El-Hayah

JURNAL BIOLOGI

Journal Homepage: http://ejournal.uin-malang.ac.id/index.php/bio/index

e-ISSN: 2460-7207, p-ISSN: 2086-0064

Original research article

Qualitative Analysis Of Orange Peel Organic Waste Ecoenzyme Application In Delaying Of Ripening And Decaying Fruits

[1]Hafsah Hafsah and [2]Kameliah Mushonev

[1]*Program studi Biologi, Universitas Wanita Internasional, Bandung Indonesia*
[2]*Program studi Pendidikan Biologi, Institut Teknologi dan Sains Nahdlatul Ulama Pasuruan, Indonesia*

*Corresponding author
Email: hafsah@iwu.ac.id
DOI: 10.18860/elha.v9i1.18532

Article Info

Article history:
Received 21 August 2022
Received in revised form 30 August 2022
Accepted 25 September 2022

Key Word:
acetic acid,
descriptive test,
garbage enzymes,
organoleptic

Abstract

Fruit damage due to overripe/rotten is a major constraint in the fruit industry. Efforts to restrain the rate of ripening are generally made by coating the fruit using certain chemicals, one of which is acid. Ecoenzyme is a liquid acidic resulting from anaerobic fermentation. Its organic acids have the potential to slow down fruit rot. This study aimed to analyse qualitatively (visually) the effect of applying specific ecoenzymes (orange peel waste) in delaying the ripening and spoilage of strawberries, bananas, green tomatoes, and red tomatoes. Tested fruits were immersed in ecoenzymes with different concentrations (100%, 50%, 25%, 12.5%, and 6.25%). Physical changes in the morphology of the fruit skin were observed every day until the fruit became ripe/rotten. Control strawberries showed a decrease in quality (mold appearance) on the 3rd day, while the concentration of 12.5% occurred on the 4th day. In bananas, a concentration of 100% can delay skin discoloration (yellowing) one day later than the control, while at a concentration of 50%, the appearance of the white mold is one day later than the control. In green tomatoes, a concentration of 50% can delay skin discoloration five days longer than controls. Concentrations of 6.25% and 50% were able to delay the emergence of white mold on red tomatoes for eight days longer than the control. Different commodities have different optimal concentrations of orange peel ecoenzymes in delaying fruit ripening/rotting. The higher acidity of the ecoenzyme is not always in line with the better result in delaying fruit ripening/rotting.

1. INTRODUCTION

Fruit damage due to overripe or rot is a significant constraint in the fruit industry. Rotten or damaged fruit has an impact on the amount of fruit traded. The reduction in the number of fruits due to post-harvest damage can reach 10-40% (Widiastuti et al. 2015).

Various efforts have been made to restrain fruit ripening and spoilage rate, including preservation, controlled storage, and cooling (Amit et al. 2017; Fang and Wakisaka, 2021). One of the common preservation efforts is coating the fruit using certain chemicals, one of which is acid. Benzoic acid is a chemical preservative that is widely used. In addition to chemicals, natural acids such as sorbic acid, fumaric acid, and acetic acid are also used as preservatives (Yuliana et al, 2014). The use of natural acid preservatives is undoubtedly better than chemicals.

Eco enzyme is a liquid resulting from anaerobic fermentation, which is acidic. The organic acids have the potential to slow down fruit rot. One of the organic acids found in eco enzymes is acetic acid. Acetic acid from fermented fruit peels contributes to antimicrobial activity (Mavani et al., 2020). Acetic acid is an active preservative that can inhibit the growth of pathogenic microorganisms (Pundir and Jain, 2010). Acetic acid is antimicrobial because it has an undissociated part that can enter the cell, causing osmolysis and disrupting microbial cell activity (Lund et al., 2014) (Halstead et al., 2015).

Eco enzyme is a kind of artificial vinegar from fermentation kitchen waste with sugar as a substrate (Li et al., 2013). Fruit and vegetable peels are the most commonly used kitchen waste as an ingredient for making eco enzymes. Citrus fruit peels are often chosen as an ingredient for making eco enzymes because of their refreshing aroma, rich in vitamin C content, and also high acidity (Vama and Cherekar, 2020).

Ecoenzymes are easy to manufacture and inexpensive economically (Arun and Sivashanmugam, 2015) (Vama and Cherekar, 2020). The raw material for eco enzymes only requires organic fruit and vegetable waste to be fermented with brown sugar and water.

