THE PERFORMANCE AND ENERGY UTILIZATION IN ONGOLE CROSSBRED CATTLE RAISED UNDER TWO LEVEL SUPPLEMENTATIONS OF CONCENTRATE TO THE RICE STRAW

A. Purnomoadi, B.C. Edy, R. Adiwinarti, and E. Rianto
Faculty of Animal Agriculture Diponegoro University, Semarang

Received August 17, 2006; Accepted November 30, 2006

ABSTRACT

Eight Ongole Crossbred young bulls (aged 1.5 years; weight 217.5 kg) were used to study the effect of level concentrate supplementations to the rice straw on the energy utilization. Animals were randomly divided into two groups, first group were fed on 50% concentrate supplementation (C50), and the second group were fed on 70% concentrate supplementation (C70). The concentrate feed composed of rice bran and wheat bran at a ratio of 50:50. The rice straw was given to animals *ad libitum*. The parameters observed were daily intake of dry matter (DMI), gross energy (GE), fecal energy (FE), urine energy (UE), methane gas energy (CH4E) and daily body weight (BW) gain by total collection method for 7 days. Energy loss as methane gas was calculated by using the Kurihara's equation of methane gas production. The average daily BW gain was measured after the animal being raised for 12 weeks. The data were analyzed using the *t*-test. The results showed DMI and GEI of cattle fed C70 was higher (P<0.05) than that of cattle fed C50. The percentage to the GEI of energy excreted as feces, urine and methane were found lower (P<0.05) in C70 than that in C50. The metabolizable energy in C70 was higher (P<0.05) than that in C50, being 55.99 and 40.33 MJ/d or equal to 53.18 and 45.11%GEI, respectively. These results were correlated with the BW gain in C70 and C50, being 0.62 and 0.45 kg/d, respectively. The increasing of concentrate by 20% (from 50 to 70%) of the total DMI could significantly increase the available energy and body weight gain.

Keywords: energy utilization, supplementation, productivity, Ongole Crossbred

INTRODUCTION

The productivity of Indonesian Ongole Crossbred (OC) cattle was reported low, around 0.4-0.6 kg/d (Harmadji and Sudiono, 1975), 0.52 kg/d (Amini, 1998), 0.6 kg/d (Arifin *et al.*, 1998), but it much lower as 0.04 kg observed from cattle raised in farmer at Playen, Yogyakarta (Supriyono and Wartomo, 1979). This was resulted from most feeding applied at farmer level that was only around 55-60% of animal requirement based on NRC 1978 (Umiyasih *et al.*, 2002), and it did not meet the animal requirement for production. Animal productivity could be enhanced by improving the feed quality (Leng, 1993), such as by supplementation. The productivity of animal in form of body weight gain is the rest of metabolizable nutrients or energy after being utilized for their body maintenance.

It has been known that not all of the nutrient (i.e. energy) intake could be 100% utilized by animal, because a part of this feed will be excreted as feces that varied at 5–45% (Minish and Fox, 1979), 10–40% (Davies, 1982), 20–50% (Cole and Ronning, 1974), 40-50% (Maynard *et al*., 1979), and 45–50% (Bondi, 1987) depend on type and quality of the feedstuff (Maynard *et al*., 1979). Moreover, a part of this digestible energy will be excreted as urine and methane (NRC, 1996). Energy lost in urine varied at 4–5% (Maynard *et al*., 1979) or 3–5% (Parakkasi, 1999) resulted from nutrient metabolism in the form of urea that cannot be utilized by animal (Crampton and Harris, 1969; Ranjhan, 1981). The correlation between high protein feeding and energy utilization is that the excess of amino acid for protein synthesis will increase the energy loss from urine, and therefore reduce metabolizable energy (Davies, 1982). Meanwhile, energy loss as methane is resulted from digestion of carbohydrates by methanogenic bacteria

