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Thickness Analysis of Low Density Polyethylene Plastic as Packaging for White Oyster Mushroom (Pleurotus florida)

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ABSTRACT

The purpose of this study was to study the effect of the thickness of low density polyethylene plastic as a packaging material for White Oyster Mushrooms on the modification of O2 and CO2 gases and the physical changes that occur during storage. P Completely randomized design (CRD) was used to analyze data on changes in the composition of O2 and CO2 and followed by a T test if the analysis of variance showed that different treatments had a significant effect on changes in O2 and CO2 concentrations. The results of the diversity test showed that the treatment of differences in LDPE plastic thickness had a very significant effect on the concentration of O2 and CO2 gases in the plastic packaging. The thickness of LDPE plastic 0.04 mm is the best thickness that is able to maintain the quality of white oyster mushrooms with a texture value of 0.022 mm/g.sec, weight loss of 0.74%, reduction of water content of 1% and an average minimum oxygen concentration in the package of 3.2 % and the maximum concentration of carbon dioxide in the package is 8.2%. The highest decrease in water content at 0.03 mm thickness was 1.3% and the lowest at 0.08 mm thickness was 0.63%. The lowest respiration rate was 21.71 mlCO2/kg/hour which occurred at a thickness of 0.08 mm on the 5th day of storage. If the respiration rate of a commodity can be matched with the permeability of the film on the package, then a favorable passive atmosphere condition can be achieved within the package. This method is commonly known as Modified Atmosphere Packaging (MAP).

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1. INTRODUCTION

Oyster mushroom is a type of agricultural commodity that has been widely cultivated by farmers in Indonesia, especially in areas that have an altitude between 700 – 1500 m above sea level. Oyster mushroom is a type of wood mushroom that grows sideways on weathered logs. This mushroom has a fruiting body that grows to form a shallow funnel like a shell (Oyster).

The fruiting body of this mushroom has a hood (Pileus) and a stalk. The hood is in the form of a short oyster shell or measuring 5-15 cm and the lower surface is layered like white and soft gills. While the stem can be short or long (2 - 6 cm) depending on the environmental and climatic conditions that affect its growth. This mushroom is a versatile type of mushroom, besides being consumed in the form of cooking, oyster mushrooms can also be consumed raw or fresh. It can

even be processed into a kind of crips, crispy or chips. So that the market opportunity for mushroom products is currently quite high, the domestic market needs around 35% and the foreign market 65%. Every year the demand for mushrooms in the country and abroad has increased between 10 - 20%.

Freshness of Oyster Mushrooms in room conditions (temperature ± 28o C and humidity ± 50%) only lasts 4 - 6 hours and then withers, the color changes to yellow-brown, the texture, aroma and flavor change, eventually it dries or rots. the process of respiration and transpiration which means the process of catabolism or the decomposition of organic compounds into inorganic compounds.

Respiration is a process of oxidation of organic matter that occurs in cells and takes place both aerobically and anaerobically. Aerobic respiration requires oxygen and carbon dioxide and energy are produced. The organic material that is oxidized is Glucose (C6H12O6) then the reaction equation Anaerobic respiration can take place in free air, but this process does not use the O2 provided in the air. Anaerobic respiration can also be called fermentation or intramolecular respiration. The purpose of fermentation is the same as aerobic respiration, which is to get energy, it's just that the energy produced is much less than aerobic respiration. Respiration rate for a type of commodity can vary depending on the variety. Respiration is a measure of metabolic activity.

According to Hotchkin (1988), there are several factors that affect the shelf life under modified atmospheric conditions, namely: 1) The amount of free water used by microbes for their growth (aW) and the respiration rate of the product, 2) The atmosphere in the package, 3) The empty space in the package , 4) Packaging permeability, and 5) Storage temperature. Storage in modified atmosphere conditions can also cause damage due to abnormal metabolism because the composition of the atmosphere is different from normal air.

Tomkins (1966), reported that an atmosphere with 10% CO2 could delay the damage to the mushrooms and excess CO2 could cause discoloration. In addition to temperature, another way to reduce damage is by packing foodstuffs with plastic. Syarief et al. (1988), stated that a type of low density polyethylene plastic is usually used to package fruits and vegetables. This is because the use of this type of polyethylene plastic results in an increase in CO2 concentration and a decrease in O2 concentration which can slow down the ripening process and shelf life.

2. METHOD

2.1 Types of research

The research method used in this study is the experimental method. The experimental method is a form of observation under artificial conditions, where these conditions are created and regulated by the researcher. That is, basically conducting an experiment to see the results, and the results of the experiment will confirm how the causal position is between the variables being investigated.

2.2 Research variable.

Variable observations include changes in O2 and CO2 composition of oyster mushrooms stored in plastic packaging.

2.3 Research design

This study was conducted using a completely randomized design (CRD) where the treatment was the difference in the thickness of the LDPE plastic, namely 0.03 mm (T1), 0.04 mm (T2), 0.05 mm (T3), and 0.08 mm (T4), and the treatment was repeated three times. time. RAL is then used to analyze data on changes in the composition of O2 and CO2 in the plastic packaging where the White Oyster Mushrooms are packaged.

