Research Article

Hematology and Milk Production of Murrah Buffaloes with Local Forage-Based Feeding in Kapau Village, Agam Regency, West Sumatra, Indonesia

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Abstract | Buffalo livestock has the potential to be developed because it has high economic value. Murrah buffalo is one of the milk-producing livestock with a total production that the average milk production for 294 days of lactation is 1.76 kg per lactation. Buffalo milk has an advantage 6–8% fat and 4–8% protein compared to 3–4% fat and protein content in cow's milk. Generally, the maintenance of dairy buffalo is still traditional, so the productivity of Murrah buffalo is still not optimal. This study aims to improve the health of Murrah buffalo by providing feed based on local forages to increase milk production. This research is an experimental study with the Latin Square Design (LSD), using four female Murrah buffaloes as research samples with the following feeding: P1 = basal feed (10% of body weight); P2= 30% sweet potato leaves + 30% cassava leaves + 40% of P1 + urea saka block (USB); P3 = 40% sweet potato leaves + 40% cassava leaves + 20% P1 +USB; P4 = 50% sweet potato leaves + 50% cassava leaves + USB. The parameters measured in this study were the hematology (erythrocytes, leukocytes, hemoglobin, and hematocrit) of Murrah buffalo. The results obtained in sequential studies are as follows: Erythrocytes (3.94 – 5.30 x10^6/ µL), Leukocytes (6.6 – 9.8 x10^3/µL), Hemoglobin (8.9 – 9.8 g/dL) Hematocrit (21.2 – 24.2%) and milk production (3.75 – 5.95 kg/head/day). From the results of the study, it was found that feeding 50% sweet potato leaves, 50% cassava leaves, and USB can increase milk production and improve the health of Murrah buffaloes through their hematological profile, where the better hematological levels indicate that the transportation process of the feed nutrients provided will be better so that the milk biosynthesis process in the mammary glands will increase.

Keywords | Cassava leaves, Hematology, Milk production, Murrah buffalo, Sweet potato leaves, Urea saka block

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INTRODUCTION

Buffalo is one of the livestocks that has the potential to be developed because of buffalo have their advantages compared to cows, namely being able to live in relatively tricky areas, especially if the available feed is of low quality. Apart from that, buffaloes are also reasonably capable of overcoming extreme environmental pressures and changes. Buffaloes have very high adaptability and can thrive in an extensive range of agroecosystem conditions ranging from dry climate areas to swamplands in mountainous and lowland areas. Buffaloes can survive well despite changes in temperature (heat load) and alterations in grassland vegetation (Diwyanto and Handiwirawan, 2006). In West Sumatra, buffalo produce meat, labor, and milk, complementing traditional ceremonies.

As a milk producer, the role of buffalo livestock is quite essential. Where buffalo milk is processed into products for daily consumption, including dadiah, which is a typical food from West Sumatra with the main ingredient made from buffalo milk, one buffalo that has the potential to produce milk is the Murrah buffalo, with an average milk production of around 6-8 liters/head/day (Roza *et al*., 2017; Mihaiu *et al*., 2011). However, the expected milk production has yet to be realized because maintenance management is traditional (extensive), and feeding is still carried out without paying attention to the needs of the Murrah buffalo. Feed availability is one of the determining factors for the success and sustainability of livestock production. Ma'sum (2011) stated that feed directly affects production, productivity, and livestock health. Hogberg *et al*. (2005) added that livestock's less-than-optimal hematological blood profile indirectly influences low milk production.

Hematological levels (erythrocytes, leukocytes, hemoglobin levels, hematocrit) can help farmers determine livestock's physiological condition. In the livestock's body, blood is essential in transporting oxygen, carbon dioxide, metabolites, hormones, feed nutrients, and immune system components (Roza *et al*., 2015). Feed is critical for increasing blood metabolism because it contains protein, vitamins, and minerals to form red blood cells. Feed with good nutritional content is needed to obtain an average hematological profile, including using local forage such as sweet potato leaves, cassava leaves, and additional minerals urea saka block (USB).

