Changes in Plasma Cholesterol Concentrations During Early Lactation in Holstein Cows and its Association with Production Variables

L.J. Spicer and C.C. Francisco

Story in Brief

Cholesterol has been implicated as one possible metabolic mediator of reproduction in lactating dairy cows. This study evaluated the effect of time after calving on plasma cholesterol concentrations and evaluated correlations between plasma cholesterol and production variables. Mature Holstein cows (n=19) were milked twice daily and milk samples were collected twice a week for analysis. Plasma cholesterol concentration significantly increased progressively between wk 1 and 7 of lactation. Plasma cholesterol concentrations were positively correlated with energy balance, dry matter intake, milk production, and concentrations of urea nitrogen and lactose levels in milk. Plasma cholesterol concentration was negatively correlated with milk fat and protein levels. We conclude that week of lactation should be considered when interpreting plasma cholesterol values, and that these changes are most closely associated with dry matter intake.

Key Words: Cholesterol, Correlations, Dairy Cows, Lactation

Introduction

Many high producing dairy cows are unable to consume enough feed to meet energy demands during early lactation. Therefore, they rely on their ability to mobilize body energy reserves to meet energy requirements, and subsequently enter a state of energy balance deficiency. Energy balance is quantified using measures of milk production, dietary intake, and body weight (Spicer et al., 1990). Lactating dairy cows in positive energy balance have greater reproductive function than cows in negative energy balance (Spicer et al., 1990). Because energy balance is impractical to measure, other factors have been measured to relate nutritional status and reproductive function (Spicer et al., 2002). One of these factors, plasma cholesterol, is a precursor for steroid hormone synthesis of bovine ovarian cells in vitro (Spicer and Echternkamp, 1995). However, little work has been conducted to evaluate normal changes in plasma cholesterol levels during early lactation. The objective of this study was to determine the changes in cholesterol concentrations during early lactation in Holstein cows.

Materials and Methods

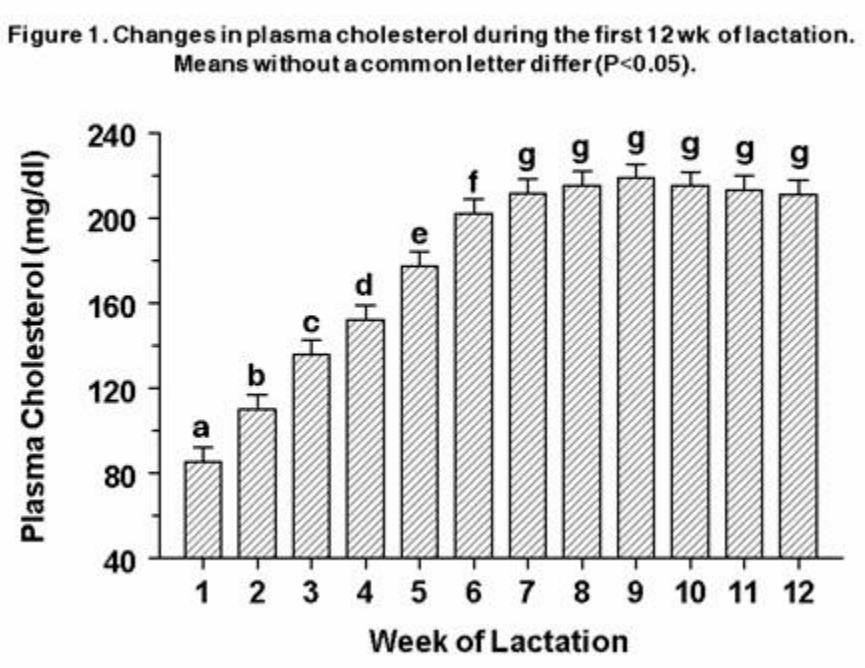
Mature (i.e., $\geq$ 2 lactations) Holstein cows (n=19) maintained at the Oklahoma State University Dairy Cattle Center were fed a total mixed ration consisting of concentrates (29%), sorghum silage (24%), alfalfa hay (16%) and cottonseed (6%). Energy concentration of the diet was formulated to support daily milk production of 100 lb. Daily feed intake was recorded and the diet was sampled weekly and composited by month for analyses.

Cows were milked twice daily (0300 and 1500 h) and milk yield was recorded. Milk samples were collected weekly during successive a.m. and p.m. milkings and analyzed for milk fat,

protein, lactose, solid non-fat, somatic cell count and urea nitrogen content at the Heart of America DHIA (Manhattan, KS). Blood samples were collected twice weekly for measurement of total plasma cholesterol concentrations which were determined using an enzymatic method using a total cholesterol kit (Sigma, St. Louis, MO) as previously described (Spicer et al., 1993). Body weights were recorded weekly. Experimental data are presented as least squares means ± SEM. Data were analyzed as a repeated measures analysis using the MIXED procedure of SAS.

Results

Plasma cholesterol concentrations increased ($P < .001$) with week postpartum (Figure 1) such that concentrations of cholesterol more than doubled ($P < .01$) between wk 1 (85.6 ± 6.6 mg/dl) and 7 (211.7 ± 6.6 mg/dl) and remained unchanged ($P > .10$) between wk 7 and wk 12.



Simple correlation coefficients among weekly averages (n = 228) of plasma cholesterol, EB, FCM, DMI, milk fat and protein are shown in Table 1. Significant positive correlations existed between plasma cholesterol and EB, FCM, DMI, milk lactose and milk MUN. Significant negative correlations existed between plasma cholesterol and milk fat and protein. Significant correlations associated with EB and its components are as follows: EB was positively correlated ($r = .68$, $P < .001$) with DMI but negatively correlated with FCM ($r = -.38$, $P < .001$), milk fat ($r = - .64$, $P < .001$), and milk protein ($r = - .35$, $P < .001$).

Discussion

In the present study, plasma cholesterol concentrations increased with week postpartum. Similar trends were observed previously (Spicer et al., 1993). The increased cholesterol concentrations during the first six weeks of lactation parallel DMI of cows. In support of this statement,

positive relationships between DMI and cholesterol (r=.69) was observed in the present study. Further research will be needed to determine the specific reasons for negative correlations between plasma cholesterol and milk fat and protein.

Literature Cited

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Table 1. Correlation coefficients among average weekly (n = 228) energy balance (EB), dry matter intake (DMI), fat corrected milk (FCM), body weight (BW), milk fat (FAT), milk protein (PROT), lactose (LAC), milk urea nitrogen (MUN), and plasma cholesterol (CHOL, n=114) during the first 12 wk of lactation in dairy cows (n = 19)

				Milk Components				Plasma
Variable	FCM	DMI	BW	FAT	PROT	LAC	MUN	CHOL
EB	-.38**	.68**	-.18**	-.64**	-.35**	.22**	.14*	.44**
FCM		.37**	.17**	.48**	-.22**	.02**	.21**	.29**
DMI			.08	-.33**	-.44**	.22**	.28**	.69**
BW				.06	.11	-.18**	-.09	-.07
FAT					.20**	-.23**	-.16*	-.29**
PROT						-.33**	-.43**	-.45**
LAC							.26**	.30**
MUN								.43**
*P<.05		**P<.01						

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