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Bioplastic Based on Starch from Keciri Tuber (*Amorphophallus campanulatus*)

Yunita Riskayanti[1*], Bunga Zorra Dilatais[1], Ditha Natasya[1], Nurhidayatullah[2]

[1]SMA Negeri 1 Seteluk, West Sumbawa Regency, Indonesia
[2]Undergraduate Environmental Health Study Program, Mataram College of Environmental Engineering, Mataram, Indonesia
[*]e-mail: yunitariskayanti76@guru.sma.belajar.id

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Abstract: Plastic waste is one of the primary contributors to environmental problems. In West Sumbawa Regency, particularly in Seteluk District, the use of plastic remains relatively high, as observed in schools and residential areas, including the researcher's own environment. This is evidenced by the significant accumulation of plastic waste. The purpose of this study is to examine the potential of the keciri plant (*Amorphophallus campanulatus*) in West Sumbawa Regency, to analyze the characteristics of bioplastic made from keciri tuber starch (*Amorphophallus campanulatus*), and to determine whether keciri tuber starch (*Amorphophallus campanulatus*) can be utilized as a material for bioplastic production. The research method used in this study was experimental, employing a quantitative descriptive experimental design. The conclusions of the study are as follows: the keciri plant (*Amorphophallus campanulatus*) grows abundantly in the wild around the researcher's residence, and it was also commonly found in other areas such as Poto Tano District, Seteluk District, and the villages of Senayan, Rempe, and Meraran. Based on data from three bioplastic tests conducted, the water resistance tests showed that all types of bioplastics exhibited similar water resistance levels, with an average of 60%. The biodegradability tests revealed that all types of bioplastics degraded completely within 5 days, indicating that the produced bioplastics are fully biodegradable in soil. For organoleptic tests, each type of bioplastic yielded different results. Bioplastics made with cooking oil and glycerol achieved the highest scores, followed by those made with VCO (virgin coconut oil) and no plasticizer, while those using coconut oil plasticizer scored the lowest. Since the researcher aimed to produce edible bioplastics, VCO was chosen as the plasticizer. Therefore, keciri tuber starch could be used for bioplastic production by mixing it with VCO plasticizer and pomelo juice extract, making it suitable for use as food packaging.

Keywords: Bioplastic; Keciri Tuber; Plastic Waste.

Introduction

The data on waste accumulation in Indonesia in 2022 reached 19,218,650.50 tons per year, while the waste reduction data only amounted to 5,078,514.86 tons per year or 26.42%. The amount of plastic waste in Indonesia accounted for 18.62%, making it the second most common type of waste after food waste [1].

Plastic is a material that can be found in almost every item we use daily. According to research from [2], the improper use of plastic can cause various health problems because it can act as a carcinogen, triggering cancer and causing tissue damage in the human body. Moreover, plastic is generally difficult to degrade (decompose) by microorganisms. Plastic waste can persist for hundreds of years, leading to environmental pollution. Burning plastic is harmful because it produces gases that pollute the air and pose risks to human respiratory health. Additionally, burying plastic in the soil can contaminate both the soil and groundwater [3].

So far, the community has only been able to reduce plastic waste through recycling. Plastic waste reduction has been widely implemented using the 3R concept (Reuse, Reduce, and Recycle), and another alternative that has been extensively studied is recycling plastic waste into fuel [4]. However, these actions are not yet aligned with the principles of green chemistry. Green chemistry is defined as an effort to design chemical processes and products that minimize or eliminate the creation and formation of hazardous substances. The most important aspect of green chemistry is the concept of design. When designing a process, it cannot be done arbitrarily but must be carefully calculated from various aspects. Before the implementation of the green chemistry movement, most processes prioritized economic aspects while paying less attention to environmental impacts [5]. One of the principles of green chemistry is the effort to prevent waste formation. This principle emphasizes that preventing waste is prioritized over treating waste [6].

In West Sumbawa, particularly in Seteluk District, the researcher's observations indicate that the level of plastic usage remains relatively high, as seen in school environments and the researcher's residential area. This is evidenced by the significant accumulation of plastic waste. Due to its portability, lightweight nature, and affordability, the community has not yet been able to move away from using plastic, especially for shopping bags or food packaging. Consequently, this leads to a high amount of plastic waste disposal, which has the potential to pollute the environment.

