PJN
ISSN 1680-5194
ansinet.com/pjn

PAKISTAN JOURNAL OF NUTRITION

Science Alert
scialert.net

ANSInet
an open access publisher
http://ansinet.com

OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2020.86.90

Research Article
Consumption and Body Weight of Bali Cows Fed Only Forage from a Palm Oil Plantation Under Indonesian Tropical Environmental Conditions

[1]Eny Endrawati, [2]Panjono, [2]Bambang Suhartanto and [2]Endang Baliarti

[1]Faculty of Agriculture, Khairun University, Jl. Pertamina Kampus II Unkhair Gambesi Kota Ternate Selatan, Indonesia
[2]Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No. 3, Bulaksumur, Yogyakarta 55281, Indonesia

Abstract

Background and Objective: An integrated system of cattle with oil palm plantations in Indonesia has the potential to increase the cattle population in a sustainable manner. This study aimed to assess the adequacy of Bali cow nutrient consumption and body weight of cows fed only with forage from oil palm plantations under Indonesian tropical environmental conditions. **Materials and Methods:** Twelve Bali cows were divided into two physiological groups, i.e., five pregnant cows and seven nonpregnant cows were observed to determine their feed consumption. Cows were given only forage from oil palm plantations in Riau Province, Indonesia that contained 22.24% dry matter (DM), 10.67% crude protein (CP),36.85% crude fiber (CF) and 54.37% total digestible nutrients (TDN). The observation of consumption was performed on cows in individual cages for seven consecutive days. **Results:** The results showed that when the cows were only fed with forage from oil palm plantations, the nutrient requirements of the cows were not met. For the pregnant cows, the DM deficiency was 2.76±0.20 kg head^{-1} day^{-1} (44.29±2.56 g kg^{-1} BW$^{0.75}$ day^{-1}), the CP deficiency was 176.0±35.8 g head^{-1} day^{-1} (2.83±0.62 g kg^{-1} BW$^{0.75}$ day^{-1}) and the TDN deficiency was 1.39±0.20 kg head^{-1} day^{-1} (22.30±1.58 g kg^{-1} BW$^{0.75}$ day^{-1}).For the nonpregnant cows, the DM deficiency was 2.01±0.41 kg head^{-1} day^{-1} (32.77±5.85 g kg^{-1} BW$^{0.75}$ day^{-1}), the CP deficiency was 81.4±40.5 g head^{-1} day^{-1} (1.30±0.65 g kg^{-1} BW$^{0.75}$ day^{-1}) and the TDN deficiency was 1.03±0.22 kg head^{-1} day^{-1} (16.80±3.16 g kg^{-1} BW$^{0.75}$ day^{-1}). After four months of observation, the average weight of the cows of each group decreased. **Conclusion:** From the study, it was concluded that Bali cow fed only forage from oil palm plantations did not consume enough to meet their nutrient requirements; additional nutrients are needed regardless of the pregnancy status of the cows.

Key words: Feed consumption, forage, oil palm plantation, Bali cows, pregnant cows, tropical environment, Indonesia

Received: January 28, 2019 Accepted: December 06, 2019 Published: January 15, 2020

Citation: Eny Endrawati, Panjono, Bambang Suhartanto and Endang Baliarti, 2020. Consumption and body weight of bali cows fed only forage from a palm oil plantation under Indonesian tropical environmental conditions. Pak. J. Nutr., 19: 86-90.

Corresponding Author: Endang Baliarti, Animal Science Production Departement, Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No. 3, Bulaksumur, Yogyakarta 55281, Indonesia

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

The system of raising cattle on a commercial scale must be low-cost to be economically feasible because the production period is long, especially in the cow-calf production system. As ruminants, the basal feed of cows is forage, which grows abundantly and naturally and is very diverse in tropical regions. The forage production of oil palm plantations has been studied by many previous researchers. The production of dry matter (DM) forage on oil palm plantations aged 6 years was 1.2 t ha^{-1} $year^{-1}$, with a nutrient content of 10.5% crude protein (CP), 22.43% extract ether (EE), 2.4% crude fibre (CF), 2.48% ash and 60.69% nitrogen free extract (NFE). The quantity and quality of forage production as a cattle feed vary depending on topography, climate, age of oil palm plants, etc[1].

