

Development of Tomato Jam and Tomato Seasoning From Surplus Tomatoes: A Product Development and Shelf-Life Evaluation Study

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ABSTRACT

Tomato (*Solanum lycopersicum* L.) is one of the most widely produced vegetable crop in the Philippines and has a great potential. However, the seasonal surplus of this crop is often associated with significant post-harvest losses which lower farmer income and contributes to food wastage. Although tomatoes are traditionally processed into products such as sauces, ketchup and paste, there are few studies on the development of alternative value-added products from surplus tomatoes in the local farming communities. The objective of this study was to formulate tomato jam and tomato seasoning from surplus tomatoes harvested in Roxas, Isabela and assess their sensory acceptability and shelf-life stability under different storage conditions. A research and development (R&D) design was employed, including the formulation of standardized processing protocols, product development, sensory evaluation, and shelf-life assessment. The developed products were evaluated for appearance, color, aroma, flavor, texture, mouthfeel and overall acceptability and tomato seasoning was also evaluated for saltiness, sourness and bitterness. Shelf-life evaluation was done under refrigerated storage, room-temperature storage and direct sunlight exposure over three- and six-month storage periods. Sensory evaluation data was analyzed using weighted mean and Analysis of Variance (ANOVA). The results revealed that the tomato jam and tomato seasoning had generally good sensory acceptability, suggesting that surplus tomatoes can be processed into consumer-acceptable value-added products. Shelf-life evaluation also showed that the products were acceptable in sensory characteristics during the storage period. Refrigerated storage was the most favorable for the preservation of product quality. The developed processing protocols provide a practical approach to reduce postharvest losses and create opportunities for value addition, food entrepreneurship and community-based livelihood development. The study provides empirical evidence in favor of the utilization of surplus tomatoes for innovative food processing and contributes to sustainable agricultural development through the promotion of locally developed, shelf-stable tomato-based products.

Keywords: tomato jam, tomato seasoning, value-added processing, postharvest losses, sensory evaluation, shelf-life evaluation, tomato processing, agricultural entrepreneurship

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is one of the most cultivated and economically important horticultural crops in the world, owing to its nutritional value, culinary versatility and its wide-ranging use in fresh and processed food products. It is recognized as an excellent source of vitamins A and C, dietary fiber, potassium and bioactive compounds such as lycopene, β -carotene and phenolic antioxidants, which have been associated with reduced risks of cardiovascular diseases, certain cancers and other chronic illnesses. Because of these nutritional and functional properties, tomatoes have become an essential component of household consumption and the food processing industry. Besides their importance for human consumption, tomatoes also provide a significant source of livelihood for millions of farmers, processors, traders and entrepreneurs around the world. As consumer demand for ready-to-eat and value-added food products continues to increase, tomatoes remain one of the most commercially significant agricultural commodities for both domestic and international markets.

Tomatoes are an important commercial crop but highly perishable due to their high moisture content, delicate skin and rapid physiological deterioration after harvest. These characteristics make tomatoes particularly

susceptible to mechanical damage, microbial spoilage and quality deterioration during handling, transportation, storage and marketing. Therefore, postharvest losses remain a persistent problem in tomato-producing regions, especially in developing countries where access to cold chain facilities, postharvest technologies and processing industries is often limited. During peak harvest periods, large quantities of marketable tomatoes are often discarded when supply exceeds market demand, resulting in reduced farm-gate prices and significant economic losses for producers. These losses not only reduce farmers' incomes but also contribute to food waste and inefficient use of agricultural resources.

The Philippine tomato industry plays a vital role in rural livelihoods and local food systems. Tomatoes are grown all over the country and are consumed fresh or as an ingredient in various processed food products. Yet, seasonal overproduction still leaves farmers vulnerable to price fluctuations in the market and increased postharvest losses. When production peaks, farmers often cannot sell fresh tomatoes immediately and are compelled to sell at very low prices or in many cases discard the unsold produce due to spoilage. These ongoing challenges highlight the need for sustainable solutions that can extend shelf life, open new marketing channels and add value to agricultural products through food processing and product innovation .

The Municipality of Roxas, Province of Isabela is one of the agricultural communities where the production of tomatoes is one of the main sources of income of many local farmers. Based on interviews with farmers and local stakeholders, and observations of the researchers, overproduction of tomatoes is a recurring problem every harvesting season. The surplus produce's excess is stored in collection points and trading areas, and is usually much higher than the demand of consumers and locally available distribution channels. Hence, an enormous volume of tomatoes remains unsold causing significant economic losses to farmers and needless food wastage. These recurring circumstances call for pragmatic and sustainable strategies that can convert surplus tomatoes to products that are marketable with longer shelf life and higher economic value.

One of the most promising avenues for reducing postharvest losses is value addition through food product development. Product development is an important approach in the conversion of agricultural products into novel commodities that are more stable, commercially sound and are capable of generating higher income to producers and entrepreneurs. In addition to waste reduction, value-added processing improves food security, development of rural enterprise, agricultural efficiency and sustainability, and empowerment of local economy through the provision of alternative income opportunities along the value chain. The development of shelf-stable food products also enhances market access since products can be distributed beyond the harvest seasons while still retaining acceptable sensory quality and consumer acceptability.

The commercialization of value added tomato products has traditionally been limited to ketchup, sauces, tomato paste, puree, juice and canned tomatoes. While these products have established markets, there are opportunities for the development of alternative tomato based products to diversify consumer choices and to maximize the utilization of surplus harvests. Innovative development of products such as tomato jam and tomato seasoning are potential alternatives that combine consumer convenience and nutritional value with entrepreneurial viability. However, before these products can be recommended for wider commercialization, their sensory acceptability and storage stability needs to be scientifically evaluated to determine whether product quality can be maintained over a period of time under different storage conditions.

Sensory evaluation remains one of the most reliable means of determining consumer acceptance of newly developed food products. Product attributes such as appearance, color, aroma, flavor, texture and overall acceptability are important determinants of purchasing decisions and market success. Similarly, shelf-life evaluation provides basic information about the ability of processed food products to retain desirable sensory characteristics throughout storage. These evaluations serve as valuable scientific evidence for product developers, entrepreneurs, extension workers and policy makers interested in promoting value-added processing as a strategy for reducing agricultural losses and increasing farmers' incomes.

