

Analysis of aggressive behaviour in high-production dairy cows through differential expression transcriptome analysis

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EAAP 2024
Session 85. Genetics of novel health and welfare traits
September, 4 2024



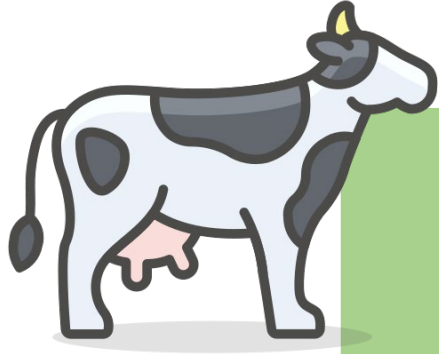
Introduction - aggression in cattle

- Aggression is a fundamental behaviour observed across species, often triggered by stress and serving crucial roles such as: self-defense, competition for resources, social hierarchy maintenance
- Types of aggression in cattle:
 - Maternal - protective behaviour by cows towards their calves
 - Feed-related - competition for food resources
 - Comfort-influenced - aggressive behaviour due to discomfort or poor housing conditions
 - Pain-induced - reaction to injury or discomfort
 - Stress-induced - triggered by environmental stressors or changes
- Aggression in cattle can arise from both genetic and environmental factors

The aim

- To discover gene expression profiles and enrichment pathways characteristic of aggressive behaviour
- The results were correlated with selection indices and production traits derived from utility assessments and breeding value evaluations of high-production dairy cows using a whole gene co-expression network analysis

Data



CALM

8 x cows

Cortisol level
< 4.7
(mean 3.1)

Material

Hair samples
Blood samples

Databases

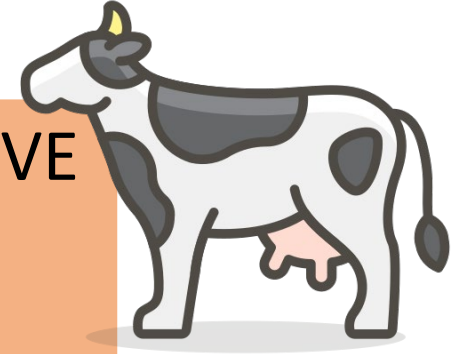
Fedinfo
CRS (crs.izoo.krakow.pl)



AGGRESSIVE

8 x cows

Cortisol level
> 4.7
(mean 5.9)



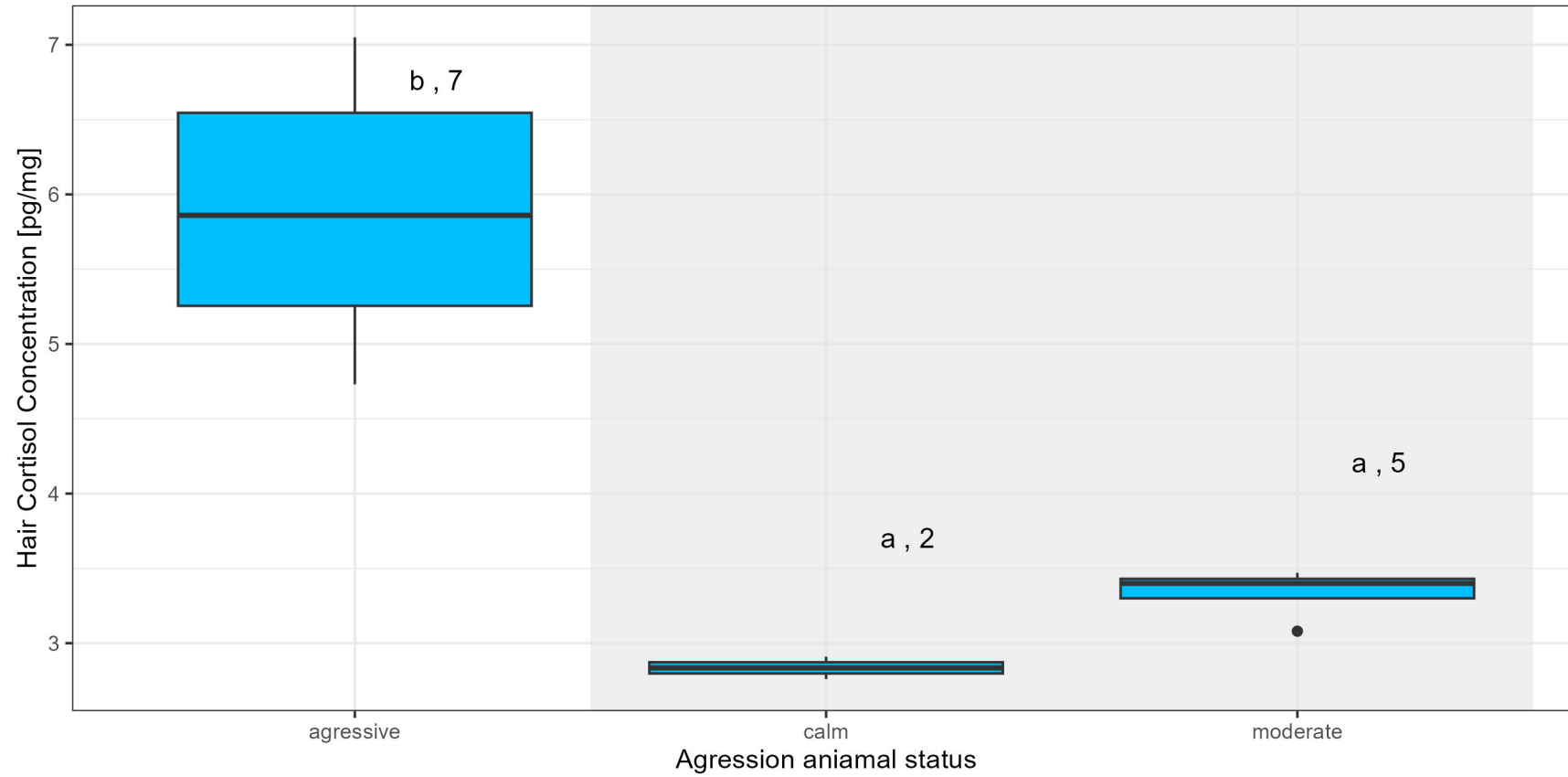
In total 16 high production and unrelated cows
from two farms with full data from utility and
breeding assessment

