

## **UTILIZATION OF RED DRAGON FRUIT PEEL (*Hylocereus Polyrrhizus*) AS A FUNCTIONAL FOOD INNOVATION FOR DIABETES MELLITUS PREVENTION**

**Safridha Kemala Putri<sup>\*1</sup>, Fitriana<sup>2</sup>, Ritawati<sup>3</sup>**  
<sup>1,2,3</sup>Poltekkes Kemenkes Aceh

\* Corresponding email: [safriidhakemalaputri@gmail.com](mailto:safriidhakemalaputri@gmail.com)

### **ABSTRACT**

Diabetes Mellitus (DM) is a chronic non-communicable disease with a rapidly increasing global prevalence and significant economic burden. Preventive strategies through functional food innovations are urgently required. Red dragon fruit peel (*Hylocereus polyrrhizus*), often discarded as waste, is rich in anthocyanins, flavonoids, vitamins, minerals, and dietary fiber with strong antioxidant properties. This community service program was conducted in Gampong Klieng Cot Aron, Aceh Besar, aiming to improve public knowledge on diabetes prevention and provide training in processing dragon fruit peel into hygienic syrup with economic potential. A total of 25 participants were involved in health education sessions followed by practical syrup-making training. Pre-test and post-test evaluations revealed a significant knowledge increase of 51%, with the highest improvement (+60%) on the benefits of dragon fruit peel for diabetes prevention. Beyond knowledge enhancement, the program fostered practical skills, waste utilization, and small-scale entrepreneurship. The results demonstrate that functional food-based interventions can contribute to health promotion, local empowerment, and sustainable economic development.

**Keywords:** *Dragon fruit peel, diabetes mellitus, functional food, community empowerment, anthocyanin.*

### **INTRODUCTION**

Diabetes Mellitus (DM) is one of the most prevalent non-communicable diseases globally, marked by chronic hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both, which can lead to

serious complications such as cardiovascular disease, nephropathy, neuropathy, and retinopathy (American Diabetes Association [ADA], 2020). According to the International Diabetes Federation (2021), more than 537 million adults lived with diabetes in 2021, with projections reaching 643 million by 2030 and 783 million by 2045.

In addition to health challenges, DM poses a significant economic burden, with global healthcare expenditure estimated at USD 966 billion in 2021, nearly tripling within 15 years (IDF, 2021). In Indonesia, prevalence increased from 6.9% in 2013 to 10.9% in 2018 (Kementerian Kesehatan Republik Indonesia [Kemenkes RI], 2018), largely driven by lifestyle changes such as excessive sugar intake, lack of physical activity, obesity, and low awareness of healthy living.

Functional foods containing bioactive compounds have emerged as promising preventive strategies. Red dragon fruit peel is rich in anthocyanins, flavonoids, vitamins, minerals, and dietary fiber, all with strong antioxidant activity (Nurliyana et al., 2010; Wu et al., 2006). Anthocyanins not only act as antioxidants but also demonstrate anti-inflammatory, anticancer, and cardiometabolic protective effects relevant to DM prevention and management (Khoo et al., 2017). Recent studies highlight that anthocyanin-rich foods enhance insulin sensitivity and reduce blood glucose levels (Arivalagan et al., 2022).

Within the local context of Gampong Klieng Cot Aron, Aceh Besar, limited community knowledge on diabetes prevention and the lack of utilization of dragon fruit peel prompted this program. The initiative sought to combine health education with practical training in processing dragon fruit peel into functional syrup, aiming to enhance community knowledge, health, and economic welfare.

## **METHODS**

The program was conducted in Gampong Klieng Cot Aron, Aceh Besar, involving 25 participants (housewives, village health cadres, and youth).

1. Health Education: Interactive lectures and discussions on diabetes definition, risk factors, complications, and prevention.
2. Training Session: Demonstration and hands-on practice in syrup preparation, covering selection of peel, boiling, filtering, healthy sugar addition, and packaging.
3. Evaluation: Pre-test and post-test questionnaires (10 items) assessing knowledge of diabetes and dragon fruit peel utilization.

