Trans fatty acids reduce plasma total- and non HDL-cholesterol concentrations in rats

LM Gatto[1], MA Lyons[2], AJ Brown[2] and S Samman[1]

[1]Human Nutrition Unit, Dept of Biochemistry, University of Sydney, NSW, 2006
[2]Cell Biology Group, Heart Research Institute, Camperdown, NSW, 2050

Studies in humans have shown that trans fatty acids (TFA) increase plasma concentrations of total cholesterol (TC) and low density lipoprotein-cholesterol (LDL-C), and decrease high density lipoprotein-cholesterol (HDL-C) relative to oleic acid. It has been suggested that these effects are modulated by an increase in the activity of cholesteryl ester transfer protein (CETP). This study uses the rat model, which is devoid of CETP activity, to investigate the effects of dietary oleic, palmitic and TFA on selected aspects of cholesterol metabolism.

Male Sprague-Dawley rats were fed semipurified diets comprising 20% energy (%en) from protein, 45%en from carbohydrate, 35%en from fat and 0.2% w/w cholesterol for four weeks. The fatty acid composition of the diets differed such that 10%en was provided as either oleic acid in the CIS diet, palmitic acid in the SAT diet or TFA in the TRANS diet. Rats were randomised into three groups of 22 (n=10 for lipid measurements, n=12 for the kinetic study).

After four weeks of feeding, the plasma TC concentration was 20% lower in animals fed the TRANS diet compared with those fed the CIS diet ($P<0.005$). Plasma HDL-C concentrations were similar in animals fed the CIS and TRANS diets, but 10% higher in their SAT fed counterparts ($P<0.01$). Compared with the CIS diet, non HDL-C concentrations were reduced by 21% ($P<0.01$) in those fed the SAT diet and by 25% ($P<0.005$) in those fed the TRANS diet. The TC to HDL-C ratio was lower in animals fed the SAT diet ($P<0.005$) and the TRANS diet ($P<0.05$) compared with those fed the CIS diet (2.46, 2.60, 3.14; SAT, TRANS and CIS diets respectively).

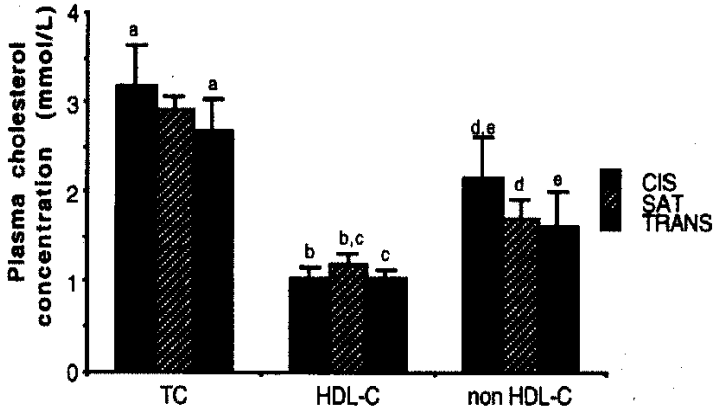

Figure. Plasma total cholesterol, HDL-C and non HDL-C concentrations after four weeks on diet. Data is presented as mean ± SD of 10 observations. Values sharing a common superscript are significantly different.

To investigate the metabolic fate of cholesterol, rats were injected with tracer quantities of acetylated LDL containing [^{3}H]-cholesteryl oleate via the jugular vein and the reappearance of radiolabel into plasma and HDL were followed at timed intervals over 24 h. Consistent with the plasma cholesterol concentrations, labelled cholesterol detected in plasma was lower in rats fed the TRANS diet compared with those fed either the CIS or SAT diets ($P<0.05$). This difference was due to a reduction of radioactivity associated with apo B-containing lipoproteins ($P<0.05$). Despite differences in plasma HDL-C concentrations, radioactivity associated with HDL was similar in all groups when expressed as % of initial radioactivity or as specific activity.

In contrast to the effect in humans, rats which are devoid of CETP activity, respond to high levels of dietary TFA by a reduction in lower density lipoproteins without any effect on HDL. The results of this study reinforce the significant role of CETP activity in determining the distribution of cholesterol in plasma in response to dietary TFA.