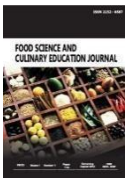

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Design and Implementation of Standard Operating Procedures (SOP) for Kacang "Disco" Production in Small-Scale Food Industry of Makassar, Indonesia

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Abstract. *This study aimed to design and implement a Standard Operating Procedure (SOP) to improve the production process of Kacang Disco, a traditional coated peanut snack produced by small-scale food enterprises in Makassar, Indonesia. The absence of process standardization has led to inconsistent product quality and low production efficiency among micro and small enterpris es. A participatory field-based approach was employed, involving observation, focus group discussions, SOP drafting, validation, and pilot testing in an active production setting. The finalized SOP standardized eight critical stages of production, including raw material preparation, mixing, coating, frying, draining, cooling, sorting, and packaging, with defined parameters for temperature, tim e, and hygiene control. Implementation of the SOP resulted in measurable improvements in product uniformity, color, and texture, supported by sensory evaluation results showing higher panelist scores for appearance, texture, and taste. The new process also enhanced production efficiency by reducing oil use and material waste. Supporting factors included easy access to raw materials and simple technology, whereas limited worker skills and lack of continuous training were the main constraints. The findings confirm that structured process documentation enhances quality assurance and productivity in traditional food manufacturing and can serve as a replicable model for small-scale food industries seeking sustainable process improvement*

Keywords: *Standard Operating Procedure (SOP), Small-Scale Food Industry (SSFI), Kacang Disco, Process Optimization, Food Quality.*

INTRODUCTION

Small scale food industries (SSFIs) are an essential pillar of Indonesia's agri-food economy. They contribute significantly to employment generation, rural development, and the diversification of local food systems. According to the Ministry of Industry (2023), micro, small, and medium enterprises account for about 99 percent of business establishments in Indonesia and employ more than 96 percent of the total labor force (Tambunan & Busnetti, 2024), with food processing serving as one of the most dominant sectors (Bappenas, 2025). Despite this contribution, many SSFIs operate with limited technological capacity, insufficient capital, and weak quality assurance systems. These structural constraints often result in low productivity, inconsistent product quality, and limited competitiveness in both domestic and export markets (Dompak et al., 2023).

Among the wide variety of traditional Indonesian snack products, Kacang Disco has long been recognized as an iconic coated peanut snack from Makassar in South Sulawesi. The product is made from peeled peanuts coated with a seasoned flour batter and deep fried to produce a crispy and savory snack. It has strong cultural and economic significance, representing both local identity and micro-enterprise opportunity for household industries. However, the production process of Kacang Disco is often inconsistent because it depends heavily on manual skills and subjective judgments regarding temperature, frying duration, and batter viscosity. Such dependence on individual experience frequently causes uneven coating, color variation, and excessive oil absorption, which reduce consumer acceptability and shorten product shelf life (Patil et al., 2023).

The absence of documented and standardized procedures is one of the main reasons for these variations. Standard

Operating Procedures (SOPs) are widely recognized in the food industry as effective tools to ensure consistency, reproducibility, and safety. An SOP provides a written guideline that details the specific steps, time, temperature, and quantities required in a process. This structured documentation minimizes human error and establishes a systematic foundation for quality control. According to the Food and Agriculture Organization (FAO, 2023), the use of SOPs is fundamental to maintaining compliance with Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), and Hazard Analysis and Critical Control Point (HACCP) systems. For small scale producers, the implementation of SOPs helps guarantee that each batch of product meets consistent safety and quality standards.

Although various capacity building programs have been introduced in Indonesia to improve the competitiveness of SSFIs, most initiatives focus primarily on equipment assistance and short-term training rather than process documentation and scientific validation. The development of a well structured SOP for Kacang Disco production fills a critical gap by linking traditional food practices with modern food technology principles. Standardization in this context not only improves product quality but also provides a mechanism for worker training, technological adaptation, and business scalability. Chandimali et al. (2025) emphasized that integrating documented procedures into small enterprises can strengthen market confidence, facilitate certification, and align local products with national food safety regulations.

