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EFFECT OF FEED FEEDING ON MILK PRODUCTION AND QUALITY IN A MIXED BREED OF HOLSTEIN FRIESIAN COWS IN INDONESIA- A REVIEW

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ABSTRACT: Cultivation of tropical alfalfa (*Medicago sativa* L.), or lucerne provides breeders with a high-quality feed, leading to significant improvement in the condition and health of livestock and an increase in the production of meat, milk, and eggs. This review will be very important source of information not only for researchers but also for businessman who have a concern to develop alfalfa tropic either for feed or food (growth characteristic, function and nutrient content).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 cakel, 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 wit 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. 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. This study aimed to determine the effect of concentrate to forage ratio (C/F) on milk urea nitrogen (MUN), milk production, and reproductive performance of dairy cows of smallholder farmers of Tani Wilis cooperative in Sendang, Tulungagung, Indonesia. A survey was conducted to identify productive cows based on records from the cooperative. Sampling was conducted twice. First sampling was based on reproductive efficiency and milk production criteria. Data on age, parity, postpartum lactation, milk production, reproductive efficiency, body condition score, weight, and feed measurements (forage and concentrates) were obtained from 60 productive cows. Second sampling selected 26 dairy cows with normal estrous cycle. These cows were then allocated into two groups based on their C/F. Their milk and feed were sampled to measure MUN and conduct proximate analysis, respectively. T-test showed that cows that received dietary intake with C/F >30% showed higher ($P<0.05$) MUN, milk production and reproductive performance than those with C/F <30%.

Key words: Elephant grass (*Pennisetum purpureum*), Alfalfa (*Medicago sativa* L.), Milk urea nitrogen, Friesian Holstein (FH) and Indonesia

INTRODUCTION

Global production of cow milk in 2019 amounted to almost 716 million tonnes and was 36 times higher than production of goat's milk and nearly 68 times higher than production of sheep's milk. Since 2000, global production of cow milk has increased by over 46%. Europe remains the largest producer of this raw material. However, its percentage in world

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production decreased by almost 11 p.p. to 31.5%, mainly due to a small increase in production (8.6%) compared to other parts of the world, such as Asia (133%). Due to the 12.5% increase in the production of cow milk in the EU28, milk production in these countries has increased its share of production in Europe (by 2.5 p.p. to 74.5%), while the role of the EU globally has decreased (by 7 p.p. to 23.5%) (**Brodziac, 2021**).

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. It's 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. Most Indonesian dairy cattle are Friesian Holstein (FH), imported from European nations with a temperate environment with low temperatures in the range of 5°C–25°C. Indonesia has a tropical climate with a high ambient temperature that can reach 34°C during the day and the local relative humidity varies between 70% and 90%. Temperature and humidity are two microenvironment factors that may impact the production and heat release in FH cattle. More than 98% of the entire dairy cattle population in Indonesia is found on Java Island. On Java Island, there are between 534.22 and 543.55 thousand heads of cattle, while the dairy cattle population outside Java Island is just 6.59 thousand heads of cattle. The milk output climbs by an average of 3.34% per year, or approximately 909.64 thousand tons and the average annual growth in whole milk consumption was 0.19 L/capita. Indonesian cow milk output has been unable to keep pace with the country's increasing demand.

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 **(Ako *et al*., 2023)**.

Nutritional management plays a very important role in cow farming, especially in dairy cows. Feeding should contain all the nutrients needed by the livestock, including carbohydrates, fats, proteins, vitamins, water and minerals, as well as inorganic elements. However, these have to be given in balanced amounts. Balanced and adequate amount of feed, as needed, will result in optimal production and reproductive efficiency. In particular, high protein content feeding can stimulate high milk production, so that an increase in the concentration of feed protein corresponds to a proportional increase in milk production (**Tyasi *et al*., 2015; Alstrup *et al*., 2016**). The current study aims to find out the best feed feeding on milk production and quality in a mixed breed of Holstein Friesian cows in Indonesia or most appropriate green fodder, whether it is alone or loaded with other types of leguminous or grassy fodder crops, concentrated feed additives, or the use of silage that should be used to produce high quantities of cow's milk, as well as quality in Indonesia.

Methodology

Information and data were obtained from published research papers, databases, statistics and reports. In the search for previous studies, several keywords and database sources were used. Studies were searched using the first category (X variable) keyword sets (tropical alfalfa in Indonesia, feeding various forages, grazing and green forage feeding, hay feeding, silage feeding, maize silage feeding, legume and grass silages feeding, Effect of Diet, Type of Forage, Oilseeds, Concentrate To Forage Ratio, Cows fed hydroponic fodder and conventional diet, nutritional value of milk, feeding system, feeding regimen, Milk Production System, Fermented Complete Feed Making (variable Y) (fatty acid composition of milk fat, Major fatty acids in bovine milk fat, milk fatty acid composition in cow's milk, Indices for Evaluation of Milk Fat Quality, Milk Faty Acid Profile and Human Health, Milk Urea Nitrogen, Milk Production and Reproductive Performance of Dairy Cows, milk quality, Milk fat, fat content of cow's milk, Milk protein, cow's milk proteins, micronutrients and lactose content in cow's milk, organoleptic properties and volatile organic compounds, Cow's milk, Milk Yield, Hygienic Quality, Somatic Cell Count, Microbiological Quality, Physicochemical Quality), and category III (the place of study) (Indonesia as an Asian country. Google Scholar Database sources, Web of Science, Science Direct, and JSTOR Search were used as search platforms.

