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Improving the Productive Performance of Bali and Madura Bulls using Agricultural by-products as Feed Sources

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ABSTRACT

This study aimed to determine the level of rice straw and concentrate feed composted from agricultural by-products to improve the productive performance of Bali and Madura cattle. Two experiments were conducted parallelly in the Indonesian Beef Cattle Research Station at Grati, East Java. In each experiment, 28 bulls were used (Bali bulls>18 months; 312±15kg; LW sem; Madura bulls>18 months; 213±8kg). The experimental design in each experiment was a randomized complete block design with four treatments and seven replicates. The feed provided was rice straw and the concentrate feed that was offered at 3.5% live weight on a DM basis. The treatments were A: 20% rice straw (RS) + 80% concentrate (Conc.), B: 40% RS+60% Conc., C: 60% RS+40% Conc., and D: 80% RS + 20% Conc. The total DM intakes were not different between treatments. The DM digestibility tended to be higher (52 and 73% for Bali and Madura bulls, each) in groups eating high levels of rice straw. The high LW gain (0.6kg and 0.53kg in Bali and Madura cattle, respectively) was in the groups that ate 60-80% of concentrate feed. Bali bulls performed highly when they ate around 7kg DM/d of concentrate feed and 3.5kg DM of rice straw. Madura bulls need around 5kg DM each for rice straw and concentrate feed to support rapid growth.

Keywords: Agricultural by-products, Bali, Bulls, Feed sources, Growth, Madura

INTRODUCTION

Bali and Madura cattle are small indigenous Indonesian cattle predominantly kept by smallholder farmers in eastern Indonesia. Bali cattle were domesticated from wild Banteng and have adapted to the tropical climate of Indonesia for many years (Soetanto & Fatchiyah 2023). A report showed that Bali cows kept by smallholder farmers in an intensive system resulted in excellent reproductive performance (Budisatria et al. 2021). Another positive performance of Bali cattle is its high adaptability to low-quality feed such as agricultural by-products (from production and industries). However, Quigley et al. (2014) showed a low-efficiency use of metabolizable energy for increasing live weight gain in Bali cattle. However, the small size of Bali cattle is potential in the low input system that can produce low output in fattening. This may be more profitable for smallholder farmers that cannot provide high-quality feeds. Bali cattle have small mature sizes, low feed requirements, high fertility, and heat tolerance. Similarly, Madura cattle are also indigenous Indonesian cattle that are crossbreeding between Zebu cattle and Banteng. They are originally from Madura Island in the northeast of Java Island. Kusmartono et al. (2023) reported that Madura cattle are well adapted to low-quality feed, stress and diseases. These two breeds adapt well to the tropical climate of Indonesia.

Bali and Madura cattle are mostly kept by smallholder farmers and have low productive performance but have a potency to be improved. The growth rate of Bali cattle under a variety of diet regimes was extensively reported to have live weight gain (LWG) from 0.3 to 0.7kg/d (Quigley et al. 2014; Rahayu et al. 2021; Dahlanuddin et al. 2024). The variety of feed provided by the farmers caused the low LWG, especially during the dry season when the availability of grass is limited. What is more, the cause of the low productive performance of Bali cattle is low DM intake and other nutrients primarily energy (Tahuk et al. 2017). Similarly, Madura cattle at a weight of 200kg need 5.2kg/d of DM and 3.9kg/d of total digestible nutrient

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(TDN) to increase 1kg of live weight (LW) (Umar 2015). While the live weight gain of Madura cattle kept by smallholder farmers in the villages ranges from 0.2 to 0.5kg/d (Rab et al. 2016). Under an experimental condition, the LWG of Bali and Madura cattle was higher than 0.5kg/d (Bata et al. 2021; Kusmartono et al. 2023). Therefore, there is a potency to improve the growth rate of Bali and Madura cattle using more nutritious feeds.

