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Blood Glucose Levels, Platelet Count, and Urinary Ketone Levels in Lame Bali Cattle

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ABSTRACT

Lameness is a common problem in Bali cattle. It is caused by various factors, both infectious and non-infectious. This study aims to evaluate the physiological changes in the levels of blood glucose and urinary ketone in lame Bali cattle. This study included 18 Bali cattle with locomotive disorders. Blood glucose levels were assessed from blood samples taken from the jugular vein, while urinary ketone levels were assessed from manually taken urine samples during urination of Bali cattle. The results showed that Bali cattle with locomotive disorders had significantly low blood glucose levels as well as mild to moderate ketonuria and thrombocytosis, which were associated with the increased energy requirements of lame cattle for maintaining postural balance. The results also suggested that the incidence of lameness in Bali cattle was relatively high.

Keyword: Bali cattle, glucose, ketone, lameness, thrombocyte

INTRODUCTION

Bali cattle are considered one of the best beef-producing breeds in the world due to their many advantages over other breeds. Bali cattle offer high reproductive and growth rates with good body condition, making them excellent quality cattle (Matondang & Talib, 2015). Bali cattle farming business plays an important role in achieving beef self-sufficiency programs. However, poor maintenance and health management can pose a threat to the cattle farming business.

Lameness is a significant economic problem that affects livestock health. It is common to find cattle that are lame and collapsed in the field. This condition can occur due to infectious and non-infectious factors, environment, and poor management. Cattle that experience lameness exhibit clinical signs, such as movement-evoked pain and abnormal gait (Lin et al., 2018). Behavioral changes are intended to protect limbs from further injury (Coetzee et al., 2017). Lameness in cattle is typically reported in cases of bovine ephemeral fever (Nururrozi et al., 2017) and

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during the periparturien period (Merdana et al., 2020).

Non-infectious lameness in cattle is typically associated with metabolic disorders (Shearer & Van Amstel, 2011). Livestock require glucose as their primary monosaccharide for energy production (Nafikov & Beitz, 2007). This compound can be produced from glycogen stored in muscles or synthesized through gluconeogenesis from amino acid, lactate, or propionate (Navarro et al., 2019). Blood glucose levels are a reflection of the metabolic rate of the body. As a result, livestock can become weak if their needs for energy production are not met. In addition, metabolic disorders that increase energy requirements of the body can lead to ketosis in livestock (Nazeer et al., 2019). Moreover, lameness can cause pain and stress, which can further affect their homeostasis (Twomey et al., 2018). Platelet count is one of the physiological parameters that can be observed under stressful conditions (Otter, 20123). To determine the relationship between physiological changes in Bali cattle with locomotive disorders, it is necessary to evaluate their blood glucose levels, platelet count, and urinary ketone levels.

MATERIALS AND METHODS

Research Design

This study used an observational design that used 18 female Bali cattle aged between two and four years with clinically confirmed lameness. Four healthy female Bali cattle were used as controls. The degree of lameness was assessed using a method adapted from Sprecher et al. (1997). Age and results of clinical and lameness examination of the Bali cattle were recorded.

Materials and Instruments

This study used blood and urine samples from Bali cattle with locomotive disorders. The equipment used in this study included 3 mL syringes, VENOJECT tubes, EDTA tubes, 200 mL sterile urine pots, a Nesco MultiCheck GCU 3-in-1 glucometer, Verify 10 Parameter urine test strips, and a hematology analyzer.

Sample Collection

A minimum of 3 mL of blood was collected from the jugular vein and placed in a Vacutainer tube containing ethylenediaminetetraacetic acid (EDTA) as an anticoagulant solution. Urine samples were collected manually using a 20 ml urine pot when during urination of the Bali cattle. The blood samples were stored in a cool box with ice gel packs.

Blood Glucose Levels Test

The collected blood samples were immediately placed on the tip of glucose test strips. The glucose levels were observed on the glucometer after several seconds.

Urinary Ketone Levels Test

The urine test strips (dipsticks) were immediately dipped into the collected urine samples in a 200 mL sterile urine pot. After 30 seconds, changes in color of the ketone level parameter was observed.

Data Analysis

Clinical analysis was performed on the data from observations of Bali cattle with locomotive disorders. The degree of lameness was identified. In addition, blood glucose levels and platelet count were measured and the average was calculated. Meanwhile, the data from the urinalysis

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results for ketone levels were analyzed and grouped on the basis of mmol/l values.

RESULTS AND DISCUSSION

The results of observation of 18 Bali cattle showed that the cattle had moderate to severe lameness, as presented in Table 1. Lameness is a common clinical problem in livestock, but early detection can be challenging for veterinarians because sick animals rarely show signs of discomfort (Shearer et al., 2012).

Table 1. Locomotion Scores of Bali Cattle

Locomotion Score	n
Score II (Mildly lame)	**-**
Score III (Moderately lame)	**3**
Score IV (Lame)	**5**
Score V (Severely lame)	**10**

Note: The scoring system was adapted from the locomotion scoring developed by Sprecher et al. (1997).

The examination of the Bali cattle revealed that the majority of the cattle had a locomotion score V (n = 10). This resulted in 10 Bali cattle suddenly collapsing. This was followed by locomotion scores IV (n = 5) and III (n = 3). No locomotion score II was reported. This was probably due to the difficulty in assessing the locomotion score II because of the lack of sensitivity of observers (Shearer et al., 2013).

