Effect on animal performance of the source of energy (glucogenic vs. lipogenic) of early lactating dairy cow diets with similar content of metabolizable energy

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Introduction

High-producing dairy cows are challenged *post partum* with large metabolic demands caused by the sudden increase in energy requirements. Two approaches to increase the energy content of diets fed to cows in early lactation are to increase the grain content of the diet or to supplement the diet with fat (Gong, 2002). The characteristics of metabolic problems of this lactation phase suggest a role for the balance in availability of lipogenic and glucogenic nutrients (Van Knegsel *et al.*, 2005, 2007). In ruminants, lipogenic nutrients originate either from fibre that stimulates the ruminal production of acetate and butyrate or from dietary fat, or are derived from body reserves. Glucogenic nutrients originate from starch escaped from rumen degradation or gluconeogenesis (Gaynor *et al.*, 1995). However, the contribution of intestinally digested starch to metabolic glucose is highly variable (Mills *et al.*, 1999). The aim of the present study was to determine the effect of early lactating dairy cow diets containing different energy sources (glucogenic vs. lipogenic) with equal metabolizable energy (ME) content on early lactation performance of Holstein cows.

Materials and methods

Three early lactating dairy cow diets were provided containing different energy sources including glucogenic source [barley grain (BG)] or lipogenic sources [sugar beet pulp (SBP) or protected palm fat (PF)]. The sources of energy provided 18% of the total daily requirements for metabolizable energy (312 MJ/head/day). Diets were formulated to support 43 kg milk/d and consisted of forge (alfalfa hay and corn silage) and concentrates (maize grain, soybean meal, cottonseed meal and BG or SBP or PF) in a ratio of 1:1 (CP= 180 g/kg DM). Diets were fed as TMR to 120 multiparous early lactating Holstein dairy cows (DIM= 16±3, 40 cows per each diet) for 10 weeks as *ad libitum*. Feed intake was monitored daily, milk yield and composition were recorded weekly, and body condition score (BCS, five-point scale where 1=thin to 5=obese) was determined monthly. Data were analyzed using the MIXED procedure of SAS (2001) for a completely randomized design with repeated measures. The model included the energy sources, time, and 2-way interactions of energy sources with time. Duncan's test was used to determine the significance of means at $P<0.05$.

Results and discussion

Data of feed intake, milk production and composition, and BCS are presented in Table 1. Results indicated that the animals fed SBP had a lower ($P<0.05$) daily feed intake compared with the other groups. Milk yield of the cows receiving the diets of BG and PF was considerably higher ($P<0.05$) than those fed the SBP diet. However, milk fat concentration (g/kg) of the cows fed SBP was higher ($P<0.05$) than that of the other animals. There was no significant effect of the diet on BCS.

The results of the present study did not confirm the findings of the previous studies that observed no increase in milk fat percentage after feeding a lipogenic diet (Van Knegsel *et al.*, 2007). Extra lipogenic nutrients, as digestible fiber, often increase the milk fat percentage, as also observed in this study, which is not the effect of the lipogenic character of the diet but of its effects on ruminal fermentation. The present study was designed to feed diets of similar ME content but contrast in

Table 1 Dry matter intake (DMI, kg/d), milk production (kg/d), milk composition (g/kg) and body condition score (BCS) of dairy cows fed diets containing different energy sources including glucogenic source [barley grain (BG)] or lipogenic sources [sugar beet pulp (SBP) or protected palm fat (PF)] during weeks 2 to 12 of lactation.

Variable	Diet			SEM	*P*-value		
	BG	SBP	PF		Diet (D)	Week (W)	DxW
DMI	24.2[a]	22.1[a]	23.7[a]	0.6	<0.050	<0.050	NS
Milk yield	41.9[a]	37.8[a]	40.4[a]	1.1	<0.05	<0.050	NS
Milk fat	35[a]	37[a]	34[a]	1.2	<0.05	<0.050	NS
Milk protein	30.2	30.4	30.3	1.3	NS	<0.050	NS
Milk lactose	47.4	48.3	47.5	1.7	NS	NS	NS
BCS	2.9	3.0	3.0	0.3	NS	-	-

[a,b] The difference between means with different letter is significant at $P<0.05$. NS = not significant.

lipogenic (in two different types as fat or digestible fiber) and glucogenic nutrient supply. Despite a similar quantity of available ME, cows fed the FP as lipogenic diet and BG as glucogenic diet partitioned the same amount of energy to milk. Therefore, the present data did not confirm the hypothesis that energy partitioning between milk and body tissue can be altered by feeding isoenergetic diets that differ in lipogenic and glucogenic nutrient supply (Van Knegsel *et al.*, 2007).

References

Gaynor, P.J., D.R. Waldo, A.V. Capucco, R.A. Erdman, L.W. Douglass and B.B. Teter, 1995. Milk fat depression, the gluconeogenic theory, and trans-C18:1 fatty acids. J. Dairy Sci. 78, 2008-2015.

Gong, J.G., 2002. Influence of metabolic hormones and nutrition on ovarian follicle development in cattle: Practical implications. Domest. Anim. Endocrinol. 23, 229-241.

Mills, J.A.N., J. France, and J. Dijkstra, 1999. A review of starch digestion in the lactating dairy cow and proposals for a mechanistic model: 2. Postruminal starch digestion and small intestinal glucose absorption. J. Anim. Feed Sci. 8, 451-481.

Van Knegsel, A.T.M., H. van den Brand, J. Dijkstra, S. Tamminga, and B. Kemp, 2005. Effect of dietary energy source on energy balance, production, metabolic disorders and reproduction in lactating dairy cattle. Reprod. Nutr. Dev. 45, 665-688.

Van Knegsel, A.T.M., H. van den Brand, J. Dijkstra, W.M. van Straalen, R. Jorritsma, S. Tamminga, S. and B. Kemp, 2007. Effect of glucogenic vs. lipogenic diets on energy balance, blood metabolites, and reproduction in primiparous and multiparous dairy cows in early lactation. J. Dairy Sci. 90, 3397-3409.