



Integrating Product Innovation and Sustainable Packaging to Enhance Competitiveness of Dodol SMEs

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ABSTRACT

Dodol Betawi, a traditional Indonesian confection, faces limited competitiveness due to its high sugar content, lack of product diversification, and reliance on plastic packaging. These challenges reduce consumer appeal, restrict entry into modern retail channels, and hinder export readiness. This study reports a participatory community service program with UMKM D'Tungku in Bojonggede, West Java, aimed at developing a replicable model that integrates product innovation, appropriate technology, and sustainable packaging. Five low-sugar dodol variants enriched with local botanicals—pumpkin, pineapple, pandan leaves, hibiscus, and butterfly pea—were formulated to provide functional benefits such as dietary fiber, antioxidants, and potential anti-diabetic properties. Alongside product reformulation, eco-friendly packaging prototypes were introduced using bamboo, natural leaves, and linen pouches to replace single-use plastics. A preliminary sensory evaluation involving SME workers indicated strong acceptance for color, taste, and aroma, though texture improvements remain necessary. Packaging innovations were well-received for their aesthetics and sustainability, despite higher production costs compared to plastic alternatives. Furthermore, appropriate technology in the form of mixing and rolling machines improved efficiency and ensured consistent product size, reducing processing time from four hours to one and a half hours. Initial export activities through the Indonesian diaspora in Japan confirmed international interest in Dodol Betawi, while underscoring the importance of sustainable packaging to meet environmentally conscious consumer expectations. The findings highlight that integrating nutritional innovation, technology adoption, and eco-friendly design provides a holistic and scalable strategy for enhancing SME competitiveness, preserving cultural food heritage, and strengthening readiness for global markets.

ABSTRAK

Dodol Betawi sebagai pangan tradisional Indonesia menghadapi keterbatasan daya saing akibat tingginya kandungan gula, minimnya diversifikasi produk, serta ketergantungan pada kemasan plastik. Tantangan ini menurunkan daya tarik konsumen, membatasi akses ke saluran ritel modern, dan menghambat kesiapan ekspor. Penelitian ini melaporkan program pengabdian masyarakat partisipatif bersama UMKM D'Tungku di Bojonggede, Jawa Barat, yang bertujuan mengembangkan model replikasi melalui integrasi inovasi produk, teknologi tepat guna, dan kemasan berkelanjutan. Lima varian dodol rendah gula diperkaya bahan botani lokal labu kuning, nanas, daun pandan, kembang

sepatu, dan bunga telang diformulasikan untuk memberikan manfaat fungsional seperti serat pangan, antioksidan, dan potensi antidiabetes. Sejalan dengan reformulasi produk, prototipe kemasan ramah lingkungan diperkenalkan menggunakan bambu, daun alami, dan pouch linen sebagai pengganti plastik sekali pakai. Evaluasi sensoris awal yang melibatkan pekerja UMKM menunjukkan penerimaan positif terhadap warna, rasa, dan aroma, meskipun tekstur masih memerlukan perbaikan. Inovasi kemasan diterima baik dari aspek estetika dan keberlanjutan, meski menghadapi tantangan biaya lebih tinggi dibanding plastik. Selain itu, penerapan teknologi tepat guna berupa mesin pengaduk dan pelinting meningkatkan efisiensi dan konsistensi ukuran produk, serta memangkas waktu produksi dari empat jam menjadi satu setengah jam. Upaya ekspor awal melalui diaspora Indonesia di Jepang membuktikan adanya minat pasar internasional, sekaligus menegaskan pentingnya kemasan berkelanjutan untuk memenuhi ekspektasi konsumen yang peduli lingkungan. Temuan ini menegaskan bahwa integrasi inovasi gizi, adopsi teknologi, dan desain ramah lingkungan merupakan strategi holistik dan terukur untuk meningkatkan daya saing UMKM, melestarikan warisan kuliner, dan memperkuat kesiapan memasuki pasar global.