Alfalfa is popularly known as the "Queen of Forages" towing to its high forage yield and nutrient quality content. The alfalfa plant is native to the Mediterranean mountainous areas and was brought to other countries, such as Indonesia, for cultivation. Tropical alfalfa is cultivated in tropical areas for its superior nutrient and crude protein content, secondary metabolic content, amino acid content, and macro and micro mineral content. The plant can be used as forage to increase the production of meat, milk, and eggs. Additionally, the cultivation of tropical alfalfa provides breeders with high-quality feed, leading to a significant improvement in livestock production.

Biological Characteristics of Alfalfa

Alfalfa has a high nutrient content that includes Ca, chlorophyll, carotene, and vitamin K (**Suwignyo *et al*., 2020b**), and contains several bioactive materials such as saponins, sterols, flavonoids, cumarins, alkaloids, vitamins, amino acids, sugars, proteins, and minerals. Additionally, alfalfa contains large quantities of dietary fiber, which could help to lower cholesterol levels. The use of tropical alfalfa (Kacang Ratu BW) in ducks (35 days) from 3% up to a level of 10% did not affect the production performance of ducks, but reduced FCR, reduced cholesterol from 66.5 to 34.8 mg/ 100 g (**Samur *et al*., 2020**) from 177.7 to 116.2 mg/100g (in the liver), 162.9 to 134 mg/100 (in the blood) and reduced LDL from 83.70 to 68.0 mg/dL but increased HDL from 54.6 to 71.96 mg/dL (**Suwignyo *et al*., 2022**). The use of 2% tropical alfalfa in laying hens (hyline 50 weeks old) produced eggs with higher levels of Fe, Zn, beta carotene, vitamin A and antioxidants than controls, respectively 5.6 vs 4.9 mg/100 g, 3.4 vs 1 mg/100 g, 1818.1 vs 1512.7 µg/100 g, 4934.9 vs 4382.9 µg/100 g, 4.9 vs 15.8%, making it good for nutritional intervention for stunting eradication programs, that are still high in several developing countries, including Indonesia.

The Nutrient Content of Alfalfa

The protein content of alfalfa can reach up to 29%; further, the proximate composition of alfalfa is as follows: dry content (DC), 19%; organic matter, (OM), 88%; crude fat (EE), 10%; and crude fiber (CF), 31% (**Hermanto *et al*., 2017**). Research has been carried out on three varieties of alfalfa, namely Multiking 1, Vernal, and Common. The highest crude fat content was observed in the Common varietal (2.49%), whereas the lowest crude fiber content was observed in the Vernal varietal (26.22%), which also had the highest ash content (12.46%). The highest water content was observed in the Multiking 1 varietal (69.62%). The crude protein (CP) content found in the Common varietal was 20.61%. The nutrient content of alfalfa during the first regrowth under different photoperiods with respect to the control (100% soil) was as follows: DM (18.55%), OM (87.95%), CP (28.5%), and CF (8.5%) (**Suwignyo *et al*., 2020c**). The nutrient content of alfalfa in the second regrowth under different photoperiods was as follows: DM (17.31%) and OM (87.41%) (**Suwignyo *et al*., 2020c**). Alfalfa is considered a good forage crop owing to its high adaptability, production potential, and quality as feed fodder. Furthermore, it is high in protein, Ca, and fiber. The average values of the various nutrients found in alfalfa (summarized from several sources) are shown in Tables 1 and 2.

Alfalfa has higher crude fiber content than other leguminous plants; this has a significant impact on the digestibility of feed by livestock. The nutrient contents of alfalfa ranged from 16.0 to 29.1% (CP), 40.45–44.9% (NDF), and 16.2–25.4% (ADF), respectively (**Sajimin and Purwantari, 2011**). It was found that the type of growth media does not significantly affect the

Table 1. Nutrient content of Tropical Alfalfa

Nutrient	Average value (%)
Dry matter (DM)	17.7–21.2
Organic matter (OM)	87.72 + 3.55
Crude protein	15.3–32.27
Crude fiber	25.47 + 4.01
Extract ether	8.21 + 1.54
Nitrogen free extract	39.18 + 1.43
Total Digestible Nutrient	56.27 + 1.90
DM In vitro digestibility	68.78 + 5.97
DM In vitro digestibility	67.30 + 5.09
DM In vitro (HCL) digestibility	21.61 + 0.54
DM In vitro (HCL) digestibility	26.43 + 0.40
L-Lysine	0.52–0.58
L-Leucine	1.02–1.29
L-Isoleucine	0.82–0.91
L-Methionine	0.09–0.14
L-Glycine	0.66–0.87
L-Valine	0.96–1.08

Source: Suwignyo *et al.* (2023).

