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Differential transport of *trans* fatty acids by bovine plasma lipoprotein fractions: 1. Soya oil and partially hydrogenated vegetable oil

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Introduction Dietary fatty acid (FA) source influences fat and *trans* FA (tFA) content of bovine milk. Vaccenic acid (VA; 18:1 *trans-11*) arises from rumen biohydrogenation of polyunsaturated FA (PUFA), is the predominant tFA in milk and, unlike some tFA, does not interfere with fat synthesis. Because mammary epithelial cells do not absorb HDL-lipoproteins, we hypothesized that effects of tFA on milk FA composition could be related to differential plasma transport mechanisms. The objective of this experiment was to elucidate which lipoprotein fractions are involved in plasma transport of tFA isomers by infusing oils that induce different plasma tFA profiles.

Materials and methods Three non-lactating Holstein cows (Live weight 773 ± 63 kg), each fitted with a rumen cannula, were used in a 3 x 3 Latin square design. Cows were fed on a diet of grass hay (7 kg/d) and concentrate (based on barley, sugar beet and wheat; 2 kg/d) and treated with bolus ruminal infusions of: 1) skim milk (SM; control; 500 ml/d); 2) soya oil (SO; 250 g/d in 500 ml SM); and 3) partially-hydrogenated vegetable oil (PHVO; 250 g/d in 500 ml SM). Each three-day infusion period was followed by a four-day washout interval to minimize carryover effects. Blood samples were obtained prior to each infusion (0 h) and 1, 2, 3 and 6 h after infusion. Plasma was ultracentrifuged at 39,000 x *g* for 20 h at 12ºC using a Beckman XL-70 ultracentrifuge to separate lipoproteins into low density (LDL) and high density (HDL) fractions. Fatty acid profiles of plasma and lipoprotein fractions were determined by gas chromatography. Data were analysed by repeated measures ANOVA to study effects of treatment, period, sampling day within period and infusion time within sampling day. Results presented are least-square means for each treatment because there was no interaction between treatment and period, day or time.

Results There was no difference between treatments in concentrations of saturated FA and PUFA, but monounsaturated FA were higher (P<0.05) in both plasma and LDL for SO and PHVO compared with SM (Figure 1). Compared with SM and PHVO, SO increased (*P*<0.05) VA concentration in both HDL and LDL. Compared with SM and SO, PHVO increased (*P*<0.05) HDL concentrations of 18:1 *trans*-9 but reduced (*P*<0.05) concentrations of 18:1 *trans*-10, *trans*-11 and *trans*-12 (Figure 2). Compared with SM and SO, PHVO, increased (*P*<0.05) LDL concentrations of 18:1 *trans*-5, *trans*-6-8, *trans*-9 and *trans*-10, and reduced (*P*<0.05) concentrations of 18:1 *trans*-11.

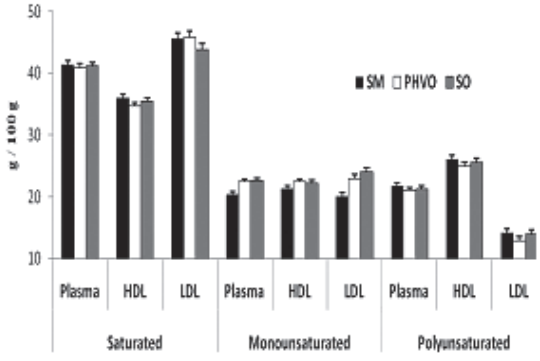

Figure 1 Treatment effects on major fatty acid classes in plasma and lipoprotein fractions

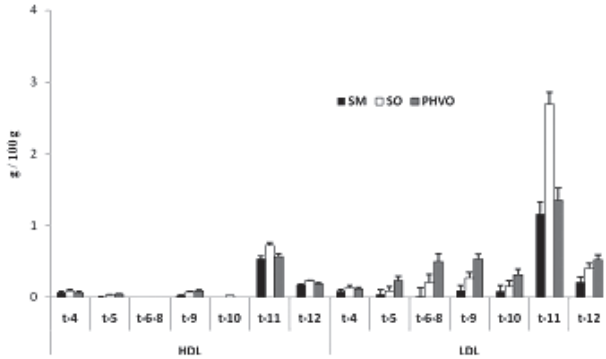

Figure 2 Concentrations of 18:1 *trans* isomers in lipoprotein fractions

Conclusions Effects of oil infusion of FA profiles of plasma, HDL and LDL were consistent with differences in oil composition. Soya oil is rich in PUFA, which increase VA after ruminal biohydrogenation; PHVO contains a mixture of tFA isomers, which are not changed during rumen passage. The results confirm, therefore, that tFA concentrations of plasma and lipoprotein fractions depend on dietary lipid source. This study suggests that LDL is more responsive to source of tFA, although further fractionation is required to distinguish between true LDL-cholesterol, chylomicrons and very low density lipoproteins (VLDL) that are also present in this fraction.

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