2.4 Sampling location

The study used oyster mushroom samples which were tested by storing them in plastic and the effect of storage on the characteristics of the mushrooms.

2.5 Time and Place of Research.

This research was conducted from 3 January 2010 to 14 January 2010, at the Laboratory of Food Processing and Agricultural Products (TPHP), Department of Agricultural Engineering, Brawijaya University Malang.

2.6 Tools and materials

The tools used in this study include: Cooling room; O2 analyzer to measure O2 concentration; CO2 analyzer to measure CO2 concentration; Scales to measure the weight of the material; Clamp

to clamp the hose on the packaging; Penetrometer to measure the texture of the material; Hygrometer to measure the humidity in the storage room; Sealer to glue the plastic; Small hose for measuring CO2 and O2 gas concentrations.

The materials used are: Fresh White Oyster Mushroom; Low density polyethylene (LDPE) plastic measuring 20 cm x 12 cm with a thickness of 0.03 mm, 0.04 mm, 0.05 mm, 0.08mm.

2.7 Research procedure

the implementation of the research began with taking samples of oyster mushrooms where the mushrooms were taken directly from mushroom farmers in the Songgoriti Batu area, East Java. Mushrooms that have been harvested cleaned the roots. The time for taking the mushrooms was in the morning at 08.00 WIB then the mushrooms were cleaned and divided into equal amounts and stored using different methods and observations were made taking into account weight loss, concentration of O2 and CO2 gases, changes in color, texture and respiration rate during storage.

2.8 Data analysis.

The Least Significant Difference Test (LSD) for the mean of treatment was carried out when the analysis of variance showed that the difference in treatment had a significant effect on changes in O2 and CO2 concentrations.

3. RESULTS AND DISCUSSION

3.1 Research result

3.1.1 Storage by MAP (Modified Atmosphere Packaging) Method

Mushrooms after being harvested still continue to carry out respiration and metabolism, because of that this commodity is considered to be still alive. During the process of respiration and metabolism, CO2, water and energy are produced, and O2 is consumed in the surroundings. The composition of the air in the storage space has a major influence on the properties of the freshly stored material.

The content of O2 and CO2 mutually influence the metabolism of the fungus itself. Modification of the air composition is done by reducing the O2 content and/or increasing the CO2 content. In general, air that is depleting the O2 content and increasing CO2 content will result in a decrease in the rate of respiratory activity of fresh mushrooms. Oxygen in the air cannot be completely removed from the atmosphere, because the presence of O2 is still needed to maintain normal metabolism.

3.1.2 Changes in O2 and CO2 Concentrations

Mushrooms that are placed in LDPE plastic bag packaging with different thicknesses of plastic are sealed with a sealer to prevent leakage or prevent O2 from entering and CO2 escaping freely. To measure the gas concentration, a hole is made in the package which is connected to a plastic hose equipped with a clamp. Furthermore, the packed mushrooms are placed and stored at 5-8 o C. Changes in the concentration of O2 and CO2 gases in the plastic packaging are measured at 0 hours (first day), then measurements are carried out every 24 hours until damage occurs which is indicated by a change in color.

Table 1. Test Results for the Average Difference of O2 and CO2 Concentrations During Storage.

Treatment	Oxygen Gas Concentration (%)				
	Day-0	Day-1	Day-2	Day-3	Day-4
LDPE 0.03mm (T1)	20.9a	16.13a	11.1a	7.87a	5.03a*
LDPE 0.04mm (T2	20.9a	14.27b	8.57b	5.17b	3.17b
LDPE 0.05mm (T3	20.9a	11.07c	6.47c	2.27c	1.2c*
LDPE 0.08mm (T4)	20.9a	8.7d	4.07d	1.4d	0.13s*
	Oxygen Gas Concentration (%)				
Treatment	Day-0	Day-1	Day-2	Day-3	Day-4
LDPE 0.03mm (T1)	0.03a	2.07a	4a	5.83a	7.3a*
LDPE 0.04mm (T2	0.03a	2.53b	5.27b	6.8b	8.2b
LDPE 0.05mm (T3	0.03a	6.8b	8.2b	3.67c	7.13c
LDPE 0.08mm (T4)	0.03a	9.33c	10.83c*	4.77d	13.03d
BNT	mr				

Note: The same letter in the same column behind the average value indicates no significant difference for the concentrations of O2 and CO2. Mushrooms are damaged (brown).