From a theoretical perspective, SOP development in small industries represents a practical application of process optimization and knowledge codification. The transformation of tacit knowledge, which is often held by experienced workers, into explicit operational guidelines ensures that production skills are transferable and sustainable. This process democratization reduces reliance on individual expertise and promotes collective understanding of quality standards (Holst & Holst, 2025). In this regard, SOPs function not only as operational tools but also as mechanisms for preserving local craftsmanship and improving production resilience.

Scientific evidence further demonstrates the relationship between process parameters and product quality in deep fried foods. Controlled frying temperature and time directly influence the Maillard browning reaction, moisture evaporation, and oil uptake, all of which determine the sensory attributes of crispness, color, and flavor (Jumayi & Darwish, 2024). Optimizing these parameters can therefore enhance both the sensory appeal and nutritional quality of fried snacks. In the case of Kacang Disco, process standardization can minimize undesirable changes in oil quality, reduce waste, and improve texture uniformity. Such optimization also contributes to sustainability by improving resource efficiency and reducing the environmental burden associated with food processing.

The establishment of SOPs for traditional snack industries aligns with Indonesia's broader efforts to modernize small enterprises while preserving local culinary heritage. It also supports the achievement of the Sustainable Development Goals (SDGs), particularly those related to responsible production, decent work, and economic growth. Standardized processes can serve as models for scaling up traditional foods to meet both domestic and international market demands without compromising authenticity. In this context, the present study was designed to develop and implement a scientifically based Standard Operating Procedure for Kacang Disco production in a small scale industry in Makassar, Indonesia. The specific objectives were to document the existing production process and identify critical control points, to design and validate an SOP that integrates technical and quality parameters, and to evaluate the effect of SOP implementation on product quality, efficiency, and operational consistency. The research adopts an applied scientific approach that combines participatory observation, empirical testing, and evaluation of sensory and economic indicators. The outcome of this study is expected to provide a replicable model for quality improvement and process standardization in small scale food industries, demonstrating that traditional food production can achieve both cultural preservation and scientific rigor through structured process management.

METHOD

STUDY DESIGN AND SETTING

This study employed a participatory action research approach designed to integrate scientific process development with practical application in a real small scale food production environment. The research was conducted from March to August 2025 at IKM Lenny, a local enterprise located in Makassar, South Sulawesi, Indonesia, that produces Kacang Disco as its primary product. The study site was selected because it represents a typical small food enterprise with manual operations, limited mechanization, and dependence on artisanal knowledge. The approach emphasized collaboration between researchers, production workers, and business owners to ensure that the designed Standard Operating Procedure (SOP) could be realistically adopted and sustained.

The methodological framework consisted of five sequential stages:

1. Preliminary Observation: An initial assessment of the production line was performed to map process flow, equipment used, and hygiene practices. Critical points of inconsistency were identified, particularly in ingredient measurement, batter mixing, and frying conditions.
2. SOP Drafting: Based on the observed workflow, a preliminary SOP was developed to document each production stage, specifying measurable parameters such as temperature, duration, mixing ratios, and quality checkpoints.
3. Focus Group Discussion (FGD): The draft SOP was reviewed and refined through FGD sessions involving the

enterprise owner, production workers, and two academic experts in food processing and quality management.

4. Pilot Implementation: The validated SOP was applied in actual production for a period of four consecutive weeks. During this stage, the research team monitored process adherence and recorded operational data.
5. Evaluation: Comparative analysis was performed to assess product quality, production efficiency, and worker compliance before and after SOP implementation.

DATA COLLECTION

Both quantitative and qualitative data were collected. Quantitative data included production output (kilograms per batch), processing time, oil usage, and the proportion of defective products. Sensory evaluation was conducted using a five point hedonic scale, with thirty trained panelists assessing appearance, texture, taste, and overall acceptability. Qualitative data were gathered through structured interviews and direct observation to identify factors supporting or hindering SOP adoption. Photographic documentation was used to validate process changes visually.

