EVALUATING BIOLOGICAL ALTERNATIVE MATERIAL FOR POULTRY BEDDING

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ABSTRACT

Poultry production is widely dispersed across the globe and one of the important issues for growers is the selection of suitable bedding material. Recently, low supplier of the raw material increases the price of bedding material. This study aimed to evaluate the most suitable biological alternative bedding material for poultry production. The effects of moisture content, pH value and ammonia nitrogen absorption by bedding material are considered. The selected materials were banana fiber, coconut fiber, oil palm frond fiber and rice straw. Ammonia nitrogen concentration of bedding material was determined by using HACH spectrophotometer. Based on result, within these four alternative bedding materials, banana fiber shows the best absorbent bedding material where the rate of ammonia concentration is increase in every an hour and followed by rice straw. The more concentration of ammonia nitrogen in the bedding material after experiment showed the ability of the material to absorb ammonia nitrogen emission from chicken manure in poultry house. This alternative bedding material has potential to minimize ammonia nitrogen in poultry house since their pH already in acidic condition and moisture content also in the range of published value 30 to 70%. The pH of the sample must in form of acidity in order to maintain ammonia the non-volatile ionized from (ammonium) and significantly can reduce the ammonia nitrogen emission. For further study, this study needs to be conduct in real poultry house to observe and analyze the potential of this alternative bedding material in real environment.

Keywords: biological alternative bedding material, poultry production, spectrophotometer

ABSTRAK

Pengeluaran ayam secara meluas tersebar di serata dunia dan salah satu daripada isu-isu yang penting bagi pembesaran adalah pemilihan bahan katil yang sesuai. Kebelakangan ini, kekurangan pembekalan bahan mentah telah meningkatkan harga bahan katil. Kajian ini bertujuan untuk menilai biologi altrnatif bahan katil yang sesuai untuk penternakan ayam. Kesan-kesan kandungan kelembapan, nilai pH dan penyerapan ammonia nitrogen oleh bahan tempat tidur dipertimbangkan. Bahan-bahan yang terpilih adalah gentian pisang, gentian kelapa, gentian pelepah kelapa sawit dan jerami padi. Kepekatan nitrogen ammonia di dalam bahan ditentukan dengan menggunakan HACH spectrophotometer. Berdasarkan keputusan, empat katil alternatif bahan-bahan ini, gentian pisang menunjukkan keputusan terbaik untuk bahan katil, di mana kadar penyerapan amonia bertambahan setiap satu jam dan diikuti oleh sekam padi. Kepekatan nitrogen ammonia dalam bahan katil selepas eksperimen menunjukkan keupayaan bahan menyerap pelepasan nitrogen ammonia daripada tahi ayam di rumah ayam. Bahan alternatif ini mungkin boleh digunakan untuk mengurangkan nitrogen ammonia di rumah ayam kerana pH bahan katil berada dalam keadaan dan kelembapan yang berasid dan juga dalam lingkungan nilai diterbitkan 30 hingga 70%. pH sampel perlu berada dalam bentuk keasidan untuk mengekalkan ammonia terion tidak menentu dari (ammonium) dan boleh mengurangkan pelepasan nitrogen ammonia. Untuk kajian lanjut, kajian ini perlu menjalankan di dalam rumah ayam sebenar untuk memerhati dan menganalisis potensi ini bahan peralatan tempat tidur alternatif dalam persekitaran sebenar.

Keywords: Bahan peralatan tempat tidur alternatif biologi, pengeluaran ayam, spektrofotometer

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1 INTRODUCTION

This chapter discusses the overview of this research. It gives a brief introduction to the research conducted. There are five main topics covered in this chapter which are the background study, problem statement, objective, scopes of study and the significance of the study.