Using eco enzymes as natural preservatives are expected to reduce post-harvest management costs, especially for fast-ripe and rotting fruits. Maula et al. (2021) reported that ecoenzymes made from a mixture of pineapple, mango, melon, and watermelon peel waste could be used to delay the rotting of strawberries and red tomatoes. No information exists on whether ecoenzymes made from a single raw material (orange peel only) can delay fruit rotting and ripening, especially on bananas, green tomatoes, red tomatoes, and strawberries. The purpose of this study was to analyze qualitatively (visually) the effectiveness of applying specific eco enzymes (orange peel waste) in delaying the rotting of strawberries and red tomatoes and inhibiting the ripening of bananas and green tomatoes.

2. MATERIALS AND METHODS

Study area

Ecoenzymes were made regarding research by Vama and Cherekar (2020). The fruit samples used in this study included strawberries, bananas, green tomatoes, and red tomatoes, with relatively similar maturity levels in each fruit group (Table 1).

Table 1. Description of the ripened level of experimental fruit samples

No	Fruits	Fruit Description
1	Strawberry (*Fragaria* sp.)	Skin color and fruit size are relatively the same. Produced in the same period. The level of freshness is relatively the same.
2	Banana (*Musa accuminata*)	Bananas come from the same fruit bunch. The color of the skin and the size of the fruit are relatively the same. The type of banana is jambe banana.

No	Fruits	Fruit Description
3	Unripened Tomato (*Lycopersicum* sp.)	Tomatoes are picked from tomato trees planted at the same time. The size and color of the fruit are relatively the same. When picked, the tomato's age is 50 days after planting (the fruit is still unripened).
4	Ripened Tomatoes (*Lycopersicum* sp.)	Tomatoes are picked from the same garden as unripened tomatoes, but the age of the tomatoes when picked is about 75 days after planting (the fruits are ripened). The size and color of the fruit are relatively the same.

Procedures

Three liters of water, 300 grams of brown sugar, and nine hundred grams of cleaned and sliced orange peel were mixed. The solution was incubated for three months in an airtight plastic container. For the first month, the mixture is stirred daily using a glass rod to release gases formed from fermentation. The mixture is stirred every two weeks in the second month. While in the third month, the solution is stirred once in the middle of the month. After three months, the eco enzyme solution was harvested and separated from the pulp. A clear eco enzyme solution (without pulp) was used for the experiment.

Each fruit sample (n=3) was immersed in orange peel eco enzyme with varying concentrations of 100%, 50%, 25%, 12.5%, and 6.25% for about one minute. After dipping into the eco enzyme solution, the fruit is stored in clear plastic containers with non-tight lids. Physical changes in the morphology of the fruit skin were observed every day until the fruit became ripe or rotted. The number of days observed for each fruit group differs depending on the physical characteristics observed.

The physical parameters observed in general were the change in skin color of the fruit and the appearance of white mold (followed by fruit rot). In strawberries and red tomatoes, the parameters observed were the appearance of mold and rot, while in green tomatoes, the parameter observed was the change in skin color of the fruit (from green to reddish-orange). In bananas, the parameters of fruit skin discoloration (from green to yellow), the appearance of white mold, and decay were observed.

The condition of each fruit was given a score according to the observed parameter changes daily. Under the following conditions, the observed fruits were assigned a score of 100%:

- The strawberries, red tomatoes, and bananas were completely overgrown with white mold and rotting.
- The unripe tomato's color was utterly reddish-orange.
- The banana's skin color was completely yellow.

If these conditions are not met, then the score given adjusts to the area of the emergence of white mold or changes in color on the surface of the fruit, then divided by the total fruit surface area (assumed 100) and then multiplied by 100%.

(area of the mold or skin discoloration)/100 x 100%

Data analysis

The average daily observation score that has been collected is then presented in a graph

3. RESULTS and DISCUSSION

The orange peel eco enzyme extract prepared has a pH of 3.4. Acid levels below 4 indicate the eco enzyme is of good quality and meets the requirements for further use (Win, 2011). The dilution of eco enzymes in various concentrations resulted in different acidity levels. Concentrations of 50%, 25%, 12.5%, and 6.25% have pH 3.49, 3.59, 3.66 and 3.73, respectively. In the pH range below 4, organic acids (acetic acid) are expected to function optimally.