1. Health Education

The first stage of the program consisted of providing health education to the community through interactive lectures and group discussions. The material delivered covered the definition of Diabetes Mellitus, risk factors, signs and symptoms, possible complications, and preventive strategies. Educational tools such as slide presentations, posters, and flipcharts were used to facilitate participant understanding. The two-way communication approach allowed participants to ask questions directly and discuss their own health-related challenges.

In addition to delivering information, the facilitators emphasized the importance of adopting healthier lifestyles, such as reducing excessive sugar consumption, increasing physical activity, and consuming locally available nutritious foods. Group discussions were employed to explore participants' daily practices and compare them with scientific recommendations. This approach ensured that the education was not only informative but also contextualized to the local situation, making the content more practical and applicable to their everyday lives

2. Practical Training

Following the education sessions, the program continued with hands-on training on how to process dragon fruit peel into a healthy syrup. Participants were first introduced to the nutritional composition and bioactive compounds of dragon fruit peel, and why it is considered a functional food ingredient. The facilitators demonstrated the steps of syrup preparation, starting from selecting raw materials, washing and slicing the peel, boiling in clean water under controlled temperature, and filtering the extract to obtain a clear solution.

In the second stage of training, participants were actively involved in practicing each step under close supervision. The process included adding healthy sugar in appropriate amounts, stirring, and reheating to ensure product safety. The syrup was then packaged hygienically in sterilized bottles. By engaging in hands-on practice, participants not only gained theoretical knowledge but also developed practical skills to produce a ready-to-consume product with potential economic value.

3. Evaluation

To measure the effectiveness of the program, evaluation was conducted using pre-test and post-test questionnaires consisting of 10 items assessing basic knowledge of Diabetes Mellitus and the utilization of dragon fruit peel. The pre-test was administered prior to the health education session, while the post-test was conducted after the completion of all activities. The questionnaire assessed knowledge on definitions, risk factors, symptoms, complications, preventive measures, as well as the nutritional and functional benefits of dragon fruit peel and its processing methods.

In addition to quantitative assessment, qualitative observations were carried out during the activities, including participant engagement, enthusiasm, and the quality of syrup produced. The questionnaire results were analyzed to identify the average improvement in community knowledge, while qualitative data such as feedback and direct involvement were used to assess the social impact of the program. This mixed-method evaluation provided a comprehensive understanding of the program's effectiveness in improving both knowledge and skills.

## **RESULTS AND DISCUSSION**

### **Results**

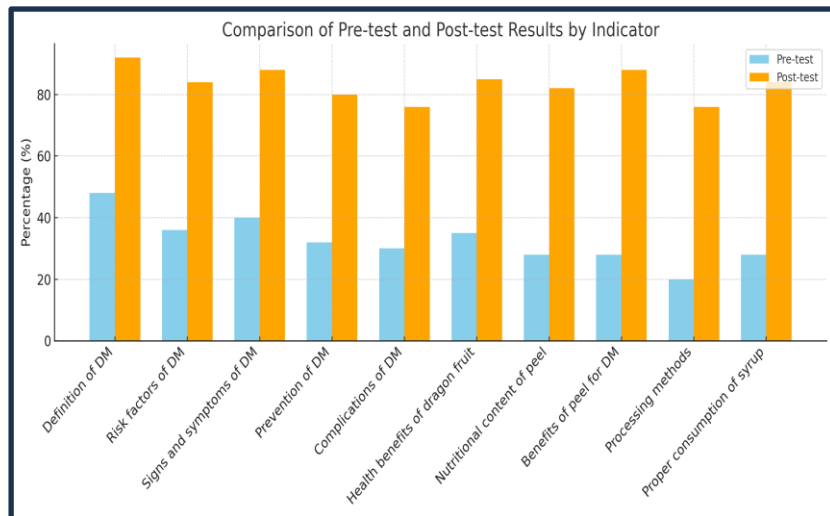
The program involved 25 participants, including housewives, village health cadres, and youth. Activities began with interactive health education sessions on diabetes risk factors, complications, and prevention, followed by practical training in producing dragon fruit peel syrup.

