RUMINAL CONDITION BETWEEN MADURA CATTLE AND ONGOLE CROSSBRED CATTLE RAISED UNDER INTENSIVE FEEDING

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ABSTRACT

Each four young bulls of Madura cattle and Ongole Crossbred (OC) cattle were used to study the efficiency of ruminal fermentation by comparing the proportion of Volatile Fatty Acid (VFA) of these two breeds which were raised under intensive feeding. All the cattle were in about 1.5 years-old with an average body weight of 147.75 ± 14.57 kg and 167 ± 22.57 kg, for Madura and OC cattle, respectively. They were fed Napier grass (*Pennisetum purpureum*) hay, and concentrate feeding consists of pollard, soybean meal and rice bran for 10 weeks. Parameters measured were concentration of VFA at 0, 3 and 6 h post-feeding and pH. The concentration of VFA in both Madura and OC cattle was peaked at 3 h post-feeding, being 136.1 mmol and 158.9 mmol, respectively, and then were decreased at 6 h post-feeding at a level of 58.1 and 98.2 mmol, respectively. The proportion of acetic acid in Madura and OC cattle were 53.33% and 52.0% of total VFA, respectively, while the proportion of propionic acid and butyric acid were 28.80% and 17.87% for Madura cattle, and 30.71% and 17.28% for OC cattle, respectively. In addition, the Acetic/Propionic ratios were 1.85 and 1.69 for Madura and OC cattle, respectively. Rumen pH conditions of both cattle breeds tended to be basic, i.e. Madura cattle was ranged at 8.0-8.4, while the PO cattle was ranged at 7.6-8.4. In conclusion, both cattle breeds (Madura and OC cattle) have a similar efficiency to utilize the feeds in the rumen.

Keyworsds:Ongole crossbred cattle, ruminal fermentation,VFA, Madura cattle

INTRODUCTION

Beef cattle population has not been able to meet the national requirement of cattle, and Indonesian government still must import more than 500,000 cattle per year. This condition leads to a greater attention to develop indigenous cattle as a beef producer. The indigenous cattle are superior in adapting to tropical conditions than imported beef (Rusfidra, 2005).

Madura Cattle are protected and preserved germplasm in the Madura island, as stated in Staatblad No. 57 year of 1934, No. 115 year of 1937, and is implicitly stated in Law No. 6 of 1967. Nowadays, Madura cattle in the main island are allowed to be crossed with other breed, except the cattle which were confined in Sapudi island (about 5000's head). Traditionally, Madura cattle are used to be work animals, bull race, and less being developed as beef cattle despite of having a compact body conformation and good beef quality as shown by her high carcass percentage (52%).

The effort to improve the productivity of Madura cattle has been done by two ways; firstly by genetic quality improvement, and secondly by improving feeding management including feed quality. In order to develop the Madura cattle to become beef-like cattle breeds, the detail program for improving the productivity of Madura cattle should be established. Similar study on another Indonesian indigenous cattle lives in Java (Java-Brebes cattle) showed that Java cattle has a feed conversion ratio in Java cattle was 2.2 point worst than of the OC cattle despite the DMI was little bit higher than OC (Lestari *et al*., 2011), but no further explanation on the reason on that phenomenon. Studies in Australia have shown marked differences in feeding patterns between *Bos taurus* and *Bos indicus* cattle in feedlot environment (Robinson *et al*. 1997 cited by Archer and Bergh, 2000), suggesting that differences between breeds in required to obtain a reliable estimate of feed intake may exist. In addition, there is an indication a relationship between low rumen pH and termination of voluntary feed intake (Fulton *et al*., 1979). Therefore, the basic potential of these cattle on feed utilization as well as on the rumen ability to degrade the feed prior to be utilized by animal's body should be studied.

MATERIALS AND METHODS

Animal and Feeding Management

The study was conducted at Laboratory of Meat and Drought Animal, Faculty of Animal Agriculture, Diponegoro University, Semarang. The animal used were eight young bulls consisted of four Madura cattle with an average initial body weight (BW) 147±14.57 kg (CV = 9.86%), while another four Ongole Crossbred (OC) cattle with an average initial BW 167±22.57 kg (CV=13.46%). All these cattle were in similar age, ranged at 12-16 months old. Madura cattle were brought from Madura island, while OC cattle was obtained from local livestock market around Semarang. They were adapted to the experimental condition for 3 months prior to data collection.

The intensive feeding management given to the cattle was composed of 30% Napier grass (*Pennisetum purpureum sp*) and 70% concentrate feeding. The feeds were formulated to fulfill the requirement for maintenance and production of animal by providing 15% crude protein (CP) and at least 55% total digestible nutrients (TDN) in dry matter requirement at 2.5% body weight (BW). Practically, the concentrate feeding was given to animal at a level of 1.75% BW, and was offered twice daily, i.e. morning (30% portion) and early afternoon (70%), while the grass was allowed *ad libitum*. The feedstuffs used to compose the feeds and its nutrient contents are presented in Table 1. Drinking water was provided freely.