Some previous researchers added concentrates to the cattle diet because the quality of the forages was insufficient. A proportion of 60% concentrate and 40% oil palm fronds, resulting in a higher digestibility of nutrients and apparent bioavailability of minerals and reduced mineral deficiencies[2]. The combination of 50% oil palm fronds and 50% *Setaria grass* plus a sakura block resulted in the best performance of Kaur cattle[3]. A lack of nutrient intake, especially in the prenatal phase, increases the risk of death during parturition and decreases calf health during growth[4]. The nutritional status of cows is one of the extrinsic factors that greatly affects the growth, development and main functions of the fetal organ system[5].

It is necessary to study whether or not sufficient consumption by pregnant and nonpregnant cows to meet their nutrient requirement is achieved if they are only fed with forage from oil palm plantations. The results of this study are very useful in terms of building or developing livestock industries based on cow-calf production systems.

MATERIALS AND METHODS

Experimental site: The experiment was conducted in one of the oil palm plantations in Riau Province Indonesia.

Materials and research tools: Five pregnant Bali cows and seven nonpregnant cows aged four to five years with a body weight of approximately 250-275 kg were used (Fig. 1). Bali cows when eaten forage from under oil palm plantation can be seen in Fig. 2. For use as feed, forage was obtained from oil palm plantations (Fig. 3). Individual enclosures were equipped with separate feeding and drinking places, digital

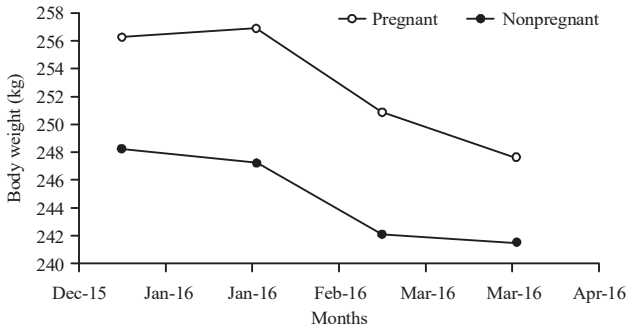

Fig. 1: Graph of body weight from pregnant and nonpregnant Bali cows with forage under oil palm

Fig. 2: Bali cows when eaten forage from under oil palm plantation

Fig. 3: Forage feed obtained from oil palm plantations

scales (Ruddweigh) with a capacity of 1,000 kg and an accuracy of 0.2 kg for weighing livestock and ACIS digital scales with a capacity of 15 kg and accuracy of 1 g to weigh feed and feed samples. A Wiley mill with a diameter of 0.2 mm, jars, an oven and a set of laboratory equipment were utilized for proximate analysis (DM, CP and TDN).

Research procedure: The livestock (12 cows)were divided into two groups: pregnant and nonpregnant. Each animal was placed in an individual cage equipped with a place to eat and drink *ad libitum*. Forages were provided 3 times a day, which were weighed before and after the cows were fed. The forage samples taken from the survey area were then subjected to proximate analysis (DM, CP and TDN) according to the method explained byAOAC[6].

Parameters measured: Consumption of DM, CP and TDN as well as the balance of the dietary requirements of DM, CP and TDN were measured. The body weight (BW) was measured once a month for 4 months and expressed as average values during the four months of the study.

Statistical analysis: Feed consumption and body weight data were analyzed with the independent t-test using the Statistical Program for Social Sciences (SPSS) version 16.0. Values of $p<0.05$ were considered statistically significant.

