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Research Article

Effect Of Glycerol And Sorbitol Plasticizers On Bioplastic Characteristics Of Mbote Sweet Potato Starch

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Abstract : Bioplastics are plastic biopolymers made from starch that are easily degraded by soil microbes and may be an alternative to traditional plastics. Mbote tuber starch may be used as the main mass for the production of bioplastics by adding glycerin and sorbitol plasticizers. This research aims to determine the influence of plasticizers with different composition. Starch making, mixing the ingredients with plasticizer, heating, printing and drying are the sequence steps of making bio-plastic. In this study, plasticizers used glycerol and sorbitol with variations in the composition of the plasticizers 0, 0,6, 0,9, 1,2, 1,5 ml. The results showed the maximum tensile strength of glycerol bioplastic (56,12 out of 0,06) MPa with elongation (5,23 to 1,43)%, for sorbitol bioplastic the maximum tensile strength was (70, 66 then 0,09) MPa and it has an elongation value (7,85 then 0,08)%. The maximum degradability test of glycerol emollient showed that the emollient volume was 46,93% and the resolution was 3,28 mg per day and it took 14 days and 9 hours to completely reduce, while the sorbitol emollient obtained meant 1, It was 2,4%. 5 mg is required for decomposition for 11 days and 4 hours for / day and overall reduction. The maximum area test of gliserol plasticizer is volume 0,9 plastisizer was 20,00±0,39 %, for sorbitol plastisizer is volume 1,5 plastisizer wes 14,00±0,51 %.
Key words : Plasticizer Glycerol and Sorbitol, Mbote tuber starch, Bio-plastics.

Introduction

Synthetic plastic is an indispensable need for human life to make it easier to pack an item. Plastic has many advantages, namely flexible or easy to form, transparent surface, not easily broken, can be combined with other materials, and is not easy to corrosion (Coniwanti et al., 2014). However, synthetic plastics are difficult to destroy naturally (*non-bio-degradable*) with soil micro-organisms so that they pollute the environment. Data from the Ministry of General Workers states that data on the potential for synthetic plastic waste that pollutes Indonesia's oceans has reached 187 million tons per year (Dwityo A, 2015). Plastic waste has become a problem in the world, especially in countries where synthetic plastic users are high. From some of the information above, an environmentally friendly synthetic plastic replacement with natural materials is needed, namely by developing bioplastic research. Bioplastics are natural plastics that can be easily decomposed or degraded by soil micro-organisms. Bioplastics themselves are made from biomass sources such as vegetable oils, microbiota, and polysaccharides jenis starch. Biopastics have been widely researched and developed, while research on starch-type polysaccharides can be used as bioplastic materials with a plasticizer mixture (Yuniarti et al., 2014). So natural materials in the form of starch can be used to make bioplastics.

Starch comes from plants that contain high carbohydrates such as corn, potatoes, and sweet potatoes, one of which is Mbote yam. Mbote yam belongs to taro yam which is widely grown in malang and has been spread The ingredients used in research are Mbote yam (Araceae), Plasticizer (Glycerol
and sorbitol) and Aquades. The use of equipment in this study is digital balance sheet (200,000±0,001) g, Measuring cups of 2,5 ml and 250 ml, Acrylic glass, Beaker glass, *Magnetic stirer*, *Hot plate*, Alqohol thermometer 100 ºC, Sieve 200 mesh, Oven max temperature 250 ºC, Knife,

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Blender, Tensile test equipment (Tensile Strenght ZP Recorder 50N Imada, as well as computer) and thickness test equipment (TT210), basin/tray.

Mbote sweet potatoes peeled off the skin and cut into smaller pieces, clean the surface of the mbote yam with clean water. Blender mbote sweet potatoes with small slices-keil compare the mass of Mbote : aquades = 3/4 kg : 250 ml of aquades. Mbote's soft sweet potatoes are extracted using a coton combed cloth with a size of 150 messes to separate from the pulp. Keep squeezed water for 1 day until there is a precipitate of white color, replace the water with a new one and then precipitate for 1 day, repeat the treatment by 2 river. Dry the starch deposit until dry, then sift it using a 200 mesh sieve to obtain granules throughout East Java so this sweet potato is very easy to get. The starch content of Mbote sweet potatoes is 68,31%, kabohydrate is 75,90%, water content is 12,57%, crude fiber is 1,66% (Minantyo et al ., 2017). From this reference, Mbote's sweet potato starch has the potential to be used as a bioplastic manufacturing material.

Plasticizers are additives added to natural polymers as plasticizers or emollients because the mixing of pure natural polymers creates brittle and brittle properties that increase flexibility and prevents polymer cracks on surfaces (Fatimah, 2017).

Material and Method

Store starch in a sealed container to be safe from dirt. Store starch at cool, dry room temperatures while remaining durable.

Bioplastics Manufacturing

1. Starch and aquades are mixed in beakerglass 250 ml, stirring for 5 minutes with a temperature of 30 °C.
2. Glatinization process by raising the temperature on the hot plate to the glatinization point of 65 - 70 oC. when the temperature is up to 45 oC add the plasticizer with the composition written in Table 3.1 the stirring process is carried out for 20 minutes for each variation of the sample.

