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Effects of the timing of initiation of glucogenic diet on performance of transition Holstein dairy cows

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Abstract

The mismatch between energy demand and dietary energy supply leads to a negative energy balance in high-yielding dairy cows during early lactation. Therefore, to offset the energy deficit, and maintain lactation, the cows will catabolism a considerable amount of body fat. However, excessive mobilization of body fat leading to fatty liver syndrome and ketosis and also impairs reproductive performance. Several management strategies arising from the extensive research on lipid mobilization, which include feeding lipogenic and glucogenic diets, have been shown to limit body fat mobilization. The aim of this study was to evaluate the effects of the timing of initiation of glucogenic diet on dry matter intake (DMI), body condition score (BCS), and milk yield and composition in transition Holstein dairy cows. Holstein cows (n=36) were randomly assigned to 1 of 3 treatments (GGG and GGL or GLL). Cows were fed a glucogenic diet from 3 wk prepartum. Postpartum animals continued to receive glucogenic diet until 49 DIM (GGG) or shifted to a lipogenic diet at either 21(GGL) or 1(GLL) DIM and remained on said diet until 49 DIM. Diets were isocaloric and isonitrogenous. NDF and fat content in lipogenic and glucogenic diets were 465 and 408, and 57 and 31 g/kg DM in prepartum and 403 and 324, and 79 and 36 g/kg DM in postpartum, respectively. Diets were prepared and fed as a total mixed ration (TMR) in ad libitum amounts twice daily to allow for 10% refusal in the prepartum and postpartum periods, respectively. Body weights and body condition scores (BCS) were recorded weekly on all cows throughout the trial at the same time on the same day each week. Individual cow milk yields were recorded daily. Milk samples were collected from all cows on 3 consecutive milking, once a week and analyzed for fat, true protein, and lactose. Data were analyzed by using a mixed model (Proc Mixed, SAS 2001) for a completely randomized design with repeated measures. Overall effect of treatment was tested using cow within treatment as the error term. For all analyses, least square means were calculated. Diets had no effect on dry matter intake (DMI) in prepartum and body condition score (BCS) in prepartum and postpartum. The GGL diet increased DMI compare with GLL ($P<0.05$) in postpartum. The effect of time was significant ($P<0.001$) and DMI was increased over the time. The BCS was decreased by 6 week of experiment ($P<0.001$). Milk production and milk fat, protein and lactose content were not affected by diets. Diets had no effect on fat-to-protein ratio. Milk protein yields were increased by the GGG and GGL diets compared with GLL ($P<0.05$). The results of this study demonstrated that glucogenic diet feeding should be continuing until 21 DIM and the lipogenic diet can be feed after that. This pattern of feeding could be better in terms of reducing the diet expenses and it would have increasing effect on cow performance.

Keywords: Dairy cow, transition, glucogenic diet

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Introduction

The mismatch between energy demand and dietary energy supply leads to a negative energy balance in high-yielding dairy cows during early lactation period (Schröder & Staufenbiel, 2006). Therefore, to offset the energy deficit, and maintain lactation, the cow will catabolize a considerable amount of its live weight. Estimates indicate that around 41 to 90 kg of body fat (Erdman & Andrew, 1989) primarily from intramuscular, subcutaneous and internal fat (Gibb et al., 1992), are mobilized during this period.

Mobilization of body fat is a normal process which enables the cow to augment the energy supply as the mobilized body fat avails energy for milk production to the cow (Bauman & Currie, 1980). However, excessive mobilization of body fat elevates plasma non-esterified fatty acid (NEFA) concentration and increases its uptake by the liver, thereby leading to fatty liver syndrome and ketosis (Drackley, 1999). Over-mobilization of body fat also impairs reproductive performance (Lucy, 2001). Several management strategies arising from the extensive research on lipid mobilization, which include feeding glucogenic diets (van Knegsel et al., 2007), have been shown to limit body fat mobilization.

The objectives of this study were to evaluate the effect of the timing of initiation of glucogenic diet on dry matter intake (DMI), body condition score (BCS), and milk yield and composition of Iranian Holstein dairy cows.

Material and methods

Thirty six Iranian Holstein cows were randomly assigned to 1 of 3 treatments (GGG and GGL or GLL). Cows were fed a glucogenic diet from 3 weeks prepartum. Postpartum animals continued to receive glucogenic diet until 49 days in milk (DIM) (GGG) or shifted to a lipogenic diet at either 21(GGL) or 1(GLL) DIM and remained on said diet until 49 DIM. Diets were isocaloric and isonitrogenous. NDF and fat contents of the lipogenic and glucogenic diets were 465 and 408, and 57 and 31 g/kg DM in prepartum period and 403 and 324, and 79 and 36 g/kg DM in postpartum phase, respectively. Diets were prepared and fed as a total mixed ration (TMR) in ad libitum form twice daily to allow for 10% refusals. Body weights and body condition scores (BCS) were recorded for all cows throughout the trial at the same time on the same day each week. Individual cow milk yields were recorded daily. Milk samples were collected from all cows on 3 consecutive milking, once a week and analyzed for fat, true protein, and lactose contents. Data were analyzed by using a mixed model (Proc. Mixed, SAS 2001) for a completely randomized design with repeated measures. Overall effect of treatment was tested using cow within treatments as the error term. For all analyses, least square means were calculated.

Results and Discussion

DIM was not affected by the fed diets in prepartum and similar effects were detected for body condition score (BCS) in prepartum and postpartum periods. The GGL diet increased DMI compared with GLL ($P<0.05$) in postpartum. The effect of time was significant ($P<0.001$) and DMI increased over the time. The BCS was decreased during the 6 weeks of experiment ($P<0.001$). Milk production and milk fat, protein and lactose contents were not affected by the experimental diets. The fat-to-protein ratio was not affected by diets. Milk protein yields were increased following feeding the GGG and GGL diets in comparison with GLL diet ($P<0.05$).

Table 1. Least squares means of production parameters in cows fed the experimental diets (GGG, GGL, or GLL) during the first 6 weeks postpartum.

Parameter	Diets			SE	*Diet* *P*-Value	*Time.* *P*-Value
	GGG	GGL	GLL			
Milk, kg/d	34.13	33.98	31.19	1.110	0.142	<0.001
Fat						
%	3.46	3.65	3.65	0.130	0.510	<0.001
kg/d	1.16	1.23	1.12	0.050	0.307	0.0116
Protein						
%	3.16	3.17	3.14	0.031	0.780	<0.001
kg/d	1.07[a]	1.08[a]	0.98[b]	0.030	0.047	0.0584
Lactose						
%	4.73	4.72	4.70	0.043	0.910	<0.001
kg/d	1.61	1.60	1.46	0.051	0.103	0.1250
F/P*	1.09	1.15	1.15	0.040	0.530	<0.001
DMI, kg/d	17.13[ab]	18.30[a]	15.71[b]	0.520	0.004	<0.001
BCS	2.80	2.94	2.59	0.14	0.230	<0.001

***** F/P= Fat to protein ratio

Conclusions

The results of this study demonstrated that feeding glucogenic diet could be continuing until 21 DIM and the lipogenic diet fed after that for obtaining the better performance. This feeding pattern can reduce the cost of diet feeding in significant level. However, more studies with various level of lipogenic and glucogenic diets are required.

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