RESULTS AND DISCUSSION

Composition of forage nutrients: The composition of nutrients in the forage from oil palm plantation in Riau that was given to the pregnant and nonpregnant Bali cows is presented in Table 1. The nutrient composition of the forage used in this study is similar to that of other feed with a CP of 11-12% and a TDN of 48.5%[7]. The range of feeding densities in wetlands is 12-15.5% for DM; CP, 7.1-8.9%; EE, 2.2-2.5%, CF: 25.5-26.5% and TDN, 58-59%. The feeding densities in dry area range from 8-15.5% for DM; gray, 15-15.6%; CP, 6%; EE, 1.9-2%; CF, 25.5-26.3% and TDN, 55-56%[8]. Our results are also consistent with a previous study[1] reporting a nutrient content composition of forage that grew under oil palms for 3 years of 8.25% CP; CF, 23.2%; EE, 4.2% and gray, 2.48%, while after 6 years, the content was 10.5% CP; CF, 22.43%; EE, 2.4% and gray, 2.48%[1].

Consumption of forage feed: The average consumption of forage feed from oil palm plantations is presented in Table 2. The results of the study show that the consumption of DM in nonpregnant cows was higher than in pregnant cows. The consumption of DM and CP forage from oil palm plantations by the cows, based on the metabolic weight of nonpregnant cows, was higher than that of pregnant cows. The rumen volume in the late pregnancy phase will drop by 30% due to the suppression of the rumen ventral part by the fetus, resulting in a decrease in the ability to consume dry matter. The decrease in consumption of DM will be followed by decreased consumption of CP[9]. The level of consumption of dry matter is strongly influenced by the energy requirements for livestock and rumen capacity as well as by the nutrient content of the feed provided. Livestock will continue to consume feed until their energy needs are met and will then stop eating, even if the rumen capacity is not full. Conversely, if the rumen capacity is full, then the livestock will stop eating even if energy needs have not been met[10].

The total digestible nutrients consumption by the pregnant cows, based on the metabolic body weight, was higher than that of the nonpregnant cows, which shows that the efficiency of energy usage based on metabolic body weight (MBW) of the pregnant cows was higher than that of the nonpregnant cows (Table 3); this increases the lack of

Table 1: Composition of nutrients in forage from palm oil plantation in Riau

Nutrient	(%)
Dry matter	22.29
Ash	11.53
Crude protein	10.67
Extract ether	4.26
Crude fiber	36.85
Total digestible nutrient	54.37

Table 2: Consumption of forage feed from palm oil plantations

Parameters	Pregnant cow	Non-pregnant cow
Initial weight (kg)^{ns}	249.58±12.31	241.46±15.58
Consumption		
Percentage of BW (%)^{ns}	1.47±0.07	1.67±0.14
Dry matter (kg $BW^{-0.75}$)	58.84±3.18^{a}	65.75±5.34^{b}
Crude protein (g $BW^{0.75}$)	6.34±0.64^{a}	7.66±0.60^{b}
Total digestible nutrient (kg $BW^{0.75}$)^{ns}	31.64±1.83	34.56±5.27
Feed requirement		
Dry matter (kg $BW^{0.75}$)	103.12±1.25	98.50±1.60
Crude protein (g $BW^{0.75}$)	9.17±0.11	9.97±0.70
Total digestible nutrient (kg $BW^{0.75}$)	53.93±0.66	52.58±0.87
Balance requirement		
Dry matter (kg $BW^{0.75}$)	-44.29±2.86^{a}	-32.77±5.85^{b}
Crude protein (g $BW^{0.75}$)	-2.83±0.62^{a}	-1.30±0.65^{b}
Total digestible nutrient (kg $BW^{0.75}$)	-22.30±1,58^{a}	-30.33±3,16^{b}

BW: Body weight, a,b: Different superscripts on the same line show a real difference ($p<0.05$), ns: Non-significant ($p>0.05$)

Table 3: Average of body weight in Bali cattle during experiment

Body weight (kg)	Pregnant cow	Non-pregnant cow
First week of experiment^{ns}	247.66±12.31	241.46±15.58
Last week of experiment^{ns}	249.08±14.66	236.76±16.81
Average of body weight^{ns}	248.37±13.35	239.11±15.87

ns: Non-significant ($p>0.05$)

nutrition and the balance requirements of pregnant cows in terms of DM and CP is higher than that of nonpregnant cows. The balance requirement of non bovine TDN of nonpregnant cows was higher than that of the pregnant cows. The cow nutritional requirement for 3 months after pregnancy is as follows: 6.6 kg DM, 0.579 kg CP and 3.4 kg TDN[11].

