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## PREFACE

In this edition, Volume 26 No 2, we proudly present articles from animal and veterinary sciences including genetics; reproduction, feed technology, and veterinary. The articles published in this edition are:

“Association of SNP g.232 G>T Calpain Gene with Growth and Live Meat Quality Prediction using Ultrasound Images in Bali Cattle”; “Metabolism Energy and Performance of Several Local Cattle Breeds Fed Rice Straw and Concentrate”; “Application of Plantaricin as an Antimicrobial Substrate in the Milking Process to Maintain Milk Quality in Smallholder Dairy Farm”; “Effect of Chicken Bone Extract Powder on Epididymal Sperm Quality of Male Wistar Rats”; and Avian Beta Defensin 2 (AvBD2) Gene Polymorphism Identification in IPB-D1 Chicken”.

We extend high appreciation to all peer reviewers who make this journal academically high value. Hopefully, these articles would offer any benefit to readers and the end-users of technological innovation, and attract interests from scientists to contribute their papers to the Indonesian Journal of Animal and Veterinary Sciences.

Chief Editor

Bogor, June 2021

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## LIST OF CONTENT

	Page
Association of SNP g.232 G>T Calpain Gene with Growth and Live Meat Quality Prediction using Ultrasound Images in Bali Cattle Dairoh, Jakaria, Ulum MF, Ishak ABL, Sumantri C .....	49-56
Metabolism Energy and Performance of Several Local Cattle Breeds Fed Rice Straw and Concentrate Utami ETW, Bata M, Rahayu S .....	57-64
Application of Plantaricin as an Antimicrobial Substrate in the Milking Process to Maintain Milk Quality in Smallholder Dairy Farm Wahyuningtyas AN, Arief II, Taufik E .....	65-73
Effect of Chicken Bone Extract Powder on Epididymal Sperm Quality of Male Wistar Rats Buranaamnuay K, Kettawan A, Changsangfa C, Aiemongkot S .....	74-81
Avian Beta Defensin 2 (AvBD2) Gene Polymorphism Identification in IPB-D1 Chicken Masrurah, Khaerunnisa I, Murtini S, Sumantri C .....	82-88
Acknowledgement	

# Metabolism Energy and Performance of Several Local Cattle Breeds Fed Rice Straw and Concentrate

Utami ETW, Bata M, Rahayu S

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## ABSTRAK

Utami ETW, Bata M, Rahayu S. 2021. Metabolisme energi dan performans beberapa bangsa sapi lokal yang diberi pakan jerami padi dan konsentrat. *JITV* 26(2): 57-64. DOI: <http://dx.doi.org/10.14334/jitv.v26i2.2711>.

Penelitian bertujuan mengkaji pengaruh bangsa sapi lokal terhadap metabolisme energi dan performans pada kondisi lingkungan dan pakan yang sama. Penelitian menggunakan empat bangsa sapi lokal yang berbeda 40 ekor sapi lokal jantan (2.5 tahun; BB awal  $300.30 \pm 0.68$ ) yang terdiri dari sapi Madura (M), sapi Sumba Ongole (SO), sapi Bali (B) dan sapi Bali Timor (BT) dan keempat jenis bangsa sapi tersebut sebagai perlakuan (10 ekor/perlakuan). Penelitian menggunakan rancangan acak kelompok (RAK) dengan bobot badan awal ternak sebagai kelompok. Jerami padi diberikan secara ad libitum dan pemberian konsentrat sebanyak 2.5 % dari BB (BK 86.53%). Peubah yang diukur yaitu konsumsi energi (KE), energi tercerna (ET), energi termetabolis (ME), retensi energi (RE), rasio RE terhadap KE, rasio RE terhadap ET, rasio C2/C3, efisiensi konversi heksosa menjadi VFA (EKH) dan rata-rata pertambahan bobot badan harian (PBBH). Hasil penelitian menunjukkan bahwa perbedaan bangsa sapi lokal berpengaruh nyata ( $P < 0.05$ ) terhadap KE, ET, ME, RE, rasio RE terhadap KE, rasio RE terhadap ET, rasio C2/C3 dan EKH, tetapi tidak berpengaruh nyata terhadap PBBH ( $P > 0.05$ ). KE, ET, ME, dan RE tertinggi pada M masing-masing 139.52 MJ/hari, 99.69 MJ/hari, 65.84 MJ/hari, dan 98.45 MJ/hari, rasio RE terhadap KE tertinggi pada B, sedangkan untuk rasio RE terhadap ET, rasio C2/C3, EKH dan PBBH terbaik pada SO yaitu masing-masing 99.24%, 28.85, 74.97%, dan 1.24 kg. Penelitian dapat disimpulkan bahwa SO memiliki kemampuan terbaik dalam performans dan memanfaatkan energi pakan.

