p-ISSN 1410-5659 e-ISSN 2621-5144
Published by:
Unpad Press

Jurnal Ilmu Ternak Universitas Padjadjaran, March 2026, 26(1):48-57
DOI: 10.24198/jit.v26i1.66212
Available online at http://journal.unpad.ac.id/jitunpad

Research Article

REPLACING FIELD GRASS BY CASSAVA LEAF SILAGE ADDED WITH KEFIR ON THE PRODUCTIVITY OF LACTATING DAIRY COW

Afton Atabany[1], Azhar Amir[2,a], Ade Syahrul Mubarak[2], Hilda Susanty[3], and Sutomo Syawal[4]

[1] *Department of Animal Production and Technology, Faculty of Animal Science, IPB University, Bogor, 16680, Indonesia*
[2] *Research Center for Animal Husbandry, National Research and Innovation Agency of Indonesia (BRIN), Cibinong, Bogor 16915, Indonesia*
[3] *Department of Animal Production and Technology, Faculty of Animal Science, Andalas University, Padang, 25175, Indonesia*
[4] *Department of Animal Production, Faculty of Animal Science, Hasanuddin, University, Makassar 90245, Indonesia*
[a] *email:* azha001@brin.go.id

Abstract

This study aimed to analyze the effect of cassava leaf silage (CLS) with added kefir on the productivity of lactating dairy cows when replacing field grass. Four Holstein cows in the early lactation phase (66 ± 11 days in lactation) in the second lactation cycle were randomly divided into four dietary treatments based on a 4×4 Latin square design. Diet treatments consisted of control (50% field grass + 25% concentrate + 25% tofu dregs); CLS 0 Kf (30% field grass + 20% CLS with no added kefir + 25% concentrate + 25% tofu dregs); CLS 2.5 Kf (30% field grass + 20% CLS with 2.5% added kefir + 25% concentrate + 25% tofu dregs); and CLS 5 Kf (30% field grass + 20% CLS with 5% added kefir + 25% concentrate + 25% tofu dregs). Results showed differences between treatments in dry matter intake, crude protein, crude fat, and total digestible nutrients (TDN); milk yield; 4% fat-corrected milk (FCM); and milk fat showed significant differences (P<0.05). In conclusion, CLS supplemented with 5% kefir can replace field grass in ruminant diets for lactating cows by increasing nutrient consumption, milk production, and milk fat without changing milk composition and feed efficiency.

Keywords*:* Cassava, feed efficiency, lactating cows, milk composition, nutrients intake

INTRODUCTION

Dairy cow production in Indonesia has primarily been supported by smallholder farmers in west, central, and east Java. These three provinces accounted for 97.56% of Indonesia's 485,809 dairy cattle population. The rest of the population is spread slightly across the other 35 provinces in Indonesia. The primary feed sources for dairy cattle used in West Java are grass, tofu dregs waste, and commercial concentrate. The problem faced by farmers is the limited availability of grass feed during the dry season, hampering the supply of nutrients needed to increase production. Although concentrated mixtures could enhance nutrient content, farmers usually do not utilise them due to their high cost (Sudarman *et al*., 2016).

The outbreak of foot-and-mouth disease (FMD) in Indonesia in 2022 has hurt the livestock sector, particularly in the dairy cattle subsector. This impact is evident in the decline in the national dairy cattle population and milk production. The number of dairy cows in 2021 was 582,169. After being affected by this outbreak, it decreased by 12.9% in 2022 and 8.4% in 2023 due to deaths and forced slaughter. The population increased by 4.7% in 2024, but milk production decreased by 3.45%, totaling 808,352 tons of fresh milk

Submitted 17 August 2025; accepted 29 December 2025.
Available online 30 March 2026.

domestically. It indicates that recovery from the FMD outbreak is occurring gradually (BPS, 2024).

Milk production from dairy cattle on smallholder farms is low and variable. Milk yield ranges from 8-18 L/d (Sutawi *et al*., 2021; Zahera *et al*., 2015; Widyobroto *et al*., 2016). Diverse feeding patterns cause these results, such as feeding with a combination of elephant grass and concentrates (Harmini *et al*., 2020), field grass, concentrates, straw, and tofu pulp (Asminaya *et al*., 2017), elephant grass, concentrates, corn silage, and cassava waste (Hasanah *et al*., 2017). Due to limited land, most smallholder farmers did not plant superior grasses, so they used field grass as the forage feed for dairy cows (Priyanto & Rahmayuni, 2020). However, field grass is also limited during the dry season, so crop by-products are needed as substitutes.