While there are many studies on processing and preservation of tomatoes, few studies have been conducted on the conversion of surplus tomatoes from local farming communities into novel value added products and the sensory acceptability of the products in different storage environments for extended periods. Majority of the existing studies are on conventional tomato products or lab-scale preservation techniques, and there is limited

empirical evidence on the development of tomato jam and tomato seasoning from locally available surplus tomatoes in the Philippine context. Little attention has also been paid to the evaluation of the effect of refrigerated storage, room temperature, and direct sunlight on the sensory characteristics of these products over storage periods of three and six months. This absence of localized scientific information restricts the availability of scientific data that could support community-based food processing and technology transfer programs for tomato-producing municipalities.

To address this research gap, the present study developed tomato jam and tomato seasoning from surplus tomatoes harvested in Roxas, Isabela and evaluated their sensory acceptability and shelf-life stability under three storage conditions, namely refrigerated storage, room temperature, and direct sunlight exposure, over observation periods of three and six months. The sensory characteristics of the developed products were also statistically compared for the storage periods to determine whether there were significant differences in the storage periods. The study provides practicality on the possibility of converting the surplus tomatoes into value-added food products that has potential for commercialization through the development of standardized processing protocols and evaluation of product quality.

The study findings contribute to the growing knowledge in food product development, minimization of product postharvest, and agricultural value addition. Practically, the study provides a helpful intervention to farmers, food processors and innocators, entrepreneurs, local government and private agencies to address the seasonal surplus of tomatoes and to promote the sustainable development of agricultural products. Further, the processing protocols generated and the product evaluation results can be valuable references for future research, technology commercialization, and community-based livelihood programs that aim to maximize the economic potential of surplus agricultural commodities.

REVIEW OF RELATED LITERATURE

Tomato Production and Postharvest Losses Tomato (*Solanum lycopersicum* L.) is one of the most economically important vegetable crops in the world due to its nutritional value, adaptability to different climatic conditions and wide application in both household consumption and industrial food processing. Tomatoes are cultivated on millions of hectares worldwide and contribute significantly to food security, employment generation and agricultural income. They are consumed fresh and processed into a wide range of products such as sauces, ketchup, puree, paste, juices, soups and dehydrated ingredients making tomatoes one of the most commercially versatile horticultural commodities.

Tomato is economically important but is still suffering from huge postharvest losses because of its highly perishable nature. Tomatoes are high in moisture content and experience rapid physiological and biochemical changes post-harvest, making them prone to microbial contamination, mechanical injury, moisture loss, enzymatic degradation and quality deterioration. These factors considerably reduce shelf-life and marketability especially in areas with still deficient storage and transportation facilities. Thus, large quantities of the harvest are lost before reaching the consumers, resulting in economic losses for the producers and inefficiencies throughout the entire agricultural supply chain.

Post-harvest losses are particularly high in developing countries where cold chain infrastructure, processing facilities and efficient distribution systems are still in infancy. Farmers often find themselves in a situation where market supply exceeds consumer demand during peak harvest seasons leading to a steep decline in farm-gate prices. In such circumstances, many producers are forced to sell their harvest below the cost of production or allow unsold tomatoes to rot. These recurring circumstances negatively impact on farmer profitability, food availability and agricultural sustainability.

In the Philippine context, tomato farming is an important source of livelihood for a great number of farming communities. However, the seasonal nature of production still makes farmers vulnerable to unpredictable market conditions and recurring post-harvest losses. Similarly, the same situation is experienced in the municipalities of tomato producers in Isabela where overproduction often exceeds the demand in the local market. Thus, there is a growing need for sustainable interventions that can reduce waste and increase the economic value of the harvested tomatoes through value-added processing.

Food processing has been proved as a viable method to extend the shelf life of highly perishable agricultural products, increase product diversity and expand market opportunities. This study is on the processing of fresh produce into products with better storage stability, convenience and higher commercial value. Conventional processing of tomatoes has produced products such as ketchup, tomato paste, sauces, canned tomatoes, puree, juice and dehydrated tomato powder. These products not only reduce postharvest losses but also increase profitability by expanding marketing channels beyond the fresh produce market.

Value addition has become a major arm of agricultural development as it helps farmers and rural entrepreneurs to realize higher returns from existing agricultural resources. Farmers can undertake processing activities leading to products with higher consumer demand and longer shelf availability instead of depending on sale of fresh produce. Value-added products also contribute to rural employment generation, food security and local economic development by expanding opportunities for small and medium enterprises.

Recent research has stressed the importance of adding value to agricultural products to improve not only the shelf life but also nutritional quality, consumer preferences, product safety, processing efficiency, and commercialization potential. Innovative food products from locally available agricultural commodities are becoming increasingly attractive because they promote sustainable food systems and encourage entrepreneurship and community-based enterprise development.

The present study is in accordance with these principles and aims to investigate the development of tomato jam and tomato seasoning as alternative value-added products from surplus tomatoes. These novelties offer more chances for product diversification compared to traditional tomato products and at the same time offer practical solutions to recurring overproduction in tomato growing communities.

Food Product Development Food product development is a systematic process for conceptualizing, formulating, testing, evaluating, and refining new food products to satisfy consumer needs while ensuring safety, quality, and commercial viability. Product development success depends on balancing nutritional value, functional properties, sensory acceptability, processing feasibility, shelf-life stability and production costs. With consumer preferences changing, food manufacturers and researchers are focusing more and more on developing new products that offer convenience, health benefits and unique eating experiences.

Usually the development of new food products goes through several stages such as concept generation, prototype development, product optimization, sensory evaluation, shelf-life testing and commercialization assessment. Sensory analysis plays a major role in identifying the consumer acceptance of the product based on its appearance, aroma, flavor, texture and overall quality. Products with a high level of sensory acceptance are more likely to be commercially successful, irrespective of their nutritional value.

Besides consumer acceptance, food product developers need to ensure the stability of newly developed products during storage. Shelf-life evaluation provides scientific evidence of product stability under different environmental conditions, and the manufacturer can define suitable storage recommendations and expiration periods .

The present study on the development of tomato jam and tomato seasoning follows these basic principles by standardizing processing methods, consumer acceptability and storage stability over time.

Sensory Evaluation of Food Products Sensory evaluation is one of the most reliable methods of determining consumer acceptance of newly developed food products. It is the scientific evaluation of a product using the five human senses of sight, smell, taste, touch and hearing; however, food studies focus on the appearance, aroma, flavor, texture and mouthfeel of a product. These sensory characteristics play a large role in consumer acceptance as their purchasing decisions are based on first impressions before considering nutritional value or health benefits.

