Utility of Biogas Sludge as Media for White Oyster Mushroom (*Pleurotus florida*)

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ABSTRACT

The aim of this research was to determine the effect of chicken manure in sludge biogas as substitute material for bran on oyster mushroom media to the productivity and to oyster mushroom produced. In each treatment, the media, biogas sludge, chicken manure, and mushroom produced were tested to define their chemical content, including water content, organic matter, crude fiber, organic C, total-N, total P, total K, C/N ratio, and microbiological test. The observed parameters included the time to start harvesting, fresh weight, number of mushroom caps, stem length, and diameter of the caps. The data was processed using the analysis of Variance-Completely Randomized Design Unidirectional and the average difference was tested using Duncan's Multiple Range Test (DMRT). The result of the chemical tests showed that the best quality of the media was obtained with 15% chicken manure addition as substitute for bran in biogas sludge (P4) with crude fiber content, organic-C level, P level, and K level were 15,14% , 49,1%, 0,54%, 77,56%, 1,42% and 0.94% respectively. The best results in biological test parameters such as age to start harvesting, fresh weight, stem length, diameter of caps, and number of caps were obtained in treatment P2 (50% bran and 50% sludge) because it could increase the fresh weight of the mushroom into 95,63 g. The results of proximate analysis showed that the quality of the oyster mushroom was most excellent in treatment P3 (25% bran and 75% sludge) because it could increase the level of water and organic materials into 82,86% and 79,60% respectively.

Keywords : Chicken Manure, Biogas Sludge, Oyster Mushroom Media, White Oyster Mushroom

INTRODUCTION

Livestock is one of agricultural sub-sector needed to meet the needs of food for the community, especially the nutritional needs of animal protein. The largest livestock commodity in Indonesia comes from the poultry sector, almost 70% of livestock industry is dominated by poultry industry, as evidenced by the production of 146,660,415 chicken eggs in 2014, 155,007,388 eggs in 2015, and 160,051,262 eggs in 2016 (Anonymous , 2016). Despite being an indispensable sub-sector to fulfill people's needs of food, these livestock commodities also produce waste that can cause environmental pollution.

Sludge as the waste of biogas production is generally not utilized by the community and even is just thrown away, causing problems for biogas owners and the surrounding environment. Sludge is only used as fertilizer that is directly applied in agricultural land and forage land. Therefore, the utilization of biogas sludge as mushroom planting media is expected to increase the use value of sludge and the production of mushrooms.

One of the efforts to utilize biogas sludge with chicken manure addition is by using it as substitute material for bran in mushroom planting media. Estheria (2008) stated that the addition of biogas sludge could increase the fresh weight of oyster mushrooms by adding it with sawdust and other materials such as bran. Mushroom planting media is one of the factors that affect growth, in addition to environmental factors. The growing media should be made to resemble the conditions needed by the oyster mushroom to grow in nature.

Parjimo and Andoko (2013) stated that every 100 g of oyster mushroom contains 27% protein while the protein in soybean tempeh is 18.3% per 100 g. According to Alex (2011), white oyster mushrooms can be consumed because it is safe and non-toxic . In addition, oyster mushrooms are also one of the nutritious food. The composition and other nutritional contents of oyster mushrooms are carbohydrates, fats, thiamin, riboflavin, niacin, and calcium. The calories contained in the mushroom is 100 kj / 100g with 72% unsaturated fat. Mushroom fiber is very good for digestion, and the fiber content reaches 7.4 to 24.6% so it is suitable for the body.

MATERIALS AND METHODS

The research was conducted at Agro Technology Innovation Center (PIAT), Gadjah Mada University; Leather Technology Laboratory; Livestock Waste Testing Laboratory, Faculty of Animal Husbandry, Gadjah Mada University; Laboratory of Agricultural Technology Assessment Institute of Yogyakarta; Animal Feed Laboratory, Faculty of Animal Husbandry, Gadjah Mada University; and Integrated Research and Testing Laboratory, Gadjah Mada University, Yogyakarta. The oyster mushroom strain used was Pleurotus florida, which was the product of Agricultural Education, Research, and Development's Farm (KP4), Gadjah Mada University.

