Innovation and technology to utilize agricultural co-products for animal feed

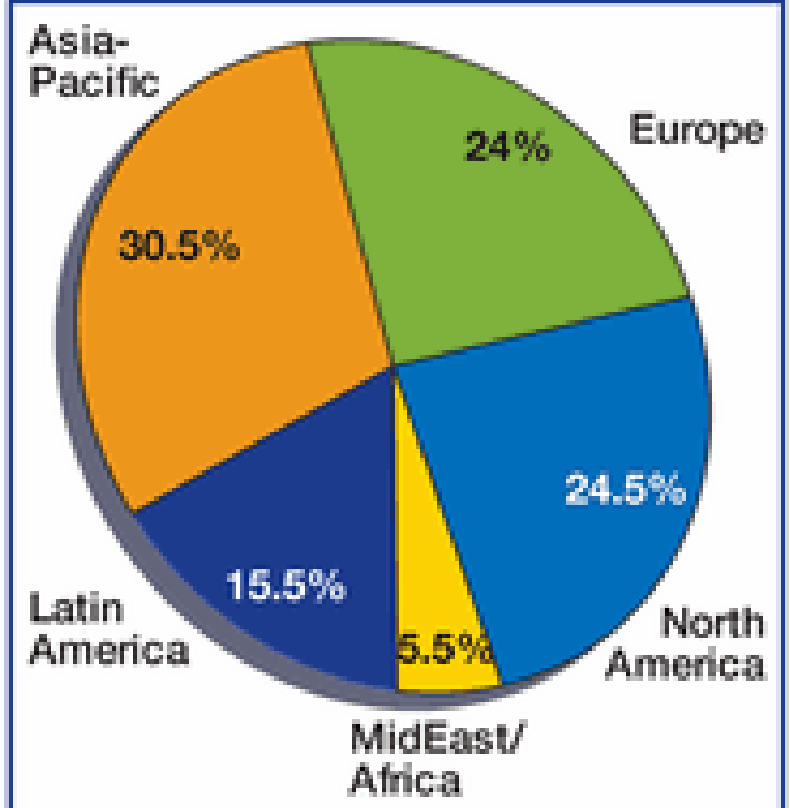
Budi Tangendjaja PhD
Technical Consultant to
USGC SEA

Outline

- Introduction
- Type of Agriculture co-product
- Nutritional and technological problems
- Current technologies
- Future challenges
- Conclusion

World feed panorama

FIGURE 3: Regional shares of world feed production



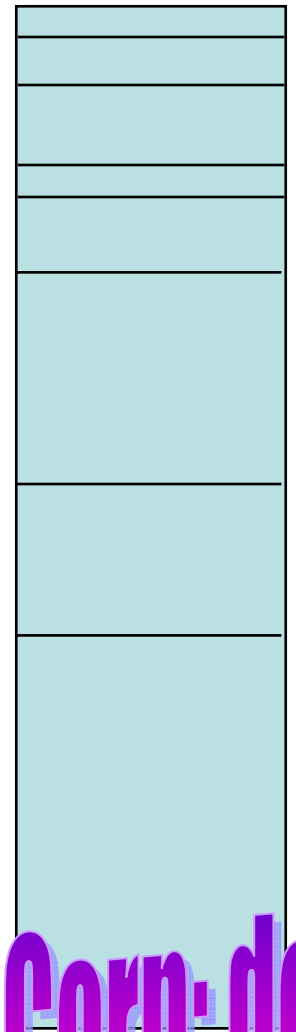
Asia-Pacific continues to account for the largest share of global feed production.

