*Eco. Env. & Cons. 27 (1) : 2021; pp. (123-128)*
*Copyright@ EM International*
*ISSN 0971–765X*

# Comparing the use of Bioplastic Cassava and Plastics ethylene as packaging Cayenne Pepper

**Akhmad Rizali[1]**

***[1]Agriculture Faculty, Lambung Mangkurat Unversity, A.yani Street km 36, Banjarbaru, South Kalimantan Indonesia***

(Received 9 June, 2020; accepted 23 July, 2020)

**ABSTRACT**

The high use of plastics has a negative impact on sustainable, environmental because it is difficult to be degraded so that there is waste build up of plastic waste that pollutes the environment. Environment pollution due to plastic waste taking too long to decompose has become problem. There have been numerous solutions proposed, one of which is the use of bioplstics. The use of cassava starch as the main ingredient in the manufacture of bioplastics shows great potential, since Indonesia has diverse range of starch-producing plant. The aims of the present study is to compare the use of cassava bioplastic and polyethylene plastic as packaging for cayenne pepper. The experimental research investigated the use of cassava bioplastic. Observation by using cassava bioplastic that is P2.SD treatment that is with an average rate of good chili damage is 85%, 15% rather soft, 0% soft, and 0% rotten. This data shows the best results compared to the other two treatments. This is because the chili only shrinks and does not decay. This is because the packaging of cassava-pectin starch has a high value of the rate of water vapor transmission. The packaging of horticultural commodities is an effort that places fresh commodities into a container that meets the requirements so that the quality is maintained or only slightly decreases when received by consumers, by using packaging, the commodity can be protected from mechanical and microbiological collisions during transportation and storage.

***Key words:*** *Cassava Bioplastic, Polyethylene plastic, Cayenne pepper*

## Introduction

Plastics waste has become a worldwide problem. Indonesia is the world's second-largest contributor of plastics waste after china (Jambeck, *et al*., 2015), since it produces approximately 100 million tons of plastics of various industrial sectors .According to the most recent data provided by INAPLAST (Indonesian Olefin Aromatic Plastic Industry Association), the annual consumption of plastics in Indonesia was 4.7 million tons in 2015, rose o 5 million tons in 2016 (Suryanto *et al.,* 2016), and is predicted to hit 9.52 million tons in 2019.

The high use of plastics has a negative impact on environmental sustainable, because it is difficult to be degraded so that there is waste build up of plastic waste that pollutes the environment.

Consumer demands for varieties of food throughout the year, and preference for convenience have encouraged unprecedented growth of new developments in food packaging to ensure available of safe and healthy food. The primary function of food packaging is to separate food item(s) from the surrounding environment minimizing or preventing exposure to spoilage factors including the effects of microorganisms, oxygen, temperature and humidity to avoid or delay loss of quality and nutrition. However, food packaging

system perform several other important functions such as providing convenience, communication with consumer, and marketing of packaged product.

Generally, starch-based bioplastic in the form of natural polymer of the extraction plant. Bioplastics made from plants that contain lots of starch such as sweet potato, sago, cassava and potato taro. However, the use of these materials will reduce the portion of food. An additional value if the development of bioplastics to address environmental problems from waste as well. In previous studies, we have succeeded in making bioplastics from waste starch cassava. Wealth will be the source of basic materials such as mentioned above, on the country, become serious potential problem in countries that have the developed and mastered the science and technology of packaging biodegradable, particularly in Germany. The country with the mastery of science and high technology field of packaging are worrying shortage of basic materials resources (raw materials) and will be highly dependent on countries with rich natural resources.

Cayenne pepper (*Capsicum frutescens* L.) is horticultural product that cannot be stores for along time because it is easily damaged, so post-harvest handling is required so transportation must be done carefully. If not handled properly it will cause damage and shrinking the weight of the chili. According to Suyanti (2007), the amount of damage that occurred starting from the field to the level of retailers was 23 percent.

Several studies have resulted in the technology of making plastics from natural materials that can be degraded in a short time called raw materials such as cassava starch that is widely available in Indonesia. This research aims to compare cassava bioplastic packaging materials that are environmentally friendly and polyethylene plastic in storing Cayenne pepper (*Capsicum frutescens* L.).