Published data showed that the productive performance of Bali and Madura cattle that are fed agricultural by-products varies depending on the nutritional contents of the feed provided. For example, the LWG of Bali and Madura cattle fed rice straw *ad libitum* and 2.5% LW of concentrate feed (containing 13.8% crude protein, 42,8% neutral detergent fiber and 26.6% acid detergent fiber and 14.8MJ/kg of gross energy) was 0.95 and 0.98kg/d respectively, while the feed intake was 9-10kg DM/d (Utami et al. 2021). It was also reported that the LWG of Bali and Madura cattle fed ammoniated rice straw *ad libitum* and 2% of concentrate diet was 0.54-0.89kg/d and 1.34kg/d (Bata et al. 2021). Therefore, feeding agricultural by-products combined with nutritious feed can enhance the LWG of Bali and Madura cattle.

However, under farmer conditions, a recommendation on how much rice straw and concentrate feed composted from agricultural by-products needs to be elucidated. This study aimed to determine the level of rice straw and concentrate feed composted from agricultural by-products to improve the productive performance of Bali and Madura cattle.

MATERIALS AND METHODS

Animals and experimental design

Two separate on-station experiments were conducted in parallel and aimed to evaluate the effect of increasing rice straw and concentrate levels on *ad libitum* intake, LWG, the body condition score (BCS) and other parameters in Bali (experiment 1) and Madura (experiment 2) cattle were observed. The bulls were sourced from the herd of the population in the Indonesian beef cattle research station, Grati-Pasuruan. The duration of the experimental period in each experiment was 20 weeks and the bulls were previously undergoing a 2-week adaptation period. Experiment 1 was conducted from April to July 2021 and Experiment 2 was conducted from August to November 2021 in the Indonesian Beef Cattle Research Station (-7.717660036442408, 113.00717031243155), Grati, Pasuruan, East Java. All bulls were treated with anthelmintic (Albenol 100, Tekad Mandiri Citra, Ltd, Bandung, Indonesia) at 10mL/100kg LW before the commencement of the experiment.

The experimental design for both experiments was a completely randomized block design, consisting of four treatments and seven replicates (bulls) per treatment. At the commencement of each experiment, bulls were ranked and blocked based on live weight. Within blocks, animals were then randomly allotted to individual pens and treatments. The bulls remained in the same individual pens during each experiment with feed intake and digestibility determined.

Diets and feeding

The nutritional treatment for both experiments was rice straw (RS) (containing 71.5% dry matter, 4% crude protein, 1.6% extract ether, 27.4% crude fiber, 20% ash, 47.8% total digestible nutrient, and 65% neutral detergent fiber) and concentrate diet composted from 20.33% mashed dried cassava, 9.89% rice bran, 19.85% copra meal, 17.97% corn gluten feed, 30.11% wheat pollard, 0.9% salt and 0.95% limestone. The concentrate feed (Conc) contained 91.77% dry matter, 13.82% crude protein, 2.56% extract ether, 20.4% crude fiber, 15% ash, 64.9% total digestible nutrient, and 45.2% neutral detergent fiber. The feed was offered twice at 07:00 and 14:00. The feed was given to the bulls *ad libitum* at around 3.5% LW on a DM basis. The four experimental treatments were A: 20% rice straw (RS) + 80% Conc; B: 40% RS + 60% Conc; C: 60% RS + 40% Conc; and D: 80% RS + 20% Conc.

In experiment 1, twenty-eight Bali bulls, >18 months of age, and 311.8±15.5kg (Mean LW ± se), and in experiment 2 twenty-eight Madura bulls, >18 months of age, and 213±8kg (Mean LW ± se) were used. The bulls were then allocated to treatments and individual pens as described above.

