SABRE
CUTTING EDGE GENOMICS FOR SUSTAINABLE ANIMAL BREEDING

WP5 Mammary Function

Understanding the Genetics of Mastitis

Partners:
MTT (Finland)
RI (Scotland)
ARO (Israel)
AU (Denmark)

Food Quality and Safety

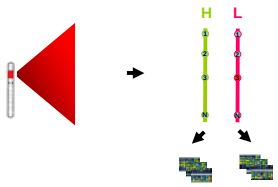
Genetics of Mastitis

- **Population level**
  - low heritable trait ~ 5-15%
  - clinical mastitis and somatic cell score correlated ~ 0.6-0.7
  - correlated to milk yield ~ 0.4-0.6
- **QTL studies**
  - Several QTL identified
  - BUT no causative genes
- **Variation on different levels**
  - Genome
  - Transcriptome
  - Proteome
  - Phenotype

Objectives WP5

- **QTL studies**
  - Finemapping of QTLs for mastitis/SCS
  - Assess pathogen specificity of mastitis QTL
- **Expression studies**
  - Identify candidate genes/pathways associated with infection
  - Identify candidate genes/pathways associated with mastitis QTL
- **Association study**
  - Identify SNPs in candidate genes associated with mastitis in population

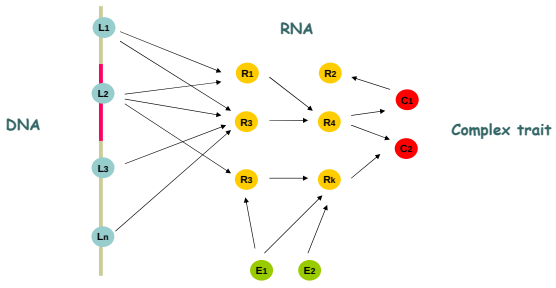
Combine QTL and Expression studies



QTL study identifying a chromosomal region associated with mastitis

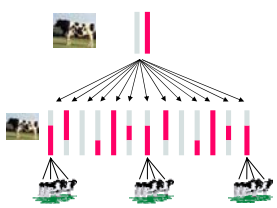
Expression study comparing expression profiles of animals carrying high (H) or low (L) resistant haplotypes

Combine QTL and Expression studies



QTL study

Mastitis QTL finemapped in Danish Holstein population



Pathogen specificity of haplotypes

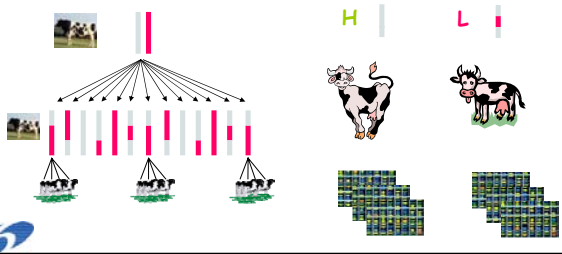
H L

High resistant Low resistant
E-coli

Combine QTL and Expression studies

Mastitis QTL finemapped in Danish Holstein population

Expression profiling of of H/L haplotypes



Expression studies

Experiment 1: Cows challenged with LPS (from E-coli)

Experiment 2: High/Low cows challenged with E-coli

Cows challenged with LPS

- Mastitis QTL associated E-coli
- Lipopolysaccharide (LPS) – from E.coli
- Initiating factor of acute phase response:

  A systemic response with physiological phenomena like fever, leukocytosis and altered serum concentrations of acute phase proteins (APP)

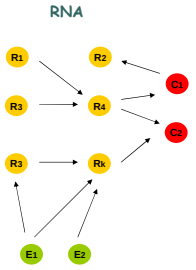
- Altered gene expression in liver is thought to be responsible for altered serum concentrations of APP

Cows challenged with LPS

Challenge with LPS | Liver | Gene expression

(-22, 3, 6, 9, 12, 48)