## Materials and Methods

Material needed in this research is the starch peel cassava, acetic acid, distilled water, glycerol, distilled water, 1 M NaOh, HCL 2 M NaOH 20%, glycerol, and materials characterization TGA, XRF, testing tools tensile strength and elongation, measurement tools for proximate analysis. Equipments for bioplastics manufacturing (Figure 1A.) process: glass beakers, Petri dishes, spatulas, measuring cups, and a pipette, Erlenmeyer, pumpkin heads of three, funnel, thermometer, magnetic stirrer, hot plate, analytical balance, oven, pan heater. And plastics polyethylene (Figure 1B.)

### Statistical analysis

Statistical analysis was carried out in five replicates for the one control and experimental samples. The data has been analyzed by one-way analysis of variance (ANOVA) followed by Turkey's test, Duncan's multiple range test for the average value of parameter among the three treatments and used to compare the means values between each treatments.

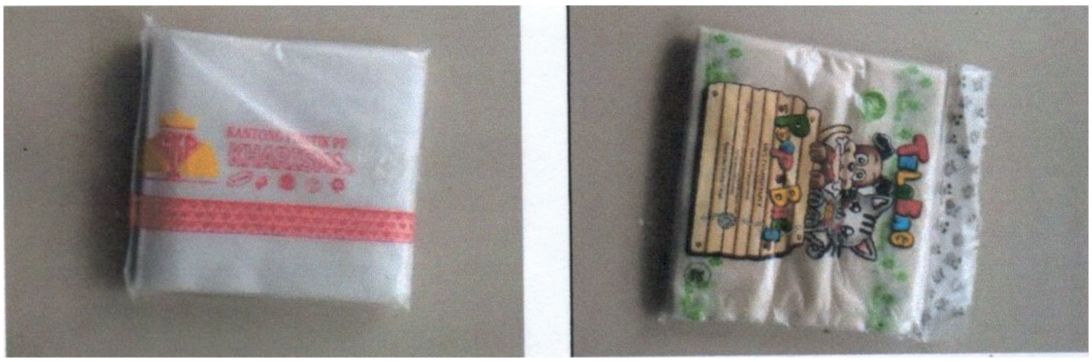
There are 3 levels of statisticals used in this treatments :

Po : Without using packaging (control)

P1 : Polyethylene type synthetic plastic packaging (PE)

P2 : Cassava bioplastic packaging

5 kg chili is taken from the field, then weight 20 g each for treatment. Observations were made every 3 days, starting on days 3, 6, 9, 12, and 15, on the water content, weight loss and the level of fruit damage.



**(A)** **(B)**

**Fig. 1.** (A). polyethylene plastic (PE) (B). cassava bioplastic

## Results

### Weights Loss

Based on statistical analysis on weight loss measurements seen on day 3 to 15 shows that treatment has a significant effect on weight loss can be seen in Figure 2.

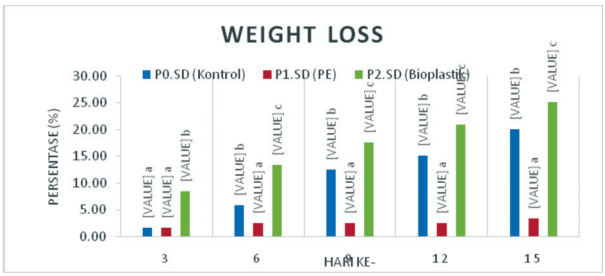



**Fig. 2.** Comparison chart for weight loss on day 3 trough 15.

Observations from day 3 to day 15, showed P2.SD treatment using cassava bioplastics obtained the highest weight loss, for example day 3 (6.33%), day 6 (13.33%), day 9 (17.50%), 12th day (20.83%), and 15th day (25.00%). The treatment that the lowest weight loss was P1.SD, packaging using synthetic polyethylene (PE) plastic which was day 3 (1.67%), day 6 (2.50%), day 9 (2.505), day 12 (2.50%), and day 15 (3.33%). While for the control are the 3rd day (1.67%), the 6th day (5.83%), the 9th day (12.50%), the 12th day (15.00%), and the 15th day (20.00%).

### Water Content

Based on the data of water content is on the 15th day we showed that the packaging treatment had influence on the water content of chili. It can be seen in Figure 3.

