Effect of feeding fractionated RBD palm stearin on milk yield and quality of dairy cattle

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Abstract

Energy intake of dairy cows is important during the peak of milk production to maintain consistency of milk yield. To overcome energy deficiency, diet with high energy density is required for lactating dairy cows which can be enhanced by incorporating fats. Therefore a feeding trial was conducted to determine the effects of supplementing fat with fractionated RBD Palm Stearin on feed consumption, milk yield, composition and fatty acid profile of dairy cows. A total of 35 lactating dairy cows in early and mid-lactating periods were used in this trial. The trial was conducted for 12 wk and individual milk yield was recorded twice daily. Daily milk yield was increased ($p<0.05$) from 8.18 l for diet without fat to 8.42 and 8.32 l of milk yield per day, for inclusion of 5% and 2.5% fractionated RBD Palm Stearin, respectively.

Keywords: fat supplement, dairy cows, palm oil

Introduction

Lactating dairy cows have the most complex nutritional requirements and these requirements change through early, mid and late lactation. Dairy cattle achieve peak milk production in the early lactation period and require more energy intake from their diet. High energy intake is important to meet nutrient and milk production demand as well as to support body weight gain and for body maintenance. Usually, if energy intake is less than energy demand, dairy cattle will start to mobilize their body nutrient reserves, which can result in poor uterine muscular tonicity that can cause parturition difficulties and retention of placenta. Other health problems associated with low energy consumption are undeveloped mammary system that can affect milk production and lead to mastitis problem (Goff and Horst, 1997). To avoid negative energy balance from happening, one method is increasing the energy density of dairy cattle diet by adding rumen bypass fat.

Currently there are four generations of bypass fats used in lactating dairy cattle: first generation fats which are partially hydrogenated fats. Animal or vegetable fats need to be hydrogenated to make them solid so as to increase the level of unsaturated fatty acids however hydrogenation decreases digestibility by 40% or less. Calcium (Ca) salts were the second generation bypass fats. Calcium salts of long-chain fatty acids have been shown to be effective as ruminally inert fat supplements for lactating cattle (Palmquist, 1991). With 84% gross fat they are able to increase energy and improve digestibility compared to the first generation bypass fat, however these fats contain 45% or more unsaturated fatty acids that upset the rumen fermentation, reduce appetite and depress dry matter intake. The third generation of this series were pure fatty acids

with 100% gross fat. The fats are high in saturated, long chain fatty acids and naturally designated to be inert in rumen. The triglycerides or saturated fats are the latest innovation derived from palm oil solely by fractionation process and rich in palmitic acid that contributes to milk fat percentage.

Fractionated refined, bleached and deodorized Palm Stearin (RBD Palm Stearin) is the solid fraction of palm stearin, which is produced by fractionation of palm oil. Fractionated RBD Palm Stearin is higher in saturated fatty acids, 85.7% with higher melting point *(*Norliza *et al.*, 2012). The objective of this study was to determine the effect of feeding fractionated RBD Palm Stearin on milk yield and milk compositions of early and mid-lactating dairy cows.

Materials and Methods

RBD Palm Stearin was obtained from Sime Darby Jomalina Sdn Bhd. RBD Palm Stearin is a solid fraction of RBD Palm Oil which is produced by crystallization of RBD Palm Oil at controlled temperature. Fractionated RBD Palm Stearin have an iodine value of 13 g gI2/100g with 78% palmitic fatty acid and melting point of 60°C. Production of fractionated RBD Palm Stearin was conducted according to Norliza *et al*. (2012).

Feeding trial

Fifteen lactating dairy cows in early and mid-lactating periods were housed in group pens, and were allowed 2 wk to adapt to the experimental condition and diet supplied. The study was conducted at Pusat Ternakan Haiwan Ayer Hitam, Johor. The cows were divided into 3 diet groups where T1 was a control diet (without fat), T2 was formulated with 2.5% fractionated RBD Palm Stearin and T3 was with inclusion of 5% fractionated RBD Palm Stearin. Rations were formulated to be isocaloric and isonitrogenous as shown in Table 1.

The experiment was conducted for 12 wk and the animals were milked twice a day - at 08:00 and 14:00. Daily milk yield was individually recorded. Milk samples from individual cow were collected weekly and subject to laboratory analysis. The milk was analyzed for fat, protein, lactose, solid nonfat (SNF), total solid (TS) and fatty acids content.

Table 1. Feed ingredients composition (%) of dairy cattle diets (as fed basis)

Ingredients, %	T1*	T2*	T3*
Guinea grass	35.00	35.00	35.00
PKE	7.25	20.44	19.06
Corn	15.37	3.62	1.29
Wheat pollard	25.00	25.00	25.00
Rice straw	-	0.50	5.00
Soybean meal	1.14	0.78	4.51
Molasses	1.00	1.00	1.00
DDGS[1]	14.00	10.00	3.00
Fat	-	2.50	5.00
Min-vit premix	0.10	0.10	0.10
Salt	0.05	0.05	0.05
Limestone	1.09	1.01	0.99

*T1 without fat, T2 with 2.5% Fractionated RBD Palm Stearin, T3 with 5% Fractionated RBD Palm Stearin, [1]DDGS: Distiller's dried grains with soluble

Statistical analysis

Data were subjected to one-way analysis of variance (ANOVA).The data are normally distributed and significance of difference between diet means was determined using Tukey Method with 95% confidence. Values are expressed as means ± SD.