Table 2. Macro-Micro Nutrient others Concern of Tropical Alfalfa

Macro-Micro Nutrient	Average value
DPPH	9.19–11.98%
Ca	0.46–0.9%
P	0.19–0.33%
Na	0.07–0.12%
Fe	309.46–426.2 mg kg^{-1}
Zn	22.9–68.0 mg kg^{-1}
K	2.85%
Total Flavonoids	1.99%
Saponins	5.1%
Tannins	4.28%
Total Fenol	3.9%
Chlorofil	0.81–1.00 mg g^{-1}
Mature Leaf color	RHS Green group N 137 A
Young Leaf color	RHS Green group N 138 A
Flower color	RHS Purple Violet Group N 81 A
Young podd color	RHS Yellow green group 144C
Mature podd color	RHS Grey Brown group N 199 D

Source: Suwignyo *et al.* (2023).

quality of CP and CF, or the digestibility of dry and organic matter obtained during the first harvest of green alfalfa.

The leaves of alfalfa have high protein and fiber contents and can be used as green forage and supplements for ruminant livestock, as well as for non-ruminants, including poultry. **Suwignyo *et al.* (2020b)** have showed that supplementation with fresh and hay alfalfa in the diet of hybrid ducks has a significant impact on feed consumption, feed conversion ratio (FCR), and body weight (BW). When compared to the control diet (basal diet without alfalfa supplementation), supplementation with 6% fresh alfalfa increased the feed consumption of hybrid ducks in weeks 2, 3, and 4 more than when they were supplemented with hay alfalfa; this might be due to increased palatability of the fresh alfalfa feed. Bodyweight and FCR significantly increased in the second, third, and fourth weeks 4th, respectively. These increases in body weight and FCR of hybrid ducks occurred due to increased feed intake following supplementation with 6% fresh alfalfa.

Furthermore, the same study found that supplementation with fresh and hay alfalfa also had a significant impact on meat quality (**Suwignyo *et al*., 2020a, 2020b, 2020c, 2020d**). The isoenergy and isoprotein rations do did not have any significant impact on the live and carcass weights of hybrid ducks. Additionally, supplementation with fresh and hay alfalfa could reduce the cost of feed. Higher income was generated from the ducks (live and carcass) supplemented exclusively with 6% alfalfa, followed by those supplemented with both 6% fresh alfalfa and the control diet. The study by **Samur *et al*. (2020)** on the supplementation with alfalfa in different basal rations showed that by supplementing commercial and alternative feeds with 10% fresh alfalfa had a significant impact on feed consumption, BW, and FCR. The commercial feed supplemented with 10% alfalfa resulted in the highest feed consumption, BW, and FCR. Furthermore, **Addini *et al*. (2020)** have reported that supplementation with 5% alfalfa in commercial rations resulted in the best physical and chemical meat quality.

Therefore, the 26 dairy cows can represent the population. Farmers of Tani Wilis cooperative feed their dairy cows similarly, with elephant grass planted around the cage. This forage and concentrate, produced by the cooperative, contains 16-18% protein (Table 3).

Fatty Acids in Fresh and Preserved Forages

The usual total FA content in different forages is in the range of 20–50 g/kg dry matter (DM). This is a relatively low level; however, forages have often been the major and also the cheapest and safest source of FAs in ruminant diets. Fatty acid content and composition are affected by numerous factors such as plant species and variety, climate, day length, rainfall, fertilization and stage of growth. The highest level is in young plants at the first cut, and then it decreases during summer, particularly around flowering. Such level and trends were reported by **Van Ranst (2009a)**.

On the contrary, **Boufaied *et al*. (2003a)** have observed a higher content of linoleic, ALA and total fatty acids in cocksfoot (*Dactylis glomerata*) and timothy (*Phleum pratense*) in summer regrowth than in spring cut. Similarly, **Lee *et al.* (2006)** have reported a higher concentration of ALA in cocksfoot, timothy and red clover (*Trifolium pra-tense*) in summer regrowth, while there were comparable levels in lucerne (*Medicago sativa*) from both cuts. A progressive increase in total FAs and in the proportion of ALA was observed in the stay-green trait of perennial ryegrass (*Lolium perenne*) from early to late season.

Studying changes in the content of three UFAs (oleic, linoleic and ALA acids), **Mir *et al*. (2006)** have reported a higher availability in young plants of cocksfoot and perennial ryegrass as compared with tall fescue (*Festuca arundinacea*). However, dry matter yields of both former grasses were too low in that period.