Based on observations of shrinkage of water content on the 15th day showed that the packaging treatment significantly affected to the water content. Based on the water content graph shows that the highest P1.SD treatment (72.50%) and P2.SD treatment, the lowest (67.83%).

### Level of Fruit Damage

To determine the level of damage to the fruit that is by observing one by one visually with the provisions of the texture as follows (Kalsum, 2018): good, somewhat soft, soft androtten can be seen in Figure 3.

Based on the diagram above, the treatment of

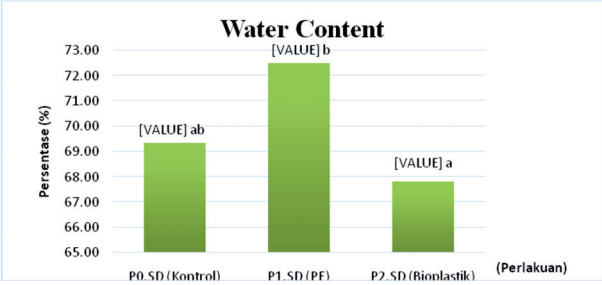



**Fig. 3.** Comparison chart of water content on day 15

PO.SD shows the average level of damage to the fruit that is 79% good chili, 18% rather soft, 3% soft and 0% rotten.

The observation of packaging using plastic PE, the P1.SD treatment showed better results than the PO.SD treatment, however, average damage rate of good cayenne pepper was 84%, rather soft 13%, and rotten 0%.

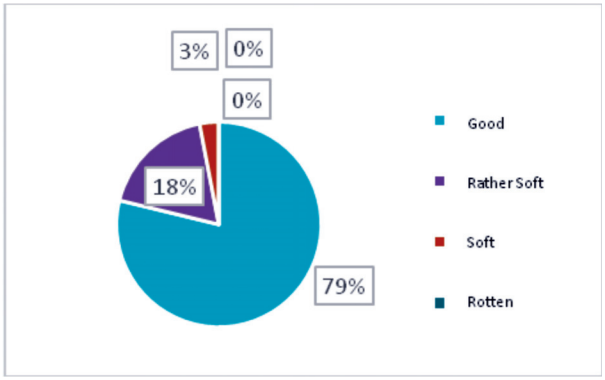



**Fig. 4.** Control (without treatment)

The observation of packaging using cassava bioplastics for example P2.SD treatment showed better results than the treatment of PO.SD and P1.SD that is with an average level of damage to good cayenne pepper is 85%, rather soft 15%, soft 15%, and rotten 0%. This data is taken based on the results of observations made from day 3 to day 15.

## Discussion

### Weight Loss

Weight loss is the amount of weight reduction of fresh products during storage due to loss of water in fruits that occur at harvest until consumed by consumers. Weight loss is one of factors of the rapid decline in the quality of fruit (Marlina *et al.*, 2014). The purpose of observing weight loss in this study