Measurements and sampling procedures

The parameters observed were live weight gain, body condition score (BCS), hip height gain, dry matter intake, feed conversion ratio (FCR), the concentration of plasma metabolites (urea, glucose, and total protein), and the concentration of insulin-like growth factor-1 (IGF-1). The LWG and BCS (1-5 scales) of bulls were measured fourth nightly, in the morning before feeding. The hip height was measured every two weeks at the highest point of bone between two *tuber coxae* using a measuring stick. The dry matter intake of bulls in individual pens was measured daily throughout the experimental period by weighing the amount of feed offered and refused. Subsamples of feed offered were collected daily and subsamples of feed residues were collected weekly. The digestibility of the diets was calculated from total feces collection on week 5. Feces were collected from each bull over 24 hours for 7 days. Daily fecal output for each bull was weighed, and mixed, then a 10% subsample was collected and stored for each bull at -20°C. At the end of digestibility week, subsamples were thawed and dried at 60°C for 3 days or up until reached a constant weight for DM determination. The dried samples of each feed were bulked for each week and ground to pass through a 1-mm screen in a Retsch GmBH 5657 HAAN mill. Organic matter (OM) was determined by combusting samples at 600°C for 3 h in a NEY M-525 Series II furnace (AOAC, 1984). Total N was analyzed using the Kjeldahl technique (AOAC, 1984). Residues of each feed type for each bull were bulked each week and a subsample was taken to determine DM and OM as described above.

The blood samples were collected before feeding at the end of the experiment. Blood plasmas were obtained from the jugular vein into lithium heparin-coated vacutainers (Becton Dickinson, Franklin Lakes, NJ, USA). The vacutainers were inverted 8 times and centrifugated at 3000rpm for 20min. Plasma samples were collected for measurement of plasma IGF-1 and blood metabolites. The plasma bovine IGF-1 concentration was determined using a commercial enzyme-linked immunosorbent assay (ELISA) kit (E0016Bo, BT Lab, Shanghai, China) as per manufacturer procedures. The plasma glucose and total protein concentrations were analyzed using commercial kits (BioSystem, S.A., Barcelona, Spain) in an A25-Biosystem Random Access Analyser. While plasma urea concentration was determined using commercial kits (Bavaria Diagnostica, Hamburg, Germany) as per manufacturer procedures.

Statistical Analysis

The data obtained were analyzed using SPSS for Windows series 23 based on an analysis of variance in every variable observed. No statistical comparison was made between the two experiments. Duncan's multiple range tests were applied to differentiate the treatment means at a 5% probability.

RESULTS

Feed intake and body measurements

The dry matter intake was not different between treatments (Table 1). The Bali bulls ate around 10kg DM/day while Madura bulls ate around 8kg DM/day and were not different between treatments in both breeds. Low concentrate intake was mainly related to the high rice straw offered, which varied from 20 to 80%. However, it did not affect total DM intake. The level of feed offered affected the DM digestibility with a high level of rice straw resulting in a higher DM digestibility.

The feed conversion ratio in Bali bulls was not different between treatments but in Madura bulls, a lower rice straw level resulted in a lower amount of feed that should be provided to gain 1 kg of LW.

In the Bali bull experiment, the LWG declined when more rice straw was offered, surprisingly, the high LWG could be reached in the B group and did not differ from A bulls. The live weight increased steadily until the end of the experiment, and the B group tended to reach a high live weight (Fig. 1). This was also shown in the BCS scores but not in the increase in hip height gain.

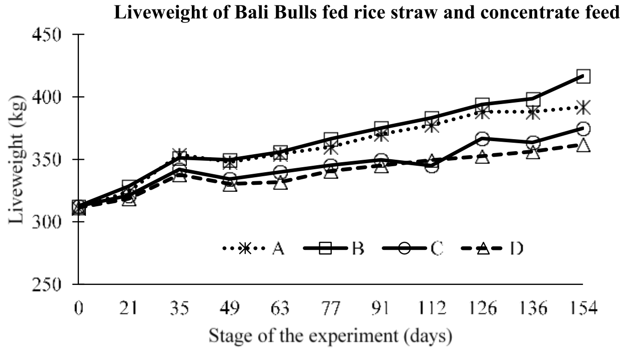

Fig. 1: The live weight of Bali bulls fed different levels of rice straw and concentrated feed composted from agricultural by-products at different ratios: A. 20: 80, B. 40: 60, C. 60: 40, and D. 80: 20.