The average DM consumption shown in the results was lower than that reported in another study, which stated that the consumption of DM, CP and TDN of pregnant cows on a farm were 8,089±0.61, 0.664±0.09 and 3.79±0.08 kg head^{-1} day^{-1} [12], respectively and Bamualim and Wirdahayati[7] stated that the consumption of DM in a wet area was 5.55±0.91 to 7.78±1.11 and similar to that in dry areas, which was 3.83±0.65 to 7.80±1.17 kg BW day^{-1}. The consumption of DM, CP, TDN and the percentage of BW in the other cattle at the farmers level were 4.45±0.44 kg, 0.41±0.04 kg, 2.26±0.22 kg and 1.86±0.11%[13], respectively. According to Imran and Budhi[8], the average CP consumption of the results of this study was lower than the results of previous study, which stated that the consumption of CP in the wet area was 0.42±0.06 and almost the same for dry areas, which was 0.31±0.05 to 0.44±0.06 kg BW day^{-1}.

Body weight of Bali cows: Changes in cow body weight in this study are presented in Fig.1. It was found that the body weight decreased for both pregnant and nonpregnant cows. This declining body weight indicates that the feed consumption was insufficient for basic living requirements. The weight loss in the pregnant cows was more than in the nonpregnant cows due to the insufficiently met nutrient requirements in the pregnant cows. Nutrient deficiencies, especially in pregnant cows, cause disruptions in fetal growth and calves are born with a low BW as a result of being born weak or are even still born. Pregnant cows that lack sufficient nutrient intake will experience a decrease in BCS. The nutrient consumption of the pregnant and nonpregnant Bali cows was based on an inadequate NRC standard, which is indicated by a decrease in body weight, as shown in Fig. 1.

Dry matter intake plays a major rolein meeting the nutrient requirements of cattle to maintain their health and productivity (production and reproduction). A low dry matter intake and deficiency in the nutrient supply (especially of protein and amino acids) could lead to immunosuppression and the incidence of metabolic disorders consisting of a decline in the value of body condition, ketosis, fatty liver and displacement of the abomasum[14]. Diets that have higher levels of CP are effective in maintaining cow productivity (production and reproduction) and the body condition value[15]. Oil palm plantations can be used as the pasture for Bali cattle or for other ruminants because it contains forage with sufficient nutrients, especially crude protein but for the Bali cows in this study, the DM consumption did not fulfill the nutrient requirements of the cows. Thus, when used as a grazing area, forage from oil palm plantations must be supplemented with concentrate to improve feed consumption and body weight, especially for Bali cows.

CONCLUSION

The consumption of DM, CP and TDN of Bali cows was not sufficient to meet basic living requirements if only given forage from oil palm plantations, causing weight loss in both pregnant and nonpregnant cows. Therefore, the addition of other feed ingredients that are better in quality are required to achieve optimum productivity.

SIGNIFICANCE STATEMENT

This study discovered that oil palm plantations can be used as grazing areas for ruminant animals but for optimum productivity, they must be supplemented with other feedstuffs, which may be beneficial for farmers and companies that act as locations for cattle farming.

ACKNOWLEDGMENT

This study was supported by PTUPT 2016, Penelitian Disertasi Doktor Grant 2018 from the Directorate of Higher Education, the Ministry of Research, Technology and Higher Education, Republic of Indonesia (RISTEKDIKTI-RI). The authors would like to thank the oil palm plantations in Riau that provided use of their land.