Sweet potato leaves and cassava leaves are agricultural products that have nutritional value and have the potential to be used as animal feed (Baba *et al*., 2018; Borin *et al*., 2005). The protein and crude fiber content of sweet potato leaves and cassava leaves, respectively, are as follows: crude protein 12.93%; 29% (Iqbal *et al*., 2014) and crude fiber 16.72%; 19.06% (Nurulaisyah *et al*., 2021). Local forage (sweet potato and cassava) can be fed fresh or processed, such as hay or silage. Giving cassava leaves to *Friesian Holstein* cows can increase milk production (Handayani *et al*., 2021). Apart from providing local forage, additional minerals in the form of urea saka block (USB) are intended as additional supplements for livestock, forming amino acids needed by ruminant livestock and also helping increase digestibility by stabilizing the acidity (pH) conditions in the rumen and increasing livestock palatability. Garg and Sherasia (2011) reported that providing additional minerals in the form of urea molasses mineral block (UMMB) can reduce the use of expensive concentrates by 30-40% without affecting milk production. This study aimed to provide forage-based feed (combination of sweet potato leaves and cassava leaves) with addition of USB minerals; and the impact of the forage-based feed to the milk production and health status of Murrah buffalo.

MATERIALS AND METHODS

Location

This research was conducted on Murrah buffalo farms, Kapau village, Agam Regency, West Sumatra Province, Indonesia, with an altitude of 500-1000 meters above sea level; the temperature in Kapau village has a cool temperature ranging from 21-25°C. In the tropics, this temperature has great potential for Murrah buffalo livestock development and is also the center of the Murrah buffalo livestock development location in West Sumatra Province. The 303.86 Ha area in Kapau village is agricultural land where the agricultural by-products can be forages (cassava leaves and sweet potato leaves) for Murrah buffalo. Like the tropics, it generally has two seasons, namely dry and rainy. The rainy season runs from September to February, and the hot season runs from March to August, while this research was conducted from June to September 2023.

Experimental design

The material used was four female Murrah buffaloes aged 3–5 years from North Sumatra and kept in Kapau village, Agam Regency, with feed given basal forage (breeders), basal concentrate (livestock), sweet potato leaves, cassava leaves, and USB at different levels. The research method used was an experimental method using a Latin Square Design (LSD), which consisted of 4 treatment groups and four replications. The treatments applied in this research are:

P1= basal feed (field grass given as much as 10% of body weight) (control)
P2= 30% sweet potato leaves + 30% cassava leaves + 40% P1 + USB
P3= 40% sweet potato leaves + 40% cassava leaves + 20% P1 + USB
P4= 50% sweet potato leaves + 50% cassava leaves + USB

Before being treated, Murrah buffaloes were first put into the research cages that had been prepared, while testing and sampling of milk and hematology were carried out four times according to the number of treatments given, on days 10, 27, 44, and 61.

Parameter

Milk production

Milk production is examined from milk production total in the morning and the afternoon, known as milk kg/head/day. Milk production is also determined by the volume secreted during the lactation period in liters (Sudono *et al*., 2003). The production is regulated with the conversion method (7% FCM/days) (Gaafar *et al*., 2009)

Milk production 7% FCM = (0.265 x milk production) + (10.5 x fat production).

Note: FCM = Fat-Corrected Milk; Fat production = fat content % x milk productions.

Hematology

In this study, the variables measured were the blood picture, including the number of erythrocytes, leukocytes, hemoglobin levels, and hematocrit. Counting the number of leukocytes, erythrocytes, hemoglobin, and hematocrit is known using the Hematology Analyzer-Exigo (Figure 1). By homogenizing the blood in a venoject tube containing 1 cc of blood, then inserting the tubes one by one into the Hematology Analyzer-Exigo, the results are obtained after 2 minutes.

Figure 1: Hematology test using Hematology Analyzer – Exigo.

Data analysis

Data taken to analyze by Minitab 14 through Analysis of Variant (ANOVA).

RESULTS AND DISCUSSION

Hematology

The hematology of Murrah buffalo with local forage and USB mineral-based feed can be seen in Table 1.

Erythrocytes (x10^6/µ L)