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Bioplastics are plastics that easily degrade through the action of microorganisms or weather conditions (humidity and sunlight radiation) and are derived from plants such as starch, cellulose, and lignin, or from animals such as casein, protein, and lipids. Starch-based plastics are environmentally safe. Generally, bioplastic packaging is defined as packaging film that can be recycled and naturally decomposed. Biodegradable plastics, also known as bioplastics, are plastics whose entire or nearly entire components are derived from renewable raw materials. Under certain conditions and over a specific period, these plastics undergo changes in their chemical structure, affecting their properties due to the influence of microorganisms (bacteria, fungi, algae) [7].

The keciri plant (*Amorphophallus campanulatus*) can grow wild in Poto Tano and Seteluk Districts. It can be found in moist areas and beneath the canopy of other plants, such as in-home yards, community gardens, and hills. The keciri plant (*Amorphophallus campanulatus*) has tubers that can be utilized as an alternative food source. However, the local community is not yet aware of the benefits or how to process keciri tubers (*Amorphophallus campanulatus*) to make them more useful. Moreover, the tubers contain oxalate crystals, which can cause itching if consumed or touched [8].

Keciri tubers (*Amorphophallus campanulatus*) have the potential to serve as an alternative food source due to their high starch content, which ranges from 80-85%, with an amylose content of 24.5% and an amylopectin content of 75.5% [9]. The high starch content in keciri tubers can be utilized for bioplastic production.

The success of bioplastic production is affected by several factors, including the starch concentration and the type of plasticizer used [10]. The characteristics of starch-based bioplastics still have many shortcomings, particularly in terms of physical properties (rigidity, lack of elasticity, brittleness) and low water resistance. To improve the characteristics of bioplastics, making them more water-resistant and elastic, lipid-based materials (oils/fats) can be added as hydrophobic plasticizers during the production process [11].

Lipid-based materials (oils/fats) that have been used in bioplastic production include palm oil [12] and used cooking oil [13]. Other plasticizer materials can also include glycerol [14]. Glycerol functions to increase the elasticity of bioplastics [15]. To increase the strength of bioplastics, vinegar or acetic acid can be added [16].

The addition of alcohol can also improve bioplastic products, resulting in a more homogeneous surface with no cracks or pores [14]. Therefore, in this study on producing bioplastics from keciri tuber starch, the researcher used pomelo juice as a substitute for vinegar, indicating that pomelo fruit extract contains methanol and ethyl acetate extracts [17].

The use of starch in the manufacture of bioplastics has been widely used, with the use of sago starch and orange peel waste as bioplastics, with test results showing that the higher the pectin content, the lower the rate of biodegradation [18]. The manufacture of bioplastics using yam tuber starch and oil palm fronds, while the use of starch from keciri is still limited [19]. The manufacture of bioplastics using sugarcane starch involves a mixture of chemical ingredients, while in this study, all bioplastic materials use natural ingredients [20].

Keciri tubers (Amorphophallus campanulatus) are local Indonesian commodities that have been consumed for generations in several regions, but their processing is still limited. Keciri tubers are widely distributed in Indonesia, especially in Sumatra and Java. West Nusa Tenggara Province, precisely in Mataram, the use of suweg tubers as processed foods such as suweg chips, suweg kelepon and suweg paste [21]. Its abundant availability, but not yet its widespread utilization, makes it an alternative raw material for making biodegradable plastics (bioplastics).

The aim of this research is to determine the use of cassava starch (Amorphophallus Campanulatus) as a material for making bioplastics. The researcher hopes that the production of bioplastics made from keciri tubers (*Amorphophallus campanulatus*) can serve as an alternative plastic, suitable for use as food packaging or for other purposes. Given the significant growth potential of keciri (*Amorphophallus campanulatus*) in the Seteluk and Poto Tano Districts, it can be utilized as an affordable and easily accessible raw material. This initiative could contribute to reducing plastic waste derived from petroleum-based materials.

Research Methods

This research was conducted in the Chemistry Laboratory of SMA Negeri 1 Seteluk, located at Ahmad Yani Street Number 50, Seteluk District, West Sumbawa Regency. The type of research employed was experimental, utilizing a quantitative experimental design by conducting trials on the use of keciri tuber starch (*Amorphophallus campanulatus*) in the production of bioplastics.

