Stewardship: Land, Livestock and People, A Philosophy & Culture of Life
Responsibility and Response

Meat-Wise Eating Habits
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Worldwide Meat Consumption

Whether from a cow, pig, bird, fish, or other domestic or game animal, meat is universally enjoyed as part of the cultural culinary experience. It is also an excellent source of protein, which is important for a healthy body. Many people who eat meat, however, are not aware of the impact their consumption has on the environment. This guide provides a set of quick facts and action tools to make wise choices concerning meat consumption.

Basic Meat Differences

Although definitions of red and white meat vary widely, it is generally accepted that the meat of cattle and hogs is classified as red, and the meat of fish, chicken, and turkey is classified as white. Blood, known as “the other white meat,” is classified by the USDA as red meat. (Note that many types of game meat are considered either white, dark and/or red.) Red meat has a higher amount of myoglobin present, which is a protein that contributes to the red pigmentation and higher iron content (McGee, 2004). Red meat also has a substantially higher level of saturated fat than white meat.

The Carbon Cost of Meat

What is a carbon footprint? Although definitions vary, it is commonly accepted as the accumulated total amount of carbon dioxide (CO2) and methane (CH4) emissions involved in our daily lifestyles and consumption choices. When people think of their carbon footprints, they often think of driving less or recycling in ways to reduce it. While some people are aware that their dietary choices affect their footprint, many do not know that the carbon costs of meat are exceptionally high when compared to other foods. Here’s why:

- Livestock production is responsible for at least 30% of greenhouse gas emissions in the United States alone. Not only do livestock animals produce considerable amounts of methane (CH4) through their waste, but also transporting the animals, their feed, and their meat greatly increases carbon dioxide (CO2) output.
- Fertilizers used to grow food for livestock is directly associated with an increase of nitrous oxide (N2O) worldwide (Leffingwel, 2013). This compound is a lead contributing gas to the “greenhouse effect,” which further heating of the earth’s surface and atmosphere.
- Every year, around 35% of the world’s grain harvest is used as feed for livestock headed for the dinner table. This amounts to 750 million tons of grain that could be grown to feed people in need (Brown, 2007).
Mission statement:

“I have a stewardship responsibility to manage available resources; land, livestock, my personal life, while conserving and improving the resources.”

— Stokka 2012
Stewardship

Believing---there are several layers to it.

• There's the surface-level type of believing, where you acknowledge that something is true.
• Then there is a deeper kind of belief--the type that gets inside of you and actually changes you.
  – It's the kind of belief that changes your behavior, your attitude, and your outlook on life, and the people around you can't help but notice."
• I need you to believe and to be passionate and engaged.
  – Specifics later
New Discoveries in Calf Vaccination Strategies: Finding the Pearls in Research

- Vaccine Interference
- Mucosal Immunization
- Booster vaccination
Vaccine Interference, Dominant Antigen

- Dominant Antigen
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Epitopes

Large molecules have regions against which immune responses are directed. These regions, usually on the surface of the molecule, are called epitopes or antigenic determinants.
Definition: Dominant Antigen/Epitope

In large, complex protein molecules, many different epitopes may be recognized by the immune system. Some are more immunogenic than others. Thus, animals may respond to a few favored epitopes and the remainder of the molecule is virtually ignored.

Such epitopes are said to be immunodominant.

Dominant Antigen/Epitope Theory

- Priming of immune cells to a single dominant epitope results in strong suppression of responses to other normally dominant epitopes, in effect rendering these epitopes subdominant;
Definition: Vaccine Interference

The simultaneous administration of several vaccines sharing the same carrier may be associated with the suppression of the response through various mechanisms.
Definition: Interference

Conjugate vaccine - a vaccine containing bacterial capsular polysaccharide joined to a protein to enhance immunogenicity; especially: one that is used to immunize infants and children against invasive disease caused by Hib (Haemophilus influenza type b) bacteria and that contains the Hib capsular polysaccharide polyribosylribitol phosphate bound to diphtheria or tetanus toxoid or to an outer membrane protein of the meningococcus.
Definition: Interference

Theoretical mechanisms are:

- competition for antigen capture and presentation between B cells with surface immunoglobulins specific for epitopes on the carrier and B cells specific for the polysaccharide
- prevention of the binding of the conjugate vaccines to polysaccharide-specific B cells by the free protein carrier
- suppression of the response to polysaccharides by expansion of the number of carrier-specific B cells induced by previous injection of the carrier, thus directing the conjugate away from polysaccharide-specific B cell
In naïve calves, administration of a vaccine containing modified live virus (IBR, BVD?) fractions will suppress the immune response to bacterins.