Cassava is one of the most popular carbohydrate crops after rice and corn. The production of this crop in Indonesia reached 18.3 million tons in 2020. In the last five years, cassava in Indonesia has increasingly been positioned not only as a traditional food ingredient but also as a multi-sector strategic commodity: modern food, downstream industry, bioenergy, animal feed, and a source of income for community businesses (Rozi *et al*., 2022). The production achievement declined in the following two years as the land area decreased, and most farmers switched to other crops. However, this production still has potential by-products as ruminant feed. Cassava leaves have a high protein content ranging from 21.0 to 30.0%, based on the variety (Jamil & Bujang, 2016). However, treatment is needed to reduce hydrogen cyanide (HCN) and tannin levels before utilizing cassava leaves as ruminant feed.

Silage treatment of cassava leaves has been proven to reduce HCN and tannin levels within safe limits for livestock consumption (Amir *et al*., 2021). Several reports show that cassava leaves silage (CLS) feeding positively affects the productivity of ruminants. Sudarman *et al*. (2016) state Adding 20% CLS to sheep feed can improve growth performance and feed efficiency, as well as concentrate supplementation levels. Providing feed CLS to goats has a positive effect on their health and production, as indicated by an increase in average daily feed intake, average daily growth, and feed conversion efficiency. (Li *et al*., 2023). Wanapat *et al*. (2018) found that The addition of cassava top silage (young steam, leaf, and petiole) to the feed of lactating dairy cows in tropical regions can result in a 10.2% increase in milk production and milk quality. In addition, the research by Amir *et al*. (2021) found that a 5% kefir additive in silage could increase digestibility in old cassava leaves of bitter varieties. Kefir is a fermented milk product inoculated with a mixture of bacteria, particularly lactic acid bacteria such as Lactobacillus acidophilus, Lactobacillus casei, and Lactobacillus kefiri, and yeast such as Saccharomyces cerevisiae. Therefore, this study aimed to analyze the effect of field grass replaced by CLS with or without kefir liquid on feed intake, milk yield, milk composition, and feed efficiency of lactating dairy cows.

MATERIALS AND METHODS

Study Site

The research was conducted from July to September 2019 (dry season) at a smallholder dairy farm in Kebon Pedes, an urban village in Bogor, West Java, Indonesia. This location is in the lowlands at an altitude of 200 m asl, with annual rainfall ranging from 3000 to 4000 mm. Feed samples were analyzed at the Feed Science and Technology Laboratory, and milk samples were analyzed at the Animal Production and Technology Laboratory, Faculty of Animal Science, IPB University.

Production of Milk Kefir

Kefir grains used in commercial products were identified to contain bacteria such as *Lactobacillus kefiri*, *Lactococcus cremoris*, *Acetobacter* and yeast in the form of *Saccharomyces cerevisiae*. Kefir grains were inoculated at 5% in cow's milk that had been sterilized at 105ºC for 5 minutes and cooled at temperature. After incubation for a day, kefir grains were filtered to make kefir milk further. Filtered or kefir milk is added as part of the treatment for making cassava leaf silage. The chemical composition of kefir milk has a pH of 4.3, moisture content of 88.9%, protein of 3.3%, fat of 2.1%, Solid non Fat (SNF) of 9%, and lactose of 5.2%.

Silage Production

The cassava leaves were harvested from bitter cassava varieties at 7 to 9 months of age by farmers in Ciampea Village, Bogor, West Java. Leaves and stalks were sun-dried daily to reduce HCN and tannin levels. They were then cut into 3-5 cm pieces and put into drums with a capacity of 100 kg. CLS production is made with no additives of kefir, adding 2.5% kefir and 5% kefir as field grass replacement treatments. Milk kefir was obtained from the dairy animal science division, IPB University. The anaerobic ensilage process for 28 days resulted in an average CLS pH of 4.0.

Animals, Experimental Diets, and Experimental Design

Four Holstein lactating cows with conditions of 398±7 kg body weight, early lactation (66±11 days in milk), and a second lactating cycle were randomly given according to a 4×4 single Latin square design to accept four dietary treatments (20% field grass replacement by cassava leaf silage). The DM feed was 3% body weight and divided into two feedings. Water was supplied ad libitum. The cows were fed morning and afternoon: 6 am, 5 pm. The ratio of forage (field grass, CLS), commercial concentrate, and tofu waste was 50:25%:25%. Feed treatments that replaced field grass with cassava leaf silage were: 50% field grass + 25% concentrate + 25% tofu waste (control); 30% field grass + 20% CLS without additive of kefir + 25% concentrate + 25% tofu waste (CLS 0 Kf); 30% field grass + 20% CLS with additive of 2.5% kefir + 25% concentrate + 25% tofu waste (CLS 2.5 Kf), and 30% field grass + 20% CLS with additive of 5% kefir + 25% concentrate + 25% tofu waste (CLS 5 Kf). The chemical composition of feed ingredients presented in Table 1 was analysed proximate using the AOAC method (AOAC, 2005).

