



The Potential of Onggok Starch Waste in Daleman Village, Tulung District, Klaten Regency and its Management as a Biotechnology Learning Resource

Erna Noor Savitri*, Margareta Rahayuningsih, Aditya Marianti

Doctoal Program of Science Education, Faculty of Mathematics and Natural Sciences,
Universitas Negeri Semarang, Indonesia

DOI: <https://doi.org/10.15294/jese.v4i1.3776>

Article Info

Received 2 January 2024

Accepted 15 April 2024

Published 30 April 2024

Keywords:

**Waste, Onggok Starch,
Biogas,
daleman village,
Biotechnology**

*Corresponding author:

Erna Nor Savitri

Universitas Negeri Semarang

E-mail: ernanoors@mail.unnes.ac.id

Abstract

This research examines the presence of onggok starch waste in Daleman Village, Tulung District, Klaten Regency and the handling efforts that have been carried out. The existence of waste and efforts to handle it can potentially be used as a learning resource in biotechnology and bioenergy lectures. This research uses a descriptive qualitative approach. Data was collected through observation, interviews, documentation and literature study. The results of this research show that people in Daleman Village, Tulung District, Klaten Regency have a household scale business in the form of making starch flour which will be used as an ingredient for making noodles, cendol and other processed foods. Until now, many efforts have been made to process this waste, but have not produced optimal results. Based on the results of scientific studies, it was found that onggok starch waste can be processed and processed into biogas and briquettes so that it can be used as a student learning resource to foster students' environmental ethics.

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p-ISSN 2797-0175

e-ISSN 2775-2518

INTRODUCTION

Indonesia is an agricultural country that has richness and suitability of land resources, agro-climatic suitability and very high biodiversity. Various types of plants can live in Indonesia and are used as industrial products, including food, drinks and other processed ingredients (Prasedya et al., 2022). One of the plants used is the sugar palm plant which is processed into palm flour (starch onggok). The sugar palm plant (*Arenga pinnata merr*) belongs to the areca nut tribe (Arecaceae) which is a closed seed plant, that is, the fruit seeds are encased in fruit flesh. Sugar palm plants produce various commodities that have high economic value and even have the potential to become export commodities (Muda & Awal, 2021; Refi Arioen & Indriyani, 2023). Almost all parts of the sugar palm plant can be processed into various economical products, both food and/or non-food. Palm tree wood can be used as raw material for making furniture, the leaves for making roofs, and the sticks for making brooms. The fibers can be processed into craft products, and the roots can be used as herbal medicine because they contain secondary compounds such as saponins, flavonoids and polyphenols. Palm sap is processed into sugar, palm wine, nata de pinna, and bioethanol, immature palm fruit (caruluk) is usually processed for kolangkaling, palm stems produce flour if the sap is not tapped and the flour is processed into vermicelli, hung kwe, pearl palm, and as raw material for making edible films (Imraan et al., 2023).

The main products produced by palm trees are 1) the male flowers that are tapped will produce sap for palm sugar (palm sugar, brown sugar); 2) the young fruit, namely palm fruit; 3) the fibers are used for ropes, roofs and water absorption filters in buildings; 4) sugar palm stems (outer part) are hard wood (ruyung) that is resistant to decay which is used as additional income for the entrepreneur himself; 5) Sugar palm also produces flour from the pith of the stem before the plant flowers (Azhar et al., 2021). Palm flour is obtained from starch extracted from mature palm tree trunks. The stem of the sugar palm plant has a starch content of approximately 26-37 percent, but each sugar palm tree produces varying amounts of flour, apart from that, palm flour also has low protein and fat content, because of this content, palm flour is widely used as a food ingredient (Sarkar et al., 2023).

The palm flour (pati onggok) manufacturing industry in Daleman Village, Tulung District,

Klaten Regency has been operating since the 1960s (Aditama, 2019). Processing sugar palm into palm flour goes through 3 stages, namely the washing and grating stage, the starch extraction stage, and the drying and packing stage of palm flour. Processing sugar palm stems into palm flour produces solid waste in the form of skin, tips, and cassava (Pires et al., 2019).

