Variation of milk fat triacylglycerol structure within Dutch Holstein Friesan cattle population

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Background

Fatty acids (FA) within milk fat triacylglycerols are not randomly distributed. The distribution of FA varies within species. In bovine milk fat, short chain FA are positioned mainly in the outside part of the molecule (α position) and long chain FA, such as C16:0 and C18:0, are positioned in the inside (β position). The positioning of the FA within the triacylglycerol molecule could be determined by FA preference of enzymes related to milk fat synthesis.

Objective

•To study the variability of the structure of milk fat triacylglycerols from individual samples with contrasting FA composition.

•To investigate the effect of DGAT1 polymorphism on the structure of triacylglycerols.

Introduction

Milk fat is composed of over 400 different FAs. Diets and genetics affect the FA composition of milk fat. A wide range of FA profiles has been found in induvidual samples. Summer milk fat is typically more unsaturated than winter milk fat. Cows with DGAT1 KK polymorphism produce more saturated fat than those with AA polymorphism.

Within the triacylglycerol molecule, FAs are placed in a non-random way. Differences on FA distribution between highly unsaturated milk fat and a milk fat with a normal FA profile have been found. Triacylglycerol structure studied with a regiospecific approach divides the molecule in two regions: outside or α position and inside or β position (Figure 1).

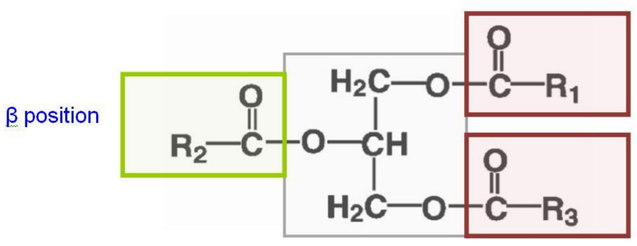
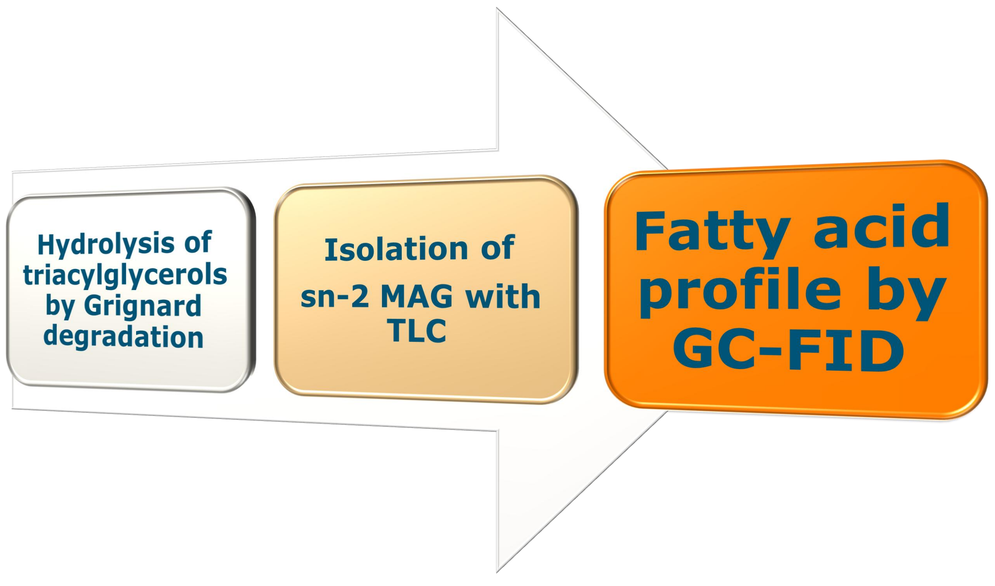


Figure 1. Regions in a triacylglycerol molecule. In green : FA known as β position; in red: FAs known as α position; in grey: glycerol backbone.

Methods.

▪The structure was analyzed with a regiospecific approach.



Results. *Interpositional approach*

The interpositional approach describes the proportional distribution of one FA over the three positions of the triacylglycerol.

- The proportion of C14:0, C16:0, and C18:1 cis 9 FA at sn-2 was related to the total amount of C16:0 in the triacylglycerol.
- We suggest that an increase in availability of C16:0 for fat synthesis will increase the activity of GPAT in mammary gland. This increase in activity will increase the proportion of C16:0 and other SFAs acylated at sn-1 at the expenses of sn-2. The decrease of C16:0 and other SFAs at sn-2 will be compensated by an increase of C18:1.

