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Improving the product quality of sea lettuce crips through the implementation of technology processes

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ABSTRACT

Sea lettuce is commonly consumed fresh in salads. However, its underutilization has attracted the interest of the Giri Sari group of women farmers in Pecatu Village, who are exploring the production of sea lettuce chips. While their families enjoy the chips, they tend to be oily and lack crispness. The group aims to market sea lettuce chips to the community, but faces challenges in achieving and maintaining optimal crispness, durability, and effective packaging. The purpose of this community service is to apply appropriate technology that specifically focuses on the process of draining and packaging products. The methods used include socialisation, technology application, monitoring and evaluation, and ensuring the sustainability of the programme. As a result, there was a 75 percent increase in partners' knowledge and skills regarding the processing of sea lettuce chips. In addition, the quality of the chips improved by 90 percent, and they are now packaged in attractive aluminium foil that extend the product's shelf life by up to three months. With technological support from the PKM team, it is expected that the partners will be able to produce sea lettuce chips that are worthy of being marketed to the community.

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1. INTRODUCTION

Pecatu Village has an area of 2,642 hectares, is a village located in South Kuta District, Badung Regency, Bali. Pecatu Village has natural potential such as cliffs and white sand beaches which are tourist attractions (Augustine et al., 2022). The beaches owned by Pecatu village, such as Dreamland Beach, Labuan Sait Beach, Bingin Beach, Nyang-Nyang Beach, and Suluban Beach (Pemerintah Desa Pecatu, 2022). Beaches in Pecatu Village produce fish and algae that are abundant in availability, but their utilisation is not optimal (Breanita et al., 2020). One of the algae found in Pecatu Village is sea lettuce. Sea lettuce (*Ulva lactuca* L) belongs to a group of green algae that are found on many seas (Mohan et al., 2023). Sea lettuce has not been widely utilised by the community, generally sea lettuce is utilised in fresh form into salads. Sea lettuce contains vitamins A, B, C, E and K. It also contains dietary fibre, calcium,

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magnesium, sodium, zinc, iron and iodine (Mohan et al., 2023; Panjaitan et al., 2021). Sea lettuce has properties such as antioxidants, antibacterial, antifungal, and antitumour, anticancer, antihyperglycemic, anti-inflammatory (Putri et al., 2020). The residents of Pecatu Village earn a living as labourers, private employees and traders (Pemerintah Desa Pecatu, 2022). To improve the welfare of people in the social environment, they form empowerment groups. One of the empowerment groups in Pecatu village is a farmer women's group consisting of women in the village. The farmer women's group accommodates women to improve their knowledge and skills (Afifah & Ilyas, 2021; Ardiani & Dibyorini, 2021; Kumalasari et al., 2023). They empower the local community by processing natural materials in Pecatu Village. In Pecatu Village there are several women farmer groups, one of which is the Giri Sari women farmer group with 10 members. The Giri Sari women farmer group is chaired by Anak Agung Sagung Bintang Sri Utami Dewi (50 years old). Under the leadership of Mrs Sagung Bintang, the group has been utilising sea lettuce as an ingredient for making chips. But the processing of sea lettuce chips is still limited to personal consumption and has not been introduced to the community outside their group. The sea lettuce chips they make have a savoury taste and are loved by their families. Because their families like the sea lettuce chips which they have made, they want to market the sea lettuce chips to the community.

Interviews conducted by the PKM team to the head of the Giri Sari farmer women's group found that the problems experienced by partners in terms of processing sea lettuce chips include sea lettuce chips that they produce are still oily so that the products they produce are not crispy. They expect chips that remain crispy and last long so that later the product can be sold. They also want sea lettuce chips that they produce can be used as souvenirs typical of Pecatu Village.

The PKM team addresses partner challenges by providing appropriate technological support, specifically through the use of a spinner. Spinner is a tool used to drain the oil attached to fried food products, so as to produce products that are maintained in quality (Dewi et al., 2023). The use of spinners can provide a solution to reduce the oil content contained in sea lettuce chips, so that the chips produced remain crispy (Wardono et al., 2022). The application of a spinner enhances both the effectiveness and efficiency of the oil draining process (Marisa & Putri, 2018), the oil draining process becomes faster and easier to use (Wardono et al., 2022). The use of spinners can maintain product quality by draining the remaining oil attached to the product. Oil is prone to oxidation which is characterised by a rancid odour. The presence of oil attached to the product can cause the product to be not crispy and easily damaged, resulting in low product durability (Nasution et al., 2021). In addition to the use of spinners, product durability is also supported by the packaging used. The choice of packaging used can increase the durability of the product (Afriyanti et al., 2018).

