

Sustainable Packaging Design for Chinese Mooncakes: Balancing Tradition, Consumer Appeal, and Environmental Responsibility

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Abstract: *The research explores the need for improvements in the excessive packaging practices of the mooncake industry in response to new regulations introduced by China's State Administration for Market Regulation. Through a combination of literature review and theoretical analysis, this paper examines three key aspects of sustainable design: economic, social, and environmental. It then proposes a sustainable packaging design framework specifically for mooncake packaging. Despite the increasing awareness of sustainability, mooncake packaging still faces challenges such as excessive use of materials, over-large packaging gaps, and costly materials. By analyzing the framework, this paper advocates for mooncake companies to incorporate sustainability from economic, social, and environmental perspectives, thus transforming the industry toward more sustainable practices.*

Keywords: Sustainable design, mooncake packaging, excessive packaging, packaging, consumer behaviour

1. Introduction

In recent years, with the rapid development of the global economy and the continuous improvement in living standards, consumer demands have shifted from purely material needs to a richer combination of cultural and emotional satisfaction. Packaging design, as an integral part of a product's perceived value, has increasingly gained importance across various industries. Packaging no longer merely serves the functional purpose of protecting goods; it also acts as a vehicle for conveying brand culture, product identity, and meeting consumer psychological expectations. This is especially relevant in the field of gift items, where the aesthetic appeal and uniqueness of packaging often become key factors influencing consumer choices.

The Mid-Autumn Festival, one of China's most cherished traditional holidays, has long symbolized family reunion and harmony. Mooncakes, as the festival's signature treat, carry deep cultural significance, representing the warmth and blessings of family gatherings. Over time, mooncakes have evolved from simple holiday pastries into luxurious gifts exchanged between families, friends, and business associates. Consequently, mooncake packaging design has taken on a critical role in the marketplace. However, recent years have seen a growing issue of excessive packaging in the mooncake industry. This phenomenon not only increases production costs but also results in significant resource waste and environmental pollution, which contradicts the principles of sustainable development.

As the problems of resource depletion and environmental degradation have become increasingly severe, sustainability has gained widespread global attention. Sustainable development defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs has become a guiding principle for governments and industries alike (Jian et al., 2020). In 1996, China formally adopted sustainable development as a national strategy, followed by the introduction of various policies to promote greener practices across all sectors of the economy (Harper & Simonsen, 2017).

The food industry, being a pillar of economic development, plays a vital role in achieving sustainability goals. In recent years, the Chinese government, through the State Administration for Market Regulation, has implemented several regulations aimed at reducing excessive food packaging, with a special focus on mooncakes a product with both cultural and commercial importance. In 2021, the regulatory body introduced new national standards for 31 categories of food packaging, including mooncakes, to encourage businesses to adopt sustainable packaging practices. A transition period was set, with full compliance expected by 2023. These regulations are pushing the mooncake industry to rethink its packaging strategies, balancing government mandates with the need to maintain the cultural and aesthetic appeal that consumers expect from holiday gifts (Steenis, Van Herpen, Van Der Lans, Ligthart, & Van Trijp, 2017). Packaging is significant to attract consumer intention and their preferences, as well as adding cultural value through its attributes (Halabi & Hands, 2018).

Despite the clear government directives aimed at curbing excessive packaging, mooncake manufacturers still face considerable challenges. This is largely due to consumer preferences for visually appealing and luxurious packaging, particularly during the Mid-Autumn Festival, when mooncakes are often given as gifts. To cater to this demand, many companies continue to invest heavily in creating elaborate, multi-layered packaging designs that project a sense of luxury and status. This trend has not only escalated production costs but also significantly contributed to environmental degradation through increased resource use and waste generation. Moreover, the personality of packaging conveys its value and impacts consumer purchasing behavior as the brand reflects the consumer's own identity (Halabi, 2021).

However, the rise in environmental consciousness among consumers has begun to shift the industry landscape. Particularly in the mid-to-high-end markets, consumers are increasingly mindful of a product's environmental impact. They are not only concerned with the quality and taste of the mooncakes but also with the sustainability of the packaging (Otto, Strenger, Maier-Nöth, & Schmid, 2021). This growing awareness presents a significant opportunity for mooncake companies to innovate and lead the way in sustainable packaging design. In promoting products, businesses and designers should integrate ideas with creative design to elevate the added value of packaging, ensuring it meets consumers' preferences and needs (Li, Halabi, & Ren, 2022).

