Metabolic Differences in Temperamental Brahman Cattle Can Affect Productivity

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Temperament

- Temperament in cattle can be defined as the response of an animal to being handled by a human (Fordyce et al., 1982). It is assessed by the way that cattle react to human handling and interaction.

- Temperament and cattle management
  - Human interaction is inevitable.
  - Destructive to themselves, facilities, other animals.

- Cattle temperament can influence many areas of production including reproduction, immunity, and carcass traits.

- Petherick et al. (2009) reported that fear response can be reduced with proper human handling and association with positive events.
  - Scores re-evaluated over time did not change, even though fear was sometimes lessened.

- Temperament is predominately innate and heritable in *Bos taurus* cattle (Gauly et al., 2001).

- Heritability of pen score (0.44), exit velocity (0.28), and temperament score (0.41) has been reported in Brahman cattle (Loyd et al., 2011).

Temperament

- Cattle that are more temperamental:
  - Tend to have significantly lower body weights than more calm animals (Tulloh, 2004).
  - Lower BCS, carcass and slaughter weights, dressing percentage (Burrow and Dillon, 1997; Petherick et al., 2002)
  - Lower ADG and higher shear force values (del Campo et al., 2010)
  - Decreased tenderness at slaughter (King et al., 2006)

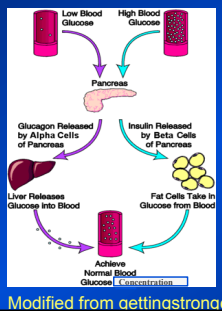
Temperament

- Animals of different temperaments have diverse functional characteristics of their HPA axis and therefore react to stress differently (Curley et al., 2008).
- Cattle that are more excitable have greater concentrations of stress hormones such as cortisol and epinephrine than calm cattle, which is correlated to temperament.
  (King et al., 2006; Curley et al., 2006, 2008).
- Cortisol (a glucocorticoid) is known as the hormone of stress.

Glucocorticoids

- Glucocorticoids are steroid hormones that bind to the glucocorticoid receptor, which is present in most animal cells.
- Cortisol is the most important glucocorticoid in cattle.
- Metabolism:
  - Inhibits the uptake of glucose into adipose and muscle tissue.
  - Stimulation of gluconeogenesis in the liver.
  - Stimulates fat breakdown in adipose tissue.

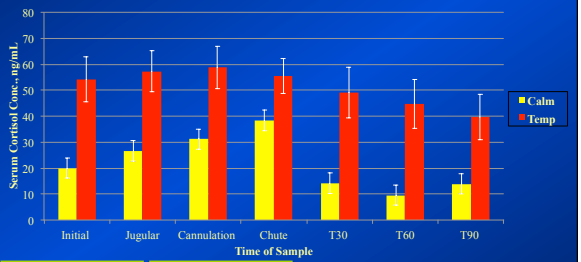
Glucose Homeostasis



- Glucose is the most important cellular energy source.
- Insulin is a metabolic hormone that regulates the concentration of glucose in the blood.

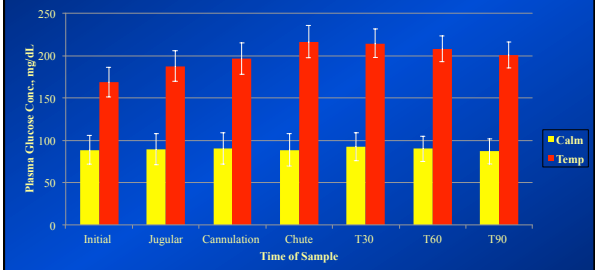
Modified from gettingstronger.org

Cortisol



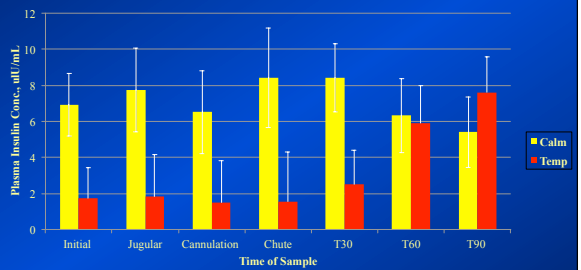
Temp *P*=0.0238 | Time *P*=0.0002 | TimeXTemp *P*=0.2359

Glucose



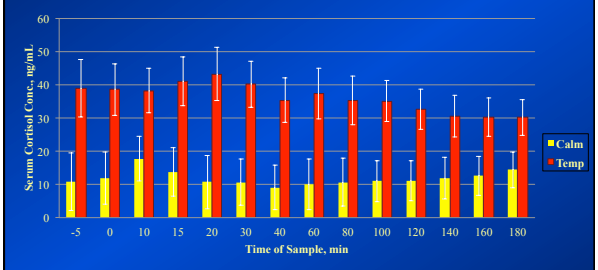
Temp *P*=0.0005 | Time *P*=0.1521 | TimeXTemp *P*=0.1765

