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Vol. 6 No. 02 (2026)

Andalasian International Journal of Social and Entrepreneurial Development (AIJSED)

ISSN: 2808-6732 (Online)

Available at: http://aijsed.lppm.unand.ac.id/index.php/aijsed

DOI: https://doi.org/10.25077/aijsed.6.02.12-17.2026

Article

Solar Dome Dryer Technology for Improving the Quality and Market Competitiveness of Kamang Cassava Crackers: An International Community Service Program

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Article Information

Received : 2026-07-15
Revised : 2026-08-05
Accepted : 2026-09-01
Published: 2026-10-17

Keywords

Cassava Cracker, Community Service, Dome Dryer, Food Safety, MSME Competitiveness

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Abstract

This article reports on an international community service program that introduced dome dryer technology to improve the quality and market competitiveness of Kamang cassava crackers (kerupuk ubi kayu Kamang), a traditional food product of Nagari Koto Tangah, Tilatang Kamang, Agam Regency, West Sumatra, Indonesia. The program was implemented by the Faculty of Agricultural Technology, Andalas University, in collaboration with Universiti Putra Malaysia (UPM) under the Enhancing Quality Education for International University Recognition (EQUITY) Program funded by the Indonesian Endowment Fund for Education (LPDP). Activities included knowledge-sharing sessions delivered by an international resource person and a university research-commercialization expert; a field visit to cracker production houses; installation and demonstration of a solar-powered dome dryer; and mentoring on food-product legality, packaging, and labeling. Pre-test and post-test comparisons indicated improved partner understanding of hygienic and efficient processing techniques, product quality standards required for export markets, and packaging and branding strategies to strengthen competitiveness. The dome dryer, which raises the drying chamber temperature by approximately 10 to 25 degrees Celsius above ambient conditions, offered a practical solution to open-sun drying practices that previously exposed products to weather variability and the risk of contamination. The activity also produced tangible outputs, including improved product labels exhibited alongside the training, and dissemination through the university website and national and regional mass media. The results suggest that combining appropriate drying technology with food-safety and branding mentoring can support micro, small, and medium enterprises (MSMEs) in moving toward standardized production and broader market access, including potential entry into Malaysian and other ASEAN markets. This experience also illustrates how international academic partnerships can strengthen the internationalization agenda of higher education institutions while delivering direct benefits to rural food-based MSMEs.

INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) play a really important role in supporting Indonesia's economic growth, especially as a source of jobs and a driver of the local economy (Ibrahim 2025; Koesrianti & Tanega 2024). Kamang cassava crackers (kerupuk ubi kayu Kamang) are a well-

known regional food product of Nagari Koto Tangah, Tilatang Kamang District, Agam Regency, West Sumatra, Indonesia, and have long served as an economic backbone for dozens of household-scale producers in the area. Despite this long tradition, producers continue to face several structural constraints, namely conventional, non-standardized processing technology; limited knowledge of product innovation and diversification; product quality management that does not yet meet export standards; and packaging and branding that remain uncompetitive in national and international markets. The Faculty of Agricultural Technology, Andalas University, has core competencies in food processing technology, food engineering, and agro-industry, and its lecturers have produced applied research on cassava-based product processing that is directly relevant to helping producers improve production quality, process efficiency, and product innovation. This community service activity also aligns with several Sustainable Development Goals (SDGs): SDG 1 through increased producer income, SDG 2 through optimized local food processing, SDG 8 through inclusive economic growth for MSME actors, SDG 9 through technology transfer to local industry, and SDG 17 through the international partnership between Andalas University and Universiti Putra Malaysia (UPM). The involvement of an international resource person from UPM represents a concrete step toward the internationalization of the Faculty, widening institutional networks, opening opportunities for joint research, and giving students first-hand experience of cross-cultural, internationally oriented community engagement. This paper reports the design and field application of a solar-powered dome dryer, together with accompanying training and mentoring on food-product legality and packaging, undertaken to improve the hygiene, quality, and market competitiveness of Kamang cassava crackers and to strengthen the international academic partnership underlying the activity.

Drying is a critical step in cassava-cracker production because it directly determines the moisture content, shelf life, and hygienic quality of the final product. Open-sun drying, still practiced by most producers in Nagari Koto Tangah, leaves the product exposed to dust, insects, and unpredictable weather, and produces uneven moisture content that shortens storage life. Solar dryers, including dome-shaped designs, have been widely reported to shorten drying time, raise chamber temperature above ambient conditions, and improve product hygiene compared with open-sun drying, while remaining affordable for small-scale, rural producers (Suherman et al., 2024). Beyond the drying process itself, market access for MSME food products increasingly depends on formal legality, such as the Home Industry Food Production Certificate (SP-PIRT) and halal certification, which strengthen consumer trust and open the way to modern and export markets (Vasani & Abdulkareem, 2024). These two strands, appropriate drying technology and food-product legality and branding, form the basis of the intervention described in this paper.

