ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jun634

Packaging and Marketing Practices of Canned Pineapple at JA Okinawa, Japan

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Publication Date: 2026/06/18

Abstract: The Japan Agricultural Cooperative (JA) Okinawa is a major agro-industrial organization that supports the processing and marketing of agricultural commodities throughout Okinawa Prefecture, Japan. One of its key processing facilities, located in Higashi Village, Nago City, specializes in the production of canned pineapple products using pineapples supplied by local farmers. This study aimed to examine the packaging processes and marketing system of canned pineapple products implemented at JA Okinawa and to evaluate their contribution to product quality and market competitiveness. Data were collected through direct observations, semi-structured interviews, and documentation of processing and marketing activities conducted at the facility. The canned pineapple production process consists of several sequential stages, including weighing, grading, peeling, senbetsu (quality sorting), canning, syrup filling, sterilization, packaging, and storage. The implementation of standardized processing procedures and quality control measures ensures product safety, consistency, and compliance with quality standards. Packaging serves a critical role in protecting the product from physical damage and contamination, preserving product quality, extending shelf life, and enhancing consumer appeal. The marketing system employed by JA Okinawa integrates direct distribution through farmers' markets with indirect distribution through affiliated companies and retail networks. This dual-channel marketing strategy improves market accessibility, expands product reach, and strengthens the competitiveness of canned pineapple products in regional and national markets. Overall, the integration of efficient processing operations, effective packaging practices, and well-structured marketing channels contributes significantly to product quality assurance, distribution efficiency, consumer satisfaction, and the sustainability of the pineapple agro-industry in Okinawa, Japan.

Keywords: C*anned Pineapple, Packaging, Marketing System, JA Okinawa, Agro-Industry.*

How to Cite: Wahyu Astiko; Ayu Saputri (2026) Packaging and Marketing Practices of Canned Pineapple at JA Okinawa, Japan. *International Journal of Innovative Science and Research Technology*, 11(6), 520-530. https://doi.org/10.38124/ijisrt/26jun634

I. INTRODUCTION

Agricultural cooperatives play a strategic role in strengthening agricultural value chains by facilitating production, processing, packaging, and marketing activities that enhance the economic value of agricultural commodities. In Japan, the Japan Agricultural Cooperative (JA) system serves as an important institution that supports farmers through the provision of technical assistance, processing facilities, quality control systems, and market access. Among the regional cooperative organizations, the Japan Agricultural Cooperative (JA) Okinawa has made significant contributions to the development of the agricultural sector by promoting the efficient utilization and commercialization of local agricultural products.

Pineapple (*Ananas comosus* (L.) Merr.) is one of the most important tropical fruit crops in the world due to its high economic value, nutritional content, and broad consumer acceptance. Globally, pineapple ranks among the leading fruit commodities after citrus and banana and is widely consumed in both fresh and processed forms (Ali et al., 2020; Chaudhary et al., 2019). The fruit is rich in carbohydrates, dietary fiber, vitamins, minerals, and bioactive compounds, making it a valuable component of a healthy diet. In addition to its nutritional benefits, pineapple has substantial commercial potential because it can be processed into a variety of value-added products, including juice, jam, dried fruit, concentrates, and canned pineapple products (Dhar et al., 2024; Lobo and Siddiq, 2017).

Despite its economic importance, pineapple is highly perishable due to its high moisture content and active metabolic processes after harvest. Without appropriate postharvest handling and preservation techniques, substantial losses in quality and market value may occur during storage and distribution. Therefore, the development of effective processing technologies is essential to extend shelf life, maintain product quality, and increase the marketability of pineapple products. Among the available preservation

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jun634

techniques, canning remains one of the most effective and widely adopted methods because it provides long-term storage stability while preserving acceptable sensory, nutritional, and microbiological quality (Lucci et al., 2016, 2003; Rout et al., 2026).

Okinawa Prefecture possesses favorable agroclimatic conditions for pineapple cultivation, including suitable temperatures, abundant sunlight, and adequate rainfall. Consequently, pineapple has become one of the region's most important horticultural commodities and contributes significantly to local agricultural production and rural economic development. To maximize the value of pineapple production, JA Okinawa has established an integrated agro-industrial system that combines processing, packaging, quality assurance, and marketing activities.