Results and Discussion

Nutrient content of diets

The chemical composition of total mixed diets is presented in Table 2. All diet treatments contained similar amount of CP at 13.3% and ME at 10.5% compared to diet requirement at 12.98% CP and 12.49% ME, respectively.

Table 2. Nutrient composition (%) of experimental diets

Composition,%	Diet requirement, %	T1*	T2*	T3*
Crude protein	12.98	13.30	13.30	13.30
ME (MJ/kg)	10.49	10.50	10.50	10.50
Fat	Not Available	3.84	6.70	8.60
Crude fiber	Not Available	17.26	19.43	20.86
Neutral Detergent Fiber ,NDF	Not Available	31.65	41.17	42.69
Calcium	0.49	0.60	0.60	0.60
Phosphorus	0.28	0.57	0.59	0.55

*T1 without fat, T2 with 2.5% Fractionated RBD Palm Stearin, T3 with 5% Fractionated RBD Palm Stearin

Lactation Response

Supplementation of fractionated RBD Palm Stearin into cattle pellet had significant effect ($p<0.05$) on milk production (Table 3). Cows fed diet with 5% Fractionated RBD Palm Stearin showed the highest milk yield compared to other treatments with total production for 3 months was 706 l.

Table 3. Average daily milk yield and total milk yield for 3 months of feeding trial

Diets*	Milk production, l	Total production, l
T1	8.18±0.25	688
T2	8.32±0.39	700
T3	8.42±0.11	706

*T1 without fat, T2 with 2.5% Fractionated RBD Palm Stearin, T3 with 5% Fractionated RBD Palm Stearin

As presented in Table 4, supplementation of RBD Palm Stearin showed a decrease in average daily gain and depressed dry matter intake of the dairy cows. The control treatment with no supplemental fat showed higher daily gain with higher dry matter intake. There was no significant difference among the diets was observed.

Table 4: Average daily gain and dry matter intake of cows fed different levels of RBD Palm Stearin

Diet*	Average daily gain, kg	Dry matter intake, kg
T1	0.44±0.05	9.31±0.42
T2	0.26±0.02	8.74±0.35
T3	0.32±0.03	8.77±0.67

*T1 without fat, T2 with 2.5% Fractionated RBD Palm Stearin, T3 with 5% Fractionated RBD Palm Stearin

Concentration of fat in milk increased significantly ($p<0.05$) with increase of fractionated RBD Palm Stearin added in the diets. On the other hand, protein increased in T2 and decreased in T3 diets. This is in an agreement with Schroeder *et al*.(2004) who reported that feeding high levels of supplemental fat to dairy cattle resulted in depressed concentration of protein in milk due to its effect on dry matter intake and fiber digestion in the rumen.

Table 5. Milk compositions (%) of cows in control and RBD Palm Stearin supplemented diets

Diet*	Fat	Protein	Lactose	Total Solids	Solid Non Fat	Casein
T1	3.79±0.05	3.50±0.09	4.60±0.14	13.35±0.32	9.12±0.19	2.63±0.11[a]
T2	3.82±0.07	3.59±0.08	4.26±0.05	11.87±0.44	8.86±0.22	2.62±0.10[a]
T3	4.84±0.12	3.35±0.08	3.84±0.03	12.68±0.26	8.10±0.34	2.29±0.11[b]

[ab] Values with different superscript are significantly different ($p<0.05$)
*T1 without fat, T2 with 2.5% Fractionated RBD Palm Stearin, T3 with 5% Fractionated RBD Palm Stearin

The FA composition of the milk fat triglycerides changed with the addition of fractionated RBD Palm Stearin to the cows' diet (Table 6). C12:0, C 18:0. C18:1cis and C18:2 decreased, with addition of fractionated RBD Palm Stearin. The C16:0 increased tremendously in the milk triglycerides for cows fed with fractionated RBD Palm Stearin.

Table 6. Milk fatty acid composition (%) of cows in control and RBD Palm Stearin supplemented diets

Diet*	C10:0	C12:0	C14:0	C16:0	C18:0	C18:1t	C18:1c	C18:2
T1	1.89±0.06	6.37±0.09	6.75±0.11	29.95±0.12	10.8±0.19	1.31±0.04[a]	29.30±0.15	6.52±0.13
T2	2.42±0.08	5.84±0.04	9.11±0.16	40.90±0.15	6.73±0.22	1.40±0.02[a]	23.25±0.09[b]	2.52±0.58
T3	1.31±0.03	3.66±0.06	5.39±0.09	48.33±0.36	5.51±0.09	0.80±0.08	24.04±0.17[b]	4.31±0.66

[ab] Mean values with same superscript are not significantly different ($p>0.05$)
*T1 without fat, T2 with 2.5% Fractionated RBD Palm Stearin, T3 with 5% Fractionated RBD Palm Stearin

Conclusion and Recommendation

Supplementing dairy cattle rations with fractionated RBD Palm Stearin shows potential for increasing milk yield, fat content and fatty acid composition. Results from a feeding trial indicated that fractionated RBD Palm Stearin available as supplementary energy sources for dairy cattle markedly influenced the fatty acid composition of milk fat, thus improving milk quality. However in terms of economic value, fractionated RBD Palm Stearin can only be used at 2.5% inclusion level.

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