Materials

Tool. The tools used in the field included tarpaulins, stoves, shovels, barrels, buckets, sprayers, stirrer (spatula), Bunsen burner, cotton, baglog ring and ring cover, analytical balance, thermohygrometer, and polypropylene plastic (PE 0.5). The tools used in the laboratory included dishes, analytical balance, beaker glass, oven, desiccator, muffle furnace, kjeldahl pumpkin, destruction tool, distillation device, Erlenmeyer flask, vacuum pump, filter paper, chemical tube, pipette, vortex mixer, waterbath, glass wool, gooch crucible, and spectrophotometer.

Materials. The materials used in the field were water, biogas sludge with chicken manure addition, sawdust, bran, lime, and white oyster mushroom seeds (Pleurotus florida), while the materials used in the laboratory were $K_2Cr_2O_7$, H_2SO_4, H_3PO_4, diphenylamine indicator, aquades, blue tip, yellow tip, $FeSO_4$, NaOH, selenium mixture, H_3BO_3, HCl, HNO_3, tartrate buffer, Na Phenate, color generators (H_2SO_4, ascorbic acid, K-antimonyl tartrate, molybdat), W-41 filter paper, agar technical, biological peptone, meat extract, alcohol 70%, and methylated spirits.

Method

Biogas sludge with chicken manure addition was dried in the sun. The dried sludge was then crushed using a grinding machine or by knocking it to pieces. After that, the sludge was filtered to obtain small particles. Each treatment consisted of 3 replications. The composition of white oyster mushroom media is presented in Table 1.

Table 1. Composition of White Oyster Mushroom Media

Materials for the media	P_0 (g)	P_1 (g)	P_2 (g)	P_3 (g)	P_4 (g)
Sawdust	5478	5478	5478	5478	5478
Bran	990	742,5	495	180	-
Biogas sludge	-	180	495	742,5	990
$CaCO_3$	132	132	132	132	132

The mixed ingredients of mushroom media were put into a polypropylene plastic bag with a thickness of 0.5 mm. Both ends of the plastic bag were bent so once filled and compacted, the plastic bag can stand like bottles. The plastic bag was filled approximately 3/4 parts, then the remaining 1/4 part was bend in, given a baglog ring, and then covered with cotton and ring cover. The sterilization process was then carried out for 7 hours at a temperature of approximately 95^0C. After being sterilized, the planting media was then cooled by letting it remain in the sterilization room for a night.

Seed planting began with leveling, using a long spatula that had been sprayed with alcohol and burned on a bunsen flame. The seedlings were then inserted on the planting media through the mouth of the plastic ring by opening the cotton and covering the baglog ring first. The seeds inserted was about 15 g. After the seeds were inserted, the baglog ring was closed again using a cotton pad without a ring.

After the seed planting was complete, the media was then incubated by storing the baglog that had been inoculated into the incubation room. The temperature required for the incubation process was 25 to 30^0C with the humidity of 65 to 70%. The baglog was left for 40 days until the mycelium growed and fulfilled the baglog until its color became solid white. The success of fungal mycelium growth could be known about 1 week after inoculation. After the mycelium was full, the baglog was ready to be moved into the growing chamber (*kumbung*).

The growing chamber was cleaned first and sprayed with alcohol 70%. The baglogs were arranged horizontally on the shelves that had been cleaned, and the baglog cotton was opened slowly. Maintenance was done by spraying water around the baglog body using a sprayer. It should be made sure that the sprayed water did not affect the inside of the baglog because it might make the media rot.

After about 1 week of the opening, the mushrooms would usually grow and ready to be harvested. Harvesting was done by removing all parts of the mushroom, including the base. The part of the mushrooms left on the media could cause decay on the media so it could not produce again. Harvesting was done in the morning or evening to keep the freshness of the mushrooms.