Insulin



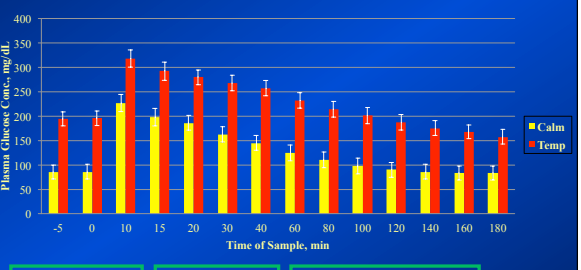
Temp *P*=0.1560 | Time *P*=0.4235 | TimeXTemp *P*=0.0434

Cortisol



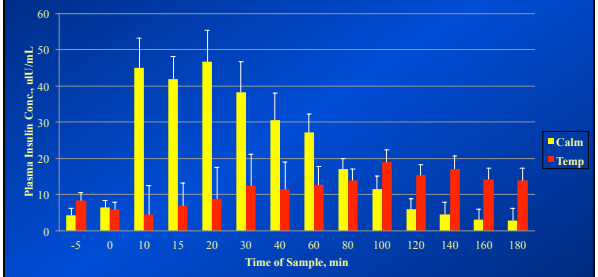
Temp *P*=0.0282 | Time *P*=0.0099 | TimeXTemp *P*=0.0041

Glucose



Temp *P*=0.0011 | Time *P*=0.0001 | TimeXTemp *P*=0.0428

Insulin



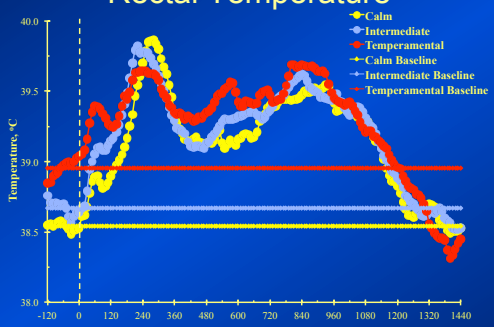
Temp *P*=0.0793 | Time *P*=0.0022 | TimeXTemp *P*=0.0001

Conclusions

- Temperamental cattle have greater concentrations of cortisol, which remain elevated when stressed.
- Temperamental cattle have higher concentrations of glucose in their blood.
- Temperament modifies metabolic regulatory responses in heifers and this altered metabolism of temperamental cattle may partially explain their decreased productivity.

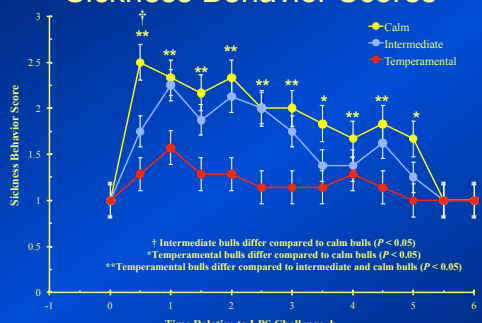
How do temperamental cattle respond to a disease challenge?

Rectal Temperature



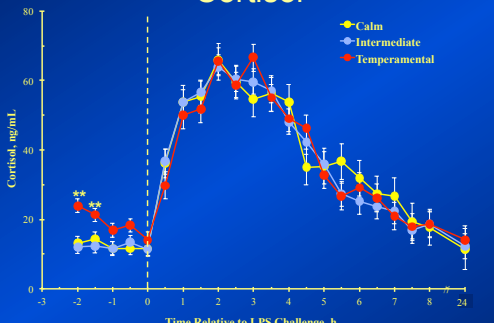
Pre and Post-LPS: Temp: P < 0.001; Time: P < 0.001

Sickness Behavior Scores



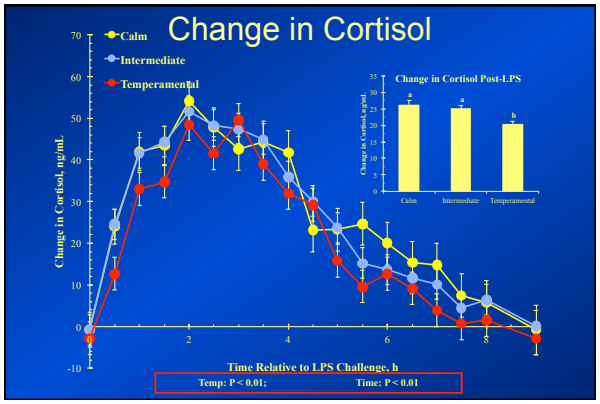
Temp: P < 0.001; Time: P < 0.001; Temp x Time: P = 0.064

Cortisol

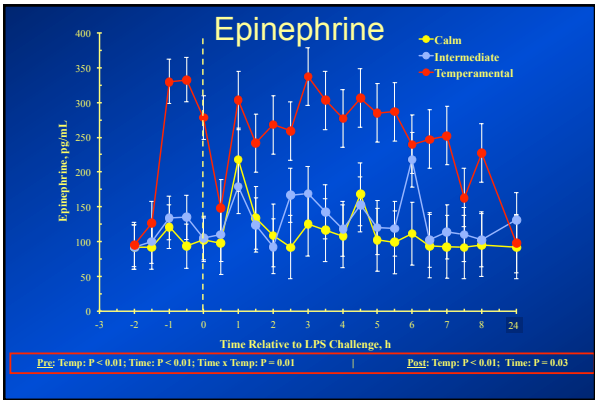


Pre: Temp: P < 0.01; Time: P = 0.07; | Post: Temp: P = 0.80; Time: P < 0.01

Change in Cortisol



Epinephrine



Results

1. Temperamental bulls had greater pre-LPS rectal temperature but produced a lesser response to LPS.
2. Temperamental bulls displayed less signs of sickness following LPS administration.
3. Relative to baseline values, temperamental bulls produced a lesser cortisol response to LPS.
4. Temperamental bulls produced greater epinephrine pre- and post-LPS.