**Kata Kunci:** Efisiensi energi, Bangsa sapi lokal, Metabolisme energi, Jerami padi

## ABSTRACT

Utami ETW, Bata M, Rahayu S. 2021. Energy metabolism and performance of several local cattle breeds fed rice straw and concentrate. *JITV* 26(2): 57-64. DOI: <http://dx.doi.org/10.14334/jitv.v26i2.2711>.

This study was conducted to examine the effect of different local cattle breeds on energy metabolism and performance fed on rice straw basal diet. Fourty local male cattle (2.5 years; initial BW  $300.30 \pm 0.68$ ) of Madura cattle (M), Sumba Ongole cattle (SO), Bali cattle (B), and Bali Timor cattle (BT) were used in this study, where types of local breed were used as treatments (10 animals/treatment). The study used a randomized block design (RBD) with cattle's initial body weight as a group. The cattle were fed on rice straw ad libitum and concentrate 2.5% BW (DM 86.53%). The variables measured were energy intake (EI), digestible energy intake (DEI), metabolizable energy intake (MEI), energy retention (RE), RE to EI ratio, RE to DEI ratio, C2/C3 ratio, the efficiency of hexose conversion to VFA (ECH) and the average daily body weight gain (ADG). The results showed that the different breeds of local cattle had a significant effect ( $P < 0.05$ ) on EI, DEI, MEI, RE, RE to EI ratio, RE to DEI ratio, C2/C3 ratio, and ECH, but had no significant effect on ADG ( $P > 0.05$ ). M has the highest EI, DEI, MEI, and RE 139.52 MJ/day, 99.69 MJ/day, 65.84 MJ/day, and 98.45 MJ/day, respectively, but the highest RE to EI ratio at B, while for the best RE to DE ratio, C2/C3 ratio, ECH, and ADG, at SO were 99.24%, 28.85, 74.97%, and 1.24 kg, respectively. It can be concluded that the best local cattle in terms of performance and feed energy efficiency are Sumba Ongole cattle.

**Key Words:** Energy efficiency, Local cattle breeds, Metabolism energy, Rice straw

## INTRODUCTION

Agricultural waste such as rice straw are used as alternative feed for ruminants to overcome limited land for forage cultivation. However, rice straw has a low digestibility only about 40-50% (Suryani et al. 2015). To meet energy requirement of livestock, it is necessary to supply energy source or concentrate feeds. Increased price of conventional feed ingredients has generate

efforts to increase feed efficiency due to feed could contribute about 60-70% of the total production costs.

Feed efficiency in ruminants is influenced by the presence of microbes in rumen. About 80% of ruminant energy needs for metabolism are obtained from the fermentation of feed by rumen microbes (Kong et al. 2016). Various studies have been conducted to manipulate rumen microbial environmental conditions, such as changing maintenance patterns, dietary

properties, or adding certain additives into feeds (Vera et al. 2014; Khan et al. 2016; Bata & Rahayua 2017; Soltan & Patra 2020). Although feeds have significant influences on rumen microbial community (Henderson et al. 2015), in adult ruminants, the attempts to manipulate rumen microbes have only able to survive temporarily (Anderson et al. 2016; Malmuthuge & Guan 2017; Weimer et al. 2017; Huws et al. 2018). Recent studies have informed a relationship between cattle breeds and the rumen microbial community (Hernandez-Sanabria et al. 2013; Sasson et al. 2017). Although this difference is only a small part, it affected the host performances, including its energy utilization efficiency (John Wallace et al. 2019).