EXPERIMENTAL SECTION

The community service activity used a continuous mentoring approach consisting of coordination, problem identification, field survey, technology preparation, and implementation of a drying-technology innovation, followed by an evaluation stage described below.

Materials

The activity was carried out in Nagari Koto Tangah, Tilatang Kamang District, Agam Regency, West Sumatra, on 9 July 2026. Materials used included a bilingual (Indonesian-English) training module, pre-test and post-test questionnaires, cassava dough and traditional cracker-processing equipment belonging to the partner MSMEs, and the components for building the dome dryer, namely a galvanized steel frame, UV-resistant transparent polycarbonate sheeting, a concrete base, and perforated drying racks. Participants comprised owners and workers of Kamang cassava-cracker MSMEs, lecturers and students from the Faculty of Agricultural Technology, Andalas University, representatives of the Nagari Koto Tangah government and the Agam Regency Industry Office, and members of the Forum Komunikasi Perguruan Tinggi Teknologi Pertanian Indonesia (FKPT-TPI).

Instrumentation

The main technological instrument developed for the partner was a dome dryer. This dome-shaped solar drying chamber uses a transparent covering to admit solar radiation and an internal air-circulation and ventilation system to remove moisture-laden air, thereby raising the internal drying temperature by approximately 10 to 25 degrees Celsius above ambient conditions, depending on sunlight intensity. Evaluation instruments consisted of structured pre-test and post-test questionnaires administered to

partner participants to measure changes in understanding of hygienic processing techniques, export-oriented quality standards, and packaging and branding strategies.

Procedure

The program was implemented in three stages. In the preparation and planning stage (April-June 2026), the team coordinated with the partner MSMEs to identify technical production problems, communicated intensively with the international resource person from UPM to design context-appropriate training materials, developed the bilingual training module, arranged venue permits, and organized the resource person's travel and the invitation of participants. In the implementation stage (9 July 2026), the activity was held for a full day in Nagari Koto Tangah and comprised an opening ceremony with traditional Minangkabau welcome performances, remarks from the Dean of the Faculty of Agricultural Technology and the Sub-district Head of Tilatang Kamang, presentation of materials by the international resource person and a university research-commercialization expert, a joint visit to the MSME production houses, demonstration of the dome dryer, an exhibition of labelled cracker products, and a traditional culinary festival. In the evaluation and dissemination stage (July-August 2026), pre-test and post-test results were compared to measure the increase in partner knowledge, an activity report and scientific manuscript were prepared, and the results were disseminated through the official Andalas University website and national and regional mass media, with acknowledgment of LPDP-EQUITY funding included as required.

RESULT AND DISCUSSION

The community service activity was implemented in stages with the partner Kamang cassava-cracker MSMEs, beginning with coordination, problem identification, field survey, and technology preparation, and culminating in the installation of a dome dryer as a processing technology innovation. The activity comprised presentations by the resource persons, a visit to MSME production houses, a demonstration of the dome dryer, and mentoring on packaging and product labeling. The first resource person, Prof. Ts. Dr. Rosnah Bt Shamsudin of Universiti Putra Malaysia (UPM), presented on "Empowering Rural Food Industries through Innovation and Technology," while the second, Dr. Eng. Muhammad Makky, Director of Research Cooperation and Commercialization at Andalas University, presented on "Research Commercialization and Technological Innovation for Enhancing MSME Competitiveness and Sustainable Development." Partner participants showed a high level of engagement, evident in their active participation in the discussion sessions and the hands-on demonstration of the introduced processing innovation.



Figure 1. Field survey

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Figure 2. Photo of the presentation by the speaker

A direct visit to the MSME production houses in Nagari Koto Tangah showed that drying was still performed mainly by open-sun exposure, resulting in uneven moisture content, shorter storage life, and a higher risk of contamination from dust and insects. As a solution, the team introduced a dome dryer, a dome-shaped chamber that captures solar energy through a transparent cover and circulates the resulting heated air to draw moisture from the product before venting it out. This raised the internal chamber temperature by approximately 10 to 25 degrees Celsius above ambient conditions, depending on sunlight intensity. Shortened drying time, reduced weather dependency, protected the product from dust and insects, and produced more uniform product quality, consistent with findings reported for dome and solar dryer applications in other rural food-processing contexts (Surahman et al., 2026).