Table 1. Dry Matter Intake, Body Weight gain and feed conversion ratio

Parameters	C50	C70	P
Initial body weight (kg)	213	222	
Dry matter intake (kg)	5.19	5.91	0.034
Rice straw	2.12	1.56	0.001
Concentrate	3.06	4.35	0.001
Dry matter intake (%BW)	2.28	2.46	0.355
Digestibility of DMI (%)	49.98	60.05	0.015
Daily BW gain (kg/d)	0.45	0.62	0.118
Feed Conversion Ratio	11.20	8.81	0.288

P: Probability

in the rumen (Crampton and Harris, 1969) that varied at 2-12% of feed energy intake, depends on the feed quality (Holter dan Young, 1992) and the feed quantity (Shibata *et al*., 1993). Therefore, the lack of the study in energy utilization on Ongole Crossbred cattle leads this study on the feed utilization in OC cattle by giving two different levels of supplementation.

MATERIALS AND METHODS

Eight Ongole Crossbred young bulls (aged 1.5 years; weight 217.5 kg; CV: 6.9%), were used in this experiment. Animals were randomly divided into groups, each group consisting of 4 cattle and were kept into individual pen. First group receiving 50% concentrate supplementation (C50), while the second group receiving 70% concentrate supplementation (C70). The concentrate feed that composed of rice bran and wheat bran at 50:50 ratio was given to animal twice a day at 0700 and 1500. All cattle allowed to rice straw *ad libitum* to meet the dry matter (DM) intake of 3% of body weight. The rice straw contained 79.85% organic matter (OM), 4.49% crude protein (CP), 2.20% ether extract (EE), 31.97% crude fiber (CF) and 15.07 kJ/g gross energy (GE), while the concentrate contained 93.42% OM, 15.67% CP, 5.11% EE, 11.91% CF and 18.84 kJ/g GE, respectively. Drinking water also freely allowed to the animals.

The animals were adapted to the diet for two months prior to data collection periods. The total collection was done for 7 days by fitting the animal to the harness equipped with fecal collecting bag and urine delivery tube to the jerrycan for collecting the urine. The data collected were daily intake of dry matter (DMI), gross energy (GE), fecal energy (FE), urine energy (UE), methane energy (CH4E) and daily body weight (BW) gain. During the total collection period, dry matter intake was measured by weighing the given feed and residual. The fecal collected was sprayed by H2SO4 20%, while the urine was added H2SO4 to make the pH of urine become 3 or below.

The gross energy intake was calculated by multiplying the feed intake to the energy content of the feedstuff. The fecal energy was calculated by multiplying the fecal weight (in DM basis) to the energy content of the feces. The urine energy was calculated by multiplying the urine weight to the energy content of the urine. These energy values were determined by bomb calorymeter. Energy loss as methane was calculated by using the equation of methane production (Kurihara *et al*., 1995) such as follow: CH4 energy (liter/d) = 63.27 + 0.02678 DMI (g/d). The methane energy was determined by converting the methane production (L/d) into kJ that multiplied by 39.54 (Brouwer, 1965). The average daily gain was measured after the animal being raised for 12 weeks. Feed conversion ratio was determined by dividing the dry matter intake and the average daily BW gain. The data were analyzed by the *t*-test.

RESULTS AND DISCUSSION

Animal Productivity

Table 1 showed the dry matter intake, body weight gain, dry matter digestibility and feed efficiency. The dry matter intake of cattle fed C70 was higher ($P<0.05$) than that of cattle fed C50. This was considered as an effect of concentrate intake in C70 (4.35 kg or equal to 74% total DMI) that was higher ($P<0.05$) than that in C50 (3.06 kg or equal to 59%). The increasing DMI in C70 was pointed to the better rumen condition due to the concentrate supplementation that was shown by the increasing of digestibility ($P<0.05$) and might be the passage rate of feed (Tillman *et al*., 1998) that affected total dry matter intake.

The productivity performance in form of daily BW gain of cattle receiving C50 and C70 statistically was not different (P>0.05), even though there was a 0.17 kg/d difference. Similarly, feed conversion ratios (feed per BW gain) of both group cattle were not different.

