Milk Production and Quality of Murrah Buffalo Supplemented by Turmeric Powder and Casava Leaf in Agam Regency, Indonesia

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Abstract: Buffalo farming in Indonesia is still managed traditionally due to low milk production and quality. Like in other developing countries, buffalo farming has becomea side business. Murrah Buffalo milk has better fat and protein content compared to dairy milk. Production and quality of buffalo milk affect farming management, such as keeping systems and feed management. The study aimed to reveal the effect of turmeric powder supplement and cassava leaf as forage on Murrah Buffalo in terms of milk production and quality (protein, fat, and lactose content). The study was conducted experimentally for four female Murrah Buffalo fed several formula feeds. The formula feed treatments are A (basal feed 100%), B = A + cassava leaf (1kg) + Turmeric Powder (0.015% Body weight), C = A + Cassava Leaf (1.5kg) + Turmeric Powder (0.030% Body Weight), D = A + Cassava Leaf (2kg) + Turmeric Powder (0.045% Body Weight). The result shows Milk production, protein, fat, and lactose is 5.40-7.91kg, 2.93-3.41%, 4.81-10.69%, and 4.39-5.11%, respectively. In summary, the best turmeric powder supplementation and Cassava leaf supply belong to treatment D, which significantly increases Murrah Buffalo milk production and quality.

Keywords: Cassava leaf, Murrah Buffalo, lactose, fat, protein, milk production, turmeric powder.

INTRODUCTION

Buffalo is a ruminant type that potentially develops as milk and meets suppliers in Indonesia. In several places in Indonesia, Buffalo takes a rule of socio-culture [1]. One of the most potential buffalo milk producers is Murrah. Murrah buffalo is typically black to brown, with a white color sign at the head and legs, short curly or spiral horn with a height of shoulder of 122.80cm, hips of 125.40cm, body length of 123.20cm, and chest size of 190.22cm [2]. milk production around 6-8liter/head/day, fat content 6-8% and Protein content 4-8% [3,4]. Murrah Buffalo hasthe potential to meet national dairy needs as a milk supplier.

However, like other developing countries, buffalo farming in Indonesia is a side income cause and is still adopting traditional management that does not focus on good production or quality milk. That is the reason dairy milk dominates the dairy market. Even though buffalo milk has better nutrient content than dairy milk, it dominates the consumer cause of its availability and consumption habits. Most buffalo farmers adopted semi-intensives that did not focus on the quality of animal nutrient intake.

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Nutrient intake is the main factor in increasing milk quality to supply the energy needed for milk secretion, especially protein, fat, and lactose. Good balancing concentrate and forage supply also affect milk quality. The abundance of cassava leaves surrounding the research location can potentially become a forage source for Murrah Buffalo. Cassava leaf is full of protein content to support buffalo milk production.

Generally, forage supplies combine with feed supplements to improve buffalo health and affect milk production and quality. Feed supplement containsanti-microbes, antioxidants, anda bioactive compound found in Turmeric (*Curcuma domestica Val*) [5]. The bioactive combination of Turmeric can potentially become an alternative to maintaining cell membranes at udder tissue to prevent microbe infection, increase milk productivity, and improve buffalo health [6]. Suggesteda turmeric dose supplement of 0.03% of body weight, improving propionate up to 4.24mMol/l related to milk quality.

MATERIAL AND METHODS

Ethical Approval

The implementation of this study refers to the ethics of research using experimental animals based on the law of the government of the Republic of Indonesia concerning animal husbandry, killing, treatment, and reasonable care, Number 18 of 2009 article 66.

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Experimental Site

This research was conducted on the Murrah buffalo farm, Nagari Kapau, Agam Regency, West Sumatra Province, Indonesia, with an altitude of 500-1000 meters above sea level; with this altitude, the temperature in the Nagari Kapau has a cool temperature ranging from 21-25^{o}C. With this temperature, the Kapau area has excellent potential for developing Murrah buffalo cattle. 303.86 Ha of the Kapau village area is agricultural land where the agricultural by-products have the potential as forage feed (cassava leaves, sweet potato leaves, and Moringa leaves) for Murrah buffalo cattle. The Kapau area has two seasons: dry and rainy, where the rainy season lasts from September to February, and the hot season lasts from March to August. This research was conducted from November 19, 2022, untilMay 11, 2023.