Indonesia has various local cattle breeds including Pesisir cattle, Aceh cattle, Jabres cattle, Pasundan cattle, PO cattle, Sumbawa cattle, Sumba Ongole cattle, Bali cattle and Madura cattle, and those locals cattle are known to have high adaptability to low-quality feed (Hendri 2013). This low-quality feed adaptability is a distinct advantage for local cattle breeds to develop. Local cattle used in this study were Madura cattle, Sumba Ongole cattle, Bali cattle, and Bali Timor cattle, where Sumba Ongole and Bali Timor cattle are extensively raised and grazed in the pasture (Manu 2013; Palandi & Ngundjuawang 2014), while Bali cattle and Madura cattle are maintained intensively and generally rely on agricultural waste as basal feed (Kutsiyah 2016; Besung et al. 2019). Local cattle breeds are known to have different performances. Sumba Ongole cattle have ADG of 0.8-1.5 kg/day, feed efficiency equal to 10-19%, and percentage of carcass equal to 51-56% (Agung et al. 2015; Bata et al. 2016; Yantika et al. 2016). Bali cattle have ADG of 0.5-1 kg/day (Hau & Nulik 2017; Budiari et al. 2020) with percentage of carcass equal to 50-54% (Suryanto et al. 2017; Neno 2018; Priyono & Priyanto

2018) while Madura cattle have ADG of 0.2-0.6 kg/day (Wisnuwati et al. 2014; Rab et al. 2016) and percentage of carcass equal to 53% (Umar et al. 2011). It's presumably because local cattle breeds have different abilities in energy utilization. However, that performance was shown under different conditions and feeds. Therefore, the research objective was to examine the effect of local breeds of cattle on energy metabolism and performance in the same environment and feed. The information obtained can be applied to improve feed efficiency to support the fulfillment of national meat needs.

## MATERIALS AND METHODS

### Animal and diets

Fourty local male cattle aged around 2.5 years old were used in this experiment, consisting of: Madura cattle (M), Sumba Ongole cattle (SO), Bali cattle (B), and Bali Timor cattle (BT). Ten of each M, SO, B, and BT were imported directly from Madura, Sumba Island, Bali Island, and Timor Island, respectively. The average initial body weight of cattle used was 300.30±0.68 kg.

The cattle were grouped into ten group base on body weight. There were ten groups of body weight, namely 255-263; 264-272; 273-281; 282-290; 291-299; 300-308; 309-317; 318-326; 327-335; 336-344. Cattle were fed with rice straw and concentrate. Concentrate was composed of 47.60% cassava pulp, 24.00% pollard bran, 10.50% palm kernel meal, 10.00% rice bran, 7.00% soy bean meal, 5.70% coconut meal, 4.00% molasses, 1.6% dolomite, 1.0% salt, 0.60% Urea, and 0.30% mineral mix. The nutrient contents of feed is presented in Table 1.

**Table 1.** Nutrient of feed during experiment

Nutrient Content	Feed	
	Rice Straw	Concentrate
Dry Matter (%)	73.07	86.53
Ash (%)	23.45	17.16
Crude Protein (%)	4.00	13.82
Crude Fiber (%)	31.16	19.19
Ether Extract (%)	1.3	3.97
NFE (%)	40.09	45.86
TDN (%)	38.21	64.45
NDF (%)	71.43	42.83
ADF (%)	52.95	26.61
Gross Energy (MJ/Kg)	12.79	14.78

Result analysis of laboratory according to AOAC (2019)

NFE: Nitrogen-free extract; TDN: Total digestible nutrient; NDF: Neutral detergent fiber; ADF: Acid detergent fiber

## Experimental procedure

The study was conducted for 52 days, consisted of preliminary study for 14 days and measurement period 38 days. Before the preliminary study cattle was dewormed using Dovenix. The rice straw was bought from the rice fields area in Banyumas, Central Java and sun dried. The concentrate was given twice a day at 07.00 WIB and 15.00 WIB with a total daily offered 2.5% of body weight. Drinking water and rice straw were offered *ad libitum*. During the study, cattle were weighed 3 times, before preliminary, before measurement period, and the end of the measurement period using digital scale (SABB, Type:A1GB-3, Cap: 2 ton x 0,5 kg).

Data collection samples of feed (consumed and refusal), feces, and urine was carried out for 5 days using total collection method (Cole & Ronning 1974). Feed were sampled as much as 250 gr. The feed refusal was taken before morning feeding, weighed, and recorded. The samples of feed offered and the refusal dried in an oven at 60° for 48 h. Feces were collected used a known weight container, sprayed every 4 h using formalin solution to prevent the decomposition process. Feces were collected for 24 h then weighed, and recorded. The feces were sampled ( $\pm 3\%$ ) and dried in an oven at 60°C for 48 h. Feces and feed that had been collected for 5 d were compiled per individual and subsampled for analysis.