In the Madura bull study, the group that had a maximum of 60% of rice straw could gain >0.4kg/d, those that were given 20% of concentrate feed only gained 0.3kg/d. Live weight of Madura bulls rose slightly from day 42 until the end of the study (Fig. 2). The level of rice straw and concentrate feed did not significantly affect the increase in hip height and BCS. In both experiments, the age of the bulls probably was at the stage of maturity that did not result in a dramatic increase in height.

The plasma metabolite and insulin-like growth factor 1 concentrations

The rice straw and concentrate feed levels did not affect blood glucose and total protein concentrations (Table 2). However, the blood urea nitrogen concentration differed significantly in Bali but not in Madura bulls, the concentration of BUN in Bali and Madura bulls was >36mg/dL and was around 33mg/dL, respectively.

Table 1: Dry matter intake (DMI), Concentrate (Conc.), and rice straw (RS) intakes, dry matter digestibility (DMD), live weight gain (LWG), hip height gain (HH gain), body condition score (BCS), and feed conversion ratio (FCR) of Bali and Madura bulls fed rice straw and the concentrate feed at different ratios.

Parameters	Experiment Groups					
	A	B	C	D	SEM	P-value
Experiment 1 in Bali Bulls						
Total DMI (kg/day)	9.76	10.28	10.19	9.13	0.67	0.62
Conc. intake (kg DM/day)	7.37[a]	6.72[a]	5.02[b]	2.62[c]	0.43	<0.05
RS intake (kg DM/day)	2.36[d]	3.56[c]	5.18[b]	6.54[a]	0.43	<0.05
DMD (%)	40.07[c]	44.69[bc]	50.04[ab]	52.36[a]	2.07	<0.01
FCR	20.10	17.44	26.13	30.93	4.56	0.22
LWG (kg/day)	0.51[ab]	0.61[a]	0.35[bc]	0.30[c]	0.06	<0.05
HH gain (mm/100 days)	30	31	28	21	6.85	0.73
BCS (at the end of study)	3.96[a]	3.79[ab]	3.64[b]	3.32[c]	0.08	<0.01
Experiment 2 in Madura Bulls						
Total DMI (kg/day)	8.11	8.55	8.58	7.10	0.48	0.11
Conc. intake (kg DM/day)	6.03[a]	5.10[b]	4.24[c]	2.05[d]	0.38	<0.01
RS intake (kg DM/day)	2.08[d]	3.44[c]	4.31[b]	4.98[a]	0.32	<0.01
DMD (%)	48.58[c]	56.95[bc]	62.05[b]	73.45[a]	2.88	<0.01
FCR	15.39[b]	20.92[a]	20.21[a]	22.45[a]	1.58	0.02
LWG (kg/day)	0.53[a]	0.44[a]	0.43[a]	0.32[b]	0.04	<0.01
HH gain (mm/100 days)	38	44	34	37	4.22	0.40
BCS (at the end of study)	3.1	3.0	2.9	2.9	0.11	0.17

Rice straw and concentrate feed at different ratios: A. 20: 80, B. 40: 60, C. 60: 40, and D. 80: 20. Within rows, means followed by different letters are significantly different.

Table 2: Blood metabolite concentration of Bali and Madura bulls fed rice straw and concentrate feed.

Parameters	A	B	C	D	SEM	P-value
Experiment 1 in Bali bulls						
Urea (mg/dL)	44.29[ab]	46.14[a]	37.00[b]	36.86[b]	2.43	0.02
Glucose (mg/dL)	61.86	65.86	61.71	63.14	1.86	0.40
Total Protein (g/dL)	8.51	8.14	8.32	8.52	0.15	0.23
Experiment 2 in Madura bulls						
Urea (mg/dL)	33.43	32.14	35.71	33.86	2.18	0.30
Glucose (mg/dL)	67.14	61.14	65.29	63.43	3.24	0.14
Total Protein (g/dL)	7.55	7.56	7.48	7.56	0.22	0.81

Rice straw and the concentrate feed at different ratios: A. 20: 80, B. 40: 60, C. 60: 40 and D. 80: 20. Within rows, means followed by different letters are significantly different.