Researchers frequently employ hedonic rating scales to assess product acceptability. The scales allow the evaluators to express their perception of specific quality attributes and to identify the strengths and improvement areas of the product. Generally, high sensory ratings suggest a greater market potential, whereas low ratings provide useful information for product reformulation.

Sensory attributes evaluated for tomato jam and tomato seasoning in this study included appearance, size, color, aroma, flavor, sweetness, saltiness, bitterness, sourness, texture, and mouthfeel. These quality attributes provide a comprehensive evaluation of consumer acceptability and allow for comparison across different storage conditions and observation periods. Shelf-Life Evaluation and Storage Stability Shelf life is defined as the period of time during which a food product maintains acceptable quality, safety, and consumer acceptability under specified storage conditions. Shelf-life studies are a critical component of food product development because they determine whether products can retain desirable sensory and physicochemical characteristics throughout storage.

The temperature at which food is stored is one of the most important factors affecting its stability. Storage under refrigeration generally slows down the growth of microorganisms, enzymatic activity and oxidation reactions, thus prolonging the quality of the product. In contrast, high temperatures and direct sunlight accelerate deterioration by pigment degradation, flavor changes, loss of moisture and destruction of nutrients.

Food products can be tested in different storage environments, enabling investigators to make evidence-based recommendations about storage practices. This information is useful to manufacturers, retailers, and consumers by identifying conditions under which products retain optimal quality.

In this study, evaluation of tomato jam and tomato seasoning were done after three and six months of refrigerated storage, room temperature and direct sun light exposure. The comparison of these storage environments gave practical information on product stability and possible commercialization. Entrepreneurship and Agricultural Value Addition Agricultural value addition has become a major strategy to promote rural development and increase farmers' incomes. Instead of depending on primary production only, value added processing enables farming communities to diversify income sources while generating employment in food manufacturing, packaging, marketing and distribution.

Community food processing projects also enhance sustainable agriculture by reducing food waste and making the most of resources. The commercialization of locally developed products promotes innovation, strengthens local food systems, and supports inclusive economic growth. Government agencies, state universities, and extension programs are emphasizing value-added processing technologies as practical solutions to ongoing agricultural challenges such as overproduction and postharvest losses.

Agricultural research can be used to convert surplus tomatoes into marketable products with longer shelf life and commercial potential and benefit farming communities and local entrepreneurs by producing technologies such as tomato jam and tomato seasoning.

Synthesis of Literature and Research Gap

Literature reviewed consistently shows that tomato production has a significant contribution to food security and agricultural development, but postharvest losses continue to threaten the crop's highly perishable nature. Several studies have shown that value-added processing has been effective in extending shelf life, reducing waste and improving economic returns to farmers. In addition, food product development emphasizes the value of sensory evaluation and shelf-life testing in determining product quality and commercialization potential.

However, current studies have focused mainly on traditional tomato products such as ketchup, sauces, puree and paste. There is a dearth of comparative studies on developing tomato jam and tomato seasoning as alternative value-added products that utilize surplus tomatoes from local farming communities. In addition, little research has been conducted to evaluate the sensory acceptability and storage stability of these products at refrigeration, room temperature and exposure to direct sunlight for prolonged storage periods, particularly in the Philippine setting.

This gap provided the basis for the present study which developed standardized processing protocols and evaluated the sensory acceptability and shelf-life stability of tomato jam and tomato seasoning produced from surplus tomatoes in Roxas, Isabela, contributing localized scientific evidence to support postharvest loss reduction, food product innovation and community-based agricultural entrepreneurship.

METHODOLOGY

Research Design

This study employed a Research and Development (R&D) design for the development, evaluation and establishment of standardized processing protocols of two value-added tomato products, tomato jam and tomato seasoning from surplus tomatoes produced in the Municipality of Roxas, Isabela, Philippines. The R&D approach was adopted as it is suitable for studies involving the systematic development, refinement, evaluation and validation of new food products prior to their potential commercialization.

The study was conducted in the sequential process of product development which included identification of local problem of surplus tomato production, selection and preparation of raw material, formulation of tomato based products, processing, packaging, sensory evaluation, shelf-life assessment, statistical analysis and development of recommended processing protocols. Throughout the study, emphasis was placed on the development of products which are technically feasible, sensorially acceptable and capable of extending the utilization of surplus tomatoes while maintaining product quality during storage.

Compared to purely experimental studies on treatment effects, the present study incorporated product innovation in addition to quality evaluation to evaluate the feasibility of producing tomato jam and tomato seasoning from surplus tomatoes, and their acceptability and storage stability under various environmental conditions.

Location of the Study The study was conducted in the Municipality of Roxas, Province of Isabela, Philippines, one of the major tomato producing areas in the province. Tomato farming is a major source of livelihood for many households in the municipality. However, in peak harvest periods production often exceeds market demand causing oversupply, falling farm-gate prices and considerable postharvest losses.

The municipality was purposely selected as a result of the longstanding problem of overproduction of tomato. The researchers' observations and discussions with local farmers and stakeholders revealed that huge quantities of tomatoes were left unsold during the bumper harvest periods. This context provided a conducive environment for the development of value-added products that could address food waste and generate alternative income streams for farming communities.

Research Materials The main raw material used in the study was fresh surplus tomatoes from local tomato producers of Roxas, Isabela. Only mature and marketable tomatoes suitable for processing were used. Fruits with signs of spoilage, heavy bruising, insect damage or disease infection were discarded to assure the quality and safety of the finished products.

Prior to processing, the tomatoes were sorted, washed, trimmed and other necessary preparation procedures were done. All ingredients and processing materials used during product development were prepared in accordance with the standardized processing procedures developed by the researchers. Appropriate food grade containers and packaging materials were also used to maintain the quality of the product during the storage period.

Product Development Procedure

The development process of tomato jam and tomato seasoning was carried out using a systematic product development procedure. The selected tomatoes were cleaned and prepared for processing and appropriate formulation methods were used to prepare the two tomato-based products using standardized processing techniques.

Preparation of each product involved a series of activities such as ingredient preparation, mixing, cooking, formulation adjustment, packaging, cooling and storage. During product development, special attention was paid to product consistency, desirable sensory characteristics, food safety and processing efficiency. The finalized formulations were the products that were subjected to sensory evaluation and shelf-life testing.

The processing protocols developed in this study served as the basis for the uniformity of product preparation. These protocols were intended to facilitate replication of the procedures and to provide practical guidance for future adoption by farmers, entrepreneurs, extension workers, and community-based food processors.

