



Nutrition Mass Changes of Teak Leaves (*Tektona grandis*) Complete Feed Silage Fermented at Different Storage Duration

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Abstract

This study aimed to increase the nutritional value of teak leaves as feed for ruminants by carrying out fermentation at different storage times. This research was conducted in April - July 2020. The preparation of complete feed silage made from teak leaves (*Tektona grandis*) was carried out in the UNASMAN Animal Husbandry Study Program. The nutritional analysis was carried out at the Feed Chemistry Lab, Faculty of Animal Husbandry, Hasanuddin University. This study was designed using the CRD method with five treatments and three replications so that the number of experimental units was 5. The treatments are A0 = 0 weeks (control); A1 = 2 weeks; A2 = 4 weeks; A3 = 6 weeks; A4 = 8 weeks. The results showed that storage time had a significant effect lower ($P < 0.05$) on the nutrients mass (dry matter, crude protein, crude fat, and crude fiber). Storage of complete feed silage made from teak leaves is effective for 2-4 weeks of storage.

Keywords: teak leaves, storage time, complete feed, silage.

A. Introduction

The land for ruminant animal feed crops is currently decreasing due to the change of function to housing, industry, agriculture, and plantations. It is inversely proportional to the increasing demand for ruminants, especially cattle. (Badan Pusat Statistika Nasional, 2018) reported that the need for national beef in 2017 reached 784 thousand tons. Meanwhile, beef production in 2017 is estimated at 532 thousand tons, to meet this need is supplied by imports. One of the causes of low cattle production is that there is no land available for livestock, so that feed is not available.

One alternative that can overcome the availability of feed is utilizing teak forest waste (*Tektona grandis*). Teak leaves are abundant in production and have not been used by the community. Therefore, this study uses teak leaves (*Tektona grandis*) as an alternative forage for cattle. Agustono et al. (2017) reported that teak leaves' crude protein content is 5.05%, and crude fiber is 31.02%.

Low protein and crude fiber levels from teak leaves (*Tektona grandis*) limit factors as feed; therefore, feed processing is carried out. Combining teak leaf silage with Gamal can improve the quality of teak leaf feed. Silage is a feed processing technology with a fermentation method that can reduce levels of feed fiber. According to Syahrir (2017), the leaves of Gamal (*Gliricidia maculata*) are legume plants containing 15.78% crude fiber and 24.68% crude protein.

Silage feed is feed preservation by the anaerobic process. In this process, it is hoped that the bacteria will improve the nutritional quality of feed ingredients, and the acid produced by bacteria can preserve the feed ingredients. Making silage takes time for the fermentation process to occur, which will impact the breakdown or addition of nutrients in the fermentation medium. Therefore, in this research, complete feed silage is made from teak leaves with different fermentation times. The implementation of this research aims to increase the nutritional value at a certain storage time.

B. Methodology

1. Material of Research

The tools used were tarpaulin, rope, plastic bags, scales, knives, vacuum tools for proximate analysis. The materials used were teak leaves, gamal leaves, bran, minerals, salt, and proximate analysis materials.

2. Procedure of Research

All ingredients for complete feed silage, including teak leaves, are weighed and mixed within the percentage of ingredients, as shown in Table 1. It having been mixed, two kg of complete feed was placed in the plastic vacuum bag and stored according to each treatment. According to a completely randomized design (CRD), this study was designed, which consisted of 5 treatments with three replications. Overall, there were 15 unit combinations of experimental treatments storage duration: 0, 2, 4, 6, 8 weeks, respectively.

Table 1. Composition of Complete Feed Silage Made from Teak Leaves

No	Ingredients	Composition % of DM
1	Rice bran	8.5
2	Teak leaves	50
3	Gamal leaves	40
4	Molasses	1
5	Minerals	0.5
Total		100

3. Parameters of Research

The parameters measured in this study are nutrient mass (dry matter, crude protein, crude fat, and crude fiber) and Nutrition Mass Change.

4. Data Analysis

Data obtained were analyzed according to the completely randomized design general linear model (GLM), and means was separated using multiple Duncang range test. The models are as follows:

C. Result and Discussion

1 Nutritional Mass

The fermentation of complete feed silage made from teak leaves has decreased the nutritional value of silage. Average dry matter weight, crude protein, crude fat, and crude fiber can be seen in Table 2.

