

# The effect of leaf meal in supplements on milk yield and quality of Friesian Holstein dairy cows

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## 3 The effect of leaf meal in supplements on milk yield and quality of Friesian Holstein dairy cows

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### Abstract

10 This study aimed to determine the effect of leaf meals on the milk production of Friesian Holstein (FH) dairy cows. The 15 FH dairy cows were 5–6 years old and 3–5 months in lactation with a range in milk production of 9–12 kg/d. The leaf meal supplements used as feed comprised elephant grass (*Pennisetum purpureum*), leaf meal of *Leucaena* (*Leucaena leucocephala*), *Gliricidia* (*Gliricidia sepium*) and Mulberry (*Morus alba*), partially replacing rice bran, coconut cake, fish meal, maize epidermis, molasses, and minerals. This study used a completely randomized design with five replications for each of the three treatments: feed concentrate without leaf meal (control, CTL), feed concentrate with 25% leaf meal (LM25) and feed concentrate with 50% leaf meal (LM50). Feeding the leaf meal to FH dairy cows had no effect on total dry matter intake. However, there was a linear increase in milk yield, and a depression in milk fat, as the level of leaf meal in the diet was increased.

**Keywords:** Friesian Holstein, *Gliricidia*, leaf meal, *Leucaena*, Mulberry

### Introduction

Friesian Holstein (FH) dairy cows are the highest milk producers among dairy cattle species in subtropical and tropical areas (Franzoi et al 2020). Imports account for approximately 80% of the demand for raw milk materials in Indonesia. Milk is produced by the mammary glands of dairy cattle or mammals and could directly be consumed or used as an ingredient for food. Milk is safe and healthy even when its components have not been reduced or other materials have not been added. As an ingredient for foods/drinks, milk has a high nutritional value because it contains the nutrients needed by the human body, such as calcium (Ca), phosphorus (P), vitamins A and B, and riboflavin. Its easy-to-digest composition makes milk a flexible source of food with adjustable fat content to meet the consumer's needs. Milk is a source of food/drink that is needed to improve the health of humans. However, several obstacles must be overcome by the milk industry, such as low production and quality.

The low production and quality of dairy cow's milk are influenced by several factors, one of which is feed management. Feeding addressed the needs of life maintenance, production, and reproduction. Adequate cattle feeding could increase the production and quality of their milk. The feed must contain essential nutrients, such as dry matter (DM), ash, crude protein (CP) content, crude fiber (CF) content, fat, and extracted ingredients without nitrogen (beta-N). Feeding could be in the form of forage as the main feed and concentrate as additive feed (Despal et al 2019). Feed concentrate is obtained from cereals, grains, agro-industrial byproducts, minerals, and forages such as grasses and legumes. Enrekang District is a center for dairy cattle where Mulberry (*Morus alba*), *Gliricidia* (*Gliricidia sepium*) and *Leucaena* (*Leucaena leucocephala*) are indigenous and affordable. Farmers will benefit when the milk production and quality of their dairy cattle can be maximized by providing concentrates that are sourced from these three raw materials and could be used as substitutes for commercial feed concentrates.

6 Mulberry, belonging to the Moraceae family, is widely known as a fast-growing plant found in various climatic, topographical, and soil conditions. Historically, in Asia, for the traditional treatment of various diseases such as infections and internal medicine, mulberries are very useful (Teng-Gen Hu et al 2019). (Kandyliis et al 2009) stated that Mulberry leaves are very useful as a feed source of protein in sheep feed. *Gliricidia* (*Gliricidia sepium*) is a legume tree found in areas with dry land and can grow well in dry seasons. However, this species may have limitations in productivity, palatability, presence of toxic substances, and adaptability (Akinbamiyo O O et al 2006; Atta Krah A and Reynolds, 1989). (Rusdy M et al 2019) The supplementation of *Gliricidia* up to more than 45% could improve the performance of Bali cattle. (David M Mbugua et al 2008) stated that this legume contains alkaloids and tannins, which compound protein binders are acting as antinutritional substances. However, the amount of these compounds in *Gliricidia* is not as high as that in *Calliandra calothyrsus*.