Data Collection

The length of the experiment was 84 days, divided into four periods. Each period consisted of 21 days. The initial 14 days were early trials to remove the effects of previous treatments and adapt to the subsequent treatments, followed by seven days for data collecting. The variable of temperature humidity index (THI) was obtained by measuring the ambient temperature and relative humidity through the formula: THI: (0.8 x Ta) + (RH/100) x (Ta-14.4) + 46.4 (Mader *et al*., 2006). Where: Ta is the ambient temperature (ºC), RH is the relative humidity (%), and THI is the temperature humidity index. The Clasification for THI, normal: THI≤74; alert: 74<THI<79, danger: 79≤THI<84, emergency: THI≥84.

Feed intake of lactating dairy cows is measured daily by weighing the quantity of feed given, subtracting the remaining feed, and then multiplying it by the dry matter content of the feed. The parameters include dry matter (DM), crude protein (CP), extract ether (EE), crude fiber (CF), and total digestible nutrients (TDN). Daily milk yield was measured from 2 milkings in the morning and afternoon: 5 am, 4 pm. Milk composition measurement was done through Milkotester Ltd., Bulgaria, to determine protein, fat, lactose, and SNF levels. The procedure for measuring milk composition is to turn on the Milkotester by pressing the on button. Press the menu button and select cow's milk as the sample to be analysed. Pour 25 ml of the prepared milk sample into the container. Press the Enter button to start the automatic analysis process. The device draws in the sample, performs the measurement, and displays the analysis results on the digital screen. Once finished, press the clean button to prepare for the subsequent sample measurement. Milk production was standardized with fat-corrected milk by Gaines's equation, FCM = (0.4 x kg milk yield) + (15 x kg total milk fat). Feed efficiency (FE) was measured by formula, FE = milk production (kg)/DM intake (kg) (VandeHaar, *et. al*., 2016). Economic efficiency (EE) was calculated using the formula, EE = milk price (IDR) x milk production (kg)/feed cost (Hasanah *et al*., 2017). Income over feed cost (IOFC) was calculated using the formula, IOFC = milk production (kg) x milk price – total feed cost (Adduci et al., 2015).

Statistical Analysis

The data from THI was analyzed descriptively. Data on feed intake, milk production, FCM, milk composition, and feed efficiency were analyzed through the analysis of variance procedure of a 4x4 single latin square design using the General Linear Model (GLM) of SPSS version 26 by IBM Corp. 2019. Duncan's New Multiple Range Test determined differences between treatment among means, when probability was 5%.

RESULTS AND DISCUSSION

Microclimate Condition

Microclimate measurements at the research site were rainfall ranging from 115–399 mm with 43 rainy days, wind speed of 0.6–1.9 m/s, ambient temperature ranging from 23.6-31.9 °C, and air humidity ranging from 59–85% (low–high, respectively). The study site has a wet tropical climate with high rainfall and temperature but low wind speed. The observation data obtained was higher than the range of optimum values for the comfort zone of dairy cows. It is suspected that dairy cows experience heat stress. The adverse effects of heat stress on livestock include increased body temperature, panting, water intake, reduced activity, feed intake, and decreased body weight and milk production (Polsky & von Keyserlingk 2017; Habeeb, 2020; Narmilan *et al*., 2021)

The THI data also indicates that cattle are experiencing heat stress. Based on Habeeb (2020) that classification of THI values, cattle experience mild stress in the morning (THI 72-79) and moderate stress in the afternoon (THI 79-89). The THI value calculation is shown in Figure 1. Heat stress indicators help farmers minimize its adverse effects by improving barn circulation, feed management, nutrient balance, drinking, and spraying cows during heat stress (Al-Khafaji *et al*., 2023; Prabowo *et al*., 2025)

Nutrients Intake of Lactation Dairy Cow

Dairy cows require feed and nutrients to meet their basic life needs, lactation, and reproduction. The feed consumption of lactating dairy cows from the study treatments is shown in Table 2. The analysis of variance showed that the provision of cassava leaf silage in place of field grass affected the intake of DM, ash, CP, EE, CF, and TDN (P<0.05). The DM intake in the CLS 5 Kf treatment was higher than the other treatments. Thus, adding 5% kefir to cassava leaf silage increased the palatability of lactating dairy cows. In addition, research conducted by Suyitman *et al.* (2020) showed the positive effects of adding cassava leaves to Simmental cattle feed, which improved palatability, digestibility, and production performance.