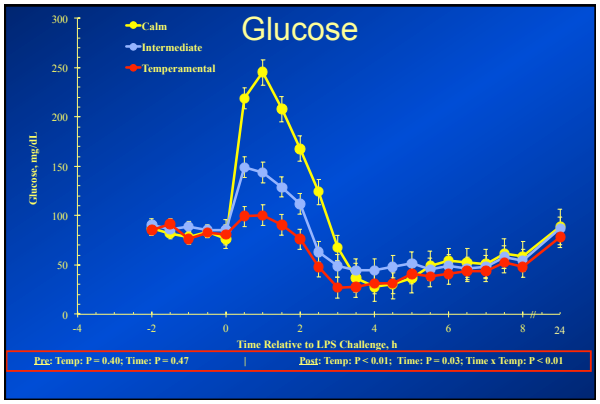
Conclusions

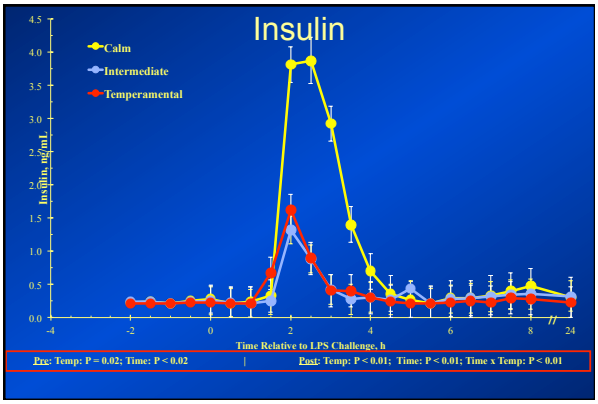
1. Temperament differentially influenced physiological and endocrine responses to LPS challenge.
2. As temperamental cattle do not display as many behavioral signs of sickness, they may increase the risk of infection to calmer cattle.
3. Other factors may be influencing the response of temperamental cattle to LPS.

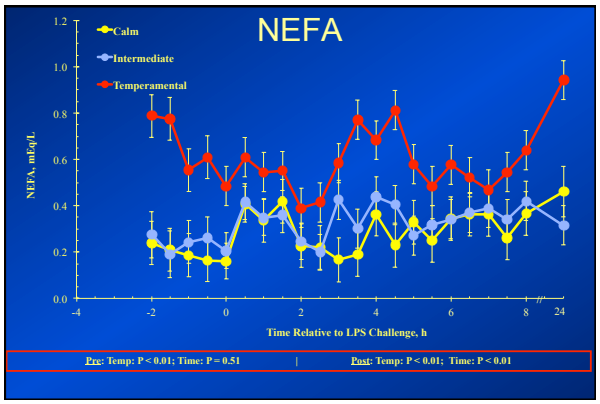
The immune response has a high energy demand.

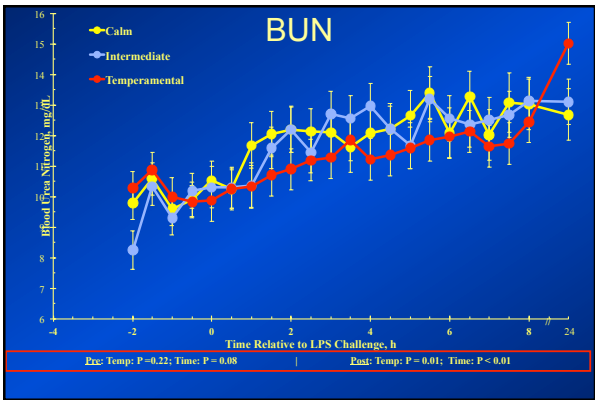
Hypothesis:

Differences observed in response to an immune challenge are due to differences in energy availability between calm and temperamental cattle.









Results

1. Glucose increased in response to LPS in calm and intermediate bulls.
2. Insulin release was greater in calm bulls following LPS.
3. Concentrations of NEFA were greater before and after LPS in temperamental bulls.
4. Concentrations of blood urea nitrogen were lower in temperamental bulls.

Conclusions

1. Calm bulls became insulin resistant following LPS challenge.
2. Elevated cortisol and epinephrine before LPS challenge of temperamental bulls may reduce subsequent glucose responsiveness.
3. Temperamental bulls use NEFA for energy as they have less glucose available.

Metabolic differences exist between temperaments in cattle.

Separate management strategies should be devised for temperamental cattle to decrease input costs and maximize profit.

QUESTIONS?