Leucaena is a tree shrub that contains active substances such as alkaloids, saponins, flavonoids, tannin, mimosine, leukanin, protein, fat, Ca, P, iron, and vitamins A and B. The flavonoids in Leucaena have anti-inflammatory properties. Flavonoids in the form of aglycone are non-polar, and those in the form of glycoside are polar (Setiawan and Felix 2014). (Garcia et al 1996) reported that Leucaena contains the median chemical composition for Leucaena leaf meal [g 100 g<sup>-1</sup> dry matter (DM basis)] was calculated to be 4.15 nitrogen (N), 29.2 crude protein (CP), 19.2 crude fibre (CF), 10.5 ash, 1.01 tannin (Tn), 1.9 calcium (Ca), 0.23 phosphorous (P), 0.34 magnesium (Mn), 1.7 potassium (K), respectively. Leucaena contains high amounts of protein and is commonly used as feed cattle. It is the most widely used as a tree legume as a valuable fodder shrub in increasing livestock production in the tropics (Khamseekhiew et al 2001).

Leaf meal supplement comprising Mulberry, Gliricidia and Leucaena have a high content of protein are thought to have the same nutritional value as commercial feed concentrates. Thus, this study aimed to examine the potential of leaf meal supplement composed of the leaf flour of Mulberry leaf, Gliricidia leaf and Leucaena leaf as a substitute for commercial feed concentrates and its effect on the DM intake, milk yield and quality, also feed conversion of the total diet in terms of DM intake per liter of milk FH dairy cows.

## 2

## Materials and methods

This study was conducted in Tallang Baba Sub-Village, Cendana Village, Cendana District, Enrekang Regency, South Sulawesi, Indonesia. The fifteen FH dairy cows of 5–6 years in lactation with a lactation period of 3rd–5th was used for in vivo study months and an average production of 9–12 kg/d. Elephant grass (*Pennisetum purpureum*) was used as the main feed. Feedstuff of feed supplement consisted of the leaf flour of Mulberry, Leucaena and Gliricidia added with rice bran, coconut cake meal, fish meal, corn epidermis, molasses and minerals.

This study used a complete random design (CRD) with five replications for each of the three treatments: feedstuff commercial without leaf meal in the supplement (control, CTL), leaf meal in supplement with as much as 25% leaf meal (LM25) and leaf meal in supplement with as much as 50% leaf meal (LM50). Feeding of elephant grass and leaf meal in the supplement were as much as 8 and 7 kg DM/day, respectively. Feeding of the composition and nutritional value of feed ingredients for each treatment are presented in Table 1.

## 8

Elephant grass and drinking water were given ad libitum to the cows in the morning and afternoon. The parameters measured were DM intake, milk yield and quality. DM intake was obtained from the amount of one-day consumption (24 h). The adaptation period lasted for 7 days. The feed conversion was measured by the total diet in terms of DM intake per liter of milk.

The CP, fat, lactose, Ca, and P of milk were analyzed. CP concentration was analyzed by the Indirect Kjeldahl method (method 991.23; AOAC International, 2005) while fat was by the Babcock method (method 989.04; AOAC International, 2005), lactose by Nelson Somogy method (Sudarmadji et al 1984), Ca and P by Atomic Absorption Spectrophotometric and Colorimetric methods (method 991.25; AOAC International, 2005).

