Can biomarkers for oxidative stress early predict BRD in calves?

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Bovine Respiratory Disease

• Complex of diseases characterized by many types of infections
• The most commonly and costly disease of feedlot cattle
• Causes the main morbidity and mortality of feedlot cattle
Economic implications of BRD

BRD

- Mortality
- Performance
- Feed utilization
- Veterinary care

lead to

Enormous economic burden
Economic implications of BRD

In Israel annual losses are estimated to 10 million $.

In the United States annual losses are estimated to 1 billion $.
Stress and BRD

• Combination with stress cause to severe disease.

• BRD resulted from stress-related alteration in susceptibility of respiratory track to colonization by pathogens.

Major stress event associated with BRD is the transportation of young calves.
The problem in identifying sick calves

- Subjective identifications
- The clinical signs are vary widely
- “Tip of the iceberg”- asymptomatic calves
The aims of this study

1. To identify the **individual** physiological response to transportation using physiological and biochemical biomarkers
The aims of this study

2. To examine the effectiveness of these biomarkers in objective prediction of BRD in young calves at early life stage
The experimental design

- 32 Holstein-Friesian bull calves were transported 20 km (half hour) at the age of 8±2 days
The experimental design

• Blood samples were collected from each calf at the following time points relatively to transportation:
  • Pre-transportation (0D) and, 1 hour (1H), 4 hour (4H), 1 day (1D), 3 days (3D) and 7 days (7D) post-transportation
Materials and Methods

**Immunology**
- IgG
- Acute phase protein
- Hsp 72
- NQO1
- ProInflammatory genes

**Metabolic stress**
- BHB
- NEFA
- Glucose
- Urea
- Creatinine

**Oxidative stress**
- LT
- MDA
- FRAP
- Oxidized fibrinogen
Oxidative stress indicators

Imbalance between

Supply of Free radicals

Supply of antioxidants
Exogenous linoleoyl-tyrosine (LT) marker

Tyrosine
Indication for protein oxidation

Linoleic acid
Indication for fatty acid oxidation

Unique oxidative fingerprint for each calf
Correlation between the oxidative fingerprint to specific pathological condition

LT oxidation products
epoxide C9-10, C12-13
hydroperoxide C9,C13
Profile of LT oxidation products relatively to transportation

% of LT-epoxid from LT

significantly increase manifested already one hour post-transportation

P=0.0008
P=0.0025
P=0.0008

n=12 Time relatively to transportation
LT-epoxide was found to effectively predict BRD three months ahead, already 1 hour after the stress event.
Two oxidative stress behavioral patterns

**Sick**
Increase in Oxidative Stress during transportation

**Healthy**
Transportation does not cause Oxidative stress

% of total oxidation products of LT

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responding calf vs. nonresponding calf
time relatively to transportation
Antioxidant capacity of plasma

• Antioxidants are chemical compounds that giving an e- to free radicals, convert them to an harmless configuration.

• Including enzymes, hydrophilic scavengers and lipophilic scavengers.

• The great majority of antioxidants are supplied with the diet.

• Measured by FRAP method
The antioxidant capacity of plasma was found to effectively predict BRD three months ahead, already before the stress event.
The relationship between antioxidant capacity pre-transportation and LT oxidation products post-transportation

FRAP-ascorbic acid equivalent (µmol/l) 0D

% of LT-oxidation from LT

sick calves
healthy calves

n=11
Conclusions

• Following transportation calves possess differential stress response

• The susceptibility of calves to BRD can be predicted at early life stage, even before transportation

• Healthy calves shown higher levels of antioxidant capacity that correlated with lower levels of lipid peroxidation
To examine whether antioxidant therapy, pre-transportation, may be used to reduce the incidence of oxidative stress related morbidity.
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