We are Growing!

“IntelliBond Trace Minerals”
Shattering Trace Mineral Perceptions!
Who We Are?

• Our ownership:
  – Held by the Heritage Group, a 3rd generation family owned business located in Indiana
    • 71 total companies
    • $6.5 Billion in annual receipts

• Our business focus:
  – The development, production and representation of trace mineral products that deliver unique value to livestock producers

• Our mission:
  – Create trace mineral solutions that:
    • Promote essential nutrient stability
    • Increase formulation flexibility and handling functions
    • Optimize trace mineral delivery to the blood stream, supporting cow health & productivity
Core Manufacturing

- Original IntelliBond Plant
  - Began operation in 1996
  - Located in Indianapolis, IN
  - IntelliBond C focus
  - Annual capacity – 7,000 Mt
New Investment

- “New” IntelliBond Plant
  - Operational Spring 2012
  - Located in Indianapolis, IN
  - Production of all IntelliBond products
  - 15,000 Mt of total annual capacity
And Improving!

Significant investment in:

- Development of IntelliBond Z & M
- Large particle technology (250 µ)
- Qualified staff

Resulting in:

- Industry leading product forms:
- High product purity
  - HACCP, SF / SF, ISO 9002, FAMIQs
  - OMRI certification for IntelliBond C
- Heterogeneous Blended Products
Trace Mineral Nutrition Must Evolve:

• In the past 20 years dairy nutrition has moved from:
  – TDN - starch, sugar, VFAs, etc.
  – Crude protein - RDP, RUP & specific amino acids
  – Crude fiber – ADF, NDF, etc.

• Trace mineral nutrition has not responded in kind:
  – Poor industry understanding of the relative bioavailability differences between ingredients
  – When faced with challenges, the industry has typically gone with “more is better”!
  – Limited choices for solution
Trace Mineral Feeding Objectives:

• Ensure that an optimized level of essential trace minerals are delivered to the **blood stream** as cost effectively as possible
  – Upon entering the blood stream; Trace minerals are no longer differentiated by source!

• Avoid potential trace mineral interactions in the GI tract that can reduce essential trace mineral availability
  – Trace mineral nutrition in the cow is not linear
  – How much is too much?
  – Potential for negative antimicrobial impact on rumen micro flora

• What sources create best return on investment
  – Basal ration ingredients
  – Inorganics Trace Mineral
  – Organic Trace Mineral
  – Hydroxy Trace Mineral
• Basal ration ingredients:
  – Typical corn / alfalfa / co-product based diets contain:
    • 35 – 40 ppm zinc
    • 6 – 8 ppm copper
    • 30 – 35 ppm manganese

• Water: Variable, but can contribute trace minerals

• External sources of trace mineral nutrition
  – Inorganic trace minerals - oxides and sulfates
  – Organic trace minerals – Proteinates, chelates, complexes, polysaccharides, etc.
  – Hydroxy trace minerals
Hydroxy Trace Minerals are Different:

- Fully defined & recognized crystalline structures
  - Kempite = Mn; Simonkolleite = Zn; Atacamite = Cu
- High metal potency (manganese 44%; zinc 55%, copper 58%)
  - Higher metal concentration = More space in the premix
- Low product solubility at neutral pH (Rumen Bypass)
  - Avoid interaction with known rumen antagonists
  - No antimicrobial interactions - Increased rumen function (DM digestibility)
- More Zn, Cu & Mn delivered to the small intestine / blood stream
  - Increased absorption supports optimized cow health and productivity
  - Ability to reduce total mineral fed:
    - Reduce product & logistics costs
    - Reduce environmental impact of excreted metals
- Maintains essential nutrient potency in the supplement / premix
  - Consistent Nutrient Delivery
  - Lowers risk of nutrient tagging compliance
Copper absorption prior to and following rumen development in lambs

<table>
<thead>
<tr>
<th></th>
<th>Apparent Copper Absorption (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre – weaning (Milk only)</td>
<td>47 – 71%</td>
</tr>
<tr>
<td>Post – weaning</td>
<td>8 – 10%</td>
</tr>
</tbody>
</table>

Suttle 1975
Increase Trace Metal Intestinal Absorption

**Trial Design:**
- 98 day depletion period
- 60 steers
- 3 X 2 factorial setup
- 10 steers / treatment
- Trts @ 0, 5 & 10 ppm Cu
- 5 ppm Mo & .15 % S

**IntelliBond C Relative Bioavailability in Cattle**

\[ \text{CuSO}_4 = 100\% \quad \text{HTM Cu} = 196\% \quad (P < .04) \]