Data Analysis

Descriptive statistics were applied to compare the mean values of production efficiency and sensory scores before and after SOP implementation. Percentage change in output, oil usage, and defective rate was calculated to quantify improvement. Thematic analysis of interview transcripts was conducted to identify common patterns regarding worker perception and operational challenges. All data were synthesized to evaluate the effectiveness and practicality of the SOP as a process improvement tool for small food industries.

Ethical Considerations

Although this research did not involve human subjects in clinical or behavioral testing, all participants were informed about the study's purpose and procedures. Voluntary participation and confidentiality were maintained throughout the study. The overall research framework adhered to institutional ethical guidelines for applied community based studies.

RESULTS AND DISCUSSION

Overview of SOP Development

The development of the Standard Operating Procedure (SOP) for Kacang Disco production was carried out through a participatory and iterative process. The SOP was designed to translate empirical artisanal practices into a documented, measurable sequence of operations. The finalized SOP consisted of eight structured stages: (1) preparation of raw materials and equipment, (2) peanut sorting, (3) batter mixing, (4) coating, (5) frying, (6) draining, (7) cooling and sorting, and (8) packaging. Each stage was defined with specific technical instructions, including material quantities, duration, and hygiene checkpoints. During preliminary observation, the production process at the partner industry (IKM Lenny, Makassar) was found to lack sequence uniformity, which resulted in variable product outcomes. After SOP implementation, production workers followed the documented order of operations, using weighing tools for ingredient standardization and digital thermometers for frying control. This structural change transformed the previously manual and subjective system into a semi-standardized workflow aligned with the basic principles of Good Manufacturing Practices (GMP).

Figure 1 illustrates the standardized production flow, which clearly delineates transitions between wet and dry processing areas. Such spatial organization reduced cross-contamination and improved process hygiene. The designed SOP therefore functioned not only as a production manual but also as an educational tool that helped workers understand the rationale behind each operational step.