Methods

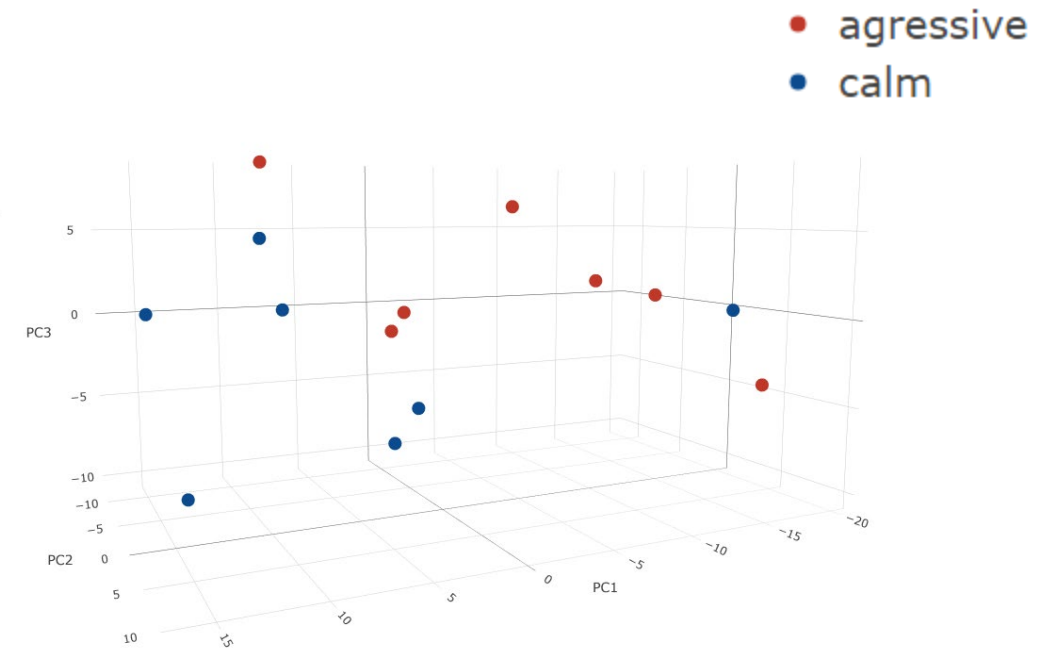
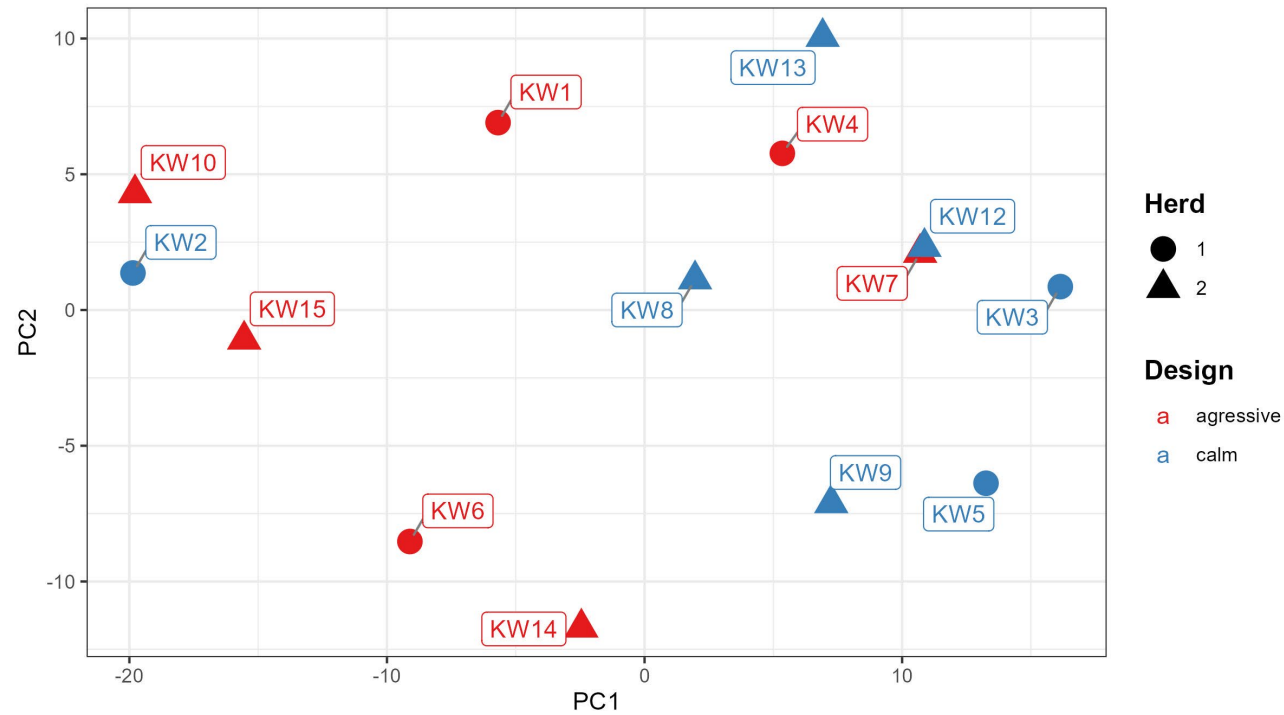
- Cortisol levels in hair samples were measured in the study group
- Transcriptome sequencing: The study generated over 35 million paired-end reads, with an average alignment rate of 90% of the ARS-UCD1.3 reference genome
- Bioinformatics: quality control, trimming, alignment, counting, analysis of differentially expressed genes (DEGs) using DESeq2 + removing batch-effects, pathway analysis with GSEA, and co-expression analysis using GWENA (Gene Whole Co-Expression Network Analysis)



