Uniquely High Quality Soy-Protein

Midwest-Ag Enterprises, Inc.
Minnesota, USA
Composition of Soybean

- 15% Soluble Carbohydrates (sucrose, stachyose, raffinoise, others)
- 18% Oil (0.5% Lecithin)
- 14% Moisture, ash, other
- 38% Protein
- 15% Insoluble Carbohydrates (dietary fiber)
Soybean & Soybean Meal
(Nutrient Composition)

Soybean:
90% cotyledon
8% hull
2% germ

Hull removed

Dehulled soybean:
40% protein
30% carbohydrates
20% oil
6% water
4% minerals

Oil extracted

Soybean meal:
48% protein
35% carbohydrates
10% water
5% minerals
<1% oil
<1% others
Anti-Nutritional Factors

Compounds that interfere with the intake, availability, or metabolism of nutrients in the animal

- **Protease inhibitors**: At least 5 trypsin inhibitors identified: Kunitz factor (1.4%) & Bowman-Birk factor (0.6%) which resistant to action of heat, alkali and acid

- **Lectins**: Glycoproteins noted for capability to agglutinate erythrocytes and bind sugar components (10-200 ppm)

- **Goitrogenic factors**: Glycosides belonging to the isoflavinic group, some of which like genistin; have goitrogenic activity

- **Saponins**: Although they appear in low levels they can decrease feed palatability (0.6%)

- **Phytic acid**: Phytates (1.0-2.3%) complexes with certain minerals (Ca, P, Mg, Cu, Fe and Zn) & amino acids - reducing their bioavailability
Anti-Nutritional Factors

Compounds that interfere with the intake, availability, or metabolism of nutrients in the animal

- **Oligosaccharides:** a saccharide polymer containing a small number (typically two to ten) of component sugars, also known as simple sugars; a flatulence factor in GIT of animals & interfering nutrient utilization
  - Raffinose (0.5-1.0%)
  - Stachyose (4.5-7.0%)
- **Glycinin:** Antigenic factor (66,000 ppm)
- **β-Conglycinin:** Antigenic factor (16,000 ppm), considered as a factor causing diarrhea in piglets
- **Rachitogenic factors:** Genistin (0.10% of raw soybeans) which interfere with calcification of bone (turkeys are particularly sensitive)
- **β-galactomannans:** Increasing stress proteins (0.25%)
Anti-Nutritional Factors

Compounds that interfere with the intake, availability, or metabolism of nutrients in the animal

1) **Heat-labile ANFs:** Proper processing of soybeans requires precise control of moisture, temperature and processing time to destroy most of anti-nutritional factors. Both over and under-toasting of soybeans can result in a meal of lower nutritional quality

- **Under-heating** produces incomplete removal of the anti-nutritional factors, while
- **Over-toasting** can reduce digestibility of protein & amino acids (particularly lysine)

2) **Oligosaccharides** are still remaining in the processed meal until they are denatured or removed by a special process
### Analysis of SBM from Different Cultivars

<table>
<thead>
<tr>
<th>Components</th>
<th>SBM</th>
<th>LO-SBM*</th>
<th>Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CP</td>
<td>47.7%</td>
<td>54.7%</td>
<td>7.0%</td>
</tr>
<tr>
<td>• Sucrose</td>
<td>6.95%</td>
<td>8.38%</td>
<td>1.43%</td>
</tr>
<tr>
<td>• Raffinose</td>
<td>0.71%</td>
<td>0.21%</td>
<td>-0.5%</td>
</tr>
<tr>
<td>• Stachyose</td>
<td>6.79%</td>
<td>1.56%</td>
<td>-5.23%</td>
</tr>
<tr>
<td>• Starch</td>
<td>0.89%</td>
<td>1.24%</td>
<td>0.35%</td>
</tr>
<tr>
<td>• ADF</td>
<td>5.54%</td>
<td>3.52%</td>
<td>-2.02%</td>
</tr>
<tr>
<td>• NDF</td>
<td>8.09%</td>
<td>4.60%</td>
<td>-3.49%</td>
</tr>
<tr>
<td>• Cellulose</td>
<td>5.53%</td>
<td>3.74%</td>
<td>-1.79%</td>
</tr>
</tbody>
</table>

* Low oligosaccharides SBM

Experiment 1. Apparent Metabolizable Energy (nitrogen corrected)