The collection of urine production by seting a diaper/harness made of used tires attached to the part of the cattle's penis that circles its stomach. A plastic hose connected to the bottom of the harness with a jerry can (20 l capacity), 20 ml of H<sub>2</sub>SO<sub>4</sub> 75% was filled into the can before the urine collection to keep the pH below 3 to prevent evaporation of ammonia. The urine was collected for 24 h, then the volume was measured, and sample was taken for 20ml. Urine samples were stored in a freezer (-20°C) until the sample collection was completed. Total urine collected for 5 d were mixed and stirred until homogen, and then sub samples were taken for analysis.

Rumen fluid samples were taken 3 h after the morning feeding. Sampling was conducted using a rumenocentesis technique (Petrovski. 2017), sterile needle was injected in the rumen position (done by an expert). The samples were taken as much as 3 ml, deposited, and 1.5 ml was separated from the feed sediment. The liquid was then put into the Eppendorf tube and centrifuged at 5000 rpm for 10 minutes. The supernatant was moved into a new tube and stored in a freezer at -20°C until analysis.

At the end of the experiment the cattles were weighed using digital cattle scale and the average daily gain (ADG) was determined by the difference between the

final weight and initial weight over the length experiment period. The energy utilization was determined by measuring energy intake (EI), digestible energy intake (DEI), metaboloizable energy intake (MEI), energy retention (RE), RE to EI ratio, and RE to DEI ratio using the total collection method (Cole & Ronning 1974). RE was determined from the difference between digestible energy intake and the total urin energy output. MEI was determined by the difference between energy retention and methane energy output. Methane energy output was calculated using estimation by Ryle & Ørskov (1990), ie.  $((2pa+2pb)-pp)/4 \times 210.8$ , pa is the proportion of asetate, pb is the proportion of butyrate, and pp is the proportion of propionate. Concentrations of VFA partial was measured using gas chromatography techniques (Guan et al., 2008). The efficiency of conversion of hexose to VFA (ECH) was calculated using estimates by Ryle & Ørskov (1990), ie. percentage of  $(0.622 pa + 1.092 pp + 1.560 pb) / (pa + pp + 2pb)$ , where pa is proportion of asetate, pb is proportion of butyrate, and pp is proportion of propionate.

## Chemical analysis

Proximate analysis of feed and analysis of moisture content in samples of feces and refusal feed during collection using the procedure AOAC., (2019). Feed, feces, and urine samples were analyzed using a bomb calorimeter (Dittmann et al. 2014) for gross energy and VFA partial from rumen fluids was analyzed using gas chromatography techniques was following procedures described by Guan et al., (2008).

## Statistical analysis

Randomized block design (RBD) (Steel & Torrie 1993) was applied in this study. The treatments were local cattle breeds, namely M, SO, B, and BT with the initial body weight of cattle as a group. Data were analyzed using analysis of variance and further testing using Duncan's Multiple range tests (DMRT) at level 5% performed by IBM SPSS statistic 25.0.

## RESULTS AND DISCUSSION

Average Feed Intake, EI, DEI, MEI, RE, RE to EI ratio, RE to DEI ratio, daily fecal energy output, daily urine energy output, methane energy output and the ratio of consumption rice straw and concentrates are presented in Table 2. The variance analysis showed that cattle breeds significantly affected ( $P < 0.05$ ) EI, DEI, MEI, RE, RE to EI ratio, RE to DEI ratio.



The EI of B and SO cattle similar, but was significantly lower than M and higher than BT. M cattle reasonable ability to consume feed was thought to be more adaptable to the environment's conditions and the feed given. The maintenance pattern on the cattle's origin area affects the cattle's ability to consume the feed. Several studies had revealed that Madura Island and Bali Island is an island with a relatively high density of livestock population so that another alternative to meet requirement for livestock feed, agricultural waste was as feed ingredients and maintain intensively (Kutsiyah 2012; Nugraha et al. 2015; Kutsiyah 2016; Besung et al. 2019). Liu et al., (2016) study using cannula dairy cows revealed that type of forage affects the dynamics of the microbial composition of rumen, where the presence of *Fibrobacteria*, unclassified *Bacteroidales*, unclassified *Rikenellaceae* and unclassified *Ruminococcaceae* digested more of low-quality forage such as rice straw than alfalfa hay. The ratio consumption of concentrate and rice straw (Table 2), show that M and B were able to consume more rice straw compared to SO and BT.