Sensory Evaluation

Following product development, the acceptability of tomato jam and tomato seasoning was determined through sensory evaluation using the evaluation procedures described in the original study. Sensory evaluation is widely recognized as an essential component of food product development because it measures consumer perception and determines whether newly developed products possess characteristics acceptable to potential users.

The developed products were evaluated according to several sensory attributes.

The quality attributes of tomato jam tested were: Appearance Color Aroma Flavor Sweetness Texture Mouth feel Overall acceptability The quality attributes of tomato seasoning tested were: Appearance Color Aroma Flavor Saltiness Sourness Bitterness Texture Mouth feel Overall acceptability Each attribute was rated using the sensory evaluation instrument used in the original research. The individual responses were summarized by calculating weighted mean scores and the values obtained were interpreted based on the descriptive scale used in the research. This procedure enabled the researchers to identify the overall level of consumer acceptability for each developed product.

Shelf-Life Evaluation

To determine the stability of the developed products during storage, shelf-life evaluation was conducted under three storage environments:

Refrigerated storage;

Room-temperature storage; and

Direct sunlight exposure.

The products were stored continuously under their assigned storage conditions and were evaluated after three months and again after six months.

During each evaluation period, the products were assessed using the same sensory attributes employed during the initial evaluation. This method allowed the researchers to evaluate if long storage and different environmental conditions affected the visual aspect, smell, taste, consistency and general acceptance of the products.

Researchers were also able to compare sensory ratings across storage conditions to determine which storage environment best preserved product quality and consumer acceptability over time.

Data Gathering Procedure

The conduct of the study followed a systematic sequence of activities designed to ensure consistency across the research process.

First, the researchers identified the perennial problem of surplus tomato production in Roxas, Isabela. They then purchased fresh surplus tomatoes of good quality for processing from local producers. The tomatoes were sorted, washed and prepared after procurement before processing into tomato jam and tomato seasoning using the standardized processing protocols developed by the researchers.

The finished products were then packed in appropriate food-grade containers and divided into three different storage environments, namely, refrigerated storage, room temperature, and direct sunlight exposure.

Following three months of storage, sensory evaluation was conducted to determine the acceptability of each product under the respective storage conditions. The same evaluation procedure was repeated after six months of storage to determine changes in sensory quality over time.

All sensory evaluation results were carefully recorded, organized into tabular form, and subjected to statistical analysis to determine the acceptability of the developed products and to assess whether significant differences existed between the two observation periods.

Statistical Treatment of Data

Both descriptive and inferential statistical techniques were employed in analyzing the data generated by the study.

Weighted Mean was used to determine the degree of acceptability of tomato jam and tomato seasoning for each sensory attribute. The computed weighted mean values were interpreted using the descriptive equivalents provided in the original study.

To determine whether significant differences existed between the sensory evaluation results obtained after three months and six months of storage, Analysis of Variance (ANOVA) was employed. A statistical analysis was carried out to determine whether the storage time had a significant effect on the sensory properties of the developed products when stored under refrigerated conditions, at room temperature and in direct sunlight.

The results of the statistical analyses served as the basis for determining the stability of the developed products throughout the storage period and for identifying appropriate storage recommendations.

Ethical Considerations

The researchers observed ethical standards throughout the conduct of the study. Participation in the sensory evaluation was voluntary, and the purpose of the evaluation was explained to all participants prior to data collection. The responses received in the sensory evaluation were treated as confidential and used for research purposes only.

Similarly, appropriate food sanitation and hygienic handling procedures were followed during the preparation, processing, packaging, storage, and evaluation of the products to ensure product safety and quality. All processing activities were carried out according to acceptable food handling practices to reduce contamination and maintain product integrity during the conduct of the study.

Research Flow The research was conducted following a sequential Research and Development scheme which had the following major phases: Identification of the problem of surplus tomato production; Procurement and preparation of raw materials; Development of tomato jam and tomato seasoning formulations; Standardization of processing protocols; Packaging of the finished products; Storage under refrigerated, room-temperature, and direct-sunlight conditions; Sensory evaluation after three months and six months of storage; Statistical analysis using weighted mean and Analysis of Variance (ANOVA); and Formulation of conclusions, recommendations, and processing protocols for potential technology transfer and commercialization.

RESULTS AND DISCUSSION

This part discusses the results of the study on the development, sensory acceptability and shelf-life stability of tomato jam and tomato seasoning from surplus tomatoes of Roxas, Isabela. The discussion is organized based on the major objectives of the study. It starts with the successful development of the value-added products, followed by the results of the sensory evaluation at different storage conditions, the comparative shelf-life evaluation after three and six months of storage and the statistical analysis of the observed differences. The findings are discussed in relation to existing literature on food product development, sensory science, postharvest management and value-added processing to provide a wider understanding of their practical and scientific implications.

4.1 Development of tomato jam and tomato seasoning The major aim of this research was to develop practical processing protocols to convert surplus tomatoes into novel value-added products to reduce postharvest losses and increase their economic value successfully. The successful development of tomato jam and tomato seasoning demonstrated that surplus tomatoes that are normally discarded or sold at very low prices during peak harvest seasons could be successfully converted into commercially promising food products by appropriate processing techniques. The study successfully achieved its intended objective of producing standardized tomato-based products and establishing processing procedures that can be reproduced for household, community and small-scale commercial applications.

The development of these products addresses a common problem among tomato farmers in Roxas, Isabela where overproduction during the season typically leads to excess supply and greater postharvest losses. As cited in the original study, oversupply of tomatoes typically exceeds market demand during peak harvest seasons, leaving many farmers with lower farm-gate prices and less opportunity for income. By processing fresh tomatoes into shelf-stable products, the study offers an alternative means of utilizing the commodity that extends its usefulness beyond its normal marketing period while minimizing needless food wastage.

Tomato jam is an alternative to traditional fruit jams and the main raw material is tomatoes. Tomatoes contain good color, organic acids, soluble solids and bioactive compounds that influence the taste, consistency and the nutritional quality of the product. The right processing can retain these qualities and produce spread with acceptable sensory characteristics similar to commercially produced fruit jams.

The development of tomato seasoning is another example of value addition. The fresh tomatoes are processed and dried to develop a seasoning product with added benefits of convenience, longer shelf life, ease of storage and versatility in food preparation. Tomato products in dried form exhibit better storage stability than fresh tomatoes that have a short shelf life due to their high moisture content, and are therefore suitable for distribution, retail marketing and household use .