REFERENCES

1. Daru, T.P., A. Yulianti and E. Widodo, 2014. Potensihijauan di perkebunankelapasawitsebagaipakansapipotong di kabu patenKutaiKartanegara. Pastura, 3: 94-98.
2. Warly, L., Suyitman, Evitayani and A. Fariani, 2017. Nutrient digestibility and apparent bioavailability of minerals in beef cattle fed with different levels of concentrate and oil-palm fronds. Pak. J. Nutr., 16: 131-135.
3. Jarmuji, U. Santoso and B. Brata, 2017. Effect of oil palm fronds and *Setaria* sp. as forages plus sakura block on the performance and nutrient digestibility of Kaur cattle. Pak. J. Nutr., 16: 200-206.

4. Funston, R.N., D.M. Larson and K.A. Vonnahme, 2009. Effects of maternal nutrition on conceptus growth and offspring performance: Implications for beef cattle production. J. Anim. Sci., 88: E205-E215.
5. Godfrey, K.M. and D.J. Barker, 2000. Fetal nutrition and adult disease. Am. J. Clin. Nutr., 71: 1344S-1352S.
6. AOAC., 2005. Offical Methods of Analysis. 18th Edn., Association of Official Analytical Chemists, USA.
7. Bamualim, A. and R.B. Wirdahayati, 2003. Nutrition and management strategies to improve Bali cattle productivity in Nusa Tenggara. Proceedings of the ACIAR No. 110 on Strategies to Improve Bali Cattle in Eastern Indonesia, June 5, 2003, Canberra Australia, pp: 17-22.
8. Imran and Ir. S.P.S. Budhi, 2013. Dampak pening katankualitaspakanter had approduktivitassapibali di lomboktengah Nusa Tenggara Barat. Universitas Gadjah Mada, Yogyakarta.
9. Yulistiani, D., I.W. Mathius, I.K. Sutama, U. Adiati, R.S.G. Sianturi, Hastono and I.G.M. Budiarsana, 1999. Responproduksikambing pe induksebagaiakibatperbaik anpemberianpakan pada fase bunting tua dan laktasi. J. IlmuTernak Vet., 4: 88-94.
10. Sentana, P., 2005. Perbaikan status nutrisi pada sapi Bali bunting dalamupayameningkatkanbobotlahir dan pertumbuhanpedetprasapihsebagaipenghasildagingbermutu. Pros. SemilokaPeternakan, Kupang.
11. Kearl, L.C., 1982. Nutrient requirements of ruminants in developing countries. Ph.D. Thesis, International Feedstuff Institute, Utah Agricultural Experiment Station, Utah State University, Logan, UT., USA.
12. Anggraeny, Y.N. and U. Umiyasih, 2007. Tinjauantentangkecukupannutrisi dan dukunganteknologipeningkatankualitaspakan pada usahapembibitansapipotongrakyat. Proceedings of the Seminar Nasional Hari PanganSedunia XXVII. Dilaksanakan Pada Tanggal, Nopember 21, 2007, Badan Penelitian dan PengembanganPertanian, Jakarta, pp: 238-242.
13. Ketut, M.I., B. Endang, P.S.B. Subur, U. Nafiatul and N.C. Tri *et al*., 2016. Calf birth weight and post partum estrus Bali cow fed complete feed from palm oil plantation in Central Borneo Indonesia. Proceedings of the 17th Asian-Australasian Association of Animal Production Societies Animal Science Congress, August 22-25, 2016, Fukuoka, Japan, pp: 345-349.
14. Drackley, J.K., T.R. Overton and G.N. Douglas, 2001. Adaptations of glucose and long-chain fatty acid metabolism in liver of dairy cows during the periparturient period. J. Dairy Sci., 84: E100-E112.
15. Duffield, T.F., K.D. Lissemore, B.W. McBride and K.E. Leslie, 2009. Impact of hyperketonemia in early lactation dairy cows on health and production. J. Dairy Sci., 92: 571-580.