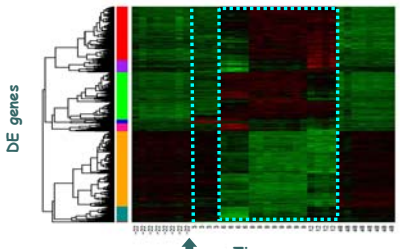
Cows challenged with LPS



Clinical traits

before/after LPS

Cows challenged with LPS



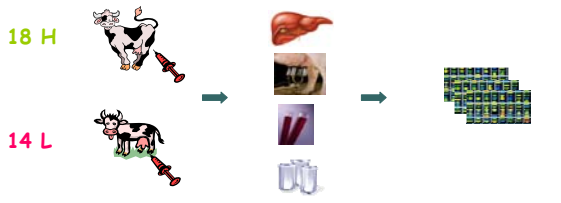
- immune response
- metabolism

Expression studies

Experiment 1: Cows challenged with LPS

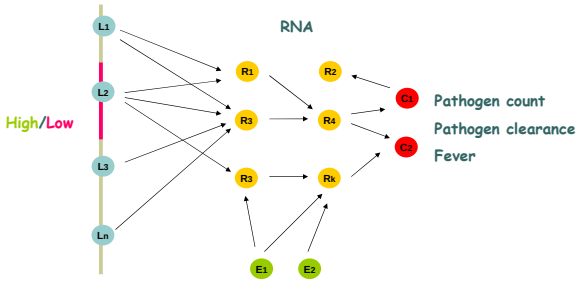
Experiment 2: High/Low cows challenged with E-coli

High/Low cows challenged with E-coli

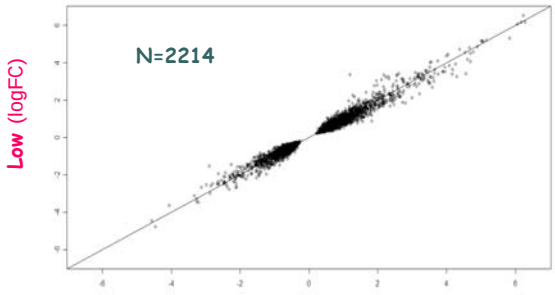


(-144, 12, 24, 192)

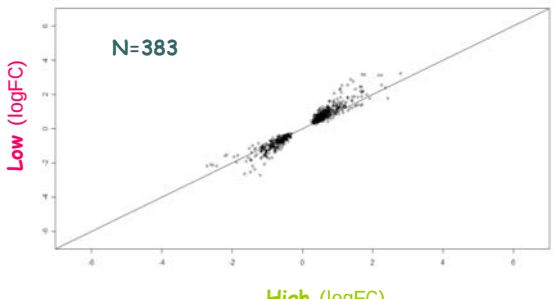
High/Low cows challenged with E-coli



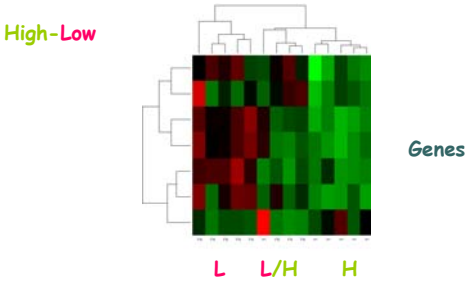
DE in udder due to E-coli (inf. quarter)



DE in udder due to E-coli (cont. quarter)



DE in udder due to QTL (24H, E-coli)



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Summary

- **QTL studies:**
  - Mastitis QTL finemapped in Holstein population
  - Mastitis QTL associated with E-coli
- **Expression studies:**
  - LPS induced mastitis coordinately altered the expression of immune response and metabolism genes in the bovine liver
  - E-coli induced mastitis indicate a different expression profile in the udder of high/low resistant cows
- **Next steps**
  - Bioinformatic approaches for integrated analyses of linkage and expression data for ranking candidate genes within linkage region
  - Identify SNPs in candidate genes and associate with mastitis phenotypes in population

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