Morphometric and Body Condition Score of Preweaning Pasundan Calves Fed Flushing Diets under Extensive Grazing

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Research Article

Morphometric and Body Condition Score of Preweaning Pasundan Calves fed Flushing Diets Under Extensive Grazing

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Abstract | The preweaning period is a critical period for calves that extensively graze in tropical areas because calves are very susceptible to various heat stresses and ectoparasites. This condition is exacerbated by the low nutrient content in the natural grass available in the southern regions of West Java, Indonesia. Feeding flushing diets on the preweaning calves are expected to improve the calf's performance. A study on the inclusion of flushing diets aims to improve preweaning calves' performance grazed extensively. The study used 15 male and 15 female preweaning Pasundan calves allocated to a completely randomized factorial design with two factors (gender: two levels and diets: three levels) and five replicates. The three levels of the diet factors were 1) grazing, 2) grazing and fed flushing diets without urea-impregnated zeolite, and 3) grazing and fed flushing diets containing urea-impregnated zeolite. The observed variables included morphometric variables (chest girth, chest depth, body length, shoulder height), body condition score, and body weight gain. The collected data were analyzed by a general linear model univariate analysis. The results showed that feeding of flushing diets increased ($P < 0.05$) daily body weight gain (252.78 ± 77.22 g in grazing calves vs. 362.50 ± 141.69 in flushing-1 calves or 486.11 ± 173.47 g in flushing-2 calves) and improved ($P < 0.05$) body condition score change (1.33 ± 0.51 in grazing calves vs. 2.33 ± 0.51 in flushing-2 calves) of the preweaning calves but did not affect the morphometric variables. In conclusion, the inclusion of both flushing diets increased daily body weight gain, and the inclusion of flushing diet containing urea-impregnated zeolite improved the preweaning calves' body condition score but did not affect the morphometric variables.

Keywords | Body weight gain; Chest girth; Morphometric; Shoulder height; Urea-impregnated zeolite.

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INTRODUCTION

The pre-weaning period is a transitional period that is very important for breeders to pay attention to because both the life of the cow and her newborn calf undergo physiological changes that threaten their life. The cow must provide extra nutritional intake to produce milk in large quantities and good nutritional content for her calf (Kardaya et al., 2021). The newborn calf also experiences changes in their environment that are very different from a closed environment in their mother's uterus to a completely open environment, so they are very susceptible to various infectious diseases and other environmental stressors (Matamala et al., 2021).

If the preweaning calves are not well managed, left exposed to the open environment, and have no access to high-quality feedstuff, the calves will suffer due to bad environmental influences that will impact increasing mortality. The mortality rate of these preweaning calves can reach in extreme range, i.e., 4.5% - 30% (Rahayu, 2014; Mahendran et al., 2017; Santman-Berends et al., 2019; Santos et al., 2019) and becomes even higher, reaching 67.8% if the calves are left in the open environment as occurred in Australia (Bunter et al., 2014).

The calf's performance needs to be improved through nourishing diets that meet livestock needs to overcome the negative impact of an open environment. However, daily concentrates feeding will not be applied by the breeders who maintain their animals with a grazing system throughout the year because of the economic considerations. The provision of flushing diets formulated from unconventional feed is expected to meet the needs of preweaning calves at an affordable price. This study aims to improve the performance of preweaning calves under extensive grazing by providing flushing diets.

MATERIALS AND METHODS

Animals and Experimental Design

All applicable international, national, and/or institutional guidelines for the care and use of animals were followed. The study used 30 preweaning Pasundan calves aged 3 - 4 months consisting of 15 males and 15 females that were extensively grazed. The initial average body weight was 39.44 ± 13.57 kg for male calves and 37.167 ± 7.78 kg for female calves. Either flushing-1 or flushing-2 diet was provided in a coarse mash form. The adaptation period for flushing diet was carried out for 14 days and the feeding trial period was carried out for 60 days. Flushing diet was fed twice a day, i.e., in the morning at 0600 – 0800h as many as 500 grams before the calves were grazed and in the afternoon at 1700 - 1900h as many as 500 grams after the calves were driven back into the shed without rooftop from the grazing field. Every morning at 0800 h, the calves were moved out of the shed without rooftop and then led to pasture or areas overgrown with natural grass for grazing. Drinking water for the calves during grazing was available in the ponds around grazing areas. In the afternoon, the calves were driven back into the shed without a rooftop.