Kefir inoculation in silage of other crops also has positive effects. Adding kefir to ensiling can increase the digestibility of bitter cassava leaf dry and organic matter (Amir *et al*., 2021). Adding kefir at 5–6 log cfu^{-1} to alfalfa can improve fermentation quality and aerobic stability despite low WSC levels (Koc *et al*., 2021). In addition, adding 1.6 mL of kefir to the concentrate can improve rumen fermentation and feed digestibility without affecting microbial counts (Al-Galbi & Majeed, 2022).

Lactating cows favored cassava leaf silage, but consumption was no more than 20% of the DM requirement at 3% of body weight in the initial study. CLS consumption was 8–9 kg/day. This amount does not cause toxic effects because the HCN content has been successfully reduced to a safe level of 25-28 mg/kg for consumption by ruminants through the ensilage process (Amir, *et al*., 2021). Cassava leaf silage with or without kefir had higher CP, EE, and TDN consumption than the control treatment. Silage technology maintains the nutritional value of cassava leaves, which are high in protein. Cassava leaves have 25% pure protein and a relatively high nutritional value. CLS digestibility is better because the crude fiber content is lower than the crude fiber of field grass. The nutrient consumption of lactating cows in this study is still within the Nation Research Council (NRC) standard that small breed of dairy cows producing 15 kg/day of milk require DM intake of 9.4–9.9 kg/day, protein intake of 1.5 kg/day (16% DM), and TDN intake of 6.4 kg/day (68% DM).

Milk Yield and Milk Composition

Genetic and environmental factors such as climate, nutrient intake, health, and the lactation cycle affect milk production and composition. Milk yield and milk composition are shown in Table 3. The effect of treatment on milk yield, FCM, and milk fat showed significant differences (P<0.05). While the effect of treatment on other milk compositions such as protein, lactose, solid non-fat (SNF), and total solids did not show significant differences (P>0.05). Silage treatment with adding 5% kefir tended to produce better milk production and fat milk than other treatments. Milk production was associated with higher DM and CP intake in CLS 5 Kf. There is an association between increased DM intake and milk yield and feed efficiency (Tadesse *et al*., 2024). In addition, Adi *et al*. (2020) CP and TDN intake are influential in increasing milk yield in early lactation.

The milk composition level in the present study is still above the minimum quality standards value of fresh cow's milk in Indonesia with a density 1.027, protein 2.8%, fat 3.0% and SNF 7.8%. CLS has good potential as a nutritional substitute for other feed ingredients without compromising milk quality. This potential is supported by research showing that CLS can replace corn silage well without affecting milk production or composition. In this experiment, cassava leaf silage can replace field grass well without changing the milk composition of lactating cows. Interestingly, adding kefir to the ensilage increased milk fat content. So, further studies are needed to analyze the fatty acid (FA) profile and proportion of saturated and unsaturated fatty acids. Inoculating dairy cow feed with kefir is thought to have the potential to produce milk beneficial to human health.

Milk yield and milk composition in this study were similar to those reported by Wanapat *et al*. (2018). The addition of cassava top silage at a rate of 2.25 kg/day to the offered an lactating cows increased milk production. Increasing the level of cassava leaf silage supplements in lactating cow feed can significantly increase milk yields and 3.5% FCM from 12.7 to 14.0 kg/day and from 14.6 to 17.2 kg/day. However, it was not significant for milk composition, such as protein, fat, lactose, SNF, and total solids. Milk production may increase due to the intake of rumen-undegradable protein from cassava leaves, which can increase the flow of essential amino acids such as methionine and lysine for milk production. This findings also suggests that cassava leaf silage can be a promising source of high-quality crude protein for improving milk production and quality, while reducing rumen methane in lactating cows.

Feed Efficiency

The average feed efficiency, economic efficiency, cost per kg of milk and IOFC are presented in Table 4. The results of analysis of variance showed that there were no significant differences between treatments (P>0.05) on FE, EE, cost per kg of milk and IOFC. Milk production relative to DM intake is an essential way to quantify FE. The guideline is based on feeding 3.5% DM of body weight, while this study uses 3% DM feed of body weight. The FE values in this study ranged from 1.19 to 1.29. The average FE value was higher than the FE values in the studies by Lestari *et al*. (2015), which was 1.07-1.16, and Asminaya *et al*. (2017), which was 0.11-0.17, but lower than that of Hasanah *et al*. (2017), which was 1.31-1.42, which was also conducted on smallholder farms.

