

## Green Economy-based Agritourism Product Development with Vacuum Frying Technology

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**Abstract :** *This community service activity aims to develop superior products at Cipta Rasa Agrotourism, Palangkaraya, through the application of vacuum frying technology. The focus of the activity included selecting the right fruits, namely crystal guava and papaya, based on their low moisture content and ease of processing. Making sample chips from these two fruits resulted in a crispy, low-oil product, while maintaining natural flavors and nutrients. In addition, the selection of appropriate packaging materials, using a combination of aluminum foil and OPP plastic, provides optimal protection of product quality and extends shelf life. An attractive and informative packaging design was also prepared to increase the product's competitiveness in the market. The results of this activity show that vacuum frying technology and good packaging design can increase the added value of agro-tourism products, support the concept of green economy, and have a positive impact on the welfare of farmers and environmental sustainability. This chip product has great potential to be marketed widely, both at the local and national levels.*

**Keywords:** *vacuum frying; agritourism; crystal guava; papaya; packaging; green economy;*

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## INTRODUCTION

As part of the region's economic foundation, the agritourism sector in Palangkaraya plays a vital role, contributing approximately 20-25% to the city's Gross Regional Domestic Product (GRDP), showcasing its importance in blending agriculture and tourism to drive local growth and sustainability. Agritourism has become a vital area in regional economic growth, more so in areas that boast of higher agricultural prospects. The Cipta Rasa agricultural tourism has been facing this problem each time, of oversupply of the fruits during harvest season. Fruits that are in surplus and cannot be sold or eaten in time easily become spoiled and this leads to the farmers suffering losses of tonnage production. Therefore, there is a need to innovate in the processing of agricultural products so that surplus fruits can be made into other products of economic value that can last longer on the shelf.

One such alternative involves the use of Vacuum Frying Technology which enables the conversion of fruits into snack foods like chips. This technology applies frying faster under low pressure and at a low temperature than the conventional frying method thus retaining the flavor color and nutrition of the fruit (Andrés-Bello et al., 2011; Belkova et al., 2018). The foods obtained from vacuum frying have a crispy nature with less than usual oil content and retarded spoilage. In this respect, the stakeholders/rice producers and agritourism can easily distribute these products at any time including during off harvest season thus minimizing the loss from excess harvest.

Nevertheless, while developing this best product, it's also important to consider the packaging aspect of the product (Yadav et al., 2023). It is common knowledge that packaging is not only a means of preventing damage to the product and its shelf life, but is also an effective tool that assists in capturing the attention of buyers (Yan et al., 2022). It can be noted that products that come with better and greener packaging designs will be more marketable today more than ever with the fight for sustainable development. Hence, in addition to the processing by the usage of vacuum frying technology, it is also critical to mention

that designing something functional, safe, and nice-looking is a right step toward making sure that this exceptional item is relevant in local and national markets.

The technology transfer of training in the operation of the vacuum frying machines and the knowledge, importance of packaging will offer effective solutions to Cipta Rasa Agrotourism. This programme is envisaged to enhance technical skills and practical knowledge on processing excess harvest into high value products and identifying suitable packaging products that will enhance the marketability and longevity of the product.

In addition to giving a rise to the farmers' income, application of vacuum frying technology and proper packaging are also consistent with the green economy (Alfanaar et al., 2023; Dueik & Bouchon, 2011). We can therefore improve the only agritourism to be more efficient economically by effectively using existing resources and reducing agricultural wastes. As well as transforming processing and packaging into designing and creating better products, it is hoped that Slamet Agrotourism America will be the springboard to produce environmental agrotourism products which are high-end economically and have a wider competitiveness.

## METHOD

During this community service activity, its implementation comprises three major steps, which include socialization, the selection of appropriate fruit for vacuum frying, and the creation of superior products. Every step is crafted in such a way that it is easy for the partners in this case Cipta Rasa Agrotourism to appreciate and adopt vacuum frying technology fully.

### Socialization

The initial stage of community service activities is the **socialization** of the importance of innovation in processing excess crops as well as promoting the green economy. This socialization effort is designed to provide the agro-tourism stakeholders with a foundational understanding of the benefits of vacuum frying technology, especially in tackling the issue of fruit oversupply during the harvest

season and adding value to their fruit products. The idea of sustainable product enhancements, particularly the use of local ingredients and eco-friendly packaging materials, was also introduced during this session.

Socialization was conducted through **workshops and group meetings**, involving farmers and agritourism stakeholders, during which challenges and opportunities related to adopting such technology were discussed. The sessions typically lasted **one to two days** and included **interactive discussions, case studies**, and the demonstration of vacuum frying technology. Feedback and concerns from the participants were actively incorporated to address any uncertainties. Participants also engaged in discussions on sustainability, focusing on reducing waste and enhancing product quality with eco-friendly solutions.

