The effect of supplementation of *Leucaena leucocheapala* leaf in Friesian Holstein cows ration on milk production and composition

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Abstract. This study aims to investigate effect of supplementation of *Leucaena leucocheapala* leaf in the ration on milk production and composition of Friesian Holstein cow. The experiment was performed using 3 treatments namely P0 (basal ration, composed of 40% concentrates + 60% forage of total dry matter), while P1 and P2 contained basal ration and *Leucaena Leucocheapala* leaf, supplemented with 10 and 20% of total forage dry matter (DM), respectively. The experiment was performed for 60 days, with 12 lactation cows at body weight average 400 - 450 kg. Cows were at 3 to 4 months of lactation stage. Parameters observed were milk production (L/d) and milk composition namely percentage of protein, fat and lactose. Results showed that P2 significantly increased milk production compared to P1 and P0, while in milk composition in P1 and P2 were significantly higher compared to control. The average of protein, fat and lactose of milk in P0 were 2.87%, 4.73% and 4.44%, P1 were 2.99%, 3.29% and 4.86%, P3 4.91%, 4.59% and 4.60%, respectively. It is concluded that supplementation of *Leucaena Leucocheapala* leaf at 10 and 20% improve milk composition, but only at 20% supplementation the milk production was increase.

1. Introduction

One of farming activities that benefits to be developed is dairy agribusiness. It is supported by appropriate characteristics of field, ecological condition, geographical and soil fertility in some areas of Indonesia [1]. Public awareness on the consumption of milk, made milk as an economic commodity that has strategic value. The demand of milk is growing fast, around 14.01% during 2002 to 2007. On the other hand, milk production in Indonesia only increased 2% per year [2]. The low domestic production of milk provides great opportunity for farmers to develop dairy business. One of the efforts to improve milk production and its quality can be done by improving feed management.

Supplement is a complementary feed to complete the ingredient, which is not available in forage and concentrates. Supplement was provided any time, in order to meet nutrient requirement of the animal, therefore the amount of supplement was not given based on body weight or production [3]. Supplementation might increase growth rate and population of microbes in the rumen, thus stimulates crude fiber consumption which lead to increase production [4].
This study used *Leucaena leucocephala* leaf, leguminous, as feed supplements due to its nutritive value, containing high protein content [5]. This was not common in practical dairy feeding due to *Leucaena leucocephala* leaf commonly being used for supplementation in beef cattle ration. *Leucaena leucocephala* leaf can be utilized as protein source to increase weight gain and milk production [6]. Supplementing *Leucaena leucocephala* leaf mill in cows ration at level 25, 50 and 75% resulted in improvement of milk production. This due to *Leucaena leucocephala* has protein content, amino acid, minerals, balanced, have a slightly crude fiber and tannins [7]. Tannins gives positive effect, feeding with small amount of condensed tannin caused protein-binding protein-forming tannins which prevent protein degradation in rumen and improve by-pass protein. This leads to high amount of protein can be absorbed in the body [8]. The purpose of this study is to investigate the effect of feeding *Leucaena leucocephala* leaf as feed supplement on dairy cow ration. The evaluation would be focused on the aspect of milk production and milk composition.

2. Material and methods
This study was performed from January to February 2019 in the private dairy farm Sengon Kerep, Gedong, Karanganyar, Central Java. Twelve lactating Friesian Holstein cows, at around 3 to 4 months post calving, were used in this experiment. The cows were in the 2nd and 3rd lactation with body weigh around 400 to 450 kg. The feed in this study was consisted of Elephant grass (*Pennisetum purpureum*), concentrate, mineral mix and *Leucaena leucocephala* leaf as supplement. The concentrate was mixed from several by-products i.e. rice bran, wheat pollard, coffee bean peel, coconut peel, tofu waste and poultry litter waste.

There were 3 different rations, as treatments, in the experiment namely P0, P1 and P2 with 4 replications per treatment. Dairy cows in P0 were given basal diet, consisted of 40% concentrates + 60% forage on dry matter based. In P1 and P2, cows were received the same proportion of concentrate and forage as basal diet and supplemented with 10 and 20% *Leucaena leucocephala* leaf of total forage DM, respectively. The cows were reared in a semi opened stall with individual feed and water container. Data observed were milk yield and milk composition, included percentage of protein, fat, lactose, and solid nonfat (SNF) of individual cow. Milk yield was recorded from morning and evening milking of each cow every day for 30 days. Milk composition was determined by analysing total solid (TS), fat, protein, lactose, and SNF in milk. Samples were collected at the beginning and end of the experiment period. To determine the milk components, Lactoscan was used. Data were statistically analyzed using ANOVA followed with Duncan’s multiple range test (DMRT) at α = 5%.

