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RESPONSE OF GLUMERULAR FILTRATION RATE AND PURINE DERIVATIVES EXCRETION TO FEED INTAKE IN BALI AND ONGOLE CROSSED BRED CATTLE

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ABSTRACT

Endogenous purine derivatives excretion in urine should be considered in estimating rumen microbial protein synthesis using urinary purine derivatives (UPD) method. This experiment was conducted to examine the response of UPD, nutrient digested and glomerular filtration rate (GFR) to feed intake in different breed of cattle. Four animals of Bali and Ongole Crossed Bred cattle were fed at four fixed levels of feed intake. The highest levels of intake was 90% of voluntary intake and the other levels were 80%, 65% and 40% of voluntary intake. The treatment was allocated according to 4x4 Latin Square Design. Each period last for 3 weeks. During the last 10 days of each feeding period, sample urine were collected daily for PD and creatinine excretion. Sample feces also collected for, Organic Matter and Dry Matter analyses. Blood samples were taken in every feeding period for creatinine and PD content. GFR was calculated based on creatinine content in blood and daily excretion of creatinine in urine. Using correlation approach, endogenous PD excretion in urine was estimated based on UPD at different level of feed intake. The result show that UPD excretion of cattle receiving 95%.80%,60% and 40% of voluntary feed intake were 398, 309, 272 and 214 µmol/MBW/d for Bali cattle and 349, 225, and 203 µmol/MBW/d for Ongole cattle respectively. There was significant positive correlation between Organic Matter Digested and UPD excretion at different levels of feed intake (P<.01). Endogenous UPD excretion were estimated to be 66 and 74 µmol/kg MBW/d for Bali and Ongole Crossed Bred cattle respectively. The GFR of Bali Cattle tended to increase when the level of feed increased, while GFR of Ongole Cattle were affected significantly by level of feed intake (P<.01). When it was expressed in metabolic body weight the GFR of Bali cattle significantly higher than that of Ongole cattle (10.86 vs. 9.54 l/ kg MBW/d). It was concluded that the proportion of PD entering the plasma that is excreted in the urine of Bali and Ongole cattle should be studied and taken in to account in the application of Urinary Purine Derivatives (UPD) excretion method for estimating rumen microbial protein.

Key words : Glumerular Filtration Rate, Purine Derivatives Excretion, Bali, Ongole Crossed Bred Cattle

INTRODUCTION

Ruminants can obtain protein direct from the diet that is not degraded in the rumen as well as from microbial protein that is synthesized in the rumen.

It has been realized that determination of microbial protein is very important. A calorimetric technique using enzymatic procedures has been developed for measuring purine derivatives (PD) in urine. The microbial protein supply to host animal can be estimated from the amount of purine derivatives excreted in the urine. The method has been developed mainly with European breeds of cattle and sheep (Chen *et al.*, 1990). Therefore, it would be important to investigate if *Bos sondaicus* (Bali cattle) and *Bos indicus* (Ongole cattle) were different in purine derivatives excretion rates and would require different prediction models.

Based on the reasons above, four experiments were carried out to develop prediction models for estimating the rumen microbial protein supply for Bali and Ongole cattle.

The relationship between PD excretion (Y) and purine uptake (X) can be written as Y = a + bX, where "a" is the endogenous excretion in the urine and "b" corresponds to proportion of PD entering the plasma that is excreted in the urine (Chen *et al.*, 1992). Since

some information indicated that there are huge differences between species in their responses of PD excretion to purine absorption, the differences between breed in one species might be occurred. The differences could be in the endogenous excretion or in the proportion of plasma PD that is excreted in the urine

This experiment was conducted to examine the response of PD excretion to feed intake. Extrapolation of PD excretion to zero level of feeding then could be calculated and the result expressed endogenous with PD excretion.

MATERIALS AND METHODS

Four animal of each breed were used in this experiment. All animals were fed twice daily at 8.00 h and 15.00 h with 49 days of King Grass.

During the preliminary period, all animals were fed at *ad libitum* level of intake and the lowest intake among animals of was set as the "voluntary intake". During each feeding period, feed samples were taken every day, and then composite. All animals were put in the individual metabolism cages. The four animals of each breed were fed at four fixed levels namely 95%, 80%, 60%, and 40% of voluntary intake. The treatments were allocated according to a 4X4 Latin Square Design. During each feeding period, feed samples were taken every day.

