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Nutrition Mass of Fermented Coconut Pulp with Rumen Fluid as Poultry Feed

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ABSTRACT. *The use of coconut pulp as animal feed is still limited due to the high content of crude fat and crude fiber, which are difficult to digest by livestock and low palatability, so feed processing technology is needed, one of which is through the fermentation process with the addition of microorganisms from rumen fluid. This study aimed to determine the nutritional quality of coconut (Cocos nucifera l.) pulp with different fermentation lengths using Bali cow rumen fluid. The study used a completely randomized design (CRD) consisting of 3 treatments and 4 replicates. The treatments used in this study were AA = 0-day coconut pulp (control), AB = 5-day fermented coconut pulp, and A2 = 7-day fermented coconut pulp. The variables observed were dry matter (DM), crude protein (CP), crude fiber (CF), and crude fat (FF). The results showed a significant effect (P<0.05) on the mean values of BK AA (94.669±0.33) AB (91.89±0.23) and AC (90.46±0.44), PK AA (5.33±0.41), AB (6.00±0.14) and AC (6.59±0. 15), SK AA (16.99±0.31), AB (10.16±0.21), and AC (9.24±0.24) and showed no significant effect (P>0.05) on the mean value of LK AA (44.55±0.50), AB (44.52±0.3), and AC (43.29±0.58). Based on the results of the study, it was concluded that 7-day fermentation decreased BK, LK, and SK and increased PK of coconut pulp. The best fermentation time of coconut pulp with Bali cow rumen fluid is on day 7.*

Keywords: Coconut pulp, Feed, Fermentation, Rumen fluid.

INTRODUCTION

Feed is a very important factor in poultry production. The quality of the feed material depends on the quality of the nutrients it contains. The cost of feed is one of the largest components of production costs, so efforts must be made to ensure the availability of feed of the quality and quantity that meets the needs of the animals. One of the efforts that can be made to maintain feed availability is the use of non-conventional feed ingredients from waste that has potential and guaranteed availability, namely coconut pulp.

Coconut pulp is a waste that has great potential to be used as a feed ingredient because coconut pulp is very easy to obtain, especially from the production of traditional coconut oil and waste from the production of virgin coconut oil. Coconut meat pulp can be used as a substitute feed ingredient because coconut meat pulp also contains nutrients such as protein (11.84%), crude fat (29.20%) and crude fibre (24.85%) (Kurniawan, 2016). However, the use of coconut pulp as animal feed is still low. The low use of coconut pulp is due to its high crude fat and crude fibre content, which is difficult for livestock to digest, and low palatability, so its use as animal feed requires feed processing technology, one of which is a fermentation process.

The fermentation process can improve the quality of feed to better than the original material in terms of nutritional components, digestibility, and shelf life (Suwitari et al., 2019). Improving the quality of coconut pulp as animal feed can be done through a fermentation process using rumen fluid as an activator. Rumen fluid is one of the slaughterhouse

wastes that has not been optimally utilized and even thrown away, causing environmental pollution. In the fermentation process, rumen fluid contains many microorganisms that will produce cellulase enzymes as fiber degraders including fiber-breaking enzymes which are a multienzyme complex, such as endoglu-konase, exogluconase, β-glucosidase so that it can reduce crude fiber levels in coconut pulp (Purnomohadi, 2006). Furthermore, in fermentation, in addition to the activator material, the fermentation time must also be considered, as the fermentation time will affect the nutritional quality of the coconut pulp (Laksono et al. 2023). The research results of Kurniawan (2016) stated that the best time for fermentation of coconut pulp with the addition of *Aspergillus niger* 3.248 grams per kilogram of coconut pulp was for 4 days. Contrary to the results of the research reported by Laksono et al. (2023), fermentation of coconut pulp with *Aspergillus niger* is best in fermentation for 6 days with the highest crude protein (PK), and crude fiber (SK) and crude fat (LK) decreased. Based on this, this study was conducted to see the effect of fermentation using activators from rumen fluid on the nutritional content of coconut pulp as animal feed.

MATERIALS AND METHODS

Time and place

This research was conducted from June to July 2023 at the Animal Husbandry Laboratory, University of West Sulawesi. In addition, proximate analysis was carried out at the Livestock Product Quality Testing Laboratory of the Livestock and Animal Health Service Office of South Sulawesi Province.

Tools and materials

The tools used in this research are 10 kg digital scales, test tubes, tube caps, 1000 uL micropipettes (Joan Lab), 5 ml graduated dropping pipettes, and tube racks. The materials used are bovine ruminal fluid, coconut pulp, distilled water, round aluminium foil containers (RX-1200), plastic wrap, labels, non-medical masks (onemed), tissues, and latex examination gloves.