Statistical analysis showed that the number of erythrocytes obtained showed a significant effect (P <0.05). The highest total erythrocytes were obtained in treatment P4 (5.30 x10^6/µL) followed by treatments P3 (5.17 x10^6/µL), P2 (5.10 x10^6/µL) and P1 (3.94 x10^6/µL). By feeding sweet potato leaves, cassava leaves, and USB minerals, the number of erythrocytes can be increased to a higher level within the normal range. This is caused by the higher percentage of administration of sweet potato leaves, cassava leaves, and USB with relatively high nutritional content, especially protein, Fe, and Cu minerals, resulting in increased erythrocyte levels. Roza *et al.* (2015) stated that protein content, Fe, and Cu minerals are precursors in the formation of blood erythrocytes. The erythrocyte levels obtained were within the normal range, namely 5.30–7.90 x10^6/µL (Diwyanto and Handiwirawan, 2006). In addition, the content of amino acids and tannins in the given forage (cassava leaves and sweet potato leaves) can help microbial synthesis in the rumen, which will indirectly affect the formation of erythrocytes (Roza *et al.*, 2015), where the content of condensed tannins in cassava leaves and sweet potato leaves can increase the supply of protein to the digestive tract (Wanapat, 2009). The condensed tannin content in foliage influences ruminant protein, leading to increased nutrition and red blood cell formation (Niezen *et al.*, 1996), so erythrocyte levels can increase in the P4 treatment.

Table 1: Murrah buffalo hematology.

Treatment	Erythrocytes (RBC) (x10^6/µL)	Leukocytes (WBC) (x10^3/µL)	Hemoglobin (HGB) (g/dl)	Hematocrit (HCT) (%)
P1	3.94^a	9.80^a	8.90^a	21.20^a
P2	5.10^b	7.80^b	8.80^a	21.80^a
P3	5.17^b	7.30^b	9.50^b	22.50^b
P4	5.30^c	6.60^c	9.80^c	24.20^c

Leukocytes (x10^3/µ L)

Statistical analysis showed that the number of leukocytes obtained showed a significant effect (P <0.05). The total leukocytes obtained were within the normal range by administering sweet potato leaves, cassava leaves, and USB. This was due to the flavonoid content, an antioxidant that can control pathogens, and the number of leukocytes in the blood remained stable. Apart from that, the Zn content (0.5 g) in USB is very helpful in controlling the number of leukocytes. *Zn* is an essential micronutrient that is important in improving immune function (Maulia and Farapti, 2019). The total leukocytes obtained in this study were still in the normal category. According to Mihaiu *et al.* (2011), the average value for total ruminant leukocytes is 6.5–12 x10^3/µl. Suprayogi *et al.* (2017) also added that the total normal leukocytes in lactating livestock ranges from 6.2–10.6 x 10^3/µl. According to Roza *et al.* (2015), leukocytes are a blood component that plays a role in the immune system and body defense. In contrast, leukocytes provide antibodies to the defense system th at are fast and

strong in fighting infection. The number of leukocytes will generally increase if an infection occurs. Therefore, stable leukocyte levels in Murrah buffalo fed with sweet potato leaves, cassava, and USB show positive results for the body (Roza *et al*., 2015).

Hemoglobin (g/dL)

Statistical analysis showed that the hemoglobin levels obtained showed a significant effect (P <0.05). The highest hemoglobin levels were obtained in treatment P4 (9.8 g/dl). This was due to the protein and Fe content contained in sweet potato leaves, cassava leaves, and USB, which met the needs of Murrah buffalo. Fe is an essential micronutrient in producing hemoglobin, transporting oxygen from the lungs to body tissues, transporting electrons in cells, and synthesizing enzymes containing Fe (Bentley *et al*., 1997). Fe and protein content in feed are precursors in the formation of red blood cells (Roza *et al*., 2015). Apart from that, the Zn content (0.5 g) in USB can also increase hemoglobin levels. This is by Septiarini *et al*. (2020). Zn supplementation is essential to improve hemoglobin level status in livestock. Zn, an essential nutrient, plays a role in the functioning of more than ten types of enzymes (Ridwan, 2012). Some Zn uses transferrin transport, which is also a means of transporting Fe to form hemoglobin. The hemoglobin levels in buffalo obtained were within the normal range, namely 9.7–73.7 g/dL (Bukittinggi Veterinary Center, 2023). Roland *et al*. (2014) revealed that ruminant livestock have Hb levels of 8.4–15 g/dL.

Hematocrit (%)

Statistical analysis showed that the hematocrit levels obtained showed a significant effect (P <0.05). The highest hematocrit levels were obtained in treatment P4 (24.20%), followed by treatments P3 (22.50%), P2 (21.80%) and P1 (21.20%). There was an increase in hematocrit levels in buffalo-fed sweet potato leaves, cassava leaves, and USB because the protein, amino acid, and mineral (Fe, Cu, Co) content in the feed played a significant role in average growth and maturity of erythrocytes and hematocrit. Ali *et al*. (2013) supported this, stating that blood formation (hemopoeisis) requires substances such as Fe, Co, vitamins, amino acids and hormones, thus affecting blood status values. Kayyis *et al*. (2008) stated that the hematocrit value is closely related to the quality and quantity of feed consumed by livestock, where providing feed with higher nutritional levels affects the hematocrit. Hematocrit levels depend on the number of erythrocytes where the erythrocyte and hematocrit values are interconnected (Roza *et al*., 2015). The levels in treatment P4 still show within normal limits, namely 24–46% (Schalm *et al*., 1975).