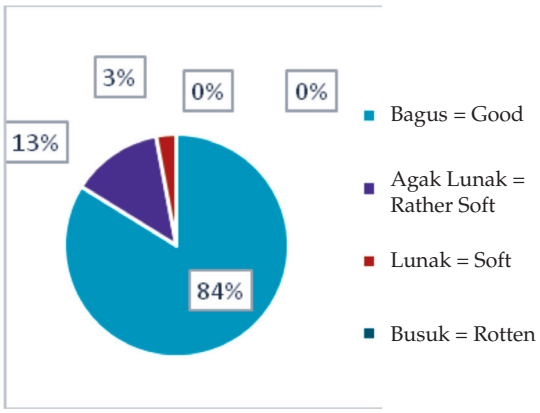



**Fig. 5.** Polyethylene plastic packaging (PE)

is to determine the amount of weight depreciation of fresh products during storage. The smaller the amount of weight loss, the quality of cayenne pepper is maintained, due to the less amount of water that evaporates so that the amount of weight decreases the smaller. Conversely the greater the reduce weight loss due to transpiration will be even greater. The highest value of weight loss is on P2.SD or cayenne pepper with packaging treatment using cassava bioplastics with average value of weight loss on day 3 (6.33%), day 6 (13.33%), day 9 (17.50%), 12th day (20.83%), and 15$^{th}$ day (25.00%) (Figure 5). The highest weight loss is produced by cayenne pepper in cassava bioplastic packaging until the last storage. The use of cassava bioplastics as a packaging causes the water content of the chili to evaporate, causing chili to shrink quickly, that is because the increase in weight loss is mostly due to high respirations. The opening and closing of the rind determine the amount of water loss that results in fruits loss (Pantastico, 1986). The average weight loss of cayenne pepper with PO.SD treatment or chili that was not given packaging treatment with the average value of weight loss is 3rd day (1.67%), the 6$^{th}$ day (5.83%), the 9$^{th}$ day (12.50%), the 12$^{th}$ day (15.00%), and the 15$^{th}$ day (20.00%) (Figure 1). According to Lamona *et al.* (2015), because of the high-water content in freshly harvested chili, which is about 77.74% so it must be immediately treated so that rotting occurs due to the high respiration activity that occurs in chili after harvesting. Packaging and storage at low temperatures is part of post-harvest handling that can be applied to withstand the decrease in chili water content which is very influential on weight loss.

The lowest weight loss of cayenne pepper was found in the P1.SD treatment or using polyethylene plastic (PE) type during storage for 15 days, day 3 (1.67%), day 6 (2.50%), day 9 (2.505), day 12 (2.50%), and day 15 (3.33%), and significantly different from the control, this is because of the packaging of this type of polyethylene synthetic plastic, the water content of chili dose not evaporate, but the fruit becomes soft and rots quickly, causing weight loss in the treatment is very low.

**Water Content**

The results of the water content is shown in figure 6, have a significant effect on the type of packaging on differences in water content. According to Lownds *et al*. (1994), that packaging can reduce water loss by an average of 20 times or more in each storage. The highest water content of cayenne pepper in P1.SD treatment or packaging using synthetic polyethylene (PE) plastic type was 72.50%, PO.SD or chili which was not given packaging treatment was 69.33%, while the lowest was in P2.SD treatment or packaging using cassava bioplastic which is 67.83%. This is because on the last day of storage the condition of cayenne pepper is shriveled and dried (without packaging), soft, runny and decomposed (packaging using polyethylene plastic), For cassava bioplastic packaging, the fruit is shrinking and dry. This affects the yield of cayenne pepper. Acooding to Sembiring (2009), it states that the porous packaging can protect the product from moisture.

**Level of Fruit Damage**

Determine the level of fruit damage is done by observing one by one visually with the provision of the texture as follows (Kalsum, 2014) : good, rather