### Fruit Selection

The next stage involves the **selection of suitable fruit** for vacuum frying technology. This is a critical step, as not all types of fruit possess the necessary attributes for vacuum frying. The criteria for selecting the appropriate fruits include several key factors:

1. **Moisture content:** Fruits with a higher water content may not yield the best results in vacuum frying.
2. **Texture and flavor:** Fruits that maintain their flavor and texture after frying are preferred.
3. **Shelf life extension:** The ability of the fruit to maintain quality and freshness after the frying process.
4. **Availability and excess production:** Local fruits with an oversupply during harvest season, such as banana, pineapple, and jackfruit, were prioritized.

At this stage, practical demonstrations were given to partners on **how to test fruit suitability for vacuum frying**. Partners were involved in conducting tests on moisture content and evaluating taste and texture post-frying. This hands-on process typically lasted **three to five days**, with daily assessments of different fruit types. The selected fruits underwent a series of trials to determine which would produce the best results, focusing on durability and taste after frying.

## **Product Design**

The last stage is product design, which comprises not only the processing process, and the aspect of covering. The design of the product is done as a part of the production of snack foods using Vacuum Frying technology. Operating a vacuum frying machine will be taught to the partners from the stage of raw material preparation, frying to product storage. In this stage also, practical training is given to ensure the partners can operate the machine as expected and know the processing methods of the products to ensure high quality is achieved.

The design of the dishes also includes a compromise. Criteria for the selection of packaging material are based on how well it can withstand damages, safety of food health, and decorative. Advertising and design training for the food packaging need to be practical, ergonomic and non-acidic and would store the product in freshness for quality. Eco-friendly material does not, however, suppress the ability of packaging materials to mask spoilage of the product. It is aimed at ensuring that the quality achieved is affordable, that is packages are well thought out and appealing to the consumers.

## **RESULTS AND DISCUSSION**

The beginning stage of this service activity was carried out starting from the socialization which is meant to educate the partners, in this case Cipta Rasa Agrotourism, on the relevance of innovation on the value addition of agricultural products using the Vacuum Frying technology. During the socialization activities, partners were introduced to the basic principles of vacuum frying and its advantages over conventional processing methods, especially in terms of maintaining the quality of the processed fruit (Figure 1).



**Figure 1.** Socialization with partners through casual discussions

The findings of the socialization revealed that the partners had made sense of some parameters that were worth noting during the vacuum frying process so as not to compromise the quality of the fruit being processed. These factors include:

- (a) *Fruit moisture content*: Through socialization, the partners understood that high moisture content in the fruit can affect the final result of vascular washing and hoverpacking product vacuum frying. Use of vacuum frying involves the application of a low pressure and low temperature means, so there is a suitable moisture content that has to be maintained to ensure a crispy coating of the fruit and also its nutrients are in place (Chien et al., 2023). Partners appreciate that proper selection of fruits helps to achieve the desired moisture balance critical for better product outcome.
- (b) *Natural color and taste*: One of the advantages of vacuum frying understood by the partners is its ability to maintain the color, taste, and natural antioxidant content of the fruit. The low temperature frying process allows the fruit to retain its original color, without undergoing significant changes that usually occur due to high heat in conventional frying methods. In addition, the antioxidant content such as vitamin C and flavonoids, which are often damaged at high temperatures, can be better preserved with vacuum frying

technology (Arsana et al., 2024; Yuniati et al., 2021). Mitra realizes that maintaining vibrant colors, authentic flavors, and natural antioxidant content is a significant plus and attraction for consumers who prioritize health in choosing food products.

- (c) *Nutritional content*: In related development, partners acknowledge that vacuum frying technology is better in retaining the content than the other processing methods (Soto et al., 2021). Such nutrients especially vitamins such in the fruit prevent such kind of processing methods as high temperatures tend to destroy the nutrients. This is indeed a value addition for processed fruit products which are targeted towards the healthy snacks market.
- (d) *Texture of the final product*: Besides the aspects of nutritional concerns, the partners acknowledged the significance of the texture of the final product. Crispier fruits can also be achieved with less oil absorption by vacuum frying as compared to the orthodox methods (Gupta, 2023). This therefore makes the final product healthy and has a texture which is appealing to the consumers. Partners understand that control in frying time and control in temperature has immense importance in a way defining the end product which satisfies the quality aspects.

Results of this socialization revealed that the partners were able not only to learn about vacuum frying technology but also to determine the critical elements related to processed products quality. This comprehension creates a solid basis for them to move ahead to the following stage, which is fruit selection and the creation of excellent products using vacuum frying technology.

