Application of metabolomics on selecting for litter size in American mink

S. Spencer\textsuperscript{1}, A. Kenez\textsuperscript{2}, Y. Montanholi\textsuperscript{1} & Y. Miar\textsuperscript{1}

\textsuperscript{1} Dalhousie University, Department of Animal Science and Aquaculture, Truro, Canada
\textsuperscript{2} Institute of Animal Science, University of Hohenheim, Stuttgart, Germany
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• Mink Genomics Research Program
• Background
• Mink metabolomics
• Results
Mink Genomics Research Program
Background

• Over 99% of ranch-raised pelts sold in Canada are American mink pelts
• Nova Scotia produces 61.4% of pelts in Canada
• Increasing litter size will produce a higher financial gain than improving any other trait in mink
• This study is one of the first metabolomic studies on mink
Objectives

• To determine metabolites and their association with litter size in mink

• To assess the potential of metabolomics in selecting for economically important traits in mink
**Mink Breeding**

- Induced ovulators - seasonal breeder
- Gestation ranges from 40-75 days
- Litter size ranges from 0-17 kits
- Litter size heritability of 0.07±0.03

**Factors Affecting Litter Size**

- Length of gestation
- Nutrition
- Ovulation rate
Metabolomics

- The study of metabolites present within an organism, cell or tissue
- Metabolites are substances formed in or necessary for metabolism
- Ability to study the phenotype while taking environmental stresses into account

Previous Research

- Predict desired phenotypes
  - Body mass
  - Growth rates
  - Meat quality
  - Feed intake
- Discover biomarkers for diagnosing diseases
  - Diabetes
Animals

- 21 dams from the Canadian Centre for Fur Animal Research (CCFAR) – Dalhousie AC
  - Age ranges from 2-4 years

- Selected based on the reproductive performance (2016)
  - 11 selected for high litter size (Avg. 9)
  - 10 selected for low litter size (Avg. 0)
Sample Collection

1. Cut toenail past quick
2. Collect blood into 5 capillary tubes (~350 uL)
3. Centrifuge for 7 minutes
4. Collect plasma into labelled cryovials (~50uL)
5. Disinfect and freeze in liquid nitrogen
6. Store at -80 °C until further analyzed at NRC

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**Metabolite Assay Using NMR**

- Samples prepared at NRC
  - Dilute samples with D20 to 10-20%
  - Transfer into 1.7mm NMR tubes
Data Analysis

• NMR spectra imported into NMRProcFlow 1.2
  • Alignment
  • Removal of water signal
  • Intelligent binning

• Binned NMR spectral data then analyzed in MetaboAnalyst 3.0

• Principle Component Analysis (PCA) was used to visualize the impact of reproductive performance on plasma metabolic fingerprints

• No obvious separation between groups

• Remarkable variation between individuals

• Individual patterns present
  • Mink 10, 13, 19
  • Mink 17, 20
PCA Score Plot

- PC1 and PC2 accounted to 49.4% of the total variation
- Little variation seen within low litter size group
- Plenty of variation within high litter size group
**T-test**

- Significance level: $P<0.05$
- Majority of spectral bins not significantly different
- Significant difference seen between 5 bins
  - Greater concentration of metabolite in high litter size group in all 5 spectral bins
Conclusion

• Lack of difference may be due to small sample size
• Next step is to determine the association between the metabolites and litter size
• Cao et al. (2015) found progestin level to be higher in mink dams with reproductive success
• Results from this study show the good potential for future metabolomic studies in mink
  • Feed conversion
  • Aleutian disease
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Dalhousie University Faculty of Agriculture

Dalhousie University 1818 2018

Mink Genomics Research Program
Younes Miar, Ph.D.
Assistant Professor & Industry Research Chair in Mink Genomics

miar@dal.ca

902-893-6165

Graduate Student Positions – Mink Genomics