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Effect of Katu Leaf (Sauropus androgynus) Extract Supplementation on Milk Quality and Yield of Bali Cow Fed Rice Straw and Natural Grass Basal Diet

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Abstract
Milk yield and quality of bali cows given supplementation of katu leaf (Sauropus androgynus L. Merr) extract were investigated. A completely randomized design with three treatments and three replications were used in this experiment. The results showed, milk yield of bali cows in treatment B (0.5% w/bw supplementation of katu leaf extract) and C (0.1% w/bw supplementation of katu leaf extract) were respectively 43.22% and 9.63% higher than that of bali cows in treatment A (0% w/bw supplementation of katu leaf) (P<0.05%). Protein content, fat percentage, lactose content and total solids of milk of bali cows given katu leaf extract supplementation were ranging from 3.42-3.55%, 6.37-6.67%, 3.77-3.93% and 15.67-16.95% respectively. There was no significant differences in protein, fat, lactose and total solid percentages of bali cows milk in treatments A, B and C (P>0.05)

Keywords: milk yield, quality, bali cow, katu leaf

1. Introduction
Almost 70% of Indonesian milk consumption, come from abroad, due to low domestic milk production. Much of the milk produced in Indonesia harvested from dairy cattle, the rest come from goat and buffalo. Bali cattle was a beeit cow that yield high quality meat. This cattle yield milk of about 1.1 kg/head/day on natural grass of traditional feeding regime. In 1982, Aldana et al. (1978) stated that 75% milk production was affected by environment including feeding regime. Ind. 1996, Sarini et al. (1998) found that milk yield of bali cattle increase of about 45.4% as concentrate was added to basal feeding peanut grass. Sukarni (2000) found that milk yield of bali cow was 2.2 kg/head/day as concentrate, Guibicaria sepium, Hibiscus leaf and Zn mineral was added to basal feeding peanut grass. Patra (2000) stated that milk yield of bali cow may reach 4.5 kg/head/day in peak lactation. Better quality and quantity of feed offered to the cow will increase the availability of milk precursors in blood so that increase the milk yield.

Katu leaf (Sauropus androgynus L. Merr) was known, capable of increasing milk yield of human, goat and dairy cattle (Marwati et al., 2010; Gaoaet et al. and Lee, 2011) and was grown naturally in farm and wild field. Saka et al. (2011) claimed that katu leaf supplementation increase blood prolactin and oxytocin concentration in mice Balb/C, as well as their milk yield. Schiess (1971) and Tocker (1985) explained that, in addition to the availability of milk precursors in blood enter the mammary gland, milk production was also affected by the occurrence of some hormones that regulate milk synthesis and milk let down. Prolactin is a hormone that responsible in milk synthesis in the mammary gland, while oxytocin was a hormone that squeezed the milk drain out from the alveoli, down to the gland ectorin of the mammary gland. This processes call "milk let down", which emptied the lumen of the alveoli. Furthermore Schmidt (1971) stated that full milk content in human of alveoli will retard milk synthesis in secretory cells and milk synthesis start again, as the milk in the lumen of alveoli was drawn out. So that in the presence of oxytocin and prolactin the secretory cells of the mammary gland could synthesized milk continuously.

The present study was intended to find out milk yield of bali cow given basal feeding rice straw, natural grass and pollen, supplemented with katu leaf (Sauropus androgynus L. Merr) extract. It is hoped that the increase in milk yield of bali cows could be used for human consumption.

2. Materials and Methods
2.1 Animal Feed
Nine, 4-5 years old bali cows were used and allocated to 3 group of 3 animals each in a completely randomized design. The animals were subjected to three treatments namely: A (without supplementation of katu leaf extract or control); B (0.5% w/bw supplementation of katu leaf extract); C (0.1% w/bw supplementation of katu leaf extract) and three replications. These animals were hired from farmers at Tahunan Regency, province of Bali, Indonesia. All cows were given a basal diet composed of rice straw, natural grass, pollen, and katu leaf extract (Sauropus androgynus L Merr) supplementation. Rice straw procured from nearby paddy field was chopped manually. Natural grass was also procured from nearby fields. Pollen bought from nearby poultry shop. The ingredient composition of the diet is presented in Table 1.
Table 1. Ingredient and chemical composition of diet used in this experiment