The concept of sustainable packaging goes beyond reducing waste; it involves rethinking the entire lifecycle of packaging materials, from production to disposal, and designing in ways that minimize environmental harm while enhancing product value (Becker, van Rompay, Schifferstein, & Galetzka, 2011). This shift towards sustainable packaging is no longer just a regulatory requirement but also an avenue for brands to differentiate themselves in a highly competitive market. Brands that successfully integrate sustainability into their packaging can appeal to eco-conscious consumers, enhance their reputation, and contribute to broader environmental goals.

This study aims to explore the current state of mooncake packaging from a sustainability perspective, identifying the key challenges and proposing a framework for sustainable packaging design. The research focuses on three pillars of sustainability: economic, social, and environmental, and analyzes how these elements can be applied to mooncake packaging design (Zhou, 2014). By examining sustainable design theories and methodologies, the study provides insights into how mooncake manufacturers can balance aesthetic and cultural expectations with environmental responsibility.

Through the development of a sustainable mooncake packaging design framework, this research offers practical recommendations for mooncake brands to adopt more eco-friendly practices. This framework not only seeks to address the industry's current over-reliance on excessive materials but also encourages innovation in design to meet both consumer demand and sustainability goals (Jiang, 2017). Ultimately, this study hopes to contribute to the long-term development of the mooncake industry, ensuring that it can thrive economically, socially, and environmentally in the future.

2. Development of Sustainable Design

Sustainable design has its roots in the recognition that the traditional modes of production and consumption have caused significant harm to the environment. With the rapid advancement of industrialization and mass production since the early 20th century, global industries began focusing primarily on efficiency, profit, and scalability, often at the expense of natural resources and ecological balance (Cui, 2019). As the environmental impact of unchecked industrial activity became evident, a movement toward more responsible and thoughtful design began to emerge.

The concept of sustainability in design initially took shape in the 1960s, during the rise of environmental awareness movements in Western countries, particularly in the United States. This period marked the beginning of green design, a response to growing concerns over pollution, deforestation, resource depletion, and waste. Green design emphasized minimizing the environmental footprint of products by reducing energy consumption, using renewable resources, and employing recyclable or biodegradable materials (Boz, Korhonen, & Koelsch Sand, 2020). It focused primarily on mitigating the environmental impact during a product's lifecycle, from raw material extraction to disposal.

As awareness and understanding of environmental issues grew, eco-design emerged in the 1990s as a more comprehensive approach. While green design sought to address the environmental aspects of a product's lifecycle, eco-design went further by integrating considerations of human health and safety, product functionality, and the surrounding environment. Eco-design aimed to create products that were not only less harmful to the environment but also safer and more efficient for users. This shift reflected a deeper acknowledgment of the interconnectedness of environmental health and human well-being, as well as the role that design plays in shaping both.

With the turn of the 21st century, the concept of sustainable design began to take center stage. Unlike its predecessors, sustainable design does not solely focus on environmental impact; it adopts a broader, more holistic approach by incorporating the triple bottom line of sustainability: economic viability, social equity, and environmental responsibility (Choi, Lee, & Rodgers, 2021). The aim of sustainable design is to create products, systems, and

environments that not only minimize harm but also actively contribute to the long-term health of both people and the planet.

Sustainable design considers the entire lifecycle of a product, from initial conception and material sourcing to production, distribution, use, and eventual disposal. It challenges designers to think beyond the immediate function of a product and to consider how their work can positively impact society and the environment. This approach promotes innovation in material selection, production processes, and end-of-life management (Khan, Kamran, Bino, & Mahmood, 2021). It also encourages collaboration across different industries to find solutions that are not only practical but also regenerative, ensuring that the resources used can be replenished and that the waste generated is minimized or repurposed.

One of the key drivers behind the development of sustainable design is the growing recognition of resource scarcity and the need for more responsible consumption. As the global population continues to rise and industrial activity increases, the strain on natural resources has reached critical levels. The over-exploitation of resources, including water, fossil fuels, minerals, and forests, threatens not only ecosystems but also the long-term viability of industries and economies. Sustainable design seeks to address this by promoting more efficient use of materials, energy, and water, as well as encouraging the use of renewable resources.

Moreover, sustainable design aligns closely with the principles of circular economy, a concept that has gained traction in recent years. Unlike the traditional linear economy, which follows a “take-make-dispose” model, the circular economy seeks to keep resources in use for as long as possible through strategies such as recycling, reuse, remanufacturing, and upcycling (Shen, 2021). Sustainable design plays a crucial role in enabling the circular economy by creating products and systems that are designed to be repaired, disassembled, and repurposed, thus reducing the need for virgin materials and minimizing waste.