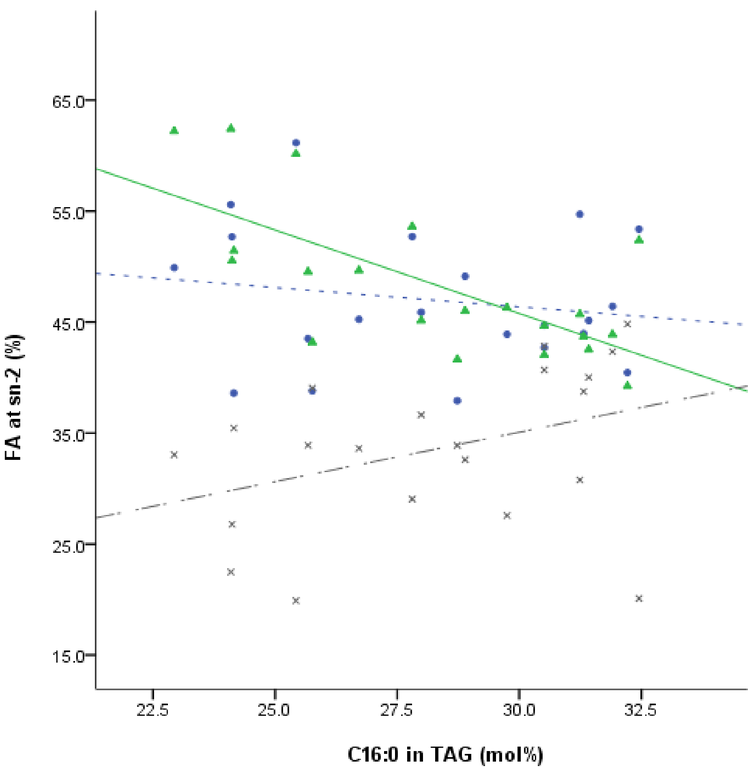


Figure 2. Percentage of C14:0, C16:0 and C18:1 cis 9 esterified at sn-2 and its relation to the total amount of C16:0 (mol%) in the TAG.
(●) % C14:0 at sn-2; (▲) % C16:0 at sn-2; (**X**) % C18:1 cis 9 at sn-2

Results. *Effect of DGAT.*

▪ DGAT1 showed a significative effect (p=0.03) on the proportion of C16:0 placed at sn-2.

▪ DGAT1 KK polymorphism showed a higher change rate than DGAT AA polymorphism.

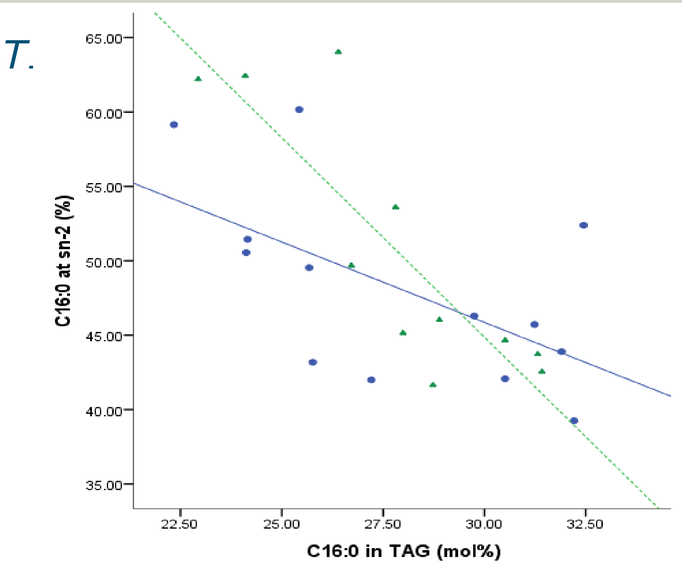


Figure 4. Proportional change of C16:0 esterified at sn-2 whith a change of C16:0 in the triacylglycerol.

Conclusions

- We found large variability of milk fat triacylglycerol structures within Dutch Frisian dairy cows.
- The proportion of FAs placed at sn-2 is related to the amount of C16:0 in the total TAG.
- DGAT1 polymorphism affected the rate change in wich C16:0 is placed at sn-2.

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