The successful formulation of both products also highlights the value of standard agricultural innovation. Product development is not only about the development of new food products but generating technologies that improve the utilization of agricultural resources and creating opportunities for entrepreneurship and rural enterprise development. The standardized processing protocols developed in this study provide a preliminary framework that can be adopted, refined, and transferred to farming communities, cooperatives, local government units, and small and medium enterprises interested in tomato processing.

In terms of sustainability, the products created here serve as an example of how food processing can help to reduce postharvest losses and encourage a more efficient use of agricultural commodities. Processing provides an opportunity to improve the product quality, make products more marketable and generate additional income streams throughout the value chain, rather than letting surplus tomatoes rot due to a temporary oversupply in the market. This is in line with broader objectives of food security, sustainable agricultural development and community-based enterprise creation.

To summarize, the successful development of tomato jam and tomato seasoning confirms the technical feasibility of utilizing surplus tomatoes for value-added processing, and more importantly, provides the foundation for the succeeding sensory evaluation and shelf-life assessment, which determine whether the developed products possess sufficient quality and consumer acceptability to support future commercialization and technology transfer initiatives.

4.2 Sensory acceptability of tomato jam The results of the sensory evaluation indicated that the developed tomato jam achieved a generally favorable level of consumer acceptability for the evaluated sensory attributes. The achieved ratings demonstrated that the product had desirable organoleptic characteristics which were maintained throughout the evaluation period, suggesting that tomatoes can be successfully used as an alternative raw material for jam production. The results indicated that surplus tomatoes can be converted into a value-added product that is technically producible and acceptable to potential consumers.

All the attributes evaluated obtained positive scores, confirming the processing protocol was successful in preserving the visual characteristics of the product, with appearance and color being the attributes with the best scores. Visual appeal is one of the first quality attributes evaluated by consumers and often determines the initial willingness to purchase a food product. The appealing appearance of the developed tomato jam may be due to the natural pigments present in ripe tomatoes and the standardized processing procedure used in product preparation. Maintaining an attractive color is of particular importance as often degradation of the pigments occurs during processing and long storage. The favorable ratings obtained in this study indicate that the developed processing protocol was effective in producing a visually acceptable product.

The product was also satisfactorily evaluated for aroma and flavor, which indicates that the usual sensory characteristics of tomatoes were maintained in the manufacture of a jam with good eating quality. Taste is generally considered one of the most important factors for consumer acceptance as it is the expression of the overall perception of taste and aroma during consumption of food products. The positive evaluations demonstrate that the formulation obtained a good balance between the natural acidity of tomatoes and the sweetness typical of jams. This balance is probably responsible for the overall acceptability of the processed product and confirms that tomatoes can be successfully used in a preserve without negatively affecting consumer preference.

Furthermore, the ratings of sweetness, texture and mouthfeel suggest that the prepared jam had desirable physical properties. Texture is an important quality parameter affecting spreadability, consistency and the general eating experience. A jam that is too runny or too solid can result in reduced consumer satisfaction regardless of flavour quality. The positive evaluation of these qualities suggests that the process conditions and formulation resulted in a product with a consistency that was satisfactory to the evaluators. Also, an appropriate mouthfeel increases the palatability of the product and has an impact on the overall sensory perception.

The overall acceptability rating shows that the developed tomato jam was generally accepted by the evaluators. This finding is very important since it indicates that tomatoes, which are traditionally regarded as a vegetable ingredient in culinary applications, can be successfully converted to a jam product that meets the consumer expectation. The results thus support the technical and commercial feasibility of tomato jam as an innovative value-added product that can augment the utilization of surplus tomatoes.

The positive sensory evaluation has important implications for postharvest management and agricultural value addition. Huge quantities of tomatoes remain unsold during seasonal glut due to limited market demand and the highly perishable nature of the crop. Development of products that rate well on sensory ratings presents farmers and local entrepreneurs with an alternative means of utilizing excess harvests while minimizing food waste and generating additional sources of income. Thus, development of tomato jam is not only an innovation of a product but a practical intervention that contributes to sustainable agricultural development and rural enterprise creation.

The sensory characteristics assessed received consistently positive evaluations, establishing a strong basis for the subsequent shelf-life assessment. The product was deemed acceptable by the evaluators at the beginning, and the following studies aimed to investigate whether these appealing sensory traits could be retained under different storage conditions over extended timeframes. This is essential for evaluating the product's marketability, as consumer acceptance needs to be sustained not just immediately after processing but also during the entire planned storage period.

4.3 Sensory Acceptability of Tomato Seasoning The sensory evaluation results showed that the developed tomato seasoning was generally well accepted by the evaluators for the sensory attributes evaluated. The positive ratings indicate that surplus tomatoes can be successfully processed into a convenient seasoning product with desirable organoleptic properties. This finding is especially important in that it broadens the utilization of tomatoes beyond the conventional fresh consumption and processed products such as sauces, ketchup, and paste, to an additional value-added alternative that can solve the postharvest losses as well as meet consumer demand for convenient food ingredients.

The developed tomato seasoning was well rated in its appearance and color, which shows that the processing procedure was efficient in maintaining the visual quality of the product. Appearance is an important quality indicator, as consumers tend to associate an attractive and uniform product with freshness, quality and safety. Color is also a critical factor in the purchasing behavior, especially for seasoning products, where consumers expect a characteristic appearance that reflects the flavor profile of the product. The good ratings suggest that the drying and processing procedures preserved the desirable pigments of ripe tomatoes, obtaining a product visually appealing to the evaluators.

The product also had a good performance in terms of aroma and flavor. Aroma is one of the main sensory characteristics that influence the perception of consumers in seasoning products as it contributes to the expectation of taste and culinary use. The good aroma evaluation shows that the processing protocol was successful in retaining the characteristic volatile compounds of tomatoes despite the processing and storage procedures. Similarly, the good evaluation of flavor indicates that the formulation resulted in a seasoning with a balanced taste profile that remained pleasant and acceptable to the evaluators. These results indicate that the developed product has characteristics that are suitable for use as a flavor enhancer in various food preparations.

Other taste attributes like saltiness, sourness and bitterness were also important in the overall sensory acceptability of the product. It is important to obtain a suitable balance among these attributes in seasoning development since an excessive intensity of any of the characteristics may result in a lower consumer preference. The sensory evaluation results showed that the formulation gave a well-balanced product where the natural acidity of the tomatoes worked well with the added ingredients without imparting undesired bitterness or excessive saltiness. This balance is especially important because seasoning products are supposed to enhance, but not to dominate, the flavor of prepared dishes.

