THE EFFECT OF SATURATED FAT ON CHYLOMICRON METABOLISM IN RATS

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It has been reported that randomly rearranging the position of fatty acids (FA) in butterfat triacylglycerol (TAG) by interesterification, thus reducing the proportion of saturated FA in the sn2 position, reduces its hypercholesterolaemic and hypertriglyceridaemic properties when fed to humans. The aim of this work was to determine the importance of saturated FA at the sn-2 position of TAG in butterfat with regard to cholesterol and TAG metabolism in the rat model. Rats were fed either native butterfat (NBF) or randomised butterfat (RBF) at 50% of energy of the diet for five weeks. No significant differences were found in plasma cholesterol and TAG levels or lipoprotein profiles in male or female rats. Significant decreases, however, were found in liver cholesteryl esters (CE) in animals fed NBF along with increases in liver phospholipids (PL). Levels of these two lipid classes in RBF-fed animals were similar to those of a control group fed canola oil.

To determine if these differences were due to different rates of chylomicron (CM) metabolism between NBF and RBF-feeding, plasma CM clearance studies were performed. Lymph CM were prepared from rats given a bolus dose of either NBF or RBF, and injected into the bloodstream of conscious chow-fed rats. Rates of disappearance of CM-TAG and CE labelled with C^{14} and H^3, respectively, from the bloodstream were similar in the first 30 min following injection. CM's derived from polyunsaturated corn oil and injected into the bloodstream of animals previously fed either NBF or RBF for five weeks were also metabolised at similar rates. These results indicate that decreased levels of liver CE observed in rats fed NBF were not attributable to a slower removal of NBF CM's from the blood stream over the first 30 min following injection. Similar CM clearance rates between rats chronically-fed NBF or RBF and injected with corn oil CM's indicate no alteration in receptor-mediated uptake of CM remnants by the liver, or activities of lipases in rats chronically-fed both diets.

Because the difference in saturated FA's in the sn-2 position was not very marked between NBF and RBF, it was decided to study the CM clearance rates of native cocoa butter (NCB) and randomised cocoa butter (RCB). Although randomisation markedly increased the amount of saturated FA in the sn-2 position of cocoa butter (from about 5% to about 60%), clearance rates of TAG and CE were similar between the two fats. This result was explained due to partial endogenous randomisation of NCB producing CM-TAG with a similar positional distribution to RCB. Analysis of CM-TAG also indicated reduced absorption of 18:0 from both NCB and RCB. Plasma clearance rates of CM-TAG and CE were slower for cocoa butter when compared with butterfat even though they had relatively similar total and sn-2 levels of saturated FA. Partial endogenous randomisation of cocoa butter in this case resulted in a significant increase in solid fat content at body temperature, while butterfat is liquid at body temperature. The increased proportions of solid fat in cocoa butter CM at body temperature may explain their slower rate of metabolism compared with butterfat. Hepatic lipid alterations resulting from feeding RBF compared with NBF may result from increased plasma clearance of CM by the liver, which is not distinguishable in the first 30 minutes, but may be important over a longer postprandial time interval . These studies suggest that the melting point of fats, influenced by the amount of saturated FA in the sn-2 position, may be important in determining the rate of plasma CM clearance.

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