At the societal level, sustainable design also emphasizes the role of design in promoting social equity. It recognizes that the negative impacts of unsustainable practices, such as pollution and climate change, disproportionately affect marginalized communities. Therefore, sustainable design advocates for solutions that are inclusive and equitable, ensuring that the benefits of sustainability are shared across all segments of society. This includes considering the accessibility of products, their affordability, and their impact on local communities, especially in terms of labor practices and resource management.

In the business context, sustainable design is increasingly seen as a competitive advantage. Consumers today are more informed and concerned about the environmental and social impacts of the products they buy (Elkhattat & Medhat, 2022). As a result, brands that prioritize sustainability in their design and production processes are more likely to gain consumer trust and loyalty. Sustainable design not only helps companies reduce their environmental footprint but also enhances their reputation, opens up new market opportunities, and drives innovation. In conclusion, the development of sustainable design reflects the evolving understanding of the complex challenges facing the modern world. From its origins in green and eco-design, sustainable design has grown into a comprehensive approach that balances economic, social, and environmental considerations (Lin, 2022). It encourages designers to think beyond short-term gains and to create products and systems that contribute to a healthier, more equitable, and more sustainable future.

3. Current status of mooncake packaging

3.1 Current Situation of the Mooncake Market

The mooncake market has evolved significantly over the past few decades, influenced by economic growth, changing consumer preferences, and cultural trends. Once a simple traditional food item consumed during the Mid-Autumn Festival, mooncakes have now become a highly commercialized and competitive product, particularly during the holiday season. This transformation has brought both opportunities and challenges for businesses in the mooncake industry, shaping the way mooncakes are produced, marketed, and packaged.

(1) Economic Growth and Consumer Demand

With China's rapid economic development and the rise in disposable income, consumer behavior has shifted toward more sophisticated and personalized purchasing decisions. This has affected the mooncake market in two key ways: the expansion of the market size and the diversification of consumer preferences.

Mooncakes, once limited to basic flavors and simple packaging, are now offered in a wide range of varieties, including unique and luxurious flavors designed to appeal to a more affluent consumer base. Many high-end mooncake brands have introduced gourmet flavors, such as truffle, abalone, and even international-inspired fillings, catering to the growing demand for premium products. This has made mooncakes a symbol of luxury and status, especially when given as gifts to family members, friends, or business associates.

A report on mooncake consumption trends from 2016 to 2021 shows a significant increase in market size, growing from RMB 11.65 billion to RMB 16.88 billion. By 2022, the mooncake gift box market had reached RMB 18.87 billion, marking an 11.8% increase year-over-year (Shi et al., 2023). This surge in demand is attributed not only to economic growth but also to the cultural importance of mooncakes during the Mid-Autumn Festival, which has driven both consumer spending and brand competition.

(2) Cultural Importance and the Role of Gifting

The Mid-Autumn Festival holds a central place in Chinese culture, symbolizing family reunion, unity, and harmony. Mooncakes, as the festival's iconic food, have come to embody these values, making them an essential part of festive celebrations. Beyond their culinary value, mooncakes have evolved into popular gifts exchanged between family members, friends, and colleagues, further driving demand for premium and well-packaged mooncakes.

The cultural significance of mooncakes has led to the development of intricate packaging designs that emphasize not only the quality of the product but also the symbolic meaning behind the gift. For many consumers, the packaging of mooncakes is just as important as the taste, as it reflects the care, respect, and thoughtfulness of the giver. This has encouraged brands to invest heavily in packaging design, using materials and aesthetics that convey luxury, tradition, and festive spirit.

For example, many mooncake packages feature traditional Chinese symbols such as the full moon, rabbits, lanterns, and scenes of family reunions, all of which evoke the cultural essence of the Mid-Autumn Festival (Cui, 2019). Additionally, regional designs that reflect local culture and customs have become increasingly popular, allowing consumers to feel a deeper connection to the traditions represented by the mooncakes they purchase or receive as gifts.

(3) The Competitive Landscape of the Mooncake Industry

The mooncake industry is characterized by intense competition, with a large number of brands vying for consumer attention during a relatively short sales window leading up to the Mid-Autumn Festival. As of July 2022, there were over 40,478 registered mooncake enterprises in China. This highly competitive environment has led to a proliferation of mooncake styles and flavors, as brands strive to differentiate themselves and capture market share.

In addition to traditional bakeries and confectioners, luxury brands and international companies have entered the mooncake market, offering high-end, exclusive mooncake gift boxes designed to appeal to affluent consumers. These brands often collaborate with renowned designers or artists to create visually stunning packaging that enhances the product's perceived value. Moreover, many companies invest in limited-edition mooncake collections, leveraging exclusivity and scarcity to create a sense of urgency and desire among consumers.