Experimental Design

This study used four healthy lactating female Murrah buffaloes aged 3-4 years, weighing 400-450kg. The feed supply is basal feed (field grass, concentrate, and cassava leaf) and Turmeric Powder. The experimental research method uses a Latin square design consisting of four treatments and four repetitions. The treatments are:

A = Basal Feed (100% as control) + Concentrate (Tofu waste)

B = A + Cassava leaf (1kg) + Turmeric powder 0.015% of body weight

C = A + Cassava leaf (1.5kg) + Turmeric powder 0.030% of body weight

D = A + Cassava leaf (2kg) + Turmeric powder 0.045% of body weight

The nutritional content of the feed given in Table **1**.

The implementation of this research was divided into four stages of feed treatment. Each stage had an observation phase, which was carried out for ten days; in this phase, milk production measurements and milk quality testing of Murrah buffaloes were carried out. Besides that, there was also a rest phase for ten days,

Table 1: Nutrient Content of Forage and Concentrate Feeds

Sample	%Dry Material	%Crude Protein	%Crude Fiber	%Crude Fat
Basal feed	90.59	8.6	22.91	3.82
Concentrate (tofu waste)	26.73	15.08	16.45	2.21
Cassava leaf	19.32	23.80	19.1	9.25
Turmeric powder		8.34	4.08	0.61

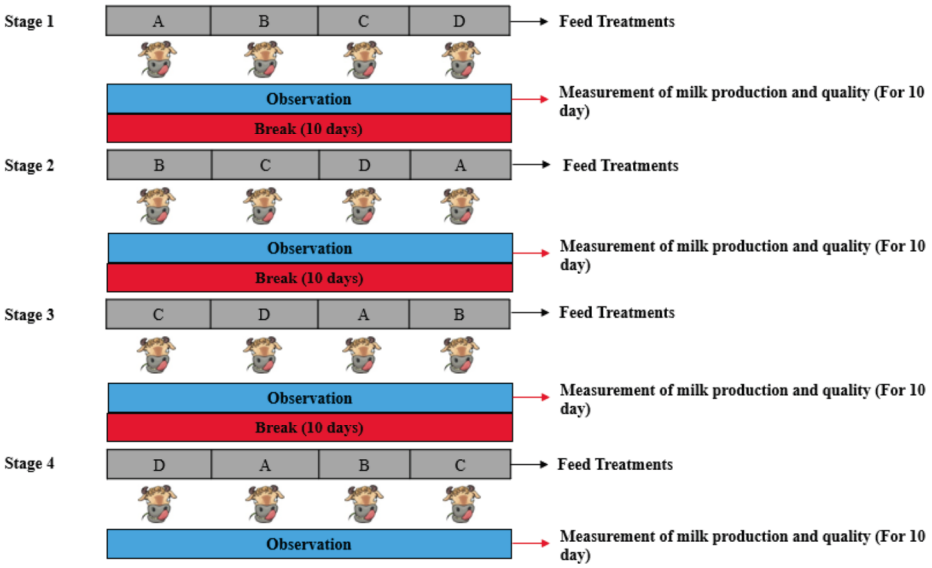

Figure 1: Research implementation stages.

which aimed to eliminate the effect of treatment in the previous phase (Figure **1**).

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 inliters [7]. The production is regulated by the conversion method (7% FCM/day) [8].

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

Fat production = fat content % x milk productions

Milk Quality (Protein, Lactose, and Fat)

Milk quality testing (protein, lactose, and fat) using the LactoScan Milk Analyzer Biobase CN (Model: BKMA-MK). With the following stages of LactoScan operation:

A. Press the LactoScan power button to the ON position.

B. Insert the analysis pipe into the prepared milk sample (5 ml milk/analysis).

C. Press the enter button and select the menu at the position of the milk to be tested.

D. Wait momentarily, and LactoScan will display the analysis results on the monitorscreen.

E. Print the analysis result.

Data Analysis

The data obtained were processed and analyzed using Analysis of Variant (ANOVA). If the treatment showed significantly different results (F count > F table 0.05), then the analysis continued with further tests using Duncan's Multiple Range Test (DMRT). The data were analyzed using Minitab 14 and Origin Pro 8.5 applications.

RESULTS AND DISCUSSION

Milk production

Table **2** shows the milk production of Murrah Buffalo farming supplemented with Turmeric Powder and Cassava Leaf at Nagari Kapau, Agam.

Table 2: Milk Production of Murrah Buffalo Farming Supplemented with Turmeric Powder and Cassava Leaf

Treatment	Average and SD
A	5.40±0.01[a]
B	5.65±0.96[a]
C	6.45±1.02[a]
D	7.91±0.54[b]

Note: [a,b]significant superscript represented by different letters (P<0.05).