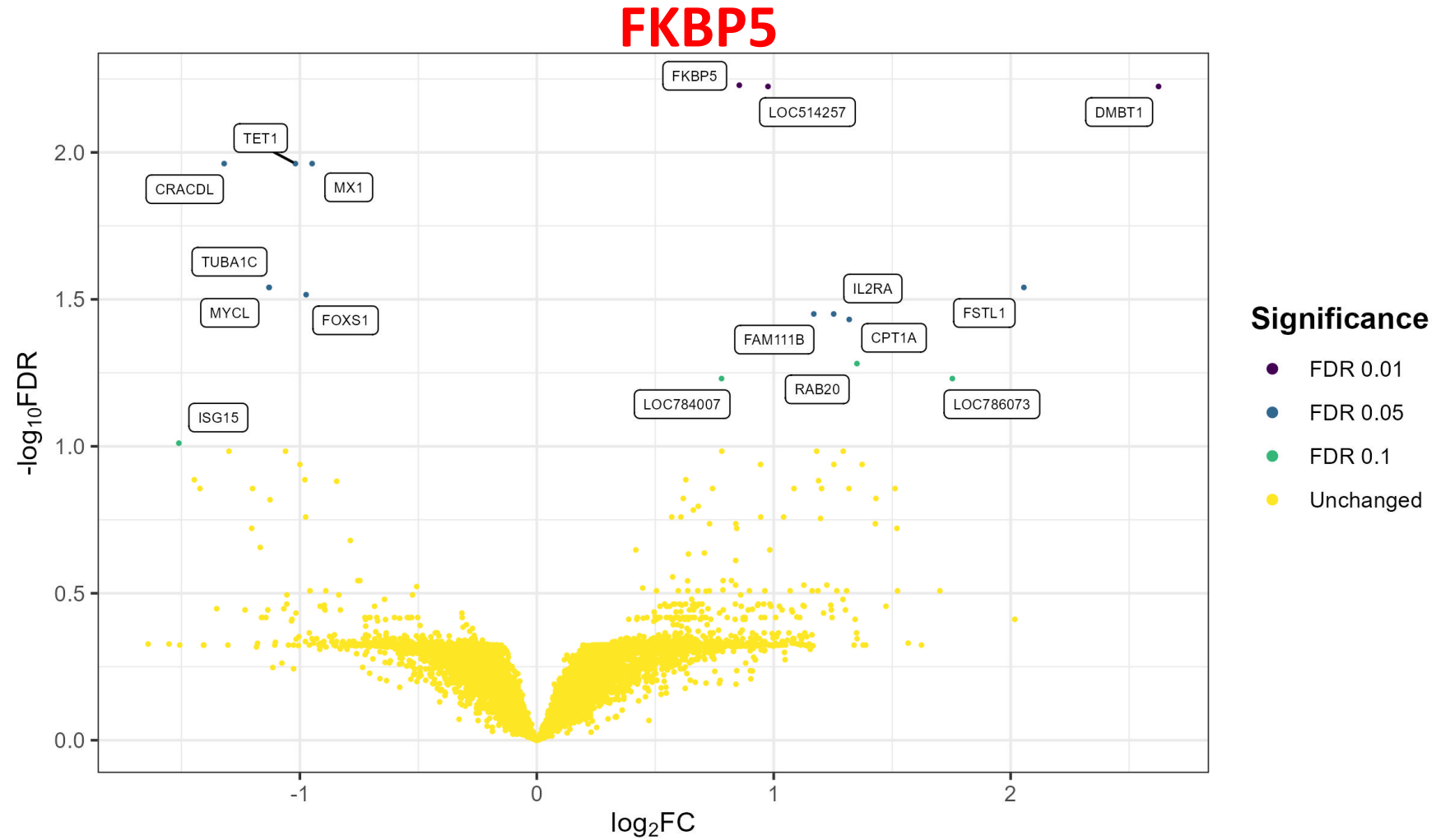
Results: Cortisol level



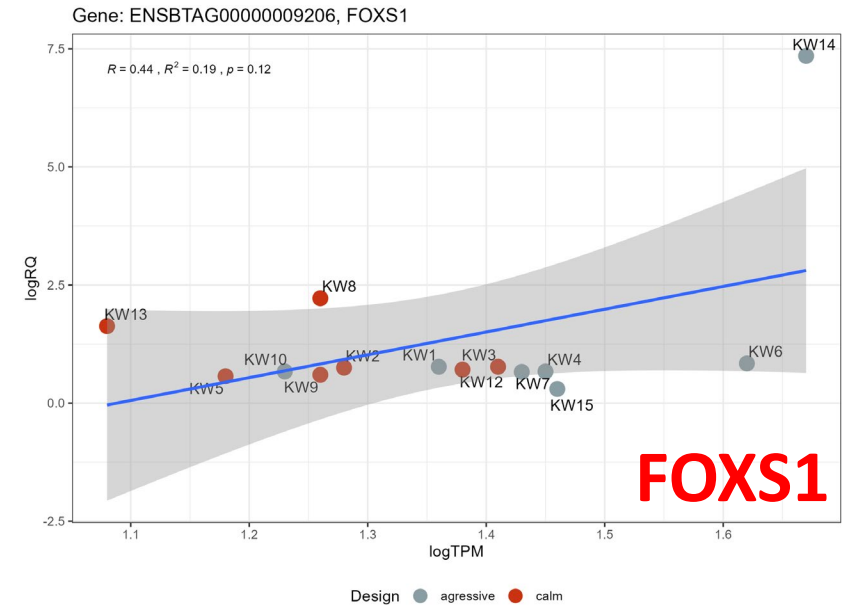