1.1 Background study

Poultry litter is a solid waste that composed of bedding material, excreta, spilled feed, feathers and water. Poultry manure refers to pure excreta from layers in batteries. In poultry house, bedding material usually is used to covers the facility floor where chicken walk and sleep on it. But, the most important used of bedding material is to minimize the ammonia emission from poultry house. The poultry house atmospheric pollution (dusts, ammonia and others gas) are a factor that can influence on production performances and the health of the chicken. Bedding material also plays a vital role in absorbing the fecal moisture, promotes drying by increasing surface area of the house floor, insulates chick from cooling effects of the ground and provide a protected cushion (Hafeez, A et al., 2009). The common type of bedding material used in poultry house are hardwood sawdust, sugarcane pulp, sugarcane bagasse, sand, wood shavings, oat hulls. Hardwood sawdust is the one of most suitable material for bedding but it highly in cost to use. The alternative bedding material should be easily available with a maximum ammonia absorption capacity. This is because, ammonia produced of decomposition and fermentation of the litter and excrements in poultry houses can influence on the growth of chickens and can especially encourage respiratory diseases (Tahseen, 2010). Besides that, ammonia productions are depending on the moisture content, temperature and acidity of the bedding material. Higher moisture means higher ammonia production and that can lead to problems with bird health as increased intake of ammonia will increase stress on the birds. (Dr. Tom Tabler et al., 2012)

1.2 Problem statement

Nowadays, poultry is a dynamic sub-sector of agriculture that has been rapidly growing. In terms of meeting the demand for the poultry products, Malaysia has been self-sufficient in poultry production since 2002. The growth in the total domestic output of poultry meat in past 10 years is almost two-fold rising from 682,000 to 1,214.37 million tons (Malaysian Company Commission, 2012). Within rising poultry production capacity over the years, the demand for bedding material by poultry industry increased. Over the past few years, hardwood sawdust has been used in poultry industry as bedding material. However, low supplies of hardwood sawdust due to shortage of raw materials and unavailability of the suitable material, the price of material increased drastically. Since there will be limited supplies of conventional bedding materials in the future, the alternatives sources are desperately needed. Because of these factors, it encouraged the researchers around the world to find the alternative material that suitable for poultry house and in order to replace the hardwood sawdust. The major characteristic of alternative material, it should be used to reduce the ammonia level in poultry house. This is because the emissions of ammonia from poultry bedding can cause several problems. Ammonia is a pungent gas that irritates the eyes, respiratory system and it can also reduce resistance to infection in poultry. High ammonia levels in poultry houses can result in poor bird performance and health. (Sanjay Shah *et al.*, 2006)

1.3 Objective

The objective of this study is to evaluate the suitable biological alternative materials that can be used to replace hardwood sawdust in poultry bedding. The selected materials bedding are:

1. Banana fiber,
2. Coconut fiber,
3. Oil palm frond (OPF) fiber,
4. Rice straw

1.4 Scope of study

To achieve the objective, several scope of study is highlighted as follows:

1. To determine the moisture content in alternative bedding material
2. To measure the pH value of the alternative bedding material
3. To analyze the ammonia absorption of alternative bedding material

1.5 Significant of research

The main purpose of this research is to replace the hardwood sawdust as poultry bedding with an alternative bedding material that can minimize the ammonia emission in poultry house. In this research, oil palm frond fiber, banana fiber, coconut fiber and rice straw was used as alternative bedding material because this agriculture waste is an abundant waste in Malaysia and easy to get them. The main contribution of this research is:

- Help the farmer to reduce the problem cause by the chicken's litter.
- Provide the data for the suitable alternative bedding material that can minimize the ammonia emission in poultry house.
- Help people to cultivate socio-economy development in rural area.

2 LITERATURE REVIEW

This chapter contains the detailed descriptions of the development of the study based on the literature. It gives brief explanations on study conducted. The topics covered in this chapter are biological alternative material for poultry bedding, effect of moisture content, pH and ammonia emission in poultry house.

2.1 Biological alternative material for poultry bedding

This Hardwood sawdust has been used as bedding material for many years and many products have been produce to replace it. Regardless of the material used, bedding materials should be water absorbent, inexpensive, readily available, and not create problems for the chicken or for user (Parkhurst & Mountney, 1988). Due to physical, chemical, and biological properties which are cost, availability, compatibility with handling practices, and logistical issues, only a limited number of these products have been successful substitutes for good quality such as pine shavings and sawdust. The alternative materials can be grouped into four general categories which are wood, plant, earth and recycled waste products. The wood products include soft and hardwood shavings, sawdust, straw reprocessed shredded pallets, wood fiber pellets and paper mill residues. Plant-based residues that have been used or evaluated include hulls (peanut, cocoa bean, coffee bean, sunflower), and straw (wheat, oat, flax, soybean, citrus pulp). Earth type products include such materials as sand, clay and peat moss. However, this alternative bedding material has been extensive according to their nation resources and environment condition. Bud Malone (2008) also added in his research, the particle size, moisture content and microbial population have a significant impact of the quality of these bedding materials. In an effort to use less bedding depth following total cleanout while maintaining quality litter, some prefer to start with the driest material available and implement management strategies to minimize litter moisture and cake removal.

