → agricultural waste as feedstock → processed to create a flexible, leather-like material.	Flexible, durable material
Cork Leather:	cork oak trees	Bark is sustainably harvested → cork oak trees → flattened into sheets → layered with resin for added durability.	Natural, waterproof, and biodegradable
Cactus Leather (Desserto):	Leaves of the prickly pear cactus	Leaves are harvested without harming the plant → dried in the sun → processed into a leather-like material with a proprietary resin.	Requiring minimal water and no chemicals.
Banana Leather (Barktex)	Fibers	Extract and refine fibers from banana plant stems → Weave into durable textile → Treat for leather-like properties	Lightweight, smooth texture and versatility
Wine Grape	Skins, seeds, and stems	The pomace is processed into a biopolymer material resembling leather.	Reduces agricultural waste, a sustainable, plant-based alternative.
Corn	Corn starch and fibers	Extract starch from corn → Blend with natural or bio-based polymers → Process into leather-like material	Renewable resource; biodegradable (depending on binder used)
Coconut Waste	Coconut water and fibers	Ferment coconut water → Blend with natural fibers and resins → Process into sheets	Utilizes food industry waste; biodegradable; low environmental impact
Tea Leaves	Tea Leather	Used tea leaves are collected, dried → processed into bio-composite sheets → mimic leather, often treated with natural resins.	Lightweight, eco-friendly, and biodegradable

Challenges of Vegan Leather

Vegan leather has several issues that prevent it from becoming widely accepted, despite its potential as a sustainable substitute for conventional leather. Common significant issue is performance and durability, as many plant-based materials—like apple leather or mushroom leather (mycelium)—cannot equal the strength, pliability, and longevity of animal leather. For instance, mycelium leather may deteriorate more rapidly in moist environments, rendering it inappropriate for high-use or long-term applications. Another major challenge is cost and scalability. New materials like cacti and lab-grown leather are still costly and resource-intensive to produce commercially. The industry faces challenges from consumer perception and misinformation. Greenwashing, the dishonest promotion of goods as environmentally benign, is commonly caused by the absence of defined definitions and certifications for "sustainable" or "eco-friendly" materials. This damages consumers' faith in really sustainable solutions in addition to confusing them.

Future direction

In an effort to balance sustainability, durability, and aesthetics, scientists and producers are creating hybrid materials that combine synthetic and plant-based ingredients. One practical method for creating high-performing, environmentally friendly alternatives to conventional leather is the development of bio-engineered leather made from microbial cellulose or genetically modified proteins.

Reducing waste and resource consumption can be achieved by incorporating vegan leather into a circular economy framework. Programmes for recycling and upcycling are becoming more popular, with a focus

on reusing vegan leather goods to prolong their lifespan and lessen the impact on landfills. By passing stringent legislation and certification initiatives, policymakers can also aid in the prevention of greenwashing and promote transparency in the vegan leather industry. By educating consumers about the ethical and environmental advantages of vegan leather, brands can boost demand and trust. Consumer trust in vegan leather products can be strengthened by transparent labelling and narrative regarding the sustainability and place of origin of materials.

CONCLUSION

In terms of striking a balance between ethical and environmental concerns and customer expectations, vegan leather is a positive move. Although promising, plant-based substitutes need to be made more scalable and durable in order to rival synthetic and conventional leather. Eco-friendly leather is a workable way to balance social and environmental issues with consumer demands. By employing cleaner production methods, reducing waste, and depending on renewable resources, it challenges the conventional wisdom around the production of leather. Eco-friendly leather is becoming increasingly important in changing global industries for a more environmentally friendly future as demand for sustainable alternatives rises. Improved leather may be essential to sustainable fashion and other fields, but more research should focus on renewable resources to reach its full potential.

REFERENCES

- Desserto. (2023). *Cactus Vegan Leather: A Sustainable Alternative*. Retrieved from <https://www.desserto.com>.
- Frasquet, M. L., et al. (2020). Agricultural By-Products in Sustainable Materials. *Materials Advances*.
- Higgitt, C., et al. (2022). Sustainable Materials in Fashion: A Review. *Journal of Cleaner Production*.
- Huber, D., et al. (2021). Biomaterial Innovations in the Textile Industry. *Materials Today: Proceedings*.
- Li, Y., & Chen, X. (2019). Mycelium-Based Materials as a Sustainable Alternative. *Sustainability Journal*.
- Minh, N. T., & Ngan, H. N. (2021, September). Vegan leather: An eco-friendly material for sustainable fashion towards environmental awareness. In *AIP Conference Proceedings (Vol. 2406, No. 1)*. AIP Publishing.
- Muthu, S. S., & Ramchandani, M. (2024). Environmental Issues of Traditional Leather and Need for Vegan Leather. In *Vegan Alternatives for Leather (pp. 9-35)*. Cham: Springer Nature Switzerland.
- Pereira, H. (2015). The Sustainable Use of Cork in Modern Industries. *Journal of Forestry Research*.
- Smith, J. (2021). Advancements in Synthetic Textiles. *Journal of Cleaner Technology*.
- Tewari, S., Reshamwala, S. M., Bhatt, L., & Kale, R. D. (2024). Vegan leather: a sustainable reality or a marketing gimmick?. *Environmental Science and Pollution Research*, 31(3), 3361-3375.
- Vegea. (2023). *Grape Leather: A Circular Approach*. Retrieved from <https://www.vegeatextile.com>.
- White, R. (2022). Circular Economy in Fashion. *Journal of Sustainable Textiles*.