The study used a completely randomized factorial design with two factors and five replicates. Five of each male or female calf was randomly selected and allocated to the following three treatments: 1) calves are allowed to graze without feeding flushing diet, 2) calves are allowed to graze and fed a flushing diet without urea-impregnated zeolite (flushing-1), 3) calves are allowed to graze and fed a flushing diet with urea impregnated zeolite inclusion (flushing-2). Flushing diets and drinking water were provided before and after the calves were grazed. Both flushing diets had similar protein and energy contents as the previous research (Kardaya et al., 2020; Kardaya et al., 2021). Urea-impregnated zeolite was formulated based on the previous (Kardaya et al., 2018).

Measurements and Data Collection

The measured variables consist of feed intake, morphometrics (chest girth, chest depth, body length, shoulder height), body condition score, and average daily gain. Flushing diet intake was calculated by subtracting the refusals from the offered.

All morphometric parameters, body condition score, and body weight were measured before morning feeding. Chest girth was measured by wrapping a measuring tape around the chest through the hump and shoulder joint of the *scapula*. Body length was measured precisely from the *tuber humerus* to the *tuber ischium* using a measuring stick. Shoulder height was measured directly behind the *scapula* from the dorsal point up to the ground using a measuring stick (Ozkaya, 2012). Each morphometric gain was calculated by subtracting each initial morphometric measure from each corresponding final morphometric measure during the 60-day experimental period. Bodyweight (BW) was measured using a portable digital weight scale, and the body condition score (BCS) was determined based on a 9 scale (Nicholson and Butterworth, 1986). Average daily weight gain (ADWG) was calculated by subtracting initial BW from the final BW divided number of days between initial weighing day and last weighing day (60 days).

Statistical Analysis

All variables (dry matter intake of the flushing diets, morphometrics, body condition score, and average daily gain) were analyzed by General Linear Model Univariate Analysis using IBM SPSS Statistics version 24.0 (IBM Corp, 2018). All diet treatments and calf gender (male and female) were considered as fixed factors. The covariate analysis applied to chest girth gain (CGG), body length gain (BLG), shoulder height gain (SHG), BCS change, and ADWG variables used each corresponding initial measurement as the covariate variable, respectively. However, the covariates were removed from the model if it was not significant. All dietary treatments and gender main effects were subject to the least significant difference (LSD) test option. The result of each variable analysis was considered as statistically significant if $P \leq 0.05$. The statistical model applied for analyses was:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \beta(X_i - \bar{X}) + \varepsilon_{ijk}$$

Where, Y_{ijk} is the dependent variable; μ is the overall mean; α_i is the effect of gender; β_j is the effect of dietary treatment; $(\alpha\beta)_{ij}$ is the effect of the interaction between gender and dietary treatment; $\beta(X_i-\bar{X})$ is the covariate variable; ε_{ijk} is the overall error term.

RESULTS AND DISCUSSION

Feed Conversion

Feed to the ADWG ratio of flushing-1 and flushing-2 (Table 1) for body weight was 1.91 ± 0.61 for male calves

Table 1: Feed conversion in grazing-preweaning calves fed the flushing concentrates

Variables	Treatments	Male	Female	Average
Feed to ADWG ratio, kg/kg	Flushing-1	1.56 ± 0.33	2.16 ± 0.61	1.86 ± 0.56
	Flushing-2	2.26 ± 0.65	2.31 ± 0.44	2.29 ± 0.52
	Average	1.91 ± 0.61	2.24 ± 0.51	
Feed to CGG ratio, kg/cm	Flushing-1	4.26 ± 0.97	3.49 ± 0.63	3.87 ± 0.87
	Flushing-2	3.92 ± 1.02	3.10 ± 0.37	3.51 ± 0.84
	Average	4.09 ± 0.96	3.29 ± 0.53	
Feed to BLG ratio, kg/cm	Flushing-1	4.16 ± 0.52	4.20 ± 0.72	4.18 ± 0.59
	Flushing-2	3.91 ± 0.49	3.33 ± 0.73	3.62 ± 0.66
	Average	4.04 ± 0.50	3.76 ± 0.82	

ADWG: Average Daily Weight Gain; CGG: Chest Girth Gain; BLG: Body Length Gain.