Energy Utilization

The average of gross energy intake, excreted energy and available energy are presented at Table 2. The GEI of C70 was higher (P<0.05) than that of C50, and this was considered as an effect of increasing DMI. This result was agreed by the statement of Crampton and Harris (1969) and Choi and Song (2001) that the increasing of DMI as well as concentrate intake will increase GEI.

The percentage to the GEI of energy excreted as feces, urine and methane were found lower (P<0.05) in C70 than that in C50. This phenomenon was correlated to the fact that the percentage of rice straw in total DMI was lower (P<0.05) in C70 (26%) than that in C50 (41%). This was in agree with the statement that excreted energy in feces is affected by the feed intake, type of feedstuff and digestible fraction of feed (Crampton adn Harris, 1969; Maynard *et al.*, 1979; Bondi, 1987). Reducing energy loss in feces resulting in increasing the digestible energy. Similar reason was also pointed to the energy loss in methane (Maynard *et al.*, 1979; Tillman *et al.*, 1998). Moreover, methane energy negatively correlated to the feed quality (Holter and Young, 1992; Leng, 1993). However, the excreted energy in urine was due to the balance of energy and protein in the diet (Oltner and Wiktorsson, 1983; Refsdal *et al.*, 1989).

The metabolizable energy in C70 was higher (P<0.05) than that in C50, being 55.99 and 40.33 MJ/d or equal to 53.18 and 45.11%GEI, respectively. This result was correlated with the obtained BW gain in C70 and C50, being 0.62 and 0.45 kg/d, respectively. This was in agreement with fact that the body weight gain is the rest of metabolizable nutrient (in this study is energy) after gross energy intake was utilized for body maintenance. Since the energy for maintenance is correlated with the body weight, in this study it was similar due to the similarity in their body weight. Therefore the rest of energy for BW gain was bigger in C70 than that in C50.

This study can be concluded that the increasing of concentrate by 20% (from 50 to 70%) of the total DMI could significantly increase the available energy and body weight gain. However, the significant increase of available energy was not followed by significant decrease in feed conversion ratio. The possibility that may explain this phenomenon is that the energy for body maintenance was too high, so that the rest of the energy for increasing gain was not significantly different. Therefore, further experiment to explore the energy requirement for body maintenance should be carried out.

Table 2. Gross Energy Intake, Energy Excreted and Available Energy

Parameter	C50	C70	P
Gross Energy Intake (MJ/d)	89.59	105.49	0.024
Excreted Energy (MJ/d)	49.20	49.50	
Feces	38.45	38.64	0.851
Urine	2.17	1.99	0.755
Methane	8.58	8.87	0.034
% Excreted Energy (% GEI)	54.89	46.82	
Feces	42.89	36.53	0.032
Urine	2.42	1.87	0.039
Methane	9.58	8.41	0.014
Available Energy (MJ/d)			
Digestible	51.14	66.86	0.007
Metabolisable	40.38	55.99	0.006
% Available Energy (% GEI)			
Digestible	57.11	63.47	0.032
Metabolisable	45.11	53.18	0.020

P: probability

ACKNOWLEDGEMENTS

The authors thank to the ONGOLSTEIN 2006 research team for assistance during data collection.

REFERENCES

Amini, R. 1998. Pengaruh penggunaan jerami padi fermentasi terhadap performan ternak sapi Peranakan Ongole. Jurnal Ilmiah Ilmu-Ilmu Peternakan 1 : 40–47.

Arifin, M., W. Sukaryadilaga, E. Purbowati, R. Adiwinarti dan S. Mawati. 1998. Uji penggunaan kombinasi jerami padi-urea untuk peningkatan produktivitas sapi Peranakan Ongole. Jurnal Pengembangan Peternakan Tropis 23 : 7–12.

Bondi, A.A. 1987. Animal Nutrition. A Wiley-Interscience Publication (John Wiley & Sons). Chichester.

Brouwer, E. 1965. Report of sub-committee on constants and factors. In: Proceedings of the 3rd Symposium on Energy Metabolism, KL Blaxter (editor). Academic Press. London. pp441-443.