The lower rice straw consumption in SO and BT due to SO and BT originated from Sumba island and Timor island in which they were raised extensively with source of forage from pasture land, beside that various types of legumes have been planted to improve quality of the pasture (Palandi & Ngundjuawang 2014; Kleden et al. 2015; Hau & Nulik 2017), because SO and BT initially consumes better quality forage, possibly the fewer microbes able to digested low-quality feed. Zhang et al., (2014) mention that forages with more complex nutrients require greater microbial complexity to utilize all the components of the forage efficiently.

In contrast to EI, DEI and MEI showed differences significantly ( $P < 0.05$ ) for each local breed. This is due to the difference in energy wasted through feces, urine, and methane. M had the highest DEI and MEI, namely 99.69 MJ/d and 65.84 MJ/d, respectively, while the lowest was in BT at 79.51 MJ/d and 46.91 MJ/d. The low DEI and MEI in BT were due to BT consuming less energy, besides that, the energy lost through excreta and urine on

**Table 2.** Metabolism of energy on several breeds of local cattle

Parameter	Cattle Breeds			
	M	SO	B	BT
Feed Intake (DM/kg)	9.92±0.01 <sup>c</sup>	8.79±0.02 <sup>b</sup>	9.00±0.06 <sup>b</sup>	7.84±0.03 <sup>a</sup>
Concentrate (DM/kg)	6.34±0.03 <sup>b</sup>	6.32±0.02 <sup>b</sup>	5.57±0.04 <sup>a</sup>	5.60±0.02 <sup>a</sup>
Rice Straw (DM/kg)	3.58±0.03 <sup>c</sup>	2.46±0.03 <sup>b</sup>	3.43±0.02 <sup>c</sup>	2.24±0.03 <sup>a</sup>
C/RS ratio (%)	64:36	72:28	62:38	71:29
Energy Intake (MJ/d)	139.52±0.17 <sup>c</sup>	124.95±0.30 <sup>b</sup>	126.25±0.87 <sup>b</sup>	111.44±0.47 <sup>a</sup>
Energy Intake (kJ/kg BW <sup>0.75</sup> )	1836.35±2.27 <sup>c</sup>	1703.05±4.11 <sup>b</sup>	1557.53±10.73 <sup>a</sup>	1531.32±6.46 <sup>a</sup>
Fecal Energy (MJ/kg)	11.78±0.04	11.65±0.06	11.76±0.04	12.56±0.06
Fecal Energy Output (MJ/d)	39.83±0.15 <sup>c</sup>	38.62±0.25 <sup>b</sup>	32.53±0.15 <sup>a</sup>	31.93±0.19 <sup>a</sup>
Fecal Energy Output (kJ/kg BW <sup>0.75</sup> )	524.23±2.03 <sup>c</sup>	526.45±3.35 <sup>c</sup>	401.27±1.89 <sup>a</sup>	438.81±2.62 <sup>b</sup>
Digested Energy Intake (MJ/d)	99.69±0.20 <sup>d</sup>	86.33±0.34 <sup>b</sup>	93.72±0.77 <sup>c</sup>	79.51±0.29 <sup>a</sup>
Digested Energy Intake (kJ/kg BW <sup>0.75</sup> )	1312.12±2.59 <sup>c</sup>	1176.61±4.62 <sup>b</sup>	1156.26±9.51 <sup>b</sup>	1092.77±3.96 <sup>a</sup>
Energy Digestibility (%)	71.45±0.11 <sup>b</sup>	69.09±0.19 <sup>a</sup>	74.22±0.13 <sup>c</sup>	71.35±0.06 <sup>b</sup>
Urine Energy (kkal/g)	0.04±0.001	0.02±0.001	0.04±0.001	0.04±0.002
Urine Energy Output (MJ/d)	1.24±0.02 <sup>b</sup>	0.66±0.02 <sup>a</sup>	1.18±0.02 <sup>b</sup>	1.18±0.05 <sup>b</sup>
Urine Energy Output (kJ/kg BW <sup>0.75</sup> )	16.36±0.26 <sup>b</sup>	8.97±0.25 <sup>a</sup>	14.50±0.22 <sup>b</sup>	16.18±0.64 <sup>b</sup>
Methane Energy Output (MJ/d)	32.61±0.22 <sup>b</sup>	28.77±0.29 <sup>a</sup>	30.76±0.41 <sup>ab</sup>	31.42±0.32 <sup>b</sup>
Methane Energy Output (kJ/kg BW <sup>0.75</sup> )	429.21±2.92 <sup>b</sup>	392.15±3.91 <sup>a</sup>	379.45±5.09 <sup>a</sup>	431.83±4.34 <sup>b</sup>
Metabolizable Energy Intake (MJ/d)	65.84±0.29 <sup>d</sup>	59.90±0.44 <sup>b</sup>	61.79±0.36 <sup>c</sup>	46.91±0.12 <sup>a</sup>
Metabolizable Energy Intake (kJ/kg BW <sup>0.75</sup> )	866.55±3.86 <sup>c</sup>	775.49±5.96 <sup>b</sup>	762.31±4.41 <sup>b</sup>	644.77±159 <sup>a</sup>
Energy Retention (MJ/d)	98.45±0.21 <sup>d</sup>	85.67±0.34 <sup>b</sup>	92.55±0.76 <sup>c</sup>	78.33±0.29 <sup>a</sup>
Energy Retention (kJ/kg BW <sup>0.75</sup> )	1295.76±2.74 <sup>c</sup>	1167.64±4.53 <sup>b</sup>	1141.76±9.44 <sup>b</sup>	1076.60±3.97 <sup>a</sup>
RE to EI Ratio (%)	70.56±0.11 <sup>b</sup>	68.56±0.19 <sup>a</sup>	73.29±0.13 <sup>c</sup>	70.30±0.09 <sup>b</sup>
RE to DEI Ratio (%)	98.75±0.02 <sup>a</sup>	99.24±0.02 <sup>b</sup>	98.74±0.02 <sup>a</sup>	98.52±0.06 <sup>a</sup>