• 1,284 Ross broilers on 48 pens (16 replicates per treatment) for period of 18-32 days of age

• $\text{AME}_n$ (Kcal/kg)
  - SBM 2,241
  - LO-SBM 2,435 (+194 meaning +8.7% AME)

Experiment 2. Amino Acid SID Coefficient

• 2,996 Ross broilers on 24 pens (12 replicates per treatment) for period of 18-32 days of age to test digestibility of SBM & LO-SBM at 43% in test diets

• Standardized Ileal Digestible AA Coefficient (%)
  o Met, Lys, Thr, Val, and Ile: SBM<LO-SBM (P<0.001)

• Analytical value of Met, Lys, Val, and Ile
  o 0.02-0.03% higher in LO_SBM

Perryman, K.R. & Co-workers,
Int’l Poultry Expo, 2011
What is NutriVance?

• A novel raw material derived from SBM by a special process technology (manufacture started @Midwest-USA in 2012)

• A protein concentrate of superb nutritional quality for piglets, young animals and marine fish/shrimp since it contains very low levels of oligosaccharides and heat-labile ANFs
Features of NutriVance

1) A unique proprietary process which has combined the oil extraction with enzymatic treatment of soybeans

2) The special process rendered a soy-protein that has superior palatability and digestibility for young animals to conventionally-produced soybean meal
   - Low in anti-nutritional factors (TIA, oligosaccharides, etc.)
   - Micronized particle size to maximize surface area

3) Concentrated protein: CP ≥ 60% (typically over 63%)

4) Excellent alternative for fish meal, dairy product, SPC or fermented soy-proteins in diets for piglets, young animals, breeding stocks, concentrate feed, aqua-feed
Trypsin Inhibitor and Oligosaccharides

<table>
<thead>
<tr>
<th>Soy Protein Sources</th>
<th>CP (%)</th>
<th>TIA (mg/g)</th>
<th>Stachyose (%)</th>
<th>Raffinose (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBM (47)</td>
<td>47</td>
<td>4-8</td>
<td>4-4.5</td>
<td>0.8-1.0</td>
</tr>
<tr>
<td>NutriVance</td>
<td>60</td>
<td>2.31</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>SPC</td>
<td>65</td>
<td>2-3</td>
<td>1-3</td>
<td>&lt;0.2</td>
</tr>
<tr>
<td>HP300</td>
<td>53</td>
<td>2-3</td>
<td>&lt;0.5</td>
<td>&lt;0.1</td>
</tr>
</tbody>
</table>

- Stachyose and raffinose are the major oligosaccharides that cause the symptom of flatulence in the lower GIT
- NutriVance contains very low level of stachyose and raffinose as well as lower TIA level than SBM
Trial I: Effect of Nutrivance on Nursery Pig Performance

University of Missouri
Dr. Gary Allee and Greg Gerlemann
(January 2012)
• **Location:** Moberly, MO, Nursery Facility
• **Researchers In Charge:** Dr. Gary Allee and Greg Gerlemann

**Experimental Design**

• **Animals:** 966 heads of PIC sired pigs;
  - 7 pens of 23 pigs per treatment

• **Dietary Treatments**
  1) Control (Fish meal)
  2) Dr. Allee’s Treatment
  3) HP 300
  4) NutriVance
  5) NutriVanceE
  6) PepSoyGen
Experimental Design (continued)

• *Duration:* Started 1\textsuperscript{st} week of January 2012 and then finished 42 days post-placement
  – *Phase 1:* 0-7 day
  – *Phase 2:* 8-21 day
  – *Phase 3:* 22-42 day (common feed)

• *Measurements:*  
  – Weighed at day 0, 7, 21 and 42 (pen base)
  – Measured feed intake for day 0, 7, 21 and 42 (pen base)
  – Recorded mortality/morbidity by pen & treatment
  – Kept records of treatment for sick pig by pen & treatment

• *Composition of Test Diets:*  
  – *As in Table*
## Diets (phase I)