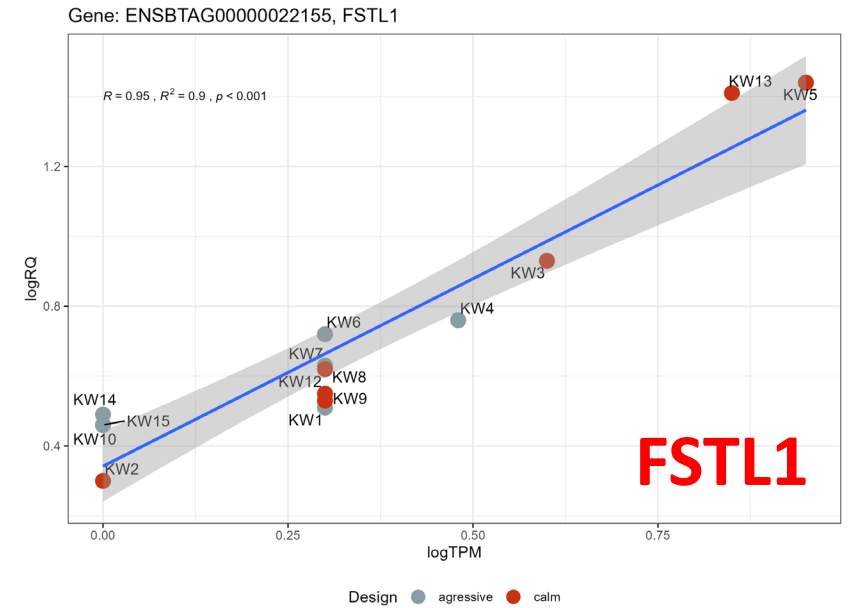
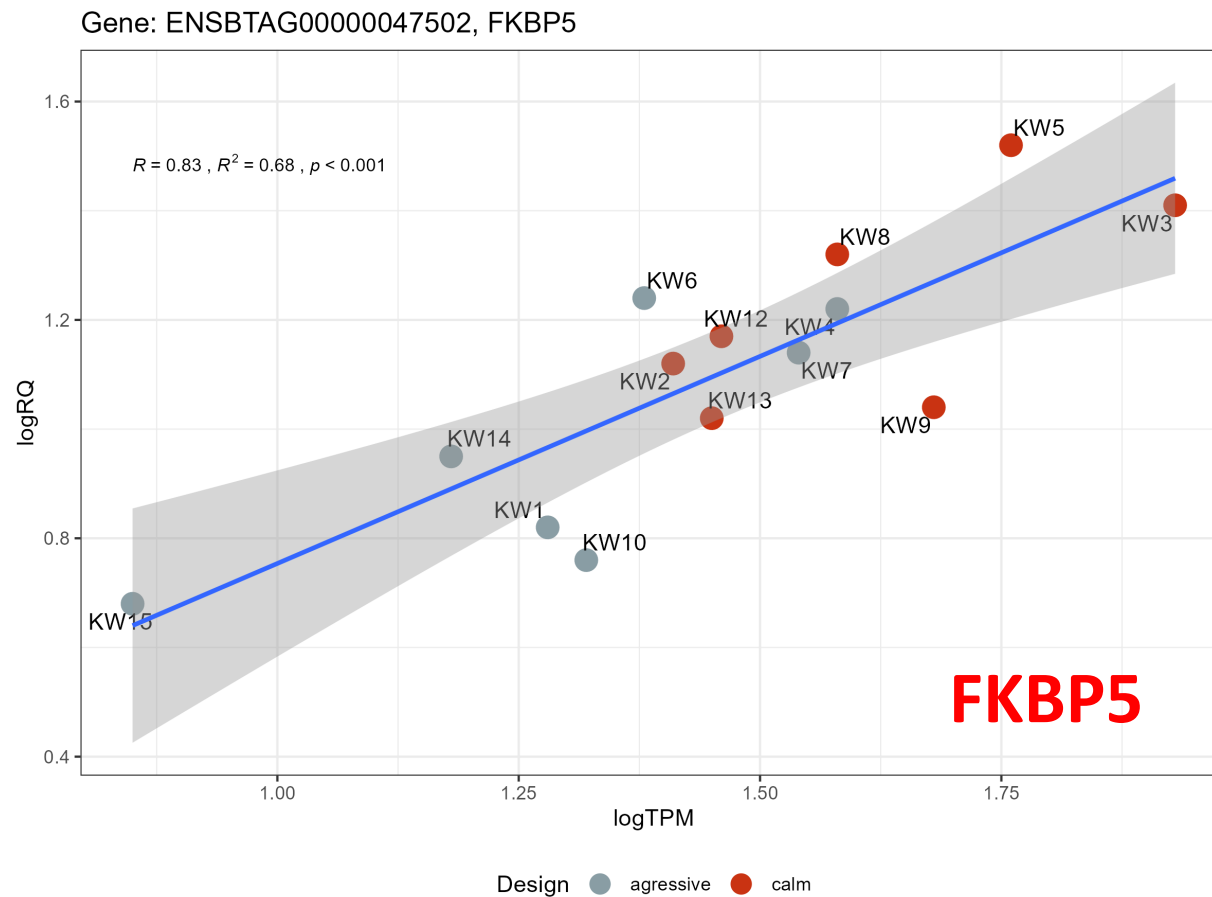
Results (PCA)