Table 3: Insulin-like growth factor-1 plasma concentration of Bali and Madura bulls fed rice straw and concentrate feed at different ratios.

Parameters	A	B	C	D	S.E.M	P-value
Experiment 1 in Bali bulls						
IGF-1 start (ng/mL)	88.93	95.40	90.71	88.67	5.05	0.77
IGF-1 end (ng/mL)	105.07	103.23	102.51	109.37	5.12	0.78
Experiment 2 in Madura bulls						
IGF-1 start (ng/mL)	115.27	190.93	198.44	146.07	24.45	0.08
IGF-1 end (ng/mL)	177.67	191.03	231.87	184.24	24.89	0.43

Rice straw and concentrate feed at different ratios: A. 20: 80, B. 40: 60, C. 60: 40 and D. 80: 20.

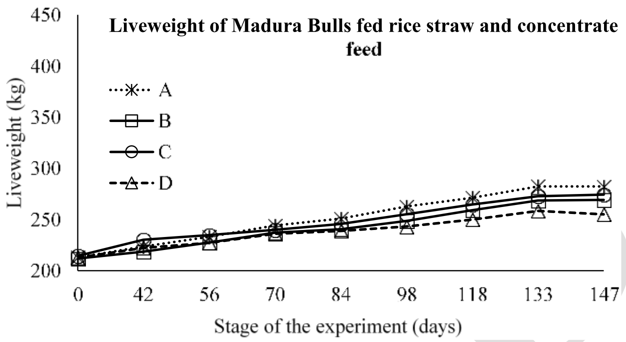

Fig. 2: The live weight of Madura bulls fed different levels of rice straw and concentrated feed composted from agricultural by-products at different ratios: A. 20: 80, B. 40: 60, C. 60: 40, and D. 80: 20.

At the start of the experiment (Day 0), the concentration of IGF-1 in the plasma did not differ between groups of Bali and Madura bulls subsequently allocated to rice straw and concentrate feed levels (Table 3). At the end of the experiment, the concentration of IGF-1 increased slightly but did not differ significantly between the groups in both Bali and Madura bulls.

DISCUSSION

Feed intake and body measurements

Our results demonstrate that small-size Bali and Madura bulls ate less than 10kg DM/d. More importantly, the DMD can indicate the feed quality (Cholisa et al. 2021). The inclusion of concentrate feed in the diet increased with the increase of concentrate offered. Bali bulls ate around 7kg DM/d supporting high LW and LWG. The diet offered to the bulls here was typical of feed provided under the village management system in Eastern Indonesia. The feed was composted from agricultural by-products usually harvested at the maturity stages. The characteristics of agricultural by-products have high fiber content; however, ruminants might be able to use those feed resources because of the microbes in the rumen that can help the digestion process through the fermentation of fibrous components (Desta 2023). The potential role of the crop residues in the ruminant feeding system in Indonesia is to improve the productive performance of ruminants due to the nutritional content (energy) that is abundance during the harvest times, this also helps the growth of ruminants especially in the dry land where high quality of forages are hard to be produced. Higher growth of bulls was achieved when a minimum of 40% of concentrate under this scenario was included in the diet. Higher levels of concentrate feed are required to increase the feeding value of a mixed diet because it was composted properly to achieve certain nutritional contents, the basal diet was rice straw, and concentrate feed offered here increased the weight of the bulls, and this highlights the appropriateness of concentrate feed supplement to the rice straw as roughage for the bulls with high energy demands such as in a fattening period. Normally, smallholder farmers in Indonesia try to minimize the inputs to achieve a greater profit. This concept was also proposed by Makkar (2016) who also applied the low input system using a forage-based diet to minimize the use of concentrate feed, thus maximizing the profits. However, another study conducted by Cowley et al. (2020) showed that smallholder farmers might increase their profits when they adopt a higher input feeding system that is nutritionally balanced so that high live weight gain is potentially achieved. In this study, our Bali bulls eating a minimum of 60% concentrate feed performed high LWG. At the same time, high LWG in Madura was achieved in bulls who ate a minimum of 40% concentrate feed. The high level of concentrate feed in the diet enables the microbes in the rumen to ferment the feed and produce volatile fatty acids mainly propionate and butyrate, to support the high productive performance of the ruminants and more efficiently use those feeds provided.