The results of the diversity test in Table 1 show that the treatment of differences in LDPE plastic thickness had a significant effect on the concentration of O2 and CO2 gases in the plastic packaging on the storage of White Oyster Mushrooms on days 1, 2, 3, and 4. However, the real

differences occurred on day 3. 4 shows that the concentration of gas generated in plastic T1 causes normal physiological damage in the form of a change in the color of the mushroom flesh to brown. T3 and T4 plastics tend to cause conditions in the storage space to become anaerobic which also causes physiological damage. This change in concentration indicates that the interaction between plastic permeability at T3 and T4 thicknesses with the respiratory activity of the fungus is unable to maintain aerobic conditions which are very important for the respiratory activity itself. In the T1 treatment,

However, T2 plastic seems to be relatively better than other plastics (T1, T3, and T4) in being able to account for atmospheric conditions, namely the optimum concentration of O2 and CO2 gases to slow down the occurrence of damage which is marked by the color change of the meat to brown and maintains a good color. as a whole is still relatively white in color than the other packages.

3.1.3 Changes in water content, shrinkage, color and texture of mushrooms.

In this study using the oven method, namely by heating the material at a temperature of 105o C for 24 hours. The observation results showed that the water content of fresh White Oyster mushrooms had an average moisture content of 92.7%, while the final moisture content after 5 days of storage obtained an average moisture content of 91.4% and the shrinkage rate in mushrooms was influenced by water content. if there is a lot of moisture in the mushrooms that respires, the weight of the mushrooms will also go down. For the color of the mushrooms, it was observed that in treatments T1, T3 and T4 there was a fairly large color change towards brown, whereas in treatment T2 the color of the mushrooms was still relatively darker. white compared to mushrooms in other packages, the change that occurs in oyster mushrooms is a fairly large color change towards brown,

3.1.4 Changes in Respiration Rate

Respiration is a process of catabolism or the decomposition of organic compounds into inorganic compounds, this process takes place aerobically or anaerobically. The speed or rate of respiration is an excellent indicator of metabolic activity in tissues. Reducing the rate of respiration can be assumed as a means of lowering the rate of metabolism. pattern of decreasing respiration rate of each packaging.

At the beginning of storage, namely on the first day, the respiration rate in each treatment was the same, namely 65.14 mlCO2/kg/hour, this was because at that time the gas concentration in each package was still the same. On the second day there was a decrease in respiration rate with not too big a difference in each package.

On the third day, the largest decrease was in the thickness of 0.08 mm with a concentration of 4.1% O2 and 10.8% CO2 while the respiration rate was 36.91 mlCO2/kg/hour. Likewise on the fourth and fifth day at a thickness of 0.08 mm, the respiration rate was 26.05 mlCO2/kg/hour and 21.71 mlCO2/kg/hour respectively. In addition to being affected by low temperatures, this decrease in respiration rate is also influenced by the availability of O2 and CO2 accumulation. According to Pantastico (1986), low O2 concentrations, respiration rates and substrate oxidation and excess CO2 accumulation can cause metabolic disturbances from stored fresh produce.

3.2 Discussion

The results of the diversity test showed that the treatment of differences in LDPE plastic thickness had a very significant effect on the concentration of O2 and CO2 gases in the plastic packaging. LDPE plastic thickness of 0.04 mm is the best thickness that is able to maintain the quality of the white oyster mushroom with a texture value of 0.022 mm/g.sec, weight loss of 0.74%, reduction of water content of 1% and an average minimum oxygen concentration in the package of 3.2 % and the maximum concentration of carbon dioxide in the package is 8.2%. The highest decrease in water content at 0.03 mm thickness was 1.3% and the lowest at 0.08 mm thickness was 0.63%. The lowest respiration rate was 21.71 mlCO2/kg/hour which occurred at a thickness of 0.08 mm on the 5th day of storage.

The choice of thickness of plastic packaging for fruits and vegetables is critical because it is related to the permeability to O2, CO2, water vapor and at the same time is also influenced by the respiratory activity of the packaged product. In this study, a type of low density polyethylene plastic with a thickness of 0.03, 0.04, 0.05 and 0.08 mm was used which was stored at low temperatures in the range of 5 - 8 o C, then measurements of changes in O2 and CO2 gas concentrations and physical changes (Weight loss, moisture content, texture, color, and respiration rate) during storage.

4. CONCLUSION

Based on the research that has been done, several conclusions can be drawn, namely the thickness of LDPE plastic 0.04 mm is the best thickness that is able to maintain the quality of packaged mushrooms with an average minimum oxygen concentration of 3.2% and a maximum carbon dioxide concentration of 8.2%. and a decrease in water content by an average of 1%, with the largest decrease in the thickness of 0.03 mm by 1.77% and the smallest in the thickness of 0.08 mm by 0.63%, The average weight loss was 0.76%, with the largest weight loss obtained in the thickness of 0.03 mm by 0.86% and the smallest at 0.08 mm thickness of 0.66%, 0.04 mm thickness is the thickness that can maintain the texture of the fungus with an average value of 0.022 mm/g.cell and the difference in thickness has an effect on respiration rate, on the 5th day the lowest respiration rate occurs at a thickness of 0.08 mm at 21.71 mlCO2/kg/hour.

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Based on the research results, some suggestions that the author can convey are the use of LDPE plastic with a thickness of 0.04 mm to package White Oyster Mushrooms at a storage temperature of 5 - 8 o C. diffusion of O2 and CO2 gases through the LDPE plastic.

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