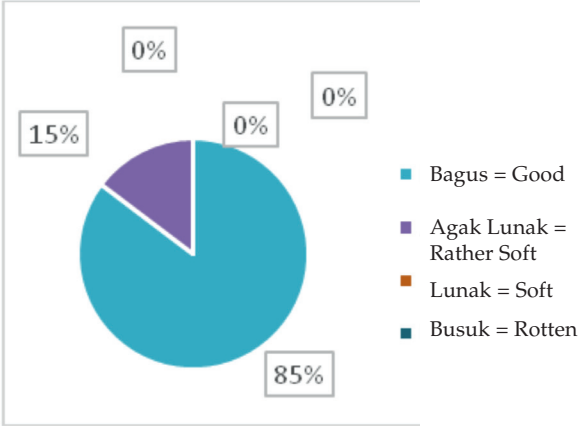


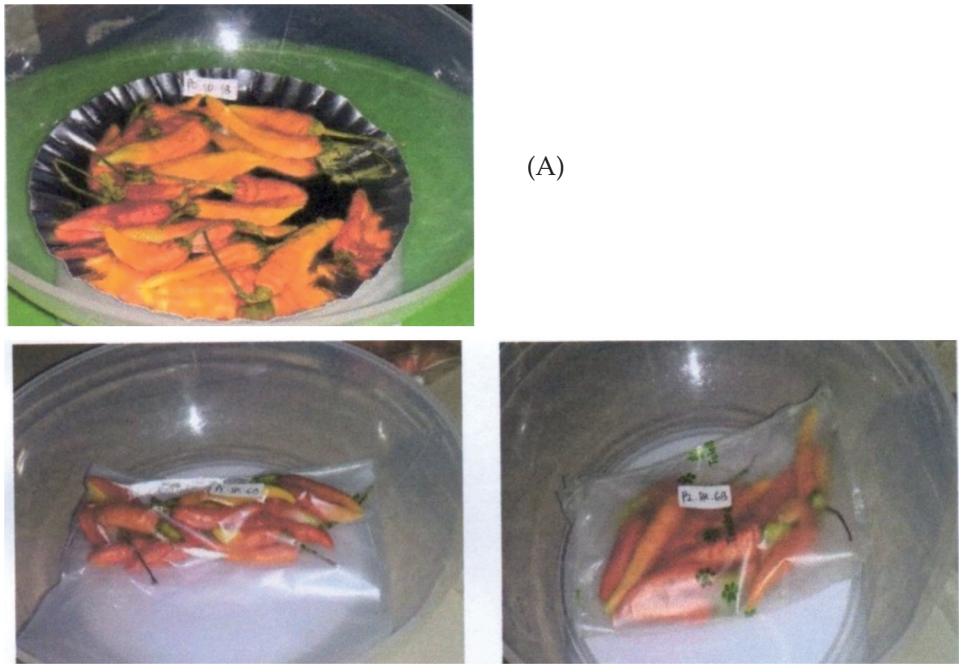

**Fig. 6.** Cassava bioplastic packaging

soft, soft, and rotten. The best texture category with the highest value is in the packaging treatment using cassava bioplastics that is 85%, then the packaging uses 84% polyethylene (PE) plastic type, and the lowest one is cayenne pepper without packaging (control) of 79%. This is because the lower the water content in the fruit, the damage to the fruit decreases. This is in accordance with the opinion of Sacharow (1980), that the packaging of horticultural commodities is an effort that places fresh commodities into a container that meets the requirements so that the quality is maintained or only slightly decreases when received by consumers, by using packaging, the commodity can be protected from mechanical and microbiological collisions during transportation and storage.

Observation in PO.SD treatment showed an average level of damage to chili is 79% which is good, 18% rather soft, 3% soft, and 0% rotten. This data shows the lowest result than the other two treatment, because this is due to this treatment not using packaging (Figure 6A). Cayenne pepper itself is one of the commodities that is prone to deterioration in quality, which causes the shelf life of chili to be not durable for 2-4 days, besides that the packaging serves to protect the product from damage (Rahmawati *et al*. 2014).

Observation of PI.SD or using PE plastic with an average damage rate of good chili is 84%, 13% rather soft, 3% soft, and 0% rotten, which shows better results than the treatment of PO.SD. This is due to this treatment using chili fruit packaging, so the level of damage to the fruit is reduce, and polyethylene (PE) plastic is type of synthetic plastic that is often used by the public (Figure 6B). The packaging is able to maintain the moisture of chili and reduce the rate of respiration and transpiration well plus one of its properties is water and steam resistant (Syarief *et al*. 1989).

Observation by using cassava bioplastic that is P2.SD treatment that is with an average rate of good chili damage is 85%, 15% rather soft, 0% soft, and 0% rotten. This data shows the best results compared to the other two treatments (Figure 6C). This is because the chili only shrinks and does not decay. This is because the packaging of cassava-pectin starch has a high value of the rate of water vapor transmission, so that is able to withstand the transmission of water vapor from inside the container (layuk *et al.,* 2002). Cassava bioplastics are also plastics that are derived from biodegradable natural materials and can be used like conventional plastics



(A)

(B) (C)

**Fig. 6.** (A). Sample treatment not using packaging (control), (B). Sample treatment using Polyethylene plastic (PE), (C) Sample using cassava bioplastic

in general to treat water and compounds that are not harmful to the environment and health (Sinaga, 2014).

## Conclusion

The results found that 1 (one) treatment of the best packaging, namely P2.SD (cassava bioplastic) treatment that is with an average rate of good chili damage is 85%, 15% rather soft, 0% soft, and 0% rotten. This data shows the best results compared to the other two treatments.

## Acknowledgment

The Authors would like to thank the Dean and Head of the Agroechotechnology Laboratory of the Faculty of Agriculture, Lambung Mangkurat University for permission and facilities provided during the study and to Dr. Yusriadi Marsuni who has provided much input in improving this paper.

