Quality of U.S. Soybean Meal Compared to the Quality of Soybean Meal from Other Origins

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Introduction

- Soybeans - important source of protein and oil
- US - dominant producer
- Year 2004:
  - Area planted: 75.2 million acres
  - Production: 3.14 billion bushels
  - Crop value exceeding $17.7 billion

Source: Soy Stats 2005
Project Motivation

- South America
- Soybean production increasing in Brazil and Argentina - 34% in 1999 to 42% in 2004
- NOPA soybean meal trading specifications
- True Processed Value of soybeans $\approx$ End-use

Soybean Production in Brazil & Argentina

Source: Soy Stats 2005
Objectives

- To survey the quality of 2004 crop soybeans and soybean meal from non-U.S. vs. U.S. origins
- To compare the results from this survey with the data from previous studies
Soybean Processing Model

Source: SPROC 3
Methods

• Samples
  ▪ 115 soybean and 153 SBM samples
  ▪ 500-1000g each
  ▪ Collected by ASA representatives in 8 countries
  ▪ Shipped to GQL, Iowa State University

Soybeans

Soybean Meal
Analysis

• All samples divided into 4 fractions: Electric Grain Divider
Analysis- Soybeans

1: Eurofins Scientific, Des Moines, Iowa
   - Moisture: AOCS Ac 2-41
   - Oil: AOCS Ba 3-38
   - Protein: AOCS Ba 4e-93
   - FFA: AOCS Ac 5-41

2: University of Missouri-Columbia Exp Station Labs
   - Amino Acids - AOAC 982.30 (a,b,c)

3 & 4: Retained for other work
Analysis - Soybean Meal

1: Eurofins Scientific, Des Moines, Iowa
   - Moisture: AOCS Ba 2a-38
   - Protein: AOCS Ba 4e-93
   - Oil: AOCS Ba 3-38
   - Fiber: AOCS Ba 6-84
   - Ash: AOCS Ba 5a-49
   - NSI: AOCS Ba 11-65
   - Non Protein Nitrogen: AOAC 941.04
   - Mold Count: AACC 42-50
   - KOH Protein Solubility: AOAC 971.09
Analysis - Soybean Meal

2: University of Missouri-Columbia Exp. Station Labs
   - Amino Acids: AOAC 982.30E (a,b,c)

3: Grain Quality Lab, Iowa State University
   - Particle Size Analysis: ASAE S319.2

4: Retained for other work
Comparison with previous studies

• Soybeans
  – Grieshop & Fahey: 2001
  – U.S. annual soybean quality surveys
    ▪ 2003
    ▪ 2004

• Soybean meal
  ▪ 1995-1999 by Moizzudin
  ▪ 1999 by John Baize and Associates
Amino Acids

• 5 key AA: Lysine, Threonine, Methionine, Cysteine, Tryptophan
  ▪ % by weight
  ▪ % of protein

• Measure of Protein Quality:
  ▪ Digestible AA = AA * KOH Solubility
Statistical Analysis by Origin

• Soybeans: 13% moisture basis
• Soybean meal: 12% moisture basis
• Asia: UAE, Indonesia, Malaysia, Philippines & Korea (n = 15)
• Others: Guatemala, El Salvador, Panama, Costa Rica, Trinidad, Barbados & Paraguay (n = 7)
• Least Significant Difference (LSD, P = 0.05) in JMP 5.1
Results: Soybean Quality

Protein (\%):

- USA: 35.0
- Brazil: 37.0
- Argentina: 34.0
- Other: 33.0

Oil (\%):

- USA: 18.0
- Brazil: 19.6
- Argentina: 18.4
- Other: 18.8

Protein Quality: 5 Key AA (% of P):

- USA: 14.4
- Brazil: 14.0
- Argentina: 15.0
- Other: 14.6

Oil Quality: FFA (%):

- USA: 1.0
- Brazil: 1.4
- Argentina: 0.8
- Other: 0.6

13% Moisture Basis
Results: Soybean Meal Quality

Protein (%)

<table>
<thead>
<tr>
<th>Country</th>
<th>Protein (%)</th>
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<tbody>
<tr>
<td>USA</td>
<td>48.0</td>
</tr>
<tr>
<td>Argentina</td>
<td>49.0</td>
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<tr>
<td>Brazil</td>
<td>48.0</td>
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<tr>
<td>India</td>
<td>47.0</td>
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<tr>
<td>China</td>
<td>49.0</td>
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Protein Quality: 5 AA (% of Protein)

<table>
<thead>
<tr>
<th>Country</th>
<th>Protein Quality: 5 AA (%)</th>
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<tr>
<td>USA</td>
<td>14.6</td>
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<tr>
<td>Argentina</td>
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<td>Brazil</td>
<td>13.8</td>
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<td>India</td>
<td>14.2</td>
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<td>China</td>
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KOH Solubility (%)

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<tr>
<td>USA</td>
<td>88.0</td>
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<tr>
<td>Argentina</td>
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<tr>
<td>Brazil</td>
<td>84.0</td>
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<tr>
<td>India</td>
<td>82.0</td>
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<tr>
<td>China</td>
<td>84.0</td>
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NSI %

<table>
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<tr>
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<tr>
<td>Brazil</td>
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<td>India</td>
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<tr>
<td>China</td>
<td>16.0</td>
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</table>

12% Moisture Basis
## Results - Soybean Meal Quality

<table>
<thead>
<tr>
<th>Origin</th>
<th>Mean particle size (microns)</th>
<th>% in desired range (250-1700 microns)</th>
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<tbody>
<tr>
<td>USA</td>
<td>1070</td>
<td>84.1</td>
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<tr>
<td>Argentina</td>
<td>1074</td>
<td>79.8</td>
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<tr>
<td>Brazil</td>
<td>1088</td>
<td>83.7</td>
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<tr>
<td>India</td>
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<td>65.5</td>
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<td>China</td>
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<td>Asia</td>
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<tr>
<td>Others</td>
<td>1125</td>
<td>82.3</td>
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Soybean Meal Samples

USA

India
Soybeans: Comparison with previous studies

Results

13% Moisture Basis
Soybean Meal: Comparison with previous studies

Protein (%)

5 key AA (% of P)

KOH Sol %

USA Argentina Brazil India

USA Argentina Brazil India

USA Argentina Brazil India
Conclusions

• U.S. soybeans
  ▪ Lower protein than Brazil, higher than Argentina
  ▪ Crude protein disadvantage of U.S. beans was offset by higher concentrations of AA
  ▪ Advantageous if market recognizes amino acids rather than protein as indicator of feeding value

• U.S. SBM more consistent
  ▪ Higher digestibility
  ▪ Lower fiber
  ▪ Better quality of protein
Conclusions

- U.S. soybean meal
  - Higher digestibility & key AA
  - U.S. producers would benefit if diets were formulated on actual AA of meal being fed
  - Mean particle size: within desired range

- Previous studies
  - General quality trend similar to previous studies
  - U.S. SBM held an advantage in digestibility & concentrations of key amino acids in all three studies
  - U.S. SBM - ↑ Protein Solubility & Brazilian SBM - ↑ Protein