Feed NDF and ADF Digestibilities in Timor Deer (*Cervus timorensis*) Receiving an Additional Feed of Oil Palm Meal and its Daily Activities in Captivity

M. Mangun[1,*], M. S. Arifuddin[1], Damry[1], Najamudin[1], Mirajuddin[1], Syahrir[1], Y. Duma[1], Sukisman[1], M. Tanari[1], and Mustafa[1]

[1] Tadulako University, Palu 94119, Indonesia
*mardiahmangun18@gmail.com

Abstract. Study to investigate the digestibility of feed NDF and ADF components in Timor deer (*Cervus timorensis*) and its daily activities (eating, drinking, resting, sleeping, and chewing activities) in Timor deer (*Cervus timorensis*) receiving an additional feed of oil palm meal at different levels was carried out in August – September 2019. This study used 4 Timor deer, aged about 1-2 years, with a body weight range of 25-30 kg. The research was designed experimentally using the Latin Square Design (RBSL) with 4 treatments and 4 replications. The treatments applied were BKS0 (oil palm meal 0% + rice bran 94.49% + urea 3.80% + premix 1.0 % + salt 1.0 %) BKS10 (palm oil meal 10 % + rice bran 84, 91 % + urea 3.08% + premix 1.0 % + salt 1.0 %), BKS20 (oil palm meal 20 % + rice bran 75.33 % + urea 2.67 % + premix 1.0 % + salt 1 0.0 %), and BKS30 (oil palm meal 30 % + rice bran 65.74% + 2.25% urea + Premix 1.0% + salt 1.0 %). Data collection of the daily activities Timor deer used a camera closed-circuit television (CCTV) of the Xiaomi Xiaofang type. The camera was placed at the front of the research cage which was connected to the cellphone and could store the recordings in a micro external memory so that it can be reviewed at any time. Results showed that the digestibility of NDF fiber components tended to be affected significantly by the treatment with an average digestibility value for the treatment BKS0 = 69.99%, BKS10 = 63.84%, BKS20 = 63.01%, and BKS30 = 63.23%. The digestibility of ADF was affected significantly by the treatment with an average digestibility values for the treatment BKS0 = 55.98%, BKS10 = 47.21%, BKS20 = 45.17%, and BKS30 = 48.06%. The daily activities of Timor deer was found to be as follows: BKS0 = resting 55.9%, eating 30.7%, chewing 8.78%, sleeping 4.26%, drinking 0.48%, BKS10 = resting 55.97%, eating 27.28%, chewing 9.3%, sleeping 7.22%, and drinking 0.41%, BKS20 = resting 48.05%, eating 29.3%, chewing 12.04%, sleeping 10.09%, and drinking 0.48%, and BKS30 = resting 52.35%, eating 27.67%, chewing 13.85%, sleeping 5.79%, and drinking 0.41%. Based on the results of the study, it was concluded that there was an effect on fiber digestibility on the lower fiber fraction content. The lower the fiber content, the better the quality of the feed because the feed is easy to digest. Daily activity of Timor deer which is given feeds with different levels of oil palm meal with 12 hours of observation shows that resting activity is more dominant followed by eating, ruminating, sleeping and the least activity is drinking.

1   Introduction

Timor deer (*Cervus timorensis*) is a wildlife animal that is endemic to Indonesia. The current population of the animal in its native habitat in Indonesia is probably declining due to many factors such as habitat loss, habitat degradation and poaching. To prevent a further decline in population, Timor deer has been included as a protected wildlife according to the Indonesian Government Regulation No. 7, 1999. Deer keeping and breeding in captivity as an effort made to preserve the animals is expected to contribute to prevent a further reduction in deer population. The regulation allows the first deer offsprings (F1) resulted from the captive breeding to be transferred to other breeder as parents, while the second offsprings (F2) may be traded commercially, Timor deer is one of the native fauna of Indonesia that has the potential to be developed through livestock business that can produce various products that are beneficial to the community. Besides being an animal with a relatively good reproductive rate, Timor deer also have high adaptability and the need for relatively easy feed support in suitable agroecosystems.

The potential of a feed ingredient in providing nutrients for livestock for example in deer can be determined through chemical analysis. However, not all of these potential nutrients can be utilized, because the true value of feed ingredients is reflected in the part that is lost after going through the process of digestion, absorption and metabolism. Therefore, it is important to know the part of feed ingredients and nutrients that are lost after digestion. The high and low quality of feed ingredients is indicated by the digestibility coefficient of the feed ingredients. The higher the digestibility coefficient of a type of feed, the higher the quality of the feed.