ALA is the prevailing acid with the usual proportion of about 50–60% in total FAs, followed by palmitic and linoleic acids. Red clover and white clover (*Trifolium repens*) seem to have a higher total level of FAs than grasses. Low content of ALA of about 6 g/kg DM was determined in lucerne. The proportion of ALA 64.7, 56.3 and 53.3% in total FAs decreased in the order red clover, white clover and lucerne, respectively. In other forage legumes, common

Table 3. Proximate analysis of elephant grass, protein contents and total digestible nutrient of concentrate used by farmers in Tani Wilis cooperative, Sendang, Tulungagung

Feed composition	Content
Elephant grass (*Pennisetum purpureum*)	
Moisture content (%)	74.11
Dry matter (%)	25.89
Crude protein	2.64
Crude fat	0.67
Rough fiber	8.21
Ash	3.19
Calcium	0.19
Phosphorus	0.05
Gross energy (cal/gram)	1157
Concentrate (%)	
Protein	16-18
Total digestible nutrient	69-70

Source: Utama *et al*. (2018).

vetch (*Vicia sativa*), hairy vetch (*V. villosa*), crimson clover (*Trifolium incarnatum*) and Egyptian clover (*T. alexandrinum*), FA profiles were affected mainly by forage species and phenological stage, however, numerous interactions among these factors occurred. Linoleic acid content and proportion increased considerably from vegetative to reproductive stage, whereas ALA decreased to a lower extent. During this period, the ratio of SFAs: UFAs increased (**Cabiddu *et al*., 2009**).

Also in sunflower (*Helianthus annuus*) forage PUFAs accounted for 81–75% of total FAs during the growth cycle. Major FAs were ALA, linoleic, palmitic and stearidonic acids with 54.9–44.6, 16.4–21.8, 10.0–12.8 and 6.5–8.8% in total FAs, respectively Nitrogen fertilization (120 vs. 0 kg/ha) increased the content of ALA in timothy at all tested maturity stages, while phosphorus (45 vs. 0 kg/ha) had no significant effect. In a report of **Elgersma *et al*. (2005**), nitrogen application (45 or 100 vs. 0 kg/ha) significantly increased the content of all five determined FAs (palmitic, palmitoleic, oleic, linoleic and ALA) in perennial ryegrass, however, the composition of the acids was not affected. Moreover, a strong positive linear correlation was found between the content of total FAs or ALA with the crude protein content of herbage. The highest FA contents were determined in perennial ryegrass which was applied high rates of nitrogen and the herbage of which was harvested after short regrowth intervals.

According to **Dewhurst *et al*. (2003c**), forage breeding to increase the supply of beneficial FA from plants into ruminant products is an important long-term strategy. However, the situation is complicated by the large genotype × management interactions, as was recently reported by **Palladino *et al*. (2009**) for perennial ryegrass.

Plant lipids are mainly associated with the thylakoid membranes of chloroplasts. An alternative strategy for reducing losses is to produce more resilient chloroplasts, e.g. “stay-green” varieties. Only a small reduction in losses of FAs during wilting for 48 h was found in stay-green perennial ryegrass as compared with normal herbage (**Dewhurst *et al*., 2002**). Overall data on the FA composition in hay and silage are given in Table 4.

Effects of grazing and green forage feeding

As reviewed by **Martin *et al*. (2009**), numerous papers reported considerable differences in the sensorial and nutritional characteristics of milk and dairy products from cows grazed, especially in spring, or fed hay or grass silage. Data on the content of selected FAs in milk fat of cows either grazed or fed fresh forages are given in Table 5. However, such data should be assessed with caution, because of numerous further factors affecting the fatty acid profile of milk fat. As can be deduced from Tables 5 and 6, green fodder causes a decrease in the proportion of SFAs, mainly of palmitic acid, and

Table 4. Total content (g/kg dry matter) and composition (g/100 g total fatty acids) of major fatty acids in hay and silage

Forage	Fatty acid						Country
	total	palmitic	stearic	oleic	linoleic	α-linolenic	
Hay							
Cocksfoot	1.8	24.1	2.8	3.4	15.5	35.0	France
	–	23.7	4.5	4.4	16.8	27.4	Australia
Lucerne	–	37.1	6.6	3.1	10.1	0.4	USA
	1.1	30.0	6.0	8.0	24.4	23.2	USA
Mountain grassland	3.0	19.2	1.5	2.3	16.2	50.4	France
Perennial ryegrass	3.2	15.8	1.8	2.0	14.0	55.9	France
Silage							
Maize	4.0	15.6	2.4	23.7	48.6	3.4	France
	–	29.5	3.5	4.0	18.7	4.9	USA
Perennial ryegrass	1.2	16.6	2.9	18.8	48.5	11.1	USA
	3.7	21.2	2.0	2.8	13.4	52.2	France

Source: Kalač and Samková (2010).