**Table 1.** Composition and nutrition value of the treatments

Treatments, Feedstuff, % DM basis	Composition, %	Nutritive Value, %						
		CP	CF	TDN	Cf	Ca	P	Ash
<b>CTL</b>								
Rice bran <sup>1</sup>	35	3.23	4.58	19.33	2.84	0.05	0.22	3.08
Coconut cake meal <sup>2</sup>	20	4.24	2.42	4.28	2.80	0.01	0.08	1.19
Shrimp waste meal <sup>3</sup>	15	6.09	2.36	0	0.89	1.04	0.17	2.51
Corn epidermis <sup>4</sup>	24	1.94	3.85	12.23	5.32	0.06	0.02	0.45
Molasses <sup>1</sup>	5	0.11	0.01	2.73	0.002	0	0	0
Mineral <sup>1</sup>	1	0	0	0	0	0.04	0.01	0
<b>Total</b>	<b>100</b>	<b>15.63</b>	<b>13.25</b>	<b>38.58</b>	<b>11.86</b>	<b>1.23</b>	<b>0.52</b>	<b>7.21</b>
<b>LM25</b>								
<i>Leucaena leucocephala</i> leaf meal <sup>1</sup>	5	0.96	0.66	1.88	0.18	0.06	0.009	0.13
<i>Gliricidia sepium</i> leaf meal <sup>2</sup>	10	2.04	1.19	4.91	0.36	0.09	0.01	0.75
<i>Morus alba</i> leaf meal <sup>3</sup>	10	1.70	1.47	3.76	0.45	0.26	0.03	1.33
Rice bran <sup>1</sup>	25	2.30	3.27	13.81	2.02	0.04	0.16	2.20
Coconut cake meal <sup>2</sup>	14	2.97	1.70	2.99	1.96	0.01	0.05	0.83
Shrimp waste meal <sup>3</sup>	10	4.06	1.57	0	0.59	0.69	0.11	1.67
Corn epidermis <sup>4</sup>	20	1.62	3.21	10.19	4.43	0.05	0.02	0.35
Molasses <sup>1</sup>	5	0.11	0.01	2.73	0.002	0	0	0
Mineral <sup>1</sup>	1	0	0	0	0	0.04	0.01	0
<b>Total</b>	<b>100</b>	<b>15.79</b>	<b>13.12</b>	<b>40.3</b>	<b>10.02</b>	<b>1.27</b>	<b>0.43</b>	<b>7.28</b>
<b>LM50</b>								
<i>Leucaena leucocephala</i> leaf meal <sup>1</sup>	10	1.92	1.33	3.76	0.36	0.12	0.01	0.27
<i>Gliricidia sepium</i> leaf meal <sup>2</sup>	20	4.09	2.39	9.83	0.72	0.18	0.03	1.51
<i>Morus alba</i> leaf meal <sup>3</sup>	20	3.41	2.95	7.53	0.90	0.52	0.07	2.66
Rice bran <sup>1</sup>	17	1.56	2.22	9.39	1.37	0.02	0.11	1.49
Coconut cake meal <sup>2</sup>	7	1.48	0.85	1.49	0.98	0.006	0.02	0.41
Shrimp waste meal <sup>3</sup>	5	2.03	0.78	0	0.29	0.34	0.05	0.83
Corn epidermis <sup>4</sup>	15	1.21	2.40	7.64	3.32	0.03	0.01	0.26
Molasses <sup>1</sup>	5	0.11	0.01	2.73	0.002	0	0	0
Mineral <sup>1</sup>	1	0	0	0	0	0.04	0.01	0
<b>Total</b>	<b>100</b>	<b>15.84</b>	<b>12.96</b>	<b>42.39</b>	<b>7.97</b>	<b>1.30</b>	<b>0.35</b>	<b>7.46</b>

Source: <sup>1</sup>(Dicky Pamungkas et al 2010); <sup>2</sup>(Jaworski et al 2014); <sup>3</sup>(Syahrir et al 2009); <sup>4</sup>(Dicky Pamungkas et al 2010)

The data collected were entered and organized in the excel spread sheet and then it was analyzed using descriptive statistics and GLM-Multivariate (SPSS, version 21).

## Results and discussions

### Influence of leaf meal in supplement on dry matter intake, milk yield, and fee conversion

Mean values for DM intake, milk yield, and fee conversion of cows fed a basal diet of Elephant grass and supplements are presented in Table 2 as follows:

**Table 2.** Mean values for DM intake, milk yield, and fee conversion of cows fed a basal diet of Elephant grass and supplements

Parameters	CTL	LM25	LM50	SEM	p
<b>DM intake, kg/d</b>					
Elephant grass	7.50	6.59	7.50	0.48	0.13
Supplement	6.92	6.95	7.00	0.06	0.54
<b>Total DM</b>	<b>14.42</b>	<b>13.54</b>	<b>14.50</b>	<b>0.47</b>	<b>0.12</b>
<b>Milk yield, kg/d</b>	<b>10.44</b>	<b>11.32</b>	<b>12.26</b>	<b>0.93</b>	<b>0.19</b>