Table 2. Nutrient Mass (Dry Matter, Crude Protein, Fiber, Crude Fat, and Crude Fiber) in Complete Feed Silage Made from Teak Leaves

Nutrient Mass g/2000g FM ⁻¹	Storage Time				
	A0	A1	A2	A3	A4
Dry Matter	1100,67 ^d	996,63 ^{cd}	862,10 ^{bc}	729.90 ^{ab}	566,93 ^a
Crude protein	106,67 ^d	94,15 ^{cd}	85,64 ^{bc}	74.31 ^b	57,05 ^a
Crude fat	56,15 ^c	49,66 ^{bc}	45,21 ^{abc}	43,34 ^{ab}	35,98 ^a
Crude fiber	211,70 ^d	189,56 ^{cd}	161,67 ^{bc}	132,67 ^{ab}	102,23 ^a

Note: Different Letters in Superscript Mean Numbers, Significantly Different ($P < 0.05$), Storage duration A0: 0 wk; A1: 2 wks; A2: 4 wks; A3: 6 wks; A4: 8 wks., FM: Fresh matter

Based on the fermentation period variation of the fermentation period, silage complete feed made from teak leaves had a significant effect ($P < 0.05$) on the mass of dry matter. Table 2 shows that the longer the storage time, the more nutrient mass decreased. (Astuti et al., 2017) reported that the decrease in dry matter is due to a large amount of water that comes out in the fermentation process, which results in a decrease in the content of dry matter in the substrate.

Based on the results of the Duncan test, it shows dry matter that A0 is not significantly different from A1 ($P > 0.05$) but is significantly higher ($P < 0.05$) than A2, A3, and A4. Treatment A1 was not significantly different from A2 ($P > 0.05$), but significantly different from A3 and A4. Treatment A2 is significantly different from A4 ($P < 0.05$) but not different from A3. A3 treatment is no different from A4 ($P > 0.05$).

Reduced dry matter due to the breakdown of nutrients and high moisture content due to microorganisms activities. Under the opinion (Surono et al., 2006), there is an increase in water content in the fermentation process and decreased dry matter. (Amaliah, Reski, Syahrir, & Natsir, 2019) that in the fermentation process, there is a breakdown of nutrients causing lactic acid levels and water levels to increase. The increase in water content causes the dry matter content to decrease.

The high and low dry matter in the treatment is also made possible by microbial activities in the fermentation process, which causes the breakdown of the substrate content. So, it makes it easier for existing microorganisms to digest dry matter. The results of fermentation of dry matter release fermentation products in sugar, alcohol, and amino acids. It is also caused by micro-service activities that affect silage's nutritional value (Astuti et al., 2017).

Based on Table 2. It shows the crude protein mass is directly proportional to storage time. The longer the storage, the lower the protein mass. Based on the results of the analysis of variance, it showed that the storage time was significantly different from the mass of crude protein ($P < 0.05$). Furthermore, the Duncan test results showed that A0 was significantly higher ($P < 0.05$) with A2, A3, A4, and not significantly different from A1 ($P > 0.05$). Treatment A1 was significantly different ($P < 0.05$) from A3, A4, and not significantly different from A2. Treatment of A2 is the same as A3, but A4 is different from A2 and A3.

The decrease in crude protein mass in complete feed silage made from teak leaves is caused by N's evaporation from the NPN in the feed material is opened fermentation. Some of it is used by microbes for protein synthesis and microbial growth. It is in line with the opinion (Mukhlis, 2017) that storage of fermented feed ingredients from 0 weeks to 3 months will decrease protein levels due to microorganisms' activity.

The variance analysis showed that the storage time for complete feed silage made from teak leaves significantly affected crude fat mass ($P < 0.05$). The longer the storage, the lower the fat mass. The highest crude fat mass was in treatment A0 = 56.15g, and the lowest was in treatment A4 = 35.98g.

Duncan's test results showed that A0 was significantly different ($P < 0.05$) from A2, A3, A4, and not significantly different from A1 ($P > 0.05$). Treatment A1 was significantly higher ($P < 0.05$) from A3 and A4, but not significantly different from A2. Treatment A2 was significantly different ($P < 0.05$) from A4 and the same as A3 ($P > 0.05$). A3 treatment was not significantly different from A4 ($P > 0.05$).

Microbial biomass in complete feed silage made from teak leaves at different fermentation times shows the metabolic results, namely, fatty acid fat. The decrease in crude fat mass during storage shows that microorganisms use fat as an energy source (Santi, 2017).

Cellulose is the main component of plant cell walls. Hydrolyze cellulose into simple sugars, and fiber degradation bacteria are needed (Lamid et al. 2009). The presence of *Actinobacillus* sp.

The cellulose was degraded into simple monomers of disaccharides, oligosaccharides by microbes, and nutrient microbes (Lamid et al., 2013).

The variance analysis showed that storage time had a significant effect ($P < 0.05$) on the crude fiber mass of complete feed silage made from teak leaves. The highest nutrient mass was in treatment A0 = 211.70g, and the lowest was in treatment A4 = 102.23 g. Duncan's test results showed that A0 was significantly higher ($P < 0.05$) from A2, A3, A4, and not significantly different from A1 ($P > 0.05$). Treatment A1 was significantly higher ($P < 0.05$) from A3 and A4, but not significantly different from A2. Treatment A2 was significantly higher ($P < 0.05$) from A4 and the same as A3 ($P > 0.05$). A3 treatment was not significantly different from A4 ($P > 0.05$).

