ผลของการให้หัวอาหารโปรตีนสูง เพื่อเพิ่มผลผลิตโคนมในฟาร์มเกษตรกรรายย่อย ในเขตภาคตะวันออกเฉียงเหนือของไทย

Feeding of high protein premix to improve dairy production in smallholder dairy farms in the Northeastern region of Thailand

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บทคัดย่อ: วัตถุประสงค์ของการศึกษาครั้งนี้คือ เพื่อศึกษาผลของการให้หัวอาหารสูตรโปรตีนสูงต่อการให้ผลผลิตน้ำนมของโคนมลูกผสมพันธุ์โฮสไตน์ฟรีเชี่ยนในฟาร์มเกษตรกรรายย่อย 15 ฟาร์ม จำนวนโครีดนม 60 ตัว ใช้แผนการทดลองแบบ Randomized complete block design (RCBD) โดยใช้ฟาร์มเป็นบล็อค และโคนม 4 ตัวในแต่ละฟาร์มถูกแบ่งเป็น 2 กลุ่ม ซึ่งกลุ่มแรกกำหนดให้ได้รับอาหารข้นปกติที่ใช้ในฟาร์ม (กลุ่มควบคุม) และกลุ่มที่สองให้กินหัวอาหารสูตรโปรตีนสูงผสมกับแหล่งคาร์โบรไฮเดรตที่ใช้ในฟาร์มให้มีโปรตีนอยู่ที่ 18 เปอร์เซ็นต์โดยทั้งสองกลุ่มให้หญ้ารูซี่เป็นอาหารหยาบแบบเต็มที่ ผลการศึกษาพบว่า โคนมที่ได้รับหัวอาหารโปรตีนมีความสามารถในการย่อยได้ของอินทรียวัตถุ และโปรตีนหยาบสูงกว่ากลุ่มควบคุม ($P < 0.05$) ผลผลิตน้ำนมและ 3.5% fat corrected milk ในกลุ่มโคนมที่ได้รับหัวอาหารโปรตีนก็มีค่าสูงกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ($P < 0.05$) นอกจากนี้ ยังพบว่ารายได้และผลกำไรจากการจำหน่ายนมในกลุ่มโคนมที่ได้รับหัวอาหารโปรตีนก็มีค่าสูงกว่ากลุ่มควบคุม ($P < 0.05$) การให้หัวอาหารโปรตีนนั้น ให้ผลการศึกษาที่น่าสนใจเป็นอย่างยิ่งในการช่วยปรับปรุงประสิทธิภาพการใช้ประโยชน์ของอาหารและเพิ่มผลกำไรให้แก่ฟาร์มเกษตรกรรายย่อย ดังนั้นจึงเหมาะอย่างยิ่งในการแนะนำให้ใช้ประโยชน์ของหัวอาหารโปรตีนเพื่อเพิ่มประสิทธิภาพระบบการให้อาหารและการเลี้ยงโคนมในฟาร์มเกษตรกรรายย่อยในเขตภาคตะวันออกเฉียงเหนือของประเทศไทย

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ABSTRACT: The objective of this study was to investigate the effect of high protein premix on milk production in lactating dairy crossbreds on 15 smallholder dairy farms. Randomized complete block design (RCBD) was employed using 60 lactating cows by using each farm as a block. Four cows per farm were subjected into 2 groups to receive traditional concentrate diet (control) and protein premix mixed with the energy source to contain 18% CP. All cows were received ruzi grass as a roughage source *ad libitum*. The results were revealed that cows received protein mixture had higher organic matter and crude protein digestibility than those in the control group (P<0.05). Milk yield and 3.5% fat corrected milk was significantly higher (P < 0.05) in cows fed with protein mixture. Moreover, milk income and the profit from milk sale were significantly higher (P < 0.05) in cows fed with protein mixture. On-farm use of protein mixtureremarkably improved digestibility and increased profitability of small dairy farms. Therefore, this protein mixture is highly recommended to prepare as on-farm for use to improve small dairy farming in the northeastern region of Thailand.
Keywords: protein mixture, milk production, dairy crossbreds, smallholder dairy farms