<table>
<thead>
<tr>
<th>Ingredients/Nutrients</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Rice Straw</td>
<td>59.04</td>
</tr>
<tr>
<td>Natural grass</td>
<td>17.73</td>
</tr>
<tr>
<td>Pollard</td>
<td>23.19</td>
</tr>
<tr>
<td>Kaua leaf (Saurupus androgynus L. Merr)</td>
<td>0.06</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
<tr>
<td>Nourshers</td>
<td></td>
</tr>
<tr>
<td>Dry Matter</td>
<td>11.319</td>
</tr>
<tr>
<td>Crude Protein</td>
<td>0.977</td>
</tr>
<tr>
<td>Total digestible nutrient</td>
<td>4.801</td>
</tr>
<tr>
<td>Crude Fiber</td>
<td>2.83</td>
</tr>
</tbody>
</table>

Note: A: 9% (wb/w) kaua leaf extract supplementation; B: 0.05% (wb/w) kaua leaf extract supplementation; C: 0.1% (wb/w) kaua leaf extract supplementation.

2.2 Preparation of kaua leaves extract.
Kaua leaf was weighed and blended with tap water to obtain kaua leaf extract with a concentration of 30%. Then 800 ml and 1000 ml of the extract were then offered daily to both cows in treatment B and treatment C, respectively. Kaua leaf extract was offered a week before parturition and continued for a period of 9 weeks lactation.

2.3 Milk collection.
Milk from each of the lactating dairy cow was collected every week and commenced 7 days after calving, to allow colostrum intake by the calf. A day before milking at 10:00 PM and during milking the calf was separated from the cow. Milking was done once a day at 01:00 AM. The milk obtained was offered to the calf after it is weighing. The weight of the milk was divided by the time (hours) from calf separation to the milking time, then multiplied by 24 to get daily milk yield.

2.4 Chemical evaluation.
2.4.1 Proximate analyses.
Proximate composition of the kaua leaf extract and experimental diets were carried out according to the procedure of AOAC (1990).
The crude protein was determined by the Kjeldahl method as described by AOAC (1990). Put 1 g ground sample into Kjeldahl digestion tube. Add sufficient catalyst tablets to supply 7 g K_{2}SO_{4}, 0.8 g CuSO_{4} and 12 ml sulfuric acid. Place the tube in block digester in an acid fume hood which was preheated to 410°C. Digest about 60 minutes. Remove tube and let cool for about 10-20 min in a fume hood. Add denitified water till the total volume of 80 ml. Add about 50 ml of 40% NaOH (w/v), then conduct distillation. Place 250 ml titration flask containing about 25 ml 4% borax acid added 3 to 4 drops methyl red indicator, on the receiving platform, with tube from condenser extending below the surface of the solution. Attach digestion tube to distillation unit and steam distill until 150 ml distillate was collected. Remove distillation flask from distillation unit, titrate with 0.1 N HCl to purple end point. Record volume of acid (V[HCl]) required for the titration. Titration reagent blank similarly.
Calculations:

\[ \% \text{ protein} = \frac{\text{VA} - \text{VB} \times N \times C \times 1.4007}{W} \]

VA = volume, in ml of HCl required for sample; VB = volume, in ml of HCl required for blank
N[HCl] = Normality of HCl; 1.4007 = milliequivalent weight of N x (0.01); W = sample weight in grams
% protein of feed = % N x 6.25
% protein of milk = % N x 6.38

Determination of crude fiber was done according to AOAC (1990). Put 1 grams of prepared sample (C) into test tube, add 60 ml of 0.3 N H_{2}SO_{4}, solution then turn Agitate and Heat for 30 minutes. Add 50 ml of 1.5 N NaOH, then again turn Agitate and Heat for 30 min. Drain the exhaust hot solution using vacuum pump. Rinse using 100 ml hot water, 100 ml 0.3 N H_{2}SO_{4}, 100 ml hot water and 100 ml alcohol, then dry in oven at 100 ± 2°C for 8 hours. Remove tubes from oven, place directly into a desiccator for 30 min, then weigh (A grams). Then add the entire tube with sample for 3 hours at 600 ± 15°C, cool in desiccator for 50 min and weigh (B grams).
Calculations:
\[ \% \text{Crude Fiber} = \frac{A - B}{C} \times 100\% \]

