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Milk Production of Friesian Holstein Cows During the First Month Postpartum as Affected by Depolarized Katuk Supplement

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ABSTRACT

This study included 21 recently calved FH cows divided into three treatment groups: control (P0), depolarized katuk (*Sauropus androgynus*) leaf powder (P1), and depolarized *katuk* leaf pellet (P2). The study found that the dry matter intake for treatment P0, P1, and P2 were 15.59 ± 0.91 kg, 15.14 ± 1.38 kg, and 16.27 ± 1.28 kg, respectively. Milk production in these three different treatments were 25.91±5.94 L, 23.80±3.42 L, and 32.11±4.75 L, respectively. The dry matter percentage of milk (total solid) in P0 was 21.75±11.67%, P1 was 21.7±0.99%, and P2 was 31.0±10.75%. Depolarized katuk leaves, particularly in pellet form, resulted in much higher milk production than the control group. These data suggest that feeding depolarized katuk leaves as a supplementary feed to FH dairy cows can improve milk supply and quality during the first month of lactation. The inclusion of depolarized katuk leaves, particularly in pellet form, may be a useful technique for increasing dairy cattle productivity and health.

Keywords: friesian holstein, depolarized katuk leaves, milk quality, 1-month lactation, milk production

INTRODUCTION

The productivity of dairy cattle is governed by both the quantity and quality of milk produced. Milk is a good source of animal nutrition and plays an important part in human diets in terms of nutritional functions such as boosting the immune system, aiding cognitive development, and promoting children's healthy growth. Milk is extremely useful to human health since it provides necessary vitamins and minerals that help the body function properly (Oka *et al*. 2017). Most of the milk produced and consumed by humans comes from dairy cattle. Among the numerous breeds, the Friesian Holstein (FH), originated in the Netherlands, is the most frequently grown and known for its remarkable milk production potential. According to Ensminger and Howard (2006), FH cattle produce more milk than other dairy breeds, distinguished by their lengthy lactation time, high milk supply, and remarkable persistence in milk production (Dematewewa *et al*. 2007). However, in Indonesia, FH cattle have not fulfilled their genetic potential and have low milk yields. Toharmat *et al*. (2007) reported that the average daily milk output of FH cattle in Indonesia is less than 16 L/ head.

Genetic variables influence milk production in dairy cow by about 30%, while environmental factors account for about 70% (Santosa *et al*. 2014). External environmental factors include management practices, nutrition, and climate conditions, whereas internal determinants are nursing cow biological characteristics such as lactation period, lactation length, dry period, and calving interval (Dwinugraha *et al*. 2018). According to Purwanto *et al*. (2013), milk supply is also linked to parity and age, all of which are directly tied to the lactation phase. According to Filian et al. (2016), the lactation time of dairy cows increases with age. Furthermore, Makin and Suharwanto (2012) found that the highest milk output of FH cattle occurred during the second lactation.

Milk output in dairy cattle is regulated by both genetic quality and environmental conditions. Environmental factors include all conditions other than hereditary features, including nutrition and feeding management, age at first calving, lactation period, milking frequency, dry period, health status, humidity, and temperature. Feed is essential for meeting dairy cattle's basic maintenance needs, promoting milk output, and maintaining reproductive performance. The type and quality of feed used can have a considerable impact on the quantity and quality of milk produced, as well as the animals' overall health. According to Ensminger and Howard (2006), the primary factors determining dairy cattle productivity are heredity

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(genetics) and environment. Susanti and Marhaeniyanto (2007) also reported that good milk output is highly related to the quality of feed ingested. Forage is the principal feed for dairy cattle, supplemented by concentrates. Feed additives are frequently used to increase milk output. As stated by Riski *et al*. (2016), feed serves not only to address basic maintenance needs, but also to promote production and reproduction. Rokhayati (2010) specified that one of the primary causes of low productivity is poor-quality and insufficient feed, which inhibits cattle from reaching their maximum output potential.