Table 1. Chemical composition of field grass, concentrate, tofu waste and cassava leave silage

Feed Ingredients	DM (%)	(% DM)				
		Ash	CP	EE	CF	TDN
Field grass	21.74	7.43	6.61	1.52	37.15	56.2
Concentrate	74.8	7.54	13.6	9.13	14.81	64
Tofu waste	17.0	2.33	20.42	12.83	24.23	72.5
Cassava leaf silage (CLS 0 Kf)	27.0	5.8	25.9	5.9	16.8	60.5
CLS with add of 2.5% kefir	20.96	7.01	26.5	7.20	26.8	64.3
CLS with add of 5% kefir	26.9	5.14	25.92	6.8	16.8	61.5

CLS 0 Kf: cassava leave silage without kefir; CLS 2.5 Kf: CLS with 2.5% kefir; CLS with 5% kefir; DM: dry matter; CP: crude protein; EE: ether extract; CF: crude fiber; TDN: total digestible nutrient

Table 2. Dry matter and nutrient intake (kg/d) of lactating dairy cows fed cassava leaf silage with added kefir to replace field grass.

Intake (kg/d)	Treatments				SEM	*p*-value
	Control	CLS 0 Kf	CLS 2.5 Kf	CLS 5 Kf		
DM	10.72±0.05[b]	10.4±0.1[a]	10.5±0.1[a]	10.9±0.2[c]	0.06	.000
Ash	0.66±0.01	0.6±0.01	0.65±0.01	0.61±0.01	0.01	.494
CP	1.27±0.01[a]	1.64±0,02[b]	1.65±0.02[b]	1.74±0.03[c]	0.05	.000
EE	0.67±0.01[a]	0.75±0.02[b]	0.77±0.01[b]	0.8±0.02[b]	0.01	.001
CF	3.03±0.01[c]	2.47±0.04[a]	2.75±0.02[b]	2.62±0.03[b]	0.05	.000
TDN	6.68±0.03[b]	6.5±0.08[a]	6.7±0.05[b]	6.9±0.1[c]	0.04	.002

DM: dry matter; CP: crude protein; EE: ether extract; CF: crude fiber; TDN: total digestible nutrient; CLS 0 Kf, CLS 2.5 Kf, CLS 5 Kf replacing field grass at 20% DM of cassava leaf silage, CLS without additive of kefir CLS with additive 2.5% of kefir, and CLS with additive 5% of kefir; SEM: standard error of means; [abc]Means within a row without common letter are different at p<0.05

Table 3. Milk yield and milk composition of lactation cows fed cassava leaf silage

Variables	Treatments				SEM	*p*-value
	Control	CLS 0 Kf	CLS 2.5 Kf	CLS 5 Kf		
Yield						
Milk yield, kg head/d	13.54±2.4[a]	13.4±1,1[a]	12.49±1,2[b]	14.07±1.6[c]	0.41	.019
4% FCM yield, kg/head/d	12,4±1.4[a]	12.35±0,8[a]	13.05±1,3[b]	12.90±1.2[b]	0.49	.027
Fat yield, g/d	480±40[a]	495±35[a]	512±42[b]	526±31[b]	28.6	.036
Protein, g/d	499±57	501±50	495±53	510±36	14.8	.230
Lactose yield, g/d	557±61	542±55	526±59	576±60	18.3	.164
SNF, g/d	1076±161	1058±98	1009±103	1105±120	32.0	.166
TS, g/d	1566±201	1554±148	1476±147	1614±136	40.5	.726
Composition						
Fat, %	3.55±1.1[a]	3.7±0.4[ab]	4.1±0.5[bc]	3.76±0.9[ab]	0.31	.025
Protein, %	3.69±0.1	3.72±0.08	3.63±0.1	3.63±0.2	0.03	.391
Lactose, %	4.12±0.2	4.05±0.2	4.05±0.1	4.12±0.2	0.04	.818
SNF, %	7.95±0.3	7.9±0.2	7.7±0.2	7.96±0.4	0.07	.914
TS, %	11.6±1.3	11.6±0.4	11.8±1.2	11.72±1.6	0.32	.519

FCM: fat-corrected milk; SNF: TS: total solid; SNF: solids-not-fat; CLS, CLS 2.5 Kf, CLS 5 Kf replacing field grass at 20% DM of cassava leaf silage, CLS with additive 2.5% of kefir, and CLS with additive 5% of kefir; SEM: standard error of means, [abc]Means within a row without common letter are different at p<0.05

Table 4. Feed efficiency, economic efficiency, and income over feed cost

Intake (kg/d)	Treatments				SEM	*p*-value
	Control	CLS 0 Kf	CLS 2.5 Kf	CLS 5 Kf		
FE	1.26±0.2	1.29±0.1	1.19±0.1	1.29±0.2	0.04	.309
EE	1.5±0.13	1.5±0.22	1.5±0.12	1.4±0.08	0.07	.956
Cost of Milk, IDR	5316±463	5318±597	5297±520	5600±264	112	.854
IOFC, IDR	35850±1221	37825±1298	37700±668	34500±1546	3169	.969