Knowledge assessment showed a marked improvement: average scores rose from 32.5% (pre-test) to 83.5% (post-test), reflecting a 51% increase. The greatest improvement (+60%) was observed in understanding the health benefits of dragon fruit peel for DM prevention. All indicators demonstrated positive changes.

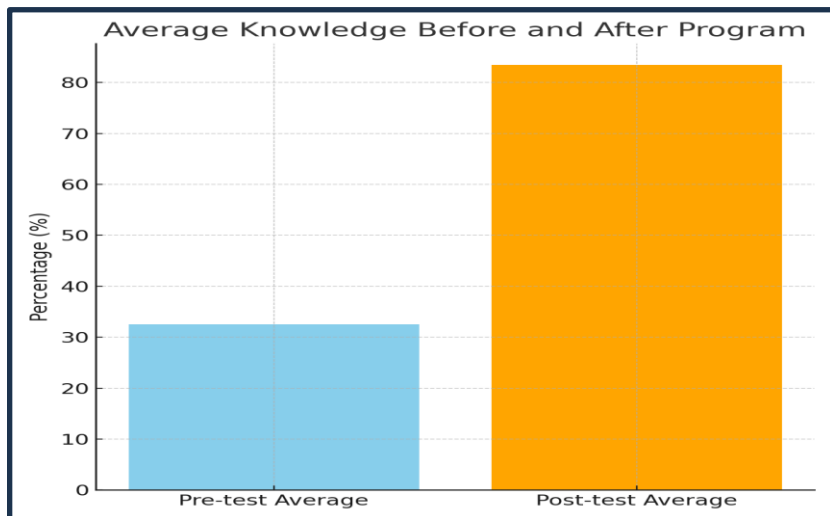
**Table 1.** Knowledge Improvement Based on Pre-test and Post-test Results

| <i>No.</i> | <i>Object</i>                            | <i>Font</i> | <i>Alignment</i> |
|------------|------------------------------------------|-------------|------------------|
| 1.         | Definition of DM                         | 48%         | 92%              |
| 2.         | Risk factors of DM                       | 36%         | 84%              |
| 3.         | Signs and symptoms of DM                 | 40%         | 88%              |
| 4.         | Prevention of DM                         | 32%         | 80%              |
| 5.         | Complications of DM                      | 30%         | 76%              |
| 6.         | Health benefits of dragon fruit          | 35%         | 85%              |
| 7.         | Nutritional content of dragon fruit peel | 28%         | 82%              |
| 8.         | Benefits of dragon fruit peel for DM     | 28%         | 88%              |
| 9.         | Processing methods of dragon fruit peel  | 20%         | 76%              |
| 10.        | Proper consumption of syrup              | 28%         | 84%              |
|            | Average                                  | 32.5%       | 83.5%            |

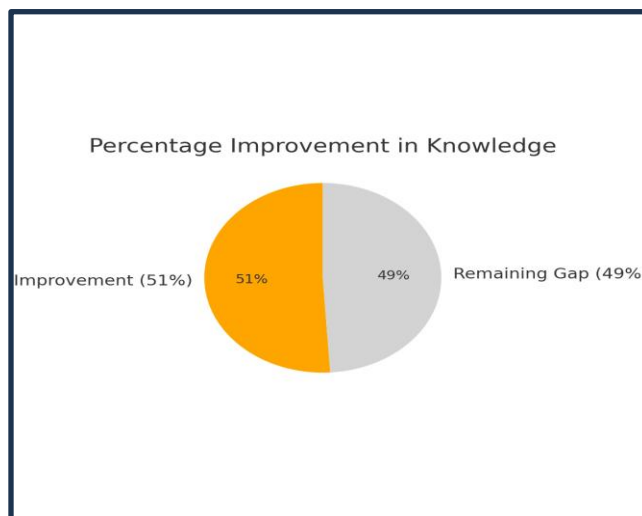
Figures 1–3 further illustrate the results:



