Consumption and in vivo digestibility of feed supplemented by katuk (Sauropus androgynus) and gamal (Gliricidia sepium) leaves in friesian holstein cattle

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Abstract. The aim of this research is to understand the effects of katuk and gamal leaf supplementation on production and quality of milk at early lactation period. The research was conducted in dairy cattle husbandry, Enrekang, with completely randomized design consisting of 4 treatments and 4 repetitions, yielding totally 16 experimental units. The experimental diet was made of forage (60%), concentrate (25%), gamal leaf (15%), and katuk leaf (135 g, 155 gr, 175 g). The results showed that supplementation with katuk leaf significantly contributed to production of milk. The diet enriched with katuk leaf of 155 gr and gamal leaf of 15% (treatment P2) was evidenced to exert desirable effects on consumption and digestibility of the forage as source of fibers.

1. Introduction

The tremendous growing population in Indonesia is estimated to reach 237 millions, with growth rate of 1.49% per year [1]. This means that the country needs for more foods including animal-sourced foods such as milk. It is rich in protein; however, with current production of 805 thousand tonnes in 2015 [1], the quantity is inadequate for fulfilling the demand.

Total domestic demand for milk reaches 3.3 million tonnes per year. This is much larger than what the country can supply, i.e. 690 thousand tonnes per year (21%); therefore, importation of milk products (skim milk powder, anhydrous milk fat, butter milk powder) is inevitable to fill the remains, reaching up to 2.61 million tonnes (79%). In terms of consumption, the average was reported at 11.09 liters per capita per year, which is lower than other countries in ASEAN, i.e. 20 liters per capita per year. Hence, milk supply through importation is necessary [2].

In light of these gaps, there is a need for improving domestic milk production; as an attempt, supplementation of feed for Friesian Holstein cattle can be promising. Currently, additive feed could be produced from the use of leguminous plants, while this method has also received more attention. In this regard, the public perspective changes remarkably since they need more foods that consider clean, green, and ethical aspects [3]. Although technological development has massively emerged, the consumers prefer food produced via safe system related to animal welfare and human health.

Leguminous crops such as katuk (Sauropus androgynus) and gamal (Gliricidia sepium) are reported to have an appreciable quantity of nutrition and beneficial active compounds [4,5]. Souropi folium in katuk plant constitutes an active substance beneficial to foster milk production. Besides, it also serves in improving transportation of nutrients to mammary gland, as well as stimulates activity of secretory cells. The leaves of katuk are rich in amino acids capable of inducing milk production
[6], while gamal (Gliricidia sepium) is favorable for its rapid growth and resistance against drought. Additionally, gamal also contains a superfluous amount of protein, approximately 17%, being higher than standard concentrate. The further desirable feature of gamal also comes from its high digestibility in intestinal tracts of livestocks, primarily in ruminant animals [7].

Previous researches have been conducted, focusing mainly on the favorable properties of katuk and gamal leaf. Supplementation of katuk leaf for Bali cattle showed a higher value of milk production, i.e. 0.05%, compared to control, although the treatment unaltered the performance of milk production. Meanwhile, the administration of gamal leaf in feed containing rice pollard could enhance milk production and weight of the experimental cattle. In addition, the increase in some key productive parameters, i.e. consumption of dry matter, metabolism of energy, milk production, as observed in dairy cattle fed by 23.4% of gamal leaf and cotton seed. Besides, the rising level of fat content and milk solidity in Ettawa goat supplemented with gamal leaf (15% of total dry matters).

However, the combined use of katuk and gamal has not been reported. Previous study of the single use of katuk and gamal leaf on lactative performance of buffalo, without combining both matters; as a result, they found increment of erythrocyte, haemoglobin and hematocrite level in blood [8]. The impacts of katuk leaf at various dose (100, 150, 200 g per individual per day), in absence of gamal leaf, which concluded that the treatments could promote positive response on generation of milk, i.e. 35, 40 and 34%, respectively [9]. Though demonstrating positive response, utilization of katuk leaf seemed to unchange the production and quality of milk. Other studies on katuk leaf focused mostly on beef cattle and dairy goat, while the use of gamal was previously reported on dairy cattle. In this present work, the research aimed at investigating the combination of katuk and gamal leaf on improvement of productivity and quality of the milk. On the other side, their effects on milk quality are scarce. Therefore, our experiment is designed to evaluate the combined use of both leaves on milk production, quality, and physiological conditions of early lactation dairy cattle.