The first appearance of the white mold on strawberries occurred in the test sample with a concentration of 100% (2nd day of observation). One day later (3rd day of observation), fruit at concentrations of 6.25%, 25%, and 50% showed the appearance of white mold. In contrast to the concentration of 12.5%, the emergence of mold occurred on the fourth day of observation, two days later than the control (Figure 1). On the eighth day, the fruit was almost entirely in a moldy rot condition.

At 100% concentration, the eco enzyme could delay the change of banana peel color (yellowing) one day later than the control (Figure 2). Meanwhile, at a concentration of 50%, the eco enzyme could delay the emergence of mold one day later than the control (Figure 3). Observations lasted eight days until the control fruit samples were completely rotted and moldy.

Control fruit skin on unripened tomatoes began to turn yellow on day four and at other concentrations (25% and 100%). Meanwhile, at a concentration of 50%, the tomatoes began to turn yellow on the eighth day. Eco enzyme concentration of 50% can delay skin discoloration (yellowing) five days later than without eco enzyme administration (Figure 4). Eco enzyme concentration of 50% becomes a relatively acidic intermediate concentration in delaying tomato ripening. Observations on unripened tomatoes lasted for 15 days until the fruit turned yellow completely.

Eco enzyme concentrations of 50% and 6.25% could delay the emergence of mold eight days longer than the control in ripened tomatoes (Figure 5). Mold on control ripened tomatoes appeared on the 22nd day of observation, while concentrations of 50% and 6.25% appeared on the 30th day. Previous studies reported that 100% and 50% eco enzyme concentrations could delay the appearance of white white mold by one day compared to controls (Maula et al., 2020). Observation of the rate of rot in ripened tomatoes lasted for 35 days. Until the 35th day, the ripened tomatoes with a concentration of 6.25% still showed the lowest percentage of fungal emergence compared to other treatments (Figure 5).