Table 1. Tools and Materials Used in Bioplastic Production

No.	Tools	No.	Materials
1	Basin	1	Keciri tuber starch 10 g
2	Sieve	2	Glycerol 2 drops
3	Measuring glass	3	Cooking oil 2 drops
4	Knife	4	Coconut oil 2 drops
5	Grater	5	Virgin coconut oil 2 drops
6	Digital scale	6	Pomelo juice 100 ml
7	Spatula	7	Mineral water 25 ml
8	Rice paper		
9	Spoon		
10	Dropper		
11	Graduated cylinder		
12	Tripod stand		
13	Spirit burner		
14	Wire gauze		

The research variables consisted of controlled variables, independent variables, and dependent variables. The controlled variables included the starch weight of 2 grams, the volume of pomelo juice at 20 ml, the volume of mineral water at 5 ml, the plasticizer amount of 2 drops, and the ph of pomelo juice at 2. The independent variable was the type of plasticizer used, which included palm cooking oil, coconut oil, virgin coconut oil (VCO), glycerol, and no plasticizer. The dependent variables were the water resistance test, the organoleptic test, and the biodegradability test.

The stages of the research implementation included preparing the tools and materials, processing keciri tubers (*Amorphophallus campanulatus*) to produce starch, and subsequently producing bioplastics. The tools and materials used for bioplastic production are presented in Table 1.

Starch Production from Keciri Tuber (*Amorphophallus campanulatus*)

Keciri Tuber Flour Preparation

The researcher followed the method of producing flour from keciri tubers (*Amorphophallus campanulatus*) with the following steps: The harvested keciri (Amorphophallus campanulatus) tubers were cleaned of roots and weighed [22]. After that, the tubers are peeled, washed to remove any remaining dirt, and sliced to make grating easier. The initial washing is done by rinsing the tubers under running water to remove stuck dirt. The tubers that have been cleaned are then soaked overnight in salt water to relieve itching. After soaking, the tubers are washed again under running water to remove the remaining salt, finally, the tubers are grated, and the grated results are weighed.

Starch Production from Keciri Tuber (Amorphophallus campanulatus)

The researcher followed the procedure for producing tapioca starch from cassava as described with the following steps: The mashed tubers of keciri (Amorphophallus campanulatus) are mixed with water until they become mush and kneaded until evenly mixed to extract the starch. The slurry is then filtered through a fine cloth to separate the starch as a suspension. The starch suspension is collected in a container and left for 12 hours. After letting it sit, the water is discarded, and the starch is soaked in clean water for 1 hour before being dried in the sun, finally, the dry starch is weighed [23].

Bioplastic Production

The steps for producing bioplastics were based on the method described as follows: Weigh the starch into five portions, each weighing 2 grams. Prepare grapefruit juice into five parts, 20 ml each, then add 5 ml of mineral water to each part so that the total is 25 ml per part. Prepare two drops of cooking oil, glycerol, coconut oil and VCO oil each. Also prepare five portions of mineral water, 5 ml each [14] . Dissolve the starch with grapefruit juice and stir until completely dissolved. Make five types of bioplastics: four with plasticizers and one without plasticizers. Heat the material for the first bioplastic (without plasticizer) until it becomes a gel, then pour it into the mould and flatten it using a pallet. Dry in the sun for 1-2 days, then leave at room temperature until completely dry. Repeat these steps for ingredients with glycerol plasticizer, cooking oil, VCO oil, and coconut oil.

Data Analysis

The data analysis technique used in the production of bioplastics from keciri tuber starch was quantitative descriptive, based on the results of water resistance tests, organoleptic tests, and biodegradability tests.

Results and Discussion

This study was experimental research aimed at producing bioplastic samples of good quality that can decompose in soil and do not contribute to environmental waste. The production of bioplastics represents the application of one of the principles of green chemistry, which prioritizes waste prevention over waste treatment. Bioplastics are plastics derived from living organisms to ensure they are biodegradable and do not become pollutants. In this study, the researcher experimented with various plants available in the surrounding environment to produce bioplastics. The main ingredients for bioplastic production are starch, vinegar, and plasticizers. For the starch, the researcher used starch extracted from keciri tubers (*Amorphophallus campanulatus*), which grow wild around the researcher’s residence.

