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Research Article
Effect of Oil Palm Fronds and *Setaria* sp. as Forages Plus Sakura Block on the Performance and Nutrient Digestibility of Kaur Cattle

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Abstract

Objective: This study aimed to evaluate the effects of oil palm fronds as a substitute for *Setaria* sp., on dry matter and organic matter intake, weight gain and nutrient digestibility in Kaur cattle. **Methodology:** This study used a latin square design that consisted of 4 treatment groups with 4 replicates each. The 4 treatment groups were as follows: (1) Kaur cattle were fed 100% *Setaria* sp. + sakura block as the control (P0), (2) Kaur cattle were fed 25% oil palm fronds+75% *Setaria* sp. +sakura block (P1), (3) Kaur cattle were fed 50% oil palm fronds + 50% *Setaria* sp. + sakura block (P2) and (4) Kaur cattle were fed 75% oil palm fronds+25% *Setaria* sp. +sakura block. **Results:** Findings of the study showed that there were significant differences among the treatments ($p<0.05$) in all observed variables. Dry matter and organic matter intake and weight gains in P2 cattle were significantly higher ($p<0.05$) than the other treatments. **Conclusion:** It was concluded that the combination of 50% oil palm fronds and 50% *Setaria* grass plus sakura block resulted in the best performance of Kaur cattle.

Key words: Oil palm fronds, *Setaria* grass, sakura block, performance, Kaur cattle

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Kaur cattles are local cattle that have been maintained by the natives of the Kaur district, Bengkulu province, Indonesia for a long time (±20 generations) and have experienced natural selection in a tropical environment with the preservation of traditional ways. The Kaur cattle population is approximately 10,284 and is spread across all villages in the Kaur district[1]. Most local cattles are maintained in the field all day and therefore, consume only natural grass. Most Kaur cattles are maintained by natives because the cattles are more familiar with the local knowledge of the local culture. The maintenance system of Kaur cattle is currently done in the wild and Kaur cattle are more resistant to local diseases and parasites[2].

The existence of Kaur cattle is especially important for increasing the incomes of the local indigenous people. However, the beef cattle business in the area of oil palm plantations have faced several problems, such as the decline of forage production in the areas of oil palm plantations[3]. Umiyasih and Anggraeny[4] reported that dry forage derived from oil palm plantations, which is harvested every 30 days from oil palm crops aged 1-2, 2-5 or 6 years is as much as 5-7 t of dry matter/ha/year, 1-5 t of dry matter/ha/year and 1 t of dry matter/ha/year, respectively. On the other hand, oil palm frond production increases with increasing age of the palm oil plants. Simanuhuruk *et al.*[5] stated that there are 150 plants ha^{-1} of oil palm plantation but in the field, there are only 130 plants ha^{-1}. Each plant produces 24 fronds each year with an average weight of 3.44 kg per frond. Thus, in 1 year, a plantation area can produce as much as 10.7 t ha^{-1} of fresh fronds, which is equivalent to 1.95 t of dry matter/ha/year[6]. Oil palm plantations produce as many as 1.07 million t of oil palm fronds[7]. However, this biomass has not been an important component in the feed system in ruminant livestock farming[8] and its removal as waste has resulted in environmental problems.

The use of oil palm fronds as forage for ruminants in an integrated beef cattle-oil palm system would be beneficial in reducing production costs and increasing income[9,10]. In addition, the forage under oil palm plantations could also be used by ruminants up to as much as 60-70%[10]. The nutritive values of oil palm fronds are suitable as a source of forage for ruminants. Astuti *et al.*[11] reported that oil palm fronds contain 92.15% dry matter, 90.27% organic matter, 33.47% crude fiber and 4.84% crude protein. Akbarillah and Hidayat[12] reported that oil palm fronds contain 4.07% crude protein and 3,293 kcal kg^{-1} gross energy.

To stimulate growth, supplementation with high nutrient supplements are needed. Our laboratory has produced a supplement called the sakura block. The sakura block is a type of urea multi-nutrient block that is formulated from local feedstuffs that supports energy, nitrogen and other nutrients[13,14]. The main objective of sakura block (a type of urea multi-nutrient block) supplementation is to provide a constant source of degradable nitrogen throughout the day and promote the growth of rumen microbes in ruminants fed poor quality forage[15].

Santoso *et al.*[13] reported that using a sakura block increased weight gain, feed intake and feed efficiency in native goats. No study has been conducted to evaluate the combination of *Setaria* sp., oil palm fronds and sakura block as a beef cattle diet. Therefore, the purpose of this study was to evaluate the effects of oil palm frond and *Setaria* sp., grass combinations plus sakura block on the performances of Kaur cattle. It was hypothesized that the combination of oil palm fronds and *Setaria* sp., grass plus sakura block would result the highest performance of Kaur cattle.