One of the major pineapple-processing facilities operated by JA Okinawa is located in Higashi Village, Nago City. At this facility, freshly harvested pineapples supplied by local farmers are processed into canned pineapple products through a series of standardized operations, including weighing, grading, peeling, quality sorting (*senbetsu*), cutting, canning, syrup filling, sterilization, packaging, storage, and distribution. The implementation of modern processing technologies and quality control procedures enables the facility to maintain product consistency, food safety, and operational efficiency (Chandimali et al., 2025).

In the agro-industrial sector, packaging serves functions that extend beyond product protection. Effective packaging contributes to quality preservation, facilitates transportation and storage, enhances product attractiveness, provides essential product information, and strengthens brand identity. Furthermore, packaging plays an important role in ensuring compliance with food safety regulations and consumer expectations. Consequently, packaging has become an integral component of value-added agricultural production systems (Opara, 2013; Kumar et al., 2025)

Equally important is the implementation of an efficient marketing system. Marketing activities determine the extent to which processed products can reach consumers and generate economic returns for producers and processing organizations. The integration of direct marketing channels, distribution networks, and strategic partnerships can improve market accessibility, strengthen product competitiveness, and support the sustainability of agro-industrial enterprises. Therefore, understanding the relationship between processing, packaging, and marketing activities is essential for evaluating the performance of agricultural processing industries (Tzatsi et al., 2018; Ahmad et al., 2005).

Although several studies have examined pineapple processing technologies and postharvest management, limited information is available regarding the integration of packaging practices and marketing systems within cooperative-based agro-industrial enterprises in Japan. Consequently, a detailed examination of the packaging and marketing practices implemented by JA Okinawa is necessary to provide insights into effective management strategies that support product quality, distribution efficiency, and market competitiveness.

Therefore, this study aims to describe the packaging processes and marketing systems of canned pineapple products implemented at JA Okinawa, Higashi Village, Nago City, Japan. Furthermore, the study evaluates the role of these practices in supporting product quality, improving market accessibility, and enhancing the sustainability and competitiveness of the local agro-industrial sector.

II. MATERIALS AND METHODS

This study was conducted from October to November 2025 at the pineapple processing facility of the Japan Agricultural Cooperative (JA) Okinawa, located in Higashi Village, Nago City, Okinawa Prefecture, Japan.

Data were collected using primary and secondary sources, supported by field documentation. Primary data were obtained through direct observation of the entire canned pineapple processing operation and semi-structured interviews with factory workers, production supervisors, and marketing personnel at JA Okinawa. The observed processing stages included weighing, grading, peeling, *senbetsu* (quality sorting), canning, weight verification, syrup filling, sterilization, packaging, and storage (Corti and Thompson, 2004).

Secondary data were gathered from scientific publications, institutional reports, previous studies, and other relevant literature related to pineapple processing, packaging systems, and marketing practices at JA Okinawa. Documentation was conducted through photographic records of the production process, covering all stages from raw material handling to the final packaging of canned pineapple products. These records were used to support and validate the information obtained through direct observations and interviews (Lake et al., 2010).

The collected data were analyzed using a descriptive qualitative approach (Lambert and Lambert, 2012). This approach was employed to systematically describe and interpret the processing, packaging, and marketing systems of canned pineapple products implemented at JA Okinawa. The analysis focused on providing a comprehensive overview of operational practices, quality control procedures, packaging technologies, and marketing channels utilized within the facility.

III. RESULTS AND DISCUSSION

Japan Agricultural Cooperatives (JA) play a crucial role in the collection, processing, and distribution of horticultural products throughout Japan, including tropical fruits and vegetables. In addition to serving as an intermediary between farmers and consumers, JA provides technical support, processing facilities, and marketing services aimed at improving the quality, value, and efficiency of agricultural production. Within Okinawa Prefecture, different regions specialize in specific agricultural commodities. For example,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jun634

Miyakojima City is well known for the production and packaging of goya (bitter melon), whereas Nago City serves as a major center for pineapple processing. In Higashi Village, Nago City, fresh pineapples harvested by local farmers are processed into canned pineapple products through a standardized agro-industrial system.