J.W. Spears et al. N.C. State University
Peer reviewed article

**Trial Design:**
- 16 yearling steers
- Depleted 14 days (basal @ 25 ppm Zn)
- Treatments:
  - Zinc sulfate @ 25 ppm
  - IntelliBond Z @ 25 ppm
- Seven day adaptation
- Five day total collection
- Urine & fecal output
- Feed in & Orts

**IntelliBond Z Relative Bioavailability in Cattle**

\[ \text{ZnSO}_4 = 100\% \quad \text{HTM Zn} = 204\% \quad (P < .01) \]

J.W. Spears et al. N.C. State University
Pending Manuscript publication
Relative bioavailability comparison of IntelliBond versus several organic trace mineral forms:

The bioavailability values listed below in red represent independent research results for several organic trace mineral forms relative to sulfate or oxide trace mineral forms:

**IntelliBond C Relative Bioavailability in Cattle**

- CuSO$_4$ = 100%
- HTM Cu = 196% (P<.04)
- OTM Cu = 105 - 150%

**IntelliBond Z Relative Bioavailability in Cattle**

- ZnSO$_4$ = 100%
- HTM Zn = 204% (P<.01)
- OTM Zn = 110 - 150%

J.W. Spears et al. N.C. State University
Peer reviewed article

J.W. Spears et al. N.C. State University
Pending Manuscript publication
IntelliBond C vs. Availa Cu in Yearlings

Study Design:
- 24 Brahman crossbred steers
- 72 day study
- 4 Trt / 6 pens per
- Trt’s
  - 10 ppm Cu – Availa Cu
  - 10 ppm Cu – IntelliBond C
  - 15 ppm Cu Availa Cu + 15 ppm Cu IntelliBond C
  - 30 ppm Cu IntelliBond C
- Free-choice access to star-grass hay
- Fed molasses supplement with Trts
- Measurements – Liver copper at:
  - 0, 24, 48 & 72 days

IntelliBond C and Availa Cu were of similar availability when fed to yearling steers

<table>
<thead>
<tr>
<th>Day</th>
<th>IBC 10 ppm</th>
<th>Availa C 10 ppm</th>
<th>IBC 30 ppm</th>
<th>IBC/Availa C 30 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>146&lt;sup&gt;a&lt;/sup&gt;</td>
<td>161&lt;sup&gt;a&lt;/sup&gt;</td>
<td>125&lt;sup&gt;a&lt;/sup&gt;</td>
<td>158&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>24</td>
<td>136&lt;sup&gt;a&lt;/sup&gt;</td>
<td>151&lt;sup&gt;a&lt;/sup&gt;</td>
<td>182&lt;sup&gt;a&lt;/sup&gt;</td>
<td>163&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>48</td>
<td>143&lt;sup&gt;a&lt;/sup&gt;</td>
<td>145&lt;sup&gt;a&lt;/sup&gt;</td>
<td>195&lt;sup&gt;a&lt;/sup&gt;</td>
<td>151&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>72</td>
<td>166&lt;sup&gt;a&lt;/sup&gt;</td>
<td>157&lt;sup&gt;a&lt;/sup&gt;</td>
<td>226&lt;sup&gt;b&lt;/sup&gt;</td>
<td>213&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Liver Cu expressed as PPM Dry Matter

J. Arthington, Ph.D / J. Spears, Ph.D.
Bioavailability versus Retained Zinc?

IntelliBond Z Retained Zn in Cattle

<table>
<thead>
<tr>
<th>RBV Basis</th>
<th>100%</th>
<th>110 - 150%</th>
<th>204%</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZnSO$_4$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTM Zn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HTM Zn</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Actual level of Retained Zn

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>9.7%</th>
<th>11-15%</th>
<th>19.9%</th>
</tr>
</thead>
</table>
**More Zinc Delivered to the Blood Stream!**

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**TMR Formulation Strategy:**

<table>
<thead>
<tr>
<th>Basal Ration Ingr.</th>
<th>Water</th>
<th>Total Basal</th>
<th>Cow req.</th>
<th>Req. Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc @ 35 ppm</td>
<td>+ 0 ppm</td>
<td>= 35 ppm</td>
<td>- 70 ppm</td>
<td>= 35 ppm</td>
</tr>
<tr>
<td>Zinc @ 875 mgs</td>
<td>+ 0 ppm</td>
<td>= 875 mgs</td>
<td>- 1,750 mgs</td>
<td>= 875 mgs</td>
</tr>
</tbody>
</table>