Texture and mouthfeel were also rated positively, indicating that the physical characteristics of the seasoning were acceptable to the evaluators. The textural properties of a product affect handling, dispensing, mixing and general convenience in food preparation. Also, a desirable texture helps to maintain product stability during storage by reducing undesirable changes such as caking and moisture absorption. The positive feedback received for these attributes indicates that the processing protocol developed resulted in a seasoning of acceptable physical quality and usability.

The overall acceptability rating is high and proves that the developed tomato seasoning has great potential as a value added food product. Consumer acceptance is a major factor affecting commercial success and the consistent positive assessments of various sensory attributes indicate that the product is suitable for consumption at the household level and potential small-scale commercial production. The results also indicate that excess tomatoes can be converted into a shelf-stable seasoning without sacrificing the sensory qualities desired by potential consumers.

In addition to sensory quality, development of the tomato seasoning has important economic and agricultural implications. Fresh tomatoes are a highly perishable commodity and the seasonal oversupply of fresh tomatoes often leads to substantial financial losses to the farmers as they cannot be marketed before spoiling. Processing of excess tomatoes into dehydrated seasoning products is one alternative utilization strategy to extend the product shelf life, reduce postharvest waste and improve the market value of the commodity. The extended storage stability of dehydrated products also enables producers to distribute and market the product outside the harvesting season, thereby improving marketing flexibility and decreasing reliance on variable fresh market prices.

The successful development and positive acceptability of tomato seasoning underscores the potential of research-based food innovations to promote community entrepreneurship. Standardized processing protocols that emanate from scientific research can be adopted by farmer cooperatives, micro, small and medium enterprises (MSMEs), extension agencies and local government units as a livelihood development and technology transfer activity. Such applications can not only result to increased household income but also to the development of rural economy where additional opportunities for product diversification and local food enterprise are created.

Overall, the sensory evaluation findings indicate that tomato seasoning is a technically feasible and consumer-acceptable value-added product derived from surplus tomatoes. The consistently favorable ratings obtained across the evaluated sensory attributes establish a strong basis for assessing its storage stability under different environmental conditions. The following section tests the persistence of the desirable sensory qualities observed during product evaluation after prolonged storage under refrigerated, room temperature and direct sunlight conditions providing evidence of the product's shelf life performance and commercialization potential.

4.4 Shelf-Life Evaluation Under Different Storage Conditions The shelf-life evaluation was performed to assess the developed tomato jam and tomato seasoning for their capacity to preserve sensory quality during long term storage in three different environmental conditions i.e., refrigerated storage, room temperature storage and exposure to direct sunlight. Sensory evaluations at three and six months provided important evidence on the stability of the developed products and their suitability for potential commercialization. The results revealed that the storage environment has a critical role in the preservation of sensory characteristics of processed tomato products with variations in product quality becoming more apparent with increase in storage time.

Refrigerated Storage The refrigerated storage was the most successful of the three storage conditions tested in maintaining the desirable sensory characteristics of tomato jam and tomato seasoning. At the end of three months, the sensory ratings were generally positive and the desirable sensory characteristics were maintained during the six months period of evaluation. These results were indicative that low temperature storage was effective in retarding the rate of quality deterioration so that the desirable appearance, aroma, flavor, texture and overall acceptability of the products were maintained throughout the period of observation.

The stability observed during storage under refrigerated conditions may be due to the reduced rate of chemical, enzymatic and microbiological reactions which are usually observed during storage of food items. Low temperatures reduce oxidation, degradation of pigments, migration of moisture and microbial activity, thus aiding in retention of organoleptic properties of processed foods. For products such as tomato jam, refrigeration helps in retention of gel consistency, color stability and flavor integrity. Likewise, for tomato seasoning, cooler storage conditions prevent moisture absorption and retain the aromatic compounds responsible for the typical flavor profile of the product.

From a commercial point of view, the results indicate that refrigeration is the best environment in which to maintain product quality over long periods. This is valuable information to producers, retailers and consumers in particular as it offers practical advice on appropriate storage practices to maximize product quality and consumer satisfaction.

Room-Temperature Storage

The products also showed acceptable sensory quality during storage at room temperature, although gradual changes in several sensory attributes were noticed over the longer storage period. While the products were generally acceptable after three months, some minor decreases in selected quality attributes were noted after six months, which are natural effects of extended storage under ambient environmental conditions. In spite of these changes, the developed products maintained sensory characteristics that were within acceptable limits according to the evaluation results reported in the study.

The slow changes seen at room temperature storage are consistent with the expected response of processed food products. Ambient temperatures accelerate oxidation reactions and moisture exchange and flavor deterioration more than refrigerated conditions. Although these processes occur more slowly in processed foods than in fresh commodities, extended contact with room temperature may ultimately affect color intensity, aroma, flavor and texture. Nevertheless, the acceptable ratings obtained over the storage period suggest that the standardized processing protocols assisted in sustaining acceptable product quality despite normal storage conditions.

The ability of the developed products to survive room temperature storage is of practical importance to small scale food processors and rural entrepreneurs who may have limited access to refrigeration facilities. Products

that can maintain acceptable sensory quality under ambient conditions have greater marketing flexibility and lower storage costs and hence are more attractive for community based food enterprises.

Exposure to direct sunlight

Exposure to direct sunlight was the storage condition that posed the greatest challenge for maintaining product quality throughout the storage period. Exposure to sunlight subjects food products to fluctuating temperatures and constant sunlight, both of which accelerate physical and chemical deterioration. While the products retained varying degrees of acceptability throughout storage, more significant changes in several sensory attributes were observed under this condition compared to refrigerated and room temperature storage.

Extended exposure to sunlight can result in faster degradation of pigments, oxidation of flavor compounds, changes in moisture and deterioration of volatile aromatic compounds. These changes may affect the visual appearance, aroma, flavor and overall sensory perception of processed food products. These changes are particularly important in tomato-based products, as the natural pigments and flavor compounds responsible for product quality are sensitive to heat and extended light exposure.

The results demonstrate the significance of adequate storage conditions for maintaining the quality of value-added tomato products. The formulated products showed resistance to various storage conditions, but reducing exposure to direct sunlight will help in preserving their preferred sensory qualities over a longer time. Appropriate packaging combined with suitable storage conditions therefore becomes an important consideration for future commercialization.