Parameters Measured

The main parameters measured were pH and VFA concentration in rumen fluid. Another parameters measured were total dry matter intake (DMI), Napier grass, concentrate intakes, and DM digestibility. Rumen fluid was collected by inserting the plastic pipe into the rumen which was then inhaled by vacuum pump. This collection was performed three times, i.e. 0, 3 and 6 h post concentrate feeding in the morning. The collected rumen fluid was filtered by cheese clothes and then was measured for pH by using a pH meter. Rumen fluid was centrifuged at 3000 rpm for 10 minutes to separate the solid materials, and was then conditioned by adding a few drops of H_2SO_4 to stop the fermentation and storage at -20 C prior to volatile fatty acids (VFA) analysis. The VFA analysis was done by Gas Chromatography.

Dry matter intake was measured by subtracting feed residual to feed given in dry matter base. Meanwhile the DM digestibility was determined by subtracting fecal weight to dry matter intake for 7 days digestion trials. The dry matter was determined by oven at 135ºC for 2 hours.

Data Analysis

The data of pH, VFA and its change between the time of post-feeding from Madura and OC cattle was statistically analyzed by t-test (Steel and Torrie, 1981).

RESULTS AND DISCUSSION

Feed Consumption

The feed consumption in both cattle breeds are presented in Table 2. The total daily dry matter intake (DMI) in both cattle breeds was similar, but in the intake from Napier grass between two breeds were found different ($P<0.05$), being 3.25 kg/d and 2.58 kg/d for Madura and OC cattle, respectively. The DMI in Madura and OC cattle at an equivalent growth phase was similar, but if these DMI were calculated in percentage to body weight (BW), the total DMI and Napier grass intake between the two breeds were significantly different ($P<0.05$), being 3.61 and 1.94%BW in Madura cattle and 3.03 and 1.38% BW in OC cattle, respectively.

The DM digestibility in Madura cattle was numerically higher than of OC cattle, being 65.5 vs 61.9%, respectively. This was not agree with Walsh *et al*. (2009) who found DM digestibility increased linearly with increasing concentrate proportion, due to the increase in highly digestible nonstructural, readily fermentable carbohydrates and the decrease in less digestible fiber as the proportion of concentrate in the diet increased. This study found Madura cattle consumed concentrate feeding lower than that of OC cattle, as shown by ratio of forage to concentrate in Madura cattle was 53:47 while in OC cattle was

Table 1. Feedstuffs Composition (100% DM Base)

Feedstuffs	DM % as Fed	CP	EE	CF	NFE	Ash
Napier grass	42.48	8.41	2.05	29.10	42.72	17.72
Concentrates	88.99	17.50	5.72	12.49	54.70	9.58

DM: Dry Matter; CP: Crude Protein; EE: Ether Extract; CF: Crude Fiber; NFE: Nitrogen Free Extract

Table 2. Feed Intake and Digestibility of Feed

	Breed		Significance
	Madura	OC	
Initial BW, kg	147	167	-
Dry matter intake, (kg/d)	6.08	5.69	ns
Nagier grass	3.25	2.58	*
Concentrate	2.83	3.11	-
DM digestibility (%)	65.5	61.9	ns

*: significant in 5% level, ns: not significant

45:55. The reduction in DM digestibility as the proportion of concentrate in the diet increased can be attributed mainly to lower ruminal pH (due to the increased concentration of VFA) selectively restricting the activity of cellulolytic rather than amylolytic bacteria (Hungate, 1966; Russel and Dombrowski, 1980).

The pH and VFA Change

The ruminal VFA and pH within 6 hours after concentrate feeding are presented in Table 3. The concentration of VFA in the rumen was fluctuated, reached the peak at 3 h and decreased at 6 h after concentrate feeding, but overall, the total VFA in Madura cattle was lower than the OC. This fact indicated that the rumen microbial activity to digest the feed was reach the highest at 3 h post-feeding of the concentrate, and decreased at 6 h. This confirmed the statement of Briggs *et al*. (1957) cited by Van Soest (1994) that the VFA rumen to peak at 2-3 hours after feeding and will go down until it reaches the same point at the beginning of fermentation.

Feed consumed by livestock will be used for energy sources and structural components of tissues. A good feed intake can provide an optimal result of microbial fermentation, especially in the form of VFA that can be used directly as an energy source by the animal and microbial growth (Thalib *et al*., 2004), which will be absorbed through the rumen wall, into the blood circulation system, then be oxidized in the liver which in turn will be used to supply most of the energy requirements of cattle. In the utilization of VFA, pH plays an important role in determining the composition of VFA (Jouany, 1991), as well as affects the VFA absorption (Prawirokusumo, 1994).