In both breeds, the dry matter digestibility was high in groups eating high levels of rice straw. The observed DMD was low in both breeds having high levels of concentrate feed, this was probably the small particle size of the concentrates and caused a short retention period in the rumen (Hummel et al. 2018). However, our results were slightly lower than those reported previously in Angus cows fed different levels of forage and concentrate-based grain, accounting for >60% DMD (Chen et al. 2021). The discrepancy was probably because of breed differences and the feed itself, as the DMD may be affected by the physical form of the feed (Heering et al. 2023) and the individual response of the animals. Our results did not align with the previous findings, that the increase in DM intake caused the rise of DMD, except in the D groups in both breeds. The phenomenon was probably because of the high percentage of rice straw. The voluminous nature of the feed potentially restricts the DMI (Bauer et al. 2023). Therefore, the bulky type of feed such as rice straw should be given less than 60% of the ration to allow high DM intake.

The feed conversion ratio in Bali bulls showed no patterns and did not differ significantly between treatments. The phenomena were probably caused by different individual responses, with a high level of rice straw tending to result in high FCR. However, the FCR of Madura bulls ranged from 15 to 22 and were different between treatments. The A group of Madura bulls had the lowest FCR, indicating the bulls required less feed per kg of live weight. Moreover, the fluctuation between feed ingredient quality and its homogenous also contributes to the FCR and affects the LWG (Marchesini et al. 2020). The FCR is associated with feed cost and profitability, so improving feed utilization ensures the success of beef cattle farming. In comparison with other livestock species, beef cattle have a special character that can convert low nutritional roughages or crop residues into edible animal food of highly biological value for human consumption (Mottet et al. 2018). Improving the level of concentrate feed in the diet potentially enhances production efficiency although it probably limits the ability of ruminants to convert poor-quality feed into high-quality meat (Terry et al. 2021). Thus, increasing the level of concentrate feed in the diet here was to confirm that the magnitude of the responses in the current experiment had the same pattern as results previously reported in the literature.

The skeletal growth measured in hip height gain seemed slow due to the age of the bulls (>18 months) in both breeds being at the maturity stage. The height of the bulls was still increasing but at a slower rate. This was in line with a report from Islami et al. (2023) who assessed the growth of Bali cattle and found that at the mature age, the hip height of Bali cattle is still increasing and the mature stage is not achieved. However, our bull's hip height was higher than that report, around 124cm at the same age. The discrepancy was probably because of the feeding system, the place where they were reared, and sex. At the same age, the height of Madura bulls increased steadily at a slower rate, and our results were similar to the height of Madura cattle reported previously, from 118.44 to 123.75cm (Adinata et al. 2023). The difference from the current experiment was our bulls were at the mature stage of development, the growth of longitudinal bone accelerates before the pubertal stage and declines afterward. This is associated with the physiological changes of the growth plate, where bone elongation occurs. This means the growth of bone assessed by hip height gain has still occurred during this age although at a slower rate.

Including rice straw up to 40% in the diet could still promote the high BCS in Bali bulls, although the score declined with the decrease in concentrate offered. However, Madura bulls did not respond differently to the level of concentrate and rice straw offered. Madura bulls tended to be skinny and slightly tall. The BCS is an important and quick tool to determine if the cattle's nutritional requirements are met. More importantly, the BCS can depict the status of animals such as health, production (yield), or weight losses.

