



Artistic Path of Changbaishan Bio-based Packaging: The Structural Contribution of Paper-cutting Craft to Achieving High-purity Recycling

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This editorial explores a decorative green packaging approach that integrates Changbaishan plant fibers with the intangible cultural heritage (ICH) paper-cutting craft, focusing on its structural contribution to high-purity recycling. It is shown that replacing chemical laminates and synthetic components in conventional modern packaging with the hollow-out aesthetics of paper-cutting can significantly increase the specific surface area of materials, thus accelerating biodegradation rates. This structural strategy not only ensures the purity of fiber recycling but also elevates the green premium of the Changbaishan brand through the infusion of ICH culture, providing a replicable practical model for the green transformation of local characteristic economies.

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Introduction

In the global response to plastic pollution and carbon neutrality goals, the packaging industry is undergoing a profound transformation from petroleum-based to high-performance bio-based materials (Meena 2025). Abundant biomass resources such as plant stems and leaves from Changbaishan (a mountain range in north-eastern China) are ideal carriers for developing high-value-added green packaging, owing to their high physical strength and distinctive regional cultural attributes. Conventional packaging, however, relies on chemical laminates for functionalization, which often leads to low recycling purity. This editorial proposes an artistic approach: integrating the intangible cultural heritage (ICH) paper-cutting craft into bio-based material design, and replacing synthetic components with its sophisticated physical hollow-out structures to achieve lightweight decorative packaging and visual narrative. Meanwhile, it delivers a substantive structural contribution to enhancing material degradation efficiency and ensuring fiber recycling purity in terms of underlying logic.

In-depth Coupling of Craft Logic and Materials Science

The integration of Changbaishan plant fibers with paper-cutting craft embodies the synergy of physical properties and subtractive structural engineering. Taking Changbaishan oak branch fibers, which are easily accessible, economically viable forestry residues, as an example, structural optimization markedly increases their specific surface

area and accelerates biodegradation. Endowed with inherent lignin content and fiber length, these fibers exhibit rice paper-like toughness and folding resistance after precise regulation of medicinal material dispersion and mechanical pulping, forming the physical foundation for complex cutting designs. From a mechanical perspective, regular hollow-out arrays created by paper-cutting craft on the packaging surface adjust the stress distribution of the bio-based substrate, endowing it with flexible folding and self-locking structures; lightweight design and structural stability are thus achieved without chemical additives (Wang 2025). Digital vector-driven high-precision laser cutting resolves dimensional deviations in manual production, and the natural texture of raw plant fibers and exquisite lines of digital paper-cutting patterns form a harmonious unity of nature and modern design. This validates the application value of ICH craftsmanship in modern packaging engineering and ensures absolute packaging purity in the recycling cycle through physical means.

Closed-loop Design from a Sustainability Perspective

As an integral part of the carbon cycle, the degradation efficiency of Changbaishan plant fibers is often constrained by the physical thickness and surface area of the materials. Through its unique hollow-out aesthetics, paper-cutting craft significantly increases the specific surface area of materials without altering their chemical composition. This structural modification expands the contact area of packaging with soil microorganisms, water and oxygen, thereby enhancing biodegradation efficiency in terms of underlying logic and objectively serving as a structural strategy to accelerate biodegradation. After fulfilling its protective and display functions, the artistic packaging can be rapidly decomposed and integrated into the ecological cycle, realizing a logical closed loop of “taking from the forest and returning to the soil”.

The recycling value of packaging hinges primarily on material purity. Changbaishan plant fiber packaging adheres to the monomaterial design principle. Unlike traditional paper packaging, which relies heavily on chemical laminates or plastic windows (Belle *et al.* 2024), paper-cutting craft achieves visual transparency through hollow-out technology, completely eliminating non-recyclable synthetic components. When the packaging enters the recycling system, fibers can be repulped, screened, and reconstituted without contamination by microplastics or adhesives. The material purity and process simplicity set a benchmark for the sustainable circulation of bio-based packaging.

Paper-cutting packaging often evokes emotional resonance among consumers, transforming it from a mere logistics container into a household ornament with decorative value. Unconscious recycling driven by artistic premium effectively delays disposal behavior at the psychological level. When packaging is reused, mounted, or preserved for a long time for its aesthetic value, the overall social material consumption is consequently reduced. Resource conservation based on cultural identity is a unique sustainable contribution of ICH craftsmanship to bio-based materials.

Empirical Logic of Cultural Asset Transformation and Brand Economics

The green premium of Changbaishan bio-based packaging stems not from emotional appeal, but from the visualization of low-carbon costs. Replacing chemical adhesives and composite films with paper-cutting hollow-out structures reduces recycling difficulty and costs from the source. Such tangible environmental value is the true embodiment of the brand’s high added value. ICH paper-cutting not only forms a unique style that is hard to replicate with plastic packaging but also achieves physical buffering by

leveraging the inherent strength and toughness of plant fibers. Replacing complex processes with ingenious design endows the packaging with an inherent sense of quality. Changbaishan's cultural assets have not only realized the recycling of waste into commodities but also enhanced industrial discourse power and gained recognition and resonance in the international market through the dual narrative of brand and sustainability in the global bio-based industrial chain.