1. Introduction

Dodol is a traditional Indonesian food classified as a semi-moist confection with a chewy texture and limited shelf life (Habyba et al., 2022). Dodol is representing a cultural heritage product that contributes to the nation's culinary identity. Dodol Betawi from Jakarta is a well-known variety that has been preserved for generations and is now produced in various regions (Solehudin et al., 2023). One of the small and medium-sized enterprises (SMEs) producing Dodol Betawi, called D'Tungku, located in Bojonggede, West Java, has been producing dodol since the 1980s, making a significant contribution to the local economy (Habyba et al., 2022). The enterprise holds halal, Indonesian National Standard (SNI), and PIRT certifications, demonstrating compliance with national quality and safety requirements. However, despite these achievements, D'Tungku faces persistent barriers that limit its competitiveness and readiness for export markets.

The first challenge is a lack of product innovation for its dodol, which currently comes in three flavors: original, durian, and sesame – a similarity shared by many other dodol producers, making it difficult to differentiate its products. Furthermore, the high sugar content reduces its appeal among health-conscious consumers and individuals with diabetes (Abdurrahman et al., 2021; Setiavani et al., 2018), particularly in light of increasing demand for low-glycemic traditional snacks. Excessive sugar influences the final product's texture and color (Setiavani et al., 2018).

The second challenge is that the uneven shape and size of dodol often occur in the dodol rolling process, especially when production is abundant,

such as during the fasting month before Eid al-Fitr and Eid al-Adha, employees have difficulty rolling this dodol, so that the shape and size of the dodol become uneven. The non-standard shape and size make it difficult for the UMKM Dodol D'Tungku's dodol to be marketed in mini markets.

The last challenge involves packaging, which currently relies on simple plastic for both primary and secondary layers (as seen in Figure 1). However, currently, the development of environmentally friendly packaging, for example, bamboo-based designs (Darwin et al., 2021; Hantoro & Soewito, 2018), or eco bags, pineapple leaf fiber as secondary packaging (Faradilla et al., 2022), emerged as a viable alternative to plastic because it is renewable, compostable, and has positive brand associations.



Figure 1. Dodol packaging in D'Tungku

The literature indicates that targeted interventions in product formulation and packaging design can significantly improve SME competitiveness in the food sector. Previous studies for dodol product innovation have been carried out by making various dodol flavors, such as snake fruit dodol (Fahimah et al., 2023; Suryawati & Irawati, 2022), pineapple dodol (Opan Arifudin et al., 2020; Perdana et al., 2025; Tresnawati, 2010; Zulfikar et al., 2022), durian dodol (Zebua et al., 2025), seaweed

dodol (Abdurrahman et al., 2021), tomato dodol (Eka putri & Faridah, 2023), cempedak dodol (Putranto et al., 2020), and mangrove fruit (Prastari et al., 2025) as an effort to focus on product diversification. In this program, nutrient-enriched innovations using locally available botanical ingredients have been shown to enhance functional value and market appeal for traditional foods used as new dodol varieties, including those enriched with pumpkin, pandan leaves, hibiscus flowers, and butterfly pea flowers, which provide health benefits such as antioxidant activity, anti-diabetic potential, and dietary fiber enrichment.

The present study addresses this gap through a community service program designed to enhance the competitiveness and export readiness of UMKM D'Tungku. The intervention integrates two core strategies: (1) developing five low-sugar dodol variants enriched with nutrients from local botanicals (pumpkin, pandan leaves, pineapples, hibiscus flowers, and butterfly pea flowers) and (2) replacing plastic packaging with visually appealing, environmentally friendly bamboo-based designs.

The contribution of this study lies in presenting a replicable model for traditional food SMEs that combines product innovation and sustainable packaging design to achieve export readiness. These findings are expected to inform policymakers, SME practitioners, and researchers on how to design holistic, technology-based, and sustainability-oriented interventions that can transform local food businesses into globally competitive brands.

