Effect of dietary olive oil and palm oil on rumen bacterial composition in dairy cows

Nathaly Cancino-Padilla1, Jaime Romero2, Sharon A. Huws3, Einar Vargas-Bello-Pérez1,4

1Pontificia Universidad Católica de Chile, Departamento de Ciencias Animales, Facultad de Agronomía e Ingeniería Forestal, Santiago, Chile.
2Universidad de Chile, Instituto de Nutrición y Tecnología de los Alimentos (INTA), Santiago, Chile
3Queen’s University of Belfast, Institute for Global Food Security, School of Biological Sciences, Belfast, United Kingdom.
4University of Copenhagen, Faculty of Health and Medical Sciences, Department of Veterinary and Animal Sciences, Copenhagen, Denmark.

Introduction

Dietary fatty acids (FA) affect FA content of ruminant meat and milk, due to their effect on the rumen microbiome. Dietary forages are high in human-health beneficial polyunsaturated fatty acids (PUFAs), nonetheless the double bonds are removed quickly and efficiently by the rumen bacteria post-ingestion in order to avoid their toxicity, in a process known as biohydrogenation. Strategies to inhibit biohydrogenation, producing ruminant products containing more human-health beneficial PUFAs, often involve dietary oil supplementation.

Materials and methods

Fifteen Holstein cows averaging (±SD) 189 ± 28 days in milk were assigned to three treatment groups. For 63 days animals were fed a control diet (basal diet; 65% forage; 35% concentrate) with no added lipid and two supplemented diets (30 g/kg DM).

Treatments

1. Control: Basal diet with no added lipid
2. OO: Basal diet + Olive Oil (30 g/kg DM)
3. HVO: Basal diet + Palm Oil (30 g/kg DM)

Lipid supplementation

Rumen samples were collected every 21 days for 63 days using an esophageal-ruminal sampling device. Total microbial DNA was extracted from samples for high-throughput sequencing of the 16S rRNA gene through Illumina MiSeq platform.

16S rRNA gene amplicon sequences were quality checked with FASTQC and analyzed by DADA2 and PhylSeq R packages. Taxonomy was assigned using the SILVA Database version 132.

Results and Discussion

Results revealed the dominance of phyla Firmicutes and Bacteroidetes, whereby Firmicutes was the most prevalent phyla in Control (75.2%), OO (71.1%) and HVO (75.2%). At genus level Succinivibrionaceae and Prevotellaceae were the most dominant, and these belong to the phyla Firmicutes and Bacteroidetes respectively. Succinivibrionaceae increased significantly in relative abundance post OO supplementation (p < 0.0001) throughout 63 days, while Prevotellaceae increased (p < 0.0001) only after 42 days of OO supplementation. Following HVO dietary supplementation, Succinivibrionaceae increased in relative abundance (p < 0.0001) in throughout the study period, whilst Prevotellaceae decreased over time (p = 0.0001).

Conclusions

Olive oil increased the relative abundance of Succinivibrionaceae and Prevotellaceae which are related to methane mitigation and energy supply for the host, respectively. Both roles could be associated with more efficient animals and thus improved milk production.

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