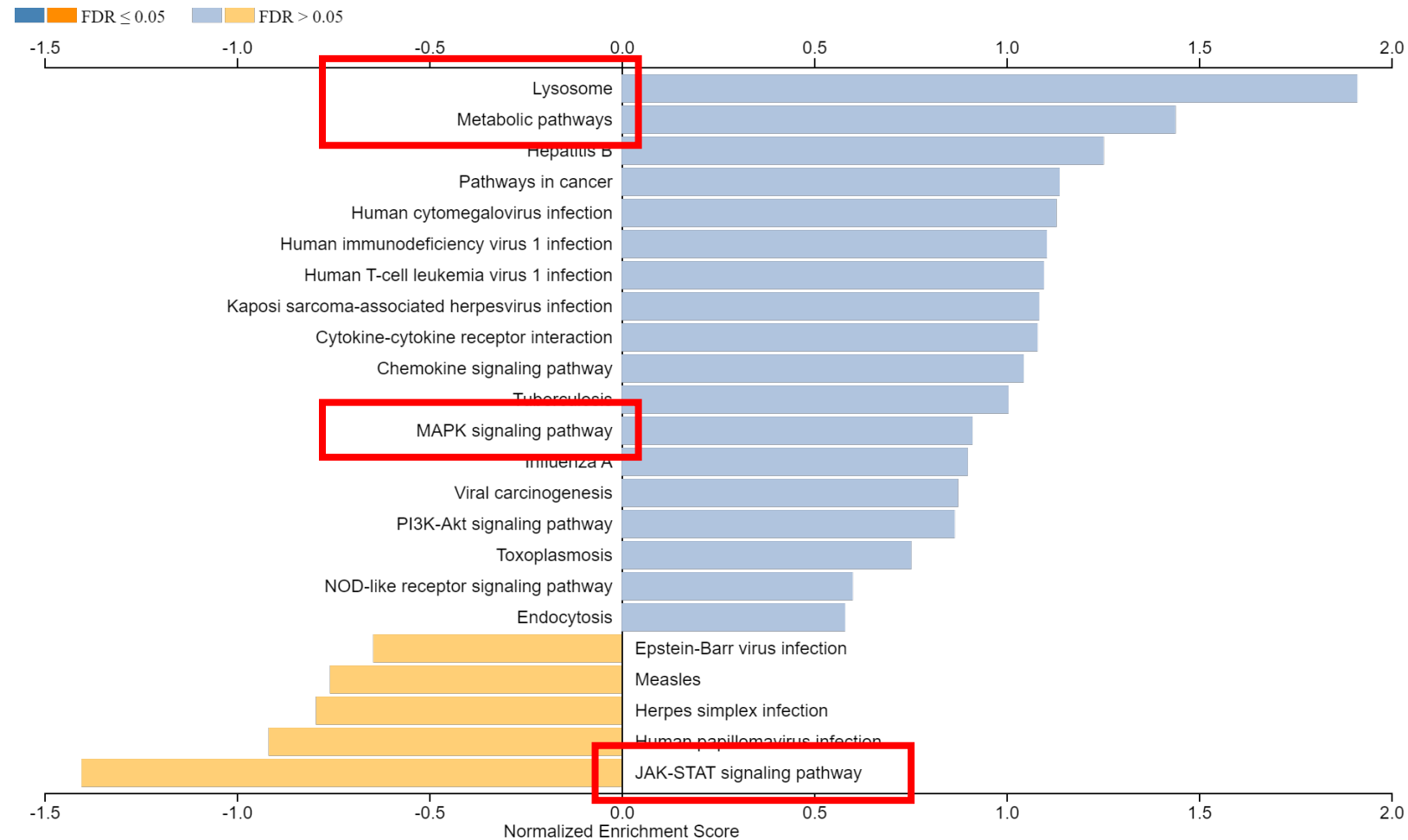
Results: DEGs (17)