2. Methods

Location

This program took place in D'Tungku, Bogor Regency, Bojonggede, West Java. The peak of the service was held on August 9, 2025, with various preparations and assistance from June to December 2025. The program was designed as an integrated model between product innovation and sustainable packaging design to improve the competitiveness and export readiness of a traditional food SME. The primary partner was UMKM D'Tungku, a small-scale producer of Dodol Betawi with halal, SNI, and PIRT certifications. The collaboration involved five core team members from the Department of Industrial Engineering and Business Economics, Universitas Trisakti. The lecturers from Industrial Engineering have expertise in food technology and packaging design. A lecturer has expertise in business and exports from Business Economics, and two students as assistants. The SME contributed three production workers and one marketing officer.

Tools and Materials

Local botanical ingredients used for product innovation included pumpkin (*Cucurbita moschata*), pineapple (*Ananas comosus*), pandan leaves (*Pandanus amaryllifolius*), hibiscus flowers (*Hibiscus rosa-sinensis*), and butterfly pea flowers (*Clitoria ternatea*). These were sourced from regional suppliers in West Java. Standard dodol ingredients such as glutinous rice flour, coconut milk, and sugar were provided by the SME. Then there was the addition of a dodol rolling machine that was designed by the team itself so that the dodol would be the same size and weight, even though it was still operated manually. For packaging innovation, samples of bamboo containers were obtained through local markets and e-commerce platforms. Supporting equipment, cooking tools, laptops, cameras, and stationery were used to facilitate documentation, formulation trials, and training sessions.

Procedures

The program was implemented in three main stages:

1. Preliminary Survey:

A preliminary survey was conducted to identify the main challenges faced by UMKM D'Tungku in terms of product formulation, packaging, and marketing (Figure 2). The survey involved interviews with SME owners, observation of production processes, and documentation of existing products and packaging. The findings highlighted two main problems: high sugar content in dodol and the exclusive use of plastic packaging.



Figure 2. Preliminary survey

2. Design and Development:

Product Innovation:

Based on the survey results, the team collaborated with SME workers to develop five new dodol formulations with reduced sugar levels and enrichment from local botanical ingredients. A stepwise reduction of sugar was applied to maintain texture, color, and shelf life. Each variant (pumpkin, pineapple, pandan leaves, hibiscus, and butterfly pea) underwent small-batch trials in the SME kitchen. A

preliminary sensory evaluation was completed on August 9, 2025, with eleven panelists, who are SME workers, excluding team members. Panelists assessed taste, texture, aroma, and overall acceptability. Feedback was used to refine the formulations.

Packaging Innovation:

In parallel, the team introduced eco-friendly packaging concepts to replace single-use plastics. Prototypes were developed using bamboo tubes for secondary packaging and natural leaves (banana or dried coconut leaves) for primary wrapping. Alternative designs, such as linen drawstring pouches with batik motifs, were also explored to position dodol as a premium souvenir product. Packaging samples were procured and tested for practicality, aesthetics, and user acceptance during the August 2025 evaluation session. Cost considerations and shelf-life implications were discussed with the SME to assess feasibility for long-term adoption.

3. Results And Discussion

Product Innovation

The program successfully developed five new low-sugar dodol variants enriched with local botanical ingredients: pumpkin, pineapple, pandan leaves, hibiscus, and butterfly pea flowers. For example, pumpkin provides dietary fiber and beta-carotene (Nurjanah et al., 2020), Hibiscus contributes antioxidant activity (Aisyah et al., 2016), Butterfly pea is associated with anthocyanin content and anti-diabetic potential (Thuy et al., 2022). These findings align with previous studies showing that botanical enrichment can improve the nutritional value and consumer appeal of traditional confections. Figure 3 illustrates the developed dodol variants, with yellow representing pineapple, purple representing butterfly pea, orange representing pumpkin, green representing pandan leaves, and red representing hibiscus.



Figure 3. New variants dodol

A preliminary sensory evaluation was conducted with eleven panelists, who are the SME workers, and

five panelists from the team members, on August 9, 2025. The assessment covered taste, texture, aroma, and overall acceptability. Based on the assessment results (Table 1), the majority of respondents strongly liked the color (81.25%), while only 18.75% liked it. In terms of taste, 81.25% of respondents strongly liked it, and 18.75% liked it. Texture was rated as "like" by 33.33% and "dislike" by 66.67%. Many disliked the texture because it was too soft, suggesting a need for reformulation to make the dodol denser and chewier. Regarding the aroma, "33.33% strongly liked it," while 66.67% were neutral.