Mg/hd/d calculation based on 25 Kgs DMI

---

<table>
<thead>
<tr>
<th>Zinc Sources</th>
<th>Metal Delv’d to the Cow</th>
<th>Retained Efficiency</th>
<th>Metal del. to the blood stream</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zn Sulfate</td>
<td>875 mgs</td>
<td>9.7%</td>
<td>84.9 mgs</td>
<td>.36 cents</td>
</tr>
<tr>
<td>OTM Zn</td>
<td>875 mgs</td>
<td>15%</td>
<td>131.1 mgs</td>
<td>2.99 cents</td>
</tr>
<tr>
<td>Zn Sulfate (75%) OTM Zn (25%) Weighted Avg.</td>
<td>656.3 mgs 218.7 mgs 875 mgs</td>
<td>11%</td>
<td>96.3 mgs</td>
<td>1.02 cents</td>
</tr>
<tr>
<td>HTM Zn</td>
<td>875 mgs</td>
<td>19.9%</td>
<td>174.1 mgs</td>
<td>.98 cents</td>
</tr>
</tbody>
</table>
Colorado State Univ. Study Design

Grow - Finish Performance Study, Conducted CSU SE Colo. Research Center

- 288 cross bred steers allocated to 4 treatments
  - 8 pens per treatment with 9 steers per pen
- Initial arrival weights of 747 lbs
- Cattle implanted (Revalor – XS)
- 3 Ration, step up program utilized
- Cattle harvested at day 172

<table>
<thead>
<tr>
<th>Treatments (supplemental)</th>
<th>CuSO₄</th>
<th>ZnSO₄</th>
<th>Availa Cu</th>
<th>Availa Zn</th>
<th>IntelliBond C</th>
<th>IntelliBond Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inorganic $ .93</td>
<td>15 ppm</td>
<td>90 ppm</td>
<td>0 ppm</td>
<td>0 ppm</td>
<td>0 ppm</td>
<td>0 ppm</td>
</tr>
<tr>
<td>ITM / OTM $ 2.27</td>
<td>11.25 ppm</td>
<td>67.5 ppm</td>
<td>3.75 ppm</td>
<td>22.5 ppm</td>
<td>0 ppm</td>
<td>0 ppm</td>
</tr>
<tr>
<td>IntelliBond $ 2.11</td>
<td>0 ppm</td>
<td>0 ppm</td>
<td>0 ppm</td>
<td>0 ppm</td>
<td>15 ppm</td>
<td>90 ppm</td>
</tr>
<tr>
<td>60% IntelliBond $ 1.26</td>
<td>0 ppm</td>
<td>0 ppm</td>
<td>0 ppm</td>
<td>0 ppm</td>
<td>9 ppm</td>
<td>54 ppm</td>
</tr>
<tr>
<td>Item</td>
<td>ITM</td>
<td>I/OTM</td>
<td>IB</td>
<td>60% IB</td>
<td>P Value</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>------</td>
<td>-------</td>
<td>-----</td>
<td>--------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>Initial Wt, lb</td>
<td>707</td>
<td>699</td>
<td>702</td>
<td>703</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>Final Wt(^b), lb</td>
<td>1287</td>
<td>1305</td>
<td>1291</td>
<td>1287</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>Dry Matter Intake</td>
<td>19.0</td>
<td>19.6</td>
<td>19.4</td>
<td>19.3</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Daily Gain, lb/day</td>
<td>3.38</td>
<td>3.48</td>
<td>3.40</td>
<td>3.38</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>Feed/Gain</td>
<td>5.63</td>
<td>5.63</td>
<td>5.69</td>
<td>5.71</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>Carcass Weight, lb</td>
<td>820</td>
<td>830</td>
<td>825</td>
<td>821</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Dressing Percent</td>
<td>63.8</td>
<td>63.5</td>
<td>63.9</td>
<td>63.8</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>Marbling Score</td>
<td>411</td>
<td>415</td>
<td>439</td>
<td>429</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>Premium Choice, %</td>
<td>7.2</td>
<td>9.9</td>
<td>20.6</td>
<td>16.9</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Choice &amp; Prime, %</td>
<td>49.3</td>
<td>53.5</td>
<td>60.3</td>
<td>60.6</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>Select, %</td>
<td>47.8</td>
<td>45.1</td>
<td>38.2</td>
<td>38.0</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td>Dark Cutters, %</td>
<td>9.0</td>
<td>1.4</td>
<td>2.9</td>
<td>2.8</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Liver Copper, ppm</td>
<td>191</td>
<td>198</td>
<td>198</td>
<td>192</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>Liver Zinc, ppm</td>
<td>148</td>
<td>142</td>
<td>146</td>
<td>147</td>
<td>0.77</td>
<td></td>
</tr>
</tbody>
</table>
Design:
- Transition cow study (21 days prepartum through 84 days post partum)
- 60 total cows – 3 treatments of 20 cows each
- Cows milked 2x / day, within the Cornell milking facility
- Milk weighed at each milking
- Separate composite milk sample taken from AM & PM milkings, weekly