Choi, S.H. and M.K. Song. 2001. Effect of feeding level of concentrate and age on the FAS activities of adipose tissues in Hanwoo steers. Asian-Aust. J. Anim Sci. 14 : 1696–1700.

Cole, H.H. and M. Ronning. 1974. Animal Agriculture. W.H. Freeman and Company. San Francisco.

Crampton, E.W. and L.E. Harris. 1969. Applied Animal Nutrition (The Use of Feedstuffs in the Formula of Livestock Ration). 2nd ed., W.H. Freeman and Company. San Fransisco.

Davies, H.L. 1982. A Course Manual in Nutrition and Growth Manual. Australian Vice-Chancellors Committee. Melbourne.

Harmadji dan G. Sudiono. 1975. Pengelolaan usaha sapi potong tradisional. Kertas Kerja untuk Lokakarya Ternak Potong di Ujung Pandang. Bidang Manajemen, Fakultas Peternakan Universitas Gadjah Mada, Yogyakarta. Hal : 45–52.

Holter, J.B. and A.J. Young. 1992. Methane prediction in dry and lactating Holstein cows. J. Dairy Sci. 75 : 2165–2175.

Kurihara, M., S. Kume, T. Aii, S. Takahashi, M. Shibata and T. Nishida. 1995. Feeding Method for Dairy Cattle to Cope with Global Warming-Technical Assesment Based on Energy Metabolism. The Bulletin of Kyushu National Agricultural Experiment Station 29: 21–107.

Leng, R.A. 1993. Quantitative ruminant nutrition - A green science. Austr. J. Agric. Res. 44: 363-380.

Maynard, L.A., J.K. Loosli, H.F. Hintz, and R.G. Warner. 1979. Animal Nutrition. 7th ed., Tata McGraw-Hill Publishing Company Limited. New Delhi.

Minish, G.L. and D.G. Fox. 1979. Beef Production and Management. Reston Publishing Company, Inc. Virginia.

National Research Council (NRC). 1996. Nutrient Requirements of Beef Cattle. 7th rev. ed., National Academy Press. Washington DC.

Oltner, R. and H. Wiktorsson. 1983. Urea concentrations inn milk and blood as influenced by feeding varying amounts of protein and energy to dairy cows. Livest. Prod. Sci. 10; 457-467.

Parakkasi, A. 1999. Ilmu Nutrisi dan Makanan Ternak Ruminan. Indonesia University Press, Jakarta.

Pond, W.G., D.C. Church, dan K.R. Pond. 1995. Basic Animal Nutrition and Feeding. 4th ed., John Wiley & Sons. New York.

Ranjhan, S.K. 1981. Animal Nutrition in Tropics. 2nd rev. ed., Vikas Publishing House PVT LTD. New Delhi.

Refsdal, AO., L. Baevre and R. Bruflot. 1985. Urea concentration in bulk milk as an indicator of the protein supply at herd level. Acta Vet. Scand. 26: 153-163.

Shibata, M., F. Terada, M. Kurihara, T. Nishida, and K. Iwasaki. 1993. Estimation of methane production in ruminants. Anim. Sci. Technol. 64: 790-796.

Supriyono dan H. Wartomo. 1979. Produktivitas sapi Peranakan Ongole di Daerah Istimewa Yogyakarta. Proceeding Seminar Penelitian dan Penunjang Pengembangan Peternakan, Lembaga Penelitian Peternakan Badan Penelitian dan Pengembangan Pertanian Departemen Pertanian. Fakultas Peternakan, Universitas Gadjah Mada. Yoyakarta. Hal : 317–320.

Tillman, A.D., H. Hartadi, S. Reksohadiprojo, S. Prawirokusumo, dan S. Lebdosoekojo. 1998. Ilmu Makanan Ternak Dasar. Cetakan Kelima, Universitas Gadjah Mada Press. Yogyakarta.

Umiyasih, U., Aryogi dan Y.N. Anggraeny. 2002. Pengaruh jenis suplementasi terhadap kinerja sapi