The PKM team supplied packaging in the form of standing pouches made from aluminum foil, which enhances the durability and shelf life of sea lettuce crisps. Effective packaging is crucial for preserving the quality of the crisps by protecting them from external factors (Manurung et al., 2023). Packaging can protect the product from exposure to light, water vapour, oxygen, and moisture that can cause damage to the product. Aluminium foil is one type of packaging that has a good ability to protect food products because it can withstand the entry of light and air into the packaging (Manurung et al., 2023; Syafira et al., 2018). The use of aluminium foil packaging makes the product look more elegant. In addition, chips packed with aluminium foil have lower moisture content, ash content, and fat content when compared to plastic packaging. High moisture content, ash content, and fat content in chips can accelerate product deterioration, such as not being crispy and smelling rancid (Rosida et al., 2020).

This community service activity is carried out to help solve the problems experienced by the Giri Sari farmer women's group in developing sea lettuce chips. Through this programme, it is hoped that the sea lettuce chips they produce can be accepted by the wider community. In addition, this activity also aims to encourage local community empowerment by improving production and packaging skills,

so that the farmer group can be more economically independent and contribute to the wealfare of the local community.

2. METHODS

This PKM activity was carried out in Pecatu Village, Kuta Selatan, Badung Regency, Bali. The partner in this PKM activity is the Giri Sari farmer women's group in Pecatu Village which has 10 members of women. Before the activity was carried out, the PKM team observed the problems experienced by the partners so that the solutions provided to the partners were in accordance with the needs of the partners. The PKM team have expertise in food processing and packaging design techniques, who come from the nutrition science and informatics engineering study programmes.

The methods used in this community service activity include socialization of activities, training, application of technology, monitoring and evaluation, and program sustainability is shown in Figure 1. The application of technology is a transfer of knowledge and technology that supports the processing of sea lettuce crisps which includes the use of a spinner, handsealer (Figure 2) and packaging of sea lettuce crisps using standing pouch packaging. A spinner is a device designed to remove excess oil from fried food products, ensuring the quality of the final product is preserved (Dewi et al., 2023). The spinner is useful for draining the oil that still remains after frying. The faster the spinner rotation is used, the oil remaining in the chips will disappear. This can be caused by the centrifugal force in the draining process using a spinner so that the oil attached to the chips will bounce out of the material (Cantikasari et al., 2022). The spinner used has a capacity of 3 litres with a rotating motor power of 55 watt, made of polymer material. The selection of spinners made from polymers is due to the nature of the polymer materialwhich can keep the chips from being crushed when colliding with the spinner material when used. Handsealer is a tool that helps the packaging process quickly by pressing the two sides of the packaging using electrical energy. The use of handsealer tools helps the production process so that product packaging is tidier, more hygienic, and adds to consumer appeal (Kurniawan et al., 2023). The handsealer used has a size of 33 cm x 8.5 cm x 14.5 cm. The material is made of iron with a power of 300 Watts. Aluminium foil packaging is used to pack the chips to maintain the crispness of the chips. The use of aluminium foil packaging can reduce product damage so that the product shelf life becomes longer (Rosida et al., 2020). The aluminium packaging used is in the form of a standing pouch of aluminium paper measuring 13x20 cm with a zipperlip.

PKM activities take place from August to September 2024. The schedules of the program implementation are listed in Table 1. PKM activities begin with a team coordination meeting to discuss solutions that must be given to partners in order to solve the problems experienced by partners. Figure 3 is the stages of PKM activities carried out based on the problems experienced by partners. Before the training, partners are given pre-test questions and at the end of the activity they are asked to do posttest questions. The pre-test and post-test are conducted to measure the success of the programme based on partner absorption, which can be used as an evaluation. The PKM team conducts monitoring once a month to ensure that the PKM programme continues and to discuss the obstacles experienced by partners in using technology to produce sea lettuce chips.