Treatments:  (Zn @ 60 ppm; Mn @ 40 ppm & Cu @ 15 ppm)
- All sulfate
- 75% sulfate / 25% Availa Zn, Mn & Cu
- IntelliBond Zn, Cu & Mn (hydroxy trace minerals)

Measurements:
- All performance parameters
- Plasma Markers - Cow well being & health

T. Overton, Ph.D, Cornell University, Ithaca, NY
Health Related Effects in Transition Dairy Cows

Cow health evaluation:

- Plasma markers indicate IntelliBond treated cows were healthier:
  - TBARS - (Thiobarbituric acid-reactive substances)
  - TAC — (Total antioxidant capacity)
  - Hp — (Haptagloboin)
- No significant differences for all major health challenges:
  - Lameness – NS
  - SCC – NS
  - Mastitis – NS
  - Metritis - NS
  - BCS – NS
  - Endometritis – NS

### Treatments

<table>
<thead>
<tr>
<th>Item</th>
<th>ITM</th>
<th>ITM/OTM</th>
<th>HTM</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TBARS, uM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole study</td>
<td>2.11A</td>
<td>1.98AB</td>
<td>1.95B</td>
<td>0.07</td>
</tr>
<tr>
<td>Prepartum</td>
<td>1.47</td>
<td>1.49</td>
<td>1.38</td>
<td>0.06</td>
</tr>
<tr>
<td>Postpartum</td>
<td>2.26</td>
<td>2.11</td>
<td>2.10</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>TAC, mM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole study</td>
<td>2.14a</td>
<td>2.07ab</td>
<td>1.93b</td>
<td>0.07</td>
</tr>
<tr>
<td>Prepartum</td>
<td>2.09a</td>
<td>1.93ab</td>
<td>1.84b</td>
<td>0.08</td>
</tr>
<tr>
<td>Postpartum</td>
<td>2.16a</td>
<td>2.09ab</td>
<td>1.95b</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>Hp, mg/mL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postpartum Period</td>
<td>0.83</td>
<td>0.91</td>
<td>0.078</td>
<td>0.09</td>
</tr>
<tr>
<td>1 week Postpartum</td>
<td>1.05AB</td>
<td>1.26A</td>
<td>0.90B</td>
<td>0.16</td>
</tr>
</tbody>
</table>

A,B Least square means within row with different upper-case superscript tend to differ (P < 0.1)

a,b Least square means within row with different lower-case superscript differ (P < 0.05)

All health evaluations completed by Cornell University vet school staff during the entire term of the study.
**Cornell Transition: Peak Milk Production**

**Peak Milk (lbs):**

- IntelliBond\(^1\) 107.9\(^a\)
- Inorganic\(^1\) 100.2\(^b\)
- ITM / OTM\(^1\) 101.7\(^{ab}\)

**Lactation persistency would indicate 1 lb peak is = 200 lbs of milk / lactation**

- Peak lactation improvement over inorganic = 1,540 lbs ($277.00 / cow\(^2\)) for $5.03 / cow\(^3\)

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1) Peak milk representative of the mean of weeks 4, 5 and 6
2) Milk value based on $18.00 cwt. mail box price
3) Mineral cost based on the incremental cost to switch to IntelliBond for a 305 days lactation cycle
The unique physical and chemical properties of all IntelliBond trace minerals provide the following benefits in premixes, supplements and feeds:

- Increased formulation flexibility: More nutrition, smaller footprint
- IntelliBond’s 250 µ particle significantly reduces carry over issues
- Greater product potency reduces logistic costs
- Increased premix / supplement stability
- Significantly improved essential nutrient (vitamins, trace metal, fats, etc.) stability in premixes, supplements and feeds
Stability Increased

Mash, Broiler diet with 3.6% added fat

- Control (18 ppm)
- Cu sulfate (200 ppm)
- IntelliBond C (200 ppm)

32% loss in Vitamin E activity at 10 days

Feed levels correspond to lower liver and plasma Vit. E in CuSO₄ fed chicks (p<0.05).

