Long-chain and unsaturated aldehydes alter enteric microbiota

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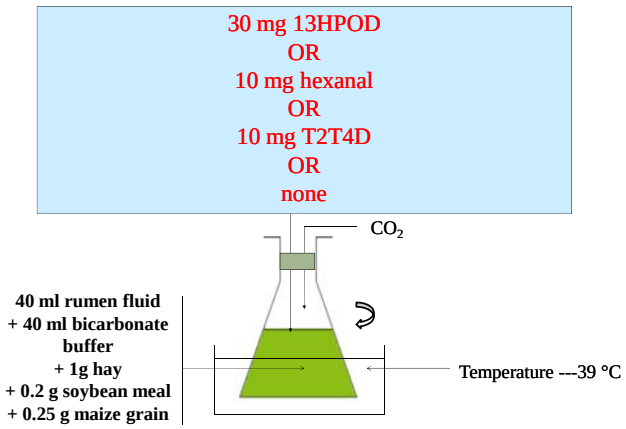
BACKGROUND

When heated, unsaturated fats undergo peroxidation, leading to the formation of oxidation products. For example, heating cis-9,cis-12-C18:2 majorly forms 13OOH cis-9,trans-11-C18:2 (13HPOD), hexanal and trans-2,trans-4-decadienal (T2T4D). In ruminants, some studies using heated seeds and oils reported an effect of heated fats on ruminal metabolism of fatty acids, which could affect milk and meat fat qualities for consumers. One possible explanation is a modification of the ruminal bacterial community, as peroxides and aldehydes are known to have antimicrobial effects. In order to investigate the effects of these three oxidation products on ruminal microbiota, a long term in vitro study was conducted.

MATERIALS AND METHODS



Total incubation time --- 54 or 102 hours

•Each day, the same quantities of respective oxidative product and fermentation substrates were added to each flask with 20 ml bicarbonate buffer.
•Blanks without oxidative products served as bacterial community controls.

Analyses/calculations:
In the laboratory, the samples were analysed for:
•Total ruminal bacteria density (qPCR , kit QIAmp DNA®),
•Bacterial community structure (CE-SSCP),
and bacterial diversity was estimated by Simpson index.

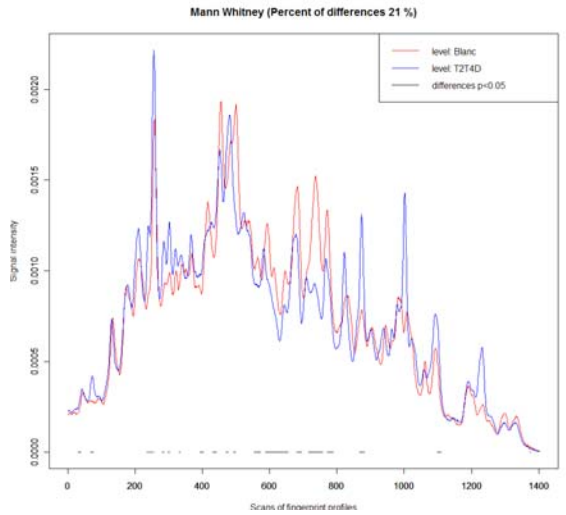
Statistics:
•Density and diversity : GLM + pairwise comparison (Tukey's Test)
•To compare the structure of the bacterial communities, pairwise Euclidean distances of the CE-SSCP profiles were calculated. Global analysis of similarity (ANOSIM) was performed to test the fixed effects of oxidation products. Finally, an iterative Mann-Whitney test was carried out on the 1700 scans of the CE-SSCP profiles to estimate the percentage of population that differed between blank and the treatment.

RESULTS

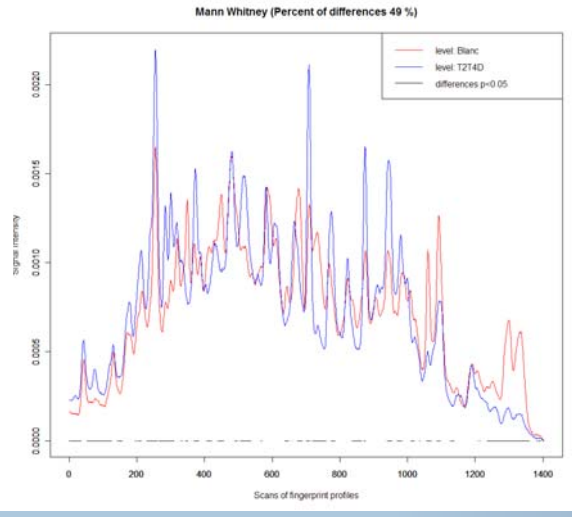
Bacterial density was not modified by treatments: 1.10^{10} DNA copies / ml of cultures, on average. Hexanal and 13HPOD had no effect on ruminal bacterial diversity and community, whereas T2T4D reduced bacterial diversity (7.6 vs. 8.0 for controls) and strongly affected bacterial community. This effect increased with incubation duration: T2T4D affected ($P < 0.05$) 21% (R-ANOSIM = 0.46; Figure 1A) and 49% of scans (R-ANOSIM = 0.92; Figure 1B) after 54 and 102h of incubation, respectively.

Figure 1: Effects of T2T4D on bacterial community compared to controls after 54h (A) and 102h (B) of incubation.

1A



1B



CONCLUSIONS

Ruminal microbiota was strongly modified by T2T4D. Bacterial species sensitive to T2T4D need to be identified and effects on enteric microbiota in other species should be investigated.