This competitive pressure has also resulted in the practice of over-packaging, where brands use elaborate, multi-layered packaging to create an impression of prestige and luxury. While this strategy may succeed in attracting consumers who associate premium packaging with high quality, it has also contributed to problems such as resource waste, environmental pollution, and consumer backlash over excessive and unsustainable packaging practices.

(4) Regulatory Changes and Sustainability Challenges

In response to growing concerns about environmental degradation and resource waste, the Chinese government has introduced new regulations aimed at reducing excessive packaging, particularly in the food industry. The State Administration for Market Regulation issued new national standards in 2021 that set specific guidelines for food packaging, including mooncakes. These standards, which came into full effect in 2023 after a transition period, are designed to limit the amount of packaging used for food products and encourage more sustainable practices within the industry.

These regulations address issues such as the use of non-recyclable materials, the size of packaging relative to the product, and the environmental impact of packaging waste. Mooncake companies are now required to reduce the amount of packaging used and to avoid excessive gaps between the product and its container. Furthermore, businesses are encouraged to adopt recyclable or biodegradable materials to minimize the environmental footprint of their packaging.

While these regulatory changes are a step in the right direction, they pose significant challenges for many mooncake companies. For years, elaborate packaging has been a key differentiator in the market, and transitioning to more sustainable designs without compromising the perceived value of the product requires careful innovation. Brands must balance the need to comply with government regulations, meet consumer expectations, and maintain their competitive edge in the marketplace.

(5) Changing Consumer Preferences

As environmental awareness continues to grow, consumers are becoming more conscious of the impact their purchasing decisions have on the planet. This shift in consumer behavior is particularly evident in younger, more eco-conscious demographics who prioritize sustainability when making purchasing choices. Many consumers now prefer products that are packaged using eco-friendly materials and processes, and they are increasingly critical of brands that engage in wasteful or environmentally harmful practices.

For mooncake brands, this presents both a challenge and an opportunity. While there is still demand for aesthetically pleasing and luxurious packaging, there is also a growing expectation that packaging should be sustainable and responsibly sourced (Jiang, 2017). Brands that can successfully align their packaging design with sustainability goals stand to gain a competitive advantage by appealing to this environmentally conscious consumer segment.

To address these changing preferences, some mooncake companies have begun experimenting with innovative, eco-friendly packaging solutions. For example, some brands are using recycled paper, biodegradable plastics, or even plant-based materials for their packaging. Others are focusing on minimalist packaging designs that reduce the amount of material used while still maintaining visual appeal. These efforts reflect a broader industry trend toward more responsible and sustainable packaging practices, which are likely to become increasingly important as consumer demand for eco-friendly products continues to rise.

3.2 Problems in Mooncake Packaging

Despite the rich cultural heritage and significance of mooncakes, the packaging design of mooncakes has only recently come under scrutiny due to growing concerns about sustainability and environmental impact. As mooncake gifting has evolved into a popular tradition during the Mid-Autumn Festival, businesses have invested heavily in the visual appeal and complexity of mooncake packaging. This has led to the emergence of several issues that affect both the mooncake industry and the environment, primarily revolving around excessive packaging, over-large packaging gaps, and the use of expensive, non-sustainable materials (Shi et al., 2023). These problems not only contradict the principles of sustainability but also contribute to resource waste and increased environmental pollution.

(1) Excessive Packaging

One of the most prominent issues facing the mooncake industry today is the practice of excessive packaging. As mooncakes have become a high-value gift item, many companies have adopted packaging strategies that emphasize luxury and opulence. Influenced by Western branding and management philosophies, Chinese mooncake companies have increasingly focused on creating elaborate packaging that conveys a sense of prestige and exclusivity. This focus on enhancing brand image often leads to the overuse of materials and unnecessary packaging elements, resulting in a significant increase in waste.

The demand for gift-worthy packaging, particularly for high-end mooncakes, has pushed brands to design intricate, multi-layered packages that include ornate boxes, trays, and additional decorative items. These packages are often much larger and more elaborate than necessary to protect or present the product, leading to a phenomenon known as "over-packaging." For example, some mooncake boxes feature multiple layers of packaging, such as outer boxes, inner compartments, and even individually wrapped mooncakes, all of which contribute to material waste and higher production costs.

