The antilipogenic effect of t10c12-CLA does not explain marine lipid-induced milk fat depression in dairy ewes: Insights from a meta-analysis

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Diet-induced milk fat depression (MFD) is presumably caused by the effects of ruminal biohydrogenation intermediates with antilipogenic activity. However, in marine lipid-induced MFD the involvement of t10c12-CLA, which is the only intermediate shown unequivocally to inhibit milk fat synthesis in ruminants, has been questioned, particularly in sheep. Thus, we conducted a meta-analysis to summarize the relationship between milk t10c12-CLA concentration and milk fat traits in lactating ewes. A database comprising 23 trials conducted by our team has been used. Fifty-five dietary conditions were characterized and grouped in two major categories (experimental treatments): non-MFD and marine lipid-induced MFD. The non-MFD category included 40 diets without supplementation or supplemented with plant oils and extracts, which modified the fatty acid profile of milk without detrimentally affecting milk fat synthesis. The marine lipid-induced MFD group comprised 15 diets supplemented with fish oil or microalgae. To ensure stable responses to diets, only the data collected after 21 or more days of adaptation were considered. Differences in diet formulation and chemical composition between the two groups of experimental treatments (non-MFD and MFD) were analyzed by one-way ANOVA. Linear and quadratic relationships between milk fat traits (yield and concentration of fat and yield of de novo synthesized and preformed fatty acids) and milk t10c12-CLA levels were examined using the MIXED procedure of SAS. Diet characteristics that may influence the response to lipid supplementation (e.g., forage:concentrate ratio, fibre concentration or starch content) did not differ between marine lipid-induced MFD and non-MFD groups. Prediction models showed an inverse linear relationship between t10c12-CLA and milk fat concentration in both treatments ($R^2=0.78$; $P<0.05$), which was unexpected, particularly in the non-MFD conditions. Nevertheless, this relationship was equivalent in the two experimental treatments and, therefore, the difference in milk fat concentration between non-MFD and MFD (on average, -19% in the latter) remained constant irrespective of t10c12-CLA levels ($P>0.10$ for the treatment × t10c12-CLA level interaction). Similarly, milk fat yield was 23% lower in MFD than in non-MFD conditions ($P<0.001$), regardless of t10c12-CLA proportions. In both treatments, the linear decrease in the yield of de novo synthesized fatty acids with incremental t10c12-CLA levels was counteracted by increases in the secretion of preformed fatty acids derived from plasma uptake ($P<0.001$). In conclusion, our results might support a relationship between increases in t10c12-CLA levels and decreases in milk fat concentration that, however, does not explain the marine lipid-induced MFD in lactating ewes.
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The antilipogenic effect of t10c12-CLA does not explain marine lipid-induced milk fat depression in dairy ewes: A meta-regression approach

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1. INTRODUCTION

Diet-induced milk fat depression (MFD) is presumably caused by the effects of ruminal biohydrogenation intermediates with antilipogenic activity.

However, in marine lipid-induced MFD the involvement of t10c12-CLA, which is the only intermediate shown unequivocally to inhibit milk fat synthesis in ruminants, has been questioned, particularly in sheep.

Aim: To summarize the relationship between milk t10c12-CLA concentration and milk fat traits in lactating ewes.

2. MATERIAL AND METHODS

Database 23 nutritional experiments (lot observations) - flock of the IGM 55 dietary conditions, divided in 2 experimental treatments (T):

- Non-MFD: 40 diets without supplementation or supplemented with plant oils and extracts
- MFD: 15 diets supplemented with fish oil or microalgae

Data collected after ≥3 weeks on diets (to ensure stable responses)

Statistical analysis (MIXED and REG procedures of SAS 9.4)

Regression analysis: relationships between milk fat traits and t10c12-CLA %

Prediction model: fixed effects of T, t10c12-CLA % (linear and quadratic), and interactions T x t10c12-CLA %; random effect of experiment

Fit statistics: root mean squared error (RMSE) and R² (for linear relationships between studentized residuals of observed and predicted values)

3. RESULTS

Diet characteristics than influence the response to lipid supplements (e.g., F:C ratio, NDF or starch content)

- milk fat % (y) vs. t10c12-CLA % (x)
  - RMSE = 0.300; R² = 0.78
  - Differences between non-MFD and MFD were not related with t10c12-CLA concentration

- de novo fatty acid yield (y) vs. t10c12-CLA % (x)
  - RMSE = 5.23; R² = 0.77
  - Inhibition of de novo synthesis with incremental t10c12-CLA levels
  - Increases in t10c12-CLA would not explain the MFD in dairy ewes

- milk fat yield (y) vs. t10c12-CLA % (x)
  - RMSE = 11.2; R² = 0.79

- preformed fatty acid yield (y) vs. t10c12-CLA % (x)
  - RMSE = 6.27; R² = 0.61
  - Counteracted by opposite variations in preformed fatty acid yield

4. CONCLUSION

Our results support that increases in milk t10c12-CLA concentrations do not explain the marine lipid-induced MFD in lactating ewes. However, the percentage of this CLA isomer is related with opposite variations in the yields of de novo and preformed fatty acids.