Timor deer found in captivity in the Morowali district, Central Sulawesi, receive feed in the form of Rai grass (Poaceae) at the seedling level with an important value index of 80.76% and Maesa ramantacea at the sapling level of 51.90% [1]. The feed obtained in the captive area sometimes has problems in continuity. The productivity of the resulting grass is limited. To overcome these limitations, additional feeding is carried out, namely by providing palm oil meal waste in the feedstuff, in addition to the more continuous amount, which has not been widely used. So that research on the digestibility of the crude fiber component of the ration in Timor deer that received additional feed from palm oil meal waste, in general, is one way to overcome the problems faced related to forage Timor deer feed in captivity. Oil palm meal has problems to be used as animal feed ingredients because it has a high crude fiber content and low palatability, so it requires a touch of technology or further processing.

One of the plantation wastes that are quite available in Morowali Regency is the availability of oil palm meal such as cake which is not utilized as additional feed for Timor deer. Provision of additional feed such as oil palm meal is expected to meet the protein needs of Timor deer, so that the provision of food sources derived from animal protein from deer meat can be fulfilled as an alternative meat provider from ruminants in the future. One type of plantation industrial waste is oil palm meal. So far,

the oil palm meal has not been used optimally and just thrown away [2]. It is hoped that the research to determine the digestibility of the fiber components of NDF, ADF in the feedstuff and the daily activity pattern of Timor deer in captivity with addition-al feed of oil palm meal can be an illustration of the interest of Timor deer towards additional feeding of palm oil meal and their daily activity patterns, so that it can be a solution. in the availability of feed in captivity locations and can also be used as an illustration for the development of animal feed by utilizing palm oil meal as an alter-native in providing additional feed for Timor deer.

2   Materials and Methods

2.1   Study Site and Procedures

This research has been carried out for 40 days in the Timor deer breeding area in Wosu Village, Bungku Barat District, Morowali Regency, Central Sulawesi, then carried out laboratory analysis at the Nutrition and Animal Feed Laboratory, Faculty of Animal Husbandry and Fisheries, Tadulako University Palu and the Animal Feed Chemistry Laboratory, Department of Nutrition and Feed. Faculty of Animal Hus-bandry, Hasanuddin University, Makassar.

2.2   Feeds and Experimental Treatment Treatment

This study used 4 Timor deer, aged about 1-2 years, with a body weight range of 25-30 kg. The deer used in this study are deer that have been kept and bred by feeding according to their natural habitat. This study used 4 permanent individual cages, equipped with places to eat and drink. Deer were placed randomly into cage plots, each plot measuring 1.25 x 2 meters. The walls of the cage are made using boards, on the roof the material used is thatched roof and the base is soil, while the feed and drink containers use plastic buckets.

The feed was given in stages one hour before the provision of forage. The experi-mental animals were first given a ration consisting of oil palm meal with different levels, after which the cattle were given kale forage continuously during the treatment period.

There were 4 (four) feed treatments used in this study:

BKS0 = oil palm meal 0% + rice bran 94.49% + urea 3.80% + premix 1.0 % + salt 1.0 %
BKS10 = oil palm meal 10% + rice bran 94.49% + urea 3.80% + premix 1.0 % + salt 1.0 %
BKS20 = oil palm meal 20% + rice bran 94.49% + urea 3.80% + premix 1.0 % + salt 1.0 %
BKS30 = oil palm meal 30% + rice bran 94.49% + urea 3.80% + premix 1.0 % + salt 1.0 %

2.3   Calculations and Assumptions

Samples of the remaining feed (ration and forage) consumed and feces were taken every day in the data collection period (5 days) in each study period (periods 1,2,3 and 4). Sampling of the rest of the consumed feed and faecal samples was carried out

on one day after the ration was given. The time needed to wait for feces to come out is one day during the study period. After the stool sample was obtained, it was then dried in the sun to dry. After a period of research, the stool samples were homogenized according to the treatment and 100 grams were taken for analysis in the laboratory. This sample was taken from the beginning of the study to the end of the study.