Analysis of chemical composition

The analysis of chemical composition was performed on biogas sludge with chicken manure addition and on the oyster mushroom media to define the moisture content, organic matter content, C content, P content, K and C/N ratio, and microbiological test for the biogas sludge.

Measurement of mushroom morphology

The measurement of mushroom morphology was performed by observing the growth environment of white oyster mushroom and morphological measurement of the mushroom during the harvest. The observation of the environmental growth of white oyster mushrooms included the measurement of the environment's temperature and humidity that was done once a day in the afternoon. The observation of white oyster mushroom morphology included the age of harvest, fresh weight, number of caps, stem length, and diameter of white oyster mushroom caps.

Data analysis

The data processing of this research involved the calculation of Completely Random Design (RAL) pattern. The average difference was tested with Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Nutrient Level of Biogas Sludge

To determine the nutrient content of biogas sludge with chicken manure addition, several elements were tested to define their chemical contents, including moisture content, crude fiber, organic carbon, organic matter, nitrogen, C/N, P_2O_5 and K_2O ratios. The result obtained from the test is shown in Table 2.

Table 2. Nutrient Level of Biogas Sludge with Chicken Manure Addition as White Oyster Mushroom Media

Variables	Sludge (%)
Water content	53,67
Organic Materials	23,59
Crude Fiber	14,39
Organic-C (CO)	45,28
Nitrogen (N)	3,01
C/N Ratio (C/N)	15,04
P_2O_5 (P)	10,52
K_2O (K)	2,73

Water content. Based on the test results, the nutrient content of biogas sludge with chicken manure addition had 53,67% water content, while Barker et al. (2014) stated that the water content of biogas sludge with chicken manure addition was 76,4%. Marlina et al. (2010) stated that the difference of water content could be caused by the composition in the biogas making process which affected the process of biogas formation and the sludge produced.

Level of organic matter. Based on the test result, biogas sludge with chicken manure addition contained 23,59% organic material, while Barker et al. (2014) stated that the content of organic material in biogas sludge was 36,9%. According to Astiti and Bulu (2014), the concentration of organic material in the sludge with chicken manure depends on the making process and type of sludge being used. The concentration of organic material is very influential for the continuity of decomposition process from complex organic substances into simple compounds.

Crude fiber content. Based on the test result, the content of crude fiber in biogas sludge with chicken manure addition was 14,39%, while Barker et al. (2014) stated that the crude fiber in biogas sludge was 6,5%. The concentration of crude fiber in biogas sludge with chicken manure addition depends on the biogas making process. The effect of this process can increase the production of gas and decrease the level of crude fiber in biogas sludge. (Krisnanti et al., 2014)

C-organic content. Based on the test result, the level of organic-C in biogas sludge with chicken manure addition was 45,28%, while Barker et al. (2014) stated that the content of organic-C in biogas sludge was 36,12%. The addition of organic material which contains carbon can increase the level of organic-C in a substance (Nardi et al., 2004).

N-level. Based on the test result, the nitrogen content in biogas sludge with chicken manure addition was 3,01%, while North and Bell (1997) stated that the nitrogen content produced by biogas sludge was 3.22%. The difference of nitrogen level in biogas sludge is caused by the biogas making process which includes the fermentation or decomposition process done by

microorganisms. Nitrogen is volatile in the form of ammonia. It can affect nitrogen content in biogas sludge. (Vebriyanti et al., 2012).

C/N Ratio. Based on the test result, C/N ratio in biogas sludge with chicken manure addition was 15,04%, while Barker et al. (2014) stated that the C/N ratio in the sludge was only 13,89%. C/N ratio depends on the material being used. High level of C/N will cause a reduction in microbiological activity, so it will take longer time to produce biogas. (Krisnawati and Asnita, 2011).