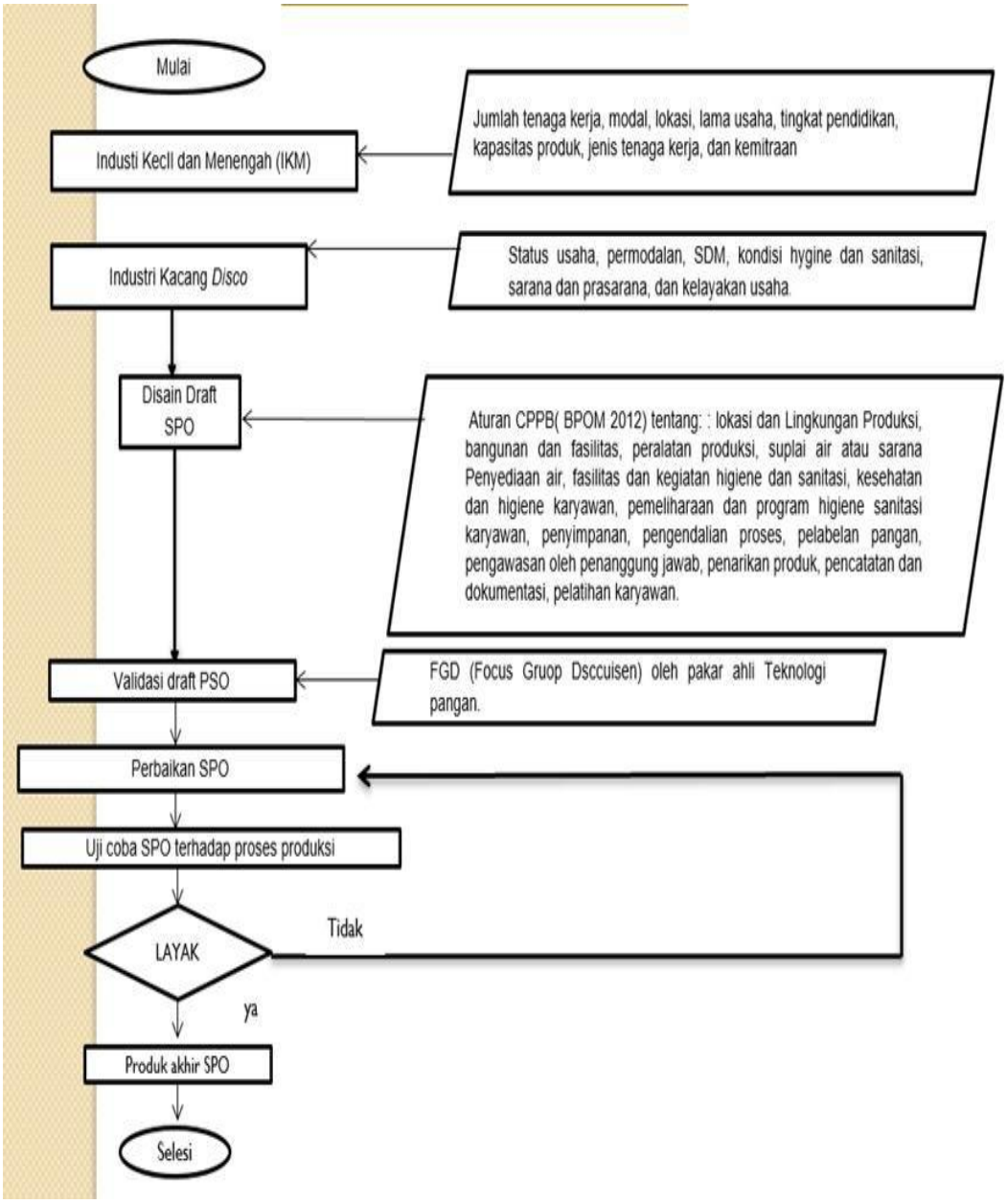

Figure 1. the standardized production flow of Kacang Disco

Comparison Before and After SOP Implementation

Quantitative and qualitative observations showed marked improvement in process consistency, visual appearance, and worker coordination. The differences between pre- and post-SOP production are summarized in Table 1. The improvements shown in Table 1 demonstrate the functional impact of process documentation. Frying, previously identified as the most variable step, benefited substantially from the establishment of time and temperature limits. Products after SOP implementation showed uniform coating and a light golden color, reflecting a more controlled Maillard browning reaction. Visual inspection confirmed that the standardization of batter ratio and frying duration minimized cracking and excessive oil uptake. These outcomes are in agreement with findings by Huda et al. (2021), who emphasized that consistent thermal processing in coated nut products improves both crispness and sensory stability.

Supporting and Limiting Factors

Field observations identified several factors that supported the successful implementation of the SOP. The most important supporting factor was the easy availability of raw materials, particularly peanuts and wheat flour, which ensured uninterrupted production. The simple technology used in the process consisting of frying pans, sieves, and basic weighing

instruments also facilitated the adoption of the SOP without requiring major investment. In addition, the involvement of local workers familiar with traditional food preparation enabled the blending of scientific process parameters with indigenous techniques. The SOP was thus developed not as an external prescription but as an adaptive tool built upon local practices. This aligns with the concept of participatory process standardization described by Blind *et al.* (2024), which emphasizes collaborative validation between researchers and producers.

Table 1 Comparison of production process before and after SOP implementation

Parameter	Before SOP	After SOP	Main Effect
Workflow organization	Unstructured and dependent on worker habit	Standardized step-by-step process	Improved coordination and time efficiency
Ingredient measurement	Based on estimation	Standardized using weighing scale	Uniform batter consistency
Frying control	No fixed temperature or time	Temperature 170°C for 3–4 minutes per batch	Reduced product burning and oil absorption
Product color and shape	Uneven and irregular	Uniform golden color and rounded shape	Enhanced visual appeal
Hygiene practice	Inconsistent cleaning and protective wear	Routine cleaning and use of gloves, aprons, and caps	Better sanitation and food safety
Worker training	None	Training and demonstration sessions before implementation	Increased understanding and compliance