Introduction

Feed quantity and quality are the major factors contributing to efficient and profitable dairy farming especially in smallholder farmers. Feed resources availabilities are very important especially in small-scale farm in the northeast region of Thailand. Due to the low quality of roughage feedstuffs, supplementation with a concentrate diet containing a high density of energy and nitrogen would be potentially useful and could be mixed on farm (Wanapat, 1999). With the present trend of rising feedstuff prices and global inflation, livestock production is increasingly constrained by feed scarcity and the high cost of feeds (Ayantunde et al., 2005). Therefore, the reduction of feed costs or improvement of productivity are important in obtaining higher profits in livestock production especially in small-scale farm. According to previous work of Wanapat et al. (2013b) who studied on the effect of high cottonseed meal in concentrate diets to be high protein premix for milking cows and young dairy bulls, and found that high protein premix mixed with cassava chip (energy source)were useful in the concentrates in improving rumen fermentation and increased milk production. However, study of effect of high protein premix in dairy cows in small-scale farm is still limited. Therefore, the objective of this experiment was to study effect of high protein premix for lactating dairy crossbreds on milk production and economical return in lactating dairy cows at smallholder farms.

Materials and Methods

The experiment was conducted on 15 small-scale dairy farms from 3 Milk Collection Centers (Ubonrat, Nampong and Kranuan in Khon Kaen Province) under the administration of Dairy Promotion Organization of Thailand (DPO) in the Northeastern region of Thailand. Preparing high prtein feed by mixing the available local feed ingredients to contain 49% CP and 72.9% TDN (Table 1). Then, mixing high protein feed further with carbohydrate source (cassava chip) in proportion as shown in Table 2 to contain 18.2% CP and 77.3% TDN, respectively. Randomized complete block design (RCBD) was used in this experiment by using each farm as a block. Four early lactating Holstein friesian crossbreds per farm were subjected into 2 groups (2 animals/group) (60 cows in total) to receive 2 treatments

which consisted of traditional concentrate (control) and high protein premix. The cows were offered concentrate at a ratio of concentrate to milk production of 1:2 after the morning (6 am) and afternoon (4 pm) milking times. Animals received ruzi grass *ad libitum* as a roughage source. The ingredients and chemical composition of diets are shown in **Tables 1** and **2** Roughage and concentrate intakes were recorded for 45-day period. Feeds were sampled for chemical composition analysis. Fecal samples were collected at 45 day of experiment by rectal sampling. Samples were analysed for DM, ash and CP content (AOAC, 1995), NDF and ADF (Van Soest et al., 1991) and acid insoluble ash (AIA). AIA was used to estimate digestibility of nutrients (Van Keulen and Young, 1977). Daily milk yield of each cow was recorded. Samples from the evening and the morning milking of each cow were pooled (70:30) were analyzed for fat, crude protein, lactose, solids-not-fat and total solids by an infrared analyzer (MILKOSCAN). Milk production costs, income and profit were calculated. All data were analyzed using the general linear procedure in PROC GLM of SAS (1996). Treatment means were significantly compared by Duncan's New Multiple Range Test (Steel and Torrie, 1980). Differences among means with $P<0.05$ were accepted as representing statistically significant differences.

Table 1 Ingredients and chemical compositions of experimental diets (% DM)

Ingredients	Cottonseed meal	High protein premix
Cottonseed meal		28.9
Palm kernel meal		30.8
Coconut meal		26.6
Urea		8.9
Molasses		3.0
Salt		0.6
Sulfur		0.6
Mineral premix		0.6
Chemical composition		
Organic matter	90.9	92.7
Crude protein	42.4	49.0
Neutral detergent fiber	33.4	26.6
Acid detergent fiber	21.3	18.7
Total digestible nutrient, (TDN*)	83.2	72.9

*by calculation

Table 2 Chemical compositions of dietary treatments (% DM)

Ingredients	Control	Protein mixture	Ruzi grass
Cassava chip	55.2	66.5	
Rice bran	10.2	-	
Soybean meal	12.4	-	
Brewerys' grain	7.2	-	
Cottonseed meal	-	9.7	
Palm kernel meal	5.8	10.3	
Coconut meal	4.4	8.9	
Urea	1.5	3.0	
Molasses	1.5	1.0	
Salt	0.5	0.2	
Sulfur	0.3	0.2	
Mineral premix	1.0	0.2	
Chemical composition (mean ± SD)			
Organic matter	95.7	95.6	90.1
Crude protein	18.1	18.2	5.9
Neutral detergent fiber	15.1	16.3	68.4
Acid detergent fiber	7.3	7.7	47.1
Total digestible nutrient, (TDN*)	75.1	77.3	62.7