MATERIALS AND METHODS

Animals: Four Kaur male cattle aged 10-12 months with an initial weight of 100±5.5 kg were used. This study was conducted from March-November, 2015 in the village of Pengubaian, South Kaur, Kaur district, Bengkulu province, Indonesia.

Feeding treatments: Sakura blocks were made from a mixture of ingredients, which included 32% brown sugar, 28% rice bran, 15% grits, 15% sago, 5% urea, 2% salt, 1% TSP and 1% top mix (Table 1). *Setaria* grass and oil palm fronds were mixed in accordance with the treatments, while sakura blocks were given in the form of blocks. The grass (*Setaria* sp.) is commonly used by farmers. Oil palm fronds were obtained after oil palm harvesting, the bottom 1/3 of the fronds were discarded and the fronds were peeled, cut into quarters and then cut into small pieces at a 4-5 cm size.

Table 1: Composition of sakura block

Feedstuffs (%)	Amount
Rice bran	28
Brown sugar by-product	32
Sago	15
Yellow corn	15
Urea	5
Salt	2
TSP	1
Mineral mixture	1
Top mix	1
Total	100%

TSP: Triple superphosphate

The diet amounts were as much as 3.5% dry matter of cattle live weight to meet the nutrient substance needs of the animals. Feeding was done 2 times a day, namely, at 09:00 and 17:00, with drinking water available at all times.

Experimental design: This study used latin square design, which consisted of 4 treatments replicated 4 times each. The four treatments tested were as follows:

- **P0:** Kaur cattle were fed 100% *Setaria* sp.+0.4 kg sakura block/head/day
- **P1:** Kaur cattle were fed 75% *Setaria* sp.+25% oil palm fronds+0.4 kg sakura block/head/day
- **P2:** Kaur cattle were fed 50% *Setaria* sp.+50% oil palm fronds+0.4 kg sakura block/head/day
- **P3:** Kaur cattle were fed 25% *Setaria* sp.+75% oil palm fronds+0.4 kg sakura block/head/day

Daily gain and feed consumption were measured. Cattle were maintained for 5 months.

Digestibility trial: The cattles were maintained in individual cages so that a quantitative collection of feces could be made. Accurate records of feed intake and fecal output were kept and a sub-sample of each (10% of daily output in the case of feces) was collected for analysis. Samples were then dried, ground and stored before analysis. After grinding, feces were stored at -20°C until analysis. Feed and feces composition analyses followed AOAC[16] standard procedures. The digestibility of nutrient was calculated as follows:

$$\text{Nutrient digestibility (\%)} = \frac{\text{Nutrient intake - Nutrient in feces}}{\text{Nutrient intake}} \text{x100}$$

Data analysis: The obtained data were analyzed using an analysis of variance[17]. If there were differences, they were then tested by Duncan's multiple range test.

RESULTS AND DISCUSSION

Kaur cattle characteristics: The cattle used in the study were male Kaur cattle obtained from farmers in South Kaur, Kaur district. The observational results showed that nearly 80% of cattle maintained by the community of Kaur district were local livestock, particularly Kaur cattle. Kaur cattles are local beef cattle in Bengkulu that must be conserved and are considered animal genetic resources for Bengkulu Province, Indonesia.

The development of Kaur cattle is very fast compared with other breeds. Kaur cattles are more attractive for small farmers due to several advantages, such as high manure fertility, high work capacity, the utilization of less nutritious forages, higher carcass percentage, lean meat, higher positive heterosis in crosses, higher adaptability to the environment and lambing percentages may reach 80%.

Male and female Kaur cattle have a white coat color that is slightly grayish, white, black and mixed black and white grayish. The bulls have an elongated head, a short neck, small ears that are straight to the top, big thighs and thick and hard skins. The wattle starts under the jaw and goes to the lower abdomen and they have a great gumba (hump) and big horns that are straight to the top, the female Kaur cattle have large bodies, which are long, deep and humped and have long horns that are rounded and positioned forward. These characteristics show that Kaur cattles are good worker cattle. These cattles have a high heat tolerance, are excellent worker cattle, are adapted to poor feed, have relatively fast growth and have a good carcass percentage.

Dry and organic matter intake: Experimental results showed that the treatments significantly increased ($p<0.05$) dry matter and organic matter intake. Kaur cattle that were given 50% oil palm fronds (P2) had 29.5% higher dry matter intake compared to P0 cattle. P1 or P2 cattles had 15.4 or 35.4% higher organic matter intake compared to P0 cattle, respectively. An increase in intake was due to the oil palm fronds (Table 2), which had a higher content of dry matter and organic matter compared to *Setaria* specie.