2. Methods
The experiment was performed in local animal husbandry located in Sub-district of Cendana, District of Enrekang, Sulawesi Selatan, between June 2017 and June 2018. This in vivo experiment involved dairy cattle Friesian Holstein (FH) fed with diets containing katuk and gamal leaf. The animals were reared in cages with feeders and waterers; further, Salter weighing scale was used to measure feed consumption. A total of 16 cattle (average weight of 300 – 450 kg, at early lactation level (first and second period, lactation period of 1 – 6 months). Experimental diets were made from forage (Pennisetum purpureum), gamal leaf, katuk leaf powder, and concentrate. The experiment was arranged according to completely randomized design with 4 treatments and 4 replications [10]. The treatments included P0 (60% forage, 25% concentrate, 15% gamal leaf), P1 (60% forage, 25% concentrate, 15% gamal leaf, 135 g katuk leaf), P2 (60% forage, 25% concentrate, 15% gamal leaf, 155 g katuk leaf), and P3 (60% forage, 25% concentrate, 15% gamal leaf, and 175 g katuk leaf).

3. Results and Discussion
3.1 Effects on feed consumption and digestibility
Table 1 presents the consumption and digestibility of experimental diets.

Table 1. Average consumption and digestibility in dairy cattle fed with diets containing katuk and gamal leaf.

| Parameters                  | P0            | P1            | P2            | P3            |
|-----------------------------|---------------|---------------|---------------|---------------|
| Consumption (kg/ind/day)    | 6.22±0.81     | 7.16±0.74     | 7.26±1.16     | 6.65±1.37     |
| Dry matter                  | 7.60±1.99     | 8.16±1.24     | 8.52±1.57     | 8.61±2.83     |
| Organic matter              | 0.59±0.80     | 1.03±0.10     | 1.20±0.18     | 1.17±0.22     |
| Crude protein               | 1.39±0.27     | 1.70±0.25     | 1.73±0.39     | 1.30±0.42     |
| Crude fiber                 |               |               |               |               |
Digestibility (%) 

| Nutrient       | P0       | P1       | P2       | P3       |
|----------------|----------|----------|----------|----------|
| Dry matter     | 42.85±6.19 | 47.04±4.48 | 47.35±4.34 | 44.67±9.96 |
| Organic matter | 41.23±2.49 | 46.57±3.77 | 46.04±4.76 | 51.35±6.94 |
| Crude protein  | 47.04±1.66 | 66.62±2.63 | 57.10±2.81 | 61.89±3.71 |
| Crude fiber    | 28.55±7.34 | 43.64±7.31 | 46.41±3.56 | 44.07±9.52 |

Note: Different superscripts following means show significant difference at P<0.05. KIVBK = in vitro digestibility of dry matters, KIVBO = in vitro digestibility of organic matters.

3.2 Nutrient consumption

Statistical analysis revealed that feed supplementation given showed significant effect on consumptive rate of dry matter, but not on consumptive rate of organic matter (P>0.05). As exhibited in Table 1, the average consumption of dry matter was recorded as follows: P0 (6.22 kg/ind/day), P1 (7.16 kg/ind/day), P2 (7.26 kg/ind/day) and P3 (6.65 kg/ind/day). Regarding to consumption of dry matter, the value was higher in feed enriched with katuk leaf than in control group (P<0.05), although no significant difference was observed between P1 and P3. The highest consumption of dry matter was attributed to P2, while the lowest one was found in control group. Furthermore, the consumption of organic matter in feed supplemented with katuk leaf was described as follows: P0 (7.60 kg/ind/day), P1 (8.07 kg/ind/day), P2 (8.52 kg/ind/day) and P3 (8.61 kg/ind/day). It is noteworthy that the score tends to increase as more katuk leaf is added in the experimental diet.