Each feeding period lasted for 3 weeks. During the last 10 days of each feeding period, urine and feces were collected daily.

Urine collection and preparation.

The daily urine was collected into plastic container with 10% H2SO4. Daily urine sub sample of about 80 ml was taken out and were stored at –20°C. The Urine samples which were collected during 10 days were used for PD and creatinine analyses.

Feces collecting and preparation.

Daily feces were collected, weight and homogenized by mixer. Ten percent of the total daily feces was taken and put in the polybag. At the end of each period feces samples were homogenized. The sub sample about 10% was taken and analysed.

Plasma sampling and preparation.

Blood samples were collected at the beginning and at the end of each period for creatinine, allantoin and uric acid analyses.

Table 1. Urine purine derivatives and creatinine of Bali and Ongole cattle fed different level of intake

	Level of feed intake				SE	P>F
	95%	80%	60%	40%		
BALI (µmol/kg MBW/d)						
Allantoin	330.93	252.93	227.27	179.95	28.34	0.046
Uric acid	67.50	56.25	44.43	34.21	5.38	0.021
Purine derivatives	398.33	309.18	271.70	214.16	33.25	0.038
Creatinine	1095.06	996.18	930.00	933.75	0.05	0.067
Live Weight (kg)	291	291	285	285	-	-
ONGOLE (µmol/kg MBW/d)						
Allantoin	349.48	312.80	225.00	202.94	12.32	0.004
Uric acid	61.10	55.11	39.48	29.90	3.68	0.033
Purine derivatives	410.57	367.91	264.49	232.84	12.89	0.002
Creatinine	828.05	961.63	747.02	770.09	0.06	0.079
Live Weight (kg)	310	309	307	303	-	-

Table 2. Nutrient digestibility of king grass fed to Bali and Ongole cattle at different level of intake

	Level of feed intake				SE	P>F
	95%	80%	60%	40%		
BALI						
Digestibility of dry matter (%)	58.69	58.35	60.25	59.69	1.93	0.982
Digestibility of organic matter (%)	62.04	62.10	64.15	64.27	2.04	0.811
Digested organic matter intake (kg/d)	1.67	1.42	1.10	0.73	0.02	0.001
ONGOLE						
Digestibility of dry matter (%)	60.03	58.02	57.78	60.70	2.62	0.723
Digestibility of organic matter (%)	63.18	61.88	61.81	65.08	2.18	0.739
Digested organic matter intake (kg/d)	1.79	1.48	1.11	0.77	0.30	0.001

Blood Samples were taken from jugular vein. Samples were centrifuged at 1500 g for 25 minutes and the plasma obtains were stored into cryotubes at -20°C for analyses.

Measurement.

The urine and the plasma samples were analyzed for uric acid and allantoin (Chen *et al.*, 1992) and for creatinine by Folin Hu method (Hawk *et al.*, 1976). Fecal samples were analyzed for dry matter and organic matter (AOAC, 1975).

RESULT AND DISCUSSION

Purine derivates excretion

Urine purine derivates excretion of Bali and Ongole cattle fed different level of intake are shown in table I, while the digested organic matter intake of both breed are shown in table II.

The daily excretion of allantoin and uric acid of both breeds gave response to the level of intake. The decreasing of feed intake level linearly decreased PD excretion. It was supported by the correlation of PD excretion