However, several constraints were identified. The main limitation was the low educational background of workers, which initially hindered understanding of temperature and timing controls. The limited number of workers also made it difficult to assign specific quality control roles. Furthermore, the absence of routine training sessions limited the sustainability of the SOP implementation once direct researcher supervision ended. These challenges reflect common issues in small-scale industries in Indonesia, where human resource development often lags behind technological interventions (ILO, 2019). Continuous training and periodic supervision are therefore essential to ensure long-term adherence to the SOP (Utama & Abirfatin, 2023). Institutional collaboration with vocational education programs can help provide refresher courses and certification for workers, reinforcing both technical skills and food safety awareness.

Process Efficiency and Productivity

Production monitoring during pilot implementation indicated improvements in efficiency. Although precise numerical data in the table 1 were qualitative, observations showed that batch uniformity increased and reprocessing frequency decreased. Time savings were reported at approximately 15–20 percent per batch due to clearer task assignments and reduced idle periods between processing steps. Oil usage also declined due to controlled frying temperature and regular oil turnover, which helped reduce overall material costs. These process improvements correspond to findings from other SOP-based interventions in small enterprises, where standardization typically enhances throughput and resource efficiency (Ahmad et al., 2025). Beyond technical efficiency, the implementation of SOPs in this study also had an educational and motivational effect, fostering a sense of professionalism among workers who now perceived their work as more systematic and accountable.

Implications for Small-Scale Food Industries

The results demonstrate that structured SOP development can serve as a model for traditional snack industries seeking to balance cultural authenticity with modern food quality standards. The Kacang Disco SOP represents an adaptable framework that can be replicated for similar peanut-based or flour-coated products across Indonesia. Its documentation enables easier training of new employees, provides a consistent reference for quality audits, and lays the foundation for compliance with Good Manufacturing Practices and Hazard Analysis Critical Control Point (HACCP) systems. By institutionalizing process documentation within the enterprise, the study contributes to the broader objective of transforming micro and small enterprises from informal to semi-formal production systems (Lashitew & Rosca, 2025). The results also illustrate that standardization need not eliminate local identity; rather, it enhances the reliability and market potential of traditional foods. In this regard, the Kacang Disco SOP serves as an exemplar of how process science can be integrated into community-based production for sustainable economic empowerment.

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CONCLUSION

The implementation of a Standard Operating Procedure (SOP) for Kacang Disco production in a small-scale food enterprise in Makassar, Indonesia, proved effective in improving product quality, process efficiency, and worker discipline. The SOP standardized eight production stages, specifying parameters for ingredient measurement, frying temperature, sanitation, and packaging. Compared with pre-SOP conditions, the new process produced a more uniform product with better color, crispness, and taste consistency. Controlled frying temperature and time reduced oil absorption and prevented over-browning, while improved hygiene practices enhanced food safety.

Successful adoption was supported by the easy availability of raw materials and the simplicity of the processing technology, although limited worker skills and the absence of routine training remained constraints. Overall, the study demonstrated that structured process documentation can transform artisanal production into a more systematic and reproducible operation. The Kacang Disco SOP provides a transferable model for other traditional snack industries seeking to meet modern food quality standards while preserving local identity. Future development should focus on continuous training and monitoring systems to ensure long-term compliance and to strengthen the competitiveness and sustainability of Indonesia's small-scale food industries.

Ethical Approval

Ethical approval was not required for this study.

Informed Consent Statement

Informed consent was not obtained for this study.

Author Contributions

Muliani contributed to the conception and design of the study, coordinated the overall project, developed the methodology, and conducted data analysis. They further revised the manuscript to enhance its academic rigor and oversaw the final editing and submission process. Anwar Lubis were responsible for conducting the literature review and providing support in data interpretation. the authors reviewed and approved the final version of the manuscript, with Anwar Lubis designated as the corresponding author.

Disclosure Statement

No potential conflicts of interest were reported by the authors.

Data Availability Statement

The data presented in this study are available upon request from the corresponding author for privacy reasons.

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Notes on Contributions

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