The changes in the concentration of total VFA in the rumen were influenced by the feed consumed by livestock. The pattern of VFA production in the rumen of Madura and OC cattle showed that at 0 h post-feeding (before concentrate feeding was given), the VFA production in Madura cattle was higher than of OC cattle, but at 3 h and 6 h post concentrate feeding the VFA concentration in Madura cattle was lower than in OC cattle. These facts were confirmed by the lower pH in higher VFA and vice versa, as shown by the pH of Madura and OC cattle in Table 3. This condition indicated that the

Table 3. The pH and Volatile Fatty Acids in Rumen fluid of Madura and Ongole Crossbred Cattle on 0, 3 and 6 h Post Concentrate Feeding

Parameter	Breed	
	Madura	OC
pH		
0 hours	8.0	8.4
3 hours	8.4	7.6
6 hours	8.4	7.8
Average	8.3	7.9
VFA total, (mmol)		
0 hours	113.02	89.99
3 hours	136.11	158.87
6 hours	81.35	75.43
Average	110.16	108.10
Acetic acid, (mmol)		
0 hours	60.27	55.07
3 hours	72.68	77.65
6 hours	30.88	47.77
Average	54.61	60.17
Propionic acid, (mmol)		
0 hours	33.85	27.82
3 hours	35.80	44.14
6 hours	34.64	18.83
Average	29.49	35.54
Butyric acid, (mmol)		
0 hours	18.90	7.10
3 hours	27.63	37.08
6 hours	15.83	8.83
Average	18.30	20.00

All parameters were not significantly difference (P> 0.05)

rumen activity in the Madura cattle was less responsive than of OC cattle to concentrate feeding in providing the VFA as a source of energy and protein for host animal.

In the rumen, carbohydrates was used for energy source for growth (Hoover *et al*., 1992.), and sources of carbon atoms (C) for skeletal structure of protein (Asplund, 1994), which were derived from carbohydrates degradation (Ginting, 2005). There are two major groups of rumen microbes, the first group is the microbes that are able to utilize structural carbohydrates (cellulose and hemicellulose), and the second group is the microbes that are able to use N source for the process of protein synthesis (Russell *et al*., 1992). The microbial users of structural carbohydrates are growing more slowly compared to the microbial users of non-structural carbohydrates (starch, pectin and sugar) and those can use ammonia and amino acids as N source for protein synthesis.

The degradation rate of carbohydrates and high pH of the rumen resulted in releasing ammonium ion (NH_4) and CO_2 gas during the metabolism of protein and amino acids, so the rumen environment becomes alkaline and affect the composition of the VFA as end products of fermentation and animal performance (Jouany 1991; Russell *et al*., 1992).

The VFA proportions in rumen fluid was varied depend on the type of feed and feeding time (McDonald *et al*., 1988). The average proportion of major component of VFA in the rumen, such as acetic, propionic and butyric acid between Madura and OC cattle was very similar being 53.33%, 28.80% and 17.87%, for Madura and 52.0%, 30.71% and 17.28% for OC cattle, respectively. This similar proportion is considered pointed to similar feeding offered, and confirmed the strong influence of feed given to animal. Those proportions will be different when cattle consume feed with different proportion of concentrates and forage, as well as the type of feed and fermentation process.

The concentration of acetic acid tended to be larger than propionic acid and butyric acid (Bondi, 1987), and therefore able to provide about 80% of the energy needed by animal (Bergman, 1983; Susanti *et al*., 2001). Usually, the increased production of VFA will be followed by the increase production of ammonia indicates that protein degradation in the rumen occurs in large quantities. Ammonia production is the main product of the deamination of amino acids and the adequacy in the rumen is useful for microbial growth (Leng, 1991).

A/P Ratio

The ratio of acetic and propionic acid (A/P ratio) in Madura cattle (1.85) was higher than that of OC cattle (1.69), respectively, and demonstrated that Madura cattle have the potential to worse than the OC in utilizing feeds. These ratios were considered as an effect of higher consumption of Napier grass (which is generating acetic acid) in Madura cattle (1.94% BW) than in OC cattle (1.38% BW). The result of the A/P ratio was linear with the digestibility which was found Madura cattle (65.51%) were numerically higher than that in OC cattle (61.94%).

The grass intake will lead to produce more acetic acid and make the value of A/P ratio higher. Moreover, the higher A/P ratio indicated the lower efficiency in utilizing feed for producing body weight gain, so this study showed that Madura cattle was less efficient than of OC cattle, and that is pointed to Madura's superiority in utilizing the grass or fiber.

CONCLUSIONS

Based on the results of this study, it can be concluded that Madura cattle has a similar potential to the OC cattle, but OC cattle has better rumen degradation than of OC cattle. This study also showed that Madura cattle may be superior in utilization the fibrous feeding than of OC cattle.

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