Onggok (dregs) is produced from the pressing and filtering process. The important components contained in onggok are starch and cellulose. The starch content from sugar palm dregs contains 95.34% cellulose, 85.8% dry matter, 2.63% crude protein, 15.90% crude fiber and 0.48% crude fat (Hidayati et al., 2020). The location of the pati onggok industry is on the edge of the village but is still close to residential areas. The activities of the pati onggok industry are closely related to the people of Daleman Village, because in its production activities the community is involved both as employees and laborers who work in the factory. This certainly affects the socio-economic aspects of the local community.

The onggok starch industry is carried out on a medium scale (manufacturing) with numbers increasing from year to year, causing the problem of onggok starch waste. Various studies have been carried out on the use of onggok starch waste, including dry unmilled onggok which can be used for animal feed, making oncom, making paper, a medium for cultivating worms, a medium for white oyster mushrooms, and making fertilizer. However, this effort is not optimal because it is not commensurate with the production of palm flour which continues to increase. Apart from that, there have been no significant efforts to utilize this biomass for other important purposes such as energy sources. In fact, with its high organic material content, onggok has the potential to be used as a substrate mixture in the production of biogas, bioethanol or for making briquettes.

Onggok starch waste that is not handled properly can cause environmental pollution in river waters because it is simply thrown away without being processed first. Various problems that have arisen include well water not being suitable for consumption (dirty), waste water that stagnates during the rainy season, and solid waste blocking irrigation channels in rice fields (Amalia et al., 2021).

Relevant research that has examined the use of onggok starch waste includes (Pratiwi et al., 2016) who used onggok starch and rice husk waste as basic materials for lightweight

earthquake-responsive wall panels. Onggok starch waste can also be used as bioplastic by utilizing the remaining starch content so that it can replace plastic and is easily decomposed (Hasanah & Haryanto, 2017). The starch content in onggok which includes amylose and amylopectin can be hydrolyzed using enzymes to produce reducing sugar in the form of liquid glucose (Yulistiani et al., 2019). Apart from that, in 2019, Arifin et al. also researched the use of onggok starch waste into organic fertilizer through a composting process mixed with cow dung. Herawati & Wibawa, 2019 utilized onggok starch waste to become bioethanol with the addition of molasses. The results of research by Hayat & Kaltsum, (2021) show that sago flour waste (onggok) can also be used as animal feed. Various studies have been carried out to overcome starch onggok waste. However, the research was still carried out on a laboratory scale and has not been carried out on a large scale.

The problem regarding onggok starch waste has existed since 2014. The community has also made various efforts to deal with this problem. In 2014-2015, trials were carried out by the Central Java Agricultural Technology Assessment Center (BPTP Jateng) which resulted in the conclusion that onggok starch waste had the potential to be processed into biogas. The results of this trial became the basis for applying for assistance and funding by the Danish government in 2017. In that year, ESP3 Danida approved the construction of a waste processing wastewater treatment plant machine carried out by the contractor PT Siskem Aneka Indonesia, which is expected to be managed by Bumdes (Village-Owned Enterprises). Processing onggok starch waste into biogas on an industrial scale certainly experiences many obstacles, including the presence of chlorine in the waste which causes obstacles to reactions with bacteria in making biogas. The chlorine content that dominates the waste liquid is a coloring agent when processing vermicelli or vermicelli noodles. This is what can later be studied further in learning.

Global environmental changes have created major challenges for humans, including in the field of education. The relationship between environmental change and environmental ethics in the educational context has a significant impact. The relationship between environmental change and environmental ethics in the scope of education is an important aspect that needs to be understood and emphasized. Environmental

changes that occur, such as climate change, environmental damage, and the sustainability of natural resources, have a significant impact on human life and the earth (Besio & Pronzini, 2014).

Science learning discusses how to know nature systematically, not only mastering a collection of knowledge in the form of facts, concepts and principles, but also a process of discovery (Asrizal et al., 2018; Septikasari & Frasandy, 2018). According to Hadiprayitno, (2018), science learning cannot be separated from students' experiences in everyday life. Science learning aims to prepare students to have an understanding of science and technology through developing attitudes, knowledge and skills so that they can understand and solve environmental problems that exist in real life (Anjarwati et al., 2022).

Science (Science) learning has an important position in building the character of society and the nation, due to the very rapid progress of scientific knowledge, the position of scientific knowledge that can be transferred to other fields, and the content of science contains values and attitudes which are the basis for the formation of human character. Science learning is a process of constructing knowledge (science) through thinking activities. The learning process should include three aspects that must be acquired by students, namely cognitive thinking skills (minds on), psychomotor skills (hands on), and social skills (hearts on). Science is needed in everyday life to meet human needs through solving identifiable problems. Science learning provides opportunities to describe objects and events, ask questions, gain knowledge, and construct explanations of natural phenomena, test explanations of natural phenomena, test explanations in various ways and communicate them to others.