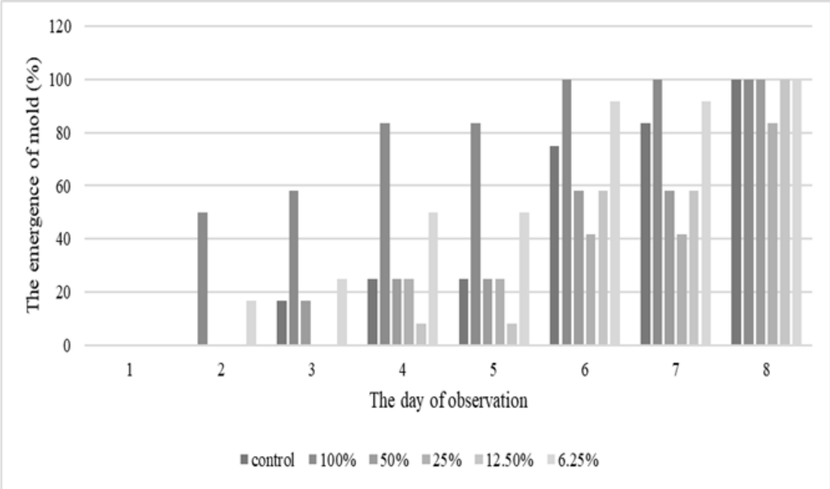

Figure 1. Daily occurrence of white mold on strawberries

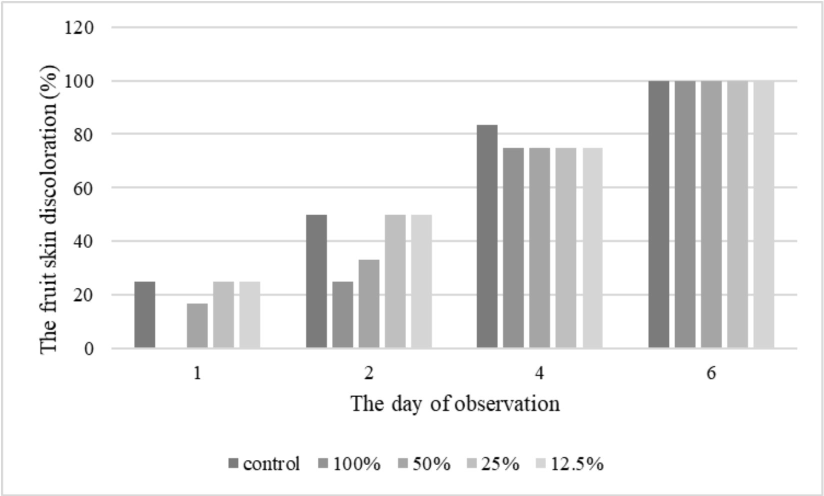

Figure 2. Daily skin discoloration on bananas

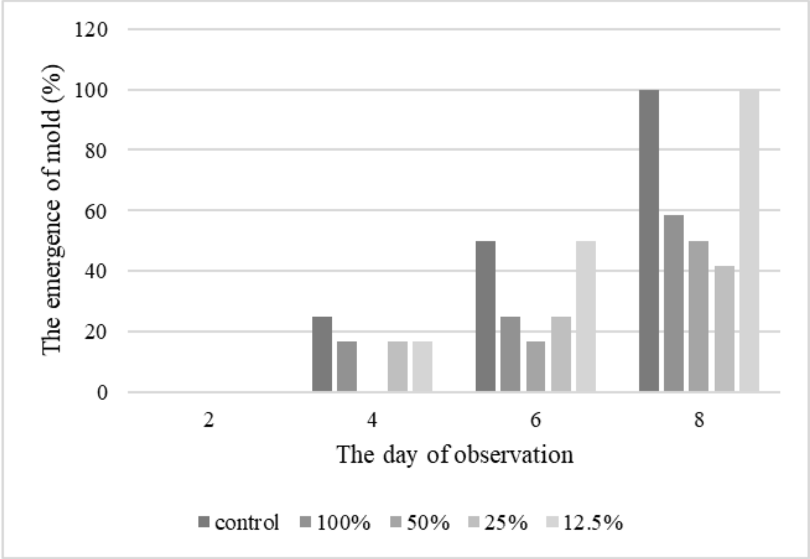

Figure 3. Daily occurrence of white mold on bananas

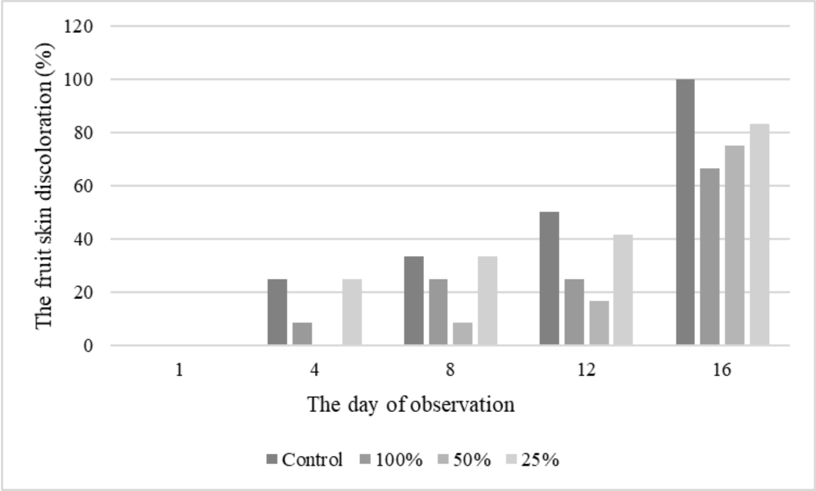

Figure 4. Daily skin discoloration on unripened tomatoes

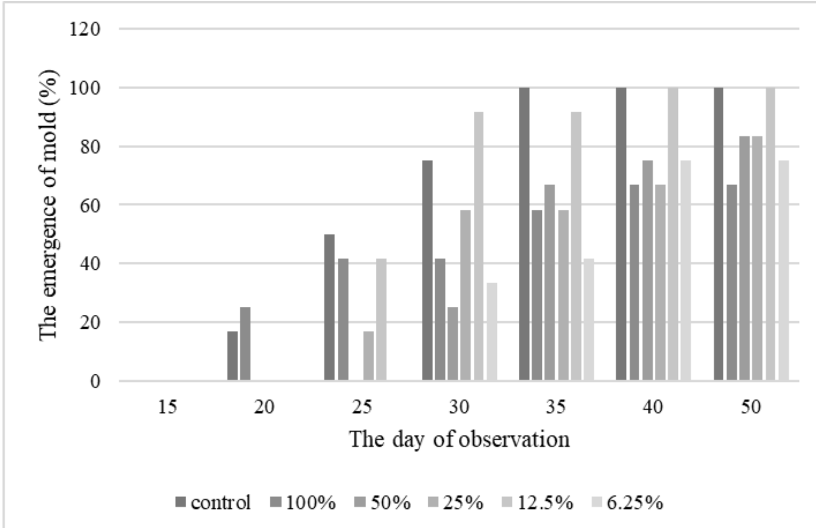

Figure 5. Daily occurrence of white mold on red tomatoes

4. DISCUSSION

Previous studies reported that concentrated eco enzymes (100%) could delay the spoilage of strawberries two days longer than controls (Maula et al., 2020). In contrast to the study, in this study, a concentration of 100% showed the fastest mold emergence compared to other concentrations. The intense acidity does not guarantee that the fruit is protected from mold. The interaction between natural microbes and various enzymes in eco enzymes, with sugar or water content in strawberries, is thought to be one of the factors causing the rapid emergence of mold at pure concentrations. The activity of the amylase enzyme increases with acidity (Smitha, 2010). Amylase enzyme in eco enzyme solution can break down carbohydrates in fruit into glucose, a source of energy for the growth of microorganisms.

The rapid rate of bananas ripening was thought to be due to injury in the sample. The incision wound at the base of the banana fruit causes the ethylene hormone to become more active. Bruised or injured fruit has higher ethylene activity, so the ripening and respiration rate becomes faster (Sudjatha and Wisaniyasa, 2017). Minimizing the injury to the test sample is expected to show better observation results. In addition, bananas are classified as climacteric fruits with a high respiration rate and ethylene production during ripening (Astuti, 2015).

The degradation of fruit skin color is caused by the presence of chlorophyllase enzymes, changes in oxidative enzymes, and changes in pH (Sudjatha and Wisaniyasa, 2017). Strong acids can change the phytophil group on the chlorophyll of the fruit skin to become feoforbides or brownish (Sudjatha and Wisaniyasa, 2017).