Table 2: Chest girth (cm) of male and female preweaning calves

Treatments	Initial CG	Final CG	CG gain	Daily CG gain
Male:				
Control (grass)	84.67 ± 8.38	89.67 ± 6.81	5.00 ± 2.00	0.08 ± 0.03
Flushing-1	86.00 ± 8.7	98.00 ± 8.19	12.00 ± 5.20	0.20 ± 0.08
Flushing-2	88.33 ± 8.14	97.33 ± 14.57	9.00 ± 6.56	0.15 ± 0.01
Average	86.33 ± 7.46	95.00 ± 9.87	8.67 ± 5.27	0.14 ± 0.08
Female:				
Control (grass)	86.33 ± 3.78	92.33 ± 5.03	6.00 ± 1.73	0.10 ± 0.03
Flushing-1	81.00 ± 7.00	89.67 ± 4.04	8.67 ± 3.06	0.14 ± 0.05
Flushing-2	81.67 ± 5.68	89.67 ± 9.50	8.00 ± 4.36	0.13 ± 0.07
Average	83.00 ± 5.50	90.56 ± 5.90	7.56 ± 3.05	0.13 ± 0.05

CG: Chest Girth.

1 kg body weight of a male preweaning calf requires 1.91 ± 0.61 kg flushing diet, and a female preweaning calf requires 2.24 ± 0.51 kg flushing diet. The feed to the CG gain ratio of flushing-1 and flushing-2 was 4.09 ± 0.96 for male calves and 3.29 ± 0.53 for female calves. Thus, to increase 1 cm CG, the calf might consume 4.09 ± 0.96 kg concentrate for male calves and 3.29 ± 0.53 kg concentrate for female calves. The average conversion of flushing diets for body length was 4.04 ± 0.50 for male calves and 3.29 ± 0.53 for female calves. Feeding flushing-1 or flushing-2 concentrate did not change the feed conversion of ADWG, CGG, or BLG.

Feed to ADWG ratio in the recent research was comparable with the feed to ADWG ratio (1.97) reported by Casper et al. (2017), who fed the calf starter containing 40% digestible corn, and the feed to ADWG ratio (2.94 – 2.04) reported by Wickramasinghe et al. (2019) who fed a calf starter. However, feed to ADWG ratio in the recent research was lower than the feed to ADWG (4.4 – 4.5) reported by Bhatti et al. (2012) who fed starter ration + hay, but it was fairly higher than the feed to ADWG ratio (1.02 ± 0.14) observed by Göncü et al. (2010). The similarity of feed to ADWG ratio, feed to CGG ratio, or feed to the BLG ratio between flushing-1 calves and flushing-2 calves were probably due to the nutrient similarity of flushing-1 and flushing-2 concentrates. Inclusion of urea impregnated zeolite in flushing-2 concentrates as the nonprotein nitrogen source to replace the soybean meal protein in flushing-1 concentrates similar feed to ADWG ratio, feed to CGG ratio, or feed to BLG ratio.

Morphometrics of Preweaning Calves

The morphometric variables measured in the experiment included chest girth (CG), body length (BL), wither height (WH), and chest depth (CD). All treatments showed a similar effect on the preweaning calves' morphometrics measurements (Table 2-5).