* Within a time point, mean is significantly different from Control (p<0.05).

Impact of Vitamin E Degradation

Cow Formulation Objectives:
- Vitamin E @ 750 IU hd/day
- Zinc (added) @ 60 ppm
- Copper (added) @ 15 ppm
- Manganese (added) @ 40 ppm

Supplement specs at 1.5 lbs / cow
- Vitamin E - .11%
- Zinc - .22% (2,200 ppm)
- Copper - .055% (550 ppm)
- Manganese - .147% (1,470 ppm)

Assumption:
- High Cu and Zn sulfate forms cause a 20% reduction in Vitamin E stability
  - Cost of Vitamin E supplementation / year @ 750 IU / Cow = $8.20
    - Vitamin E 50% at $6.75 / lb
  
Assumed loss (20%) = $1.72

Pay back:
- Cost of 15 ppm Cu from CuSO₄ = .48 Kgs ($1.35) cow per year
- Cost of 15 ppm from IntelliBond C = .21 Kgs ($1.80) cow per year
- Incremental cost to replace copper sulfate is $ .45 cow per year

(Return on Investment > 4.0:1)
IntelliBond Technology: Smart Release Crystals for Precision Delivery

- **IntelliBond C** - Basic Copper Chloride
  - Copper min: 50%, typical chlorides: 17-19%
  - A green, granular powder
  - Bulk density: 2.114 ± 10 kg/m³ (132 ± 6 lb/ft³)
  - Typical mean particle size: 20-100 μm

- **IntelliBond Z** - Zinc Hydroxychloride
  - Zinc min: 55%, typical chlorides: 11-14%
  - An off-white granular powder
  - Bulk density: 801 ± 7 kg/m³ (50 ± 6 lb/ft³)
  - Typical mean particle size: 100-300 μm

- **IntelliBond M** - Manganese Hydroxychloride
  - Manganese min: 44%, typical chlorides: 16-19%
  - A brown granular powder
  - Bulk density: 929 ± 10 kg/m³ (56 ± 6 lb/ft³)
  - Typical mean particle size: 100-300 μm

IntelliBond products are intended to be used as a source of trace mineral supplementation in swine, poultry, dairy cattle, beef cattle, horses and companion animals. For best results, it is recommended that a qualified nutritionist be consulted to establish optimized feeding levels. Store all products in a clean, dry environment.

Introducing: IntelliBond DAIRY

Newest technology available in trace mineral nutrition for dairy cattle!

One product form that delivers the proven value of IntelliBond Z, C and M in one convenient package. IntelliBond DAIRY combines the individual benefits of three IntelliBond products in one uniform particle designed to provide the right balance of zinc, manganese and copper for maximum productivity and health.

- Each IntelliBond DAIRY particle contains a blend of IntelliBond zinc, manganese and copper in a fixed ratio that fits current industry recommendations.
  - IntelliBond DAIRY Typical Analysis:
    - 28% Zinc
    - 15% Manganese
    - 6% Copper
  - IntelliBond DAIRY enables nutritionists to conveniently target the trace mineral feeding level that fits individual producer’s formulation needs.

IntelliBond DAIRY provides the following benefits:

- Each 250 micron particle contains a uniform blend of IntelliBond Z, M and C. No more concern over potential issues with trace mineral segmentation or mixing caused by different product concentrations and bulk densities. The IntelliBond DAIRY manufacturing process locks the correct amount of Zn, Mn and Cu into each particle ensuring accurate trace mineral delivery.
- Higher trace mineral potency compared with alternative trace mineral programs. IntelliBond DAIRY provides nutritionists with the ability to optimize their formulations, and reduce premix use rates, saving logistics costs.
- Uniform particle size and specific gravity provides optimal passage, supplementation and ration malleability.
- IntelliBond trace minerals are approved for use in micro-ingredient machines.
IntelliBond Key Value Points:

- Maintained cow well-being while increasing peak milk production
  - Rumen By-Pass
    - Increased rumen function (DM digestibility)
  - Crystalline structure
    - Slower Release Rate
    - Improved Absorption
  - Increased relative bioavailability (equivalent or better than best OTMs)
    - Effective mineral delivery for elite cow productivity and health
    - Increased Metal Conversation to the blood

- Maintains Essential Nutrient Potency in Supplements
- Improved formulation flexibility, reduced logistics costs
- Better health + Improved production = More income per cow!

IntelliBond is the smart trace mineral choice!