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>FISH MEAL</th>
<th>HP 300</th>
<th>NUTRIVANCE</th>
<th>NUTRIVANCEE</th>
<th>PEPSOYGEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>428.73</td>
<td>408.99</td>
<td>409.12</td>
<td>409.12</td>
<td>396.71</td>
</tr>
<tr>
<td>SBM 48%</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Fat, CWG</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>L-Lysine</td>
<td>2.45</td>
<td>3.2</td>
<td>3.3</td>
<td>3.3</td>
<td>3.33</td>
</tr>
<tr>
<td>DL-Methionine</td>
<td>1.8</td>
<td>2.2</td>
<td>2.25</td>
<td>2.25</td>
<td>2.1</td>
</tr>
<tr>
<td>L-Threonine</td>
<td>1.03</td>
<td>1.07</td>
<td>1.03</td>
<td>1.03</td>
<td>1.04</td>
</tr>
<tr>
<td>L-Tryptophan</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.03</td>
</tr>
<tr>
<td>Whey (IIC)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Plasma (APC)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>DairyLac 80 (IIC)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Fish Meal</td>
<td>60</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HP-300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>67.5</td>
</tr>
<tr>
<td>Nutrivance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>67.5</td>
</tr>
<tr>
<td>NutrienceE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>67.5</td>
</tr>
<tr>
<td>Pepsyogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>ME (Mcal/kg)</td>
<td>3.521</td>
<td>3.509</td>
<td>3.497</td>
<td>3.497</td>
<td>3.484</td>
</tr>
<tr>
<td>CP (%)</td>
<td>22.04</td>
<td>22.05</td>
<td>22.34</td>
<td>22.34</td>
<td>22.43</td>
</tr>
<tr>
<td>SID Lysine (%)</td>
<td>1.45</td>
<td>1.45</td>
<td>1.45</td>
<td>1.45</td>
<td>1.45</td>
</tr>
</tbody>
</table>
## Diets (phase II)

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>CONTROL</th>
<th>HP 300</th>
<th>NUTRIENCE</th>
<th>NUTRIENCEE</th>
<th>PEPSOYGEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn 2010</td>
<td>517.53</td>
<td>499.97</td>
<td>500.07</td>
<td>500.07</td>
<td>483.45</td>
</tr>
<tr>
<td>SBM 48%</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Fat, CWG</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>L-Lysine</td>
<td>3.1</td>
<td>3.65</td>
<td>3.75</td>
<td>3.75</td>
<td>3.55</td>
</tr>
<tr>
<td>DL-Methionine</td>
<td>1.65</td>
<td>1.96</td>
<td>2</td>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td>L-Threonine</td>
<td>1.33</td>
<td>1.33</td>
<td>1.31</td>
<td>1.31</td>
<td>1.2</td>
</tr>
<tr>
<td>Whey (IIC)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Plasma (APC)</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>DairyLac 80 (IIC)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Fish Meal</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HP-300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>57.5</td>
</tr>
<tr>
<td>Nutrivence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>57.5</td>
</tr>
<tr>
<td>NutrivenceE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>57.5</td>
</tr>
<tr>
<td>Pepsoygen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>75</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>ME (Mcal/kg)</td>
<td>3.489</td>
<td>3.479</td>
<td>3.469</td>
<td>3.469</td>
<td>3.458</td>
</tr>
<tr>
<td>CP (%)</td>
<td>21.21</td>
<td>21.27</td>
<td>21.52</td>
<td>21.52</td>
<td>21.88</td>
</tr>
<tr>
<td>Total Lysine (%)</td>
<td>1.52</td>
<td>1.52</td>
<td>1.53</td>
<td>1.53</td>
<td>1.55</td>
</tr>
<tr>
<td>TID Lysine (%)</td>
<td><strong>1.38</strong></td>
<td><strong>1.38</strong></td>
<td><strong>1.38</strong></td>
<td><strong>1.38</strong></td>
<td><strong>1.38</strong></td>
</tr>
</tbody>
</table>
NutriVance showed 30 gr/d advantage over Fishmeal in the 1st Phase.
NutriVance showed an excellent palatability over the others in the 1st seven days of trial.
NutriVanceE showed the best Feed Efficiency over the others in the 1st seven days of trial.
During the 2\textsuperscript{nd} Phase, ADG appears to be similar between the protein sources.
During the 2nd Phase, ADFI was higher in PepSoyGen group than others but with a similar daily-gain.
During the 2\textsuperscript{nd} Phase, FCR was similar between Fishmeal, HP300 and NutriVance whereas NutriVanceE and PepSoyGen was a bit worse
During the 3\textsuperscript{rd} Phase, ADG appears to be similar between the protein sources.
Body weight was slightly advantageous for NutriVance products after 42 days of feeding trial.
1) NutriVance had better ADG than other protein sources during the 1\textsuperscript{st} Phase which was not sustained in the 2\textsuperscript{nd} and 3\textsuperscript{rd} Phase