The preweaning calves' chest girth at the beginning and the end of the study period did not differ significantly between the dietary treatments. Feeding flushing-1 or flushing-2 diet resulted in an insignificant increase in chest girth. Similarly, there is no significant difference between the average size of the chest girth in male and female calves (Table 2). The chest girth of male preweaning calves at the beginning and the end of the study was 86.33 ± 7.46 cm and 2.24 ± 0.51 for female calves. It means that to produce

Table 3: Body length (cm) of male and female preweaning calves

Treatments	Initial BL	Final BL	BL gain	Daily BL gain
Male:				
Control (grass)	61.67 ± 4.72	66.67 ± 5.03	5.00 ± 1.00	0.08 ± 0.01
Flushing-1	55.00 ± 5.56	75.67 ± 6.65	20.67 ± 12.01	0.34 ± 0.02
Flushing-2	55.67 ± 6.80	69.33 ± 15.50	13.67 ± 9.29	0.23 ± 0.02
Average	57.44 ± 5.91	70.56 ± 9.67	13.11 ± 10.20	0.22 ± 0.02
Female:				
Control (grass)	57.00 ± 5.50	62.33 ± 2.08	5.33 ± 3.05	0.07 ± 0.08
Flushing-1	54.67 ± 2.08	62.66 ± 3.51	8.00 ± 1.73	0.13 ± 0.03
Flushing-2	52.67 ± 14.97	65.00 ± 8.00	12.33 ± 7.50	0.21 ± 0.12
Average	54.78 ± 8.18	63.33 ± 4.66	8.56 ± 5.15	0.14 ± 0.09

BL: Body Length.

Table 4: The withers height (cm) of male and female preweaning calves

Treatments	Initial WH	Final WH	WH gain	Daily WH gain
Male:				
Control (grass)	79.16 ± 2.75	83.00 ± 3.00	3.83 ± 0.28	0.06 ± 0.01
Flushing-1	76.76 ± 1.93	80.33 ± 2.30	3.57 ± 0.40	0.05 ± 0.01
Flushing-2	76.16 ± 5.00	79.99 ± 5.29	3.83 ± 0.29	0.06 ± 0.01
Average	77.36 ± 3.31	81.11 ± 3.5	3.74 ± 0.31	0.06 ± 0.01
Female:				
Control (grass)	75.50 ± 6.92	79.33 ± 7.23	3.83 ± 0.57	0.06 ± 0.01
Flushing-1	76.83 ± 1.25	80.67 ± 1.52	3.83 ± 0.29	0.06 ± 0.01
Flushing-2	76.67 ± 1.15	80.67 ± 1.15	4.00 ± 0.00	0.06 ± 0.01
Average	76.33 ± 3.62	80.22 ± 3.80	3.89 ± 0.33	0.06 ± 0.01

WH: Wither Height

and 95.00 ± 9.87 cm, respectively, and female preweaning calves were 83.00±5.50 cm and 90.56±5.90 cm, respectively.

The preweaning calves' body length at the beginning and the end of the study period did not differ significantly between the dietary treatments. Feeding flushing-1 or flushing-2 diet resulted in an insignificant increase in the body length of the calves reared under extensive grazing. Similarly, there is no significant difference between the chest girth in male and female calves (Table 3). The body length of the preweaning calves at the beginning and the end of the study was 57.44 ± 5.91 cm and 70.56 ± 9.67 cm, respectively, and the female preweaning calves were 54.78 ± 8.18 cm and 63.33 ± 4.66 cm, respectively.

The withers height of the preweaning calves at the beginning and the end of the study period did not differ significantly between the dietary treatments. Feeding flushing-1 diet or flushing-2 diet produces an insignificant increase in the wither height of the calves reared under extensive grazing. Similarly, there is no significant difference between the wither height in male and female calves (Table 4). The withers height of the male preweaning calves at the beginning and the end of the study was 77.36 ± 3.31 cm and 81.11 ± 3.5 cm, respectively, and the withers height of the female preweaning calves were 76.33 ± 3 respectively, 62 cm and 80.22 ± 3.80 cm.

The preweaning calves' chest depth at the beginning and the end of the study period did not differ significantly between the dietary treatments. Feeding flushing-1 diet or flushing-2 diet produces an insignificant increase in the chest depth of the calves reared under extensive grazing. Similarly, there is no significant difference between the chest depth in male and female calves (Table 5). The chest depth of the preweaning male Pasundan calves at the beginning and the end of the study was 31.72 ± 1.78 cm and 33.72 ± 1.78 cm, respectively, and the female preweaning calves were 32.00 ± 2.76 cm and 33.90 ± 2.95 cm, respectively.