The method of data collection in the study of the daily activities of the Timor deer used a camera closed-circuit television (CCTV) of the Xiaomi Xiaofang type. The camera was placed at the front of the research cage which was connected to the cellphone and could store the recordings in a micro external memory so that it can be reviewed at any time. Observations were carried out for 30 days starting from 08.00 to 17.00 WITA. Daily behavior of Timor deer was recorded every 10 minutes. Before observing the daily behavior of Timor deer, habituation was carried out on the Timor deer with the aim of preventing changes in behavior when the observations were made [3]. Daily behaviors that needed to be recorded include resting, eating, ruminatin, sleeping and drinking.

2.4   Laboratory and Data Analysis

To determine the components contained in the feed fiber, analysis was carried out using [4]. Neutral system to measure total fiber or insoluble fiber in neutral detergent (NDF) and acidic detergent system used to isolate insoluble cellulose and lignin as well as several components bound to both (ADF). The samples analyzed in the form of samples of feed (ration and forage) given and feces samples were carried out at the Nutrition and Animal Feed Laboratory, Faculty of Animal Husbandry and Fisheries, Tadulako University Palu and Animal Feed Chemistry Laboratory, Department of Animal Nutrition and Feed, Faculty of Animal Husbandry Hasanuddin University, Makassar. The working procedure of analyzing the levels of ADF, NDF, cellulose, hemicellulose and lignin according to [5]. The data obtained (digestibility of crude fiber components) as a result of the treatment tested were analyzed according to the experimental design used with analysis of variance using Minitab X. The determination of feed digestibility was carried out using the indicator method, namely lignin as an internal indicator. The formula for determining feed digestibility is as follows:

$$\text{Digestibility DM} = \frac{100 - (100\% \text{ X \% lignin in the die}}{\text{\% lignin in the feces rations)}} \text{ X \% BK in the feces / \% BK in}$$

Analysis of data was done quantitatively and descriptively. The calculation of the percentage of daily behavior of each individual was carried out using the Martin and Batcson formula. Quantitative data was obtained from the percentage of daily behavior observed [6]. Descriptive analysis was used to describe the daily behavior of Timor deer [7]. Data obtained from observations were recorded and the frequency percentage calculated for 30 days. Formula for calculating the percentage of daily behavior [8].

$$\text{Percentage (\%)} = \frac{A}{n} \text{ X 100\%}$$

Where :
A = frequency of behavior in 30 days
n = total frequency of all behaviors in 30 days

3   Results and Discussion

3.1   The Captive Breeding Area

The captive breeding area of Timor Deer is located in Wosu Village, West Bungku Subdistrict, Morowali District, Central Sulawesi Province. It is about 509 km from Palu, the capital city of Central Sulawesi Province. The captive breeding site has an area of about 20 ha which is divided into three paddocks separated one another with wooden fences. The area itself is surrounded by both wooden and iron fences.

The vegetations that were found to grow within the captive breeding area consisted of trees, forages and other plants that are potentially used as a source of feed by the Timor Deer. The trees function as shelters for the animals in which the area under the tree canopy are used by the animals for day napping and resting while regurgitating the swallowed feeds. The total population of the Timor Deer contained in the captivity was 150 heads; consisting of 30 bucks, 56 does, and 64 fawns and young deers. The body weight of bucks ranged from 65 to 75 kg, does from 45 to 60 kg, while those of fawns and young deers ranged from about 5 to 35 kg.

3.2   Digestibility of NDF and ADF

The results obtained showed that the digestibility of NDF fiber components in Timor deer, which were feeds treatment with different levels of oil palm meal, showed that the BKS0 treatment obtained a higher average digestibility value of 69.99%. The lowest average digestibility value was obtained in the BKS20 treatment with a value of 63.01%., while the digestibility of the ADF fiber component in the Timor deer, which was feeds treatment with the number of different levels of oil palm meal, showed that the BKS0 treatment obtained an average value. The higher digestibility is 55.98% and the lowest average digestibility value is obtained in the BKS20 treatment with a value of 45.17% can be seen in table 1.

Table 1. Average Digestibility of NDF and ADF Fiber Components

Treatmens	Variabels	
	NDF	ADF
BKS_0	$69,99^a$	$55,98^a$
BKS_{10}	$63,84^b$	$47,21^b$
BKS_{20}	$63,01^b$	$45,17^b$
BKS_{30}	$63,26^b$	$48,06^b$

[ab] Different superscript letters on the same line, showed a significant difference ($P<0.05$)

The results of the variance showed that the treatment of rations containing oil palm meal with different levels, on the digestibility of the neutral detergent fiber component of timo deer tended to have a significant effect (P< 0.05). The results showed that the digestibility of NDF in Timor deer, which was given treated with the feeds different, showed that the BKS0 treatment had the highest average digestibility value of 69.99%, followed by BKS10 treatment, which was 63, 84%, BKS30, 63.23%, and the lowest was in the BKS20 treatment, which was 63.01%. The digestibility value of NDF showed that the application of oil palm meal with different levels of feeding tended to have an effect on the digestibility of the NDF fiber component in Timor deer. In other words, the treatment of 0% oil palm meal in the optimal feeds met the needs of the timor deer. According to Arora [9] that the amount of digestibility determines the amount of nutrients that can be utilized to meet basic needs and growth.