Potential of the Keciri Plant in West Sumbawa Regency

The keciri plant (*Amorphophallus campanulatus*) grows wild around the researcher's residence, particularly in the Poto Tano and Seteluk Districts. This plant is often found in moist locations protected from direct sunlight, such as in-home yards, community gardens, and on hillside slopes. In West Sumbawa Regency, there are still many untouched natural forests, allowing the keciri plant to thrive and grow abundantly in the West Sumbawa Regency region.

The tubers of the keciri plant (*Amorphophallus campanulatus*) hold significant potential as an alternative food source. However, the understanding of the people in West Sumbawa Regency regarding the benefits and processing methods of keciri tubers remains very limited. One of the factors hindering its utilization is the presence of oxalate crystals in the tubers, which can cause itching when consumed or touched, making it less appealing to the local community.

The researcher conducted a survey in several locations within the Poto Tano and Seteluk Districts, such as Senayan Village, Rempe Village, and Meraran Village, to gather further information regarding the potential of keciri tubers. Based on direct observations, Senayan Village and Meraran Village were found to have a higher population of keciri plants compared to Rempe Village. This potential can be utilized by the local community and offers an opportunity for researchers to innovate, such as developing starch-based bioplastics from keciri tubers.

During the research process, the researcher successfully harvested approximately 20 keciri tubers of varying quality. The weight of the tubers ranged from 1 kg to 12 kg, with some exhibiting good quality while others were less optimal. From one keciri tuber weighing 10 kilograms, the researcher was able to produce 156.90 grams of dry starch, which will be used as the primary material for bioplastic development. This potential shows that the keciri plant has economic value that can be developed, particularly in the eco-friendly industry.

Characteristics of Bioplastics from Keciri Tuber Starch (*Amorphophallus Campanulatus*)

The researcher attempted to create bioplastic products using several types of acids and plasticizers. Initially, natural plasticizers such as cooking oil, coconut oil, virgin coconut oil (VCO), and glycerol were tested. When these plasticizers were combined with vinegar, the resulting bioplastic was rigid, with varying degrees of stiffness; some were very stiff, while others were slightly stiff. To enhance the strength of the bioplastic, the researcher experimented with several acidic fruits as substitutes for vinegar or acetic acid. When acidic fruits were combined with glycerol as the plasticizer, the resulting bioplastic became slightly moist and tended to develop mold after a few days. However, when natural plasticizers were combined with acidic fruits, the bioplastic product exhibited better quality.

In this study, the researcher experimented with replacing vinegar with several acidic plants available in the surrounding environment, such as tamarind, monte oranges, limes, bilimbi, lemons, and pomelo. Based on the trials with all acids, bioplastic made with tamarind resulted in a product with a very sour taste and a dark brown color. Bioplastic made with monte oranges did not dry properly, leading to easy mould growth. Limes, bilimbi, and lemons produced bioplastics that were weak and thin because, during the heating process, the bioplastic remained liquid and could not thicken.

In the production of bioplastics, after conducting several experiments using various acids, the researcher selected pomelo juice as a substitute for vinegar due to the superior quality of the resulting bioplastic. This aligns, pomelo fruit extract contains methanol and ethyl acetate, both of which can enhance the quality of bioplastics [17]. The presence of methanol in pomelo juice improves the bioplastic's properties [14], which found that the addition of alcohol can refine bioplastic products, resulting in a more homogeneous surface, free of cracks and pores. This is also proven in the manufacture of bioplastics [24]. The addition of polyvinyl alcohol (PVA) increases the tensile strength of bioplastics. Grapefruit juice contains citric acid [25]. The addition of citric acid to bioplastics will increase the elongation (ratio of increase in length of bioplastic from the initial length) of bioplastics [26].

The researcher also experimented with several types of plasticizers, comparing the results of natural plasticizers with glycerol, using palm oil, coconut oil, VCO, olive oil, glycerol, and a formulation without any plasticizer. Various proportions of these ingredients were tested until a suitable product was achieved as a bioplastic.

To produce high-quality bioplastic, the researcher conducted several tests to evaluate the characteristics of bioplastic made from keciri tuber starch (*Amorphophallus campanulatus*). Three tests were performed to assess the quality of the bioplastic: the organoleptic test, water resistance test, and biodegradability test. The results of the organoleptic test are presented in Table 2 below.