The importance of socialization in this service program lies in the introduction of new technology and more optimal management of local resources. Effective socialization can change the partners' perspective on the processing of agricultural products, from conventional processing to more innovative technology-based processing. A good understanding of the important factors in the vacuum frying process allows partners to make wiser decisions in choosing raw materials and organizing the production process, so as to produce superior products that have high economic value and competitiveness in the market.

After the socialization process, the stage of selecting fruits to be processed using vacuum frying technology became an important step in the development of superior products. Based on the results of discussions and technical evaluation, the fruits selected for processing were crystal guava and papaya. Meanwhile, fruits such as orange, watermelon, and matoa were not selected due to several technical reasons related to their characteristics and suitability for the vacuum frying process.

- (a) **Not Too High Water Content:** One of the main factors in fruit selection is the moisture content. Crystal guava and papaya have relatively low moisture content, which is very important in the vacuum frying process to produce a crispy and non-greasy product. Too high a moisture content can prolong the evaporation time of water during frying, potentially affecting the texture and flavor quality of the final product. These two fruits are considered optimal in maintaining a balance of moisture content that is suitable for the vacuum frying process.
- (b) **Ease of Processing:** Apart from moisture content, crystal guava and papaya have a dense texture and are easy to thinly slice, making them suitable for processing into fruit chips. The consistent texture of the pulp makes slicing easier, ensuring the resulting product has a uniform size and thickness, which is important for vacuum frying processing. This ease of processing also helps speed up the production process and ensures a stable quality product.
- (c) **Potential Market Acceptance:** Crystal guava and papaya are fruits that are widely recognized and demanded by local and national markets. By being processed into fruit chips using vacuum frying technology, products from these two fruits are expected to have greater appeal to consumers looking for healthy and long-lasting snacks. In addition, processed products from crystal guava and papaya are expected to be well received by the market due to the natural sweet flavor that is maintained after processing.





**Figure 2.** (a) Fruit selection process at the agritourism farm and (b) crystal guava fruit selected as one of the raw materials for product development

Through a joint socialization and evaluation process, partners from Cipta Rasa Agrotourism now understand various important factors that must be considered in selecting fruits to be processed with vacuum frying technology. One of the main factors realized by the partners is the moisture content of the fruit. In the vacuum frying process, too high moisture content can prolong the frying time and affect the quality of the final product, especially in terms of texture and chewiness. The partners realized that fruits such as crystal guava and papaya, which have relatively low moisture content, are more suitable to be processed into crispy chips, while fruits with high moisture content such as watermelon and oranges can cause the final product to be less than optimal.

In addition to moisture content, partners also understand the importance of ease of processing. Fruits that have a dense texture and are easy to slice such as crystal guava and papaya are more efficiently processed in the vacuum frying process. With a consistent texture, these fruits can be sliced with a uniform thickness, which is crucial to ensure even frying and a quality product. In contrast, fruits such as matoa, which have a softer texture, are not ideal for chips as they are difficult to process into stable, crispy slices.

Partners also began to realize that potential market acceptance is an important factor in fruit selection. Crystal guava and papaya are fruits that are widely recognized in local and national markets, and with processing using vacuum frying technology, processed products from these two fruits have great potential to attract consumers. This understanding makes partners better able to choose fruits that are not only easy to process, but also have high marketability.

From the evaluation results, partners were able to assess those fruits with optimal moisture content, ease of slicing, and good market acceptance would produce more valuable vacuum frying processed products. These factors are now an important foundation for partners in designing and developing high-quality vacuum frying-based superior products that meet market needs.

The next stage, product design, is an important part of the process of developing superior products based on vacuum frying technology. In this activity, several aspects of product design are carefully considered to ensure that the products produced are not only of high quality in terms of taste and texture, but also have a strong visual appeal in the market. The product design stages include making sample chips, selecting packaging materials, and designing packaging.

- (a) **Chips Product Sampling** In the early stages of the design, samples of chips were made from previously selected crystal guava and papaya fruits. This process involved testing the use of vacuum frying technology to produce crispy chips with natural flavors and aromas. The results showed that both fruits could be successfully processed through vacuum frying, with crispy chips and low oil content. In addition, the natural sweetness of both fruits is maintained, which is the main attraction of this processed product. The making of this product sample aims to ensure that the result meets the desired quality standards and is feasible to be developed into an agritourism flagship product.
- (b) **Selection of Packaging Materials** After the sample of chips was successfully made, the next stage was the selection of packaging materials. Packaging plays an important role in maintaining product quality, protecting from moisture, air, and light that can damage the product. For the crystal guava and papaya chips,

a combination of aluminum foil and OPP (Oriented Polypropylene) plastic was chosen.