Based on the description of the problem, the formulation of the problem in this research is (1) How has the onggok starch waste been processed so far? (2) Is there an impact of pati onggok waste on society?; (3) What is the potential of onggok starch waste in Daleman Village, Tulung District, Klaten Regency and how to deal with it as a biotechnology learning resource? Therefore, it is necessary to carry out research related to onggok starch waste in Daleman Village, Tulung District, Klaten Regency and its handling as an effort to foster students' environmental ethics and a source of learning biotechnology.

METHOD

The research was conducted in Daleman Village, Tulung District, Klaten Regency. This type of research is descriptive qualitative research. The data sources used are primary data and secondary data. This primary data collection was carried out through observation and interviews with the aim of making direct observations of objects. The results of the observations were information on the process of making onggok starch and processing of onggok starch waste, while in-depth interviews were conducted directly with employees of the onggok starch factory and the community around the onggok starch factory. Secondary data collection was carried out through literature study to obtain a theoretical basis and supporting data related to the process of making onggok starch and processing of onggok starch waste. In this research, the researcher is the main instrument for collecting data based on as much public knowledge as possible, carrying out verification, reconstruction, formulation and conceptualization into scientific knowledge. After the primary and secondary data verification process is complete, the next step is to analyze the potential of onggok starch waste in Daleman Village, Tulung District, Klaten Regency and how to overcome it as an effort to foster students' environmental ethics and biotechnology learning resources.

RESULT AND DISCUSSION

The development in this research is an Android-based Interactive E-Booklet that can be used as an alternative teaching material with Material Classification and Changes for class VII semester 1 in order to maximize critical thinking skills and students' learning motivation. This research was carried out in three stages according to the 4D development method, namely: The research was carried out in Daleman Village, Tulung District, Klaten Regency, which is a production center for making sugar palm flour (pati onggok). Daleman Village, Tulung District, Klaten Regency, Central Java, located around 15-18 km to the north of Klaten city, is a producer of palm flour. The palm flour industry has been going on for generations and is a mainstay of local residents. People use palm trees as raw material for making palm flour, usually the palm trees are taken from mountainous areas. Starch from sugar palm raw materials is used to make vermicelli noodles, cendol and processed cakes.



Figure 1. Place for making sugar palm flour

The palm flour industry produces solid waste and liquid waste. Solid waste in the form of sugar palm fiber powder was originally used by the mushroom cultivation industry in the city of Yogyakarta, but in recent years this industry has no longer operated. Solid waste in the form of sugar palm stalks can be resold (Figure 2), while solid waste in the form of dregs is only left to pile up near production sites and even around residential roads. Currently, the amount of sugar palm solid waste is increasing and uncontrolled. During the rainy season, people often throw waste on riverbanks and around rice fields, which can damage the river ecosystem. Apart from that, during the rainy season this waste will cause an unpleasant odor which will disturb the community. The palm flour industry in Daleman Village covers several hamlets including, Bendo, Tuban, Margoluwih, Pucang. Every day produces quite a bit of waste, on average each production produces more than 1 ton of waste. This waste has damaged the water quality in the area around the river and has polluted the river, thereby destroying the river ecosystem.



Figure 2. Solid waste in the form of sugar palm stems

Based on interviews conducted with employees of onggok starch makers and also the public, data was obtained that onggok starch

dregs have been used as fertilizer and a medium for cultivating worms. However, due to the increasing production of sugar palm flour, the dregs continue to accumulate (Figure 3).



Figure 3. Piles of Onggok Starch Waste in the Form of Solid Dregs

The public basically also experiences confusion regarding the disposal of this waste. Daleman village has made various efforts but has not been successful. Since 2014, research has been carried out on solid waste in the form of dregs and obtained results that the dregs have the potential to be made into biogas. In 2017, an IPAL (Waste Water Treatment Plant) was built in this village with the assistance of the Danish government, but it has not been operational and has been stalled until now.