Figure 3. Kamang Sweet Potato Crackers Product Exhibition

Beyond the drying technology itself, partners were introduced to the importance of product legality, including the Home Industry Food Production Certificate (SP-PIRT), halal certification, and other quality standards required for entry into modern retail and export markets, as well as to Good Manufacturing Practices for Processed Food (Cara Produksi Pangan Olahan yang Baik, CPPOB), covering environmental hygiene control, contamination prevention, process control, and sanitation, all of which remain especially relevant given that part of the Kamang cracker production process is still performed traditionally (Vasani & Abdulkareem, 2024). A pre-test and post-test comparison indicated an improvement in partner understanding across three areas, summarized in Table 1.

Table 1. Improvement in partner understanding based on pre-test and post-test comparison

No.	Aspect Assessed	Before Training	After Training
1.	Hygienic and efficient cassava processing techniques	Predominantly conventional, manual sun-drying practices	Improved understanding of hygienic, standardized processing steps
2.	Product quality standards for export markets	Limited awareness of export-oriented quality requirements	Increased awareness of SP-PIRT, halal, and export quality standards
3.	Packaging, labelling, and branding strategies	Simple, non-standardized packaging and labelling	Adoption of improved, labelled packaging to strengthen competitiveness



Figure 4. Use of Dome Dryer

Based on the comparison of the pre-test and post-test questionnaires, there was an increase in the partners' understanding regarding: 1) more hygienic and efficient cassava cracker processing techniques; 2) product quality standards to meet export market requirements; 3) strategies to enhance product competitiveness through packaging innovation and branding. Overall, the activities were carried out in line with the planned objectives, which were to improve the quality and competitiveness of Kamang cassava crackers so they have the potential to enter international markets. Collaboration with resource persons from Malaysia also strengthened these outcomes through cross-border knowledge and experience transfer. Some technical challenges identified during implementation (such as limitations in industrial-scale production equipment) serve as evaluation notes for planning follow-up programs, including the possibility of ongoing assistance and exploring marketing cooperation for products in Malaysia and other ASEAN countries.

The activity also received strong support and appreciation from the Faculty of Agricultural Technology at Andalas University and the government of Nagari Koto Tangah. The Dean of the Faculty, Prof. Dr. Ir. Alfi Asben, M.Si, emphasized that community service represents a concrete way for higher-education institutions to contribute to local potential, particularly in strengthening the capacity of food-

based MSMEs, and that synergy between academia and the community is essential for encouraging innovation, appropriate technology adoption, and sustainable competitiveness. The activity was disseminated through the official Andalas University website and national and regional mass media, including Antara Sumbar, Koran Jakarta, and several West Sumatra news portals, each of which included the required acknowledgment of LPDP-EQUITY funding, thereby broadening the visibility of the partnership and its outcomes beyond the immediate participants.

Nonetheless, several technical constraints were identified during implementation, notably the partner MSMEs' limited access to industrial-scale production equipment beyond the dome dryer itself. This constraint is noted as an evaluation point for follow-up planning, including the possibility of continued mentoring and exploring marketing cooperation with Malaysia and other ASEAN markets, building on the transfer of knowledge and cross-country experience facilitated through the collaboration with UPM.

CONCLUSION

This international community service program, carried out in Nagari Koto Tangah, Tilatang Kamang, Agam Regency, successfully improved partners' understanding of hygienic processing, food product legality, technological innovation, and product development for Kamang cassava crackers. The introduction of the dome dryer addressed a key bottleneck in the drying process that had previously depended on weather conditions and is expected to improve drying efficiency, product hygiene and quality, and production capacity. Complementary mentoring on legality (NIB, halal certification, SP-PIRT), packaging, labeling, and digital marketing further strengthened product identity and market reach. Overall, the program demonstrates how an international academic partnership between Andalas University and Universiti Putra Malaysia can translate into practical benefits for a rural, food-based MSME cluster and provides a foundation for continued mentoring toward the development of a locally rooted, sustainable Nagari Creative Hub.

ACKNOWLEDGEMENTS

This activity is funded by the Indonesian Endowment Fund for Education (LPDP) on behalf of the Indonesian Ministry of Higher Education, Science and Technology and managed under the EQUITY Program (Contract No. B/83/UN16.29.1/HK.10.00/2026).

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