P_2O_5 level. Based on the analysis, the phosphorus content of biogas sludge with chicken manure addition was 10,52%, while Barker et al. (2014) stated that the phosphorus content of the sludge was only 4,6%. According to Amrullah (2004), the high level of phosphorus in biogas sludge can be due to the mixing of chicken manure used as filler material with rice husks as litter material, which increase the phosphor content.

K_2O level. Based on the analysis, potassium content in biogas sludge with chicken manure was 2,73%, while Barker et al. (2014) stated that potassium content in the sludge was 2,66%. In the substrate material, potassium is used by microorganisms as a catalyst. Potassium is bonded and stored in microorganism cells, and this will reduce the potassium level in biogas sludge (Sutedjo et al., 1996).

Nutrient Level of White Oyster Mushroom Media

The chemical analysis conducted to determine the nutrient content of mushroom media was to measure the chemical content of several element, including water content, organic matter, crude fiber, C-organic, Nitrogen, C/N ratio, P content, and K content. The chemical content of the mushroom media with several treatments is shown in Table 3.

Table 3. Nutrient Content of White Oyster Mushroom Media

Variables	P_0	P_1	P_2	P_3	P_4
Water content^{ns}	67,97 ± 9,60	64,02 ± 5,33	67,70 ± 8,57	71,42 ± 5,16	70,82 ± 3,43
Organic Materials^{ns}	68,20 ± 19,70	60,78 ± 6,03	63,09 ± 13,44	53,15 ± 2,70	49,35 ± 1,73
Crude Fiber	28,30 ± 5,51^{b}	29,56 ± 1,24^{b}	25,05 ± 6,74^{b}	20,76 ± 3,13^{ab}	15,14 ± 3,92^{a}
Organic-C	46,67±0,81^{ab}	48,26±1,81^{b}	41,04±7,70^{a}	43,66±0,48^{ab}	49,12±0,69^{b}
Nitrogen	0,34±0,74^{a}	0,42±0,08^{ab}	0,35±0,13^{a}	0,53±0,18^{ab}	0,71±0,33^{b}
C/N ratio	142,61±27,27^{b}	118,07±24,96^{ab}	105,63±16,51^{ab}	87,75±26,75^{a}	77,56±28,63^{a}
Phospor	0,55±0,65^{a}	0,56±0,76^{a}	0,44±0,34^{a}	0,86±0,28^{ab}	1,42±0,11^{b}
Potassium	0,13±0,13^{a}	0,22±0,05^{a}	0,19±0,13^{a}	0,39±0,51^{a}	0,94±0,31^{b}

^{a,b} Different letter on the same line shows the difference ($P<0,05$)
^{ns} non significant
P_0 : mushroom media with composition of bran 100%
P_1 : mushroom media with composition of bran 75% dan sludge 25%
P_2 : mushroom media with composition of bran 50% dan sludge 50%
P_3 : mushroom media with composition of bran 25% dan sludge 75%
P_4 : mushroom media with composition of sludge 100%

Water content. The result of water content analysis on white oyster mushroom media showed that the highest water content was in P3 with 71,42% and the lowest was in P1 with 64,02%. Barker et al. (2014) stated that the water content of biogas sludge with chicken manure additon was 76,4%. The required water content in mushroom media ranged from 60 to 65% for the mushroom mycelium to grow and absorb properly the nutrients from planting medium (Hanifah, 2014). Suriawiria (2002) stated that water content of the media affected the growth

of mushroom. Water content as well as carbon dioxide will be used as energy. Water needs to be added so that the mushroom mycelia can grow and absorb the nutrients properly from the media.

Organic Materials. The analysis of organic matter content in white oyster mushroom media showed that the highest content was in P0 with 68,20% and the lowest was in P4 with 49,5%. The difference between organic matter contained in P0, P1, P2, P3, and P4 samples was caused by the content of organic matter in biogas sludge with chicken manure addition. Hartadi et al. (2005) stated that the organic material content of bran was 89,9%, while Barker et al. (2014) stated that the content of organic material in bogas sludge with chicken manure amounted to 36,9%. The content of organic matter in planting media can reflect its level of fertility, both macro nutrient content and micro nutrient content (Syamulsulbahri, 1996).