Figure 1. The methods used in this community service activity

Figure 2. (a) Spinner; (b) handsealer

Table 1. The schedules of the program implementation

Stage 1. Initial Observe	
Activity	Observe of locations and identification of patner problems in Pecatu Village
Objective	Discuss the problems of processing sea lettuce crips
Implementation time	First week of August 2024
Stage 2. Socialization of Activities	
Activity	Provided information about the work programme to be implemented and gave appropriate technology equipment
Objective	Matching the schedule of programme implementation and activities to be implemented
Implementation time	Third week of August 2024
Stage 3. Training on Making Sea Lettuce Chips	
Activity	Train using a spinner to drain the sea lettuce chips
Objective	Making crispy sea lettuce chips
Implementation time	Fourth week of August 2024
Stage 4. Training on Sea Lettuce Chips Packaging	
Activity	Train to pack sea lettuce crisps in aluminium foil standing pouches
Objective	Making long-lasting sea lettuce chips
Implementation time	First week of September 2024
Stage 5. Monitoring and Evaluation	
Activity	Evaluation of partners' knowledge and skills in processing sea lettuce
Objective	Discussion of partner constraints in applying the appropriate technology provided
Implementation time	Second week of September 2024

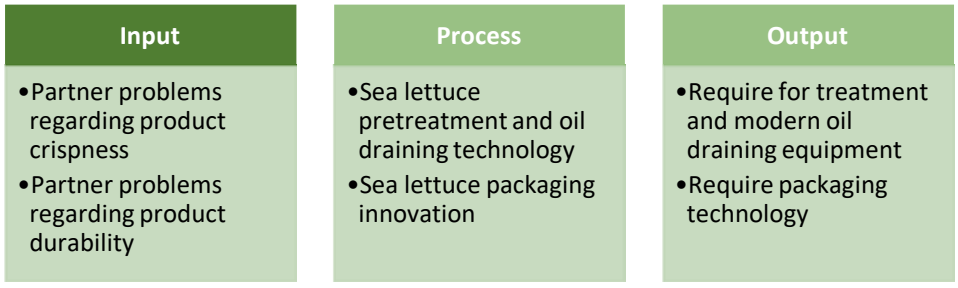

Figure 3. The stages of PKM activities

3. RESULTS AND DISCUSSION

Results

This Community Partnership Program (PKM) activity has been carried out through several stages, namely initial observations to understand partner needs, followed by program socialisation to related parties. Furthermore, training and application of appropriate technology were carried out as practical solutions to increase the effectiveness and efficiency of partner activities. The final stage of monitoring and evaluation is carried out periodically to ensure the sustainability of the results and identify opportunities for improvement in order to achieve the expected goals.

Observation

Pecatu Village is located in the Southern area of Bali Island. Pecatu Village has many beautiful and virgin beaches that produce many natural resources in the form of sea lettuce. Sea lettuce is utilised as salad raw material. The existence of abundant sea lettuce has not been able to be utilised optimally by the people living around the beach, so that many seas lettuce die and become garbage in the beach area of Pecatu village.

Women in Pecatu Village are generally housewives. They join farmer women's groups to improve their knowledge and socialise. One of the women farmer groups in Pecatu village is the Giri Sari women farmer group. This group has tried to utilise the abundant sea lettuce in their area into processed chips. They have successfully processed sea lettuce crisps, but still have problems producing crispy crisps that have a long shelf life. Their hope is that by utilising abundant natural resources it can help their family's economy if the products they produce can be sold.

Socialization of PKM activities

Before the PKM work program began, the PKM team conducted socialisation to partners first, as shown in Figure 4. The PKM team explained the work program and training activities that would be provided to partners as well as technological assistance that would be provided to support the success of the work program, as shown in Figure 5. The PKM team and partners made an agreement regarding the schedule for implementing PKM activities.

Figure 4. Socialization
Figure 5. Appropriate Technology Support

Sea lettuce chips making training and application of technology

In the training on making crispy and durable sea lettuce crisps, partners were provided with a spinner to drain the oil still attached to the sea lettuce crisps. The PKM team teaches how to use a spinner to drain deep-fried sea lettuce chips. We showed that the use of a spinner was able to reduce the oil content of sea lettuce crisps as seen from the amount of oil that came out of the spinnered crisps. The sea lettuce chips processing training is shown in Figure 6 and 7.

