



Evaluation of Cocoa Pod Husk Production and Nutrient Content as Ruminant Feed

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Abstract. This study evaluates the productivity of cocoa crop waste as feed ingredients in North Toraja Regency in terms of production and nutritional content. The research was conducted in Salu Sarre from April to June 2024, the second harvest season, using primary and secondary data. Sampling was carried out using the simple random sampling method with a total sample of 3 largest farms in the area. Data processing methods with descriptive analysis. The results of the analysis show that plant age affects productivity and skin percentage. As for the nutritional content by comparing with grass used as feed material, the results are not so different, but it is necessary to evaluate the high fiber content which is feared will reduce digestibility and even interfere with the digestive system. Therefore, it is necessary to further evaluate the fiber content and fiber fraction because it is a factor that inhibits the digestibility of feed ingredients.

Keywords: Cocoa pod husk, Animal Feed, Nutrient Content, Production.

1 Introduction

Ruminant livestock that have forage as their main feed experience problems in its provision. The limitation of forage feed is a problem often faced by farmers in the dry season so the availability of forage feed needs to be pursued so that it is available continuously and also on limited land availability. Areas with high heat stress generally experience a shortage of forage feed which has an impact on the performance of ruminants in the region. Meeting the needs of forage feed is done with various efforts including processing grass to extend the shelf life such as hay and silage, there are also those who make substitutions with potential materials geerally by utilizing waste [1].

The abundance of forage in the rainy season needs to be processed because the forage is easily damaged and the nutritional content will decrease, the processing process will help in the dry season. However, forage sources in the dry season come from land that is also limited so that even if processing is carried out there is still a shortage of forage for consumption throughout the year, especially if production capacity is sought to pursue market demand for red meat. Feed limitations will hamper the process of the

process of increasing the capacity of livestock that can be raised in a region, making it difficult to meet the demand for animal protein. Data for 2023 shows that Indonesia has a deficit of 374.1 thousand tonnes of beef and buffalo meat [2]. Cultivating ruminants requires a long time so the availability of feed must continue to meet the needs of livestock both in cultivation and fattening, so it is necessary to substitute ingredients to be able to meet the needs of forage for livestock. The substitute material used should have sufficient quantity and sufficient nutritional content to help the process of sustainability of feed availability. Forage substitutes can come from wastes that have not been utilized, be it agricultural waste, plantations, or other agro-industrial waste.

This utilization also needs consideration of the limiting factors in the materials to be used so as not to interfere with animal health. The utilization of agricultural waste is generally used in the form of complete feed consisting of several feed ingredients [3].

Plantation waste in the form of cocoa pod husk is one of the potential wastes that can be substituted for grass in animal feed forage. The potential production of cocoa fruit shells as a commodity will then become waste that must be removed from the plantation area because it can become a pest for cocoa plants. Cocoa pod husk becomes waste that must be utilized so as not to the plantation environment, on the other hand, there is a need for ruminant animal feed that has not been able to be met sustainably. The utilization of cocoa pod husk as a concentrate feed ingredient for livestock is an optimization of the utilization of agricultural and agro-industrial waste that can improve and contribute to the availability of cheap and high-quality animal feed [4]. The process of processing cocoa pod husk into animal feed needs to be reviewed in terms of production and nutrient content so that the ability to substitute cocoa pod husk as a source of fiber in ruminant feed can be known. For this reason, it is necessary to conduct research on the production and nutrient capabilities of feed ingredients in the form of cocoa pod husk to substitute grass in ruminant feed.

2 Materials and Methods

2.1 Materials

This study observed the potential of cocoa production in North Toraja sampling using the simple random sampling method with a sample size of 3 largest farms in the region. The data processing method is descriptive analysis. Cocoa plants were divided into 3 plant age groups, namely <10 years, 10-15 years, and >15 years in the second harvest season in 2024. The grass used was elephant grass planted on the riverbank with an age of 4 months in the first harvest.

2.2 Methods

This research was conducted descriptively to describe the potential of cocoa pod husk as a commodity. The variables to be observed are production potential in terms of land area, fruit weight, and cocoa pod husk ratio. The variables to be observed are the

production potential in terms of land area, fruit weight, fruit and peel ratio, as well as the overall nutrient content of cocoa fruit peels in one harvest season to be used as a substitute for grass in animal feed by proximate analysis [5]. The data was then analyzed descriptively in tabular form.