Table 5. The mean proportion of selected fatty acids (g/100 g of total fatty acids) and the ratio of saturated to unsaturated fatty acids (S/U) in milk fat from cows grazed or fed fresh herbage (adapted from Samková *et al.*, 2008)

Botanical composition[1]	Fatty acid						S/U
	Palmitic	Oleic	Vaccenic	Linoleic	A-Linolenic	Rumenic	
Perennial ryegrass (76), weeds (17)	24.0	21.3	2.89	0.58	0.90	1.21	2.09
Perennial ryegrass (51), white clover (19), weeds (19)	27.5	19.9	3.54	0.75	0.65	1.44	2.11
Perennial ryegrass (68), *Poaceae* spp. (28), white clover (2), weeds (3)	27.6	21.6	3.93	0.73	0.95	1.84	1.80
Perennial ryegrass, white clover	24.1	21.12	4.70	1.26	0.70	1.65	1.81
Perennial ryegrass (75), white clover (4), *Poaceae* spp. (2)	26.5	18.4	4.16	1.28	1.05	1.87	1.89
Perennial ryegrass (76), smooth meadow-grass/*Poapratensis* (14), white clover (5), weeds (5)	26.0	23.9	3.06	1.05	0.63	1.43	1.69
Perennial ryegrass (60), white clover (40)	26.8	22.2	2.72	1.59	1.09	1.27	1.74
Perennial ryegrass (60), red clover (40)	28.0	20.0	3.573	1.46	0.92	1.23	1.95
***Poaceae* spp. (77), clovers (6) (19 species)**	25.3	18.3	4.013	0.94	0.70	1.714	2.19
***Poaceae* spp. (36), clovers (23) (71 species)**	25.4	24.1	3.123	1.57	1.15	1.344	1.65
***Poaceae* spp. (50) (32 species)**	26.2	22.9	2.72	1.16	0.84	1.26	2.01
Smooth bromegrass/*Bromus inermis* (50), cocksfoot (33), smooth meadow-grass (7)	23.8	31.9	3.37	2.35	1.14	1.35	1.18
Lucerne (50), red clover (20), fescue (20), weeds (10)	23.3	25.4	3.39	1.93	0.59	1.12	1.34

[1]numbers in brackets mean the weight percentage of a species **(in dry matter except Leiber *et al.*, 2005)**; [2]sum of 9-*cis* and 13-*trans*-C18:1;

Table 6. The mean proportion of selected fatty acids (g/100 g of total fatty acids) and the ratio of saturated to unsaturated fatty acids (S/U) in milk fat from cows fed various silages and hay (adapted from Samková *et al*., 2008)

Silage composition[1] and proportion[2]		Fatty acid						S/U
		palmitic	oleic	vaccenic	linoleic	α-linolenic	rumenic	
One-species								
Lucerne	**50**	29.2	20.9	1.48	2.48	0.63	0.69	1.95
	83	31.0	19.43	0.85	1.55	0.22	0.48	2.50
	86	31.0	16.7	1.04	1.46	0.24	0.66	3.30
Maize	**50**	32.6	18.5	0.50	2.73	0.23	0.37	2.07
	50	32.9	16.34	0.94	2.30	0.24	0.54	2.98
	87	32.1	16.0	0.87	1.09	0.94	0.46	3.48
Perennial ryegrass	***ad libitum***	29.7	19.2	1.926	1.52	0.90	0.82	2.25
	ad libitum	38.5	21.5	–	1.00	0.56	0.45	–
	83	31.8	20.05	1.31	1.47	1.51	0.42	2.72
Red clover	***ad libitum***	26.3	18.7	0.91	1.73	1.11	0.39	2.14
	ad libitum	36.5	24.7	–	1.63	1.49	0.39	–
White clover	**70**	32.9	17.95	1.06	1.54	0.96	0.34	3.14

Table 6. Cont.

Mixed forages								
Maize silage/lucerne hay (50/50)	50	28.6	17.8	1.12	2.85	0.67	0.55	2.30
Maize silage/lucerne hay (60/40)	51	27.1	22.6	1.41	2.73	0.29	0.53	–
Maize silage/perennial ryegrass/hay (48/41/11)	65	31.9	23.0	1.61	1.68	0.32	0.71	1.86
Ryegrass (3 species)	80	34.3	19.05	1.16	0.90	0.48	0.37	3.08
Ryegrass (3 species)/red clover (50/50)	81	34.4	19.65	1.38	1.08	0.77	0.45	2.86
Perennial ryegrass/red clover (60/40)	*ad libitum*	31.3	17.1	1.786	1.43	1.04	0.71	2.57
Perennial ryegrass/white clover (60/40)	*ad libitum*	23.1	16.7	1.556	1.43	1.14	0.66	2.62
Timothy/meadow fescue	62	34.2	15.0	–	0.95	0.36	0.44	2.97
Timothy/meadow fescue	*ad libitum*	28.8	16.7	1.00	1.28	0.39	0.40	2.56
Hay								
Ryegrass hay	90	30.2	15.4	1.83	1.00	1.02	0.87	3.26
Mountain grassland hay	87	28.6	16.0	1.36	1.08	1.25	0.71	3.26

[1]numbers in brackets mean the weight percentage of a forage; [2](%) of dry matter in a diet; [3]sum of 9-*cis* and 13-*trans*-C18:1; [4]sum of 9-*cis* and 15-*trans*-C18:1; [5]sum of 9-*cis* and 11-*cis*-C18:1; [6]sum of 10-*trans* and 11-*trans*-C18:1.

an increase in vaccenic and rumenic acid content as compared with silage feeding. Nevertheless, the proportion of linoleic acid seems to be higher in the milk fat of cows fed maize silage than of grazed cows.