Differences in the raw materials of eco enzymes used in previous studies are thought to cause the different delay times for eco enzymes in preventing the emergence of spoilage mold. That study used raw materials for the skin of pineapple, mango, melon, yam, watermelon, and kale. Different fruit and vegetable raw materials used for eco enzymes show differences in enzyme activity and antimicrobial activity (Naupane and Khadka, 2019).

Thus, the eco enzyme concentration of 6.25% is recommended as a delaying agent for tomato fruit rot. Although 6.25% is the lowest eco enzyme dilution concentration, the acidity level is still below four and is still effective in inhibiting the growth of microorganisms. The amylase enzyme content in the 6.25% eco-enzyme is considered lower than the concentration above it (12.5%, 25%, 50%,100%). Thus, the peroxidase activity was to be lower than the other concentrations. Peroxidase activity is known to accelerate fruit ripening. One is the amylase enzyme's conversion of starch into glucose (Mudyantini et al., 2015).

Different commodities have different optimal concentrations of eco enzymes in delaying ripening and fruit rot. The higher the acidity of the eco enzyme is not always the better in delaying ripening and fruit rot. The presence of other components in the eco enzyme (besides organic-acetic acid), which interact with the water or sugar content in the test fruit, is thought to be a factor causing the variation in the optimal concentration of eco enzymes in delaying ripening and fruit rot. Ecoenzymes are known to contain a variety of secondary metabolites, organic acids, enzymes, and natural bacteria (Vama and Cherekar, 2020) (Mavani et al., 2020) (Teo et al., 2021). Further studies are still needed to answer this question.

The research results on applying eco enzymes in delaying fruit rot or ripeness are more recommended for green and red tomato. The 5-8 days longer delay in ripening and spoilage compared to control (without treatment) can be the basis for recommendations and potential for orange peel eco enzymes in delaying ripening and spoilage in tomatoes.