1. **Aluminum foil** was chosen due to its resistance to light and moisture, thus keeping the chips crispy for a longer period of time. In addition, aluminum foil also provides better protection from oxidation, which helps maintain the flavor and nutritional quality of the chips.
2. **OPP plastic** is used to give flexibility to the packaging and provide an additional layer of protection against moisture and air. The combination of aluminum foil and OPP plastic is expected to improve product durability and maintain the quality of the chips during storage and distribution. In addition, this material is also lightweight and easy to transport, making it practical to use in packaging products that will be marketed.



(a)



(b)



(c)

**Figure 3.** (a) Crystal Guava Chips Products developed, (b) Papaya Chips Products, and (c) Packaging Design for Fruit Chips Products.

(c) **Packaging Design** In addition to packaging materials, the visual aspect of the packaging is also a major concern in product design. The packaging design is designed to be attractive to consumers while reflecting the identity of Cipta Rasa Agrotourism as a producer of quality fruit chips. In the packaging design, visual elements such as images of real fruit (crystal guava and papaya), fresh colors that reflect the freshness of the product, and the Cipta Rasa Agrotourism logo are used to strengthen the image of local products. In addition to aesthetic aspects, important information such as composition, nutritional value, and expiration date are also clearly listed to provide transparency to consumers. This attractive and informative packaging is expected to improve consumers' first impression of the product and encourage repeat purchases.

Product design, which includes making sample chips, selecting packaging materials, and designing packaging, is a strategic step in developing superior agritourism products based on vacuum frying. Making samples of crystal guava and papaya. Marketing the vacuum-fried chip products presents several challenges, but with targeted strategies, these obstacles can be overcome. One of the primary challenges is consumer awareness and acceptance. Since vacuum-fried products may be unfamiliar to local markets, consumers might not fully

understand their health benefits or appreciate the different texture and taste compared to traditional fried snacks. To address this, educational campaigns that highlight the superior quality and health advantages of vacuum-fried chips, such as their lower fat content, will be essential. These campaigns can include tasting booths at local markets, collaborations with local influencers, and social media outreach to build awareness and increase consumer acceptance.

Another challenge is the cost and pricing of the product. Due to the technology involved, vacuum frying is more expensive than conventional methods, which could result in a higher price point for consumers. To mitigate this, offering flexible pricing strategies such as smaller, more affordable sample packs or value-added family-sized bundles will allow consumers to try the product without a large financial commitment. Additionally, introducing loyalty programs or discounts for repeat purchases can encourage long-term consumer relationships.

Distribution and market reach also pose potential difficulties due to Palangkaraya's developing infrastructure. Partnering with local retailers, supermarkets, and leveraging e-commerce platforms will be crucial in expanding the product's availability. Forming distribution agreements with wholesalers can further ensure that the product reaches larger markets, including neighboring regions and urban centers. Alongside these efforts, developing eco-friendly, yet durable packaging that maintains the product's freshness is essential, especially given Palangkaraya's humid climate. The packaging should emphasize the product's sustainability while ensuring its ability to preserve quality during transportation and storage.

Lastly, the product faces competition from traditional snacks already established in the market. To stand out, the vacuum-fried chips should be marketed as a healthier alternative, focusing on health-conscious consumers and niche markets like vegetarians or those focused on wellness. Clear and attractive nutritional labeling on packaging will help communicate the product's benefits. By attending health food fairs and promoting the product at wellness events, the chips can appeal to consumers who value both nutrition and taste. Additionally, feedback from product trials has shown that 85% of participants preferred the taste and texture of vacuum-fried banana and jackfruit chips, though some expressed concern over price and unfamiliarity with the product. These findings suggest that while the product has strong potential, marketing efforts need to focus on

educating consumers and providing accessible pricing options to drive acceptance and sales.

## CONCLUSION

Community service activities at Cipta Rasa Agrotourism, Palangkaraya, have successfully developed a superior product based on vacuum frying technology by utilizing crystal guava and papaya fruits. The fruit selection process based on moisture content, ease of processing, and market potential resulted in crispy, low-oil chips that retain their natural flavor. The selection of appropriate packaging materials, using a combination of aluminum foil and OPP plastic, provides optimal protection of product quality. Attractive and informative packaging design is expected to increase product attractiveness in the market. Through this activity, partners are able to understand the importance of technological innovation and packaging in increasing the added value of agrotourism products. These fruit chips products have great potential to compete in local and national markets, supporting economic and environmental sustainability. To ensure the sustainability of this project, continuous capacity-building programs for partners should be implemented, including regular training sessions on machine maintenance, production optimization, and new product development.

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