Research procedure

Rumen fluid enzyme extraction

The preparation of rumen fluid enzymes begins with collecting cow rumen fluid. The collected rumen fluid was then squeezed and filtered using gauze, then stored in a refrigerator at 4^{o}C. Next, the sediment and supernatant of the rumen fluid was separated using a centrifuge for 20 minutes at 10.000 rpm. The collected supernatant was then put in a test tube and phosphate buffer was added in a ratio of 1:1 between supernatant and phosphate buffer liquid and stirred until homogeneous (Zuraida et al., 2013). The enzyme that has been mixed is then stored in a vacuum tube or other airtight container to prevent contaminants and stored at a refrigerator temperature of 4^{o}C, the cellulase enzyme is an enzyme that is ready to use at any time and can last ± 4 months, if you want to use an enzyme that has been stored in a refrigerator, you need to thaw it first with warm water or store it at 27^{o}C room temperature for 12 minutes after which the substrate is added (Mahanani et al., 2020).

Incubation

Coconut pulp is added with distilled water as much as 50 ml and rumen fluid enzyme as much as 6 ml per 1 kilogram of coconut pulp. In the research of Mahanani et al., (2020) fermentation of agricultural waste-based feed with high fiber content using cellulase enzymes showed the best results in the use of 6 ml. Then stir until homogeneous. Furthermore, coconut pulp that has been mixed well with rumen fluid enzymes is then incubated in an aluminum foil container that has been filled with 1 kg of coconut pulp with a thickness of 2 cm. After leveling, cover with plastic wrap, then perforate the plastic using a toothpick. Next,

store in the fermentation room with a temperature of ± 35 ^{o}C.

Aerobic fermentation process

The fermentation process was carried out aerobically by adding Bali cow rumen fluid enzymes. The fermentation process of coconut pulp using Bali cow rumen fluid was carried out for 5 days and 7 days.

Variables

The research variables observed were dry matter, crude protein, crude fiber, and crude fat of coconut pulp (control) with 5-day and 7-day fermented coconut pulp.

Sample Testing

Proximate analysis was used to determine the chemical composition of fermented coconut pulp (following the procedure of AOAC, 2005). This analysis includes dry matter (DM), crude protein (CP), crude fiber (CF), and crude fat (LF).

Research design

This study used a Completely Randomized Design (CRD) research design consisting of 3 treatments and 4 replicates. The research treatment is the length of coconut pulp fermentation which consists of AA = Coconut Pulp (Control); AB = 5-day Coconut Pulp Fermentation; AC = 7-day Coconut Pulp Fermentation.

Data analysis

Data from each variable obtained was analyzed using the Analysis of Variance (ANOVA) SPSS Statistics 27.0 program based on a Completely Randomized Design (CRD), then the difference in the effect on the existing treatment will be continued with the Least Significant Difference (LSD) test.

RESULT AND DISCUSSION

The results of the analysis of variance showed that the nutritional content of coconut pulp which includes crude protein, and fat, crude, showed significant differences (P<0,05) in the components of crude fiber, crude protein, crude fat, and dry matter in coconut pulp fermented with rumen fluid and coconut pulp without fermentation.

Table 1. Nutrient content of coconut pulp with different fermentation duration.

Variabel (%)	Lama Fermentasi		
	AA	AB	AC
Dry Matter	94.669±0,33^{a}	91.89±0,23^{b}	90.46±0.24^{c}
Crude Protein	5.33±0,417^{a}	6.00±0.14^{b}	6.59±0.15^{c}
Crude Fiber	16.99±0.31^{a}	12.16±0.21^{b}	9.24±0.24^{c}
Crude Fat	44.55±0.50	44.52±0.31	43.29±0.58

Source: Primary Data Research Results, 2023. Different superscripts in the same column indicate significant differences (P < 0.05). AA = coconut pulp (control), AB = 5-day fermentation, AC = 7-day fermentation. Data showed as mean ± ???

Dry matter

The average dry matter of coconut pulp fermented with rumen fluid with different fermentation duration showed significant

differences (P<0.05). Fermentation of coconut pulp for 5 and 7 days showed lower dry matter content of 91.89% and 90.46%, respectively. The occurrence of a decrease in dry matter in the 5 and 7-day fermentation treatment is due to the presence of water molecules that come out during the fermentation process, which results in a decrease of dry matter content in the substrate. The longer the fermentation time, the lower the dry matter content. This is because in the fermentation process microorganisms in the rumen fluid develop more and more, the more food substances in the substrate are broken down as a source of energy. As a result, water molecules produced from the metabolic process of microorganisms also increase during fermentation. Microorganisms use carbohydrates as an energy source that can produce water molecules and carbon dioxide. Most of the water will remain in the product and some will come out of the product. Cahyadi, (2018) explains that microorganisms use nutrients in the substrate as an energy source and the metabolic process produces water molecules. The water left in the product will cause the substrate moisture content to be high and the dry matter to be low. Supported by the opinion of Nusantara et al. (2022) that the fermentation process produces water, then this water is left in the substrate material for the fermentation process by the mold and some come out through the evaporation process.

The results of this study are not much different from the results of research conducted by Laksono et al. (2023) on the content of dry matter during the fermentation of coconut pulp with *Aspergillus niger* with fermentation times of 5 and 6 days, respectively, ranging from 90%-94%. Furthermore, Rahayu et al., (2023) explained that fermentation also resulted in changes in quantity. Microbes that grow and multiply during fermentation will need food toutilize the existing substrate. This activity will reduce the dry matter components in the substrate. The type of components utilized by microbes will affect the composition of the final components after fermentation.