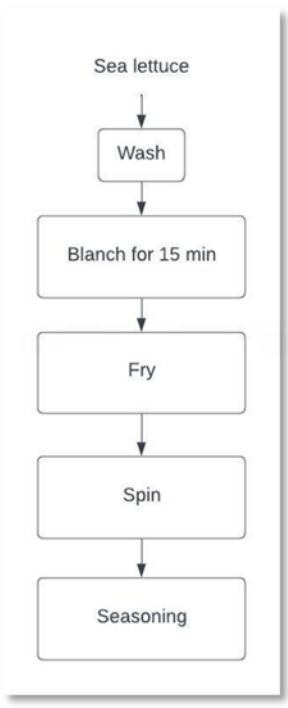

Figure 6. Flowchart of sea lettuce crisps manufacturing process
Figure 7. Processing of sea lettuce chips

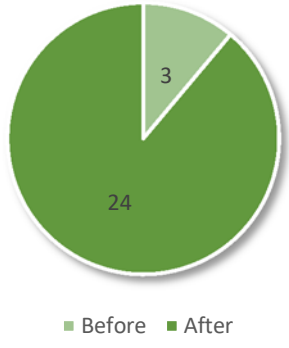

Figure 8. The crunchiness of sea lettuce chips (in hours)

Sea lettuce chips processed using the spinner technique showed significant advantages in quality and durability. The spinnered chips are able to produce a crispier texture and can last up to 24 hours without packaging, significantly longer than the non-spinnered chips, which can only last about 3 hours

under similar conditions. The crispness of the chips was tested by comparing two groups of spinnered and non-spinnered chips, then both groups of chips were stored at 25-27C and 60 percent air humidity and sensorially tested for crispness by assessing crispness, flavour, and aroma every 3 hours. The use of a spinner was shown to increase the crispness of sea lettuce chips by 700 percent, making it an effective method to improve product quality while extending its shelf life, as shown in Figure 8.

Sea lettuce chips packaging training

In the packaging training, partners were trained to package sea lettuce chips so that the chips produced can last longer and can be sold. Partners were taught how to package sea lettuce crisps using aluminium foil standing pouch packaging and seal them using a handsealer, as shown in Figure 9. The use of the packaging provided by the PKM team to partners can increase the durability of sea lettuce crisps up to 3 months, as shown in Figure 10. Measurement of the durability of sea lettuce crisps packed with aluminium foil-based packaging is done sensorially by assessing crispness, taste, and aroma once a month. The packaging of sea lettuce crisps uses a standing pouch made from aluminium foil, as seen in Figure 11.

Figure 9. Packaging training

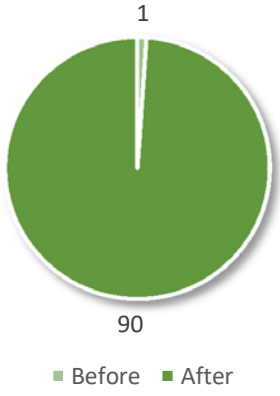

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Figure 10. The durability of sea lettuce chips (in days)
Figure 11. Packaging of sea lettuce chips

Monitoring and evaluation

Monitoring and evaluation were carried out at the end of each activity to find out the obstacles experienced by partners in implementing what has been given by the PKM team. In addition, monitoring is carried out based on the pre-test and post results, as shown in Figure 12. Pre-test and post-test testing of partners' abilities was carried out by filling out a questionnaire containing questions related to how to process sea lettuce chips and use a spinner to drain oil, how to maintain the quality and durability of sea lettuce chips, how to package sea lettuce chips and glue using a handsealer, and how to produce attractive packaging designs and components that must be present in food product packaging. The skills of the partners were assessed by assessing their ability to process sea lettuce chips to keep them crispy, as well as the use of spinners and handsealers. The results of the pre-test and post-test show that there is an increase in the knowledge and skills of partners in processing crispy sea lettuce chips that have a long durability.

This community service activity has an impact on partners. After the training, the partners' knowledge and skills in processing sea lettuce chips increased by 75 percent. Partners can now use spinners and handsealers properly and understand proper packaging techniques. The quality of the sea lettuce chips produced by the partners has increased by 90 percent, because they have been packaged with aluminium foil standing pouches. The chips are crispier and can last up to 3 months with aluminium foil packaging. The chips have been packaged with an attractive packaging design so that it can add to the attractiveness of the product when the product will be sold later.