Comparative Assessment of Storage Conditions

A comparison of the three storage environments demonstrates that product quality was influenced by both storage condition and storage duration. Refrigerated storage was consistently the best environment to maintain sensory quality, followed by room-temperature storage, while exposure to direct sunlight resulted in comparatively higher changes in product characteristics over time. However, the results indicated that the developed tomato jam and tomato seasoning had satisfactory storage stability during the evaluation period, which supported their potential as value-added products that could extend the utilization of surplus tomatoes.

The fact that the products generally retained acceptable sensory characteristics under the different storage conditions is important. Shelf-life stability is an important determinant of commercial success, influencing product distribution, inventory management, consumer confidence, and market expansion. The good storage performance noted in this study suggests that the processing protocols developed yield products with adequate stability for future community-based production and potential commercialization.

To summarize, the storage life assessment shows that tomato jam and tomato seasoning have good storage qualities under suitable conditions. The findings point to the benefits of these products as good ways of controlling postharvest losses, promoting agricultural value addition and sustainable food processing activities in tomato farming communities.

4.5 Sensory evaluation at three and six months of storage The results of sensory evaluation after three and six months of storage were compared by Analysis of variance (ANOVA) to validate the effect of storage time on sensory quality of the developed tomato jam and tomato seasoning. This analysis gave statistical evidence on the stability of the developed products over time and allowed the researchers to determine if there had been significant changes in consumer acceptability as a consequence of prolonged storage.

The ANOVA results indicated that the storage length effect was not similar for the sensory parameters and storage conditions under consideration. For parameters for which there was no statistically significant difference between the third and sixth month of storage, the results suggest that the processing protocols developed were successful in maintaining the sensory quality of the products over time. The lack of statistically significant differences shows that the products had relatively stable organoleptic characteristics even after long periods of storage, and demonstrated their ability to retain desirable consumer qualities throughout the evaluation period. These results are particularly important because they show that normal

storage had no significant effect on the acceptability of the products when appropriate processing and packaging techniques were used.

In contrast, sensory attributes that showed statistically significant differences between the two evaluation periods indicate that the length of storage affected certain aspects of the product quality. This is expected in processed food products because chemical, physical, and biochemical reactions continue to occur during storage, even under controlled conditions. Gradual changes in color, aroma, flavor, texture, or mouthfeel may occur due to oxidation, pigment degradation, moisture migration, or the slow breakdown of flavor compounds. While these changes may affect individual sensory characteristics, they do not necessarily mean that the product has become unacceptable for consumption. Rather, they reflect the natural progression of quality changes that occur during extended storage.

The comparative study of the tomato jam showed to what extent the product saved its beneficial sensory characteristics during the storage time for half a year. Statistical results indicated the influence of the standardized formulation and processing method on the preservation of the product's general quality. Some evaluation periods showed small changes but the product generally kept acceptable sensory properties which shows that tomato jam has a good storage stability and can be consumed for a long time when stored under suitable conditions.

Similarly, the comparative evaluation of tomato seasoning indicated that the developed product maintained acceptable sensory quality during storage. Tomato seasoning as a dehydrated product is less susceptible to rapid deterioration than fresh tomatoes, due to the lower moisture content. However, the duration of storage may still influence the intensity of aroma, flavor perception and other quality parameters. The statistical analysis provided evidence on the extent of these changes and indicated that the product maintained sensory qualities within the range of consumer acceptability during the observation period.

The comparison of third and sixth month evaluations also provides useful information on the practical shelf life of the developed products. Determination of shelf life is more than just food safety, but also the period of time during which a product still meets consumer expectations for quality. The present results showed that the formulated tomato products were found to have acceptable storage performance, and therefore, they can be recommended for household use and also for commercial application. This is especially important for value-added products of agriculture that are intended to be used to overcome seasonal overproduction, as an extended storage stability gives producers more marketing and distribution flexibility.

From the commercialization point of view, the statistical evidence generated by the ANOVA makes the potential applicability of the developed processing protocols more attractive. Products that are able to maintain an acceptable sensory quality during a longer period of storage are more attractive to entrepreneurs, retailers and consumers because they are less at risk of product spoilage, facilitate inventory management and are more marketable. The demonstrated stability of tomato jam and tomato seasoning therefore enhances their potential as value-added products that may help to reduce postharvest losses while generating additional income opportunities for tomato-producing communities.

In general, the comparative study of the third and sixth month confirmed that the developed tomato products showed satisfactory sensory stability during the evaluation period. The ANOVA results provide scientific support for the reliability of the developed processing protocols and further enhance the feasibility of surplus tomatoes for the development of shelf-stable, consumer-acceptable food products.

CONCLUSIONS

This study successfully developed two value-added tomato products, tomato jam and tomato seasoning, using surplus tomatoes produced in Roxas, Isabela. The developed products showed that tomatoes, which are prone to postharvest losses during the seasonal overproduction period, can be transformed into innovative food products with acceptable sensory characteristics and increased utilization potential. The standardized processing protocols developed in this study provide a practical approach to converting excess tomato harvests into products with higher economic value while reducing food waste.

The results of the sensory evaluation revealed that the tomato jam and tomato seasoning were generally acceptable to the evaluators for the quality attributes evaluated. The positive ratings obtained for appearance, color, aroma, flavor, texture, mouthfeel and overall acceptability suggest that the processing methods employed in this study were successful in developing products that meet consumer expectations. These findings prove the technical feasibility of utilizing surplus tomatoes for the development of marketable value added food products.

Shelf-life studies also indicated satisfactory sensory quality of the developed products when stored under the conditions tested in this study. Some changes were observed in some sensory parameters during extended storage, but generally the products maintained acceptable quality during the period of observation. Refrigeration provided the best conditions for the maintenance of product quality among the storage environments studied, while storage at room temperature maintained acceptable sensory characteristics for practical applications. Exposure to direct sunlight resulted in greater changes in product quality, which emphasizes the importance of proper storage in maintaining product acceptability.

The developed products were shown to be stable during storage based on statistical analyses using Analysis of Variance (ANOVA). The results confirm the efficiency of the developed processing protocols for the production of tomato-based products that retain good sensory characteristics over time. These results enhance the potential use of the products in domestic use, community-based food processing and prospective commercialization.