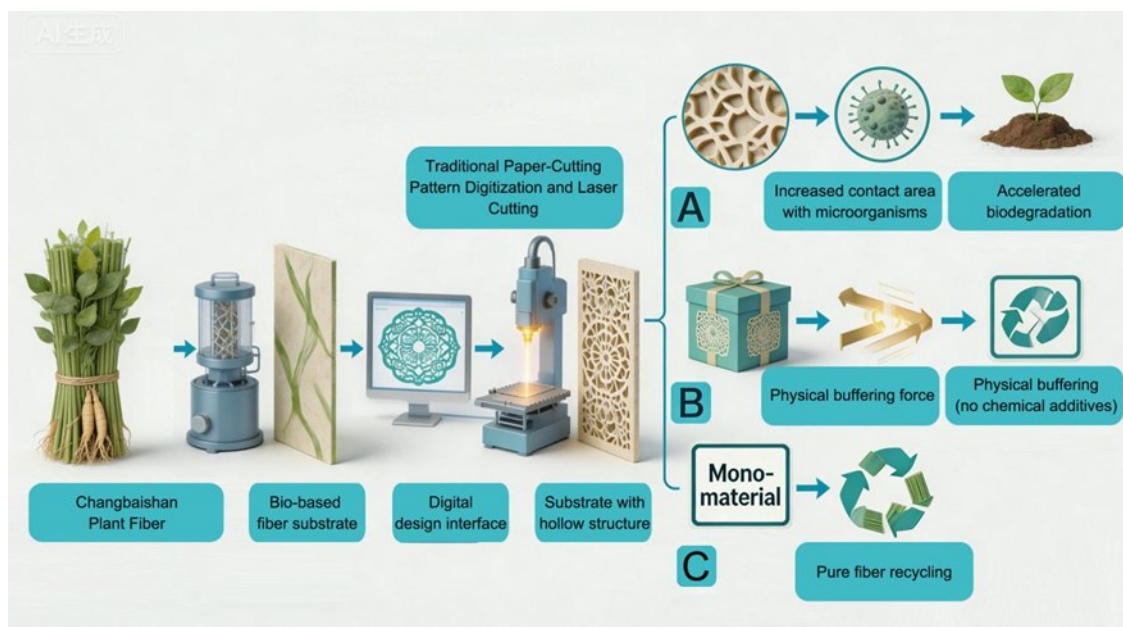


Fig. 1. Technical and physical framework

Structural Strategies and Future Prospects

Establishing an ecological system

The integration of Changbaishan plant fibers with paper-cutting craft requires the establishment of a cross-boundary collaborative innovation ecosystem. It is suggested that relevant departments guide the setup of a joint laboratory integrating industry, academia, research, and art, bringing together material scientists, design experts and ICH inheritors. Supported by special funds, the laboratory should focus on advancing the sophisticated extraction technology of biomass resources such as Changbaishan oak branch fibers and formulate digital die-cutting standards adapted to ICH patterns.

Brand upgrading

Changbaishan's characteristic industries should take the lead in implementing an integrated cultural packaging strategy, incorporating artistic packaging into the whole life cycle management of products. Through policy incentives, enterprises are encouraged to purchase locally produced plant fiber packaging to reduce environmental footprint and apply for international green access standards accordingly. Driven by the small entry point of packaging innovation, industrial upgrading can be effectively realized, which boosts the recycling of bio-based resources in surrounding rural areas and forms a modern cultural industrial chain integrating material collection, design, green manufacturing and marketing.

Future outlook

Artistic packaging made from Changbaishan fibers will no longer be a static material entity, but an evolving digital cultural asset. Utilizing technologies such as blockchain for the right confirmation and traceability of ICH designs will enhance global consumers' brand loyalty. Meanwhile, combined with artificial intelligence-aided design, the visual expression of paper-cutting packaging can be dynamically adjusted according to the aesthetic preferences of different international markets, enabling the country-specific communication of traditional craftsmanship. This empowered new productive force will allow Changbaishan's ecological story to radiate enduring vitality on the digital Silk Road.

Conclusion

The millennial evolution of traditional paper has demonstrated that the integration of plant fibers from the Changbaishan mountain range with traditional paper-cutting craft aligns with both the technical logic of bio-based material innovation and the dual demands of cultural heritage protection and green economic development. Transforming the subtractive aesthetics of ICH paper-cutting into a packaging structural strategy has endowed the originally single plant material with new functional and artistic vitality in modern industrial design. This exploration not only builds a pathway for the value transformation of Changbaishan's cultural assets but also contributes an oriental model to global sustainable packaging, which is expected to become a paradigm for the integration of traditional aesthetics and green development.

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