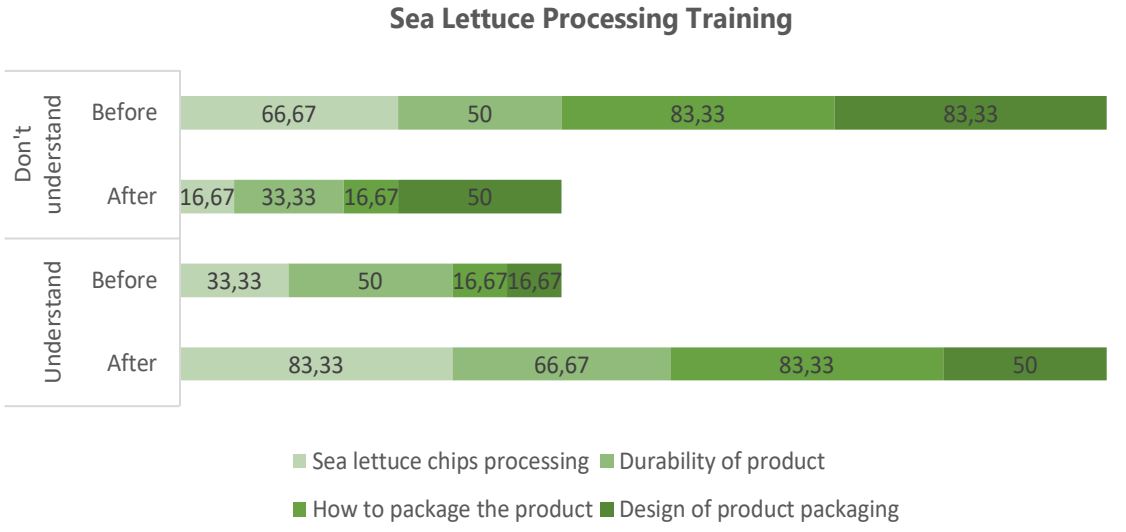

Figure 12. Pre-test and post-test results

Discussion

The results of the observation show that there is still a lack of utilisation of sea lettuce which is abundant on the beaches in Pecatu village, so processing and innovation are needed that utilise sea lettuce as raw material. Processing sea lettuce into sea lettuce crisps is an alternative in making processed innovations made from sea lettuce. By utilising sea lettuce into a processed product, it also increases the income of the local community. Similar PKM activities have been implemented by processing vegetable crips (Ririhena et al., 2023).

The work programme in this PKM activity is to produce sea lettuce chips that are crispy and have long durability so that later the product can be marketed to the community by the Giri Sari farmer women's group. In order for the work programme to run in accordance with the objectives of the PKM activity, the PKM team provides tool assistance in the form of spinners and handsealers and provides standing pouch packaging assistance with attractive designs so that the product attracts consumers when marketed. Sea lettuce chips must remain crispy if they are to be marketed, therefore the chips that have been fried must be drained before packaging. The use of a spinner can remove residual oil that sticks to the product due to the frying process using oil (Kusumawati et al., 2020). Cooking oil that seeps into the chips due to the frying process will affect the crispness of the chips and their durability. Spinnered sea lettuce crisps then need to be packaged properly. The product packaging used can also affect the durability of the resulting product. The use of proper packaging can extend the shelf life of the packaged product (Safirin et al., 2023). The packaging provided to partners is made from aluminium foil. The use of aluminium foil packaging can maintain the aroma, taste, colour and crispness of the chips produced (Asmara et al., 2024). Product packaging also needs to be designed attractively so that consumers are interested in buying the products offered (Apriyanti, 2018).

The processing of sea lettuce chips begins with washing fresh sea lettuce obtained from Nyang-Nyang Beach, Pecatu Village using running water. Washing is done to remove impurities such as stones and sand. Next, draining the sea lettuce and blanching the sea lettuce in boiling water for 15 minutes so that the colour of the sea lettuce remains green when processed into chips. The blanching method can maintain the colour of sea lettuce by inactivating enzymes (Medho & Muhamad, 2019). The blanching sea lettuce is then mixed with the prepared seasoning flour. The seasoning flour used includes garlic, salt, flavouring, pepper, and wheat flour. Then the sea lettuce is fried using hot oil until brownish in colour. The resulting sea lettuce chips are then drained using a spinner to remove the sticking oil so as to produce crispy chips and longer durability (Kusumawati et al., 2020). As a result of this activity, the chips remained crispy for 24 hours without packaging or at room temperature because the oil attached to the chips has been drained with a spinner.