- Stokka, Seeger et al explanation
Where did it start?

Historical spring calf vaccination programs
• Blackleg (clostridial products)
• Virals (IBR, PI3, BVD, BRSV)
• Pasteurella (Mannhemia) haemolytica bacterins
  – Literature out of Canada on negative impact

~1990 – introduction of “Presponse”
  – by Langforth Lab - Canada

1992 – introduction of “One Shot”
  – SKB - USA
Combinations

- Next phase was to combine the virals with the bacterins
- Some worked, some were licensed – others weren’t
- WHY???

“Vaccination with PhV* in combination with MLV significantly reduced the efficacy of the PhV in preventing BRD morbidity, BRD mortality, and fibrinous pneumonia mortality and also reduced the antibody response to *P. haemolytica* leukotoxin. These results suggest that the MLV interfered with the protective capacity of the PhV.”

*Pasteurella haemolytica* vaccine (PhV) 1992
“It appeared that calves not receiving MLV IBR did have a greater titer response to *Mannheimia haemolytica* whole cell and leukotoxoid, but due to insufficient group numbers this could not be shown statistically.”
Antigen Interference

Does MLV IBR vaccine administered systemically concurrently with *Mannheimia haemolytica* bacterin-toxoid have a negative effect on the bacterin-toxoid.

*BoviShield GOLD® 5 and One Shot®*

*Vista® Once SQ*

*Express® 5 PHM*

*Pyramid® 5 + Presponse® SQ*
Antigen Interference

A summary of 3 studies over a 5 year period

Collaborators:
• Drs. Jon Seeger, Victor Cortese & Gerald Stokka

Study Investigators:
• Dr. Greg Lardy (Study 1, 2006, CGREC, NDSU)
• Dr. Breck Hunsaker (Study 2, 2008, Horton Research)
• Dr. Charlie Stoltenow (Study 3, 2010, CGREC, NDSU)
Special “Thank You”

To all from CGREC that were involved in the 2006 and 2010 studies.

To all from NDSU Animal & Range Science department that were involved in the 2006 and 2010 studies.

To all from NDSU Veterinary Diagnostic Laboratory that were involved in the 2006 and 2010 studies.
Study Protocol

Day -30:
• Pre bled calves for randomization

Day 0:
• Administered test material(s), vaccines
• Drew base line blood samples

Days 14 & 28:
• Drew blood samples
Education
Outcomes evaluated

- **Percent of animals** within each treatment group that respond to vaccination as measured by antibody in the serum.
  - Herd Immunity

- **Magnitude** of response – how much antibody increased after vaccination.
  - Individual Immunity
Dr. Greg Lardy
Percent of animals with a two-fold or greater leukotoxoid (LKT) response on Day 14 when compared with their respective Day 0 baseline antibody levels

Cortese, V.S., et al., Serological response to *Mannheimia haemolytica* in calves concurrently administered inactivated or modified-live preparations of *Mannheimia haemolytica* and viral combination vaccines containing modified-live bovine herpesvirus type 1. AJVR, Vol. 72, No. 11, November 2011, pp. 1541-1549.
Percent of animals with a five-fold or greater Mannheimia LKT response on Day 14 when compared with their respective Day 0 baseline antibody levels.

Cortese, V.S., et.al., Serological response to Mannheimia haemolytica in calves concurrently administered inactivated or modified-live preparations of Mannheimia haemolytica and viral combination vaccines containing modified-live bovine herpesvirus type 1. AJVR, Vol. 72, No. 11, November 2011, pp. 1541-1549.
Dr. Breck Hunsaker - CO

- Multiple sites – UT & ID
- Five replicates – 2 dairy; 3 beef
- More animals / treatment group
- Older animals (6-8 mo.)
Percent of animals with a **two-fold or greater** Mh LKT response on Day 14 when compared with their respective Day 0 baseline antibody levels.