3. Results and discussion
3.1. Milk production
The result in Table 1 showed that supplementation of *Leucaena leucocephala* leaf at 20% of forage DM significantly increased milk yield (P<0.05). The data indicated that *Leucaena leucochepala* could improve the quality of daily cow ration in the farm, especially in crude protein content. The average crude protein content of supplemented ration (P2) was 11.91%, whereas in P0 and P1 respectively were 9.64% and 10.77%. The result showed association between milk yield and availability of crude protein in the ration. Milk production of cows which received P2 ration was higher than in P0 and P1. The differences were calculated as more than 1.0 L/day. The improvement of milk yield in this study possibility due to the quality of *Leucaena leucocephala* leaf which in the previous study [9] has been indicated by the capacity of *Leucaena leucocephala* species for providing high degradable protein in rumen.

The foliage of *Leucaena* showed high potential of DM rumen degradation with value of 77% [10]. The soluble DM fraction was 22.33 %. Therefore, *Leucaena leucocephala* plants had high rumen degradability, and its application in ruminant feeding systems was recommended. Based on nutrient requirement of dairy cattle [11], the amount of crude protein and total digestible nutrient in P2 ration was identified to be higher than in P0 and P1. Therefore, *Leucaena leucochepala* leaf supplementation
has benefit to support nutrient to produce milk. The result of this study was in accordance with previous reports that demonstrated the benefit of *Leucaena leucochepala* leaf utilization as nitrogen supplement on poor quality crop residues [12] and resulted better weight gain of grazing calves [13]. Other report also shows that *Leucaena Leucochepala* leaf improved quality diet in buffalo [14], goat [15] and in steer DM intake [16].

Table 1. Milk production and composition in different *Leucaena leucochepala* leaf supplementation

| Variables            | Mean of Milk Components ± SD |
|----------------------|-----------------------------|
|                      | P0  | P1            | P2      |
| Milk yield (L/day)   | 10.15 ±0.19a                 | 10.32 ±0.24a | 11.70 ±2.29b |
| Protein (%)          | 2.87 ±0.18a                  | 2.99 ±0.10b  | 3.29 ±0.16b  |
| Fat (%)              | 4.73 ±0.45a                  | 4.86 ±0.82b  | 4.91 ±0.92b  |
| Lactose (%)          | 4.44±0.05a                   | 4.59 ±0.04b  | 4.60±0.10b   |
| Solid nonfat (%)     | 7.94±0.34                    | 7.89 ± 0.11  | 7.84±0.31    |

*ab* means in the same row with different superscript shows difference (P<0.05)

3.2. Milk composition

3.2.1. Milk protein. The effect of supplementation *Leucaena leucochepala* leaf in the dairy ration in this study was significantly improved milk protein from 2.87% to 2.99% and 3.29% (Table 1). Milk protein in P2 was comparable to the effect of dry milk supplementation on Friesian Holstein cow ration as 3.25% [17]. The effect of *Leucaena leucochepala* leaf in this study was in line with [18], described that high forage in the ration could increase energy availability in the rumen to support formation of amino acid from rumen microbial. Increasing formation of amino acid, indirectly supported milk protein synthesis. According to Natsir [4], supplementation might increase growth rate and population of microbes in the rumen, thus stimulates crude fiber consumption that will increase production. In this study high milk protein content could be affected by crude protein content in *Leucaena leucochepala* leaf as amino acid sources for protein synthesis. The leaf was reported to contain 22.76% crude protein [19].

3.2.2. Milk fat. *Leucaena leucochepala* leaf supplementation caused a noticeable effect on milk fat content between treatment (P< 0.05). The average value of milk fat in this study considered to be higher than in Friesian Holstein cow, 4.07%, of the previous study [20]. High milk fat content possibility due to stage of lactation factor combined with the effect of supplementation. Apart from containing high crude protein, *Leucaena leucochepala* leaf also contained high crude fiber, which useful as the source of acetic and butyric acids in the rumen. Both acetic and butyric were known as precursors of milk fat synthesis. Therefore, feeding leaf protein supplement in this study also beneficial to maintain crude fiber concentration in the rumen.

3.2.3. Lactose. The effect of *Leucaena leucochepala* leaf supplementation significantly increased lactose in milk. In this study the effect of supplementation on lactose content was in accordance with milk production. There is relationship between production and lactose content. Lactose acted as a binder of water, more synthesized lactose lead to more amount of milk production. Milk yield greatly depends on mammary lactose synthesis due to its osmoregulation of milk induces mammary uptake of water. Therefore, the rate of lactose synthesis in the epithelial cells of the mammary gland serves as a major factor influencing milk volume production [21]. The existence of lactose was also affected by the availability of propionic acid as precursor of lactose synthesis [22]. Propionic acid was not directly converted to lactose, but it passed through glucose formation in the liver and the synthesis was
catalyzed by lactose synthetase provided by extra crude fiber in the rumen. In this regards, crude fiber is useful to generate total volatile fatty acid, including propionic acid as lactose precursor.

4. Conclusions
Supplementation with *Leucaena leucocephala* leaf at 10 and 20% of total forage DM increased milk composition in percentage of protein, fat and lactose. Moreover, the milk production only increases at *Leucaena leucocephala* leaf supplementation at 20%.

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