After calving, dairy cows gradually increase milk production until they achieve peak yield, at which point production drops until the cow dries off. After two months of breastfeeding, the daily milk supply usually starts to drop. According to Mahmud *et al*. (2018), FH cows reach maximal milk output more than 60 days postpartum. Kurnianto *et al*. (2004) explained that the rise in milk output over successive lactations from the age of 2 to 7 years is due to body growth and mammary tissue expansion, with maximum mammary gland development happening during the fourth lactation. Consistent with Ensminger and Howard (2006), total milk production normally increases during the first month after calving and then gradually decreases, although milk fat content tends to rise near the end of the lactation period. Furthermore, Atabany *et al*. (2011) defined lactation as the time span, measured in days, during which a cow produces milk from calving to drying off stage.

Based on prior investigations in human, katuk (*Sauropus androgynus* L. Merr) leaves have been discovered as a food source that can boost breast milk production. *Katuk*, a member of the Euphorbiaceae family, is a common leafy vegetable in Indonesia and is historically suggested for breastfeeding mothers, according to Arindhini (2007). Rahmanisa and Aulianova (2016) discovered that the leaves contain alkaloid and sterol compounds that improve glucose metabolism for lactose synthesis, consequently increasing breast milk production. Furthermore, the leaves contain amino acids that can increase milk secretion (Arindhini 2007). Putra *et al.* (2019) found that the presence of sauropifolium in the leaves improves nutrition supply to the mammary glands and secretory cell function.

The inclusion of katuk leaves in dairy cattle feeds is intended to boost both milk yield and quality. Milk output can be increased by either enhancing feed quality or using feed supplements and additives. Several technology-based studies have been carried out to assess the impact of the leaves on dairy cattle milk production. Depolarized katuk leaves have been recognized as an effective addition for improving milk output in dairy cows. Suprayogi *et al*. (2013) found that depolarized leaves improve milk production through the direct and indirect action of non-polar active chemicals that increase metabolic hormonal activity at the cellular level. further emphasized that the leaves function as a herbal galactagogue, containing essential nutrients such as protein, calcium, phosphorus, iron, and vitamins A, B, and C, as well as steroid compounds and polyphenols. Katuk also includes phytosterols such as sitosterol, stigmasterol, and campesterol, which are widespread in higher plants. Furthermore, Utari *et al.* (2012) indicated that the amino acids found in the leaves are absorbed in the intestine and delivered via the bloodstream to the mammary secretory cells, where they contribute to milk production.

Depolarized katuk is an innovative substance that improves milk yield and quality in dairy cattle. Several studies have been undertaken to determine the influence of the leaves on milk production in FH cows. This study aimed to increase milk yield and quality in FH cows during the first month postpartum by supplementing with depolarized katuk at the industrial level. The findings are intended to be useful as a reference and provide vital information about the effects of depolarized katuk supplementation on milk output and quality in FH dairy cows.

METHODS

This study was carried out at PT Great Giant Livestock in Central Lampung Regency, Lampung Province, over a two-month period from early September to the end of October 2021. The experiment used 21 FH dairy cows that had recently calved. All cows employed in the study were at least in their second lactation cycle. The cows were randomly assigned to three treatment groups: control (P0), depolarized katuk leaves powder (P1), and depolarized katuk leaves pellet (P2). The control group received a complete ration from PT GGL, whereas the P1 and P2 groups received the same ration supplemented with depolarized katuk. The supplementation was supplied at a rate of 100 g/head/day, mixed with the morning feed at 7:00 a.m.

Pregnant cows approaching parturition were moved to a transition barn and housed in colony pens beginning 18 days before calving. The cows were subsequently divided into three treatment groups, stratified by past milk yield and lactation period, to ensure that averages were equal across groups. Depolarized katuk supplementation was added to the feed before calving.

