The Digestibility of Different Level of Palm Kernel Cake and Rice Bran Supplementation in Sheep

Dwatmadji*, Tatik Suteky, Indah Lestari, Mafika Sari, Mei Manurung

Department of Animal Science, Faculty of Animal Science, University of Bengkulu, Indonesia.
*Corresponding author E-Mail: dwatmadji.2008@gmail.com

ABSTRACT
The purpose of this study was to evaluate the effect of giving oil Palm Kernel Cake (PKC) and rice bran with different proportions to the digestibility of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), and energy in sheep. Twelve (12) sheep were divided into 3 treatments with 4 animals each, namely T1: supplementation of 15% PKC + 40% rice bran, T2: supplementation of 20% PKC + 35% rice bran, and T3: supplementation of 25% PKC + 30% rice bran. All livestock received supplementation of 2% body weight and were given ad libitum fresh grass and drinking water. This research was conducted for 21 days, consisting of 14 days adaptation period and 7 days collection period. Samples feed offered, feed residue, and fecal output were daily collected, dried in the sun to reduce water content, stored, and measured by DM, OM, CP, energy, CF, and energy. The data obtained were then analyzed using ANOVA, and continued with Duncan's Multiple Range Test to see the difference among the means. The results showed that increasing percentage of PKC in feed supplementation did not significantly increase (P>0.05) the digestibility of DM, OM, CP, and CF in all treatments, while the energy digestibility was increased especially at P3 which was significantly higher (p<0.05) compared to P1. The increasing percentage of PKC in feed supplementation has reduced the DM intake.

Keywords: Palm kernel cake, Digestibility, Sheep

1. INTRODUCTION
Palm kernel cake (PKC) is a by-product of the palm oil industry. Indonesia was estimated to produce 49.1 million tons of palm oil fresh fruit bunch (FFB) [1], and produce 1.3 million tons of PKC Indonesia. PKC contained 14 to 16% [2] or to 20% [3, 4] crude protein and 9.5 to 10.5 MJ metabolizable energy per kg [2], making this abundant oil palm by-product can be used as ruminant feed [2,3, 5, 6]. However, PKC also contains high amounts of Cu [2, 5, 7], which could be potentially toxic to sheep [8, 9]. The high addition of PKC (80% of total DM) could reduce the DM and nutrient intake by 40% [10] and might have an adverse effect on growth performance and carcass quality in ruminants [11]. Rice bran is widely used for feed supplementation for ruminants in Indonesia, especially for energy supplementation [12]. Although representing a small portion of rice by-products, rice bran contains one of the most nutritious, supplying protein, energy, and minerals [13].

This study aimed to evaluate the effect of giving oil PKC and rice bran supplementation with different proportions to the digestibility of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), and energy in sheep.

2. MATERIALS AND METHODS
The research was conducted in Setyolembu Farm, Sukoharjo, Central Java. The processing samples were prepared in the Department of Animal Science, University of Bengkulu, while the laboratory work was conducted in the Laboratory of Microbiology and Biochemistry, the University of IPB, Bogor.

2.1 Animals and feeding treatment
Twelve (12) 10-month-old thin-tail sheep, weighing 19.1 ± 1.2 kg and having similar Body Condition Score. All 12 animals were divided into 3 treatments with 4 animal each, namely T1: supplementation of 15% PKC + 40% rice bran, T2: supplementation of 20% PKC + 35% rice bran, and T3: supplementation of 25% PKC + 30% rice bran. All animals were placed in metabolic cages, and given 2% body weight supplementation and given ad libitum of fresh Pennisetum purpuroides grass. Free access to clean drinking water was also provided. This research was conducted for 21 days, consisting of 14 days adaptation period and 7 days collection period. Samples feed offered, feed residue and fecal output were daily collected, dried in the sun to reduce water content, stored, and measured by dry matter (DM), organic matter (OM), crude protein (CP), energy, and crude fiber (CF) [14]. Feed composition and feed nutritive content are presented in Table 1.
Table 1 Chemical composition of the feeds used in the experiment.