3 Results and Discussion

3.1 Cocoa land area and production

The Fulfillment of feed needs is to be met in animal husbandry, in ruminant farms the need for fiber-source feed is a component that must be available to maintain the health of the digestive tract of ruminants. The limited ability to fulfill the form of grass as a result of limited land needs to be substituted by utilizing existing resources to ensure the availability of ruminant feed in a sustainable manner. Utilization of agricultural waste is one way to provide feed to meet the needs of ruminants. The use of agricultural waste in feed can be an effort to reduce the risk of plants being attacked by *Conopomorpha cramerella* or Cocoa Mot pests that attack cocoa so that the fruit meat is rotten.



Fig 1. The location picture of cocoa plantation in North Toraja

South Sulawesi Province has an agricultural commodity in the form of cocoa (*Theobroma cacao* L). This study collected data on production potential in North Toraja Regency, which is one of the largest cocoa contributors. North Toraja Regency with coordinates 2°59'11 "S 119°51'13 "E, has a cocoa plantation area of 1,542 Ha which is dominated by community plantations, annually capable of producing 812 tons of cocoa in 2016. This number continues to increase, especially supported by government programs that promote cocoa planting programs in the last 10 years.

Table 1. Area and cocoa productivity Toraja Utara

Area (Ha)	Productivity (Ton)	Productivity (Kg/Ha)
1.542	812	666

Source. South Sulawesi Provincial Government (2017)

Processing waste, especially commodities, will be a follow-up effort from the production process to provide more useful value into more useful products [6]. Obstacles to the utilization of agricultural waste are mostly caused by high moisture content and antinutritional factors are one of the obstacles, but drying and processing can increase the shelf life and increase its utilization. Their efficient use will enlarge the feed resource base, increase feed availability, and return wasted food to the human food chain [7].

Table 2. Effect of plant age on production

Plant Age (Year)	Weight of cacao (kg)
<10	296.4
10-15	482.8
>15	461.8

Cocoa plants scattered in the area of North Toraja regency are grouped into 3 age groups of plants scattered in the plantation owned by residents. Plant age is known to affect the productivity of cocoa plants. Table 2 shows that cocoa plants produce the most fruit in the age range of 10-15 years and experience a decrease in production after the age of the plant exceeds 15 years. The observation process of cocoa plant productivity was carried out in the second harvest of 2024 which coincided with the dry season. Changes in fruit weight Cocoa plants at plant age above 15 years have entered an unproductive age so rejuvenation is needed in order to maintain cocoa productivity. Several ways can be done in an effort to rehabilitate cocoa plants. Farmers should regenerate unproductive cocoa plants with new plants. Cocoa plant rehabilitation efforts to improve or increase potential productivity and one of them can also be done by using technological innovation in the form of side grafting technology. This needs to be done as an effort to improve and increase the productivity of cocoa plants that have entered an unproductive age [8,9].

The effectiveness of cocoa harvesting is influenced by several factors, namely fruit position, fruit distribution on the stem, pest and disease attack, clone type, harvesting characteristics, and harvester age. Fruit position distribution is a physiological factor where the higher the fruit, the greater the number. The high position of the fruit makes it difficult for harvesters with limited height to reach and confirm the maturity level of the fruit using the criteria of skin color and tapping [10].

The cocoa fruit consists of an outer part, the rind, and an inner part, the pulp, which surrounds the seeds (30-45 pieces per fruit). The cocoa pod husk (CPH) represents about 67- 76% of the whole fruit and consists of four layers: epicarp (or rind), meso-

carp, sclerotic part, and endocarp. Cocoa beans represent 33% of the whole fruit and consist of an outer shell (cocoa bean shell, CBS), two cotyledons (nibs), and a seed [11].