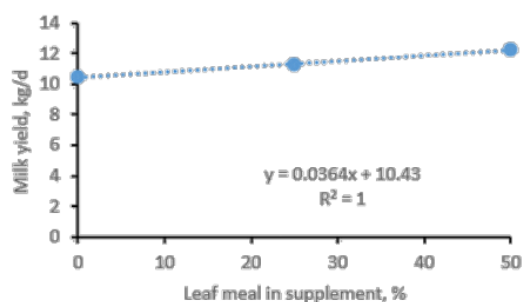


Figure 1. Milk yield was increased when leave meals were incorporated in the concentrate supplement

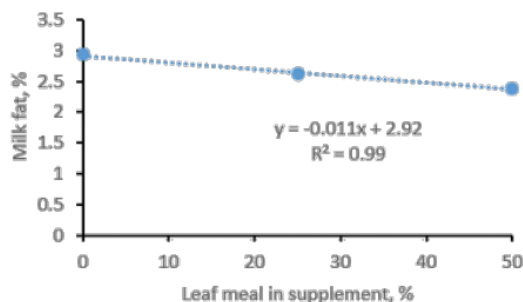


Figure 2. The milk fat content was reduced with a linear trend when leave meals were introduced into the concentrate supplement

We cannot explain the depression in fat content of the milk as the proportion of leaf meal in the concentrate supplement was increased (Table 3; Figure 2).

There was a positive correlation between milk yield and leaf meal. The leaf meal is the potential feed in enhancing milk yield. Feeding 1% of the leaf meal can increase milk yield by 0.925 kg/d (Figure 1). The combination of leaf meals supports higher milk yield because the combination is rich in bypass protein which is the factor determining the production response to this nutritional change. There was a decrease in the use of feedstuff ingredients such as rice bran, coconut cake meal, shrimp waste meal, and corn epidermis by 25% in LM25 and 50% in LM50, respectively in green concentrate. Also, the green concentrate meets the nutritional need of lactating FH dairy cows to produce milk (Pineda et al 2022). Therefore, green concentrate could be used as a substitute for commercial concentrate to meet the nutritional requirements of livestock to maintain or increase milk yield. Furthermore, (Ambo Ako 2019) stated that green biomass is a high protein source which is very potential as a basal diet.

### Effect of leaf meal in supplement on the quality of milk

The effects of leaf meal in the supplement on the contents of CP, fat, lactose, Ca and P of cow milk are presented in Table 3.

**Table 3.** Effect of leaf meal supplement on the milk quality of FH dairy cow

Parameters, %	CTL	LM25	LM50	SEM	p
Crude protein	2.67	2.41	2.69	0.12	0.09
Fat	2.93 <sup>a</sup>	2.62 <sup>ab</sup>	2.38 <sup>b</sup>	0.20	0.03
Lactose	3.43	3.44	3.27	0.15	0.29
Calcium	0.13	0.12	0.12	0.03	0.94
Phosphorus	0.09	0.08	0.08	0.009	0.28

<sup>ab</sup> Different superscripts in the same row indicate a significant difference ( $p < 0.059$ )

The leaf meal had a significant effect on fat content ( $p < 0.05$ ) but not on CP, lactose, Ca and P content ( $p > 0.05$ ). The fat content of the milk from the cows fed with CTL was significantly higher ( $p < 0.05$ ) than that from the cows fed with LM50. This might be due to the high level of rice bran in CTL (Table 1). Stødkilde et al (2019) reported that diet influences the fat content. Abdi Hassen et al (2022) also stated that feed supplementation increased the fat content of milk. This means that the fatty acids in the feed can be directly transferred to the milk fat formation system, production and quality of milk.

### Conclusion

Replacing 50% of the concentrate supplement with leaf meals from Mulberry, Gliricidia and Leucaena increased the milk production by 20% without increasing the total dry matter intake. However, the fat content of the milk was depressed by inclusion leaf meal in the diet.

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