According to Biomass Energy Southeast Asia, Malaysia produces at least 168 million tonnes of biomass, including timber and oil palm waste, rice straw, coconut trunk, municipal waste and sugar cane waste annually. Being a major agricultural commodity producer in the region Malaysia is well positioned amongst the ASEAN countries to promote the use of biomass as a renewable source. This biomass residue maybe can be used as alternative bedding material in the poultry houses in order to replace hardwood sawdust and minimize the cost of the bedding material in poultry industry since the availability of biomass is higher and a lot of suppliers. (Biomass Energy Southeast Asia, 2011)

Different country used different type of bedding material. A common bedding material in Poland is long rye straw. Wheat and barley straw (byproducts of cereal cultivation) and pine wood shavings are frequently used in Spain, but rice hulls can be found in the Mediterranean area where rice crops are prevalent (Garcia et al., 2007). In the United States, pine wood particles and rice hulls are common bedding materials, with pine shavings and sawdust considered the most desirable and widely used litter materials (Malone and Gedamu, 1995). Lacy (2002) have been listed various materials that have been tried around the region with at least some degree of success and briefly discuss the advantages and disadvantages of particular bedding material sources.

- **Pine shavings & sawdust**
  This is the most preferred litter material but limited in supply and expensive in some areas.
- **Hardwood shavings & sawdust**
  Often high in moisture and susceptible to dangerous mold growth if stored improperly prior to use.
- **Pine or hardwood chips**
  Used successfully but may cause increased incidence of breast blisters if allowed to become to wet.
- **Peanuts hulls**
  It is a very inexpensive litter material in peanut -producing areas. Some problems with pesticides have been noted in the past.
- **Crushed maize cobs**
  Limited of availability and may be associated with increased breast blister problems.
- **Sugarcane pomace (bagasse)**
  Prone to caking during the first few weeks but can be used effectively
- **Chopped straw, hay or maize stay-over**
  Considerable tendency towards caking and mold growth can also be a disadvantage of this material

- **Processed paper**

  Various forms of processed paper have proven to be good litter material in research and commercial situations. In using shredded newspaper for animal bedding, there is a concern about possible harm to animals from the newspaper ink and treatment in the manufacturing process (Heimlich & Howard, 2002). It may become more available and less costly with increased recycling. Slight tendency to cake forming and top dressing paper base with shavings may minimize this problem. Careful management is essential.

- **Sand**

According to Ross Broiler Management Manual (1996), sand can also be used. It is commonly used in arid/desert areas on concrete floors. Bilgili *et al.* (2000) reported that using sand as litter can help poultry producers reduce pollution, improve production, lower costs and create a side product to sell. Sand can work well but birds have difficulty moving about if spread to deep.

2.2 *Effect of moisture level in poultry house*

Chickens dissipate moisture from their bodies through breathing and fecal discharge. As water consumption increases as the chicken grows, and due to higher temperatures or diet salt levels, water expulsion will increase. According to Poultry Litter Management (2012) chickens use breathing as a way to cool their bodies, so expulsion of moisture in warmer weather thorough breathing is essential for chickens health and maintenance of body temperatures. Chickens did not sweat and they use increased consumption of cool water to keep their body temperature in check. Water consumption will almost double in hot weather and this process shows how moisture level increases in poultry house. The factor that influences bedding material conditions the most is moisture. Excess moisture in the bedding material increases the incidence of breast blisters, skin burns, scabby areas, bruising, condemnations and downgrades. Wet bedding material is also the primary cause of one of the most serious environmental factors affecting broiler production today and resulted in excessive ammonia (NH3) production (Lacy, 2002).