Table 1. The results of the evaluation of the new dodol variance

Category	Color (%)	Texture (%)	Aroma (%)	Taste (%)
Strongly Liked	81,25	0	33,33	81,25
Liked	18,75	33,33	66,67	18,75
Neutral	0	0	0	0
Dislike	0	66,67	0	0
Strongly Dislike	0	0	0	0
Total	100	100	100	100

Based on the panelists' comments, the team provided feedback explaining that reformulation was needed, particularly in terms of texture and flavor (Figure 4). The team also suggested adding coconut milk to the current dodol formulation. The more coconut milk in the mixture, the less sticky the dodol becomes due to the coconut milk's lubricating effect (Setiavani et al., 2024).



Figure 5. Team provided feedback

Laboratory validation of sugar reduction was not performed within this program due to resource limitations. Nevertheless, the formulation trials demonstrated the feasibility of developing lower-sugar dodol without compromising essential characteristics such as chewiness and color. This outcome highlights an important direction for SMEs: integrating functional nutrition into traditional products to address consumer health trends and expand market opportunities.

The team also provided a dodol grinding machine to simplify grinding, both in terms of time and labor, and a dodol rolling machine (Figure 5) to help produce uniform dodol products in terms of size and weight (standard). The benefit for MSMEs is that the machine reduces the usual 4 hours of mixing time for one dodol production process to just 1.5 hours.



Figure 6. Dodol grinding machine and dodol rolling machine.

Packaging Innovation

The introduction of bamboo as a secondary packaging material has generated significant enthusiasm among SMEs to replace single-use plastics. It is also hoped that primary packaging can be replaced with more environmentally friendly alternatives, such as using banana leaves or dried coconut leaves.

The proposed packaging design is shown in Figure 6. Primary packaging for dodol wrappers can use banana leaves or dried coconut leaves shaped into a cylinder and twisted at both ends (like candy). The use of this packaging looks natural and aesthetic, giving a "traditional" and zero-waste impression.



Figure 7. Inspiration for the primary and secondary packaging of dodol.

For secondary packaging, SME can use a woven cylindrical container in the form of a cylindrical bamboo tube, which is strong and has a local nuance. This can add a premium impression, suitable for regional souvenirs or exclusive hampers. The other inspiration can use a linen drawstring pouch, for example, with floral batik and embroidery motifs. Buyers can reuse it and add high aesthetic value and functionality to the packaging. The use of packaging like this is suitable for exclusive dodol products that want to be marketed as cultural souvenirs or company hampers.

When the team visited SMEs, the team provided a brief introduction to the importance of packaging for a product (Figure 7). The team provided insight into how packaging is the first thing consumers notice about a product. If an SME's target is exports, quality and packaging are crucial.



Figure 8. Brief introduction to the importance of packaging for a product

During the team's visit, bamboo packaging purchased from e-commerce sites was provided to SMEs as samples that they could use in various models or shapes, as shown in Figure 8. However, primary packaging still requires consideration due to its impact on shelf life (Eka Putri & Faridah, 2023). Apart from plastic packaging, SME can also use laminated paper as an alternative to reduce stickiness (Iznillillah et al., 2024). Furthermore, a cost analysis of bamboo-based packaging is necessary, as it will be more expensive than plastic. However, environmentally friendly packaging can play a role in increasing consumer confidence and export readiness (Versino et al., 2023).



Figure 9. Bamboo packaging that can be used as secondary packaging for dodol products.

The results reinforce the notion that packaging innovation should not only address environmental concerns but also consider market positioning. By offering packaging that combines tradition and sustainability, SMEs can differentiate their products and appeal to environmentally conscious consumers, both domestically and internationally.