Table 1. Composition of Bioplastic Manufacturing With Glycerol and Sorbitol Plasticizers

No	Name of the plasticizer	Volume pemlastis (ml)	Pati (g)	Aqua of (ml)
1	Glycerol or Sorbitol	0	6	80
2		0,6	6	80
3		0,9	6	80
4		1,2	6	80
5		1,5	6	80

3. The finished liquid bioplastic is molded on acrylic measuring 20 cm x 20 cm, let it stand for 5 minutes until the bubbles disappear. Then in the oven for 8 hours. The dried bioplastics are allowed to stand for 1 day before being taken from acrylic molds.

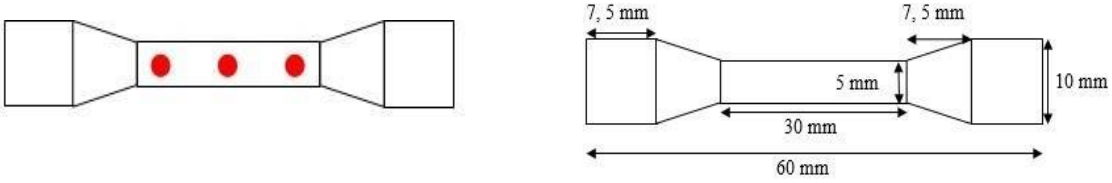

Figure 1. Thickness Measurement and Degradable Test Tensile Strength Test Image

Result

The result of the extraction obtained white, odorless dry starch and soft texture with a size of 200 mess. The resulting bioplastics are transparent with white filaments, but there are still few small bubbles. Bioplastics have the properties of bending, flat and smooth surfaces with a thickness of 50 - 100 µm. For more details see Figure 1. Picture of The Result of Making Bioplastics of Yam Mbote.With Glycerol and Sorbitol Plasticizers.

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Figure 2. Sample form 1. Tensile test, 2. Soil test, Water test and Test. milieu

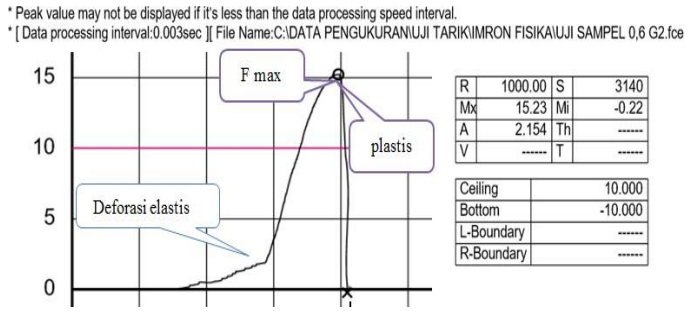

Figure 3. Images of Outside Force Recordings to Computer

The x-axis is the time function (s) and y is the force function (N/cm). The time function is the length of recording time when given a force from the outside until the sample is broken, while the force function is the magnitude of the force exerted from the outside that can be held by the sample until it breaks. Elasticity is the long fortification of a bioplastic sample after an external force is exerted, when a certain force is exerted decreases, the sample pattern returns to its original form.

Table 2. Influence Pemlastis Glycerol and Sorbitol Towards Strong Pull (Mpa) Bioplastics Ubi Mbote.

No	Plasticizers (ml)	Tensile Strength (MPa)	
		Glycerol	Sorbitol
1	0	46,00±0,19	46,00±0,19
2	0,6	56,12±0,06	51,00± 0,07
3	0,9	46,89±0,11	46,53± 0,06
4	1,2	37,00±0,13	66,80±0,12
5	1,5	30,51±0,80	70,66±0,14

The table show, decline value strength Pull bioplastics happen Over with increasingly Many pemlastis Glycerol that added, but do not to pemlastis sorbitol.

Table 3. Influence Pemlastis Glycerol and Sorbitol at Elongation Bioplastics Ubi Mbote Deep Percent.

No	Plasticizers (ml)	Elongation (%)	
		Glycerol	Sorbitol
1	0	6,19±0,12	6,19±0,12
2	0,6	5,23±1,43	5,23±0,11
3	0,9	6,42±1,65	5,71±0,12
4	1,2	10,23±1,09	6,66±0,14
5	1,5	13,57±1,47	7,85±0,08

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The Table data shows that changes in elongation values are getting smaller as the plasticizer increases due to the plasticizer properties that influence the structure of the bioplastic sample. In plasticizers glycerol decreases along with the addition of the volume of the plasticizer. This is due to the measurement of the thickness of the sample at three points that have different values from each other, Modulus elasticity or Young's modulus is the ratio between stress and strain experienced by an object.

Table 4. Plasticizing Effect of Glycerol and Sorbitol on Modulus of Young Bioplastics.