Crude fiber. Based on the analysis of white oyster mushroom media, the highest crude fiber content was 29,56% (in P1) and the lowest was 15,14% (in P4) It is because the crude fiber content found in bran was relatively high compared to the one in biogas sludge with chicken manure addition. Hartadi et al. (2005) stated that the crude fiber content of bran ranged from 15 to 20%, whereas according to Barker et al. (2014) the crude fiber content of biogas sludge with chicken manure was 6,5%.

The bran used in white oyster mushroom media served as a source of fiber. The fiber content in a material would affect the content of crude fiber that became the constituent material of the media (Hanifah, 2014). Howard et al. (2003) stated that the decrease of crude fiber content might occur due to the decomposition process undertaken by the mushrooms. Crude fiber is mostly derived from plant cell walls containing cellulose, hemicelluloses, and lignin. Mushrooms have the ability to degrade fiber components. In addition to producing lignin-degrading enzyme, mushrooms are also capable of producing cellulose-degrading enzymes.

Organic-C content. Based on the analysis of organic-C content in white oyster mushroom media, the highest organic-C content was 49,12% (in P4) and the lowest was 41,04% (in P2). The difference was because the organic-C content contained in the bran was relatively lower than the one in biogas sludge with chicken manure addition. Attoe et al. (2016) stated that the organic-C content of the bran was 32%, while Barker et al. (2014) stated that organic-C content in biogas sludge with chicken manure was 36.12%. Estheria (2008) stated that the organic-C in mushroom growing medium was used for the formation of new cells, mycelium, and fruit body, and for metabolism.

N Level. Based on the analysis of N content in white oyster mushroom media, the highest N level was 0,71% (in in P4) and the lowest was 0,34% (in P0). Sholikah et al. (2013) stated that the nitrogen contained in white oyster mushroom planting media was in two forms, which were amino acid and NH_4^+, where amino acid was used by bacteria as energy in cell operation, while NH_4^+ was converted to nitrite (nitrification), and the result could be absorbed by plants.

C/N Ratio. Based on the analysis of C/N ratio, the highest level was 142,61% (in P0) and the lowest was 77,56% (in P4). Hariadi et al. (2013) stated that C/N ratio in planting media using sawdust was 69,33%. Wahidah et al. (2015) stated that when the value of C/N ratio was high, C value was high and N value was low, and there was more energy that could be used in the formation of fruit.

P_2O_5 Level. Based on the analysis of Phospor level in white oyster mushroom media, the highest level was 1,42% (in P4) and the lowest was 0,44% (in P2). Stofella and Khan (2001) stated that the phosphorus content would increase as it related to the nitrogen content in the substrate. The greater the nitrogen content, the greater the multiplication of microorganism that overhaul the phosphor, so the phosphorus content in the media will also increase. The phosphorus content in the substrate will be used by most microorganisms to build their cells.

K Level. Based on the analysis of K content in white oyster mushroom media, the highest was 0,94% (in P4) and the lowest was 0,13% (in P0). Simamora et al. (2006) stated that the difference of potassium level in white oyster mushroom media was due to the addition of organic material to the media. The magnitude of potassium level percentage varied greatly, one of which depended on the raw materials being used in the making of mushroom planting medium itself and the organic enhancer used to increase certain content.

Biological Parameters of Oyster Mushroom Growth

The observation of biological parameters of biogas sludge with chicken manure was conducted by planting oyster mushroom. This white oyster mushroom planting was done at Agro Technology Innovation Center of Gadjah Mada University. The purpose of planting was to determine the effect of the use of biogas sludge with chicken manure to substitute bran with a certain composition. This was done to determine the quality of nutrient composition in biogas sludge that was best for the growth of oyster mushrooms. The data obtained included age to start harvesting, fresh weight, number of mushroom caps, stem length, and diameter of caps. The data would be analyzed to define the influence of bran substitution using biogas sludge with chicken manure addition to the productivity of oyster mushroom. The data of biological parameters of white oyster mushroom growth is shown in Table 4.