5. CONCLUSION

The ripening and spoilage rate of fruits treated with eco enzymes shows differences in each commodity. In this study, eco enzymes were recommended for tomatoes because they can withstand ripeness and rot for 5-8 days longer than without treatment. The variation in the concentration of eco enzymes in delaying fruit ripening and spoilage might be influenced by the sugar or water content in the test sample and other components in the eco enzyme solution that interacts with the test sample. Further research is needed to answer this question. Research on the profile of secondary metabolites in ecoenzymes and analysis of water content, sugar, and other components in the fruit sample, needs to be investigated to support the analysis.

6. REFERENCES

Arun C and Sivashanmugam P. 2015. Investigation of biocatalytic potential of garbage enzyme and its influence on stabilization of industrial waste activated sludge. *Process Safety and Environmental Protection*. 471-478.

Amit SK, Uddin MM, Rahman R, Islam SMR and Khan MS. 2017. A review on mechanisms and commercial aspects of food preservation and processing. *Agriculture and Food Security.* 6(51)

Astuti R. 2015. *Proses Penyekeban Terhadap Kematangan Buah Pisang*. Jakarta: Universitas Bakrie.

Fang Y and Wakisaka M. 2021. A Review on the Modified Atmosphere Preservation of Fruits and Vegetables with Cutting-Edge Technologies. *Agriculture.* 11(10):992

Halstead F, Rauf M, Moiemen N, Bamford A, Wearn C, Fraise A, Webber M. 2015. The antibacterial activity of acetic acid against biofilm-producing pathogens of relevance to burns patients. *PLoS ONE*. e0136190.

Li X, Wang H, Gan S, Jiang D, Tian G. 2013. Eco-Stoichiometric Alterations in Paddy Soil Ecosystem Driven by Phosphorus Application. *PloS ONE*. 12.

Lund P, Tramonti A, Biase D. 2014. Coping with low pH: Molecular strategies in neutralophilic bacteria. *FEMS Microbiol. Rev*. 1091–1125.

Maula R, Astuti A, Maharani E. 2020. Analisis Efektifitas Penggunaan Eco-enzyme pada Pengawetan Buah Stroberi dan Tomat dengan Perbandingan

Konsentrasi. *Prosiding Seminar Edusainstech*. 434-442.

Mavani H, Tew I, Wong L, Yew H, Mahyuddin A, Ghazali RA, Pow D. 2020. Antimicrobial Efficacy of Fruit Peels Eco-Enzyme against Enterococcus faecalis: An In Vitro Study. *Int. J. Environ. Res. Public Health*. 5107.

Mudyantini W, Anggarwulan E, Rahayu P. 2015. Penghambatan Pemasakan Buah Srikaya (*Annona squamosa* L.) dengan Suhu Rendah dan Pelapisan Kitosan. *Agric*. 23-29.

Naupane K and Khadka R. 2019. Production of Garbage Enzyme from Different Fruit and Vegetable Wastes and Evaluation of Its Enzymatic and Antimicrobial Efficacy. *TUJM*. 113-118.

Pundir R and Jain P. 2010. Screening for antifungal. *International Journal of Pharmaceutical*. 25-37.

Smitha R. 2010, February 27. *Dual Production of Endotoxin and Amylase From Bacillus thuringiensis subsp. kurstaky By Fermentation and Efficacy Studies of Endotoxin Against Eriophid Mite*. Disertation. University of Calicut.

Sudjatha W and Wisaniyasa N. 2017. *Fisiologi dan Teknologi Pacapanen (Buah dan Sayur)*. Bali: Udayana University Press.

Teo S, Ling R, Low C. 2021. Effective Microorganisms in Producing Eco-Enzyme from Food Waste for Wastewater Treatment. *Applied Microbiology: Theory and Technology*. 28-36.

Vama L and Cherekar M. 2020. Production, extraction and uses of eco-enzyme using citrus fruit waste. *Asian Jr. of Microbiol. Biotech. Env. Sc.* 346-351.

Widiastuti A, Ningtyas O, Priyatmojo A. 2015. Identifikasi Cendawan Penyebab Penyakit Pascapanen pada Beberapa Buah di Yogyakarta. *J Fitopatol Indones*. 91-96.

Win Y. 2011. *Eco-enzyme Activating the Earth's Self Healing Power.* Malaysia: Summit Print SDN BHD.

Yuliana N, Nurdjanah S, Sari M. 2014. Penambahan Asam Asetat dan Fumarat Untuk Mempertahankan Kualitas Pikel Ubi Jalar Kuning Pasca Fermentasi. *Agritech*. 298-307.