Throughout the trial, each cow in the treatment groups had their feed intake measured on a regular basis. Dry matter intake (DMI) was determined by subtracting the dry matter of feed refusals (kg) from the dry matter of feed supplied (kg) the following day. McDonald *et al*. (2002) provided the following formula for calculating DMI:

DMI (kg) = Feed offered (kg DM) – Feed refusal (kg

DM)

Milk yield was measured daily for each experimental cow starting on day 8 postpartum, after the colostrum period, and continuing until day 30 postpartum. Daily milk production was calculated as the sum of morning and evening milking sessions. For milk quality analysis, composite samples of 100 mL were obtained from both morning and evening milkings. The Laboratory of Milk Quality Testing, Division of Dairy Production and Technology, Department of Animal Production and Technology, Faculty of Animal Science, IPB University, Bogor, used a Lactoscan to examine milk quality and nutritional composition. The criteria evaluated were specific gravity (SG), total solids (TS), fat content, solids-not-fat (SNF), pH, protein content, and lactose content.

The gathered data were evaluated using *t*-tests to compare milk yield, milk quality, and feed intake between the control group (P0) with depolarized katuk powder (P1), the control group with depolarized katuk pellet (P2), and between P1 and P2 groups. The formula for the *t*-test (Walpole 1995) is given as:

$$t = \frac{(\bar{y}a - \bar{y}b)\ (\mu a - \mu b)}{sb\sqrt{\frac{1}{na} + \frac{1}{nb}}}$$

where
ȳa = sample mean of group a
ȳb = sample mean of group b
μa = population mean of group a
μb = population mean of group b
sb = sample standard deviation
na = sample size of group a
nb = sample size of group b
a = control group
b = treatment group

RESULTS AND DISCUSSION

Milk produced by dairy cows becomes appropriate for human consumption on the eighth day postpartum and lasts until the cows are dried off. Milk yield gradually increases until peak lactation, which usually occurs in the second month following calving. Following parturition, dairy cows go through uterine involution, which is a recovery process in which the uterus returns to its normal state. This process typically takes around 40 days; however, it might be accelerated depending on the animal's nutritional health. FH cows fed depolarized katuk were monitored for dry matter intake, milk yield, and milk quality during the first 30 days postpartum.

The average body weights of dairy cows at calving were 668.57 kg, 677.33 kg, and 650.37 kg in control, P1, and P2 groups, respectively. Cow body weights across treatments were relatively similar. Table 1 shows that the percentage of dry matter intake (DMI) based on body weight during the early postpartum period was 2.24% for P0, 2.19% for P1, and 2.27% for P2. Dry matter intake at 30 days postpartum was not different across treatments. According to BSN (2009), DMI in dairy cattle normally ranges between 3 and 4% of body weight, depending on digestibility, palatability, breed, sex, age, and physiological condition. The percentages found in this study are compatible with Ali and Muwakhid's (2017) finding, that the DMI need for dairy cows is 2−3% of body weight. Abidin (2002) also noted that, while intake levels are typically described in terms of dry matter, there is an upper limit due to rumen capacity, which is believed to be around 10% of body weight.

Depolarized katuk was added to dairy cows' full feed provided by PT GGL. The supplement was given in two forms: powder and pellets, at a dose of 100 g/head/day. The depolarized katuk was added to the morning portion with the assumption that it would be completely consumed. The findings of treatments included control (P0), depolarized katuk powder (P1), and depolarized katuk pellet (P2) are reported in Table 1. Up to day 30 postpartum, dairy cows supplemented with depolarized katuk and those in the control group had similar dry matter intake (DMI). Cows in P2 consumed 16.27 ± 1.28 kg/head/day, above P1 (15.14 ± 1.38 kg) and P0 (15.59 ± 0.91 kg). The inclusion of depolarized katuk did not influence the palatability of PT GGL's entire ration. This suggests that depolarized katuk supplementation had no effect on feed intake, as evidenced by the lack of DMI differences between treatments.