A negligible effect of grazing vs. barn feeding freshly cut grass sward was reported by **Leiber *et al*. (2005**). Have tested four isoenergetic diets with an increasing proportion of fresh perennial ryegrass to replace maize silage (0, 30, 60 and 100% dry matter of forage). The increasing proportion of fresh grass in the diet induced a linear decrease in milk fat content and a linear increase in UFA percentages at the expense of SFAs.

[3]sum of 10-*trans* and 11-*trans*-C18:1;[4]sum of 9-*cis*, 11-*trans*, 8-*trans*, 10-*cis* and 7-*trans*, 9-*cis*-C18:2.

The respective relationships were +0.38, +0.12, +0.05 and –0.69 points per 10% of fresh grass in the diet for vaccenic, rumenic, ALA and palmitic acid. Grazing or feeding of floristically diversified swards results in the production of milk fat richer in ALA and CLA (**Martin *et al*., 2009**), e.g. in Alpine milk (**Chion *et al.,* 2010**). The increased content and proportion of CLA and vaccenic acid were observed in milk fat from high altitudes (above 900 m) as compared to that from upland (600–650 m). This indicates increased biohydrogenation in the rumen probably due to the high content of PUFAs in some fodder species, such as *Leontodon hispidus*, birdsfoot trefoil (*Lotus corniculatus* and *alpina*) and red clover Only three CLA isomers (rumenic acid, *trans*-11, *cis*-13 and *trans*-8, c*is*-10), particularly the isomer *trans*-11, *cis*-13, in milk fat showed a linear increase with elevated pasture altitudes (between 600 and 2 120 m). Changes in stearic, linoleic, vaccenic acids and CLA were reported also during transhumance of cows among Alpine pastures (1 400–2 200 m) in the grazing period.

Proportions of myristic and palmitic acids were significantly lower and those of stearic, oleic, linoleic and ALA acids were higher in the milk fat of cows fed fresh lucerne compared with those fed lucerne silage. Transition from a fresh grass diet on pasture to a winter diet of mixed grass/maize silage altered the milk FA composition within two days. Most changes took place within four days after the transition. The nutritional FA profile worsened. The proportions of myristic and palmitic acids increased, while those of stearic, oleic, rumenic acids and CLA declined

There exists a general agreement that grazing or feeding of fresh forages produces milk fat with the nutritionally beneficial FA profile as compared with hay or silage.

Effects of hay feeding

Data on hay effects on the milk fat profile have been scarce as compared with fresh forage or silage. Hay or straw supplements as fibre sources to grazing cows in early lactation had a low effect on the milk FA composition. In spite of lower intakes of linoleic acid and ALA, their contents were higher in the milk fat of cows fed hay than in that of cows fed silages prepared from the primary growth of mixed timothy and meadow fescue (*Festuca pratensis*). The forage conservation method had no clear effect on milk *trans*-18:1 acids or CLA contents (**Shingfield *et al*., 2005b**). Comparing two diets with about one half of dry matter offered from meadow hay or from maize silage, **Staszak (2007**) have observed a higher level of linoleic acid, CLA, ALA and total unsaturated acids in milk fat from cows fed hay.

Effects of Silage Feeding

Overall data are given in Table 5. Comparing the values with data in Table 4 on fresh forages, some differences are apparent. Milk fat of cows fed silages has a higher ratio of SFAs:UFAs and a higher palmitic acid proportion, whereas the proportion of beneficial vaccenic and rumenic acids is lower. Extensive lipolysis during forage ensiling can be among the causes of these differences. Similarly like in fresh grass, feeding grass silage from semi-natural grasslands increases CLA content in milk due to reduced biohydrogenation in the rumen as compared with silage from intensively managed grasslands (**Lourenço *et al.,* 2005**).

The evaluation of the reported data is complicated by numerous interactions between the type of silage and other factors (mainly the proportion and type of a concentrate) affecting the milk fat composition. In most articles, the effects of two or more silages prepared from different forages on the milk fatty acid composition were compared. Grass silages were usually compared with silages of other forages.

Effects of Maize Silage Feeding

Maize silage is the main component of diet for winter feeding, and also for year-round feeding in some management systems. The following reports compared the effects of maize silage with grass silage feeding. The proportions of saturated FA in total FAs in milk fat were 67.6% and 62.9% and those of PUFA 3.6% and 4.7% following feeding maize and grass silages, respectively (**Samková *et al*., 2009**).