Furthermore, the examination results of blood glucose levels indicated that Bali cattle with locomotive disorders had lower blood glucose levels and less platelet count compared to those with normal locomotion, as presented in Table 2.

Table 2. Blood Glucose Levels and Platelet Count of Bali Cattle

Sample		Parameter	
		Blood Glucose (mg/dL)	**Platelet (K/uL)**
Locomotive Disorder	Mean	36.11 ± 8.89[a]	540.89 ± 249.89[a]
	Min	21	126
	Max	48	836
Normal Locomotion	Mean	65.80 ± 2.38[b]	266.80 ± 80.33[b]
	Min	63	197
	Max	69	383

Note: Superscripts with different letters indicate significant differences in blood glucose levels ($p < 0.05$) between Bali cattle with locomotive disorders and Bali cattle with normal locomotion.

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The average blood glucose level of Bali cattle with locomotive disorders was 36.11 ± 8.89 mg/dL, which is lower than that of Bali cattle with normal locomotion under the same rearing feeding system. The average blood glucose level of Bali cattle with normal locomotion was 65.80 ± 2.38 mg/dL. This is consistent with the findings of Kendran et al. (2012) that the blood glucose levels of healthy adult Bali cattle range from 65.85 to 68.91 mg/dL. In comparison, Garveric et al. (2013) reported that blood glucose levels of Bali cattle range from 61 to 64 mg/dL.

Blood glucose levels in Bali cattle with locomotive disorder were significantly lower compared to those of Bali cattle with normal locomotion. This was due to an increase in the glucose requirements of the cattle as a result of an increase in their body metabolism. Lameness in Bali cattle causes pain in the foot, which affects their movement. Livestock experiencing pain from lameness may suffer because they use more energy to endure pain or maintain a balanced posture. The results of this study suggested that blood glucose levels may be a reflection of the energy source in the body of cattle with locomotive disorders. This is consistent with the findings of Merdana et al. (2020) that blood glucose levels reflect the metabolic rate of the body and can lead to a decline in livestock condition when energy production is inadequate.

Furthermore, it was found that Bali cattle with locomotive disorders had higher numbers of platelets compared to those with normal locomotion. Out of 18 samples, 16 (88.9%) had thrombocytosis, while the remaining 2 (11.1%) had thrombocytopenia. This condition is believed to be caused the stress response in Bali cattle that experienced locomotive disorders due to the pain they felt while trying to maintain a balanced posture. This is consistent the findings of Roland et al. (2014), Abramowicz et al. (2019), and Patel et al. (2020) that reactive or secondary thrombocytosis is induced by the release of cytokines and associated with the stress in cattle.

Table 3 presents the varying urinary ketone levels of Bali cattle with locomotive disorders. The results of the dipstick test showed that four out of ten Bali cattle with locomotion score V had moderate ketone levels (4.0 mmol/l). In addition, seven cattle had low ketone levels (1.5 mmol/l) and five had normal ketone levels (0.5 mmol/l). Out of six cattle that were tested negative for urinary ketone, two had locomotive disorders and four had normal locomotion.

Table 3. Urinary Ketone Levels of Bali Cattle

Keton Level (mmol/l)	n
Negative	6
Normal (0.5)	5
Low (1.5)	7
Moderate (4.0)	4
High (8.0)	-
High (16)	-

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Ketones are produced when the body is low on energy (Parrah et al., 2013). They are formed from the metabolism of fatty acids and acetoacetic acid, acetone, and β-hydroxybutyrate. Ketonuria is associated with primary ketosis in livestock, secondary ketosis due to diabetes mellitus in small animals, and consumption of low-carbohydrate feeds, especially in cats or livestock that have experienced prolonged fasting or starvation (Callens & Bartges, 2015). This is consistent with Ihedioha et al. (2019) who suggested that ketonuria occurs when the carbohydrate metabolism is unable to meet the needs of the body. The urine samples of Bali cattle in this study with normal locomotion were tested negative for ketosis. According to Peek et al. (2000), ketosis may be present in cows with muscle weakness. In addition, the presence of ketones in the urine samples is associated with a decrease in blood glucose levels or hypoglycemia, which can occur clinically or sub-clinically and is further associated with ketosis (Aschenbach *et al*., 2010). Ketosis is a natural metabolic process that occurs when the body fails to use carbohydrates as its primary source of energy and uses fat reserves instead. Ketosis is commonly observed in livestock that experience sudden collapse, especially during the postpartum period (Vicente et al., 2014; Merdana et al., 2020).

CONCLUSION

The incidence of locomotive disorders in Bali cattle is quite high, with varying degrees of lameness. Scores III to V are generally more noticeable due to the abnormal gait observed in affected cattle. Bali cattle with locomotive disorder experienced a decrease in blood glucose levels or hypoglycemia. This was characterized by an increase in the metabolism of the body due to pain and an increase in the efforts of the cattle to maintain a balanced posture. This condition was confirmed by the presence of ketones in the urine samples of the cattle. In addition, the efforts to maintain a balanced posture and endure pain result in an increase in stress response. As a result, Bali cattle with locomotive disorders experienced an increase in the number of platelets in the bloodstream.

APPROVAL OF ETHICAL COMISSION

This study received ethics approval from the Animal Ethics Committee of the Faculty of Veterinary Medicine, Udayana University with a certificate number B/271/UN14.2.9/PT.01.04/2023.

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