Milk supply increased until the second month of breastfeeding (8 weeks postpartum). Table 2 shows the yields recorded during the first four weeks following

Table 1 Dry matter intake, milk yield, and milk quality of dairy cows supplemented with depolarized *katuk* during the first month postpartum

Parameter	P0	P1	P2
Dry matter intake (kg/head/day)	15.59±0.91	15.14±1.38	16.27±1.28
Dry matter intake (% BW)	2.24	2.19	2.27
Milk yield (L/head/day)	25.91±5.94^{ab}	23.80±3.42^{a}	32.11±4.75^{b}
Total solids (%)	21.75±11.67	21.7±0.99	31.0±10.75
Fat (%)	3.09±0.22	3.27±0.12	2.74±0.25
Solids-not-fat (SNF, %)	18.66±11.89	18.43±1.11	28.26±10.50
Milk protein (%)	3.18 0.81	3.06±0.93	2.53±0.13
Lactose (%)	4.67±0.02	4.16±0.93	4.55±1.40

calving, and Figure 1 depicts the weekly trend. These illustrations reveal that milk yield increased across all treatments, with P2 cows producing more than P0 and P1. These are consistent with Ensminger and Howard's (2006) findings, that total milk production generally rises during the first month after calving before gradually declining, and Mahmud *et al*. (2018), discovered that FH cows typically reach peak milk yield more than 60 days postpartum.

At 30 days postpartum, FH cows treated with P2 produced an average daily milk yield of 31.04 ± 2.68 L/head, compared to 30.50 ± 3.09 L for P1. The control group (P0) had an average daily milk output of 25.57 ± 1.92 L. The comparatively high yield seen in the control group suggests that the entire ration delivered by PT GGL was already of high quality. This conclusion contradicts Toharmat *et al*. (2007), that the average daily milk output of FH cows in Indonesia is usually less than 16 L/head. P0 and P1 generated the lowest yields, while supplementation with depolarized katuk pellets (P2) resulted in the maximum milk yield. The pellet form comprised depolarized katuk mixed with other compounds to aid in pelleting, therefore the katuk concentration was not 100%. In contrast, the powder form contained only depolarized katuk. Although dry matter consumption did not differ across treatments, the pellet form produced more milk, implying that the extra elements in the pellet likely worked synergistically to complement the nutritional profile of depolarized katuk.

After calving, dairy cows produce milk more than their calves' demands, with yields increasing until peak output is attained. Despite the ongoing uterine repair process, milk production increases in the first 30 days postpartum. During this time, dry matter intake is insufficient to fulfil the nutritional demands of peak output, causing body weight loss. Cows often have a negative energy balance at the peak of lactation. The major hormones that regulate milk production are prolactin and oxytocin. According to Supayogi (2017), bioactive compounds in katuk leaves influence lactogenesis and lactation both directly, through the action of prostaglandins and steroid hormones on mammary secretory cells, and indirectly, by stimulating anterior and posterior pituitary cells to release prolactin, growth hormone, and oxytocin, respectively.

Cow's milk is composed of water and other nutrients or other components that define its quality. The primary nutritional quality indicators are total solids (TS) or dry matter (DM), fat, solids-not-fat (SNF) or fat-free dry matter, lactose, and protein. Among these, TS is the most important predictor of milk nutritional quality, with fat content serving as another generally recognized signal. This study found that the average TS content of milk produced by FH cows up to 30 days postpartum was 21.75 ± 11.67% for P0, 21.7 ± 0.99% for P1, and 31.0 ± 10.75% for P2. Based on TS content, milk produced at PT GGL is classed as outstanding or premium quality. Descriptively, P2 had the highest TS content; however, the difference was not statistically significant due to substantial variability across the group. Nonetheless, the usage of depolarized katuk pellets (P2) is advised because they produced the highest TS value. According to SNI (2011), milk must

Table 2 Weekly milk yield (L/head/day) of dairy cows supplemented with depolarized *katuk* over a 4-week period

Week	P0 (L)	P1 (L)	P2 (L)
1	23.45 ± 6.47	27.38 ± 3.67	28.40 ± 3.71
2	26.05 ± 5.85	30.58 ± 4.00	30.97 ± 5.06
3	27.20 ± 5.79	33.55 ± 3.31	33.75 ± 4.98
4	26.92 ± 5.63	33.68 ± 2.70	35.33 ± 5.25
Mean ± SD	25.57 ± 1.92	30.50 ± 3.09	31.04 ± 2.68