Poultry litter moisture is important to controlling ammonia levels since litters at 21 to 25 percent moisture levels produce little ammonia. When poultry litter moisture exceeds 30 percent, ammonia production starts and increases as temperature goes up. Bishwo Bandhu Pokharel (2010) reported that the more moisture content in the litter, the more potential for ammonia emissions from that litter. Ferguson et.al (1998) confirmed the relationship between higher litter moisture and increased litter ammonia. If the litter becomes caked or too wet (> 50 percent moisture) the incidence of hock burn and breast necrosis will increase substantially. This shown that it is important to keep bedding material dry.

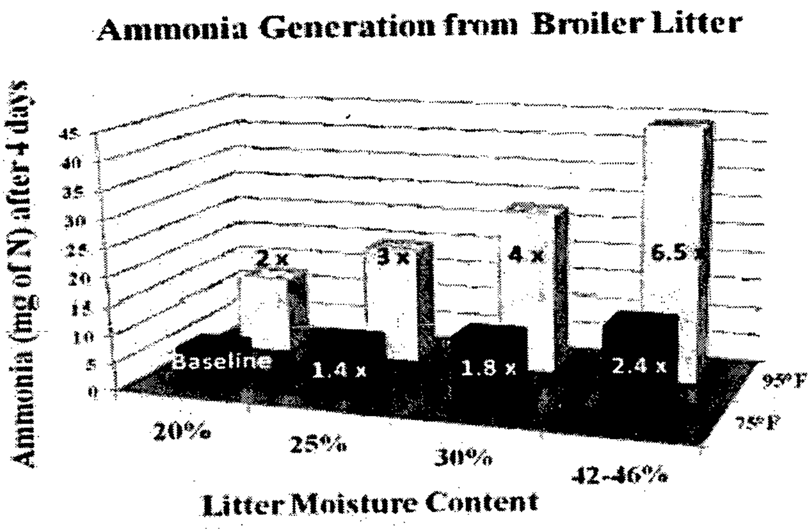

Figure 2-1: Ammonia generated from broiler litter at temperature of 75°F and 95°F with litter moisture content. (Dana Miles, 2011)

Previous researchers Dana Miles (2011) in his article, state that the effectiveness of reduced ammonia also depends on temperature of poultry house. Slight increases in litter moisture can translate into substantial increases in ammonia generation (Figure 2.3.1). The ammonia released at 75°F with 25% litter moisture is 1 .4 times more than at the same temperature with 20% litter moisture.

The most difficult part of overall management on every poultry farm is keep litter drying. This is because litter conditions influence chicken growth performance and integrators. Dry litter helps control ammonia levels, provides a health flock environment and reduces condemnation due to hock and foorpad burns. Malone, B (2006) reported that when moisture litter began to retain it will clump together where it referred as caking. If too much moisture content in poultry house can cause litter to form cake. However, it takes a long time for moisture levels in the litter to build up enough to form a cake. Moisture can build up because the ventilation rate within the house is inadequate over a prolonged period. From previous study, high litter moisture provides an ideal environment for microorganisms to grow and multiply, increasing the possibility of pathogen exposure to the birds. High moisture also decreases the bird comfort in their environment as they seek comfortable dry bedding areas. (Dr. Tom Tabler et al., 2012).

2.3 Effect of pH bedding material

Bedding material pH plays importance role in ammonia volatilization. Ammonia concentration tends to increase with increasing pH and it should be below pH 7 to reduce volatilization but can be substantial when litter pH is above 8. Uric acid decomposition is most favored under alkaline (pH>7) conditions. Uricase, the enzyme that catalyzes uric acid breakdown, has maximum activity at a pH of 9. As a result, uric acid breakdown decreases linearly for more acid or alkaline pH values. One principal ureolytic bacterium, Bacillus pasteurii, cannot grow at neutral pH, but thrives in litter above pH 8.5. Typically, litter pH in a broiler house ranges between 9 and 10. (Grimes J.L. et.al, 2002)

From previous study, in order to minimize ammonia, bedding material can be treated before being used. A surface application of an acidifier to poultry bedding and maintain ammonia in thenon-volatile ionized form (ammonium) can reduce the ammonia emission significantly. One approach is to incorporate acidifying agents such as aluminum sulfate (alum), sodium bisulfate, acidified clay, calcium chloride, calcium sulfate, magnesium chloride, and magnesium sulfate (Wheeler et. al, 2008). Bedding material treatments is an acid that produce hydrogen ions that will attach to ammonia to form ammonium which react with sulfate ions to form ammonium sulfate, a water-soluble fertilizer, reducing the ammonia emitted from the litter and increasing the nitrogen content. The acidity also creates unfavorable conditions for the bacteria and enzymes that contribute to ammonia formation, resulting in reduced ammonia production. (Bishwo Bandhu Pokharel, 2010).