Based on the table, the milk production of Murrah Buffalo is significantly highest in treatment D (Table **2**). Turmeric powder supplementation has proven to improve the milk production of Murrah Buffalo. Turmeric Powder is rich in curcumin and essential oils that act as effective antioxidants against oxidative cell break due to affected milk production. Besides antioxidants, cur cumin and essential oil shave rules to increase appetizing and accelerate feed drained on the rumen to feed optimization. The oxidant content obtained in the study was 8.94%, which can increase appetite in Murrah buffaloes [9] Girolami *et al*. (2022) states turmeric powder's antioxidant activity can protect and improve udder alveoli cells to secrete milk [10] supported Turmeric Powder and *Sauropus androgynus* feed combination by 2%, improving milk production for 2-3liter/head/day to dairy farms.

In addition, cassava leaf also has the rule to fulfill the protein 23.8% (Table **1**) needed for Murrah Buffalo feed. Cassava leaf has a crude protein high enough to improve metabolism and raise the microbe's ability to digest meals in the rumen [11]. Phytochemical Bioactivecom pounds on cassava leaf, like Tannin, protect the protein from rumen degradation by forming complex binding Protein-Tannin to reduce protein degradation on the rumen and deliver protein to the intestine to optimize protein adsorption to basal metabolite and lactating milk.

Moreover, cassava leaf nitrogen content acts as a precursor to establish NH3 in the rumen, which affects milk production. NH_3 will be used as a Nitrogen source for microorganism growth to ferment poly saccharides to become Volatile Fatty Acids (VFA). VFA is a source of animal energy for production. The high animal productivity and rising VFA secretion led to improving milk production [12] Azzaz *et al*. (2016) states supplementation has the rule to increase the microbe's ability to depredate the feed on the rumen. Furthermore, rising milk production is shown in Figure **2**.

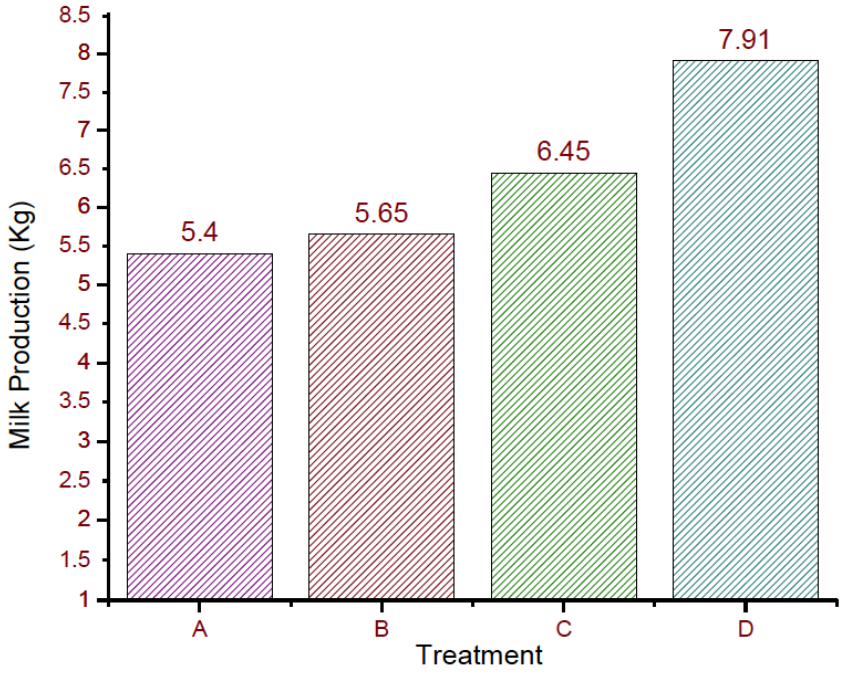

Figure 2: Murah Buffalo milk production improvement.

Table 3: Milk Quality

Treatment	Average and SD		
	Protein	Fat	Lactose
A	2.93±0.14[a]	4.81±3.08[a]	4.39±0.20[a]
B	3.00±0.24[a]	5.25±0.81[a]	4.50±0.35[a]
C	3.16±0.16[a]	8.53±2.08[a]	4.73±0.23[a]
D	3.41±0.10[b]	10.69±0.79[b]	5.11±0.16[b]

Note: [a,b] significant superscript represented by different letters (P<0.05).

Milk Quality

Table **3** describes the combination effect of turmeric powder and cassava leaf as forage, significantly improving the Murrah buffalo milk quality (Protein, fat, and lactose content).