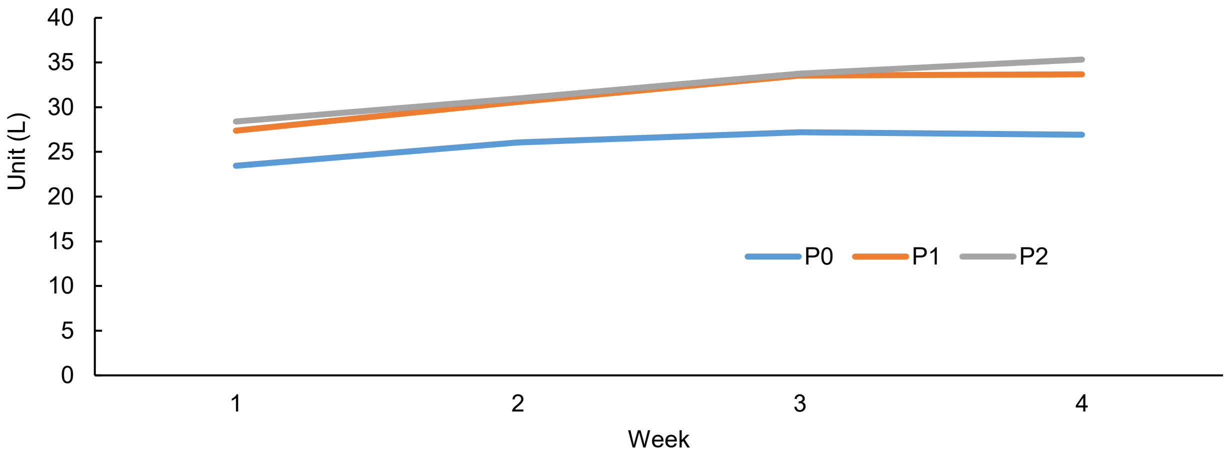

Figure 1 Weekly milk yield of dairy cows supplemented with depolarized *katuk* during the first month postpartum.

have a minimum TS content of 11.8%. The TS levels found in all three treatments were significantly higher than the standard. The comparatively high TS content in the control group suggests that PT GGL's entire ration was of outstanding quality, and the inclusion of pellet-form depolarized katuk improved the nutritional profile of the milk. The milk's high vitamin content makes it an excellent source of nutrition for humans.

Although dry matter intake did not differ across the three treatments, milk's significantly higher TS content suggests improved feed efficiency. According to Suprayogi (2017), bioactive chemicals in katuk leaves can be hydrolyzed in rumen via fermentation, resulting in volatile fatty acids (VFA) and promoting rumen microbial development. These bioactive molecules increase food availability in the bloodstream, which is then delivered to the mammary glands as precursors to milk production. The full ration provided by PT GGL, when supplemented with depolarized katuk in pellet form (P2), increased the TS content of milk in dairy cows.

The milk fat levels in the control and P1 groups were similar and relatively low. However, the colostrum fat content in P2 reached 19.65 ± 0.21%, which was significantly higher than the other treatments. This suggests that the P2 treatment resulted in a significantly higher colostrum fat content. Solid nonfat (SNF) levels in colostrum were high across all treatments, with no variations across groups, and were in line with SNI's SNF requirements. Similarly, the lactose and protein levels of colostrum and milk were consistent across treatments and met SNI requirements.

CONCLUSION

The outcomes of this study reveal that depolarized katuk can be used as a beneficial feed supplement to improve milk output and quality in dairy cows during the first month of lactation. Supplementation with depolarized katuk resulted in improved production performance, with the pellet form outperforming the powder form. These findings suggest that depolarized katuk pellets could be an effective nutritional strategy for increasing early lactation performance in Friesian Holstein dairy cows.

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