The sample pH of solid usually determined by using Method 9045D. This method is an electrometric procedure for measuring pH in soils and waste samples. Wastes may be solids, sludges, or non-aqueous liquids. If water is present, it must constitute less than 20% of the total volume of the sample Samples with very low or very high pH may give incorrect readings on the meter. For samples with a true pH of >10, the measured pH may be incorrectly low. This error can be minimized by using a low-sodium-error electrode. Strong acid solutions, with a true pH of <1, may give incorrectly high pH measurements. Temperature fluctuations will cause measurement errors. Errors will occur when the electrodes become coated. If an electrode becomes coated with an oily material that will not rinse free, the electrode can be cleaned with an ultrasonic bath, or be washed with detergent, rinsed several times with water, placed in 1:10 HCl so that the lower third of the electrode is submerged, and then thoroughly rinsed with water or be cleaned per the manufacturer's instructions. (9045D pH analysis, 2004)

2.4 Ammonia Emission in Poultry House

Ammonia is colorless, lighter than air, highly water-soluble, and has a sharp. Ammonia is also a pungent gas that irritated the eyes and can reduce resistance to infection in poultry. Ammonia is classified as a particulate precursor where in the vapor phase it will react with other compounds to form particulates. High ammonia concentrations in the air insides the chicken house can irritate the mucous membranes of chicken's respiration system.

$$CO(NH_2)_2 + H_2O \longrightarrow CO_2 + 2NH_3 \qquad (1)$$

$$C_5H_4O_3N_4 + 1.5O_2 + 4H_2O \longrightarrow 5CO_2 + 4NH_3 \qquad (2)$$

$$\text{Undigested protein} \longrightarrow NH_3 \qquad (3)$$

Ammonia is generated by microbial activity from a mixture of feces and urine in poultry houses the feces and urine combine to form the droppings. Nitrogen excreted in feces and urine is dominated by urea, uric acid and undigested protein; the simplified degradation processes for each compound are shown in Equations 1 through 3. Urea $CO(NH_2)_2$ is hydrolyzed by the enzyme Urease as shown in Equation 1 and is influenced by urease activity, pH, and temperature. Uric acid ($C_5H_4O_3N_4$) and undigested protein are degraded through microbial activity, shown in Equations 2 and 3, and are affected by temperature, pH, and moisture content. The urea-related reaction (Equation 1) is the most abundant of the three and contributes the most to NH3 emissions (Arogo et al., 2006). The volatilization of ammonia (NH_3) from poultry manure has become a major problem not only for the health of the birds and caretakers, but also in the negative perception of the public sector, concerning poultry waste. It has been known for a long time that high levels of atmospheric NH3 can negatively affect poultry performance (Anderson et al., 1964).

Numerous studies have demonstrated that high atmospheric NH_3 within layer and broiler facilities have been shown to reduce egg production, feed efficiency, and growth (Charles and Payne, 1966, Reece et al., 1980, Deaton et al., 1984). NH_3 may produce a serious threat to the health of the chicken such as increase risk of skin burns, high incidence of contact dermatitis foot, hock and breast burns that can be a gateway for bacteria causing further health problems to the birds. Similarly, NH_3 has role in causing trachea & lung lesions which are associated with fluid accumulation and low blood oxygen, rendering the birds more susceptible to bacterial infections such as *E. coli.* According to Sanjay Shah et al., (2006) in their research, ammonia levels as low as 10 parts per million (ppm) can effect bird health and performance. Carlile (1984) also recommended that ammonia levels above 25 ppm in the poultry house can damage the bird's respiratory system and allow infectious agents to become established, leading to declining flock health causes performance. E. coli bacteria can be significantly increased. Parkhurst & Mountney (1988) gave a general guideused by many poultry men for determining ammonia levels (Table 2.4)

