

# CHAPTER 1

## INTRODUCTION

More than 70% of the fatty acids (FA) in bovine milk are saturated. Higher dietary intake of saturated fats has been positively correlated with increasing incidence of hypercholesterolemia and coronary heart disease in humans (Denke and Grundy, 1992). Consequently, there has been increasing demand to lower the saturated FA content of milk in order to improve the ratio of unsaturated to saturated FA in dairy products.

Even though the diet of a ruminant contains considerable amounts of unsaturated FA especially oleic acid (18:1) and linoleic acid (18:2), the saturated FA *viz.* stearic acid (18:0) is the major dietary-derived 18-carbon FA that enters the circulatory system for delivery to the mammary gland. This is a consequence of extensive ruminal biohydrogenation of dietary unsaturated FA. Some amounts of unsaturated FA with *trans* and conjugated double bonds, such as *trans*-vaccenic acid (TVA) and conjugated linoleic acid (CLA) also enter the mammary gland from the circulatory system. These are intermediate products formed during ruminal biohydrogenation of dietary unsaturated FA.

The two major sources of FA in milk are absorption from blood and *de novo* synthesis in mammary epithelial cells. The composition of FA derived from blood will depend on dietary FA composition and the extent of ruminal biohydrogenation. However, the major products of mammary FA biosynthesis are saturated FA. Therefore any factor that

enhances mammary FA biosynthesis can also enhance the content of saturated FA in milk. Saturated FA such as stearic acid (18:0) and palmitic acid (16:0) are known to enhance *de novo* FA synthesis in many tissues. Stimulation of FA biosynthesis in the mammary gland would increase the saturated FA content of milk. There are also reports that 18:1 and 18:2 are potent inhibitors of FA biosynthesis in various tissues, and that their effects on cellular FA metabolism are tissue-specific. Most studies evaluating the effect of exogenous FA on *de novo* fat synthesis, however, were focused on liver and adipose tissue.

Several studies have provided indirect evidence that delivery of unsaturated *trans* FA to the bovine mammary gland reduced milk fat content and lowered the concentration of saturated FA in milk. Wonsil et. al. (1994) reported that there was an inverse relationship between milk fat percentage and duodenal flow of TVA. Looor and Herbein (1997) found that abomasal infusion of a mixture of linoleic acid and CLA resulted in a simultaneous increase in the unsaturated FA content of milk from 23 to 45% and a decrease in the saturated FA content from 70 to 42%. Thus, regulated delivery of TVA and CLA to the mammary gland may be a useful method to reduce saturated FA content of milk. To further enhance the ratio of unsaturated to saturated FA in milk, the supply of 18:1 and 18:2 flowing out of the rumen for absorption and transfer to the mammary gland also must be enhanced. This will be made possible when an approved source of rumen-protected unsaturated FA for dairy cattle diets becomes available.

Even though recent studies have succeeded in altering the composition of milk fat by dietary supplementation of rumen-protected unsaturated FA, the mechanism underlying this cause-effect relationship has not been elucidated. Studies at the cellular level are essential to understand the mechanisms by which external unsaturated FA modulate the cellular factors involved in FA biosynthesis in the mammary gland.

Objectives of the present study were twofold. First, to examine the effect of increasing concentrations of exogenous *cis* or *trans* isomers of 18:1 or 18:2 in mouse mammary epithelial cell cultures on:

- A. cellular 16:0 content (indicator of *de novo* FA synthesis),
- B. cellular fatty acid synthetase activity, and
- C. cellular stearoyl-CoA desaturase activity and mRNA abundance.

It is not known whether bovine mammary cells respond to unsaturated FA in the same way as murine mammary cells. So, the second objective was to examine the effect of increasing concentrations of exogenous *cis* or *trans* isomers of 18:1 or 18:2 in bovine mammary epithelial cell cultures on:

- A. cellular 16:0 content,
- B. cellular acetyl-CoA carboxylase activity and mRNA abundance,
- C. cellular fatty acid synthetase activity and mRNA abundance, and
- D. cellular stearoyl-CoA desaturase activity and mRNA abundance.