## References

Bourtoom, T. 2007. Effect of Some Process Parameters on the Properties of Edible Film Prepared from Starch. Paper presented in The 9th *Agroindustrial Conference*: *Food Innovation. 15-16 June*2007. Bangkok.

Cui, S. W. 2005. *Food Carbohydrates Chemistry, Physical Properties, and Applications.* CRC Press. Boca Raton, London, New York. Singapore

European Bioplastic. 2015. "European Bioplastic,"

Kalsum, U. 2018. Study of the Effect of Fruits Stalks on the uality of Cayenne Pepper (*Capsicum frutescens* L.) During Storage. *Skripsi.* Agriculture Faculty. Hasanuddin University. Makasar.

Jacobs, H. and Delcor, J.A. 1998. Hidrotermal Modifications of Granular Starch, with Retention of the Granular Structure:a Review. *Journal of Agriculture. Food Chemistry*. 46 (8) : 2895-2905.

Jambeck, J.R., R. Geyer, C. Wilcox, T.R. Siegler, M. Perryman, A. Andrady, R. and Naraayan, K. Lavender. 2015. Plastic Waste Inputs from Land into the Ocean. *Science.* 800, 347 (6223) : 768-770.

Lamona, A., Purwanto, Y.A. and Sutrisno, 2015. The Effect of the Type of Packaging and Low temperature Storage on Changes in the Quality of Fresh Curly Red Chili. *Jurnal Keteknikan Pertanian.* 3(2) : 145-152.

Layuk, P., Djagal, W.M. and Haryadi. 2002. Characteristics of Edible Film Pectin From Nutmeg (Myristica Fregrans Houtt) and Tapioca Flesh. *Journal Technology and Food Industry* XIII (2).

Lownds, N. K., Banaras, M. and Bosland, P. W. 1994. Postharves Water loss and Storage Quality of Nine Pepper (*Capsicum*) cultivar. *Hort Science.* 29 (3) : 191-193.

Marlina, L. Y., Y Aris, P. and Usman, A. 2014. Application of Polyethylene Plastic packaging (PE) to Increase the Shelf Life of Pondoh Fruits. *JTEP Jurnal Keteknikan Pertanian.* Bogor.

Pantastico, E. R. B. 1986. *Post-harvest Physiology, Handling and Utilization of Tropical and Sub-Tropical Fruits and Vegetables.* Gadjah Mada University Press. Yogyakarta.

Rahmawati, N., Yohanes, A.P. and Sutrisno, 2015. The Effect of the Type of Packaging and Storage of Cold Temperatures on the Physical Quality of Red Chili. *Post-harvest Journal of Agricultural Producs.*

Sacharow, S., B. A., M. A., Roger C. Griffin Jr., B. S., M. S. 1980. *Principle of Food Packaging.* AVI Publishing Company, Inc., Westport, Connecticut.

Sembiring, N.N. 2009. The Effect of the Type of Packaging Material on the Quality of the Red Chili (*Capsicum annuum* L.) Product. Tesis. Post-graduate of North Sumatra University. Medan.

Seyoum, T. W., Osthoff, G. and Steyn, M. S. 2001. Effect of Modified Atmosphere Packaging on Microbiological, Physiological and Chemical Qualiteies of Stored Carrots. *J. Food Techno Afr.* 6 : 138-143.

Sinaga, R.F. 2014. The Effect of Adding Glycerol to Healthy Tensile Strength and Elongation When Breaking up Bioplastics from Taro Tuber Starch. *USU Chemical Engineering Journal*. Vol. 3, No. 2.

Suyanti, 2007. Make a Variety of Processed Chili Molds 2. Penebar Swadaya. Jakarta.

Syarief, R., S., Isyana, B.S.T. 1989. Food Packaging Technology. PAU Food and Nutrition Process Engineering Laboratory. IPB. Bogor

Suryanto, H., P.T., Hutomo, R. Wanjaya, P. Puspitasari. 2016. The Structure of Bioplastic from Cassava Starch with Nanoclay Reinforcement. *AIP Int. Mech. Eng. Eng Educ*. 30027, pp. 1-4.