*by calculation

Results and Discussion

Experimental diets and their chemical compositions are shown in **Tables 1** and **2**. The results revealed that total feed intake, roughage and concentrate intake were similar between treatments (**Table 3**). This is in agreement with Wanapat et al. (2012) who concluded that voluntary feed intake were not different when beef cattle and young dairy bulls (Wanapat et al., 2013b) were fed with high cottonseed meal in the concentrate. However, Wanapat et al. (2013a) found that cows fed with high cottonseed meal in concentrate had a higher total feed intake. The different result could be due to the difference of animal type, feeding program and environmental study. Moreover, cows received protein mixture had higher nutrient digestibility in terms of organic matter (OM) and crude protein (CP) than those in the control group ($P < 0.05$). These findings could be due to the presence of cottonseed meal in protein concentrate fed group which contained a high level of rumen undegradable protein. Bruckental et al. (2002) also found digestibility of CP increased when the proportion of

Table 3 Effect of protein mixture on voluntary feed intake and nutrient digestibility in lactating dairy crossbreds

Items	Control	Protein mixture	SEM
Total dry matter intake, kg/hd/d	13.7	15.2	0.64
Roughages intake	7.1	7.2	0.33
Concentrate intake	6.6	8.0	0.67
Digestion coefficients, %			
Dry matter	57.2	59.9	2.15
Organic matter	69.2[a]	75.8[b]	1.21
Crude protein	52.3[a]	58.5[b]	1.14
Neutral detergent fiber	54.5	59.4	2.05
Acid detergent fiber	50.8	53.1	1.02

[ab]Value within row with different superscripts are significantly different ($P < 0.05$)

SEM = standard error of the means.

undegradable protein increased.

Milk composition in terms of fat, protein, lactose, total solids and solids-not-fat were not significantly different between treatments ($P > 0.05$) while milk yield and 3.5% fat corrected milk yield were significantly higher in cows received protein mixturethan those in the control group ($P < 0.05$). These could be attributed by having higher protein digestibility of protein mixture. Cottonseed meal has a high proportion of rumen undegradable protein which could provide amino acids to animals through small intestine digestion (Ghanbari et al., 2012). Mikolayunas-Sandrock et al. (2009) stated that the benefit of supplemental rumen undegradable protein was the increase flow of amino acid especially methionine and lysine to the small intestine which was necessary for milk synthesis. In addition, feed cost was not affected by protein mixture($P > 0.05$) whereas, income from milk sale and profit were higher in cows fed with protein mixture when compared with the control group ($P < 0.05$; **Table 4**). In the present study, similar in feeding costs between treatments were mainly justified by the use of amount of concentrate feed. These results can imply that protein mixture could enhance nutrient utilization of dairy cows particularly protein utilization and improved milk production. Moreover, the use of protein mixture is easy to practice for smallholder dairy farmers who raise animals using available local feeds and low quality roughages.

Conclusions

In conclusion, on-farm use of high protein premix demonstrated an interesting alternative approach to increase profitability under small dairy farms. Therefore, high protein premixcould be advantages and practical application for smallholder farmers in northeastern region of Thailand. Furthermore, the results obtained under this on-farm experiment should be extensively recommended for use in tropical area where dairying has been produced.

Table 4 Effect of protein mixture on milk production and economical return in lactating dairy crossbreds

Items	Control	Protein mixture	SEM
Milk yield, kg/hd/d	13.3[a]	16.2[b]	0.92
3.5% FCM	13.9[a]	16.9[b]	0.60
Milk composition, %			
Fat	3.6	3.8	0.16
Protein	3.2	3.3	0.08
Lactose	4.8	4.8	0.05
Total solids	12.4	12.6	0.24
Solids-not-fat	8.7	8.6	0.11
Economical return, $US/cow/d			
Milk income	7.8[a]	9.6[b]	0.28
Feed cost	1.98	2.07	0.62
Profit	5.8[a]	7.5[b]	0.11

[ab]Values within the same rows with different superscripts are significantly different ($P < 0.05$)

SEM = standard error of the means.

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