However, the potential of ammonia emissions exists is when manure is present. Conditions that favor microbial growth will be increased ammonia production. These conditions include warm temperature, moisture, pH in the neutral range or slightly higher 7.0 to 8.5 and the presence of organic matter also factors normally present in abundance in poultry waste handling systems (Carey, 2010). Emission of ammonia depends on how much of the ammonia nitrogen in solution reacts to form ammonia. (Bishwo Bandhu Pokharel, 2010)

Ammonia level, ppm	**Causes**
10-15	Detected by smell
25-35	Eyes burn
50	Watery and inflamed eyes of the broilers appear
75	Broilers show discomfort and one can observe the broilers jerking their heads.

Table 2-1: Ammonia levels (Parkhurst & Mountney, 1988)

In this study, HACT spectrophotometer is used to determine the ammonia nitrogen concentration. HACT spectrophotometer is common analyzer in determination of ammonia nitrogen concentration in waste management and other component. However, there is also another analyzer that can be used to measure the ammonia nitrogen concentration in solid sample. Monira et al.,(1999) suggested, nitrogen content of litter can be estimated by Kjeldahl method where phosphorus was determined by Spectrophotometer from prepared extract and by developing blue colour of the phosphomolydate complex. Potassium content was determined with the help of flame emission Spectrophotometer.

3 METHODOLOGY

This study was conducted to evaluate the most suitable biological alternative bedding material for poultry production. The selected materials were banana fiber, coconut fiber, oil palm frond fiber and rice straw. The parameters are moisture content, pH value and ammonia nitrogen absorption by bedding material are considered.

3.1 Samples preparation

Four different bedding material were evaluated in this study which are banana fiber, coconut fiber, palm oil frond fiber and rice straw was collected in area Kuala Krai, Kelantan. 20g of each sample were firstly being grinded and dried at temperature 60°C for 24 hours. After that, samples were blended to form a fiber. 15g of Commercial hardwood sawdust was purchased at Poultry House Gambang, Pahang.

3.2 Chicken manure preparation

40g of wet chicken manure was collected from Poultry House Gambang, Pahang. This chicken manure was stored in sealed bottle at 4°C.

3.3 Study of ammonia absorption by the bedding material

Five 250 ml beaker was prepared. These beakers were labeled with 1, 2, 3, 4 and 5 hours. 1 g of dried sample was weight and transfer into each beaker. Then, 4 g of chicken manure from poultry house were added and spread on the surface of bedding material. Aluminum foil was used to cover the beaker and was stored at room temperature around 23°C to 25°C. Figure 3.3 below shows how experiment was run. The bedding material in beaker was collected every an hour for 5 hours. After one hour, bedding material in beaker was taken out and chicken manure was removed from bedding material. Then, bedding sample was weight 0.5 g was used to determine moisture content and the other 0.5 g was used for ammonia concentration and pH of bedding material.

Figure 3-1: Experimental run on how ammonia absorption by bedding material

3.4 Moisture content of bedding material

Moisture content of sample was determined before and after experiment. 0.5 g of sample was taken and being analyze by moisture analyzer at temperature 100°C.

3.5 Ammonia nitrogen concentration and pH of the bedding material

Ammonia nitrogen concentration and pH was determined before and after experiment. 0.5 of bedding material was taken out and transfer into 50 ml beaker. Then, 5 ml of ultrapure water was added into beaker and stirrer by using glass probe and let the mixture suspension for 15 minutes. After 15 minutes, pH of the mixture was determined by using pH meter. Then, 2 ml of mixture was taken out and dilute with 500 ml of ultrapure water. 10 ml of dilution was used to determine the ammonia nitrogen concentration by using HACH spectrophotometer and 10 ml of

3.6 Spectrophotometer analysis

Both blank and sample bottles were added with Ammonia Salicylate Reagent and shake for 3 minutes. Then, added with Ammonia Cyanurate Reagent and shake for 15 minutes before being analyze. When the timer was expired, the blank was inserted into the cell holder with the fill line facing right. Zero buttons was pressed to zeroing the device. 0.00 mg/L NH3–N was displayed. The sample was wiped before inserted into the cell holder to avoid any impurities that will cause inaccurate reading taken. The fill line was made sure facing right. Read button was pressed and results are in mg/L NH3–N was displayed. The experiment was repeated by using different bedding materials.