While this type of packaging appeals to consumers seeking visually impressive gift items, it contradicts growing environmental awareness and sustainability goals (Q. Wang, 2024). Many consumers and environmental advocates have criticized the mooncake industry for prioritizing aesthetics over function, leading to excessive waste that ultimately ends up in landfills. This not only damages the environment but also raises concerns about the industry's long-term sustainability practices. As a result, there is increasing pressure on mooncake companies to strike a balance between creating visually appealing packaging and reducing material waste.

(2) Over-large Packaging Gaps

Another significant issue related to mooncake packaging is the prevalence of over-large packaging gaps, where the space between the product and its packaging is disproportionately large. This practice is often employed as a cost-saving measure by companies that aim to give the appearance of a larger or more valuable product without actually increasing the size or quantity of the mooncakes inside. By creating the illusion of a bigger, more substantial package, companies hope to appeal to consumers who associate size with value.

For example, many mooncake companies use small-sized mooncakes in conjunction with large boxes that contain additional decorative or filler elements, such as plastic trays or spacers, to occupy the excess space. While this gives the impression of a luxurious and carefully presented product, it results in significant material waste and inefficiency. The larger the packaging relative to the actual product, the more resources are required to produce, transport, and store the packaging, leading to higher environmental costs.

Furthermore, this type of packaging manipulation can be misleading to consumers, who may feel disappointed upon realizing that the actual product does not match the perceived value suggested by the packaging (Huang & Ghazali, 2024). This practice also complicates efforts to regulate packaging standards, as companies may use these tactics to comply with size and weight regulations while still maximizing profits.

In some cases, companies also use plastic or cardboard inserts to stabilize the mooncakes within the box, which increases the overall packaging volume without contributing to the product's protection. These unnecessary inserts not only add to the packaging waste but also hinder recycling efforts, as mixed-material packaging is more difficult to process. The excessive use of space and materials in mooncake packaging is therefore a significant issue that requires attention from both regulators and manufacturers.

(3) Expensive Packaging Materials

The use of expensive packaging materials is another problem that has emerged in the mooncake industry, particularly among premium brands. To create a sense of exclusivity and luxury, many companies opt for high-cost materials such as metal tins, wooden boxes, or lacquered containers. These materials are often chosen for their durability, aesthetic appeal, and ability to convey a premium image, which is especially important for mooncakes marketed as luxury gifts.

However, the use of such materials comes at a high environmental and financial cost. Metal, wood, and other luxury materials are not only more expensive to produce and transport, but they are also often difficult to recycle (Linlin Wang, 2023). For instance, metal tins used for mooncake packaging are typically coated with decorative finishes or designs that make them harder to recycle effectively. Similarly, wooden boxes, especially those treated with varnish or paint, pose challenges for recycling and disposal.

In addition to the materials themselves, many mooncake packages feature lavish interior elements, such as silk linings, velvet trays, or intricate embossing, all of which further increase the cost and environmental impact of the packaging. While these features may enhance the visual appeal and perceived value of the mooncakes, they contribute little to the functional protection of the product and are often discarded shortly after use.

This trend toward using expensive materials in mooncake packaging has given rise to the phenomenon of "sky-high mooncakes," where the price of the packaging significantly exceeds the value of the product inside. This not only distorts consumer perception but also exacerbates the problem of resource waste. Many consumers and environmentalists have called for a reduction in the use of non-recyclable and costly materials, urging the industry to focus on more sustainable, eco-friendly alternatives that still provide adequate protection and visual appeal.

(4) Environmental and Regulatory Concerns

The issues of excessive packaging, large packaging gaps, and the use of expensive materials are not only detrimental to the environment but also increasingly subject to regulatory scrutiny. In response to rising concerns about waste and pollution, the Chinese government has implemented stricter regulations aimed at curbing excessive packaging in the food industry, including mooncakes. These regulations set limits on the amount of packaging allowed per product and encourage the use of sustainable materials.

Under the new standards, companies are required to reduce the number of packaging layers and eliminate unnecessary materials, such as oversized boxes or non-recyclable inserts (Ruan, 2023). Additionally, there is a growing emphasis on designing packaging that can be easily recycled or reused, aligning with the broader goals of sustainability and waste reduction.

For mooncake manufacturers, complying with these regulations presents both challenges and opportunities. On the one hand, brands must find ways to reduce their environmental footprint without sacrificing the luxury and aesthetic appeal that consumers expect from premium mooncakes. On the other hand, adopting more sustainable packaging practices can enhance a brand's reputation and appeal to eco-conscious consumers, who are increasingly seeking out products that align with their environmental values.