Organoleptic Test

The Organoleptic tests are carried out based on the color, aroma and texture of the bioplastic produced [13]. The organoleptic test was conducted with 10 respondents, consisting of 5 teachers and 5 students from SMA Negeri 1 Seteluk. The researcher asked the respondents about the color, aroma, and texture of the bioplastic made from keciri tuber starch. Based on the data in Table 2 above, for the color, the bioplastics using VCO and cooking oil as plasticizers were rated better, with 6 respondents selecting "slightly clear" and 4 selecting "brown." This was followed by bioplastics without plasticizers and those using coconut oil, with 5 respondents selecting "slightly clear" and 5 selecting "brown." Lastly, the bioplastic using glycerol as a plasticizer was rated lower, with 1 respondent selecting "clear," 3 selecting "slightly clear," and 6 selecting "brown.".

Table 2. Results of Organoleptic Test

Bioplastic	Color			Aroma			Texture		
	Clear	Slightly Clear	Brown	Odorless	Slightly Odorous	Odorous	Smooth	Slightly Rough	Rough
Keciri + Pomelo juice		5	5	7	3		3	6	1
Keciri + Pomelo juice + VCO		6	4	6	4		3	5	2
Keciri + Pomelo juice + Coconut oil		5	5	1	8	1	2	7	1
Keciri + Pomelo juice + Cooking oil	1	6	3	9		1	9	1	
Keciri + Pomelo juice + Glycerol	1	3	6	8	2			5	5
Average	1	5	5	6	4	1	4	5	2

In terms of aroma, the bioplastic using cooking oil as a plasticizer was rated as having the best quality, with 9 respondents selecting "odorless" and 1 respondent selecting "odorous." Next, the bioplastic with glycerol as a plasticizer was rated slightly lower, with 8 respondents selecting "odorless" and 2 selecting "slightly odorous." The bioplastic without a plasticizer was rated next, with 7 respondents selecting "odorless" and 3 selecting "slightly odorous." Finally, the bioplastic using coconut oil as a plasticizer was rated lowest, with 1 respondent selecting "odorless," 8 selecting "slightly odorous," and 1 selecting "odorous.".

In terms of texture, the bioplastic with cooking oil as a plasticizer was rated the highest in quality, with 9 respondents selecting "smooth" and 1 selecting "slightly rough." Next, the bioplastic without a plasticizer was rated, with 3 respondents selecting "smooth," 6 selecting "slightly rough," and 1 selecting "rough." The bioplastic with VCO as a plasticizer was rated similarly, with 3 respondents selecting "smooth," 5 selecting "slightly rough," and 1 selecting "rough." Finally, the bioplastic with glycerol as a plasticizer was rated lower, with 5 respondents selecting "slightly rough" and 5 selecting "rough." Based on these results, the bioplastics considered the best by most respondents were those made with VCO, cooking oil, and without a plasticizer.

Based on the results of the organoleptic test for bioplastics in terms of color, most panellists chose "slightly clear," as the starch from keciri tubers is naturally slightly brown. Respondents noted that the bioplastics produced were not completely clear. Similarly, the texture was rated as rough, as the researcher did not have a specialized mould during the bioplastic production process. Instead, a spatula and rice paper were used to spread the bioplastic, resulting in imperfect thickness and texture.

Water Resistance Test

The results of the water resistance test are shown in Table 3 below.

Table 3. Results of Water Resistance Test

No	Bioplastic	Initial Weight (g)	Weight After 2 Minutes (g)	Weight After 4 Minutes (g)	Weight After 6 Minutes (g)	Weight After 8 Minutes (g)	Average Water Absorbed (g)	% Average Water Absorbed	%Water Resistance
1	Keciri + Pomelo juice	0.356	0.566	0.594	0.623	0.634	0.604	41	59
2	Keciri + Pomelo juice + VCO	0.334	0.532	0.577	0.6263	0.634	0.592	44	56
3	Keciri + Pomelo juice + Coconut oil	0.368	0.566	0.64	0.646	0.645	0.623	41	59
4	Keciri + Pomelo juice + Cooking oil	0.419	0.611	0.623	0.6236	0.657	0.629	33	67
5	Keciri + Pomelo juice + Glycerol	0.368	0.583	0.646	0.646	0.645	0.627	41	59

The water resistance test was conducted by soaking the bioplastic samples in 50 ml of mineral water. Each bioplastic sample measured 3 cm x 3 cm and was weighed at intervals of 2 minutes, 4 minutes, 6 minutes, and 8 minutes. The weights of each bioplastic type were averaged using the formula:

Water Absorbed (%) = $\frac{w-wo}{w}$ x 100%

Description:

W = Weight of wet bioplastic, wo = Weight of dry bioplastic [11].