The JA Okinawa branch in Nago is equipped with modern facilities and advanced processing technologies that support efficient packaging and marketing operations while ensuring consistent product quality. Packaging plays a strategic role in protecting products from physical damage, contamination, and quality deterioration during storage and distribution. Furthermore, packaging enhances consumer appeal through attractive design and informative labeling. Effective packaging serves not only as a protective medium but also as a marketing and communication tool by providing essential information, including product identity, ingredient composition, nutritional value, food safety information, and expiration dates. Consequently, proper packaging contributes significantly to extending product shelf life and increasing its market value (Wyrwa and Barska, 2017).

Following the production process, JA Okinawa implements a well-structured marketing system to ensure the effective distribution of canned pineapple products to consumers. The marketing channel involves producers, intermediary organizations, distribution agents, and final consumers. The selection and management of marketing channels are influenced by several factors, including market conditions, product characteristics, organizational capabilities, and the availability of distribution partners. Effective marketing channel management facilitates product distribution, improves market accessibility, and enhances the competitiveness of canned pineapple products in both regional and national markets (Ishii, 2021).

➢ *Canned Pineapple Packaging Process*

Canning is one of the most widely used food preservation methods and involves the application of thermal processing to reduce microbial activity and enzyme reactions. Heat treatment effectively maintains product quality and safety during storage by inhibiting spoilage microorganisms and extending shelf life (Amit et al., 2017). The effectiveness of the thermal process depends on several critical factors, including uniform heat distribution throughout the product, the process F-value, and the thermal resistance of microorganisms to elevated temperatures (Kubo et al., 2023).

In Nago City, Okinawa Prefecture (Higashi Village), the canned pineapple packaging process is carried out using modern processing technologies and follows a series of standardized production stages. The facility produces canned pineapple products in three packaging sizes: large cans (2.5 kg), medium cans (465–475 g), and small cans (160 g). Pineapples that meet the company's maturity and quality standards undergo several preliminary operations, including sorting, weighing, washing, grading, quality selection, and cutting before entering subsequent processing stages. The major processing stages are described as follows:

- *Weighing*

Fresh pineapples harvested by local farmers are transported directly to the processing facility by truck and unloaded into collection containers measuring approximately 1.20 m × 1.00 m × 0.70 m. The filled containers are subsequently weighed using a digital platform scale, with the tare weight of the empty container recorded at 36.13 kg. Following the weighing process, the pineapples are transferred via a conveyor system to the grading and classification unit (Figure 1).

This stage is essential for determining the quantity of raw materials entering the production line and for ensuring that daily processing operations are aligned with the factory's production capacity. Accurate weighing also facilitates inventory management and production planning, thereby improving overall operational efficiency.

Fig 1 Weighing Process

- *Classification*

At this stage, pineapples are classified according to fruit size using an automated grading machine. The fruit is categorized into three main size classes: small (*Shou*), with a diameter of 8.0–10.6 cm; medium (*Chu*), with a diameter of 10.7–12.3 cm; and large (*Dai*), with a diameter of 12.4 cm or greater (Figure 2). This classification process ensures product uniformity and facilitates subsequent processing operations.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jun634

Following classification, the pineapples are conveyed to the washing unit through an integrated conveyor system connected directly to the cutting section of the processing facility. The grading process is essential for maintaining consistency in product quality, optimizing processing efficiency, and ensuring that the fruit is allocated appropriately according to the specifications required for different canned pineapple products (Leung et al., 2021).

Fig 2 Pineapple Classification Process

- *Peeling*

During the peeling stage, the pineapple crowns are manually removed by operators before the fruits are fed into an automated peeling machine. The peeling machine operates using a rotary cutting system that efficiently removes both the outer peel and the central core, resulting in a uniform cylindrical fruit shape with a centrally positioned cavity (Figure 3). This automated process enhances processing efficiency, ensures product uniformity, and minimizes fruit loss during preparation.

Following the peeling operation, the processed pineapples are conveyed individually through a dedicated transport channel to the subsequent processing stage. The integration of automated peeling technology contributes to improved production efficiency, consistent product quality, and reduced labor requirements within the processing line (Wang et al., 2024).

Fig 3 Pineapple peeling process

- *Senbetsu (Quality Sorting and Inspection)*

The *senbetsu* stage integrates fruit separation, cleaning, and quality assessment procedures prior to the final cutting process (Figure 4). Following the peeling operation, the pineapples are automatically sorted into three separate processing lines according to the size and quality specifications determined by the automated grading system. This stage serves as an important quality control checkpoint to ensure that only fruit meeting the required standards proceeds to subsequent processing operations.