Chips that have been dispinned need to be packaged so that their crispness can last longer**.** The packaging of sea lettuce crisps is not only for the product marketing process but also to increase the durability of sea lettuce crisps (Gunawan et al., 2022; Kusumawati et al., 2020). Previously, the partners had never packaged their sea lettuce crisps because the crisps they made were only for personal consumption, but now that they want to sell their sea lettuce chips, they need to pack them. Packaging that can maintain the quality of the chips is aluminium foil-based packaging. Aluminium foil-based packaging can help maintain durability by protecting the product from air, odour, light, and microorganisms so that the product can last longer (Widyamurti, 2018). The use of aluminium foil packaging to package sea lettuce crisps can maintain the product for 3 months. This can be due to aluminium foil-based packaging providing protection to the product from exposure to light and air so that product damage can be inhibited by reducing product contact with light and air (Rosida et al., 2020).

Monitoring and evaluation were carried out at the end of each activity to find out the obstacles experienced by partners in implementing what has been given by the PKM team. In addition, monitoring is carried out based on the pre-test and post results. The results of the pre-test and post-test show that there is an increase in the knowledge and skills of partners in processing crispy sea lettuce chips that have a long durability. Before the activity was carried out, the partners' knowledge and skills in processing crispy sea lettuce chips and having long durability were still minimal. They did not still do manual draining after frying the chips. They also had not packaged the sea lettuce chips as they were only produced for personal consumption. After the PKM activities carried out, partners experienced an increase in knowledge and skills by 75 percent. They are able to process sea lettuce chips, use spinners and

handsealers, and package lettuce chips with aluminium foil packaging that has an attractive packaging design. Based on the evaluation results, the partners experienced problems in managing the draining time using a spinner because there was no time setting in draining. This caused the level of crispness of the sea lettuce chips to be non-uniform, so the partners needed to conduct trials repeatedly in order to get the optimal draining time. The PKM team continues to conduct monitoring and evaluation every month to ensure the programme remains relevant and applicable despite changes in market demand. So that this PKM activity can contribute to the development of a sustainable local economy.

PKM activities can run smoothly because of the support from partners. Partners provide a place to carry out activities and prepare some equipment used to process sea lettuce chips and provide raw materials in the form of fresh sea lettuce and supporting raw materials. Partners are also enthusiastic in attending activities by actively participating in every PKM activity. After participating in this activity, partners stated that there was an improvement in their quality of life because they now have new skills that can be used to increase their family income. This PKM activity also contributes to the development of science and technology (IPTEK) and innovation in society by introducing innovative processing and packaging technology to the community. The use of spinner, handsealer, and aluminium foil packaging are innovations that can be applied to other food products.

This PKM activity is expected to be continued by partners by transmitting the knowledge and skills they have gained during the activity to other farmer women's groups, especially in Pecatu Village so that processing sea lettuce into chips can optimise the use of sea lettuce. So that with the increase in the added value of sea lettuce can open new business opportunities and make sea lettuce chips as a typical souvenir of Pecatu Village.

4. CONCLUSION AND RECOMMENDATIONS

The purpose of this PKM activity is the implementation of appropriate technology in the form of a process of draining and packaging sea lettuce chips products to produce crispy sea lettuce chips and have a long shelf life. The objective of this activity has been achieved by producing crispy sea lettuce crisps for 24 hours if not packaged, whereas previously it was only 3 hours. The use of standing pouch packaging made from aluminium foil can maintain the quality of sea lettuce crisps for a period of 3 months. Sea lettuce chips have an attractive packaging design and are able to maintain the durability of sea lettuce chips. In this PKM activity, in general, there was an increase in the knowledge and ability of partners in processing sea lettuce chips from 29.167 percent to 70.83 percent. This activity has a positive impact on partners in terms of improving skills in processing and packaging sea lettuce chips.

This activity has produced products that have the potential to be developed as superior products in Pecatu Village. testing the quality and durability of new products is limited to sensory tests. To be marketable, laboratory testing should be carried out to obtain accurate data on the quality and durability of the product so that it can be listed appropriately on the packaging. Suggestions that can be given for further PKM activities are continuous assistance to monitor and evaluate the application of technology in the long term and laboratory testing of production results. In addition, because the partners want to market the product, therefore for the next PKM activity, it is necessary to ensure the quality of the product. It is necessary to conduct training and assistance in product marketing and digital marketing so that the products produced by partners can be recognised by the wider community and have a wide marketing range, as well as training in calculating product selling prices. In addition, it is necessary to conduct training and assistance in diversifying processed products made from sea lettuce to increase the variety of products owned.

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