| Parameter                             | Treatments |
|---------------------------------------|------------|
|                                       | T1        | T2        | T3        |
| Feed supplementation composition (%) |           |           |           |
| Palm Kernel Cake (PKC)                | 15        | 20        | 25        |
| Rice bran                             | 40        | 35        | 30        |
| Cassava by-product Tapioca            | 30        | 30        | 30        |
| Salt                                  | 2.5       | 2.5       | 2.5       |
| Starbio                               | 2.5       | 2.5       | 2.5       |
| Molasses                              | 10        | 10        | 10        |
| Total                                 | 100       | 100       | 100       |
| Feed Supplementation - Nutritive Content |          |           |           |
| CP (%)                                | 7.44      | 8.76      | 8.89      |
| CF (%)                                | 12.25     | 12.70     | 16.36     |
| GE (cal/kg)                           | 3,998     | 4,010     | 5,822     |
| Grass Nutritive Content               |           |           |           |
| CP (%)                                | 13.48     | 13.60     | 13.75     |
| CF (%)                                | 21.07     | 22.30     | 22.53     |
| GE (cal/kg)                           | 4,588     | 4,697     | 4,702     |

2.2 Evaluation of digestibility

The digestibility of feed was calculated using this formula [15]:

\[ \text{Digestibility (\%)} = \frac{X}{100} \times 100 \%

2.3 Statistical analysis

Data generated from this study were analyzed using a one-way analysis of variance [16] which was performed using the SPSS for Windows (IBM Corp., USA). Significant treatment means were separated using Duncan’s Multiple Range Test and indicated by p<0.05.

3. RESULTS AND DISCUSSIONS

It is apparent in the present study that increasing PKC percentage in the supplementation resulted in lower total DM intake (both in the absolute terms or in the %liveweight) as shown in Table 2, in which T3 has significantly lower (p<0.05) than of T1. However, due to similar trend on the their faecal output, the DM digestibility remained similar for all treatments, ranging from 66.7 to 71%. The non significantly difference on OM digestibility value for all treatments in the present study seems to follow the DM digestibility value. When it was calculated in terms of DMI/liweight, the DMI in this experiment ranging 2.5 – 2.9% was within the normal range for sheep of 1.8 to 4.7% [17].

Table 2 Dry matter and organic matter intake, fecal output, and digestibility fed different PKC concentration of the experiment.

| Parameter measured            | Treatments |
|-------------------------------|------------|
|                               | T1        | T2        | T3        |
| Dry matter (DM)               |           |           |           |
| Intake (g/head/day)           |           |           |           |
| Grass                         | 366.1±97.64* | 319.4±137.74ab | 294.3±91.59b |
| Supplementation               | 192.7±34.88a | 182.4±20.20a  | 198.6±30.45a  |
| Total                         | 558.7±99.54a | 501.8±146.62ab | 492.9±90.85b  |
| % Liveweight (%)              | 2.9±0.55*  | 2.7±0.60ab  | 2.5±0.52*    |
| Fecal Output (g/head/day)     | 163.1±44.7a | 136.8±41.64ab | 159.5±44.96b |
| Digestibility (%)             | 70.5±6.96a  | 71.0±11.15a  | 66.7±11.26a  |
| Organic matter (OM)           |           |           |           |
| Intake (g/head/day)           |           |           |           |
| Grass                         | 294.1±79.06a | 265.5±100.10a | 242.8±74.97* |
| Supplementation               | 159.3±28.86a | 152.3±16.88a | 167.0±25.63a |
| Total                         | 453.4±80.98a | 417.9±107.31a | 409.8±74.34a |
| Fecal Output (g/head/day)     | 325.2±71.07a | 303.5±100.73a | 283.4±79.58a |
| Digestibility (%)             | 66.4±8.07a  | 67.3±12.31a  | 62.7±12.84*  |

*Means within the same row followed by different superscript letter are statistically different at p<0.05. T1: supplementation of 15% PKC + 40% rice bran. T2: supplementation of 20% PKC + 35% rice bran. and T3: supplementation of 25% PKC + 30 % rice bran.

The present study also showed that the digestibility value of CP and CF were all similar for all three treatments (see Table 3).
Increasing PKC level at 25% increased energy digestibility.