**Figure 1.** Comparison of Pre-test and Post-test Results Across Indicators.



**Figure 2.** Average Community Knowledge Before and After Program



**Figure 3.** Percentage of Knowledge Improvement After Program

Beyond knowledge gains, social and economic impacts were evident:

1. Participants developed practical skills to prepare hygienic syrup.
2. Fruit peel previously considered waste became a useful and marketable resource.
3. Several participants expressed interest in forming small-scale entrepreneurial groups.
4. Health awareness improved, with greater attention to dietary prevention of DM

## **DISCUSSION**

The results of the community service activity in Gampong Klieng Cot Aron showed a 51% increase in community knowledge after education and training were conducted. This increase reflects the effectiveness of the interactive counseling approach combined with hands-on practice in processing dragon fruit peel. These findings are consistent with Panjaitan and Novitasari (2021), who reported that ethanol extract of red dragon fruit peel significantly reduced blood glucose levels in diabetic rats and increased antioxidant activity, thus supporting the importance of practice-based interventions in changing health behavior.

In addition to knowledge improvement, the success of this program was also evident from the high participation and enthusiasm of the community in utilizing dragon fruit peel as a functional food. While dragon fruit peel was previously regarded only as household waste with potential environmental impacts, after training the community was able to process it into healthy syrup that not only provides health benefits but also economic value. This is in line

with the findings of Alhodieb et al. (2024), which showed that both red and yellow dragon fruit peels have antidiabetic potential through mechanisms such as inhibition of starch digestion, delayed glucose diffusion, and significant control of blood sugar spikes compared with controls.

From a biochemical health perspective, dragon fruit peel has been proven to be rich in bioactive compounds such as anthocyanins, flavonoids, and phenolics, which function as antioxidants, antihyperglycemic agents, and protectors against oxidative stress. Research by Sumartin et al. (2024) showed that methanolic extract of dragon fruit peel significantly lowered blood glucose levels in alloxan-induced diabetic rats after seven to fourteen days of treatment, while also repairing the histological structure of the pancreatic islets of Langerhans, indicating protection of  $\beta$ -cells.

Similar results were also reported by Lira et al. (2023), who found that pitaya consumption reduced oxidative stress while helping to control glycemia in diabetic rat models. The combination of antioxidant and antihyperglycemic mechanisms provides a strong scientific basis that regular consumption of dragon fruit peel syrup as part of a functional diet can contribute to efforts in preventing Diabetes Mellitus.

Thus, this community service activity provides multiple benefits. From an educational standpoint, the program successfully improved community understanding of diabetes prevention and the utilization of local resources. From a preventive standpoint, functional food interventions such as dragon fruit peel syrup are supported by strong scientific evidence of their antihyperglycemic effects. From a creative economic standpoint, the community began to identify sustainable business opportunities based on the use of high-value organic waste.

In the future, program development can be directed toward diversifying dragon fruit peel-based products, such as herbal teas, jams, natural colorants, or fermented products, accompanied by laboratory analyses of the stability of bioactive compounds during processing and storage. In addition, further studies based on clinical trials in humans are needed to ensure the safety, effectiveness, and long-term potential of dragon fruit peel-based functional products.

As supporting evidence for this report, activity documentation is also presented to provide a real picture of the active participation of the Gampong Klieng Cot Aron community. The photographs illustrate the atmosphere of health education, dragon fruit peel syrup processing practices, and participants' direct involvement in discussions. The presence of community members across different age groups indicates that the activity was well received and fostered a sense of togetherness in raising health awareness while optimizing the use of local resources.

## CONCLUSION

This community service program successfully increased community knowledge (by 51%) and skills in processing dragon fruit peel into functional syrup. The initiative addressed health promotion, waste utilization, and economic empowerment simultaneously. Functional food-based interventions using local resources provide a sustainable approach to diabetes prevention and rural economic development.

## ACKNOWLEDGEMENT

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## APPENDIX

(if any)