M: Madura cattle; SO: Sumba Ongole cattle; B: Bali cattle; BT: Bali Timor cattle; C/RS ratio: Ratio of concentrate and rice straw intake

<sup>a,b,c,d</sup> The difference superscripts in the same line show a significant effect ( $P < 0.05$ )

**Table 3.** VFA production and efficiency of the conversion of hexose to VFA(ECH) of various breeds of local cattle

Parameter	Cattle breeds			
	M	SO	B	BT
Acetic acid (mMol)	68.83±4.64	73.67±3.49	56.24±4.51	55.74±1.59
Propionic acid (mMol)	16.58±1.06 <sup>a</sup>	25.86±1.21 <sup>b</sup>	16.28±1.63 <sup>a</sup>	15.27±0.73 <sup>a</sup>
Butyric acid (mMol)	9.61±0.67	10.66±0.48	8.14±0.70	7.77±0.27
C2/C3 ratio	4.15±0.10 <sup>b</sup>	2.85±0.07 <sup>a</sup>	3.45±0.14 <sup>b</sup>	3.65±0.11 <sup>b</sup>
ECH (%)	72.50±0.14 <sup>a</sup>	74.97±0.18 <sup>b</sup>	73.69±0.27 <sup>ab</sup>	73.26±0.20 <sup>ab</sup>
Initial body weight (kg)	302.60±1.79	327.40±2.58	289.10±1.69	282.10±2.47
Final body weight (kg)	340.56±2.33	374.65±2.98	325.35±1.54	317.71±2.43
ADG (kg)	0.98±0.02	1.24±0.02	0.95±0.02	0.72±0.12

M: Madura cattle; SO: Sumba Ongole cattle; B: Bali cattle; BT: Bali Timor cattle

<sup>a,b,c,d</sup> The difference superscripts in the same line show a significant effect (P<0.05)

B was also not small. This is consistent with Van Zijderveld et al., (2011) that if the DE intake is not used much for methane formation, it will increase the ME intake.