The treatment have a significant effect on the digestibility of NDF. Sseveral factors have affect on digestibility of the type of animals used. Hofmann [10] that the ability to digest feed ingredients in animals can be determined by several factors such as the type of livestock, feed chemical composition and feed preparation. It is further explained that the digestibility of a feed ingredient, depends on the compatibility of the feed substances contained.

The constituent components of animal feed consist of cell contents and cell walls in fibers. Moileti and Kaho [3] divides forage components into two parts based on their solubility in detergent solution, namely cell contents or NDS (Neutral Detergent Soluble) which is easily soluble in neutral detergent consisting of proteins, carbohydrates, fats and soluble minerals. The other part is the cell wall or NDF which consists of two fractions, namely ADS (Acid Detergent Souble) which consists of Hemicellulose and cell wall proteins which are soluble in acidic detergents and Lignocellulose ADF which is insoluble in acid detergents. This ADF consists of cellulose and lignin.

The results of the variance (Table 1) showed that the treatment of the effect of given feeds containing oil palm meal, with different levels, on the digestibility of the acid detergent fiber components in Timor deer had a significant effect (P< 0.05). The digestibility ability of ADF in Timor deer, which the feeds treatment with different levels of oil palm meal, showed that the BKS0 treatment obtained a higher average digestibility value of 55.98% and the lowest average digestibility value was obtained in the treatment BKS20 with a value of 45.17%. While the BKS10 treatment scored 47.21%, and BKS30 was 48.06%.

The ADF digestibility value showed that the provision of oil palm mealwith different levels of giving gave a significant effect. Friedriks et al. [11] stated that each treatment of feed ingredients contained in it has different degradation variations and is highly depend on the part of the plant, age, level of lignification. The level of lignification is a specific characteristic of feed ingredients. ADF is a feed substance that is insoluble in acidic detergents consisting of cellulose, lignin and silica [4]. The easily digestible component of ADF is cellulose, while lignin is difficult to digest because it has double bonds. If the lignin content in the feed is high, the digestibility coefficient of the feed will be low [12].

The digestibility of the fiber fraction is highly dependent on rumen microbial activity, especially cellulolytic bacteria. High microbial activity requires the availability of sufficient nutrients, especially energy and protein. Adequate and balanced supply of energy and protein will optimize fermentation conditions in the rumen and increase the growth and performance of rumen microbes so that feed digestibility increases [13]. ADF contains 15% pentose called micellar pentose which is more difficult to digest than other types of carbohydrates. Pentose is a mixture of araban and xylan with other substances in plants. In hydrolysis, both produce arabinose and xylose which are found in hemicellulose [9].

3.3   Daily Activities of Timor Deer

Percentage of daily activity of Timor deer, can be showed at the Table 2.

Table 2. Percentage of daily activity of Timor deer in captivity

Treatmens	Variabels				
	Resting (%)	Eating (%)	Ruminate (%)	Sleeping%)	Drinking(%)
BKS0	55,90	30,79	8,78	4,26	0,48
BKS10	55,97	27,28	9,30	7,22	0,41
BKS20	48,05	29,30	12,40	10,09	0,48
BKS30	52,35	27,68	13,58	5,79	0,41

3.4   Resting Activities

Rest activity in this study is the most dominant of other activities. The percentage in each treatment did not change significantly in Timor deer that lived in the wild by spending 600 minutes resting [13]. The results showed that the highest percentage of resting activity was in the BKS10 treatment as much as 55.97%, then followed by BKS0 55.90%, BKS20 48.05% and BKS30 52.35%. the percentage of daily activity rest behavior is the most dominant when compared to other activities. This may be due to the lack of space for the deer to rest so that the deer do not need to find a place to take shelter from the hot sun or rain because they are in the research cage so that they have quite a lot of time to rest. When in nature the deer rest under a tree which is also a shade from the heat and rain [14]. Data collection for 12 hours from morning to evening is a factor that makes high resting activity [15]. The highest resting activity is during the day, after eating around 13.00-16.30 WIB. Scheduled supplementary feeding in the form of kale is also a factor in the high resting activity. when the water spinach feed is given, the deer tend to spend the feed immediately so that the deer spend more time resting while waiting for the water spinach feed and the deer are not active enough to consume experimental feed, according to Wirdateti et al. [16] resting activities are carried out in the morning and evening after the activity. eat. Dominant deer individuals tend to choose a more palatable feed. Deer also have an interval be-

tween feeding bouts. This interval is mostly filled with sitting and rumination activities [17].