The high water content of *Setaria* grass may also cause conditions where the cattle's rumen is fully loaded (bulky), thus causing the animal to stop consuming. The average consumption of oil palm fronds in P0, P1, P2 and P3 were 0, 3.05, 6.77 and 8.77 kg day^{-1}, respectively, whereas the average consumption of S*etaria* grass in P0, P1, P2 and P3 was 16.52, 14.21, 12.36 and 8.01 kg day^{-1}, respectively. Each cattle consumed sakura block up to as much as 0.4 kg day^{-1} (Table 3).

The dry matter intake of P0, P1, P2 and P3 were 3.19 (2.36% b.wt.), 3.55 (3.38% b.wt.), 4.13 (3.23% b.wt.) and 3.35 kg day^{-1} (2.73% b.wt.), respectively (Table 3). These

Table 2: Nutrient composition of the experimental rations (%)

Feedstuffs	DM	Ash	CP	CF	EE	NFE
Setaria	18.70	2.02	7.55	28.71	2.25	56.65
Oil palm fronds	23.76	5.51	3.38	36.64	1.27	37.88
Sakura block	81.19	7.55	17.36	5.49	3.36	50.79

DM: Dry matter, CP: Crude protein, CF: Crude fiber, EE: Extract ether, NFE: Nitrogen free extract

Table 3: Effects of the feed treatments on feed intake, body weight gain and nutrient digestibility in Kaur cattle

	Treatments			
Variables	P0	P1	P2	P3
Oil palm frond intake (kg head^{-1} day^{-1})	0.00±0.00	3.05±0.20	6.77±0.17	8.77±0.15
Setaria sp., grass intake (kg head^{-1} day^{-1})	16.52±2.18	14.21±1.20	12.36±0.80	8.01±0.50
Dry matter intake (kg head^{-1} day^{-1})	3.19±0.18^{a}	3.55±0.20^{a}	4.13±0.22^{b}	3.35±0.25^{a}
Organic matter intake (kg head^{-1} day^{-1})	0.65±0.06^{a}	0.75±0/06^{b}	0.88±0.05^{c}	0.71±0.05^{ab}
Body weight gain (kg head^{-1} day^{-1})	0.21±0.07^{a}	0.34±0.07^{b}	0.60±0.60^{c}	0.22±0.03^{ab}
Dry matter digestibility (%)	44.77±5.38^{a}	54.49±2.02^{b}	55.48±3/13^{b}	56.22±2.81^{b}
Organic matter digestibility (%)	52.72±6.02^{a}	66.50±4.04^{b}	66.75±2.63^{b}	68.50±3/15^{b}

P0: 100% *Setaria* sp.+0.4 kg sakura block, P1: 75% *Setaria* sp., 25% oil palm fronds+sakura block, P2: 50% *Setaria* sp. +50% oil palm fronds+sakura block, P3: 25% *Setaria* sp. +75% oil palm fronds+sakura block. Different superscripted letters within the same row represents a significant difference ($p<0.05$)

results agree with the observations of Orskov and Ibrahim[18], who found that the consumption of dry matter in cattle ranges between 2-3% of the body weight. An increase in the consumption of dry matter may be partly due an increase in palatability and nutrient balance in the feed. The palatability is a major factor increasing feed intake[19]. The maximum feed intake depends on the balance of nutrients in the gastrointestinal tract[20]. Thus, oil palm frond is more palatable than *Setaria* sp., consumption causes diarrhea in Kaur cattle, causing lower palatability and the inclusion of palm fronds as a partial replacement of *Setaria* sp., removed the occurrence of diarrhea. However, the substitution of *Setaria* sp., in Kaur cattle diet more than 50% had a similar nutrient consumption as the control group.

It appears that the combination of 50% *Setaria* sp., 50% oil palm fronds and sakura block provided proper nutrition for the growth of microbes. An increase in microbial growth rates occurred because the sakura block provided essential substances such as glucose, nitrogen, minerals, vitamins and other nutrients[21]. Urea in the block can meet the majority of an animal's protein requirements because urea is converted into proteins by rumen micro-organisms. This process required soluble energy sources such as brown sugar and corn. The sakura block is a feed supplement that is made from materials such as rice bran, brown sugar, sago, corn, urea, TSP, salt, mineral mix and top mix and it is a good source for energy, nitrogen, vitamins and minerals[13].

Nutrient digestibility: As shown in Table 3, the experimental results showed that the treatments significantly improved the digestibility of dry matter and organic matter ($p<0.05$). It was observed that P0 cattle had lower digestibility compared to the cattle receiving the other treatments ($p<0.05$). P1, P2 and P3 had 21.7, 23.9 and 25.6% higher dry matter digestibility than that in P0. In addition, P1, P2 and P3 had 26.1, 26.6 and 68.5% higher organic matter than that in P0.