Blood metabolite characteristics

In this study, we observed significant increases in blood urea levels in Bali bulls as the concentrate feed level increased, but the trend did not occur in Madura bulls. Assessing blood biochemical parameters such as in the metabolic profile can be applied to understand the health and production status of ruminants. This allows the determination of biological responses to the feeding treatments (e.g. energy or protein supplementation). Our bulls had a high concentration of blood urea nitrogen, ranging from 32 to 46mg/dL, whereas, in comparison with other studies, the researchers reported that the BUN was from 15 to 20mg/dL (Amartsana et al. 2020; Cho et al. 2024). This was probably affected by the level of rumen degradable protein intake in the diet that affects the urea production in the liver (Souza and White 2021). The excess level of BUN indicates excess dietary protein relative to digestible energy intake, this also affects the high LWG in Bali bulls (Table 1).

The concentrations of blood glucose and total protein were not altered with the nutritional treatments. Normally, blood glucose concentration in ruminants results from feed digestion that is directly absorbed via the gastrointestinal tract and a biochemical process of gluconeogenesis in the liver from propionic acids (Loncke et al. 2020; Mikuła et al. 2020). The concentration of glucose in both breeds was comparable to those reported previously, from 61 to 67mg/dL while other studies also reported similar ranges: 61-71mg/dL (Kabir et al. 2022), 58.6-76.6mg/dL (Mikuła et al. 2020) and 45.7-89.7mg/dL (Cerrilla and Martínez 2021). The difference between research reports was probably because of the feed offered and the digestion of carbohydrates, glucose is produced in two different pathways, glycogen in the liver can be converted into glucose or through gluconeogenesis (Chandel 2021; Trotta et al. 2022). While the total protein in our bulls was (7.5-8.5g/dL) and was in a normal recommendation range for cattle, from 7.0 to 9.4g/dL (Asrar et al. 2023). Therefore, the bulls were in a healthy condition.

Insulin-like growth factor-1

The concentration of IGF-1 in our Bali and Madura bulls did not differ significantly from the start and end of the experiment. The concentration of IGF increases with the increase in DM intake causing higher gluconeogenic precursor intake, but the DM intake in both Bali and Madura bulls was not different between treatments (Table 1). Insulin-like growth factor-1 regulates muscle growth in cattle as it plays a pivotal role in the metabolic growth process. Normally, there are changes in the concentration of IGF-1 in response to the nutritional intervention, this hormone is responsible for adaptation to low protein or high carbohydrate diets (Chaumontet et al. 2019). The concentration of IGF-1 in the current experiment was comparable to the previous studies (Castro-Montoya and

Dickhoefer 2020; Chaudhary et al. 2023), but lower than the result reported by Ferreira et al. (2024). The variation of IGF-1 concentration is probably caused by the level of nutritive contents in the diet, such as protein and energy that contribute to the gluconeogenesis process in the body of animals that alter the IGF-1 concentration.

Conclusion

It was concluded that Bali bulls tended to perform highly (high LWG and BCS) when they ate around 7kg DM/d of concentrate feed and 3.5kg DM of rice straw. To achieve a rapid growth rate of Madura bulls, they need around 5kg DM each for rice straw and concentrate feed.

Conflict of interest: The authors declare that they have no conflict of interest with any party regarding the material in this study.

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Authors' Contribution: RA, YNA: conceptualized and designed the experiment, collected, analyzed, and interpreted the data, and wrote the manuscript. ASP, NHK, MM, SS, KS, DP: collected the data and reviewed the final version of the manuscript.

Informed consent: The Indonesian Animal Ethics Committee of the Ministry of Agriculture reviewed and approved all procedures under the Indonesian Code of Practice for the Care and Use of Animals for Scientific Purposes (Balitbangtan/Lolitsapi/Rm/02/2021).

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