Dr Erhard Briendedennann
Protein Research Foundation

Soya processing – nutritional and financial benefits

Sponsored by: Protein Research Foundation
SOYBEAN PROCESSING

Nutritional and financial benefits

Dr Erhard Briedenhann (MIDS)
WHY SOYBEAN MEAL?

- Peanuts: 6 MT
- Fishmeal: 5 MT
- Copra: 2 MT
- Soya: 182 MT
- Palm kernel: 7 MT
- Sunflower: 15 MT
- Cottonseed: 16 MT
- Rapeseed: 35 MT

68%
WHY SOYBEAN MEAL?

- Essential amino acid profile
- Lysine to protein ratio
- High lysine availability
- Palatability
- Variation in digestibility
- Sole source of protein
- Competitively priced protein
SOYBEAN MEALS ARE THEY ALL THE SAME?

THE ANSWER IS NO!
SOYBEAN MEAL QUALITY

• Variation in nutrient quantity and digestibility

• Variation between various sources
SOYBEANMEAL FOR VARIOUS SPECIES
FACTORS AFFECTING SOYBEAN COMPOSITION

• Protein quality from the soybean to soybean meal

  15% SOLUBLE CARBOHYDRATES
  18% OIL
  0.5% LECITHIN
  14% MOISTURE
  15% INSOLUBLE CARBOHYDRATES

• Essential amino acids and digestibility as a ratio of protein depends on source of soybeans processed

(Thakur and Hurburgh 2007)
FACTORS AFFECTING SOYBEAN COMPOSITION

- Plant
- Soil fertilization
- Nitrogen fixation
- Soil trace minerals
- Locality climate and environment
- Water
- Agronomic practices

(Gous 2012)
PROCESSING

• Moisture

• Temperature

• Time
PROCESSING METHODS
FULL FAT SOYA

Micronization
Roasting (Variable – By Pass Ruminants)
Expanding
Extrusion

Beans  Extrusion  Soybean meal high fat
CELL RUPTURE

Raw Soybean

CELL WALL INTACT

Extrusion

Extruded Soya

COMPLETE CELL RUPTURE
PROCESSING METHODS
MECHANICAL EXPPELLER

Beans

De hulling

Soya hulls

Extrusion

Expeller

Crude degummed oil

Soybean meal high fat
PROCESSING METHODS
SOLVENT EXTRACTION

Beans

De hulled cracked flaked

Expanded

Hexane extraction

De solventized

Toasted

Cooled

Crude Degummed Oil

Soybean Meal
PROCESSING METHODS
PROTEIN CONCENTRATES

• White flakes
• Residual hexane removed (Low heat flash desolventizer)
• Acid aqueous ethanol extractor
  – Remove Sucrose Raffinose Stachyose Phytoestrogens
  – Denature Antigenic Proteins Trypsin Inhibitor Conglycinin and B Conglycinin
• Alternative fermentation products
DEHULLED SOYBEAN MEAL (FIBRE FRACTION)

• De hulled Soybean Meal is always superior quality to Non Dehulled Meal

• Carbohydrates Sacharrides Cellulose non starch polysachrrides dilute

• Diminish digestibility of energy and amino acids

• Hot de hulling
METABOLIZABLE ENERGY

• More gross energy than maize

• ME only 50 – 60% of gross energy

• Soybean meal contributes 20 – 30% ME of a poultry diet

• Main effect is fibre
  – carbohydrate fraction is poorly digested

• Enzymes
ANTINUTRITIONAL FACTORS

Protease inhibitors
Lectins
Goitrogenic factors

Saponins
Rachtogenic Factors
Phytic acid
UNDERPROCESSING

- Inhibit Proteolytic Enzyme activity decreasing digestive efficiency
- Pancreas hypertrophy
- Increased demand for Vitamin D
- Diarrhoea
- Decrease nutrient absorption
- Decreased bird performance
OVERPROCESSING

• Maillard reaction

• Decrease quality of protein (Destruction of Lysine and Cystine)

• Decrease amino acid digestibility most critical for Lysine and Cystine

• Affect young bird performance
QUALITY MONITORING VS CHICK PERFORMANCE

(Adapted from Anderson-Haferman et al 1992)
QUALITY MONITORING METHODS

• Urease test (pH Method)
  – Optimum 0.2 TO 0.05

• Inconsistent non linear nature of Urease Index

• Optimum acceptable levels of Urease Index?

• Urease Index is useful to determine if soybean meal has been heated enough to reduce anti nutritional factors

(Wright et al 1981)
QUALITY MONITORING METHODS

• Protein Solubility (KOH)
  75 – 85% Acceptable
  KOH Protein Solubility Index responds inconsistently.

KOH indicator for Over processing but Is not suitable for monitoring Under processing

(Parsons 1998)
QUALITY MONITORING METHODS

• Protein Dispersibility Index (PDI)
  – Less than 45% adequately processed
• PDI may be a better indicator of adequate soybean heating than Urease or KOH.
• Soymeal with a PDI under 45% is adequately heated
• 15% TO 30% is recommended

(Batal et al 2000)
TRYPSIN INHIBITOR ACTIVITY

(Herkelman et al 1991)
QUALITY MONITORING METHODS

• Trypsin Inhibitor Activity (TIA)
• Direct measurement of Trypsin Inhibitor is an accurate measurement of animal performance
• Practical application?

(McNaughton 1981)
NIR FOR IDENTIFYING HEAT DAMAGED SOYBEANMEAL

• NIR can be calibrated as a rapid assay to determine total amino acid content and ileal digestibility in soybean meal (Amino Red)

• Bird performance improved after adjusting for total amino acids and ileal digestibility of heat damaged soybean meal

(M Wiltafsky 2013)
SOYA BEAN STORAGE

• Storage and handling during and after harvest affect the structure and extractability of glycine.

• Negatively affect the digestibility of protein in solvent extracted soybean meal

(Hou and Chang 2004)
FULL FAT SOYA STORAGE

• High levels of Tocopherols and Lecithin present in oil inhibit oxidation

• Heat treatment destroys the enzyme Lipase and Lipooxygenase can cause rancidity long term storage may require an antioxidant

• Cooling of post extruded soya is very important when producing Full Fat Soya and Expressed Soya
SOYA MEAL STORAGE

• During storage digestible lysine has been shown to decrease by 0.019% per month and negatively affect feed performance
CONCLUSION

• All soybean meals are not equal choose wisely

• Soybean meal must be produced from carefully monitored and managed soybeans

• Soybean meal manufacturing plants need accurately controlled processing conditions

• Processing conditions adjusted to quality control parameters that support optimum digestibility and bird performance
THANK YOU