No	Plasticizers (ml)	Modulus young ($\frac{N}{m^2}$)	
		Glycerol	Sorbitol
1	0	10,00±0,27	10,00±0,27
2	0,6	11,59±0,12	10,59±0,11
3	0,9	8,31±0,18	8,77±0,13
4	1,2	3,82±0,12	10,22±0,12
5	1,5	2,50±0,16	9,99±0,18

Plasticizer or *Plasticizer* is a material that can reduce cracks and increase the elasticity value of polymer films by interfering with hydrogen bonds between polimer molecules that adjacent so that the tensile strength of the tensile of the intermolecules of the polymer chain becomes reduced.

Figure 4. Visual results from the biodegradable assay from week 0 to 3.

From figure the sample was destroyed in week 4 in the absence of samples in the soil. Such data are obtained from visual observations in the form of images. From the assessment of the initial mass and the final mass obtained the quantativ results of the percentage of mass loss, degradibility and the approximate time of degradation

Table 5. Influence Pemlastis Towards Percentage Resistance AirBioplastics

No	Plasticizers (ml)	Water resistance %	
		Glycerol	Sorbitol
1	0	46,25±0,45	46,25±0,45
2	0,6	49,68±0,12	28,68±0,40
3	0,9	43,95±0,18	26,14±0,50
4	1,2	31,91±0,13	10,66±0,59
5	1,5	17,41±0,34	3,31±0,51

By Table get Known, that Resistance air Sample with pemlastis Glycerol and sorbitol increasingly experience penuruna Over Increasing composition pemlastis. Thing Ini Show that Sample plastic IsHydrophilic because Related theby characteristic basismolecule Constituent that get mebentuk bond hydrogen or happen Diffusion molecule air towards Sample bioplastics. Pemlastis Function to add Flexibility (Elongation) at plastic,but increasingly Increasing pemlastis will Increase room Blank or gap that get Occupied by molecule air.

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Figure 4. Bioplastic Images in the 0-th week Bioplastic Images in the 4-th week

The observation of the sample has changed from week to -1 to week to week to-3, the change is due to the presence of external components that diffuse with the surface of the sample. Another influence is caused by the growth of mold or dust that sticks to the surface of the bioplastic sample. The results of changes in the mass of bioplastic samples with glycerol and sorbitol plasticizers for 3 consecutive weeks, it can be observed that there are fluctuations in the massof a sample with very small changes in values. For more details, please see this Figures.

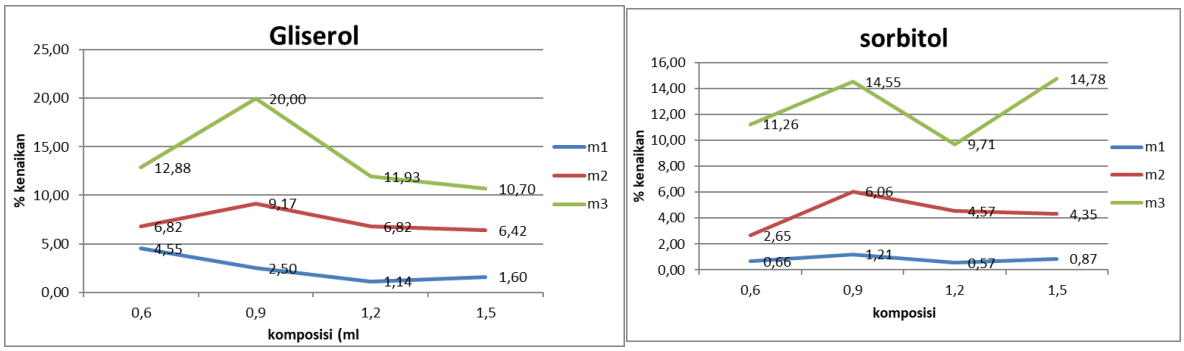

Figure 5. Test Results Percentage Increase mass Bioplastics(%) With Variations Volume with Gliserol and Sorbitol

The Glycerol and Sorbitol Plasticizer charts have similarities in composition of 0.9 ml, that is, there is an increase in the percentage in the strength test of the material. From the study showed a good plasticizer value used in the composition of 0.9 ml.

Conclusion

The resulting bioplastics are transparent with white filaments, but there are still few small bubbles. This type of plasticizer can affect the strength and durability of plastics, Glycerol plasticizers provide maximum tensile strength values (56,12±0,06) MPa with n maximum elongation value (13,57±1,47) % and plasticizer sorbitol provides the maximum tensile strength value (70,66±0,14) MPa with a maximum elongation value (7,85±0,08) %, while without plasticizer the tensile strength value (46,00±0,19) MPa with elongation (6,19±0,12) %. The type of composition can affect biodegradable tests, water tests and environmental tests, The test process is proven by the occurrence of physical changes in the sample. The maximum yield percent mass loss at a plasticizer volume of 1,2 ml, for glycerol plasticizers by 46,93 % and sorbitol by 61,4 %. The maximum result of the water resistance test was obtained at a plasticizer volume of 0,6 ml, for glycerol plasticizers by 49,68 % and sorbitol by 28,68 %. Environmental tests the maximum yield was received in a volume of 0,9 ml for gof liserol of 20,00±0,39 % and 1,5 ml for sorbitol of 14,00±0,51 %.

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