Milk production of Murrah buffalo (kg)

Milk production of Murrah buffalo by providing Local Forage Based Feed and USB Minerals can be seen in Table 2.

Table 2: Milk production of Murrah buffalo.

Treatment	Milk Production 7% FCM (kg/day)
P1	3.75[a]
P2	4.64[b]
P3	4.75[b]
P4	5.95[c]

Statistical analysis showed that the obtained Murrah buffalo milk production showed a significant effect (P <0.01). The highest milk production was in treatment P4 (5.95), followed by treatments P3 (4.75), P2 (4.64) and P1 (3.75). The increase in milk production in the P4 treatment was due to the high protein content in the forage feed, namely sweet potato leaves (29%) and cassava leaves (27%). Providing feed rich in protein can improve metabolism and increase the ability of microbes to degrade feed in the rumen (Arief *et al*., 2018). Protein in feed is a precursor in the formation of NH^3 in the rumen, which is used as a nitrogen source for the growth of microorganisms so that the activity of microorganisms in the rumen is maintained (Roza *et al*., 2021). NH^3 in the rumen is also used to ferment polysaccharides to increase volatile fatty acids (VFAs). VFAs are used as an energy source by livestock for production. The higher the VFAs production, the buffalo will get a more significant source of energy so that their productivity will be better, as indicated by higher milk production.

In addition, the content of phytochemicals such as tannin contained in sweet potato leaves and cassava leaves can help protect proteins from rumen degradation by forming protein-tannin complex bonds (bypass protein). Tannin can bind to proteins, cellulose, and hemicellulose so that the activity of protease and cellulase enzymes is inhibited, which results in feed proteins not all being degraded in the rumen. The protein will reach the intestines so that the body can efficiently utilize it for life needs and milk production (Huang *et al*., 2018; Roza *et al*., 2021). Roza *et al*. (2021) reported that cassava leaves are thought to contain steroids, which play a role in the prolactin reflex or stimulate the alveoli to produce milk, as well as stimulating the hormone oxytocin to stimulate the production and release of milk. Steroid compounds are also thought to influence the increase in estrogenic hormones so that milk production can increase. The presence of mineral content in the feed provided in the form of Zn, Co, Cu, and Fe minerals has supported an increase in the milk production of the Murrah buffalo. Sulaiman (2010) reported, who shows that giving multimineral feed can increase cow's milk production by 3.3%, followed by an increase in milk quality. Retnani *et al*.

(2014) and Akhdiat *et al*. (2021) stated that the provision of minerals (premix) can enrich low nutritional values in basic rations; premixes contain various vitamins and minerals (Co, Zn) that livestock need so that they can increase milk production. The increase in milk production obtained is in line with the increase in hematological levels in livestock, where the blood cells transport feed nutrients, which will be carried into the mammary glands consisting of lobes, and each lobe consists of lobules. Meanwhile, the lobules consist of small chambers surrounded by cells. These cells surround the blood filaments. The mammary glands then secrete milk in small chambers in the lobules and flow it to the nipple.

CONCLUSIONS AND RECOMMENDATIONS

From the results of the study, it was found that feeding 50% sweet potato leaves, 50% cassava leaves, and USB (treatment P4) can increase milk production and improve the health of Murrah buffaloes through their hematological profile, where the better hematological levels indicate that the transportation process of the feed nutrients provided will be better so that the milk biosynthesis process in the mammary glands will increase.

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NOVELTY STATEMENT

Murrah buffalo is one of the potential milk-producing livestock to be developed in West Sumatra; feeding local forage and USB (P4 treatment) is proven accurate in increasing milk production and the health of Murrah buffalo from hematology. It is hoped that this can realize national milk self-sufficiency.

AUTHOR'S CONTRIBUTION

The manuscript has been compiled and written by author and co-authors. ER: Conceptualization, formal analysis, methodology, funding and project administration. SNA: Investigation and resources. YY: Supervision. HS: Data curation. R: Data curation, software and writing.

Conflict of interest

The authors have declared no conflict of interest.

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