Table 4. Biological Parameters of White Oyster Mushroom

Variables	P_0	P_1	P_2	P_3	P_4
Age to start harvesting (day)^{ns}	65,00±3,60	72,00±5,57	71,00±8,18	72,33±11,01	66,33±7,04
Fresh weight (gr)	143,03±32,64^{ab}	173,20±37,99^{ab}	195,63±26,56^{b}	104,20±67,88^{a}	163,33±41,63^{ab}
Stem length (cm)^{ns}	7,82±1,45	8,33±0,72	8,80±0,18	6,84±1,86	8,61±0,39
Diameter of caps (cm)^{ns}	11,79±1,54	11,54±1,78	12,40±1,63	12,88±1,37	13,83±1,17
Number of caps (cm)^{ns}	13,33±5,51	13,67±8,33	12,67±8,33	5,00±2,64	6,33±1,53

^{a,b} Different letter on the same line shows the difference ($P<0,05$)
^{ns} non significant
P_0 : mushroom media with composition of bran 100%
P_1 : mushroom media with composition of bran 75% dan sludge 25%
P_2 : mushroom media with composition of bran 50% dan sludge 50%
P_3 : mushroom media with composition of bran 25% dan sludge 75%
P_4 : mushroom media with composition of sludge 100%

Age to start harvesting. Based on the analysis of harvest age of white oyster mushroom, the growth rate in P4 was 66,33 day and lowest at P3 equal to 72,33 day. Sumiati et al. (2005) stated that the increasing supply of organic materials—containing high level of cellulose and lignin with good nutrition—would support mycelium growth. It related to the growth phase of white oyster mushroom. The faster the spread of mycelium, the faster the formation of mushroom's fruit body.

Fresh weight. Based on the analysis of fresh weight during the harvest time, the highest mushroom weight was 195,63 gr (in P2) and the lowest was 104,20 gr (in P3). Djarijah and Djarjiah (2001) stated that the weight of oyster mushrooms during the first harvest ranged between 75-150 gr. The weight of fresh mushroom produced was an indicator of mushroom productivity. Sukmadi et al. (2012) stated that the difference of the weight was caused by the

components of white oyster mushroom planting media. The addition of cellulose and lignin content will affect the fresh weight. When the hemicelluloses content was higher than the cellulose and lignin, and the degree of polymer was much lower so that the media could be easily and quickly decomposed, the oyster mushroom mycelium could grow well and quickly.

Stem length. Based on the analysis of stem length of white oyster mushroom, the highest length was 8,80 cm (in P2) and the lowest was 6,84cm (in P3). Nurafles (2015) stated that the length of oyster mushroom stem was influenced by organic-C content in planting medium. The addition of substrate composition to the media with different concentration ratio can affect the length of the fruit stem of oyster mushroom. In addition to the different types of media compositions and concentrations, there are several factors that affect the growth of mushroom stems, including pH, temperature, baglog water content, contamination or pests, the condition of growing chamber, and the air circulation inside the growing chamber (Sobir, 2009).

Diameter of the caps. Based on the analysis of the caps diameter, the highest diameter was 13,83 cm (in P4) and the lowest was 11,54 cm (in P1). Maulidina et al. (2015) stated that the caps diameter was influenced by the nitrogen content to support the development of the fruit. Islami et al. (2013) stated that white oyster mushrooms have caps diameter of 8-13 cm.

Number of caps. Based on the analysis of the number of mushroom caps, the highest number was 13.67 pieces (in P1) and the lowest was 5,00 pieces (in P3). Dewi (2009) stated that the number of mushroom caps was influenced by nitrogen sources and organic materials used in mushroom growing media. Soenanto (2000) stated that the number of mushroom caps produced was an indicator of mushroom productivity.