4 RESULT AND DISCUSSION

In this study, four different biomass residue have been selected as alternative bedding material which are banana fiber (BF), coconut fiber (CF), oil palm frond fiber (OPFF) and rice straw (RS) was used and being analyze according to their physical properties and performance in ammonia nitrogen absorption, moisture content and pH. Besides that, commercial hardwood sawdust (SD) also being tasted and undergoes same procedure as alternative bedding material. This option is used to observe and compared the performance of the sawdust with the alternative bedding material.

4.1 Biological alternative bedding material

Bedding material is used to cover the facility floor in poultry and also to minimize the ammonia emission from the chicken manure. Bedding material should be easily available with a maximum ammonia absorption capacity and water absorbent material. The type of bedding material affects litter physical properties, structure, NH3 adsorption, and release rates because of differences in water adsorption capacity, rate of moisture release, and ongoing biochemical processes (Dana Miles, 2011). This experiment was run in laboratory scale where 6 hours is needed to determine all the parameters for every bedding material sample and not including preparation. Table 4-1 shows the result of the effect of bedding material on parameter.

Every alternative bedding material undergoes drying process for 24 hours to reduce water content in sample and was grinded to the small particle size in order to increase the surface area of sample during ammonia absorption. Particle size of bedding material is important to consider because too small it will give dust environment in poultry house when chicken move or fly and too bigger will reduce performance of sample to absorb moisture content and also ammonia emission from chicken manure. As shown in Figure 4-1, the particle size of the bedding material is almost same but different in texture and physical properties. Banana fiber and rice straw is simply soft in texture and high in water absorption. While, the texture of coconut fiber and oil palm frond fiber is quite hard fiber that have less in water absorption. Bedding material with high in water absorption can absorb moisture content in wet chicken manure. However, particle size of commercial hardwood sawdust is slightly big and good in texture for moisture holding capacity as shows in figure 4-2. Since sawdust is woody material, the physical properties is quick different from alternative sample where they are in form of fiber and straw.

MEASUREMENT	BEDDING MATERIAL				
	Banana fiber	Coconut fiber	Oil palm frond fiber	Rice straw	Sawdust
Moisture Content, %					
Start	13.425	9.698	10.110	8.451	12.345
1 hour	20.589	22.602	16.341	26.863	30.497
2 hours	31.139	22.781	18.232	33.579	34.912
3 hours	34.566	16.370	21.902	34.433	33.943
4 hours	33.579	23.139	22.618	34.825	31.334
5 hours	34.552	26.112	22.605	33. 794	31.817
pH					
Start	5.51	5.36	5.54	6.31	5.50
1 hour	5.57	5.40	5.37	6.50	5.71
2 hours	5.60	5.71	5.40	6.20	5.70
3 hours	5.72	5.79	5.42	6.35	5.69
4 hours	5.83	5.85	5.50	6.49	5.80
5 hours	5.87	5.88	5.71	6.82	5.96
Ammonia Nitrogen Concentration, mg/L					
Start	12.5	10.0	10.0	27.5	7.50
1 hour	40.0	10.0	20.0	40.0	87.5
2 hours	32.5	30.0	37.5	57.5	87.5
3 hours	42.5	22.5	42.5	57.5	90.0
4 hours	50.0	32.5	47.5	60.0	92.5
5 hours	57.5	40.0	47.5	67.5	97.5