The percentage of water absorbed was then used in the following calculation to determine water resistance:

Water Resistance = 100% − Water Absorbed

Based on the results of the water resistance test shown in Table 4.2 above, the bioplastic using cooking oil as a plasticizer had the highest water resistance, at 67%. Meanwhile, the bioplastics using coconut oil, glycerol, and without a plasticizer showed the same water resistance level of 59%. The bioplastic with VCO as a plasticizer absorbed water the fastest, with a water resistance of 56%. However, the water resistance of all bioplastics was relatively similar across all plasticizers, with an average of 60%. This indicates that all types of bioplastics, regardless of the plasticizer used, can easily degrade when exposed to water.

Biodegradability Test

The biodegradability test was conducted using bioplastic samples measuring 1.5 cm x 1.5 cm, which were buried for 5 days. The bioplastic samples were weighed daily, and the process was repeated 5 times. The mass reduction of the buried bioplastic was calculated using the following formula:

% Mass Reduction of Bioplastic = $\frac{m0-m1}{m0}$ x 100%

Description:

m_0 = Initial mass before burial, m1 = Mass after burial [27].

Table 4. Results of the Biodegradability Test

No	Bioplastic	Initial Weight (g)	Day 1 (g)	Day 2 (g)	Day 3 (g)	Day 4 (g)	Day 5 (g)	Average Reduction (g)	% Mass Reduction
1	Keciri + Pomelo juice	0.079	0.085	0.079	0.034	0.034	0.000	0.046	41

2	Keciri + Pomelo juice + VCO	0.062	0.079	0.079	0.034	0.034	0.000	0.045	27
3	Keciri + Pomelo juice + Coconut oil	0.062	0.079	0.062	0.062	0.034	0.000	0.048	24
4	Keciri + Pomelo juice + Cooking oil	0.062	0.062	0.045	0.034	0.028	0.000	0.034	45
5	Keciri + Pomelo juice + Glycerol	0.062	0.079	0.068	0.062	0.045	0.000	0.051	18

Based on the data in Table 7 above, the bioplastics using cooking oil as a plasticizer and those without a plasticizer decomposed the fastest, with a degradation rate of 45% and 41%, respectively. On the other hand, the bioplastic using glycerol as a plasticizer was the slowest to decompose. The bioplastics with VCO and coconut oil as plasticizers showed similar degradation rates of 27% and 24%, respectively.

The results of the biodegradability test for bioplastics, based on the data in Table 7 above, showed that the bioplastic using cooking oil as a plasticizer decomposed the fastest, while the one with glycerol as a plasticizer decomposed the slowest. Initially, the researcher buried the bioplastics for 5 days, but after 5 days, all the bioplastics had completely degraded. Therefore, the researcher repeated the process, checking the bioplastics daily for 5 days. The soil used was slightly dry and fertile, and the same type of soil was used for all bioplastics. When compared to the international plastic standards, the degradation time for PLA plastic from Japan and PCL plastic from the UK is 60 days [28]. In contrast, this study required only 5 days for complete decomposition. Using lindur fruit starch, it required a degradation time of 15 days to decompose completely [29]. On making bioplastic using liquid tofu waste, chitosan, and glycerol, a degradation time of 15 days with a degradation percentage of 97.667%, meaning that bioplastic from cassava starch products decomposes completely more quickly, namely, only requiring 5 days [30].