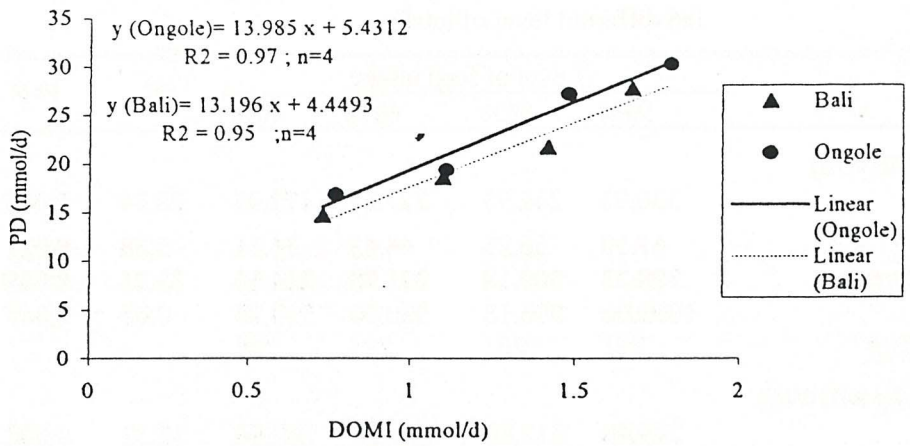

Figure 1. Relationship between purine derivative excretion and digestible organic matter intake (DOMI) in Bali and Ongole cattle.

and digested organic matter intake (DOMI) as Y =4.4493 +13.196x – (R^2 = 0.95, n = 4) for Bali cattle and Y = 5.4312 + 13.985x (R^2 = 0.97, n = 4) for Ongole cattle (see figure I).

The extrapolated endogenous PD excretion was 66 µmol/kg MBW/d for Bali cattle and 73 µmol/kg MBW/d for Ongole cattle. These values lower than that reported by (Chen *et al.*, 1990). They found the PD excretion 514 µmol/kg MBW/d.

Glomelural filtration rate

Plasma PD and creatinine, glomerural filtration rate (GFR), tubular load reabsorption of PD were listed in Table III.

Plasma allantoin, uric acid and PD of both breeds were not significantly (P>.05) affected by the level feed intake. Plasma creatinine concentration of Bali cattle was significantly affected (P<.01). The GFR of Bali cattle tended to be affected by level of feed intake, while the GFR of Ongole cattle increased significantly when the level of feed intake increased (P<.01). On the other hand, when the values were expressed in metabolic body weight, the GFR of Bali cattle decreased high significantly (P<.01) due to reducing of feed intake, while the GFR of Ongole cattle didn't influenced.

CONCLUSION

The daily excretion of purine derivatives (PD) of Bali and Ongole cattle gave positive response to the levels of feed intake. The extrapolated endogenous PD excretion was 66 and 73 µmol/kg MBW/d. for Bali and Ongole cattle respectively. The GFR of Ongole cattle increased when the level of feed intake increased, while the GFR of Bali cattle tended to be affected by level of feed intake. If it was expressed in metabolic body weight, the GFR of Bali cattle was higher than that of Ongole cattle. It was concluded that the proportion of PD entering the plasma that is excreted in the urine of Bali and Ongole cattle should be studied and taken in to account in the application of Urinary Purine Derivatives (UPD) excretion method for estimating rumen microbial protein.

Table 3. Glomelural filtration rate, tabular load and purine derivatives reabsorption of Bali and Ongole cattle fed at different level of intake

	Level of feed intake				SE	P>F
	95%	80%	60%	40%		
BALI						
Plasma (µmol/l)						
Allantoin	110.21	88.76	85.10	81.77	7.04	0.098
Uric acid	28.29	28.75	27.08	25.25	1.49	0.420
Purine derivatives	138.50	117.51	108.85	110.36	6.99	0.138
Creatinine	87.99	88.74	88.74	102.70	3.67	0.079
Urine creatinine (mmol/d)	76.77	70.18	64.83	63.74	2.64	0.043
GFR (l/d)	891.00	792.50	717.50	633.00	58.27	0.087
GFR (l/MBW/d)	12.72	11.24	10.36	9.11	0.85	0.006
ONGOLE						
Plasma (mmol/l)						
Allantoin	123.04	104.46	109.59	101.17	10.20	0.497
Uric acid	23.18	29.24	31.26	33.32	4.57	0.487
Purine derivatives	135.22	133.69	140.85	134.48	12.20	0.973
Creatinine	81.76	85.00	92.23	98.23	3.25	0.040
Urine creatinine (mmol/d)	61.04	70.88	54.66	56.00	2.58	0.016
GFR (l/d)	759.00	835.25	602.75	607.50	36.90	0.010
GFR (l/MBW/d)	10.28	11.36	8.32	8.22	0.99	0.120

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