Presence of Anthocyanins in Milk of Lactating Boer Goats Fed Red Napier Grass

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Abstract. This short communication evaluates the effect of feeding Red Napier grass (*Pennisetum purpureum cv. Red*) on anthocyanin concentration in the milk of lactating Boer goats. The study aimed to compare anthocyanin transfer into milk between goats fed Red Napier grass and those fed Napier Pakchong grass. Lactating Boer goats were allocated into two dietary groups and fed either fresh Red Napier grass or Napier Pakchong grass during the lactation period. Milk samples were collected and analyzed for anthocyanin concentration using ELISA methods. The results revealed that goats receiving Red Napier grass produced milk with detectably higher anthocyanin content compared to goats fed Napier Pakchong. These findings indicate that red Napier grass can improve the functional properties of goat milk through increased anthocyanin content, which has the potential to provide benefits for functional food applications.
Keywords: Boer goat, lactation, Red Napier grass, anthocyanin, milk quality.

1 Introduction

Napier grass (*Pennisetum purpureum*) is one of the most widely used tropical forages for ruminants due to its high biomass production [1], adaptability to various environmental conditions, and year-round availability. Several cultivars of Napier grass have been developed to improve yield and nutritive value, including Pakchong, which is known for its fast growth, high crude protein content, and palatability [2], [3]. However, another cultivar, commonly referred to as Red Napier or red Napier grass introduced in Indonesia [4] has attracted increasing attention not only because of its forage potential but also due to its high content of bioactive compounds, particularly anthocyanins[5].

Anthocyanins are natural pigments belonging to the flavonoid group, responsible for the red, purple, and blue coloration in many plants [6]. These compounds are well known for their potent antioxidant, anti-inflammatory, and health-promoting properties[7]. In human nutrition, anthocyanins are considered functional food components that contribute to reducing the risk of oxidative stress-related diseases [8]. Consequently, there has been growing interest in exploring anthocyanin-enriched animal-derived foods, such as milk and

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meat, as potential functional foods and nutraceutical [9]. Forages are the primary feed for ruminants, providing not only essential nutrients but also bioactive compounds with functional benefits. Compounds such as carotenoids and polyphenols have been detected in milk and meat, thereby enhancing the nutraceutical value of animal products [10] However, evidence regarding anthocyanins—flavonoids with strong antioxidant activity—remains limited, particularly in dairy animals. Red Napier grass is known to contain anthocyanins, yet it is still unclear whether these compounds can survive ruminant digestion and be transferred into milk. Demonstrating this potential would be an important step toward developing functional animal products with added value while supporting sustainable production systems. Milk is a practical livestock product for detecting anthocyanin content, as it is easy to collect and sensitive to dietary changes. In addition to being rich in essential nutrients such as protein, fatty acids, and bioactive compounds [10]. Although Boer goats are primarily meat-type animals, their lactating does can serve as a practical model for preliminary trials, especially when the goal is not commercial milk production but rather to generate initial evidence. Compared to dairy cattle, Boer goats offer a more accessible model for replication under controlled feeding conditions.

This short communication presents a preliminary investigation into the transfer of anthocyanins from Red Napier grass into milk. The study compared lactating Boer goats fed Red Napier grass with those fed Napier Pakchong, a widely used cultivar with high nutritive value. By evaluating anthocyanin levels in milk, this study provides the first evidence of anthocyanin enrichment in goat milk through forage feeding. These findings may serve as a basis for future studies aimed at enhancing the functional quality of livestock products through anthocyanin-rich forages

2 Materials and methods

2.1 Location

The experiment was conducted at the Sumbersekar Field Station, Faculty of Animal Science, Universitas Brawijaya, Malang Regency, Indonesia. The site is located in a tropical humid zone at 112°34’35’’ E and 7°55’07’’ S. Nutrient of the forages was analyzed at the Animal Nutrition Laboratory, Faculty of Animal Science, Universitas Brawijaya. Anthocyanin content was determined at Satwa Sehat Indonesia Laboratory

2.2. Research Variables

The variables measured were feed intake and anthocyanin content in milk.

2.3. Research Procedure

This study was conducted using six lactating Boer goats. The animals were divided into two groups: a control group consisting of two goats fed with Napier Pakchong grass, and a treatment group consisting of four goats fed with Red Napier grass. Feeding was carried out following the routine management practices of the farmers.

The experiment lasted for seven days, during which daily feed provision based on a forage-to-concentrate ratio of 30:70 and refusals were weighed and recorded to calculate feed intake. Forage samples were collected daily, dried, ground, and subjected to proximate analysis to determine nutrient composition. The nutrient composition of the feed is presented in Table 1.

On the seventh day, morning milk samples were collected from all goats. The samples were immediately transported to the Satwa Sehat Indonesia Laboratory for anthocyanin determination. Anthocyanin concentration in milk was analyzed using an Microplate Reader DR-200Bc by Diatek. Following previously reported methods by [11]. The profile of anthocyanin components present in the forage is presented in Table 2.

Table 1. Nutrition composition for goats feed.

Item	DM	% DM	
		OM	CP
Pennisetum purpureum cv.Pakchong	18,76	79,28	8,56
Pennisetum purpureum cv.Red	12,97	76,98	7,68
Concentrate	83,99	86,92	15,3

Note: Dry Matter (DM); Organic Matter (OM) and Crude Protein (CP).

Table 2. Anthocyanin content of elephant grass plants.