4. Suggestions for Improving Mooncake Packaging

Based on the sustainable mooncake packaging design framework discussed in the previous sections, several practical suggestions can be proposed to guide mooncake manufacturers toward more sustainable, cost-effective, and culturally relevant packaging solutions. These suggestions focus on optimizing the economic, social, and environmental aspects of packaging design while addressing the pressing concerns of excessive packaging, material waste, and environmental impact. By adopting these strategies, mooncake companies can align with consumer preferences for sustainable products and comply with increasingly stringent environmental regulations.

4.1 Economic Sustainability Suggestions

To achieve economic sustainability in mooncake packaging, manufacturers must strike a balance between reducing costs and maintaining the quality and appeal of the product. The key to this is maximizing material efficiency, optimizing production processes, and finding ways to add value without increasing the overall environmental footprint of the packaging.

(1) Implement Reduction Strategies

One of the most effective ways to enhance economic sustainability is by reducing the amount of packaging material used. Companies should focus on creating more compact and efficient packaging designs that eliminate unnecessary layers, components, and void spaces. This can be achieved by streamlining the structure of the packaging, using lightweight materials, and

designing smaller boxes that better fit the size of the product. By reducing material usage, companies can significantly lower production and transportation costs, leading to both economic and environmental benefits.

(2) Explore Reusable Packaging

Reusable packaging can add value to the product by offering consumers additional functionality beyond the immediate use of the packaging. For example, mooncake manufacturers can design packaging that doubles as a storage container, decorative box, or household item, encouraging consumers to keep and repurpose the packaging after the mooncakes are consumed. Reusable packaging not only enhances the product's perceived value but also promotes sustainability by reducing the need for single-use packaging. Additionally, it can foster brand loyalty, as consumers are more likely to remember and reuse attractive, functional packaging.

(3) Focus on Seasonal Production Efficiency

Since mooncake sales peak during the Mid-Autumn Festival, manufacturers should optimize their production and packaging strategies to align with the seasonal demand. By producing and packaging mooncakes closer to the festival period, companies can reduce inventory costs, avoid waste due to overproduction, and better manage the supply chain. Additionally, packaging designs that reflect the seasonal nature of the product such as incorporating Mid-Autumn Festival motifs or themes can enhance consumer appeal and strengthen the cultural connection of the packaging.

(4) Optimize the Use of Recyclable Materials

Economic sustainability can also be achieved by focusing on the recyclability of packaging materials. By selecting cost-effective, recyclable materials like paper, cardboard, or specific types of plastics, mooncake companies can reduce both production and disposal costs. Clear labeling that indicates how to recycle the packaging can further enhance the product's sustainability credentials, attracting environmentally conscious consumers and helping the brand align with government regulations on waste reduction.

4.2 Social Sustainability Suggestions

Social sustainability in mooncake packaging requires a thoughtful approach that honors cultural heritage, fosters community values, and meets the evolving expectations of modern consumers. Mooncakes are more than just a food product; they carry deep cultural significance, especially during the Mid-Autumn Festival, and their packaging must reflect this while also adapting to contemporary trends and preferences.

(1) Incorporate Cultural and Regional Elements

Mooncake packaging should continue to emphasize its cultural heritage by incorporating traditional design elements that resonate with consumers' cultural and emotional connections to the Mid-Autumn Festival. This can be achieved by using iconic symbols such as the full moon, lanterns, and rabbits, which evoke feelings of family reunion, harmony, and celebration. Additionally, regional variations in mooncakes—such as different flavors, shapes, and textures—can be highlighted through localized packaging designs that reflect the unique cultural identities of various regions in China. This not only reinforces the product's cultural relevance but also strengthens its appeal to consumers who appreciate the traditional and symbolic meaning of mooncakes.

(2) Focus on Modern Aesthetics with a Cultural Twist

While tradition is important, mooncake packaging must also adapt to modern consumer tastes, which often favor minimalist, sleek, and elegant designs. By blending traditional cultural elements with contemporary design aesthetics, mooncake packaging can appeal to both younger consumers and those who value heritage. For instance, brands can experiment with modern color palettes, typography, and packaging shapes while retaining key cultural motifs. This balance between old and new can make the product more visually appealing and relevant to a broader audience.

(3) Promote Transparency and Social Responsibility

Social sustainability also involves ensuring that packaging communicates the brand's values and commitment to sustainability. Mooncake manufacturers should use packaging to convey important information about the product's ingredients, origin, and production processes, as well as its environmental impact. Labels that emphasize the product's eco-friendliness, ethical sourcing, or compliance with environmental regulations can enhance the brand's reputation and appeal to socially conscious consumers. Clear communication about the recyclability or reuse potential of the packaging can further encourage responsible consumer behavior and contribute to broader sustainability goals.

