Effect of enhanced nutrition during early life on the transcriptional profile of the arcuate nucleus region of the hypothalamus in Holstein-Friesian bull calves

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Introduction

- In seasonal dairy production systems demand for semen from genetically elite young AI sires often exceeds supply. Thus, early onset of puberty and sexual maturity in young bulls is necessary to ensure timely availability of high quality semen during their first breeding season.
- Early life plane of nutrition can directly affect the timing of puberty through interaction with the hypothalamic-pituitary-testes axis in bulls. In particular the arcuate nucleus region of the hypothalamus is central to the relationship between metabolic status and subsequent reproductive development, however the precise biological mechanisms regulating this effect remain unknown.

Objective: To determine the effect of early life plane of nutrition on the transcriptional control of the hypothalamic arcuate nucleus region in young Holstein-Friesian bull calves.

Materials & Methods

- Holstein Friesian bull calves with a mean age of 17.5 (±2.8) days were assigned to either a high or moderate plane of nutrition, from 2 to 12 weeks of age.
- At 12 weeks of age all calves were euthanized and the arcuate nucleus region of the hypothalamus recovered.
- Total RNA was isolated from all arcuate nucleus samples using the Qiagen RNeasy Plus Universal kit and subsequently analysed using RNAseq.
- An overview of sequencing and bioinformatic analyses for both is presented in Figure 1.

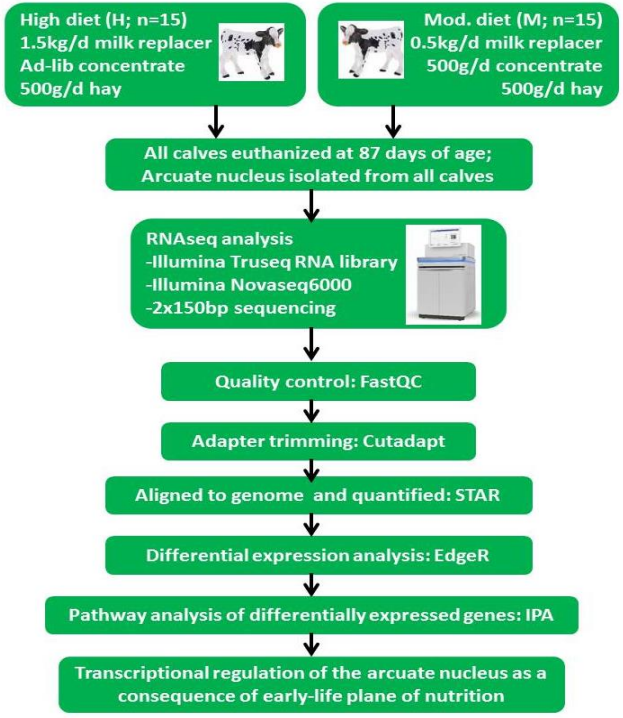

Figure 1. Overview of sequencing and bioinformatic analyses.

Results

- Altered plane of nutrition during the first 12 weeks of life resulted in greater growth rates (0.88 v 0.58 kg, P<0.001) and final live-weight (112 v 88 kg, P<0.001) between H and M calves.
- Plane of nutrition affected the expression of transcripts in the arcuate nucleus region, with 83 genes identified as down-regulated in H calves compared to M calves.
- Pathway analysis revealed enrichment of pathways involved in immune function between H and M calves (Table 1).

Table 1. Immune function pathways enriched between H and M

Pathway	P-value
Acute Phase Response Signalling	<0.001
Coagulation System	<0.001
Complement System	<0.001

Conclusions

Results from this study show an effect of early life nutrition on the arcuate nucleus transcriptome through altered expression of genes involved in immune function. However, no DEGs directly related to reproductive development were identified.

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