Treatment of P0 is control group, representing feed composition often applied in the current animal husbandry. In this experiment, the consumption of feed could be improved with presence of katuk leaf at dose of 135 g (P1) and 155 g (P2); nevertheless, the digestibility of dry matter in P3 tended to decline, which related to astringent odor derived from katuk leaf, thereby reducing the palability. Previous studies reported by Preston and Leng (1984), the high consumption rate of feed would rely on nutritional balance in digestion, since demand for nutrition served as main inducer transmitted to hypothalamus in which appetizing is modulated [11]. The imbalance in feed nutrition would then impact to feed consumption [12].

In addition, the results also demonstrated that feed supplementation of katuk leaf showed a variety of score in the consumption of crude protein, i.e. P0 (0.59 kg/ind/day), P1 (1.03 kg/ind/day), P2 (1.20 kg/ind/day) and P3 (1.17 kg/ind/day). Besides, the data exhibited that consumption of crude protein in P2 was found significantly higher than that in P1 and control group, but still comparable to P3. The highest consumption rate of crude protein was found in P2, while the lowest one was attributed to control group. In terms of crude fiber, the consumption rate between treatments slightly differed, as presented in Table 1: P0 (1.39 kg/ind/day), P1 (1.70 kg/ind/day), P2 (1.73 kg/ind/day) and P3 (1.30 kg/ind/day). Specifically, P2 exhibited the greatest score (P<0.05) among the treatments given, though not statistically differ from P1.

Considering isoprotein as important element in feed, the consumption of crude protein in feed consistently followed consumption of dry feed. In this case, treatment of P2 yielded the higher score than P0, P1 and P3; the consumption of crude protein would raise as more katuk leaf was incorporated in feed up to 155 g (P2). Interestingly, it then depleted at proportion of 175 g (P3). Furthermore, as mentioned in Table 1, consumption of crude fiber increased with a higher proportion of katuk leaf in feed. For this reason, the consumptive rate of nutrition is influenced by consumption of dry matter and content of nutrition in all treatments. Digestibility may vary noticeably, depending on content of crude fiber, crude protein, feed treatment, species of the animals, and quantity of feed. Palability remains the major factor describing the difference between consumption of dry matter among diets and less productive livestocks. Afterwards, it is argued that palability often relates to high digestibility of feed [13].

3.3 Nutrient digestibility

This present data statistically suggested that feed supplementation with katuk leaf unaltered digestion of dry matter and organic matter (P>0.05). The average percentage of dry matter digestion
was recorded at P0 (42.85%), P1 (47.04%), P2 (47.35%) and P3 (44.67%), while the average percentage of organic matter was reported at P0 (41.23%), P1 (46.57%), P2 (46.04%) and P3 (51.35%). In short, the results indicated that higher proportion of katuk leaf would result in higher digestibility of dry matter and organic matter present in experimental diets.

Analysis of variance showed that supplementation of katuk leaf provided noticeable impacts to digestibility of crude protein, crude fiber, and crude fat. The average percentage for crude protein digestibility in feed enriched with katuk leaf was found as follows: P0 (47.04%), P1 (56.62%), P2 (57.10%) and P3 (61.89%), while for crude fiber elucidated as follows: P0 (38.65%), P1 (43.64%), P2 (46.41%) and P3 (44.07%).

Statistically, our experimental data explained that digestibility of crude protein in P3 was higher than other treatments (P<0.05); although, there was no significant difference between P1 and P2. In case of crude fiber, the digestibility in P2 was statistically revealed to be higher than in control (P<0.05), but it did not differ from P1 and P3. The properties of rumen microbes could be estimated through understanding the digestibility of nutrients present in diets of the ruminant animals. The microbial quantity and type dominating the rumen depend mostly on the feed [14].

4. Conclusion
Based on experimental data, supplementation of katuk leaf at 155 g and gamal leaf at 15% (P2 treatment) was scientifically evidenced to raise consumption and digestibility of forage as source of fiber, thus improving the applicability of experimental feed. However, further investigation on feed supplementation of katuk leaf at dose of 155 g combined with forage and gamal leaf was envisaged for improving productivity of dairy cattle.

Acknowledgment
Authors would like to thank Ministry of Research, Technology, and Higher Education for funding the research, and committee of ICAST, Faculty of Animal Husbandry, Hasanuddin University, for great supports.

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