A = sample weight after drying in oven; B = sample weight after heat at 600°C; C = sample weight in grams

2.4.2 Milk analysis:

Chemical analysis of milk was carried out according to AOAC (1990), AOAC (1975) and Bradley et al. (1992). The chemical analysis included milk fat percentage, protein content as well as lactose percentage. Determination of protein was carried out by Kjeldahl method (AOAC, 1990), as described on page 2.4.1 above.

Milk fat determination was done by Babcock method according to AOAC (1975). With a pipette, transfer 17.6 g of milk into a 100 ml prepared sample at 38°C to milk-test Babcock bottle. Add the 17.3 ml 91.4% H₂SO₄ solution to the delivery. Immediately shake by hand solution until all traces of curd disappear. Place bottles in heated centrifuge, counterbalance, and after proper speed is reached, centrifuge 5 minutes. Add soft H₂O at 60°C until bulk of bottle is filled. Centrifuge 2 minutes. Add soft H₂O at 60°C until fat column top approaches the 8% mark of the graduated neck of the Babcock bottle. Centrifuge 1 minute longer at about 60°C. Transfer bottle to warm H₂O bath kept at 55 to 60°C, immerse it to level slightly above the top of fat in column, and leave until column is in equilibrium and lower fat surface assumes final convex form (≥5 minutes). Remove one bottle from bath, wipe it. The length of the fat layer, as read off on graduation, was give at once per cent of fat.

3. Result and discussion

3.1 Milk yield:

Table 2 represents average daily milk yield and nutrient intake of bali cows in this experiment. Average daily milk yield of bali cows given katu leaf extract supplement were not significantly different (P>0.05) throughout the experimental. This is not in line with Marwah et al. (2010), Suprayogi et al. (2013) and Sarasjarias et al. (2011) who stated that supplementation of katu leaf extract was significantly increase milk production of goat and Friessen Holstein (FH) cow. However, although milk yield of bali cows in this experiment was statistically not different, but biologically milk yield of bali cows given 0.85% katu leaf extract supplement was 43.22% higher than that bali cows in control group. This is in line with Suprayogi et al. (2013) in that the increase in milk yield of FH cow given 100g, 150g and 200g/head/day katu leaf extract were 30%, 40% and 34%.

Milk production was about 70% affected by environment, especially feeding (Batik et al, 1978). Suprayogi (2000) found that improve feeding quality increased milk yield of bali cows of about 36.6 – 126.5%. Furthermore, Campbell and Marshall (1979) stated that milk yield was affected by milk precursors available in blood circulate to the mammary gland, which were resulted from metabolisms of nutrient intake. Since the nutrient intake of bali cows in treatment A, B and C were not significantly different (P>0.05) (Table 2), so that milk yield of those bali cows were also not significantly different (P>0.05). This is in accordance with Suprayogi (2000) who found that average nutrient intake of FH cow given katu leaf powder was not significantly different. This is because katu leaf supplementation did not increase the palatability of the feed in this experiment.

| Table 2. Milk yield of bali cow given rice straw and natural grass supplemented with katu leaf extract |
|-------------------------------------|-------|-------|-------------|
|                                    | A     | B     | C           |
| Milk yield (kg/head/day)            | 0.696 | 0.597 | 0.763       |
| Nutrient Intake                     |       |       |             |
| DM (%/head/day)                     | 11.291| 11.085| 11.301      |
| Crude Protein (%/head/day)          | 0.394 | 0.392 | 0.391       |
| Total daily nutrients               | 4.69  | 4.76  | 4.72        |
| Crude fiber (%/head/day)            | 2.80  | 2.79  | 2.80        |
| Note: A: no supplementation; B: 0.85% (W/W) katu leaf supplementation; C: 0.1% (W/W) katu leaf supplementation; values followed by same superscript in the same row were not significantly different (P>0.05) |