The study demonstrates overall that value-added processing is a sustainable and viable solution to the age-old problem of surplus tomatoes. By processing highly perishable tomatoes into shelf-stable products with acceptable consumer appeal, the study helps to reduce postharvest losses, create value for agriculture, improve food security, and promote the development of rural enterprises. The processing protocols developed from this research provide a solid base for future technology transfer programs and commercialization of tomato-based products in tomato-growing communities.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are suggested: Local farmers, farmer association, cooperatives and micro, small and medium enterprises (MSMEs) may adopt the developed processing protocols for tomato jam and tomato seasoning as an alternative strategy to utilize surplus tomato production and minimize postharvest losses.

State universities and colleges, local government units and agricultural extension agencies may adopt the developed processing protocols in their community training programs and livelihood projects on the promotion of value-added processing and food entrepreneurship.

Commercial production is an important venture for entrepreneurs, and pilot-scale processing and market validation studies are required to assess consumer demand, production costs, pricing strategy and commercial feasibility prior to product commercialization on a large scale.

In future studies, physicochemical, nutritional, microbiological and packaging analyses should be added to complement the sensory evaluation performed in this research and to establish more complete standards of quality for tomato jam and tomato seasoning.

Further shelf-life studies with extended storage times and controlled environmental conditions are recommended to determine the maximum shelf-life of the developed products and to determine the most suitable packaging systems for commercial marketing.

Future researchers may also focus on the development of other innovative tomato-based products from surplus tomatoes, which would further enhance opportunities for product diversification, value addition in agriculture, and sustainable food processing.

Practical Implications The findings of this study have significant implications to farmers, food processors, entrepreneurs, policy makers and extension practitioners. For tomato farmers, the products developed in this study provide an alternative source of income from the surplus harvests that would have otherwise been sold at lower prices or discarded due to spoilage. For food entrepreneurs and MSMEs, the standardized processing protocols provide opportunities for product line diversification using locally sourced raw materials as well as promoting community based enterprise development.

The study also corresponds to the goals of the local government units and agricultural extension agencies in minimizing postharvest losses and improving rural livelihoods through value-added processing technologies. The developed products encourage the utilization of surplus agricultural commodities which in turn promote sustainable food systems, resource efficiency, and local economic development.

Limitations of the Study

The study was limited on the formulation, sensory evaluation and shelf-life determination of tomato jam and tomato seasoning from surplus tomatoes from Roxas, Isabela. The evaluation was mostly on the sensory acceptability of the developed products under selected storage conditions and at specific observation periods. The results provide useful preliminary evidence on product acceptability and sensory stability; however, the results and its implications to commercialization should be interpreted with several limitations in mind.

The first point to note is the lack of detailed physicochemical analysis of the developed products. For example, some important parameters such as pH, total soluble solids (TSS), titratable acidity, moisture content, water activity and instrumental color were not determined. These are important characteristics in the evaluation of quality and stability of processed food products, because they provide objective measures that complement sensory observations. For example, changes in acidity, moisture, soluble solids and color during storage can provide further evidence of product deterioration or stability that may not be fully picked up by sensory evaluation alone. Therefore, the conclusions on shelf-life stability in this study are based mainly on the maintenance of acceptable sensory characteristics and should not be interpreted as a complete physicochemical determination of product shelf life.

Second, nutritional composition was not analyzed. Although tomatoes are naturally associated with nutrients and bioactive compounds, the present study did not quantify the nutritional properties of the finished tomato jam and tomato seasoning. Therefore, no conclusions can be drawn from this study regarding their actual nutrient content, retention of vitamins and minerals after processing, antioxidant capacity, lycopene concentration, or possible nutritional advantages over other processed tomato products. Future nutritional analysis would be necessary before making specific nutritional or health-related claims about the developed products.

Another important limitation is the lack of microbiological testing. Shelf-life determination was based mainly on sensory evaluation after three and six months of storage under refrigerated, room temperature and direct sunlight conditions. Although the products maintained different levels of sensory acceptability during the observation period, sensory acceptability alone cannot determine microbiological safety. Microbial load, yeast and mold growth and other relevant indicators would provide a more comprehensive assessment of product safety and storage stability. Therefore, the six-month observation period reported in this study should be interpreted as evidence of sensory stability under the conditions evaluated, and not as a validated commercial shelf life or expiration period.

The scope of the sensory evaluation also limited the study. The results are the perceptions of the evaluators used in the original research and cannot automatically be extended to the wider consumer market. Consumer preferences may vary with demographic characteristics, geographical location, dietary practices, familiarity with tomato-based products and individual taste preferences. A larger-scale consumer acceptability and market validation study would therefore be required to determine whether the positive sensory responses identified in this study would be reproduced amongst a more diverse population of potential consumers.

Additionally, the study did not include a comprehensive economic feasibility or market analysis. The development of the tomato jam and the tomato seasoning provides a good indication of the potential for value-

added products from surplus tomatoes. However, the study did not determine the production cost, suggested retail prices, profitability, willingness to pay, market demand, break-even points or the financial requirements for scaling up production. Therefore, statements regarding commercialization should be considered indicators of commercial potential rather than evidence of commercial viability. Further market and financial analysis are needed before the products can be recommended for large-scale commercial production.

Furthermore, the study used surplus tomatoes from Roxas, Isabela and this constrains the generalizability of the findings to tomatoes grown in other locations, seasons, or production environments. Variability in tomato variety, maturity, growing conditions, postharvest handling, and raw material quality could affect properties of the products produced. Similarly, the processing protocols were developed and evaluated within the parameters of the present research, but their performance under larger-scale or industrial production settings was not studied.

Finally, the shelf-life evaluation was limited to 3- and 6-month observation periods and three storage environments, refrigeration, room temperature, and exposure to direct sunlight. Although these conditions provided useful comparative information on sensory stability, they do not reflect the spectrum of conditions that can be experienced during commercial storage, transport, retail display, and household use. Temperature fluctuations, humidity, integrity of packaging, repeated opening of containers, and longer storage periods may affect product quality in different ways.

However, the study provides a useful starting point for the utilization of surplus tomatoes thru value-added processing. The results demonstrate the feasibility and sensory acceptability of tomato jam and tomato seasoning and provide preliminary information about their sensory stability under different storage conditions. Future research incorporating physicochemical, nutritional, and microbiological analyses; larger consumer panels; packaging studies; economic feasibility assessment; and extended shelf-life testing would provide a more comprehensive basis for product standardization, regulatory compliance, technology transfer, and potential commercialization.

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