Energy retention was affected by cattle breed (P<0.05). According to Amtiran et al. (2016), increased feed intake with high digestibility will increase energy retention in the body, where at the percentage of rice straw 80%, 70%, and 60%, energy consumption and energy retention in female local goat are 1661.11 kkal/day (1379.91 kkal/d), 1689.54 kkal/day (1397.02 kkal/day), and 1720.08 kkal/day (1437.59 kkal/day), respectively. The results of this study show the same thing (Table 2), M consume higher feed, so that M had the highest RE, and the lowest was BT. RE to EI ratio was lowest at SO (68.56%), which was significantly different (P<0.05) from the other three breeds of cattle, but at M (70.56%) and BT (70.30%), there was a similar value (P>0.05). Different results were that SO actually had a higher RE to DEI ratio, which was 99.24% (P<0.05), while the other three breeds of cattle did not show any differences (P>0.05). This is because the energy lost through excreta on SO is less so that more energy can be used by cattle for maintenance and producing meat.

Consumption of higher concentrates in SO and BT should lead to lower methane gas formation than M and B. The low production of methane gas (CH<sub>4</sub>) is due to the availability of hydrogen (H<sub>2</sub>) in the rumen, which is more used for the synthesis of propionic acid (C<sub>3</sub>) (Beauchemin et al. 2020). However, Table 2 shows different results. Only SO produces lower methane gas, while BT produces more methane gas compared to B and almost equal to M. This reinforces the statement that the amount of methane gas formed is not only from feed given (Zhou et al. 2011), but other factors have important contribution to the formation of methane gas (Basarab et al. 2013). Several studies have revealed that

large amount of methane gas emissions apart from feed is also affected by cattle genetics (Pinares-Patiño et al. 2013; Tapio et al. 2017; Auffret et al. 2018). Roehe et al. (2016) revealed that there is differences in microbial communities with low methane emissions and high methane emissions, where methane gas emissions in sire progeny Aberdeen Angus cattle were smaller than that of limousine cattle. This difference in microbial communities is thought to be due to the presence of core microbes that are genetically inherited and responsible for the formation of methane gas (Wallace et al. 2015; John Wallace et al. 2019; Li, Hitch, et al. 2019; Li, Li, et al. 2019; Abbas et al. 2020).

Methane gas formation is influenced by production of VFA, and it affects the ECH value (Beauchemin et al. 2020). The average concentration of acetic acid, propionic, butyric acid, C2/C3 ratio, ECH, and ADG are presented in Table 3. Differences in local cattle breeds did not affect (P> 0.5) acetate and butyrate concentrations but did affect (P<0.05) propionate concentration, C2/C3 ratio, and ECH. The propionate concentration of M cattle was similar to B and BT (P> 0.05) but lower than SO (P<0.05). It causes the C2/C3 ratio of SO was the lowest than the other three breeds of cattle. The ratio of C2/C3 in SO was also better than Cherdthong et al., (2014), with the same basal feed, namely rice straw, Thai native beef cattle had a C2/C3 ratio of 3.8, because, in that research, the consumption of rice straw was higher than concentrate. The C2/C3 ratio shows the amount of rumen microbes that can form acetic (acetogenic) or propionic acid (glucogenic), and it can be used to measure the efficiency of energy use in ruminants (Syapura et al. 2013). That was consistent with Mukhtiani et al., (2020) statement that a low C2/C3 ratio also indicates a higher ECH. Table 3. also shows that the ECH in SO is higher than the three other local cattle breeds. ECH on SO higher than M but was not significantly different to B and BT. According to Sari et

al. (2019), the high amount of fermentable organic matter causes a low C2/C3 ratio, this is because of *Propionibacteria* sp, *Veillonella alkalescens*, dan *Peptostreptococcus elsdenii* will use more lactic acid for the formation of propionic acid, which is a precursor for gluconeogenesis. Increased propionic acid concentration causes an increase in glucose production in the blood (Klau Tahuk et al. 2017). Ladeira et al. (2018) explained that meat production and the quality of marbling formation were influenced by glucose availability in the blood. Although local cattle breeds did not significantly affect ADG ( $P > 0.05$ ), but ADG on SO was higher than the three other breeds ( $P = 0.12$ ), namely 1.24 kg. The ADG of SO recorded by Yantika et al., (2016) could reach 1-1.57 kg.

## CONCLUSION

Madura, Sumba Ongole, Bali, and Bali Timor cattles' abilities to metabolize feed energy were varied. Sumba Ongole cattle was better than the other three local breed cattle in producing higher ADG even though the differences were not significant, so the best local cattle in terms of performance and feed energy efficiency is Sumba Ongole cattle.

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