Activity and mRNA abundance of enzymes for fatty acid synthesis and desaturation in mammary cell cultures

by

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ABSTRACT

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The effect of exogenous unsaturated fatty acids on cellular fatty acid biosynthesis in mammary cells was examined. Under normal situations, even though the diet of a dairy cow contains considerable amounts of unsaturated fatty acids, *viz*. oleic acid (18:1) and linoleic acid (18:2), the major 18-carbon fatty acid that enters the circulation post-ruminally for delivery to the mammary gland is saturated fatty acid, *viz*. stearic acid (18:0). This is due to extensive ruminal biohydrogenation of unsaturated fatty acids. Studies have indicated that saturated fatty acids such as 18:0 are enhancers and that certain unsaturated fatty acids are inhibitors of *de novo* fatty acid synthesis in tissues such as the liver and adipose tissue. The present study investigated the effect of *cis* and *trans* isomers of 18:1 and 18:2 on *de novo* fatty acid synthesis and desaturation in mouse and bovine mammary epithelial cell cultures, and compared it with the effect caused by 18:0. In the first experiment 12.5, 25, 50 or 100 μM stearic acid (SA), oleic acid (OA), elaidic acid (EA), *trans*-vaccenic acid (TVA), linoleic acid (LA) or conjugated linoleic acid (CLA) were supplemented in the media of mouse mammary epithelial (MME) cells that were grown to confluence in Dulbecco's modified Eagle's medium (DMEM). As indicated by cellular palmitic acid (16:0) content and fatty acid synthetase (FAS) activity,

when compared with SA all unsaturated fatty acid treatments inhibited *de novo* fatty acid synthesis in MME cells. In addition, OA at all concentrations and LA and CLA at 50 and 100 μM inhibited cellular stearoyl-CoA desaturase (SCD) activity and mRNA abundance. However, EA and TVA, when compared with SA, enhanced SCD activity and mRNA abundance at 12.5 and 25 μM. In the second experiment 25, 50 or 100 μM SA, OA, TVA, LA or CLA were supplemented in the media of bovine mammary epithelial cells that were grown to confluence in DMEM. As indicated by cellular 16:0 content, acetyl-CoA carboxylase (ACC) activity and FAS activity, treatment with the unsaturated fatty acids inhibited *de novo* fatty acid synthesis at all concentrations, when compared with SA. Unsaturated fatty acid treatments also reduced the abundance of ACC and FAS mRNA in the cells. When compared with SA at all treatment-concentrations, OA and LA inhibited whereas TVA and CLA enhanced cellular SCD activity and mRNA abundance in the bovine cells. In both cell types, CLA and TVA appeared to be the most potent inhibitors of saturated fatty acid biosynthesis.

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REPRESENTATION OF FATTY ACIDS

FATTY ACID

Name	Representation
Palmitic acid	16:0
Stearic acid	18:0
Oleic acid	*cis* Δ^9-18:1
Elaidic acid	*trans* Δ^9-18:1
Trans-Vaccenic acid	*trans* Δ^{11}-18:1
Linoleic acid	18:2
Conjugated linoleic acid	*cis* Δ^9, *trans* Δ^{11}-18:2