The morphometrics measurements of the preweaning calves in the recent study were under some previous researchers (Ghassemi Nejad et al., 2012; Casper et al., 2017; de Assis Lage et al., 2019; Wickramasinghe et al., 2019;

Table 5: Chest depth (cm) of male and female preweaning calves

Treatments	Initial CD	Final CD	CD gain	Daily CD gain
Male:				
Control (grass)	30.50 ± 1.32	32.50 ± 1.32	2.00 ± 0.00	0.03 ± 0.00
Flushing-1	31.33 ± 1.52	33.33 ± 1.52	2.00 ± 0.00	0.03 ± 0.00
Flushing-2	33.33 ± 1.52	35.33 ± 1.52	2.00 ± 0.00	0.03 ± 0.00
Average	31.72 ± 1.78	33.72 ± 1.78	2.00 ± 0.00	0.03 ± 0.00
Female:				
Control (grass)	32.67 ± 2.02	34.53 ± 2.33	1.86 ± 0.32	0.03 ± 0.01
Flushing-1	30.33 ± 4.36	32.16 ± 4.64	1.83 ± 0.28	0.03 ± 0.00
Flushing-2	33.00 ± 1.00	35.00 ± 1.00	2.00 ± 0.00	0.03 ± 0.00
Average	32.00 ± 2.76	33.90 ± 2.95	1.90 ± 0.23	0.03 ± 0.00

CD: Chest Depth

Table 6: Body score condition of male and female preweaning calves

Variables	Diets	Male	Female	Average
Initial BCS	Control (grass)	2.33 ± 0.57	2.67 ± 0.57	2.50±0.54
	Flushing-1	2.67 ± 1.15	2.33 ± 0.57	2.50±0.83
	Flushing-2	2.67 ± 1.15	2.33 ± 0.57	2.50±0.83
	Average	2.56 ± 0.88	2.44 ± 0.52	2.50±0.70
Final BCS	Control (grass)	4.00 ± 1.00	3.67 ± 0.57	3.83±0.75
	Flushing-1	4.67 ± 1.15	3.33 ± 0.57	4.00±1.00
	Flushing-2	5.33 ± 1.52	4.33 ± 0.57	4.83±1.16
	Average	4.67 ± 1.22	3.78 ± 0.66	4.22±1.06
BCS change	Control (grass)	1.67 ± 0.57	1.00 ± 0.00	1.33 ± 0.51[a]
	Flushing-1	2.00 ± 0.00	1.00 ± 0.00	1.50 ± 0.54[a]
	Flushing-2	2.67 ± 0.57	2.00 ± 0.00	2.33 ± 0.51[b]
	Average	2.11 ± 0.60[a]	1.33 ± 0.50[b]	1.72 ± 0.67

Different superscript in the same row or column, significantly different ($P < 0.05$); BCS: Body Condition Score.

Qamar et al., 2020). Ghassemi Nejad et al. (2012) reported that body measurements of calves fed the processed starter diets were not significantly different among treatments. Calves fed calf starter contained highly digestible corn indicated similar body measurements (Casper, et al., 2017). Feeding hay, calf starter, or total solid diets also did not affect the body measurements (de Assis Lage et al., 2019). Wickramasinghe et al. (2019) offered free drinking water to calves fed a pasteurized whole milk and a calf starter obtained similar body measurements among treatments. Feeding total mix ration containing different percentages of hay also resulted in similar body measurements (Qamar et al., 2020). However, feeding milk replacer or calf starter containing low ADF and NDF resulted in a significant effect on the chest girth and wither height measurements (Chapman et al., 2017; Tao et al., 2018). Calves fed the different types of milk also resulted in a significant effect ($P < 0.05$) on the chest girth and wither height measurements (Li et al., 2019). Pre-processed milk, milk replacer, and calf starter containing low fiber resulted in better feed utilization in the preweaning calves.