Integrating Product and Packaging Innovations

The integration of product and packaging innovations positions UMKM D'Tungku to compete in broader markets, including export opportunities. The simultaneous development of healthier dodol variants and sustainable packaging represents a holistic strategy to overcome key barriers high sugar content and plastic dependency that limit traditional SMEs.

This approach reflects the growing importance of combining cultural heritage preservation with sustainability practices in food innovation. As noted in similar SME development programs, interventions that merge nutrition, design, and branding are more likely to achieve long-term competitiveness (Darwin et al., 2021; Faradilla et al., 2022; Hantoro & Soewito, 2018). For UMKM D'Tungku, the development of five nutrient-enriched dodol variants and the introduction of bamboo-based packaging create a foundation for premium positioning, especially for diaspora

markets that value authenticity and eco-friendly practices.

Following the PKM program, significant improvements have been made to MSMEs, particularly with the change in packaging, which now uses environmentally friendly packaging. Before the PKM program, weekly dodol production was 35 kg (per production run). Following the PKM program, production has significantly increased to 105 kg per day (Figure 9).

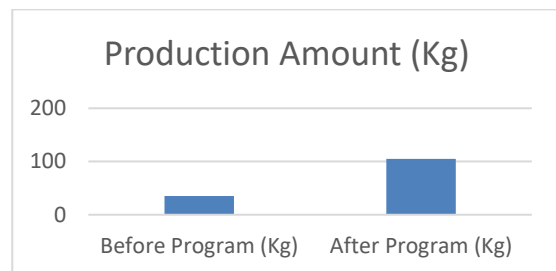


Figure 10. Increase in the amount of dodol production

Nevertheless, the findings also reveal limitations. The lack of laboratory testing, limited panel size, and preliminary stage of packaging trials indicate that further research is needed before scaling up. Future studies should include quantitative analysis of sugar reduction, shelf-life testing, consumer surveys with larger samples, and detailed cost-benefit assessments. Addressing these aspects will strengthen the evidence base and support SMEs in making informed decisions for sustainable growth.

Export Opportunities

In addition to this program, there is the potential for exporting Betawi Dodol from the D'Tungku MSME. Through the Indonesian diaspora, several batches of dodol have been brought to Japan and introduced at cultural and culinary events in 2025 (Figure 10). These activities demonstrate the appeal of traditional foods in the international market, especially when positioned as heritage-based products with unique flavors.





Figure 11. Dodol D'Tungku was introduced in Japan

However, feedback from residents and event organizers in Japan highlighted packaging as a major concern. While dodol itself is appreciated for its distinctive flavor and cultural value, plastic packaging is considered inconsistent with Japan's strong emphasis on environmental responsibility. This observation aligns with studies showing that packaging is not only a functional component but also a symbolic element that influences consumer trust, brand image, and market acceptance (Iznillillah et al., 2024; Versino et al., 2023).

These findings emphasize that for export-ready SMEs, sustainable packaging is not simply an optional feature but a requirement to meet consumer expectations in an environmentally conscious market. For D'Tungku MSMEs, the transition to bamboo-based packaging or other biodegradable packaging will be crucial in ensuring that product quality is in line with packaging that reflects global sustainability standards.

CONCLUSIONS

This program demonstrated that integrating product innovation with sustainable packaging can significantly improve the competitiveness of traditional food SMEs. The development of five low-sugar dodol variants enriched with local botanicals provided added nutritional and functional value, while packaging innovations using bamboo and natural leaves enhanced product appeal and aligned with sustainability demands. Preliminary sensory evaluation showed strong consumer acceptance of color, taste, and aroma, with recommendations for further texture optimization. Although laboratory validation and shelf-life analysis are pending, the intervention has already increased production capacity and generated international interest through the Indonesian diaspora in Japan. The results suggest that holistic interventions combining healthier formulations, appropriate technology, and eco-

friendly packaging can serve as a scalable model for traditional SMEs seeking premium positioning and export opportunities. Future research should include quantitative sugar analysis, cost–benefit evaluation, and larger consumer studies to support long-term adoption and market expansion.

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