Crude Protein

The results of the analysis of variance showed that coconut pulp with different fermentation lengths using rumen fluid showed a significant effect (P < 0.05) on the crude protein content of coconut pulp. Coconut pulp fermented for 7 days had a higher crude protein content (6.59%). This is due to the activity of enzymes produced by rumen fluid that can increase the crude protein content in the fermented coconut pulp produced. A fermentation time of 5 to 7 days causes increased microbial opportunities for growth and fermentation. This affects the increase in the number of microbes and increases the crude protein content.

Enzymatic processes can affect the increase in coconut pulp protein content, which proves that biochemical activity occurs by enzymes. During the fermentation process, in addition to producing enzymes, extracellular enzyme proteins and proteins from the metabolism of microorganisms are also produced, increasing crude protein content (Fadillah et al., 2022). Furthermore, the fermentation process using optimal microorganisms occurs in 4 days (exponential phase), then on the 5th and 6th days experiences a death phase which indicates that microorganisms are no longer working optimally.

The results of this study were lower than those of Laksono et al. (2023), who reported that the crude protein content of coconut pulp with Aspergillus niger with a fermentation time of 6 days was 7.41%. According to (Aminah et al., 2020) another factor that causes the increase in crude protein content is influenced by the decrease in crude fiber content in the fermentation process. The decrease in crude fiber content of coconut pulp fermented for 7 days affects the relative increase in crude protein content. Furthermore, according to

Bachruddin (2017) microorganism cells in the fermentation process can increase crude protein because microbes are also a source of single-cell protein.

Proteolytic activity occurs in the fermentation process helps improve protein digestibility because it is broken down by enzymes that degrade some anti-nutritional compounds bound by proteins, thereby increasing protein bioavailability (Thierry et al., 2013). Furthermore, according to Heryani et al. (2017), the difference in crude protein during the fermentation process is due to the use of rumen contents that contain nutrients and are also a source of microbes, so the more rumen contents used, the higher the crude protein content.

Crude Fiber

The average crude fiber content of coconut pulp with different fermentation times using rumen fluid showed significant differences ($P<0.05$). Coconut pulp fermented for 7 days had a lower average crude fiber content of 9.24%. This is because rumen fluid is one of the microorganisms that synthesize cellulase enzymes that hydrolyze the crude fiber component, so it has a good influence on the crude fiber content of the fermentation results. According to Melzana et al. (2020) rumen fluid contains many microbes and one of the most common microbes found is cellulolytic bacteria. These bacteria can break down cellulose by producing the enzyme cellulase. Furthermore, according to (Singgih et al., (2013) cellulase is an enzyme that digests crude fiber components, which increases the digestibility value of the crude fiber itself. The more effective the enzyme activity in hydrolyzing the fiber fraction, the more compounds are easily digestible, so the crude fiber content decreases.

The decrease in crude fiber component is also caused by the concentration of starter or microorganisms used, besides the length of fermentation time can also affect crude fiber. Aminah et al. (2020) reported an increase in the number of starters to 5% and an increase in the length of time to 14 days in coconut coir fermentation with rumen fluid, together causing the ability to degrade fiber to be higher and increase the opportunity for fiber-digesting microbes to carry out growth and fermentation. Furthermore Vilan et al., (2023) explained that the quality of coconut pulp increased after the fermentation process because the crude fiber content decreased so that the digestibility of feed dry matter was improved and could match the digestibility of feed without coconut pulp.

Crude Fat

The results of the analysis of variance showed that coconut pulp with different fermentation lengths using rumen fluid did not show significant differences ($P>0.05$). However, the average of 7 days of fermented coconut pulp with the addition of rumen fluid showed a lower crude fat content of 43.29% due to the activity of microorganisms during the fermentation process. The high crude fat content is thought to be due to rumen fluid as the microorganisms used are fiber-digesting microbes. The low content of lipase enzyme in rumen fluid and the absence of pretreatment before fermentation so that the addition of rumen fluid to fermented coconut pulp does not affect the crude fat content. This is the opinion of Aminah et al. (2020) who explained that the rumen fluid used for feed fermentation is a microbe that only contains fiber-digesting microbes, so the enzymes produced can only degrade substrates in the form of fiber and cannot degrade other substrates. In contrast to the results of research reported by Laksono et al. (2023), coconut pulp through the heating and fermentation process using Aspergillus niger as a lipase enzyme-producing starter produced a crude fat content of 11.21%. The heating process through steaming coconut pulp causes evaporation so that the fat in coconut pulp evaporates, besides that the steaming process makes the pores on the coconut pulp wide so that the lipase enzyme produced by Aspergillus

niger can work optimally. The treatment and use of activators in the fermentation process can affect the nutritional quality of the feed.

CONCLUSION

Fermentation of coconut pulp for 7 days with the addition of rumen fluid produces better dry matter content, crude protein, and crude fiber crude fat compared to coconut pulp with 5 days of fermentation.

CONFLICT OF INTEREST

We hereby declare that there are no conflict of interest in the writing of this manuscript.

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