Besides feeding regime, milk production was also affected by the biological activity of the animals namely hormonal control. Suprayogi (2000) claimed that katu leaf has 7 active compounds that contribute to the increase in milk production. The 7 active compounds were: (1) octadecanoic acid, (2) 9-ecdiosine, (3) 8, 11-Heptadecaeneoic acid methyl ester, (4) 9, 11-Octadecadienoic acid ethyl ester, (5) 11, 14, 17-Eicosatrienoic acid methyl ester, (6) androst-17-one-3-ene-5-oxo-5-oxo-5-phenylacetic acid (7) 3-4-Dimethyl-3-oxopiperidene. The first 6 active compound collectively act as (a) a precursor and is involved in compound biosynthesis of eicosanoids (prostaglandins, lipoxins, thromboxanes, prosacrine, leukotrienes), (b) as precursor in synthesis of hormones compounds such as progesterone, estriol, testosterone, and glucocorticoid (c) modulator of lactation hormone, lactogenesis and other physiological activities.

Furchenau-Schmidt (1977) and Teclker (1985) stated that synthesis of prostaglandins and steroid hormone and their occurrence in circulation will simulate the anterior and posterior pituitary gland to release prolactin, growth hormone and oxytocin which synergistically affect the secretory tissue of the mammary system through
increasing the alveolar population as well as milk synthesis. In addition, Suprayogi (2000) stated that, active compound of katu leaf increase the availability of milk precursor in blood circulated to the mammary gland. Moreover, in digestive tract of monogastrics and ruminants the active compounds such as 1,4-dimethyl-2-oxocyclopent-3-enylactic acid, neem ether, neem seed, phenylalanine, acid, cyclosporin, 2-ethyl acetate, and methylpropiolactone may hydrolyzed to macromolecules, malonic acid, acetate and glutamate. These three compounds biochemically and physiologically contribute to mechanisms of carbohydrate, protein and fat to increase volatile fatty acids (VFAs) yield through citric acid cycle in Krebs cycle, rumen microbial protein synthesis. The increase in VFAs production mean more milk precursor available in blood circulated to the mammary gland. Further more Suprayogi (1985) stated that the active compound of katu leaf increase glucose metabolisms for lactose synthesis, which caused an increase in breast milk yield. This is in line with Sarkarini (2000) who explain that lactose is the limiting factor in milk synthesis in the alveoli, for it was in correlation to osmotic pressure in the alveoli. The increase in lactose quantity in the alveoli will increase water transport into the alveoli, which caused the increase in milk produced.

On the other hand, milk production of balli cow gives 0.1% (wb/wv) katu leaf extract supplement was lower than that given 0.05% (wb/wv) katu leaf extract. Katu leaf supplementation will increase prolactin secretion of the inferior pituitary gland (Suprayogi, 2000). Suka et al. (2011) stated that prolactin secretion has its own control through a short feedback mechanisms. Increase serum level of prolactin increases hypothalamus dopaminergic synthesis and the concentration of dopamine in hypothalamo-hypophysial portal blood. These statements lead to an explanation on the higher gene expression level of prolactin at the lower dosage compared to the higher dosage. The higher dose of S. androcyclus leaf extracts is given, the higher papaverine is consumed, which enhances prolactin secretion, thus enhances dopamine secretion. A higher dopamine secretion causes an inhibition of prolactin secretion which means lower milk produced.

![Figure 1. Milk yield of balli cow given katu leaf extract supplementation to the rice straw and natural grass based diets](image)

Weekly milk yield of balli cow was presented on Figure 1. Milk yield of balli cows offered 0.05% (wb/wv) katu leaves extract supplement gradually increase from week 1 to week 3, then increase markedly in week 4. The milk yield was stable until week 8 then starting to decrease. The result was not in accordance with Suka et al. (2000) who found that a reduction in milk yield of balli cow given Gliocladium sepiarium and natural grass from week 1 to week 17 of lactation, while balli cow that offered gliocladium sepiarium natural grass and concentrate showed reduction in milk yield from week 1 to week 5, but then increase until week 9. The stable increase in milk yield of balli cows offered katu leaves extract supplement may be due to continuous secretion of prolactin hormone that stimulate the alveolar activity of the mammary gland to increase secretory cell population as well as milk synthesis. Reduction in milk yield in week 6 was caused by reduction in prolactin secretion. Tuck (1985) stated that naturally quantities of prolactin release in such milking gradually diminish as the milking period proceed.