Table 2 shows a decrease in crude fiber content in complete feed silage made from teak leaves during storage, indicating the decomposition of crude fiber from microorganism activity during the fermentation process. (Styawati et al., 2014) Crude fiber content decreases with increasing fermentation time. (Sari et al. 2015) reduction of crude fiber during storage is due to microorganisms' breakdown activity on lignocellulose from the crude fiber. (Lamid et al. 2013) It caused the cellulase enzyme produced work at seven days has loosened the α -1,4-glycosidic bonds in the cellulose components. So, a breakdown of the cellulose components into oligosaccharides has decreased in crude fiber content.

The enzymes produced by cellulitic bacteria digest the substrate and utilize organic material to become energy sources. (Murashima et al. 2002) The decrease in teak leaves' crude fiber content is due to the lignocellulose and lignohemicellulose bonds' loosening. The role of *Actinobacillus* sp. which are cellulolytic bacteria produce three main enzymes. First, C1 (b-1, 4-glucan cellobiohydrolase or Exo-b-1,4-glucanase). Second, component Cc (endo-b-1,4-glucanase. Third, the component of cellobiose (b- glucosidase) endo-1- 4-â-glucanase, Exo-1-4-â-glucanase or cellobiohydrolase, and â glucosidase.

Endo glucanase breaks down cellulose randomly into cello-oligosaccharides. Exo-glucanase breaks down cellulose from the non-reducing end chains by releasing cellobiose. B-glucosidase hydrolyzes cellobiose and oligosaccharides into glucose. Then, it can be used as an energy source for microbes. The loosening of lignin bonds and cellulose bonds causes some of the nitrogen bound to the lignin fraction to be released. Apart from this, nitrogen is utilized by cellulolytic bacteria for optimum reproduction, growth, and activity. The increased proliferation of cellulolytic bacteria causes an increase in the population of cellulolytic bacteria. So that livestock can be used to degrade the lignocellulose complex bonds of teak leaves (Lamid et al., 2013).

2 Nutritional Mass Change

The percentage change in the nutrition of complete feed silage made from teak leaves. Average dry matter weight, crude protein, crude fat, and crude fiber can be seen in Table 3.

Table 3. Percentage change in the nutrition of complete feed silage made from teak leaves

Parameters	Storage Time			
	0-2 weeks	2-4 weeks	4-6 weeks	6-8 weeks
Dry Matter	-9.45%	-13.50%	-15.33%	-22.33%
Crude protein	-11.74%	-8.95%	-13.23%	-23.23%
Crude fat	-11.55%	-9.04%	-4.15%	-16.98%
Crude fiber	-10.46%	-14.71%	-17.94%	-22.95%

Note: (-) decrease in nutritional value (+) = increase in nutrition

Table 3 shows that 0-2 weeks' storage time is a fermentation phase because of the high decrease in crude protein and crude fat. Simultaneously, 2-4 weeks of storage is a stable phase characterized by a slow decline in crude protein and crude fat. The rate of decrease in nutrient mass, which is quite high at 4 - 8 weeks of storage, is due to other microorganisms' activity, besides lactic acid bacteria. It shows that the effective storage time in complete feed silage made from teak leaves is 2-4 weeks. Under the opinion (Spienza & Bolsen, 1993), the anaerobic fermentation phase is achieved in materials preserved through several processes. Plant cells begin to be broken down in anaerobic conditions. Hence, the cell walls undergo lysis, which can have a positive and negative impact. This lysis process produces sugar for lactic acid-producing bacteria for the fermentation process. This process also produces many enzymes that function to break down polysaccharides, which add sugar to the fermentation process.

According to (Fardiaz 1992), the microbial growth pattern is at first slow (lag phase) due to adaptation efforts to the environment. Then growing fast (log phase), that is when food is abundant. Then it will slow down and stationary (stationary phase), namely when the condition of food in the substrate is depleted, then growth decreases and leads to death (dead phase), which occurs when the tau's nutrients medium substrate needed by microbes are used up.

The activity of microorganisms in the stable phase is very low due to a lack of sugar. It results in a very slow drop in pH. (Nurchaidir, 2017) Stated that the fermentation time was 14 days, the pH value was 5.3, and after 28 days, the pH value decreased by 4.5. (Ranjit & Kung 2000) A good pH in the fermentation process is 3.8 - 4.2; if the pH exceeds 4.8, it indicates fermentation failure. It was also explained in (Yunianta & Hartatik, 2015) that day 14 showed a decrease in the number of microorganisms.

D. Conclusion

This research gave conclusions that the effective storage time for complete feed silage was made from teak leaves is 2-4 weeks. From the initial wet weight of 2000 g fresh matter to producing nutritional mass (dry matter, crude protein, crude fat, and crude fiber). namely 996, 63g; 94.15 g; 49.66; 189.66 g and lower degradation nutrient mass.

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