FE: Feed Efficiency; EE: Economical Efficiency; IOFC: Income Over Feed Cost CLS 0 Kf, CLS 2.5 Kf, CLS 5 Kf replacing field grass at 20% DM of cassava leaf silage, CLS without additive of kefir CLS with additive 2.5% of kefir, and CLS with additive 5% of kefir; SEM: standard error of means

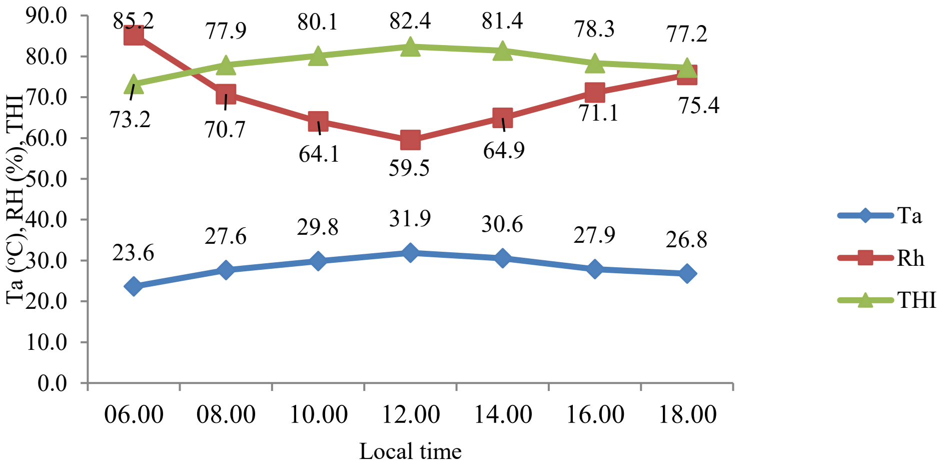

Figure 1. Observation ambient temperature (Ta), relative humidity (RH), and THI

The economic efficiency values in this study were 1.5; 1.5; 1.5; and 1.4 (Control-CLS5, respectively). A high value of economic efficiency can be obtained when milk production is optimized at a high price by reducing feed costs incurred. The profit received from the IOFC value is in the range of IDR 34,500-37,825. More efficient use of feed due to lower costs will result in a higher increase in milk production. This means that CLS with or without kefir addition can replace field grass well. Feed efficiency relates to the ability of cows to convert feed into milk. The use of local feed, such as cassava leaves, can reduce feed costs without decreasing milk production. Feed that is highly digestible and nutritionally balanced will increase milk production per kilogram of feed, thereby reducing feed costs per litre of milk and increasing the IOFC value.

IOFC is an economic indicator used to assess the profitability of milk production, with feed costs as the primary cost component. IOFC reflects the margin earned by farmers after deducting feed costs from milk sales revenue. Adduci *et al*. (2015) state that IOFC accounts for changes in feed costs and milk prices, thereby helping farmers decide whether to increase or decrease certain feed ingredients, optimise the use of local versus commercial feed, and assess the impact of ration changes on profitability. The higher the IOFC, the greater the likelihood of generating sustainable net profits. A positive IOFC indicates room to cover other costs such as labour, cow health, and other operational costs. If feed costs are higher than milk prices, this results in a negative IOFC value. In addition to feed costs, disease outbreaks can reduce IOFC or the profits earned by farmers. A study by Nur *et al.*

(2024) found that FMD outbreaks had a significant impact on IOFC values in smallholder farms in the Bogor region, reducing farmers' income by 95.41%.

CONCLUSION

Adding 5% kefir to cassava leaf silage to feed dairy cows can increase nutrient intake, milk production, FCM, and fat milk. Field grass can be well replaced by cassava leaf silage with the addition of kefir without disturbing milk production, milk composition, such as the percentage of protein, lactose, SNF, total solids and technical efficiency in lactating dairy cows.

ACKNOWLEDGMENTS

The authors want to acknowledge the Barokah Farm in Kebon Pedes urban village for the study location and the Institute for Research and Community Service and the Dairy Science division, IPB University for facilitating this research.

CONFLICT OF INTEREST

The authors declares that there is no conflict of interest.