4.3 Environmental Sustainability Suggestions

Environmental sustainability is perhaps the most pressing concern in mooncake packaging design, given the growing global focus on reducing waste and protecting natural resources. Mooncake manufacturers must adopt strategies that minimize the environmental footprint of their packaging by using sustainable materials, reducing waste, and promoting recycling and biodegradability.

(1) Reduce Material Waste and Over-packaging

To address the issue of excessive packaging, mooncake manufacturers should focus on reducing the overall volume of packaging materials used. This can be achieved by eliminating unnecessary layers of packaging, minimizing the use of plastic inserts or trays, and designing more efficient packaging structures. By carefully measuring the size and weight of the mooncakes, companies can create packaging that better fits the product, reducing the empty space between the packaging and the mooncake itself. Reducing material waste not only helps the environment but also aligns with government regulations aimed at curbing excessive packaging in the food industry.

(2) Adopt Biodegradable and Compostable Materials

Biodegradable and compostable materials offer a sustainable alternative to traditional packaging materials like plastic and metal, which take hundreds of years to break down. Mooncake manufacturers can explore the use of plant-based plastics, compostable paper, or other natural materials that decompose quickly and safely in the environment. These materials help reduce the burden on landfills and prevent pollution, particularly in countries where waste management systems are still developing. Biodegradable packaging can also enhance the brand's image as a leader in sustainability, appealing to consumers who prioritize eco-friendly products.

(3) Use Recyclable and Low-Toxicity Materials

Another critical step toward environmental sustainability is the use of recyclable materials that can be easily processed and reused in future packaging or products. Paper, cardboard, and certain types of plastic are commonly recycled and can significantly reduce the environmental

impact of packaging waste. Mooncake manufacturers should prioritize these materials in their packaging designs and clearly label the packaging with recycling instructions to encourage proper disposal. In addition, companies should opt for low-toxicity inks, adhesives, and coatings, which reduce the risk of harmful chemicals leaching into the environment during production or disposal.

5. Conclusion

The sustainable development of the mooncake industry is not just an opportunity but a necessity in today's market. As consumer expectations evolve and environmental challenges become more pressing, it is essential for mooncake manufacturers to rethink their packaging strategies. This study has proposed a comprehensive framework for sustainable mooncake packaging design, addressing key economic, social, and environmental factors. By integrating these considerations into the packaging process, mooncake companies can not only reduce their environmental impact but also improve their competitive edge and align with both regulatory demands and consumer preferences.

5.1 Economic Benefits of Sustainable Packaging

The shift toward sustainable packaging offers significant economic advantages for mooncake manufacturers. One of the primary benefits is cost reduction through the efficient use of materials and energy. By minimizing the amount of packaging material and optimizing packaging structures, companies can lower their production costs, transportation fees, and storage expenses. The use of smaller, lighter packaging can lead to more efficient shipping and handling, further driving down costs. In an industry where competition is fierce, these cost savings can help companies maintain profitability while offering competitive prices to consumers.

In addition to direct cost savings, sustainable packaging also provides long-term economic benefits by enhancing brand loyalty and customer retention. As consumers increasingly prioritize sustainability in their purchasing decisions, brands that adopt eco-friendly packaging practices are more likely to attract and retain environmentally conscious customers. Reusable and recyclable packaging adds value to the product, making it more appealing to consumers who are looking for products that align with their values. This can lead to increased brand differentiation and a stronger market position in the long run.

Moreover, compliance with government regulations on packaging waste and sustainability will help companies avoid potential fines or penalties associated with non-compliance. As countries worldwide, including China, introduce stricter regulations on food packaging, companies that proactively adopt sustainable practices will be better positioned to meet these requirements and avoid the financial risks associated with regulatory violations.

5.2 Social Impacts of Sustainable Packaging

Sustainable packaging also plays a crucial role in promoting social responsibility and reinforcing cultural identity. Mooncakes, as traditional gifts with deep cultural significance, provide an ideal platform for showcasing how packaging can contribute to the preservation of cultural heritage while embracing modern values like environmental stewardship.

By incorporating cultural symbols and motifs that reflect the history and traditions of the Mid-Autumn Festival, mooncake packaging can enhance the emotional connection between the product and its consumers. For example, the use of traditional imagery, such as the full moon,

family reunions, and mythical figures like the moon goddess Chang'e or the Jade Rabbit, strengthens the cultural significance of the mooncakes. At the same time, modern design techniques can be used to create packaging that is aesthetically appealing to younger generations, blending tradition with contemporary style.