In general, the similar digestibility value of DM, OM, CP, and CF for all treatment in this experiment has directly resulted from the relationship between total intake and its respective output feces. The other reason for similar digestibility value (DM, OM, CP, and CF) was that, as [18] and [19] mentioned, the value of digestibility was directly influenced by feed consumption, feed composition, degradability, the ratio of protein to energy, and the factors associated with livestock. The somewhat similar nutrient value of CP, CF, and GE (Table 1) and its respective total intake and fecal output (Table 2 and Table 3) would also explain the similar digestibility value among treatments.

Although CP content of feed T3 was relatively higher than those of T2 and T2, the CP intake and digestibility were non-significant differences among treatments (Table 2). This was also caused by reducing DMI as PKC supplementation increased (Table 1). The average CP intake in this study of 60.76 – 66.38 g/head/day was lower than those of the [20] which was reported to be of 127-167 gram/head/day. The average CP digestibility in this study ranging from 80.35-83.41% was higher than the results reported by [23] i.e. 52.8-55.3%. The difference in energy consumption in this research is likely due to the differences in feed energy content and the quality of feed provided.

4. CONCLUSION

The results showed that increasing levels of PKC on feed supplementation reduced the DMI, but had no effect on the digestibility of DM, OM, CP, and CF on sheep. Increasing PKC level at 25% increased energy digestibility.

Table 3. Crude protein, crude fiber, energy intake, fecal output, and digestibility fed different PKC concentration of the experiment.

| Parameter measured | Treatments |
|--------------------|------------|
|                    | T1         | T2         | T3         |
| **Crude Protein (CP)** |            |            |            |
| Intake (gram/head/day) | 66.38±13.248a | 65.87±16.059a | 60.76±12.359a |
| Output feses (g/head/day) | 10.95±3.179a | 10.45±2.451a | 11.59±3.566a |
| Digestibility (%) | 83.32±4.228a | 83.41±4.806a | 80.35±6.996a |
| **Crude fiber (CF)** |            |            |            |
| Intake (gram/day) | 102.2±21.34a | 97.3±21.65a | 84.1±20.56b |
| Output feses (g/head/day) | 36.0±8.84a | 31.0±7.73b | 28.0±7.40b |
| Digestibility (%) | 63.9±9.16a | 66.9±9.52a | 65.4±10.88a |
| **Energy** |            |            |            |
| Intake (gram/day) | 2,435±435.6a | 2,376±480.1a | 2,544±422.01a |
| Output feses (g/head/day) | 579±137.4a | 493±119.45b | 505±135.9b |
| Digestibility (%) | 75.8±5.72a | 78.6±5.92b | 79.9±5.70b |

*Means within the same row followed by different superscript letter are statistically different at p<0.05. T1: supplementation of 15% PKC + 40% rice bran. T2: supplementation of 20% PKC + 35% rice bran, and T3: supplementation of 25% PKC + 30 % rice bran.

ACKNOWLEDGMENT

We acknowledge much to “Setyo Lembu Farm” in Sukoharjo District, Central Java Provinces, which have facilitated the place, sheep, feeds, and accommodation during the collection period.

REFERENCES

[1] Kementan Palm Oil Production by Province in Indonesia, 2016-2020. https://www.pertanian.go.id/home/?show=page&act=view&id=61. Accessed at 01 August 2020.
[2] S. Jalaludin, Feeding systems based on palm oil products and by-products. In Animal Science and Development: Moving Towards a New Century, pp. 295–306 [M Ivan, editor], Ottawa, Canada: Centre for Food and Animal Research, 1995.
[3] M. Zarei, A. Ebrahimpour, A. Abdul-Hamid, F. Anwar, N. Saari, Production of defatted palm kernel cake protein hydrolysate as a valuable source of natural antioxidants. International Journal Mol Science. 13 (2012) 8097-8111.
[4] F.A.S Dairo, A.O. Fasuyi, Evaluation of fermented palm kernel meal and fermented copra meal proteins as substitute for soybean meal protein in laying hens diets. J Central Eur Agric. 9 (1) (2008) 35-44.
[5] M.Y. Abdul Rahman, H. K. Wong, H. Zaini, H. Sharif, Preliminary observation on the alleviation of copper in sheep fed with palm kernel meal based diet. In Proceedings of 12th Malaysian society of animal production conference, Malaysia, 1989, pp. 75-78.
[6] A. R. Alimon, M. Ivan, S. Jalaludin, Effects of different levels of dietary sulfur and molybdenum on concentrations of copper and other elements in plasma and liver of lambs fed palm kernel cake diets. British Journal of Nutrition, 106(8) (2011)
[7] S. Jalaludin, Z.A. Jelan, N. Abdullah, Y.W. Ho, Recent developments in the oil palm by-product based ruminant feeding system. In Proceedings of the 3rd International Symposium on Nutrition of Herbivores, Malaysia, 1991, pp. 35–44. Kuala Lumpur: Malaysian Society of Animal Production (MSAP).