REFERENCES

Adduci, F., Labella, C., Musto, M., D'Adamo, C., freschi, P., & Cosentino, C. (2015). Use of technical and economical parameters for evaluating dairy cow ration efficiency. Italian Journal of Agronomy, 10:682, 202-207. https://doi.org/10.4081/ija.2015.682

Adi, D. S., Harjanti, D. W., & Hartanto, R. (2020). Evaluasi Konsumsi Protein dan Energi terhadap Produksi Susu Sapi Perah Awal Laktasi. *Jurnal Peternakan Indonesia (Indonesian Journal of Animal Science)*, *22*(3), 292. https://doi.org/10.25077/jpi.22.3.292-305.2020

Al-Galbi, H. A. J., & Majeed, M. S. (2022). Effect of Concentrate: Roughage Ratio and the Addition of Kefir on the Production Characteristics of Ruminant in vitro. *Archives of Razi Institute*, *77*(1), 305–313. https://doi.org/10.22092/ARI.2021.356952.1943

Al-Khafaji, M. A. Q., Shwayel, M. A., & Al-Azzawi, A. M. (2023). Effect of Spraying Water on the Body of Holstein Cows under Heat Stress Conditions in Milk Production and Components. *IOP Conference Series: Earth and Environmental Science*, *1225*(1). https://doi.org/10.1088/1755-1315/1225/1/012044

Amir, A., Purwanto, B. P., Nahrowi, Atabany, A., Salundik, & Yani, A. (2021). Nutrient quality, digestibility and amino acid of cassava leaves silages in different additives. *Livestock Research for Rural Development*, *33*(4).

AOAC. (2005). Of fi cial Methods of Analysis of AOAC International 18th Edition, 2005. *Official Methods of Analysis of AOAC International 18th Edition, 2005*, (d), 4–5. Retrieved from https://www.academia.edu/43245633/Of_fi_cial_Methods_of_Anal_y_sis_of_AOAC_IN_TER_NA_TIONAL_18th_Edi_tion_2005

Asminaya, N. S., Purwanto, B. P., Ridwan, W. A., & Atabany, A. (2017). Milk Yield and Nutrient Adequacy of Lactating Dairy Cow Fed Based on Tofu Waste, Soybean Hulls and Straw. *International Journal of Science and Research (IJSR)*, *6*(7), 951–956. https://doi.org/10.21275/art20174879

BPS (Badan Pusat Statistik) Indonesia. (2024). Populasi sapi perah dan produksi susu menurut provinsi (ekor). BPS Indonesia, Jakarta. Accessed on December 10, 2025, from https://www.bps.go.id/id/statistics-table/2/NDcwIzI=/populasi-sapi-perah-menurut-provinsi.html

Habeeb, A. A. (2020). Impact of climate change in relation to temperature-humidity index on productive and reproductive efficiency of dairy cattle, *1*(June), 1–7. https://doi.org/10.31021/ijvam.20203124

Harmini, H., Evvyernie, D., Karti, P. D. M. H., & Widiawati, Y. (2020). Evaluation of Mineral Contents in Milk of Dairy Cattle Fed Elephant Grass Planted at Ex-Coal

Mining Land. *Tropical Animal Science Journal*, *43*(4), 322–330. https://doi.org/10.5398/tasj.2020.43.4.322

Hasanah, U., Permana, I. G., & Despal. (2017). Introduction of complete ration silage to substitute the conventional ration at traditional dairy farms in lembang. *Pakistan Journal of Nutrition*, *16*(8), 577–587. https://doi.org/10.3923/pjn.2017.577.587

Jamil, S. S., & Bujang, A. (2016). Nutrient and antinutrient composition of different variety of cassava (Manihot esculenta Crantz) leaves. *Jurnal Teknologi*, *78*(6–6), 59–63. https://doi.org/10.11113/jt.v78.9024

Koc F, Unal EO, Okuyucu B, Esen S, I. R. (2021). Effect of Different Kefir Source on Fermentation, Aerobic Stability, and Microbial Community of Alfalfa Silage. *Animals*, *11*(2096), 1–13. doi:https://doi.org/10.3390/ani11072096

Lestari, D. A., Abdullah, L., & Despal. (2015). Comparative study of milk production and feed efficiency based on farmers best practices and national research council. *Media Peternakan*, *38*(2), 110–117. https://doi.org/10.5398/medpet.2015.38.2.110

Li, M., Zi, X., Lv, R., Zhang, L., Ou, W., Chen, S., Hou, G., Zhou, H. (2023). Cassava Foliage Effects on Antioxidant Capacity, Growth, Immunity, and Ruminal Microbial Metabolism in Hainan Black Goats. Microorganisms, 11, 2320 https://doi.org/10.3390/microorganisms11092320

Mader, T., L., Davis, M., S., & Brown-Brandl, T. M. (2006). Environmental factors influencing heat stress in feedlot cattle. J. Anim. Sci., 84, 712-719. https://doi.org/10.2527/2006.843712x.