Table 4-1: Effect of bedding material on parameter

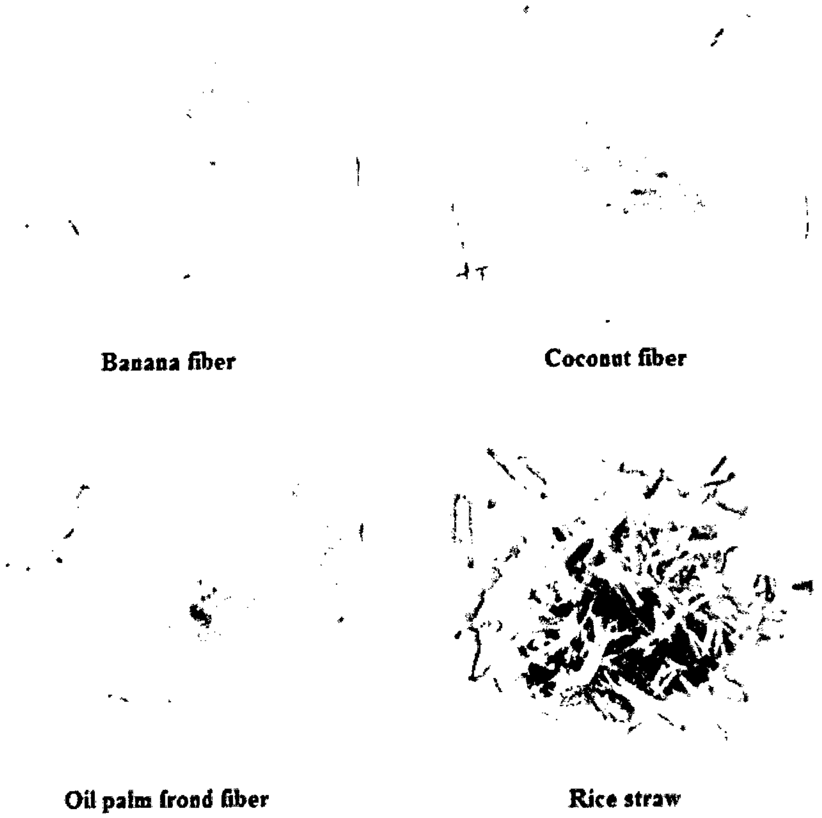

Figure 4-1: Particle size and texture of bedding materials

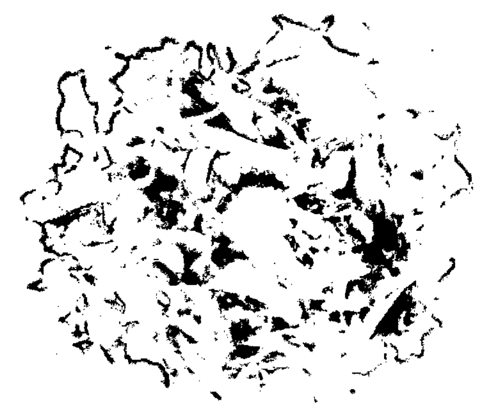

Figure 4-2: Particle size and texture of commercial hardwood sawdust

fiber was slightly high in moisture content which is around 33 to 35% compare to commercial hardwood sawdust also shows the same range of moisture content with rice husk and banana fiber. While, coconut fiber and oil palm frond fiber are between 22 to 26%. It shows that, rice straw and banana fiber have same physical properties with commercial hardwood sawdust in context of water absorption. Since coconut fiber and oil palm frond fiber is hard fiber that less capable to absorb moisture. Lucy (2002) reported that material such as straw is good in water absorption. Thus avoids moisture retention on the surface of the bedding material and also avoiding cake formation.

Alex Oderkirk (2012) in his article reported that increased moisture levels in the bedding material will be problematic to the poultry flock. Litter moisture should be in the range of 30% to 70% moisture. While, Garcia RG et.al (2012) reported that wet bedding material condition increase volatilization of ammonia from the litter and give ideal condition for microorganisms to growth. In addition, moisture release was considered to be the most important factor in bedding material evaluation. Concerning water holding capacity, Shanaway (1992) demonstrated that increased water holding capacity in bedding material increases the carcass quality score and decreases the incidence of breast blisters, while during this trial no evidence of breast blisters were found.

Besides that, Abdul Hafeez *et al.* (2009) in his research on sawdust, sand and wheat straw reported that moisture increased at each sampling time. There was no abrupt change in the moisture content of any of the three bedding materials. However, the moisture content increased more rapidly during week 3 to 6 in all of types of bedding materials. This was the result of increased waste deposition and increased respiration of growing broilers as explained by Huff *et al* (1984). Ogan (2000) also reported increase in moisture content of bedding material with time.

4.3 pH of different bedding material

The pH of bedding material is one of parameter that affects the ammonia release. Ammonia is highly producing in alkali condition. It is important to keep the pH of bedding material under acidify condition. In this experiment, the pH value was determined by pH meter. Before being tested, the sample firstly was followed the procedure of pH determination for solid wastes, the method was called 9045D. This