Chest girth similarity among recent research treatments was also reported by previous researchers (Ghassemi Nejad et al., 2012; Casper et al., 2017; de Assis Lage et al., 2019; Wickramasinghe et al., 2019). However, preweaning calves fed milk replacers containing higher CP (26%) and lower fat (18%) contents resulted in a higher chest girth than the calves fed milk replacer containing lower CP (20%) and higher fat (20%) contents (Chapman et al., 2017). The results of the chest girth of the preweaning calves in the recent research were comparable to the chest girth of the preweaning calves fed a calf starter containing highly digestible corn, i.e., 81.6 – 94.5 cm (Casper et al., 2017), or the chest girth of the preweaning calves fed a calf starter and offered drinking water from birth, i.e., 86.4 – 99.6 cm (Wickramasinghe et al., 2019). Lower chest girth obtained from the preweaning calves offered hay, starter calf, and total solid diet consisted of 98% concentrate and 2% hay (de Assis Lage et al., 2019).

Body length similarity among the recent research treatments was also reported by previous researchers (Casper

Table 7: The average body weight of male and female preweaning calves

Variables	Diets	Male	Female	Average
Initial BW (kg)	Control (grass)	36.33 ± 11.00	41.000 ± 7.56	38.67 ± 8.82
	Flushing-1	41.67 ± 13.42	33.167 ± 7.25	37.42 ± 10.71
	Flushing-2	40.33 ± 20.32	37.333 ± 9.29	38.83 ± 14.22
	Average	39.44 ± 13.57	37.167 ± 7.78	38.31 ± 10.80
Final BW (kg)	Control (grass)	55.33 ± 11.58	52.33 ± 7.01	53.83 ± 8.72
	Flushing-1	70.83 ± 14.87	47.50 ± 7.00	59.17 ± 16.47
	Flushing-2	78.37 ± 24.73	57.63 ± 8.57	68.00 ± 20.07
	Average	68.18 ± 18.58	52.49 ± 7.88	60.33 ± 16.03
ADG (g)	Control (grass)	316.67 ± 50.69	188.89 ± 9.62	252.78 ± 77.22^{a}
	Flushing-1	486.11 ± 45.90	238.89 ± 47.39	362.50 ± 141.69^{b}
	Flushing-2	633.89 ± 93.69	338.33 ± 30.60	486.11 ± 173.47^{c}
	Average	478.89 ± 149.20^{a}	255.37 ± 71.83^{b}	367.13 ± 161.64

Different superscript in the same row or column, significantly different ($P < 0.05$); BW: Body Weight; ADG: Average Daily Gain.

et al., 2017; Chapman et al., 2017; Ghassemi Nejad et al., 2012; Wickramasinghe et al., 2019). The final body length of the preweaning calves in the recent research was comparable to the body length of the preweaning calves fed a calf starter containing highly digestible corn, i.e., 63.5 – 71.3 cm (Casper et al., 2017), or the body length of the preweaning calves fed milk replacers containing different CP and fat contents, i.e., 67.7 – 68.8% (Chapman et al., 2017). However, the preweaning calves in the recent research showed a lower body length than the body length of the preweaning calves fed a calf starter and offered drinking water from birth, i.e. 71.0 – 85.3 cm (Wickramasinghe et al., 2019).

The withers height similarity among treatments in the recent research also reported by some previous researchers (Ghassemi Nejad et al., 2012; Casper et al., 2017; de Assis Lage et al., 2019). However, preweaning calves fed milk replacers containing higher CP (26%) and lower fat (18%) contents resulted in a higher final wither height than the calves fed milk replacer containing lower CP (20%) and higher fat (20%) contents (Chapman et al., 2017). Zinc supplementation as a zinc-glycine into milk also increased the wither height of the preweaning calves significantly (Adab et al., 2020).

The chest depth in the recent research was slightly similar to the chest depth (34.85 cm) of the calves measured at weaning (Ozkaya, 2012) and Tu et al. (2015) who obtained the chest depth 31.2 – 35.7 cm for the preweaning calves fed a starter feed contained corn (55%), soybean meal (25%) and wheat bran (15%). However, Yamaguchi et al. (2013) obtained a higher chest depth (45 cm) on Japanese Black preweaning calves reared in a cow-calf grazing system. The chest depth similarity among feeding treatments in the recent research also reported by Byrne et al. (2018) who reported that feeding a high or low plan of nutrition did not affect chest depth of bull calves during the first six months of life. (Kocyigit et al., 2016) also reported that feeding a calf starter and hay ad libitum supplemented with direct feed microorganism (DFM) or exogenous feed enzyme (EFE) did not affect the male and female chest depth preweaning calves.