At the beginning of this stage, a *metori* process is performed, during which any remaining fruit eyes and surface imperfections are manually removed using sterilized knives. This operation enhances the visual appearance and overall quality of the final product. Subsequently, the pineapples are conveyed to an automated cutting machine that slices the fruit into uniformly shaped ring segments with a characteristic doughnut-like appearance and consistent thickness.

Following mechanical slicing, the pineapple rings undergo an additional manual inspection process. Workers evaluate each slice to ensure uniformity in shape, size, color, and overall quality. Fruit pieces that do not meet the required standards due to defects, irregular shapes, or physical damage are redirected to a secondary cutting machine, where they are processed into smaller triangular pieces suitable for alternative product specifications.

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The triangular pineapple pieces are subsequently transported via conveyor rails to either large-can or small-can filling lines, depending on production requirements. Each conveyor system is specifically designed to connect with designated packaging equipment according to product type and can size, thereby ensuring a continuous, efficient, and well-organized production flow throughout the canning process.

Fig 4 Senbetsu (Quality Sorting and Inspection) Process

- *Pineapple Canning*

The pineapple canning process consists of three separate filling lines designed to accommodate different can sizes, namely large, medium, and small cans (Figure 5). This system enables efficient production management while ensuring consistency in product quality across various packaging formats.

For large cans, the filling operation is performed automatically using a high-capacity filling machine directly connected to the *metori* inspection table. This automated system ensures accurate filling, improves operational efficiency, and minimizes handling during the production process.

In contrast, the filling of small cans is carried out manually using specially designed molds. The empty cans are positioned within the molds, and triangular pineapple pieces are carefully arranged by workers to achieve the required weight and product appearance. These pineapple pieces originate from the secondary cutting process conducted during the previous *senbetsu* stage. Manual filling allows greater flexibility in arranging fruit pieces and maintaining product uniformity within each can.

Once the cans have been filled according to the specified product standards and weight requirements, they are automatically conveyed to the subsequent processing stage. The integration of automated and manual filling systems enables the facility to accommodate different product specifications while maintaining production efficiency and consistent product quality.

Fig 5 Pineapple Canning Process

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- *Weighing of Packaged Products*

Following the canning process, each filled can is automatically transported along a conveyor system to the weighing station for quality control verification. Product weight is monitored to ensure compliance with the established packaging standards. The target net weight for large cans is 2.5 kg, while medium-sized cans are required to weigh between 465 and 475 g, and small cans must contain 160 g of product (Figure 6).

After passing the weight verification stage, each can undergoes an additional inspection using an X-ray detection system. This inspection is performed to identify and eliminate potential foreign contaminants, including metal fragments, hair, plastic particles, or other unwanted materials that may have entered the product during processing. The implementation of X-ray inspection technology serves as a critical food safety measure, ensuring product integrity and compliance with quality assurance standards before the cans proceed to the syrup-filling stage (Haff and Toyofuku, 2008).

Accurate weight control combined with advanced contamination detection contributes significantly to maintaining product consistency, consumer safety, and overall product quality throughout the canning process.

Fig 6 Weighing of Packaged Pineapple Products

- *Syrup Filling*

At this stage, the canned pineapple products that have successfully passed the X-ray inspection are conveyed to the syrup-filling unit (Figure 7). The filling machine is equipped with three dispensing nozzles that operate sequentially, ensuring a continuous and uniform flow of syrup into each can moving along the production line. This automated filling system enhances process efficiency while maintaining consistency in syrup distribution among all packaged products.

Following syrup addition, the cans undergo a second weighing procedure to verify that the syrup content complies with the established production standards. The acceptable syrup weight ranges from 0.65 to 0.75 kg per can. This quality control measure ensures product uniformity and compliance with the specified formulation requirements.

Cans that meet the required weight specifications are subsequently transferred to the sealing stage, where they are closed using an easy-open-end (EOE) system. This closure technology is designed to provide a secure hermetic seal, thereby protecting the product from microbial contamination, physical damage, and environmental exposure during storage and distribution. In addition, the EOE system enhances consumer convenience while preserving the flavor, texture, and overall quality of the canned pineapple throughout its shelf life.