Narmilan, A., Puvanitha N., Ahamed, S. A., & Santhirakumar, S. (2021). Relationship between Temperature-humidity Index and Milk Production of Dairy Cows in Tropical Climate. Asian Journal of Dairy and Food Research. 40(3): 246-252. https://doi.org/10.18805/ajdfr.DR-213

Nur, M. S., Suharwanto, D., & Firman, A. (2024). Performa produksi susu, *income over feed cost* sebelum dan selama wabah PMK di KUNAK peternak sapi perah KPS Bogor. Jurnal Sosial Bisnis Peternakan. 6(1), 24-31. https://doi.org/10.24198/jsbp v6i1.63651

Polsky, L., & von Keyserlingk, M. A. G. (2017). Invited review: Effects of heat stress on dairy cattle welfare. *Journal of Dairy Science*, *100*(11), 8645–8657. https://doi.org/10.3168/jds.2017-12651

Prabowo, S., Yani, A., Atabany, A., Adinata, Y., Amir, A., Prihantoro, I., & Achmad, F. (2025). The Dairy Cow Shelter Aspects Assessment in Smallholder Farmer Bogor Region West Java Indonesia. IOP Conf. Series: Earth and Environmental Science1484 (2025) 012038. IOP Publishing. https://doi.org/10.1088/1755-1315/1484/1/012038

Priyanto, D., & Rahmayuni, D. (2020). Strategi dan Kebijakan Pengembangan Sapi Perah di Area Luar Pulau Jawa dalam Mendukung Produksi Susu Segar Dalam Negeri (Strategy and Policy on Dairy Cattle Development in Areas Outside Java Island in Supporting Domestic Fresh Milk Production). *Wartazoa*, *30*(3), 149–162. https://doi.org/10.14334/wartazoa.v30i3.2493

Rozi, F., Elisabeth, D. A. A., Krisdiana, R., Adri, A., Yardha, Y., & Rina, Y. (2022). Prospects of cassava development in Indonesia in supporting global food availability in future. Book Chapter of Advances in Roots Vegetables Research. Intechopen. https://doi.org/10.5772/intechopen.106241

Sudarman, A., Hayashida, M., Puspitaning, I. R., Jayanegara, A., & Shiwachi, H. (2016). The use of cassava leaf silage as a substitute for concentrate feed in sheep. *Tropical Animal Health and Production*, *48*(7), 1509–1512. https://doi.org/10.1007/s11250-016-1107-5

Sutawi, Prihartini, I., Malik, A., & Mulatmi, S. N. W. (2021). Assessment of good dairy farming practices on small-scale dairyfarms in Malang Regency of East Java, Indonesia. *Livestock Research for Rural Development*, *33*(1).

Suyitman, Warly, L., Rahmat, A., & Pazla, R. (2020). Digestibility and performance of beef cattle fed ammoniated palm leaves and fronds supplemented with minerals, cassava leaf meal and their combinations. *Advances in Animal and Veterinary Sciences*, *8*(9), 991–996. https://doi.org/10.17582/JOURNAL.AAVS/2020/8.9.991.996

Tadesse, T., Nurfeta, A., & Tolera, A. (2024). Effect of feeding different proportion of Urochloa mutica and natural grass hay as a basal diet on feed intake, milk yield and composition for lactating Jersey cows in Ethiopia. *Livestock Research for Rural Development*, *36*(2).

VandeHaar, M.J., Armentano, L.E., Weigel, K., Spurlock, D.M., Tempelman, R.J., Veerkamp, R. (2016). Harnessing the genetics of the modern dairy cow to continue improvements in feed efficiency. J. Dairy Sci. 99, 6, 4941–4954. http://dx.doi.org/10.3168/jds.2015-10352

Wanapat, M., Phesatcha, K., Viennasay, B., Phesatcha, B., Ampapon, T., Kang, S. (2018). Strategic supplementation of cassava top silage to enhance rumen fermentation and milk production in lactating dairy cows in the tropics. Trop. Anim. Health Prod. 50 (7): 1539–1546. https://doi.org/10.1007/s11250-018-1593-8.

Widyobroto, B. P., Rochijan, Ismaya, Adiarto, & Suranindyah, Y. Y. (2016). The impact of balanced energy and protein supplementation to milk production and quality in early lactating dairy cows. *Journal of the Indonesian Tropical Animal Agriculture*, *41*(2), 83–90. https://doi.org/10.14710/jitaa.41.2.83-90

Zahera, R., Permana, I. G., & Despal. (2015). Utilization of mungbean's green house fodder and silage in the ration for lactating dairy cows. *Media Peternakan*, *38*(2), 123–131. https://doi.org/10.5398/medpet.2015.38.2.123