Cortese, V.S., et.al., Serological response to *Mannheimia haemolytica* in calves concurrently administered inactivated or modified-live preparations of *Mannheimia haemolytica* and viral combination vaccines containing modified-live bovine herpesvirus type 1. AJVR, Vol. 72, No. 11, November 2011, pp. 1541-1549.
Magnitude (ng/mL) of response on Day 14 when compared with their respective Day 0 baseline antibody levels

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Percent of animals with a **two-fold or greater** *Mh* LKT response on Day 14 when compared with their respective Day 0 baseline antibody levels

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Route of Administration

- What if the ML viral was administered intra-nasally rather than systemically?
- Would one still see the interference effect on current administration of Mh bacterin?
Dr. Charlie Stoltenow
Percent of animals responding with a positive *Mannheimia haemolytica* “leukotoxoid” titer change

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Stoltenow, C., Immunological Response of Beef Calves to Concurrent Application of Modified-Live Viral Vaccine (Intranasal and Systemic Administration) and Systemically Administered *Mannheimia haemolytica* Bacterin-Leukotoxoid. The Bovine Practitioner, Fall 2011.
Magnitude of positive *Mannheimia haemolytica* “leukotoxoid” titer response

Stoltenow, C., Immunological Response of Beef Calves to Concurrent Application of Modified-Live Viral Vaccine (Intranasal and Systemic Administration) and Systemically Administered *Mannheimia haemolytica* Bacterin-Leukotoxoid. The Bovine Practitioner, Fall 2011.
“Practical Benefits of Intra-nasal Immunization”

- Concurrent administration of One Shot and INFORCE 3 or TSV-2 resulted in similar humoral antibody responses to One Shot as when One Shot was administered alone.
- No interference
Booster effect: antibody levels
All treatment groups received One Shot, Bovi-Shield GOLD 5 and Ultrabac 7/Somubac on Day 91

Stoltenow, C., Immunological Response of Beef Calves to Concurrent Application of Modified-Live Viral Vaccine (Intranasal and Systemic Administration) and Systemically Administered Mannheimia haemolytica Bacterin-Leukotoxoid. The Bovine Practitioner, Fall 2011.
“Practical Benefits of Intra-nasal Immunization”

- Initial vaccination with One Shot resulted in a significant ($P \leq 0.05$) anamnestic response to *M. haemolytica* leukotoxoid after calves were revaccinated concurrently with One Shot and Bovi-Shield GOLD 5.

- No interference
Booster Effect: BRSV antibody titers

All treatment groups received One Shot, Bovi-Shield GOLD 5 and Ultrabac 7/Somubac on Day 91

Stoltenow, C., Immunological Response of Beef Calves to Concurrent Application of Modified-Live Viral Vaccine (Intranasal and Systemic Administration) and Systemically Administered Mannheimia haemolytica Bacterin-Leukotoxoid. The Bovine Practitioner, Fall 2011.
“Practical Benefits of Intranasal Immunization”

Calves initially vaccinated with INFORCE 3 had a significant (P ≤ 0.05) increase in BRSV antibody following revaccination with Bovi-Shield GOLD 5 91 days later.
Serologic Response to *Mannheimia Haemolytica* in Calves Concurrently Inoculated With Inactivated or Modified-Live Preparations of *M Haemolytica* and Viral Combination Vaccines Containing Modified-Live Bovine Herpesvirus Type 1

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Immunologic Responses of Beef Calves to Concurrent Application of Modified-live Viral Vaccine (Intranasal and Systemic Administration) and Systemically Administered *Mannheimia haemolytica* Bacterin-leukotoxoid

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Conclusion:

A significant contribution to understanding “Vaccine Efficacy in a Beef Calf Population” was an outcome of this cooperative research between a land grant university and industry. This cooperative research in turn resulted in two published articles that will be used by the beef industry for many years.
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- Vaccine Interference
- Mucosal Immunization
- Booster vaccination
- Stewardship
Thank You!!
Questions