An increase in dry matter and organic matter in P1, P2 and P3 suggested that the addition of oil palm fronds and sakura block provided a better balance of nutrients and a better environment for bacterial activity to ferment feed in the rumen. McDonald *et al.*[22] stated that digestibility is influenced by several factors such as diet composition, the chemical composition of the ration, the physical form of the rations and animal genetics.

The process of microbial fermentation in the rumen is very important for the nutrient supply in livestock, so it needed to maximize feed utilization by optimizing the growth of microbes in the rumen[8]. Supplementation with sakura blocks with a high nutrient content, especially energy, protein and minerals was an effort to optimize microbial growth in the rumen[13]. However, the higher levels of substitution of *Setaria* grass had no effects on the digestibility of dry matter and organic matter. It was assumed that not all oil palm fronds provided in the feed were consumed because the cattle preferred to consume *Setaria* sp., than oil palm fronds when simultaneously presented. To improve the quality of oil palm fronds, they could be fermented[11,23,24].

The data indicate that oil palm fronds, which have low costs due to the products being available throughout the year, could be more widely used as a roughage source for ruminants and other herbivorous livestock[25,26].

Body weight gain: The experimental results showed that the feeding treatments significantly improved ($p<0.05$) body weight gain. The P1 and P2 cattles had a higher body weight gain than P0 cattle ($p<0.05$). The P1 cattles were 61.9% larger than the P0 cattles, whereas the P2 cattles were 190.5% larger than P0 cattles. The highest body weight gain in P2 cattle was partly caused by higher dry matter and organic matter consumption.

The high dry matter content of the oil palm fronds supplemented with sakura block in P2 may contain more suitable nutrition for the growth of micro-organisms in the rumen compared to the other treatments. It is assumed that the crude fiber of the oil palm fronds plus the sakura block could be utilized as a source of energy by rumen microbes, resulting in higher growth of the cattle rumen micro-organisms. Multi-nutrient blocks (such as sakura block) are potential sources of readily available energy and nitrogen[27]. This condition causes Kaur cattle to better utilize the nutrition[28].

Subagyono[6] reported that Bali cattle that were given oil palm fronds up to a 60% substitution, with 18% oil palm sludge, 18% palm kernel meal and 4% rice bran were able to produce a weight gain of 0.58 kg/head/day with a feed conversion ratio of 13.92. Azmi and Gunawan[29] reported that feeding oil palm frond up to a 55% substitution, with 30% natural grass and 15% solid, increased weight gain by as much as 226.66 g/cattle/day, while the cattle fed natural grass resulted in a weight gain of 215 g/head/day. Astuti *et al.*[30] reported that oil palm fronds could replace field grass with a better average daily gain in Kacang goat. Islam *et al.*[31] reported that oil palm fronds could support an efficient rumen function in terms of NH_3-N concentration and pH when given fronds at $\leq$50%. Nanda *et al.*[32] reported that feeding oil palm fronds at 60% to substitute field grass resulted in a 0.42 kg average daily gain in Bali cattle, whereas field grass at 60% resulted in a daily gain at 0.41 kg head^{-1}. Suharyono *et al.*[33] reported that feeding field grass plus urea molasses multi-nutrient resulted in a higher average daily gain (0.62 kg head^{-1}) compared to feeding field grass (0.28 kg head^{-1}) in Bali cattle.

The highest daily gain of Kaur cattle fed 50% *Setaria* sp.+50% oil palm fronds+sakura block may be due to higher dry matter and organic matter consumption and enhanced nutrient digestibility. This group reached a daily gain of 0.60 kg head^{-1}. However, feeding 75% oil palm frond drastically reduced daily gain to 0.22 kg head^{-1}. This condition may result from a drastic decrease in dry matter and organic matter consumption because dry and organic matter digestibilities were comparable to the 50% oil palm fronds group. Thus, this study demonstrates that Kaur cattle fed 50% *Setaria* sp. and 50% oil palm fronds plus sakura block performed better than those fed the control diet of *Setaria* sp., plus sakura block. To optimize the daily gain in this group, oil palm fronds could be fermented[11] and the quality of the sakura block could be improved by the addition of medical herbs[13,34-36].

CONCLUSION

It can be concluded that oil palm fronds could replace *Setaria* grass as much as 50% and result in the highest average daily gain in Kaur cattle.

SIGNIFICANCE STATEMENT

This study demonstrated that oil palm fronds could be beneficial for substituting *Setaria* sp., grass. The combination of 50% *Setaria* sp. and 50% oil palm fronds produced the highest average daily gain because of higher nutrient intake and higher digestibility. Thus, farmers could use this formula for feeding their beef cattle that are maintained under oil palm plantations. This study will help researchers uncover the critical areas of the integrated beef cattle-oil palm system (the combination of *Setaria* sp. planted under oil palm plantations and the use of oil palm fronds as forage) that many researchers were not able to explore. Thus, a new theory on the integrated beef cattle-oil palm system may have been arrived at.

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