A similar trend of SFAs (mainly of lauric and myristic acids) and PUFAs was reported by **Shingfield *et al*. (2005a**).

While the former authors found a significant difference in CLA content (0.48% and 0.92% after feeding maize and grass silage, respectively), the latter ones did not find any significant effect of silage type on total CLA and rumenic acid proportions. However, in a report of **Nielsen *et al.* (2006**), maize silage diets resulted in a higher content of CLA isomers as compared with diets based on grass silage, but there was a significant interaction between the silage type and concentrate level for the content of rumenic acid, *trans*-10, *cis*-12-CLA, vaccenic acid and *trans*-10-C18:1 acid.

The authors thus suggested that the high levels of grain did not significantly alter the pattern of PUFA biohydrogenation in the rumen, content of CLA and *trans*-C18:1 isomers in milk fat unless combined with forage naturally high in starch and linoleic acid such as maize silage. Similar results, i.e. an increase in rumenic acid and *trans*-10, *cis*-12-CLA in milk fat following maize silage feeding compared to grass silage feeding, were reported by **Norgaard *et al.* (2008)**.

Effects of Feeding Legume and Grass Silages

Two papers comparing the effects of red clover silage and silage from a mixture of timothy and meadow fescue or of perennial ryegrass silage (**Moorby *et al*., 2009**) have reported the increasing proportion of MUFA and PUFA at the expense of capric, lauric, myristic and palmitic acids in milk fat following red clover silage feeding. The effect on an increase in beneficial PUFAs in milk fat was higher in red clover silage prepared from forage cut at an early stage than at a late stage of growth. These changes could be partially explained by polyphenol oxidase activity in red clover silage. Feeding perennial ryegrass silage or mixtures of this silage with red clover or white clover silages (both at 60:40 ratio based on DM basis), **Van Dorland *et al.* (2008)** observed an increased proportion of n-3 FAs but reduced proportions of CLA including rumenic acid and of *cis*-C18:1 isomers in milk fat of dairy cows fed the variants with clovers. The lowest n-6:n-3 ratio was in milk fat of cows fed perennial ryegrass silage. Silages prepared from a sward of timothy and meadow fescue in three variants (no additive; formic acid+ phosphoric acid; inoculant of lactic acid bacteria + cellulase and hemicellulase) did not cause any clear differences in CLA and *trans*-C18:1 acids. Thus the feeding of ensiled forage legumes seems to have similar effects on UFA proportion in milk fat as the feeding of fresh legumes.

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 7.

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. 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, (**Ako, 2019**) stated that green biomass is a high protein source which is very potential as a basal diet.

Table 7. 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*
DM intake, kg/d					
Elephant grass	7.50	6.59	7.50	0.48	0.13
Supplement	6.92	6.95	7.00	0.06	0.54
Total DM	14.42	13.54	14.50	0.47	0.12
Milk yield, kg/d	10.44	11.32	12.26	0.93	0.19

Source: Ako *et al*. (2023).

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 8.

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 have 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.

Milk Urea Nitrogen

The response on high protein feeding in dairy cows depends on renal physiology. Kidneys with physiological disorders will produce high levels of BUN, where BUN level will have a linear relationship with MUN level. In Holstein dairy cows, BUN concentration is one way of measuring glomerulus filtration rate (GFR) (**Murayama *et al*., 2013**). The data in this study showed that if the MUN levels were differentiated by mean values (12 mg/dl) based on C/F >30%, more dairy cows (55.56%) receiving C/F >30% tend to have MUN levels over 12 mg/dl.

On the contrary, in dairy cows receiving C/F <30%, there were more dairy cattle (78.57%) with MUN <12 mg/dl. In dairy cows given higher C/F intake, MUN levels tend to increase. However, in dairy cows that were fed both high and low C/F, cows manifested high and low MUN levels. The average MUN level in dairy cows with C/F >30% is 1.7 (15.68/ 9.17) times greater (P<0.05) than in dairy cattle with C/F <30%. The range of nitrogen urea levels in cows is 8 to 25 mg/dl (**Rukkwamsuk, 2011**).

In multiparous cows, urea level is strongly associated with BCS but not with milk production (**Wathes *et al*., 2007**). The response to high protein feeding in dairy cows depends on renal physiology. Kidneys with physiological disorders will produce high levels of BUN, where the level of BUN is highly correlated with MUN level.

The end product of protein metabolism in the body of ruminants is urea, which then circulates in the bloodstream (Butler, 2005), and passively diffuses in the body's organs and fluids as BUN and MUN. These two parameters are positively correlated and have balanced concentration in a cow's body (**Fallahnezhad-Anarjan and Moghaddam, 2016**). MUN or BUN level indicates the nutritional status and health of dairy cattle (**Roy *et al*., 2011**). High BUN levels indicate inefficient N intake in the body for both growth and milk production (**Huhtanen *et al*., 2015**).