2) Highest ADFI was recorded by NutriVance and followed by NutriVanceE and PepSoyGen

3) In the 2\textsuperscript{nd} Phase, PepSoyGen resulted in the highest ADFI but ADG was not better than other proteins
   - Soy protein fermented in the hindgut may lead to surplus of ammonia and biogenic amines like tyramine and spermidine that may cause diarrhea and will negatively affect performance

4) In the 2\textsuperscript{nd} Phase, PepSoyGen marked the worst FCR as with the highest ADFI but without support of ADG

5) During the 3\textsuperscript{rd} Phase, ADG was similar among the trial groups since they are all fed the same common diet

6) At the end of trial, Final Body Weight was slightly better in the group of NutriVance, indicating the carryover of ADG obtained in the 1\textsuperscript{st} Phase
Trial 2: Evaluation of a novel protein supplement (NutriVance) for early-weaned pigs

University of Minnesota

Dr. Sam Baidoo
STUDY OBJECTIVES

1) Evaluate the performance of piglets weaned at 18 days of age and fed diets containing various levels of a novel soy product (NutriVance), with a focus on the early nursery period.

2) Compare the performance of nursery pigs fed NutriVance to those pigs fed the similar amount of commonly used high quality proteins such as fish meal or soy protein concentrate.
Experimental Design

- **Location:**
  Waseca, University of Minnesota Research Facility

- **Animals:**
  - Breeds: Compart x Topigs pigs
  - 192 heads with mean body weight: 5.65+/-0.47 kg
  - 8 pens of 4 pigs per treatment

- **Dietary Treatments:**
6 Dietary Treatments

1) Fishmeal: Diet containing 6 or 5% fishmeal
2) NutriVance1: Diet containing 6 or 5% NutriVance
3) NutriVance 2: Diet containing 12 or 10% NutriVance
4) NutriVance 3: Diet containing 18 or 15% NutriVance
5) Soy Protein Concentrate: Diet containing 18 or 15% SPC
6) SBM (Control): Diet containing none of test ingredients
ADG (D0-7)

- SPC has no oligosaccharides and is lower in soy antigen (glycinin and β-conglycinin)
- Diets containing higher than 12% NutriVance has improved ADG by 30% as compared to SPC
Nutrivance improved ADFI 37.5% as compared to SPC.
Control with only SBM had the highest ADG during the 2nd phase
No difference between treatments
## Overall Performance (D0-35)

<table>
<thead>
<tr>
<th></th>
<th>FM</th>
<th>NV6</th>
<th>NV12</th>
<th>NV18</th>
<th>SPC</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADG, kg</strong></td>
<td>0.41</td>
<td>0.39</td>
<td>0.40</td>
<td>0.42</td>
<td>0.40</td>
<td>0.41</td>
</tr>
<tr>
<td><strong>ADFI, kg</strong></td>
<td>0.65</td>
<td>0.66</td>
<td>0.65</td>
<td>0.68</td>
<td>0.66</td>
<td>0.66</td>
</tr>
<tr>
<td><strong>F:G</strong></td>
<td>1.59</td>
<td>1.67</td>
<td>1.61</td>
<td>1.59</td>
<td>1.64</td>
<td>1.59</td>
</tr>
<tr>
<td><strong>Final Wt, kg</strong></td>
<td>19.90</td>
<td>19.45</td>
<td>19.70</td>
<td>20.50</td>
<td>19.61</td>
<td>20.14</td>
</tr>
</tbody>
</table>
Summary

- NutriVance has significantly improved ADG and ADFI during d0-7 after weaning as compared to SPC.

- The inclusion rate of NutriVance in the nursery pigs diets can be up to 18%.
CONCLUSIONS

1) NutriVance proved to be the best protein source for young piglets as shown in two trials run by University Researchers

2) NutriVance can replace high quality fish meal or other soy proteins such as HP300, SPC and Pepsoygen for nursery pig diets with the same or higher growth performance

3) The inclusion rate of NutriVance in the nursery pig diets can be up to 18%
Thank you for your attention!

NutriVance means

“Nutrition with Advance Knowledge”