Based on the table above, treatment D represents the highest milk quality. The result is that turmeric powder and cassava leaf supplementation improves milk nutrient content (protein, fat, and lactose) (Table **3**). The reason for the improvement is that essential oil and curcumin in turmeric powder accelerate adsorption in the digestive system, making the animal feel hungry more easily than increasing digestion effectively [13] states turmeric powder contains essential oil and curcumin for 2.5%-6% and 3-5%, respectively. Furthermore, [14] explained essential oil and curcumin in turmeric powder act as anti-protozoa on the rumen, leading to nutrient digestibility and then triggering digestive enzymes on bile fluid and pancreatic juice, stimulating hunger center that affected milk quality improvement.

Protein content and crude fiber for 23.8% and 19.1% (Table **1**) of cassava leaf support nutritional needs in Murrah Buffalo. Amino acids like valin, leusin, and isoleusin in cassava leaf are easier to degrade by rumen microbiota [15]. Tannin in cassava leaves forms a protein-tannin complex that protects some proteins from degradation in the rumen for digestive efficiency. Feed protein as basic carbon stimulates the growth of cellulolytic bacteria. Ammonia cannot be used for rumen microbe protein synthesis without carbon. Milk protein improvement also causes condensed tannin content on cassava leaf, ruling to increase protein by passing on the rumen. Forage cassava leaf is a carbohydrate source catalyzed by microorganisms to VFA like Propionate acid, acetate, and butyrate. Acetate acid formed will be used as a precursor of milk fat. That is why the suspended-milk-carbohydrate content is higher, and the cassava leaf supplement is

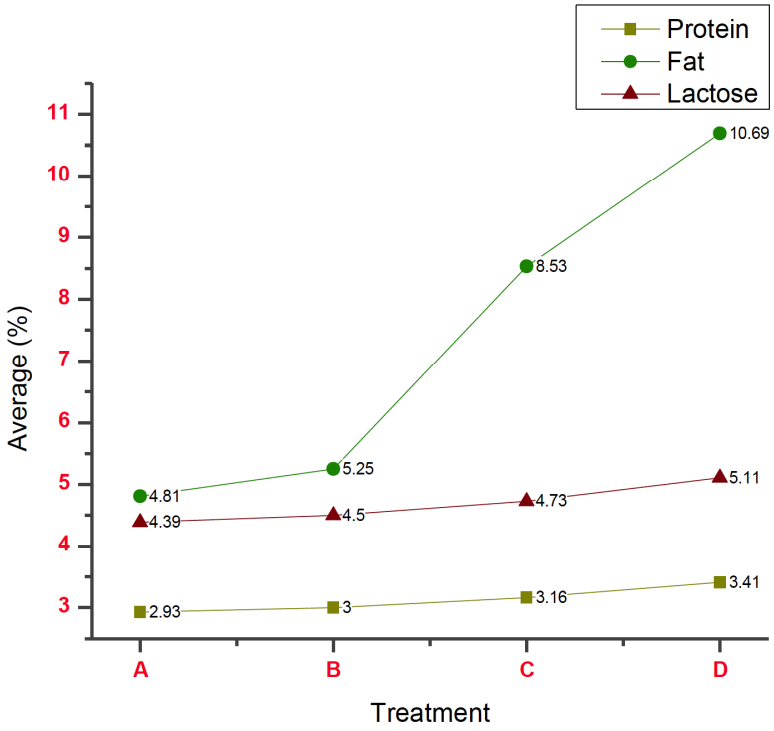

Figure 3: Protein, Fat and Lactose content improvement of Murrah Buffalo.

increased. In addition, high non-degradable protein improving glucose fermented by microbe become VFA. The idea supported by [16] states that acetate acid is necessary for fat to be uniform to milk and is related to the milk fat produced.

Propionate acid is the main precursor to forming milklactose, where 50-54% transforms to glucose, then turns to lactose [17,18]. Propionate acid absorption from the rumen is converted into glucose in the livers. Some of the glucose changed to glycogen and then saved in the liver or to be α-glycerol phosphate, then used for synthesizing triglyceride. Leftover glucose is taken to the blood vessels and the whole body tissue as a source of energy and co-enzyme, and it reduces fatty acid synthesis and muscle glycogen [19,20]. protein and energy supply triggered rumen microbe activity to produce more propionate acid due to milk lactose content improvement [20, 6] clarified that propionate acid is increased by turmeric supplement for 0.03% of body weight, increasing the propionate agent to 4.24mMol/l at the end to improve lactose. Figure **3** describes improving milk protein, fat, and lactose agents in this research.

CONCLUSION

To sum up, basic feed supplements, cassava leaf (2kg), and turmeric powder 0.045% of body weight increase productivity (milk Production and quality) of Murrah Buffalo due to support national milk self-sufficiency.

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CONFLICT OF INTEREST

The authors have declared no conflict of interest.

AUTHORS' CONTRIBUTIONS

All authors contributed equally to the manuscript.

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