3.2 Milk quality

Table 2. presented the compositional quality of milk from balli cow offered katu leaf extract supplement. Average milk fat percentage of balli cows milk subjected to treatment A, B and C were statistically not different (P>0.05). This is in line with Marwh et al. (2010) who found that katu leaf supplementation in goat did not affect milk fat content. The fat content of milk was affected by acetic acid production in rumen. Since feed intake of the animal was not different, the acetic acid production was also the same.
Table 3: Milk composition of buli cow given basal diet rice straw, natural grass, supplemented with katu leaf extract.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Milk component (%)</th>
<th>Total solids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protein</td>
<td>Fat</td>
</tr>
<tr>
<td>A</td>
<td>3.55 ± 0.26a</td>
<td>6.47 ± 1.84a</td>
</tr>
<tr>
<td>B</td>
<td>3.43 ± 0.22a</td>
<td>6.37 ± 1.58a</td>
</tr>
<tr>
<td>C</td>
<td>3.52 ± 0.22a</td>
<td>6.37 ± 1.58a</td>
</tr>
</tbody>
</table>

Note: A: 0% supplementation of katu leaf extract; B: 0.05% supplementation of katu leaf extract; C: 0.1% supplementation of katu leaf extract. Values followed by the same superscripts in the same column were not significantly different (P>0.05).

The protein content of milk from buli cows given katu leaves extract were not significantly different compared to control (P>0.05). Milk protein was synthesized from amino acid in blood. Blood amino acid content of ruminant revealed an association between amino acid intake and indigestible protein digestion in the intestine. Protein degradation in the rumen will yield amino acids. Vancorcelius et al. (2006) stated that there is a correlation between crude protein intake and blood urea concentration. Increased crude protein intake will result in blood urea concentration. Furthermore, they stated that feed’s protein that reach the intestine will hydrolyze to NH₃ which absorb into blood, then metabolized to blood area in the liver. Tillman et al.(1991) stated that intake protein entered the rumen were hydrolyzed to amino acids, organic acid, ammonia, and CO₂ by rumen microbes. The ammonia was then oxidize in blood and hydrolyzed to blood area in the liver. Therefore, the blood area of ruminant was also affected the amino acid content in the blood. It can be explained that the statistically not significantly different milk protein of buli cows given treatments A, B and C were due to a not significantly different protein intake, and blood area concentration (Table 1 and Table 4).

Table 4: Average blood glucose and urea of buli cow given katu leaves extract supplementation.

<table>
<thead>
<tr>
<th>Blood precursor</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose (mg/dl)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>48.67 ± 1.78a</td>
</tr>
<tr>
<td>Urea (mg/dl)</td>
<td>29.87 ± 2.35a</td>
</tr>
</tbody>
</table>

Values followed by the same superscripts in the same row were not significantly different (P>0.05).

Lactose percentage of milk obtained from buli cows given katu leaves extract were not significantly different (P>0.65). Lactose percentage of milk from buli cows in treatments B and C were respectively 6.9% and 8.1% higher than that of milk from buli cows in treatment A. Milk lactose was synthesized from blood precursor glucose. Blood glucose of buli cows in treatment A, B and C were significantly different (P>0.05) (Table 4). Therefore, the lactose percentage of milk cows milk in treatments A, B and C were not significantly different (P>0.05). Total solids of milk obtained from buli cow given treatments A, B and C were significantly not different (P>0.65). Total solid of milk was composed of lactose, protein, fat, mineral and vitamin of the milk. Since the lactose, protein and fat percentage of the milk was not significantly different, the total solid of the milk was also not significantly different (P>0.05).

4. Conclusion

Supplementation of 0.05% (w/w) katu leaves extract increased milk yield of buli cows of about 43.6% compared to control. Milk composition of buli cows, such as protein, fat and lactose percentage did not change by the katu leaf extract supplement.

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References