Figure 4. IPAL (Waste Water Treatment Plant) which is no longer operational

Factors that cause the installation to be unable to be used to process waste include the presence of chlorine in the waste, causing obstacles to reactions with bacteria in making biogas. The purpose of adding chlorine to the process of making ongkok starch is to produce starch products that are white in color, not cloudy

brownish in color. The white ongkok starch product will be used as raw material for making vermicelli noodles or vermicelli, so that it can produce noodles that have a clean white color. The next cause is the high operational costs of IPAL machines which are difficult to afford by the APBD, which is also a factor that hinders the realization of processing waste into biogas. This is because the operation of the machine requires an electrical power supply which is expensive. The people in the village hope that there will be efforts from the government to help manage waste so that the waste does not pollute the river and is suitable for disposal.



Figure 5. Researchers together with one of the residents taking a photo next to Onggok starch waste dregs

Based on interviews with Mr. Suryo Widodo, residents around the Onggok starch processing factory received information that rice fields contaminated with Onggok starch waste would cause the rice to be of normal size but weigh less than normal (hollow). Solid waste from pati ongkok can also damage irrigation flows in rice fields so that the rice fields do not receive enough water and become dry.



Gambar 6. Area Persawahan Tercemar Limbah Pati Onggok Menyebabkan Air Sawah Menjadi Hijau dan Pertumbuhan Padi Tidak Maksimal

According to Mr. Suryo, currently people can only use waste on a small scale as a fertilizer mixture, animal feed mixture, mushroom

medium and worm breeding medium. Much of the remaining unused pati onggok solid waste is thrown into the river by irresponsible industrial actors. Disposal of liquid and solid waste into rivers will disrupt the flow of water in irrigation canals and pollute water in surrounding agricultural land.



Figure 7. Pati Onggok Solid Waste which Interferes with Irrigation (shown by arrow)

What is also a problem to date is the existence of liquid waste from pati onggok. This liquid waste is usually left around the factory or thrown directly into the river. Liquid waste contains residual chlorine which can damage river ecosystems.



Figure 8. Pati Onggok Liquid Waste

Communities around the factory also feel the impact of piles of solid waste of onggok starch that are left for too long in open areas, these piles of waste will cause an unpleasant odor. The unpleasant odor generated will disturb the local community and residents passing on the road around the Onggok starch processing factory. This will hamper the development of local tourism potential, because not far from the factory location, only about 1 kilometer away, there are famous tourist attractions, namely Umbul Manten, River Moon and the Janti fishing water tourist area.

Various impacts and problems related to onggok starch waste can be used as contextual learning media. In this way, students can understand scientific concepts in a real and relevant context. Through the use of pati onggok waste in a learning context, students can be introduced to concepts about the importance of waste management and environmental preservation. This will help students increase their understanding of various environmental problems and solutions to these problems. The use of pati onggok waste as a learning medium can encourage students to think creatively in finding solutions to environmental problems so that it can increase student awareness about environmental problems and steps that can be taken to reduce their negative impacts. This can stimulate innovation in waste management and the development of environmentally friendly products.

Apart from that, students can also be involved in problem-based learning by using onggok starch waste as the problem raised. Students will be asked to carry out a problem analysis and then find the best solution based on literature studies and student experience. Students can also use onggok starch waste as raw material to make products such as biogas, bioethanol or briquettes on a small scale. This can provide meaningful practical experience in learning so that students understand directly the management of waste which is converted into useful resources through innovation and creativity. Thus, the use of pati onggok waste as a learning medium not only provides practical benefits in terms of waste management, but can also form positive environmental ethical attitudes and values in students. This is an important step in creating a generation that cares about the environment and is responsible for the future of the environment.

CONCLUSION

The community in Daleman Village, Tulung District, Klaten Regency has made various efforts to handle piles of starch waste, including as a mixture of fertilizer, animal feed mixture, mushroom media and worm breeding media, but these efforts are not yet optimal due to the increase production of sugar palm flour. Onggok starch waste that cannot be managed properly has impacts, namely well water that is unfit for consumption (dirty), waste water that stagnates during the rainy season and causes an unpleasant odor, and solid waste that blocks irrigation channels in rice fields. Various impacts and problems related to onggok starch waste can be used as a learning medium.

Students can be involved in problem-based learning by using onggok starch waste as the problem is raised. Students can also use onggok starch waste as raw material to make products such as biogas, bioethanol or briquettes on a small scale. Thus, the use of pati onggok waste as a learning medium not only provides practical benefits in terms of waste management, but can also form positive environmental ethical attitudes and values in students.

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