Sustainable packaging also supports social equity by promoting transparency in the product's environmental impact and aligning with ethical values. Brands that are transparent about their sustainability efforts can foster greater trust and loyalty among consumers, especially in an era where ethical consumption is on the rise. Clear labeling about the recyclability or reusability of packaging materials, along with information about the environmental benefits of the packaging, can help consumers make informed decisions that support sustainable practices. Furthermore, socially sustainable packaging can have a positive impact on the broader community by reducing waste and pollution. By minimizing the use of harmful materials and encouraging recycling, mooncake companies can contribute to cleaner, healthier environments for local communities, aligning their business practices with the goals of sustainable development and social welfare.

5.3 Environmental Benefits of Sustainable Packaging

The environmental advantages of sustainable mooncake packaging are perhaps the most compelling reason for its adoption. Traditional packaging practices have contributed to significant environmental degradation, particularly through the use of non-recyclable materials, excessive packaging, and waste generation. By transitioning to sustainable packaging solutions, mooncake manufacturers can help reduce their environmental footprint and contribute to the preservation of natural resources.

Waste reduction is one of the most immediate benefits of sustainable packaging. By designing more efficient packaging that eliminates unnecessary layers and materials, mooncake companies can drastically reduce the amount of packaging waste generated during production, distribution, and disposal. This aligns with global efforts to reduce plastic waste and lower the volume of waste sent to landfills.

In addition to reducing waste, sustainable packaging helps minimize the use of non-renewable resources such as petroleum-based plastics and metals. By adopting biodegradable, compostable, or recyclable materials, companies can limit their reliance on finite resources and support the circular economy. These materials are designed to break down naturally or be reprocessed into new products, reducing their environmental impact and helping conserve valuable resources for future generations.

The use of low-toxicity materials in packaging also contributes to environmental sustainability by preventing the release of harmful chemicals into the ecosystem. Traditional packaging processes often involve the use of toxic inks, adhesives, and coatings that can leach into the environment, posing risks to both human health and wildlife. By opting for water-based inks, non-toxic adhesives, and biodegradable coatings, mooncake manufacturers can create safer packaging that is less likely to contribute to environmental pollution.

Finally, sustainable packaging solutions can also mitigate climate change by reducing the carbon footprint associated with production and disposal. Many sustainable materials require less energy to produce and process compared to conventional plastics and metals. Additionally, packaging that can be reused or recycled helps extend the lifecycle of the materials, further reducing the need for virgin resource extraction and minimizing greenhouse gas emissions.

5.4 Future Research and Recommendations

The future of mooncake packaging lies in the continued pursuit of sustainability. As consumer awareness of environmental issues grows, and governments tighten regulations on waste and resource use, the demand for sustainable packaging solutions will only increase. Mooncake manufacturers that embrace sustainability will be well-positioned to thrive in this evolving market, while those that fail to adapt risk being left behind.

Innovation in material science will play a key role in the future of sustainable packaging. As new materials are developed that offer superior environmental performance without compromising aesthetics or functionality, mooncake companies will have more options for creating eco-friendly packaging that meets both consumer expectations and regulatory standards. The development of biodegradable plastics, plant-based materials, and recyclable composites will allow manufacturers to design packaging that is both visually appealing and environmentally responsible.

Consumer engagement is another critical aspect of the future of sustainable packaging. Mooncake brands should actively involve consumers in their sustainability efforts by providing clear instructions on how to recycle or reuse packaging and educating them about the environmental benefits of sustainable materials. Additionally, companies can explore innovative business models, such as packaging take-back programs or discounts for customers who return or recycle packaging, to encourage more sustainable consumption patterns.

Collaboration across industries will also be essential for advancing sustainable packaging practices. Mooncake manufacturers should work closely with packaging suppliers, environmental organizations, and regulatory bodies to develop and implement packaging solutions that minimize waste, reduce resource use, and promote recycling. By fostering collaboration and sharing best practices, the mooncake industry can accelerate the adoption of sustainable packaging and contribute to broader environmental goals.

5.5 Conclusions

The shift towards sustainable mooncake packaging is not just a response to regulatory pressures or market trends; it represents a fundamental transformation in the way the industry approaches packaging design and production. By focusing on economic, social, and environmental sustainability, mooncake manufacturers can create packaging solutions that are not only beautiful and functional but also aligned with the values of today's consumers and the needs of the planet.

In conclusion, the adoption of sustainable packaging practices will help the mooncake industry achieve a balance between cultural heritage, consumer satisfaction, and environmental responsibility. By reducing waste, promoting recycling, and using eco-friendly materials, the mooncake industry can play a leading role in driving sustainable development and setting new standards for the future of packaging design.

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