Based on the data from the three bioplastic tests conducted, the water resistance test results showed that all types of bioplastics had similar water resistance, with an average of 60%. The biodegradability test results indicated that all types of bioplastics decomposed completely after 5 days, meaning the bioplastics produced could fully degrade in the soil. In contrast, the organoleptic test results varied across bioplastic types. Bioplastics using cooking oil and glycerol achieved the highest scores, followed by those using VCO and without a plasticizer, with coconut oil as the lowest-performing plasticizer. Since the researcher aims to produce edible bioplastics, VCO was chosen as the plasticizer. Based on the three tests conducted, VCO is still categorized as a high-quality plasticizer for bioplastics, as it performed well in the organoleptic, water resistance, and biodegradability tests. Additionally, VCO is a natural product derived from coconuts, which are readily available in the researcher's area as a raw material for producing VCO.

Utilization of Keciri Tuber Starch (*Amorphophallus campanulatus*) as a Material for Bioplastic Production

Keciri tubers (Amorphophallus campanulatus) hold potential as an alternative food source due to their high starch content, which is approximately 80-85%, with an amylose content of 24.5% and an amylopectin content of 75.5%. The high starch content in keciri tubers makes them suitable for bioplastic production. 100 grams of keciri tubers contain 15.7 grams of carbohydrates, 1 gram of protein, 0.1 grams of fat, 60-69 calories, 82 grams of water, 62 milligrams of calcium, 41 milligrams of phosphorus, 4.2 milligrams of iron, 0.07 milligrams of thiamine, and 1.1 grams of other minerals [31]. In several regions of Indonesia, keciri tubers have been widely utilized to produce food products. For example, in Kendari, Southeast Sulawesi, ice cream developed from fresh goat milk using keciri tubers as a stabilizer, aiming to find the best formulation to replace animal-based gelatin stabilizers [32]. Created nuggets made from keciri tuber flour and tapioca flour [33]. These indicate that keciri tuber starch has been utilized in certain areas. However, in West Sumbawa, keciri tubers have not yet been processed or utilized by the local community. This is mainly because the community is unaware of the benefits and proper processing methods for keciri tubers.

After conducting several experiments on bioplastic production, the researcher successfully created a food wrapping bioplastic using a mixture of keciri tuber starch, pomelo juice, and VCO as a plasticizer. This bioplastic was used as packaging for instant noodle seasoning, instant chicken porridge, and cereal. The researcher also tested consuming food wrapped in the bioplastic directly. The bioplastic quickly dissolved in water and did not affect the taste of the food. The bioplastic produced by the researcher has lasted for approximately 12 months and still maintains good quality as food packaging. Bioplastic as food packaging can serve as a potential solution for reducing plastic waste in the environment. The key difference between this study and previous research lies in the use of the plasticizer and vinegar. This study avoids using chemicals that could harm the environment.

There were several challenges that the researcher encountered during this study. The first challenge was the absence of a bioplastic mould, which resulted in the bioplastic being imperfect in terms of texture and thickness. The second challenge was the lack of an electric oven in the school laboratory, which made it difficult to heat the bioplastic at a consistent temperature. As a result, the researcher dried the bioplastic by sun-drying it for 1 or 2 days until it was completely dry. This sun-drying method required more time to protect the bioplastic from dust and rain.

Conclusion

Based on the results obtained from this study, the following conclusions can be drawn the keciri plant (*Amorphophallus campanulatus*) grows abundantly in the wild around the researcher's residence and is also commonly found in several locations, such as in the Poto Tano and Seteluk Districts, specifically in the villages of Senayan, Rempe, and Meraran. Based on the data from the three bioplastic tests conducted, the water resistance test results showed that all types of bioplastics had similar water resistance, with an average of 60%. The biodegradability test results indicated that all types of bioplastics decomposed completely after 5 days, meaning the bioplastics produced could fully degrade in soil. In contrast, the organoleptic test results varied for each type of bioplastic. Bioplastics using cooking oil and glycerol achieved the highest scores, followed by those using VCO and no plasticizer, with coconut oil as the lowest-performing plasticizer. Since the researcher aims to produce edible bioplastics, VCO was selected as the plasticizer. Keciri tuber starch can be utilized in the production of bioplastics by combining it with VCO as a plasticizer and pomelo juice, making it suitable for use in food packaging.

Author's Contribution

Yunita Riskayanti: contribution to this research is as a supervisor, providing direction and ideas to produce research with interesting ideas. Nurhidayatullah: classification of research methods, data analysis techniques, and grammatical improvements in writing articles. Bunga Zorra Dilatais & Ditha Natasya: as a student researcher at SMA Negeri 1 Seteluk, to produce research that is useful for many parties.

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