Anthocyanin content (AU)	Elephant grass type:	
	Pakchong	Red
Pelargonidin	0,18	0,19
Cyanidin	0,45	0,38
Delphinidin	0,61	0,62
Peonidin	0,43	0,49
Malvidin	0,36	0,41
Total	2,02	2,09

2.4. Analysis Data

Data on feed intake and milk anthocyanin concentration were analyzed using descriptive statistics (mean and standard deviation).

3 Results and discussion

3.1 Feed intake

Feed intake of lactating Boer goats during the 7-day observation is presented in Table 3.

Table 3. Feed Intake for boer goats.

Item	Control	Treatment
Total DMI (kg/day)	1,81 ± 0,28	1,27 ± 0,77
Total OMI (kg/day)	1,54 ± 0,25	1,08 ± 0,45

Dry matter intake (DMI) and Organic Matter intake (OMI)

Based on Table 3, Boer goats fed Pakchong Napier grass showed higher total dry matter intake (1.81 ± 0.28 kg/day) compared to those fed Red Napier grass (1.27 ± 0.77 kg/day).

3.2 Anthocyanin in milk

Anthocyanin profiles in milk are presented in Table 4.

Table 4. Profile anthocyanin in milk boer goats.

Anthocyanin in Milk (mg/L)	Control	Treatment
Pelargonidin	1,30 ± 0,01	1,39 ± 0,09
Cyanidin	8,19 ± 0,02	8,61 ± 0,25
Delphinidin	6,24 ± 0,08	6,13 ± 0,18
Peonidin	4,54 ± 0,34	4,39 ± 0,19
Malvidin	1,02 ± 0,02	1,60 ± 1,01

Based on Table 4, Boer goats fed Red Napier grass showed slightly higher concentrations of pelargonidin (1.39 vs. 1.30 mg/L), cyanidin (8.61 vs. 8.19 mg/L), and malvidin (1.60 vs. 1.02 mg/L) compared to the control. Meanwhile, delphinidin and peonidin levels were relatively similar between groups. Milk total anthocyanin content of treatment is 4% higher than control.

4 Result and discussion

These findings are consistent with the anthocyanin profile of the feed (Table 2), where Red Napier grass contains higher levels of pigments compared to Pakchong Napier grass. The higher concentrations of cyanidin and malvidin detected in milk indicate that anthocyanins from Red Napier grass were more effectively transferred into mammary secretion. These results are in line with the findings of [12], who reported that feeding 100% Red Napier grass silage to dairy goats significantly enhanced milk lactose content, reduced somatic cell counts (SCC), and improved antioxidant activity in both plasma and milk. In that study Goats fed with Red Napier silage exhibited markedly higher anthocyanin concentrations in milk compared to the control group. The increase was observed across almost all components, including C3G, P3G, Peo3G, M3G, cyanidin, pelargonidin, and total anthocyanins. Overall, the total anthocyanin concentration in milk was reported at 3.53 mg/kg for the control group receiving Pakchong Napier, whereas goats fed with Red Napier grass reached 9.06 mg/kg. These findings indicate that Red Napier consumption substantially enhances the transfer of anthocyanins into milk.

Anthocyanins contained in Red Napier grass, particularly cyanidin-3-glucoside, are bound to sugar moieties such as glucose, galactose, rhamnose, xylose, and arabinose [13]. During ruminal fermentation, these compounds undergo hydrolysis and acylation by microbial activity, releasing sugar groups and partially degrading the anthocyanidin backbone [14]. The released sugars are absorbed in the digestive tract and enter energy metabolism, where they contribute to glycolysis and provide C3 skeletons as precursors for

lactose synthesis in the mammary gland, leading to increased lactose content in milk. Meanwhile, a portion of intact anthocyanins or their derivatives can be absorbed directly into the bloodstream and subsequently transferred into milk, as reflected in the presence of pelargonidin, cyanidin, and malvidin in the samples. This dual pathway highlights that anthocyanins not only enhance the functional quality of milk through their antioxidant properties but also indirectly support lactose biosynthesis via their sugar components [15]

Interestingly, malvidin also showed a marked increase in the treatment group, which further supports the role of Red Napier as a functional feed source that may enhance the bioactive compound content of goat milk. In contrast, delphinidin and peonidin levels remained relatively similar between the two groups, suggesting that the efficiency of transfer and metabolism of anthocyanins may differ among individual compounds. Such variability could be influenced by the chemical stability of each anthocyanin, rumen metabolism, or absorption dynamics in the digestive tract. Overall, the results highlight that feeding Red Napier grass not only provides nutritional benefits but also enhances the functional quality of goat milk through elevated anthocyanin content.

This study did not asess data on feed efficiency, as its primary aim is to offer preliminary information regarding the presence and content of anthocyanins in goat milk. The data obtained serve as an initial exploration or baseline study to confirm that anthocyanin compounds from feed can be detected and transferred into milk. Therefore, the findings of this study provide an important foundation for future research to further evaluate aspects of productivity, feed efficiency, and the physiological benefits of anthocyanins for animal health as well as milk quality.

5 Conclusion

Feeding Red Napier grass to lactating Boer goats did not improve feed intake compared to Pakchong Napier grass. However, it enhanced milk quality through the transfer of anthocyanins, particularly pelargonidin, cyanidin, and malvidin, into the milk. This enrichment highlights the potential of Red Napier grass as a functional feed that contributes to the antioxidant properties and health-promoting value of goat milk

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