Health and Metabolism as Reflected by Calves Plasma Redox State

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Studying Production Efficiency

**Nutrition**
- Pomegranate
- Olive pom.
- Woodland

**Health**
- Reduce sickness (BRD, Tick fever)

**Physiology**
- Protein depr.
- Caloric restr.
- Temperament
- Baladi

**Metabolism**
- Increase feeding efficiency
Early detection of BRD as a potential key to control disease–related production loss.

Manipulating production efficiency through management.
Bovine Respiratory Disease Complex (BRD)

- The leading cause for morbidity and mortality of young calves
- **Triggered by transportation**, weaning, biotic and abiotic factors
- Causes annual losses of 1 billion dollar (USA)
- Modulation of immune function
- **Is correlated with oxidative stress**
- Affects Kosher status of the meat, a retrospective phenotype for BRD episodes at early age
**LT:** Exogenous marker that evaluates oxidative stress

Hydroperoxide

OOGH on C9 or C13

LT-epoxy (epoxide on C9-10 or C12-13)

Tyrosine

Linoleic acid

Szuchman et al., 2006; 2008
Early prediction of Kosher state

Eitam et al., 2010
Plasma redox state at age 5d is may predict future BRD sickness at age 3 months

Post-transportation

n=32

P=0.002

P=0.007
Plasma redox state is inversely related to LT oxidation.
Healthy individuals are characterized by higher plasma redox potential attributed to uric acid (CV method)

<table>
<thead>
<tr>
<th></th>
<th>1H/0D</th>
<th>1D/0D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>2.32±0.32 a*</td>
<td>1.88±0.26 a</td>
</tr>
<tr>
<td>Sick</td>
<td>1.28±0.16 b</td>
<td>1.38±0.24 a</td>
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</table>

P=0.002
linear discriminant analysis; LDA

- The model predicts correctly 93.1% of Healthy vs Sick classifications  (P=0.031)
- 2 individuals, one from each group were wrongly classified
- **FRAP 0D (redox state)** is the most efficient measure
- **IgG 0D** is the less efficient measure

<table>
<thead>
<tr>
<th>Function</th>
<th>TREAT Centroids</th>
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<tbody>
<tr>
<td>Healthy</td>
<td>1.127</td>
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<tr>
<td>Sick</td>
<td>-1.208</td>
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<table>
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<tr>
<th>Original Count</th>
<th>TREAT</th>
<th>Predicted Group Membership</th>
<th>Total</th>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>13</td>
<td>14</td>
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<table>
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<tr>
<th>%</th>
<th>TREAT</th>
<th>Predicted Group Membership</th>
<th>Total</th>
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<tr>
<td>1</td>
<td>93.3</td>
<td>6.7</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>7.1</td>
<td>92.9</td>
<td>100</td>
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</table>

a. 93.1% of original grouped cases correctly classified.
Oral fluids proteomics: Predictive protein profile

Glycolysis/Gluconeogenesis Pathways
Age: 1–7 days

Pentose–Phosphate Pathway
Age: 2 months

Expression of these metabolic pathways distinguishes healthy from future BRD animals, implying involvement of metabolic rate/redox state
Affecting production efficiency through management manipulations (light regime)
Artificial light at night: negative effects on feeding efficiency
Reduces metabolic rate for the non-efficient animals

**Uric acid (mg/dL)**
- Dark: 2.30
- Light: 2.00
- P < 0.001

**Urea (mg/dL)**
- Dark: 6.00
- Light: 5.2
- P < 0.001

**Free T3 (pg/dL)**
- Dark: 5.2
- Light: 4.8
- P < 0.05
Lower LDH levels for the non-efficient animals

**GLUCOSE (mg/dL)**

- Dark: 100
- Light: 90

**LACTATE (mM)**

- Dark: 1.2
- Light: 0.8

**LDH (units/L)**

- Dark: 730
- Light: 710

**PYRUVATE (μM)**

- Dark: 150
- Light: 200
• Lactate/pyruvate ratio may reflect NAD+/NADH ratio

• The production of lactate is a beneficial process because it regenerates NAD+, what ensures that energy production is maintained

• Pyruvate stimulates gluconeogenic genes and decreases mitochondrial & glycolitic genes

• Caloric restriction increases pyruvate and decreases lactate levels
A decline in plasma redox state in non-efficient animals

Wavelength: 488 nm, 0.0007 nm  
Intensity: 256 lux, 0.001 lux

Critical values: \( \lambda < 460 \text{ nm}, \text{intensity} > 50 \text{ lux} \)
Summary

• **Health**: Low plasma redox state in young calves predicts future BRD episodes 2-3 months ahead.

• **Metabolism**: Non-efficient calves have reduced metabolic rate/redox state.

• Controlling plasma redox state may thus be a strategy to control health and metabolism.

• **Nutrition engineering** may be a desired approach.
Newe Ya’ar Team
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Thanks for your attention