3.5   Eating Activities

Daily activity on eating behavior in Timor deer showed that BKS0 treatment as much as 30.79% was the highest percentage of behavior. Then followed by treatment BKS10 27.28%, BKS20 29.3% and BKS30 27.69% respectively. These results indicate that deer are quite dominant in terms of eating activities compared to other daily activities. The high activity of eating behavior from all daily activities observed was because the deer did not need to compete with other deer because the deer were placed in each individual cage, equipped with complementary feeding which tended to be the same, namely kale and feeding at the same time. According to Afzalani et al. [18] the difference in the length of time the deer eats is due to differences in body weight and the type of feed given. During the observation, the Timor deer preferred the complementary feed of kale compared to the experimental feed. according to Indriyani et al. [19] that deer are ruminant animals that like to feed on fresh grass such as elephant grass.

3.6   Ruminate Activities

Ruminate activity of the Timor deer, from the observations made, showed that feeding with BKS30 treatment was 13.85%. was the highest chewing activity followed by BKS20 12.04%, BKS10 9.3%, and BKS0 8.78%. Deer ruminate activity removes food from the mouth and is ruminated on the sidelines of the deer resting or after eating. The high percentage of ruminate in the BKS30 treatment was thought to be due to the administration of more concentrate than other treatments. According to Semiadi et al. and Hoogerwerf's [20,21] foods that are more fibrous actually cause the time needed to chew longer.

3.7   Sleeping Activitie

The sleeping behavior of the deer in this study is quite high, this is thought to occur because of the influence of the deer in the research cage which has an impact on the lack of space for the deer and various other activities such as fighting between colonies. The provision of drop-in complementary feed causes the Timor deer to eat a lot and wait for feeding. feed during the day, so the deer tend to be active during the day and result in a lack of sleep behavior during the day. This is in accordance with Mahardika [22] statement that Timor deer in captivity tend to be more active during the day (diurnal) than at night (nocturnal), whereas in their natural habitat the Timor deer is an animal that is active at night. The highest percentage of sleep behavior was on feeding BKS20 which was 10.21% then followed by BKS10 7.53%, BKS30 5.79% and BKS0 4.4%.

3.8   Drinking Activities

Drinking activity is part of eating behavior. During the observation, the highest percentage of drinking activity was in the BKS0 treatment, which was 0.34%, followed by BKS10, 0.31%, BKS20, 0.51% and BKS30, 0.26%. From the total daily behavior carried out, the percentage of drinking is quite small and there are even deer that do not drink at the time of observation. This is presumably because supplementary feeding, namely kale, can meet water needs. According to Masyud et al. [23] that drinking activity is closely related to eating activity, the higher the eating activity, the smaller the drinking activity because water needs can be obtained from food in the form of grass. The small percentage of drinking activity is also related to the lack of space for deer to move in the research cage and also the research cage is protected from direct sunlight because the research cage uses a roof and is under quite thick trees, this is thought to affect the consumption of deer drinking water at the time of the study.

4   Conclusion

1. The digestibility of fiber components of NDF and ADF in Timor deer fed rations with different levels of oil palm meal showed that they tended to have a significant effect on NDF digestibility and had a significant effect on ADF digestibility. Based on the results of the study, it was concluded that there was an effect on fiber digestibility on the lower fiber fraction content. The lower the fiber content, the better the quality of the feed because the feed is easy to digest. The quality of ruminant feed is determined by the digestibility of NDF (Neutral Detergent Fiber) and ADF (Acid Detergent Fiber) while the digestibility of NDF and ADF determined by population and activity rumen microbes, especially microbes that capable and has cellulolytic activity.

2. Daily activity of Timor deer which is given rations with different levels of oil palm meal with 12 hours of observation shows that resting activity is more dominant followed by eating, ruminating, sleeping and the least activity is drinking.

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