Nutrient Level of White Oyster Mushroom

To determine the nutrient content of oyster mushrooms, several chemical elements of the mushrooms were tested, including water content, organic matter, crude fiber, crude fat, and protein. The nutrient level of white oyster mushroom with several treatments is shown in Table 5.

Table 5. Content of White Oyster Mushroom

Variables	P_0	P_1	P_2	P_3	P_4
Water content^{ns}	57,95±4,14	63,25±18,52	79,15±1,30	82,26±3,29	61,79±29,65
Organic materials^{ns}	78,76±3,65	76,72±0,52	79,35±3,56	83,16±0,92	79,57±13,30
Crude Fiber	20,59±0,18^{b}	22,75±0,73^{b}	17,45±1,73^{a}	18,05±0,79^{a}	21,46±1,96^{b}
Crude Fat	6,15±1,19	6,09±1,14	6,54±0,51	6,18±0,46	6,67±1,40
Crude Protein	20,63±3,77	20,80±3,15	18,58±2,41	20,62±2,28	16,52±4,40

^{a,b} Different letter on the same line shows the difference (P<0,05)
^{ns} non significant
P_0 : mushroom media with composition of bran 100%
P_1 : mushroom media with composition of bran 75% dan sludge 25%
P_2 : mushroom media with composition of bran 50% dan sludge 50%
P_3 : mushroom media with composition of bran 25% dan sludge 75%
P_4 : mushroom media with composition of sludge 100%.

Water content. Based on the analysis of the average water content of white oyster mushroom, the highest water content was 82,26% (in P3) and the lowest was 57,95% (in P0). Center for Agricultural Technology Assessment of East Kalimantan (2012) stated that water content in white oyster mushrooms with sawdust media was 82,01%.

Organic materials. Based on the analysis of average water content in white oyster mushroom, the highest organic material content 83,16% (in P3) and the lowest was 76,72% (in P1). Fadillah (2010) stated that oyster mushrooms contained pleuran compound. The content of

organic matter in white oyster mushrooms was about 90,7%. White oyster mushroom can serve as alternative protein, especially for vegetarians and people with high cholesterol. Nutritional content of meat is equivalent to that of mushrooms. However, mushrooms are better since it is free of cholesterol content.

Crude fiber. Based on the analysis of crude fiber in white oyster mushroom, the highest level of crude fiber was 22,75% (in P1) and the lowest was 18,05% (in P3). The Center for Agricultural Technology Assessment of East Kalimantan (2012) stated that the content of fiber in white oyster mushrooms with sawdust media was 8.41%.

Crude fat. Based on the analysis of crude fat in white oyster mushroom, the highest level of crude fat was 6,67% (in P4) and the lowest was 6,09% (in P1). Suwito (2006) stated that every 100 grams of dried mushrooms contain about 1,7 to 2,2% fat.

Crude protein. Based on the analysis of crude protein in white oyster mushroom, the highest crude protein content was 20,80% (in P1) and the lowest was 16,52% (in P4). Suparti et al. (2014) stated that the normal level of crude protein in white oyster mushrooms with sawdust media was ranging from 18 to 27%. The low level of protein can be caused by the method used when determining the protein level.

Microbiological Test. Microbiological test was conducted to determine the amount of bacteria in biogas sludge with chicken manure addition. The bacteria were grown on agar medium made from meat extract, microbiological peptone, agar, NaCl and aquades. Microbiological test was done by calculating the growth of colony in solid medium. Based on the observation, the number of colonies on the solid agar media was $57x10^8$ cfu/ml.

CONCLUSIONS

Based on the result of the research, it can be concluded that:

1. The quality of white oyster mushroom media P4 with the usage of 100% sludge was the best because it increased the crude fiber content, organic-C content, N content, C/N ratio, P content, and K content.
2. The best quality of mushrooms in biological term was in P2 with the use of 50% bran and 50% sludge because it increased the fresh weight of white oyster mushroom.
3. The best quality of mushrooms in chemical term was in P3 with the use of 25% bran and 75% sludge because it increased the water content and organic material of oyster mushroom.

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