Body Condition Scores

Body condition score (BCS) of male preweaning calves at the beginning and the end of the study was 2.56 ± 0.88 and 4.67 ± 1.22, respectively, and female preweaning calves were 2.44 ± 0.52 and 3.78 ± 0.66, respectively (Table 6). Neither diet treatments nor gender indicated a significant effect on the final BCS. The BCS change in the 2 months of the study was 2.11 ± 0.60 for male calves and 1.33 ± 0.50 for female calves. Either diet treatments or gender indicated a significant effect ($P < 0.05$) on the BCS change. The inclusion of flushing-2 diet to the preweaning calves resulted in the highest BCS change ($P < 0.05$), but flushing ration-1 resulted in a similar BCS change to the control diet.

The body condition score of the Pasundan calves in the recent study was classified as thin, which was marked by the lack of muscle tissue at the waist and at the tail head, the short ribs were visible that were following the BCS indicators set by Nicholson & Butterworth (1986). The final body score condition in the recent research was slightly lower than the BCS (4.9 – 6.2) reported by Llewellyn et al. (2013) who fed two different starter diets. Similar to the recent research, many previous researchers also said that neither the gender nor the feeding treatment affected the BCS in preweaning calves (Chang'a et al., 2010; Hill, et al., 2016; Llewellyn et al., 2013; Qamar et al., 2020). The significant result of the BCS change in the recent research was also reported by previous researchers (Hill, et al., 2016; Llewellyn et al., 2013; Qamar et al., 2020). It was an indication that supplementing flushing-2 diets improved BCS change better than the flushing-1 diets.

Body Weight

Neither gender nor diet treatment affected the final body weight. However, either gender or diet treatment showed a significant effect ($P < 0.05$) on the average daily gain (ADG). The male calves indicated a higher ADG than the female calves. Supplementing the flushing-1 or flushing-2 diet resulted in a higher ADG ($P < 0.05$) than the control diet (Table 7).

The results of the final body weight of the preweaning calves in the recent study were under the result reported by many researchers (Ghassemi Nejad et al., 2013; Tao et al., 2018; de Assis Lage et al., 2019; Wickramasinghe et al., 2019), i.e. in the range of 44 – 80 kg. The similar final body weight of the preweaning calves obtained in the recent research was also reported by many researchers (Winarti and Widyastuti, 2016; Casper et al., 2017; de Assis Lage et al., 2019; Wickramasinghe et al., 2019). Better ADG of the preweaning calves in the recent research also reported by Hill et al. (2016) who fed milk replacer combined with functional fatty acids, or Tao et al. (2018) who fed milk replacer contained higher CP (23.94%). Casper et al. (2017) obtained better ADG of the preweaning calves fed a calf starter containing highly digestible corn. A better ADG in flushing-2 ration than the flushing-1 ration indicated that urea-impregnated zeolite in the flushing-2 diets improved gastrointestinal tract environment, improved nutrient absorption, and in turn, improved the ADG. This explanation was consistent with the previous study that urea-impregnated zeolite inclusion into concentrates improved ADG ($P<0.05$) of the yearling Bali bulls (Kardaya et al., 2018).

CONCLUSION

Inclusion of flushing diets without or with urea-impregnated zeolite content increased daily body weight gain. Still, only the flushing ration containing urea-impregnated zeolite improved the preweaning calves' body condition score under extensive grazing.

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CONFLICT OF INTEREST

The authors have declared no conflict of interest.

AUTHORS CONTRIBUTION

Dede Kardaya designed the study, executed the project, and analyzed data. Deden Sudrajat designed the study and edited the draft version of the manuscript. Dewi Wahyuni assisted in the design of the study and data analyses.

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