The syrup-filling and sealing processes are critical components of the canning operation, as they contribute directly to product safety, quality preservation, and long-term storage stability (Chonhenchob et al., 2017).

Fig 7 Syrup-Filling Process

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jun634

- *Sterilization*

Following the sealing process, the canned pineapple products are transferred to the sterilization unit for thermal treatment (Figure 8). The facility utilizes two large sterilization tanks, each with a holding capacity of approximately 2,000 cans. One sterilization system is designated for large cans, while the other is used for medium and small cans. Although both systems employ the same sterilization procedure, processing schedules are arranged separately to accommodate different packaging sizes and production requirements.

During sterilization, large cans are immersed in hot water at temperatures ranging from 95°C to 98°C, whereas medium and small cans are sterilized at temperatures between 95°C and 97°C. The immersion process is maintained for 30 minutes to ensure adequate microbial inactivation and product safety. Thermal sterilization is a critical stage in the canning process, as it effectively reduces microbial populations and extends the shelf life of the final product.

To maintain hygiene and equipment cleanliness, a specialized cleaning agent is added to the sterilization system each morning to remove residual oil, dirt, and other contaminants originating from previous processing operations. This practice supports sanitation standards and enhances the overall effectiveness of the sterilization process.

Following thermal treatment, the cans undergo a secondary cooling process by immersion in cold water for approximately 30 minutes until the product temperature decreases to below 40°C. Rapid cooling prevents overprocessing, preserves product quality, and minimizes potential changes in flavor, texture, and appearance. After the cooling stage is completed, the sterilized cans are transported via a dedicated conveyor bridge to the final packaging area for subsequent handling and distribution.

The sterilization and cooling processes are essential quality assurance measures that ensure product safety, maintain sensory quality, and improve the long-term stability of canned pineapple products during storage and distribution (Jildeh et al., 2021).

Fig 8 Sterilization and Cooling Process

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jun634

- *Product Packaging*

Following the sterilization and cooling processes, the canned pineapple products are transferred to a coding machine, where each can is marked with a production code and expiration date to ensure product traceability and compliance with food safety regulations. Subsequently, the cans undergo a manual cleaning process, during which any residual moisture or surface contaminants are removed using clean, dry cloths.

After cleaning, the products are packed into standardized corrugated cardboard cartons according to can size. Small cans are packaged at a capacity of 24 cans per carton, arranged in two layers of 12 cans each (2 × 12). Medium-sized cans are packed in cartons containing 16 cans, arranged in two layers of eight cans each (2 × 8). Large cans are packaged in cartons containing six cans per carton. Standardized packaging configurations facilitate product handling, storage, transportation, and inventory management throughout the distribution chain.

Once the cartons are filled and sealed, they are automatically transferred using a robotic palletizing system equipped with a mechanical gripper arm. The system arranges the cartons in a stable and organized manner on pallets measuring approximately 1.20 m × 1.00 m × 0.20 m. The cartons are stacked in five layers to maximize storage efficiency while maintaining load stability during handling and transportation (Figure 9).

The implementation of automated palletizing technology improves operational efficiency, reduces manual labor requirements, minimizes the risk of product damage, and ensures consistency in warehouse management and logistics operations. Proper packaging and palletization are essential components of the post-processing system, contributing significantly to product protection, storage stability, and distribution efficiency (Ait-Oubahou et al., 2019).

Fig 9 Final Packaging and Palletizing Process

- *Storage*

The storage stage is a critical component of the post-production process, ensuring that canned pineapple products maintain their quality, safety, and physical integrity prior to distribution and marketing. Proper storage conditions help preserve product appearance, prevent packaging damage, and maintain product stability throughout the storage period.

In the warehouse, finished products are systematically organized according to product type, batch number, and production date to facilitate inventory management, product traceability, and stock monitoring (Figure 10). This storage system minimizes the risk of distribution errors and supports the efficient implementation of the first-in, first-out (FIFO) inventory management principle.

Effective storage management plays an important role in maintaining product quality, improving logistical efficiency, and ensuring that canned pineapple products reach consumers in optimal condition. Furthermore, proper warehouse organization contributes to smoother distribution operations and enhances overall supply chain performance.

