

## Fatty Acids and Reproduction in Dairy Cows

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Supplementary fat can increase dietary energy concentration and energy balance of the cow, thereby improving potential fertility. However, fatty acids also appear to affect reproductive processes in ways that are not related to energy. For example, increased availability of fatty acid precursors allows increased steroid and eicosanoid secretion, which can alter ovarian and uterine function. Fatty acids also affect plasma concentrations of metabolic hormones that influence oestrus cycles in the cow. At the cell level, fatty acids may have direct effects on transcription of genes that encode proteins essential to reproductive events, and may also affect membrane structure, which has implications for the egg (oocyte) to be fertilized and develop into an embryo.

When we compared dairy cows fed on isoenergetic high-fat or high-starch diets, high-fat diets reduced plasma insulin and delayed the start of oestrus cycles after calving. In other studies, however, we found that high-fat diets might improve pregnancy rates.

We have shown that cows fed on high-fat diets produced better quality oocytes. During in vitro culture, a significantly higher proportion of oocytes collected from cows on high-fat diets developed to the blastocyst stage. In another study, we compared calcium soaps of palm oil (mainly palmitic, oleic and stearic acids) with protected soya (high in linoleic acid) or linseed (high in linolenic acid); oocyte cleavage rate was significantly lower in cows given fats with high linoleic or linolenic acid content. The mechanism for this effect is not known, but in heifers we found selective uptake of saturated fatty acids within the follicular compartment so that a higher proportion of saturated fatty acids was found in oocytes than in plasma.

In a recent metabolomic study, we found that milk fatty acid profile could be used as a predictor of reproductive performance in dairy cows: saturated and monounsaturated fatty acids were associated with better fertility; *trans* fatty acids, particularly *trans*-10, *cis*-12 CLA, but not *cis*-9, *trans*-11 CLA, were associated with poor fertility.

It can be concluded that fatty acids influence reproduction in dairy cows through several direct and indirect mechanisms. However, ovarian responses to metabolic signals and nutrient profile vary according to stage of the reproductive cycle. This is supported by our recent observation that manipulation of dietary fatty acids at key stages of lactation significantly increased pregnancy rate.