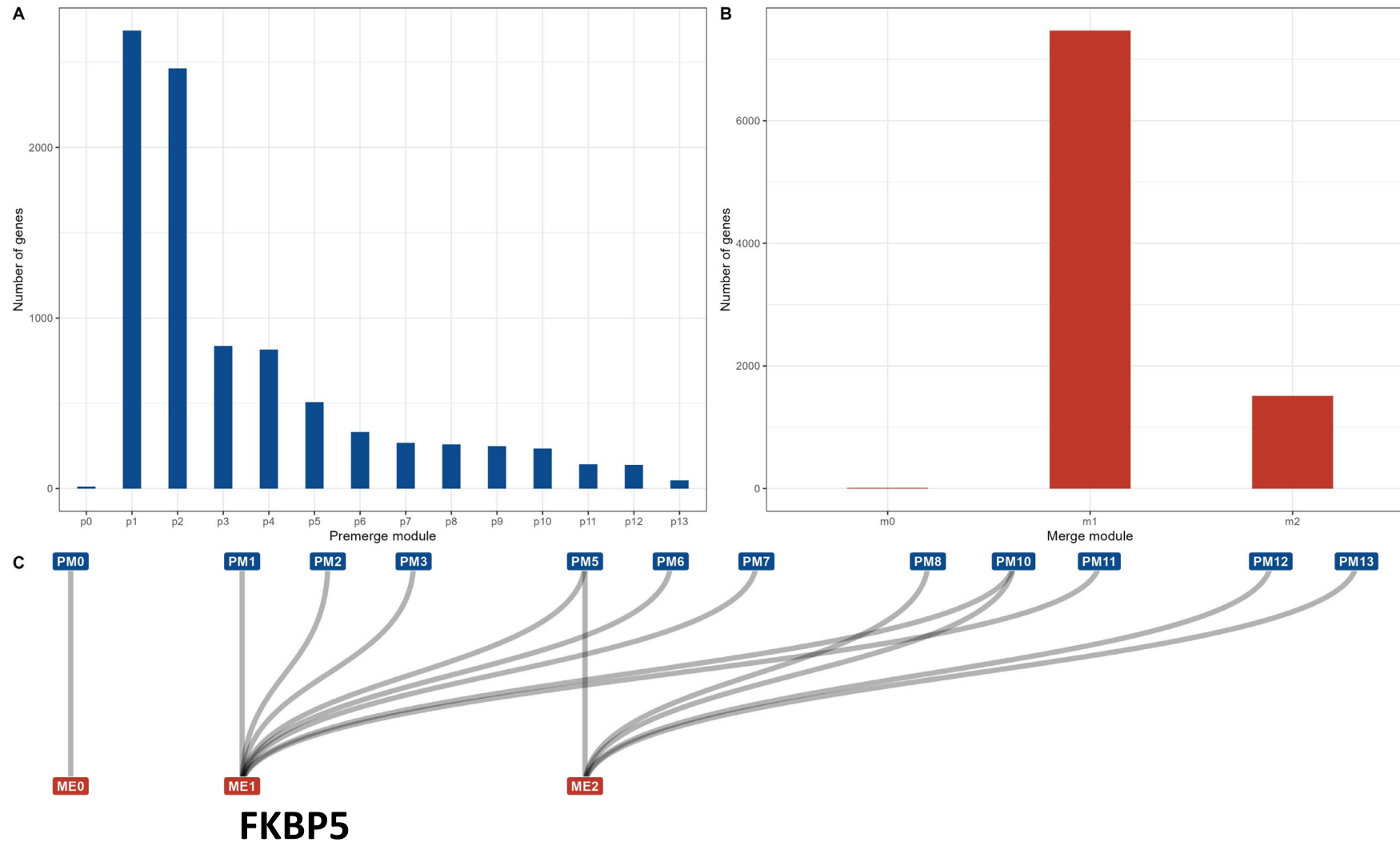
Results: DEGs validation



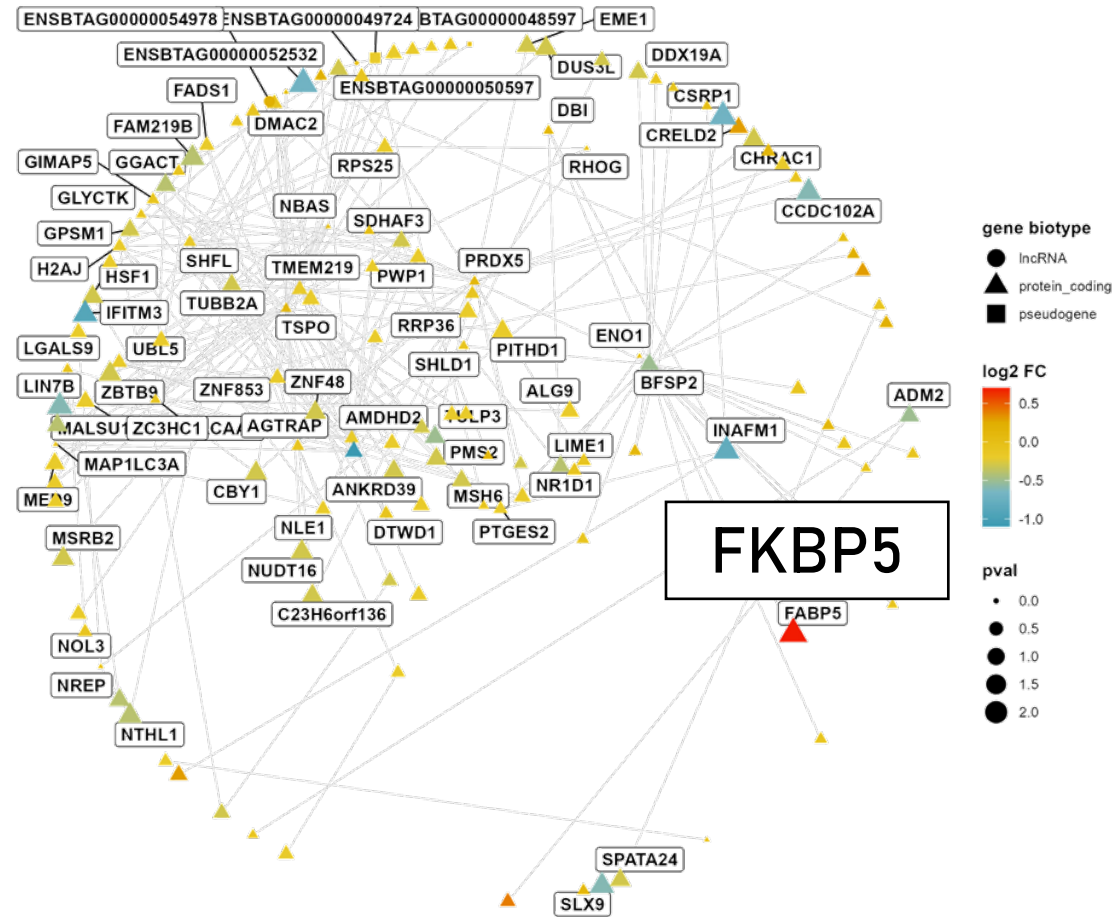
Results: pathways analysis - KEGG



Results: co-expression analysis

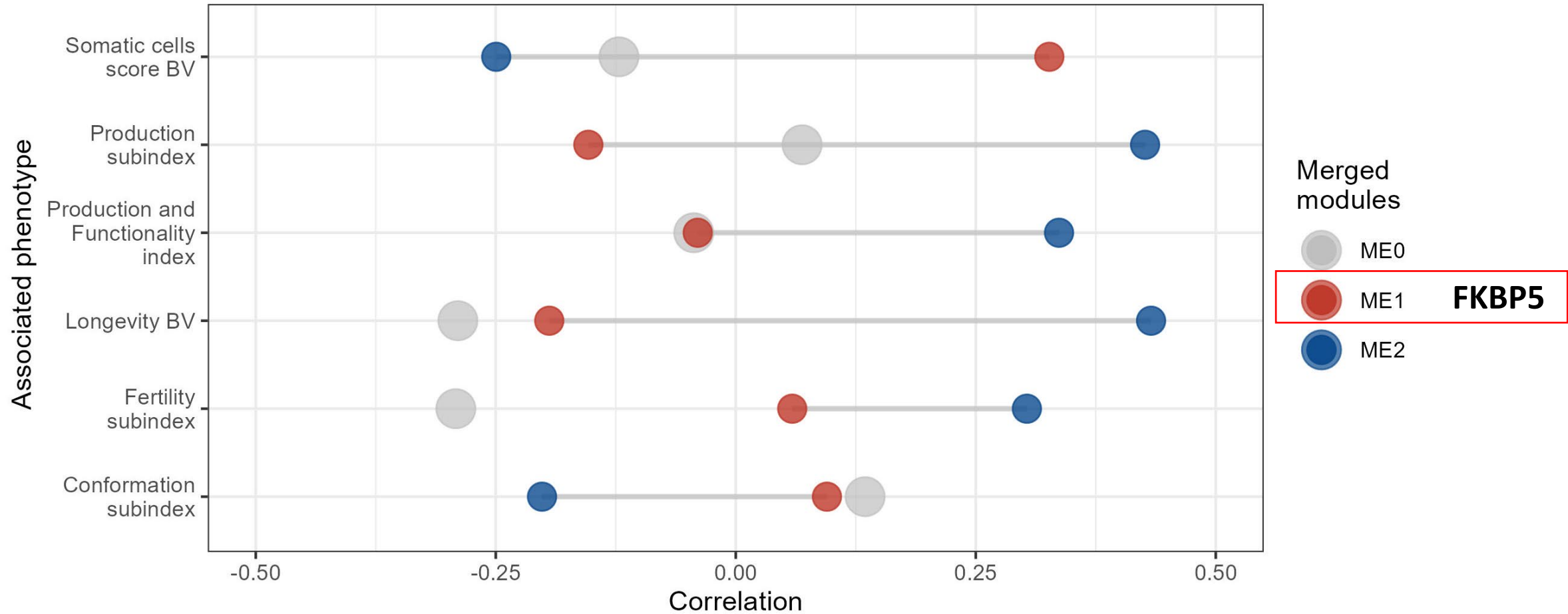


Results: co-expression analysis



Module 1

Results: co-expression analysis



Summary and conclusions

- The analysis of cortisol levels in hair is a reliable diagnostic tool for assessing stress factors, including aggressive behaviour in animals (Sharma et al., 2019)
- Seventeen highly significant genes potentially associated with aggressive behaviour in cows were identified. RNA-Seq validation using real-time qPCR confirmed the gene expression levels.
- These genes, particularly FKBP5 (Fatty Acid Binding Protein 5) located on BTA23, had previously been identified as being associated with aggressive behaviour (Fernàndez-Castillo & Cormand, 2016; Zannas et al., 2016).

Summary and conclusions

- Molecular pathways (KEGG) associated with aggressive behaviour were identified, including the lysosome, JAK-STAT signaling pathway, and MAPK signaling pathway (Fernández-Castillo & Cormand, 2016).
- Two main gene co-expression modules were identified, including 13 submodules. It was demonstrated that module ME2 (not associated with aggressive behaviour in cows) is negatively correlated with breeding value for somatic cell score (SCS) and positively correlated with the PF index, production subindex, fertility subindex, and longevity.

Thank you for your attention