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Fig 10 Storage of Canned Pineapple Products

➢ *Canned Pineapple Marketing System*

The marketing of canned pineapple products at JA Okinawa is primarily conducted through a direct-selling strategy, which enables products to reach consumers efficiently while maintaining product quality and freshness. Direct sales are implemented through the extensive network of JA Okinawa farmers' markets located throughout Okinawa Prefecture. These farmers' markets serve as important distribution centers for locally produced agricultural products, allowing consumers to purchase products directly from producers and processors. This marketing approach strengthens the connection between producers and consumers while supporting local agricultural development.

In addition to direct sales, JA Okinawa utilizes collaborative marketing strategies through partnerships with affiliated companies and distribution networks. These partnerships contribute to broader market coverage and enhance product accessibility across different regions of Japan. Such collaborative arrangements allow JA Okinawa to expand its market reach without relying solely on its own retail outlets.

The marketing channel for canned pineapple products consists of two primary distribution pathways connecting the processing facility with end consumers. The first pathway involves distribution through the JA Okinawa farmers' market network. After the packaging process is completed, canned pineapple products are transported to the JA Okinawa headquarters, where they are recorded, categorized, and allocated according to market demand. Subsequently, the products are distributed to farmers' markets located throughout Okinawa Prefecture. This demand-driven distribution system helps ensure that product supply aligns with consumer demand and sales performance. Through this channel, consumers can purchase canned pineapple products directly from JA Okinawa through a direct-selling system.

The second distribution pathway involves collaboration with affiliated companies and commercial distribution partners. After processing and packaging, products are transferred to JA Okinawa headquarters for inventory recording and order management. The products are then distributed in bulk quantities to partner companies, which subsequently market and distribute them through supermarkets, retail stores, convenience stores, and other commercial marketing channels throughout Japan. This distribution system significantly expands market coverage, increases sales volume, and strengthens the competitive position of canned pineapple products in the national market.

To enhance marketing effectiveness and achieve sales targets, JA Okinawa collaborates with various retail chains and supermarkets, including Sanei, Lawson, and Kanehide. These partnerships improve product visibility and ensure that canned pineapple products are readily available to consumers through

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multiple retail outlets across Okinawa and other regions of Japan. In addition, promotional activities are regularly conducted at JA Okinawa farmers' markets, particularly during weekend sales events. These promotional programs are designed to increase consumer awareness, stimulate purchasing behavior, and ultimately improve product sales performance.

The integration of direct marketing, strategic distribution partnerships, and promotional activities enables JA Okinawa to establish an efficient and sustainable marketing system that supports product competitiveness, market expansion, and long-term business development

IV. CONCLUSION

The Japan Agricultural Cooperative (JA) Okinawa plays a pivotal role in the collection, processing, packaging, and marketing of tropical horticultural commodities in Okinawa Prefecture, Japan. Pineapple processing activities are centralized at the Higashi Village processing facility in Nago City, where fresh pineapples supplied by local farmers are transformed into value-added canned pineapple products through a series of standardized processing operations. The production process involves several integrated stages, including weighing, grading, peeling, *senbetsu* (quality sorting), canning, syrup filling, sterilization, packaging, and storage. Pineapples are classified into three size categories—small (*Shou*), medium (*Chu*), and large (*Dai*)—to ensure product uniformity and processing efficiency. The implementation of modern processing technologies and quality control procedures throughout the production line contributes to product safety, consistency, and compliance with established quality standards. In addition to processing activities, JA Okinawa has established an effective marketing system that combines direct distribution through farmers' markets with indirect distribution through affiliated companies and commercial retail networks. This integrated marketing approach enhances market accessibility, expands product reach, and strengthens the competitiveness of canned pineapple products in regional and national markets. Overall, the integration of standardized processing operations, effective packaging practices, and well-structured marketing channels contributes significantly to maintaining product quality, improving distribution efficiency, increasing consumer satisfaction, and supporting the sustainability of the pineapple agro-industry in Okinawa Prefecture.

ACKNOWLEDGMENT

The authors gratefully acknowledge the management and staff of the Japan Agricultural Cooperative (JA) Okinawa, particularly the canned pineapple processing facility in Higashi Village, Nago City, Okinawa Prefecture, Japan, for their support, cooperation, and assistance during the internship and data collection activities. The authors also thank all individuals and institutions whose contributions, whether direct or indirect, facilitated the successful completion of this study.

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