Milk yield and gene expression in the udder of beef heifers depending on pre and post- weaning diets.

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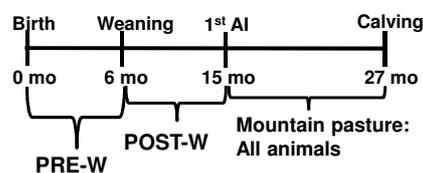
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Raising female calves and heifers on high energy planes of nutrition during the pre-pubertal period has been proposed to lower the age at first calving, reducing their "unproductive" period. However, high energy planes of nutrition during pre-pubertal period have been shown to have a negative effect on milk yield and may compromise mammary development, decrease the potential of subsequent milk yield and health and immune status of the animal

Objective

Evaluate early nutrition-induced changes on first-lactation milk yield and composition and gene expression in the mammary gland in Parda de Montaña primiparous cows

Material and methods

Animal design and diets

2x2 factorial experiment

Birth — Weaning — 1st AI — Calving
0 mo — 6 mo — 15 mo — 27 mo
PRE-W / POST-W

Mountain pasture: All animals

PRE-W: Creep: milk + concentrate ad libitum (n=8)
Control: milk (n=8)

POST-W: High: 91.7 MJ/d (n=8)
Moderate: 79.3 MJ/d (n=8)

Traits

Measurements: BW, and ADG
Blood: glucose, IGF-I and leptin
MILK: yield; protein, fat, casein, lactose and non fat solids content; and SCC
Statistical analysis using SAS

RNA extraction and microarray hybridization

Mammary gland biopsy: RNA extraction (RIN>8)

Bovine gene 1.1 st array strip (Affimetrix): GEO_GSE78173

Data processing

Babelomics: Limma test; p<0.001

MetaboAnalyst: SAM; FDR<0.005 PCA, PLS-DA and Hierarchical clustering

DAVID: Functional Annotation Clustering
KEGG: Visualization of metabolic pathways
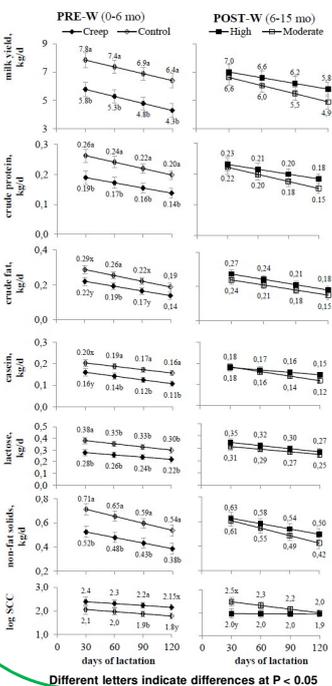
Validation by qPCR

Six coding genes and 5 miRNAs

Conclusions

Creep feeding during PRE-W period resulted in up–regulation of genes related with immune response and chemokine activity and down-regulation of ribosome and spliceosome genes. The data confirmed the lack of clinical mastitis, however, the possibility that the animals might be at greater risk to develop subclinical mastitis cannot be excluded. Therefore, increasing the energy level during the POST-W period would be advisable to reduce the age at first calving of heifers, without impairing milk yield or immune status
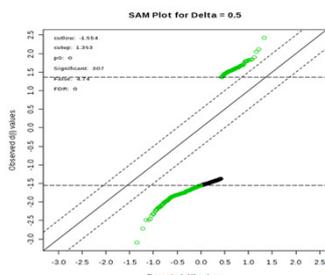
Results

Effect of PRE-W and POST-W feeding treatments on milk yield and quality

Significant differences were found only in PRE-W treatment

Different letters indicate differences at P < 0.05
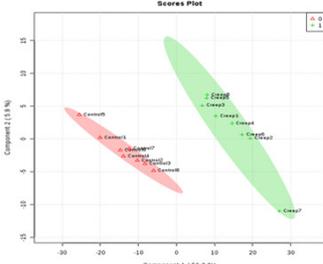
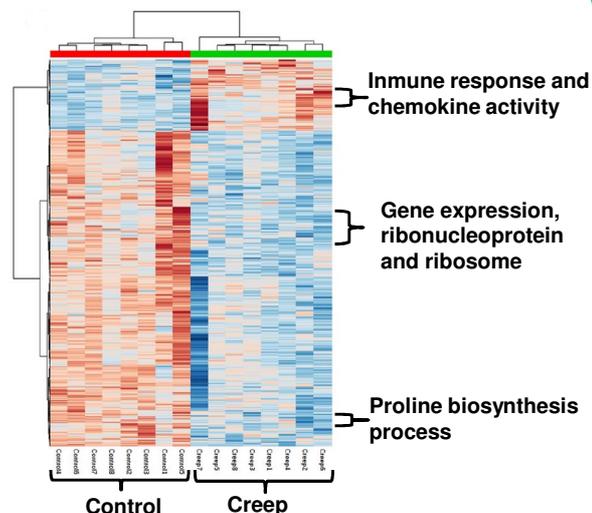### Significant genes after SAM

PRE-W: 307 genes

Fifteen miRNAs related to mastitis, and adipose tissue were identified

POST-W: 7 genes

PLS-DA (PRE-W)

Hierarchical Clustering and Functional Annotation Clustering in PRE-W

- Inmune response and chemokine activity
- Gene expression, ribonucleoprotein and ribosome
- Proline biosynthesis process

Control — Creep

Validation by qPCR

	Microarray Creep vs. Control	qPCR Creep vs. Control
mRNA (PCC=0.97)**		
PTGR1	-2.11***	-2.35***
PYCR1	-1.49***	-1.05
ANKRD26	1.47***	2.18***
CXCL11	2.22***	2.21***
SLC25A3	1.71***	1.63
KHDRBS1	-2.23***	-1.28
miRNA (PCC=0.95)**		
MIR296	2.36***	1.31
MIR197	-1.58***	-1.79*
MIR200B	1.67***	1.01
MIR1940	1.70***	1.86**
MIR143	1.99***	1.14

PCC= Pearson correlation coefficient and their significance (P < 0.05*; P < 0.01**)