Gene co-expression networks in liver and muscle transcriptome reveal sex-specific gene expression in lambs fed with a mix of essential oils

Essential oil (EO) dietary supplementation is a new strategy to improve animal health. EO compounds have antiparasitic, antimicrobial, antiviral, antifungal, antioxidant and anti-inflammatory properties. Nutrigenomics investigations represent innovative approaches in understanding the relation between diet effect and gene expression related to the animal performance. Few nutrigenomics studies have used a high-throughput RNA-Sequencing (RNA-Seq) approach, despite the great potential of RNA-Seq data in gene expression quantification and in co-expression network analyses. Our aim is to use the potential of RNA-Sequencing data in order to evaluate the effect of an EO supplementary diet on gene expression in both lamb liver and muscle. Using a treatment and sex interaction model, 13 and 4 differentially expressed genes were identified in liver and muscle, respectively. Sex-specific differentially expressed (DE) genes were identified in both sexes.

Using network-based analysis, different clusters of co-expressed genes that were highly correlated to the diet were detected in males vs. females, in agreement with DE analysis. A total of five regulatory genes in liver tissue associated to EO diet were identified: DNAJB9, MANF, UFM1, CTNNLA1 and NFX1. Our study reveals a sex-dependent effect of EO diet in both tissues, and an influence on the expression of genes mainly involved in immune, inflammatory and stress pathways. Our analysis suggests a sex-dependent effect of the EO dietary supplementation on the expression profile of both liver and muscle tissues. We hypothesize that the presence of EOs could have beneficial effects on wellness of male lamb and further analyses are needed to understand the biological mechanisms behind the different effect of EO metabolites based on sex. Using lamb as a model for nutrigenomics studies, it could be interesting to investigate the effects of EO diets in other species and in humans.

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