Table 8. Effects of leaf meal in the supplement on the contents of CP, fat, lactose, Ca and P of cow milk

Parameters,%	CTL	LM25	LM50	SEM	*p*
Crude protein	2.67	2.41	2.69	0.12	0.09
Fat	2.93[a]	2.62[ab]	2.38[b]	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

[ab] Different superscripts in the same row indicate a significant difference ($p < 0.05$)
Source: Ako *et al.* (2023).

Increased protein concentration in the diet is associated with increased levels of nitrogen urea in the body. There is a negative relationship between urea nitrogen concentration and milk production.

The concentration of urea nitrogen (in urine, blood and milk) would increase if the quantity of protein feed (rumen degradable and undegradable proteins) given is high (crude protein content >19%). This will be accompanied by a decreased efficiency in N utilization, thus, increasing the excretion of N (**Hristov *et al*., 2015**).

Balanced feeding in lactating dairy cows showed a median BUN concentration of 14-16 mg/dl. The S/C value was influenced by the high concentration of BUN (**Noordhuizen, 2012**), but insemination frequencies were not affected by urea nitrogen concentration.

Nitrogen urea concentrations in dairy cows might be influenced by protein feeding and the efficiency of N utilization for milk production (**Huhtanen *et al*., 2015**), but cows with urea nitrogen concentration below 12 mg/dl might be deficient in protein feed. MUN levels depend on cattle nutrition, season, and genotype, but lactation is generally unimportant. Daily milk production and the highest total solid percentage were achieved in CI between 351-450 days compared to less than 350 days or more than 450 days (**Baul *et al*., 2013**).

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أثر التغذية بالاعلاف على انتاج الحليب وجودته فى سـلالة مختلطة من الأبقـار الهـولشتاين الفـريـزيـان فــى اندونيسيا – دراســة مرجعية

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إن زراعة البرسيم الاستوائي أو البرسيم الحجازي يوفر للمربين علفًا عالي الجودة، مما يؤدي إلى تحسن كبير في حالة وصحة الماشية وزيادة إنتاج اللحوم والحليب والبيض. ستكون هذه المراجعة مصدرًا مهمًا جدًا للمعلومات ليس فقط للباحثين ولكن أيضًا لرجال الأعمال الذين لديهم اهتمام بتطوير البرسيم الاستوائي إما للأعلاف أو للطعام (خصائص النمو والوظيفة ومحتوى المغذيات). تتكون مكملات دقيق الأوراق المستخدمة كعلف من عشبة الفيل ودقيق أوراق Leucaena والتوت، والتي تحل جزئيًا محل نخالة الأرز وكعكة جوز الهند ودقيق السمك وبشرة الذرة والدبس والمعادن. لم يكن لتغذية الأبقار الحلوب بوجبة الأوراق أي تأثير على إجمالي تناول المادة الجافة. ومع ذلك، كان هناك زيادة خطية في إنتاج الحليب، وانخفاض في دهن الحليب، مع زيادة مستوى وجبة الأوراق في النظام الغذائي. أدى استبدال 50% من مكمل المركز بوجبات أوراق من التوت، والغليريسيديا، واللوسينا إلى زيادة إنتاج الحليب بنسبة 20% دون زيادة إجمالي تناول المادة الجافة. ومع ذلك، انخفض محتوى الدهون في الحليب عن طريق تضمين وجبة الأوراق في النظام الغذائي. هدفت هذه الدراسة إلى تحديد تأثير نسبة المركز إلى العلف (C/F) على نيتروجين اليوريا في الحليب (MUN) ، وإنتاج الحليب، والأداء التناسلي للأبقار الحلوب للمزارعين الصغار في تعاونية تاني ويليس في سيندانج، تولونجاجونج، إندونيسيا. تم إجراء مسح لتحديد الأبقار المنتجة بناءً على السجلات من التعاونية. تم أخذ العينات مرتين. استند أخذ العينات الأول إلى معايير الكفاءة الإنجابية وإنتاج الحليب. تم الحصول على بيانات عن العمر والولادة والرضاعة بعد الولادة وإنتاج الحليب والكفاءة الإنجابية ودرجة حالة الجسم والوزن وقياسات الأعلاف (العلف والمركزات) من 60 بقرة منتجة. تم اختيار العينة الثانية 26 بقرة حلوب بدورة شبق طبيعية. ثم تم تقسيم هذه الأبقار إلى مجموعتين بناءً على .C / F تم أخذ عينات من حليبها وعلفها لقياس MUN وإجراء تحليل تقريبي على التوالي. أظهر اختبار T أن الأبقار التي تلقت مدخولًا غذائيًا مع C 30 < F /% أظهرت MUN وإنتاج حليب وأداء إنجابي أعلى (P <0.05) من تلك التي تحتوي على30> C / F %.

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