Table 3. Effect of plant age on fruit percentage

Plant age (year)	Fruit percentage (%)	
	Cocoa Husk Pod	Pulp
<10	61%	39%
10-15	69%	31%
>15	78%	22%

Table 3 shows the percentage of cocoa pod husk by skin and content, the difference in plant age also varies as older trees have a downward trend in fruit percentage and reach maturity earlier, this may be due to higher soluble solids. Skin thickness is mainly influenced by the number of cells, cell size, and their arrangement in the fruit tissue. There may be some other factors responsible for peel thickness. In our results, low peel thickness may be caused by low K levels which in turn disrupts cell organization and results in higher peel thickness [12]. A more in-depth study is needed to determine the factors responsible for cocoa pod husk thickness.

Factors causing a decline in cocoa production are pest and disease attacks, age of the cocoa plant, and elemental deficiencies. Efforts to prevent factors that cause a decrease in productivity need to be made to regenerate plants, good cultivation systems, and prevent trees from being attacked by pests and diseases. However, natural factors such as climate change are also a cause of decreased productivity. Implementation of these changes requires region-specific programs with the general goal of improving the economy and the environment [13].

For substitution feed ingredients, several considerations are needed, including the use of substitute feed ingredients must have a content that is close to the nutritional content of the substituted ingredients, easily obtained and cheaper prices. The following table shows data on the nutrient content of grass and cocoa pod husk.

3.2 Potential nutrient content

Cocoa pods have a higher dry matter and ash content than grass but the nutritional composition is not much different from grass, so they have potential as an alternative feed to replace grass. However, cocoa pods have low digestibility and the presence of antinutrient compounds that affect nutrient availability [14]. Campos-Vega et al. (2018) tested that CPH less than 1 cm had 87% organic matter, consisting of fibre (55.7%), nitrogen-free extract (20.6%), crude protein (8.4%), and fat (2.5%). [15]. Cocoa pods contain anti-nutrients in the form of theobromine which can disrupt the digestive tract of livestock. In the research on the substitution of processed cocoa peels for use in rat feed, the results of substitution at 30% did not cause death or organ-specific toxicity with reference to testes, kidneys, spleen, or liver, but substitution beyond that showed a negative impact on rat organs such as substitution at 50%. The

data suggest that detheobrominated CPH can safely replace up to 30% of maize in animal feed formulations [16].

Table 4. Nutrient content of feed ingredients

Feed content	Dry Matter (%)	Nutrient content (% DM)			
		Ash (%)	Crude Protein (%)	Crude fat (%)	Crude Fiber (%)
CPH	94.00	6.9%	6.98%	8%	43%
Local grass	97.16	13.8%	8.1%	1.63%	35.05%

The fiber content of cocoa pods is higher than that of grass, and this content needs to be studied more specifically to determine the fiber fraction. Dietary crude fiber content has a negative relationship with digestibility, the lower the dietary crude fiber, the higher the diet digestibility. An increase in crude fiber causes a decrease in digestibility, so cattle will consume more feed for their energy needs. Too high levels of crude fiber lead to longer nutrient digestibility and lower productive digestibility. Lu et al. (2018) reported that fibrous compounds such as 19.7-26.1% cellulose, 8.7-12.8% hemicellulose, 14-28% lignin, and 6.0- 12.6% pectin are the main constituents of CPH [17]. The more crude fiber in the feed, the thicker and more resistant the cell walls and consequently the lower the digestibility of the feedstuff. The use of cocoa shells in rabbit diets as much as 37.5% decreased consumption but if the percentage is below 25%, the performance is opaque and efficient in digestibility [18]. Conversely, feedstuffs with low crude fiber are generally easier to digest due to thin cell walls. For this reason, cocoa should be processed to increase the percentage of substitution in grass. The use of cocoa shells in feed should go through a processing process such as fermentation, one of which using fungi can increase protein content, reduce the fraction of indigestible fiber, and can increase its use in feed due to increased digestibility [19].

4 Conclusion

In terms of production, cocoa pod husk has the potential to be used as a fiber source feed ingredient to substitute elephant grass, which is the main feed ingredient for ruminants at present. Another consideration is the nutrient content of cocoa fruit shells, especially in lignin content, which can reduce feed digestibility so that it cannot be used to substitute grass as a whole. The substitution process using agricultural waste needs to go through a processing process to increase its digestibility, as is the case with cocoa pod husk.

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

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