[8] Hair-Bejo, M. and A. R. Alimon, Hepatic damages and the protective role of zinc and molybdate in palm kernel cake (PKC) toxicity in sheep. Proceedings of the 15th Malaysian Society of Animal Production Conference, Malaysia, pp. 93–95, 1992.

[9] E.J. Underwood, The Mineral Nutrition of Livestock. Aberdeen: The Central Press Ltd, 1966.

[10] L.M.L. Bringel, J.N.M. Neiva, V.L. Araújo, M.A.D. Bonfim, J. Restle, A.C.H. Ferreira, R.N.B. Lôbo, Voluntary intake, apparent digestibility and nitrogen balance in sheep fed with palm kernel cake replacing elephant grass silage. Revista Brasileira de Zootecnia, 40 (2011) 1975–1983.

[11] A. Abubakr, A.R. Alimon, H. Yaakub, N. Abdullah, I. Michael, Effect of Feeding Palm Oil By-Products Based Diets on Muscle Fatty Acid Composition in Goats. PLoS One. 2015; 10(3) (2015) e0119756.

[12] W.L. Johnson, A. Djajanegara A, Pragmatic Approach to Improving Small Ruminant Diets in the Indonesian Humid Tropics. Journal of Animal Science 67(11) (1989) 3068–3079.

[13] T.W. White Rice by-products in ruminant rations. LSU Agricultural Experiment Station Reports. (1985), 847.

[14] AOAC, Official Methods of Analysis, fifth edition. AOAC (Association of Official Analytical Chemists) INC. Arlington. Virginia. U.S.A. 2000.

[15] P. McDonald, R.A. Edwards, J.F.D. Greenhalgh, C. A. Morgan, L.A. Sinclair, R. G. Wilkinson, Animal Nutrition (Seven Edit). Prentice Hall, 2010.

[16] W.W. Daniel, Biostatistics: A Foundation for Analysis in the Health Sciences. Fifth Edition. John Wiley & Sons. New York, 1991.

[17] C. Devendra, Utilization of Feedings Tuff from The Oil Palm. Feedings Stuff for Livestock in South Asia. Serdang, Malaysia, 1997.

[18] Van Soest, P.J., Nutritional Ecology of the Ruminant. Cornell University Press. Ithaca, NY. 1994.

[19] A.D. Tillman, H. Hartadi, S. Reksohadiprodjo, S. Prawirokusumo, S. Lebdosoekjojo, Ilmu Makanan Ternak Dasar. Gadjah Mada University Press. Yogyakarta, 1998.

[20] National Research Council, Nutrient Requirement of Sheep. National Academy Press. Washington D.C., 2006.

[21] I.W. Mathius, M. Martawidjaja, A. Wilson, T. Manurung, Studi strategi kebutuhan energi-protein untuk domba lokal: I. Fase Pertumbuhan. J. Ilmu Ternak dan Veteriner. 2 (1996) 84-91.

[22] S.R.L. Gonzaga Neto, F.H.S. Oliveira, A.N. Lima, L.R. Medeiros, J. BezerraVietas’ N.G. Nascimento Júnior, M.D. Freitas Neto, Milk production, intake, digestion, blood parameters, and ingestive behavior of cows supplemented with by-products from the biodiesel industry. Tropical Animal Health and Production 47 (2015) 191–200.

[23] K.G. Setyaningsih, A.R. Mahesti, D. Setyawati, Rahmadi, A. Purnomoadi, E. Rianto, Konversi Energi Pakan Domba Lokal Pada Bobot Hidup Berbeda Dengan Level Pakan 1.5 Kebutuhan Hidup Pokok. Fakultas Peternakan Universitas Diponegoro. Semarang, 2008.