FIGURE 4: World total feed production x million metric tons

Year	Million tons
1995	590
1996	597
1997	605
1998	595
1999	606
2000	611
2001	617
2002	624
2003	632
2004	634
2005	646
2006	656
2007	680
2008	700
2009	708
2010	718

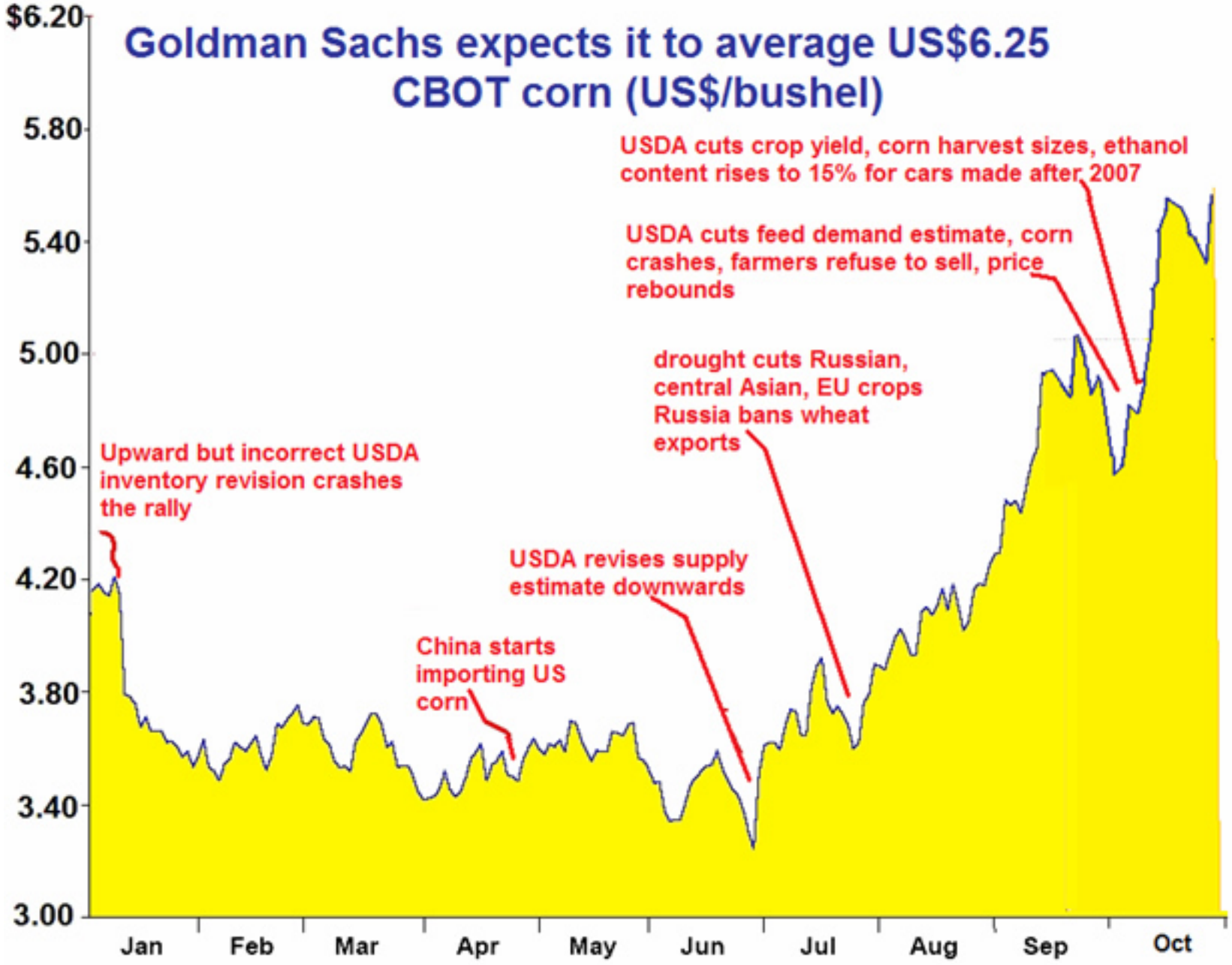
Diet structure for mono gastric-animals

- Vitamins/trace minerals 1-5 kg/t
- limestone 1-80 kg/t
- Dicalcium phosphate 0-15 kg/t
- Salt 1-4 kg/t
- Added fat/oil 0-50 kg/t
- Protein meals 10-35 %
  - * animal 0-8 %
  - * vegetable 10-30 %
- Grain by-products 10-30 %
- Grains 40-75%

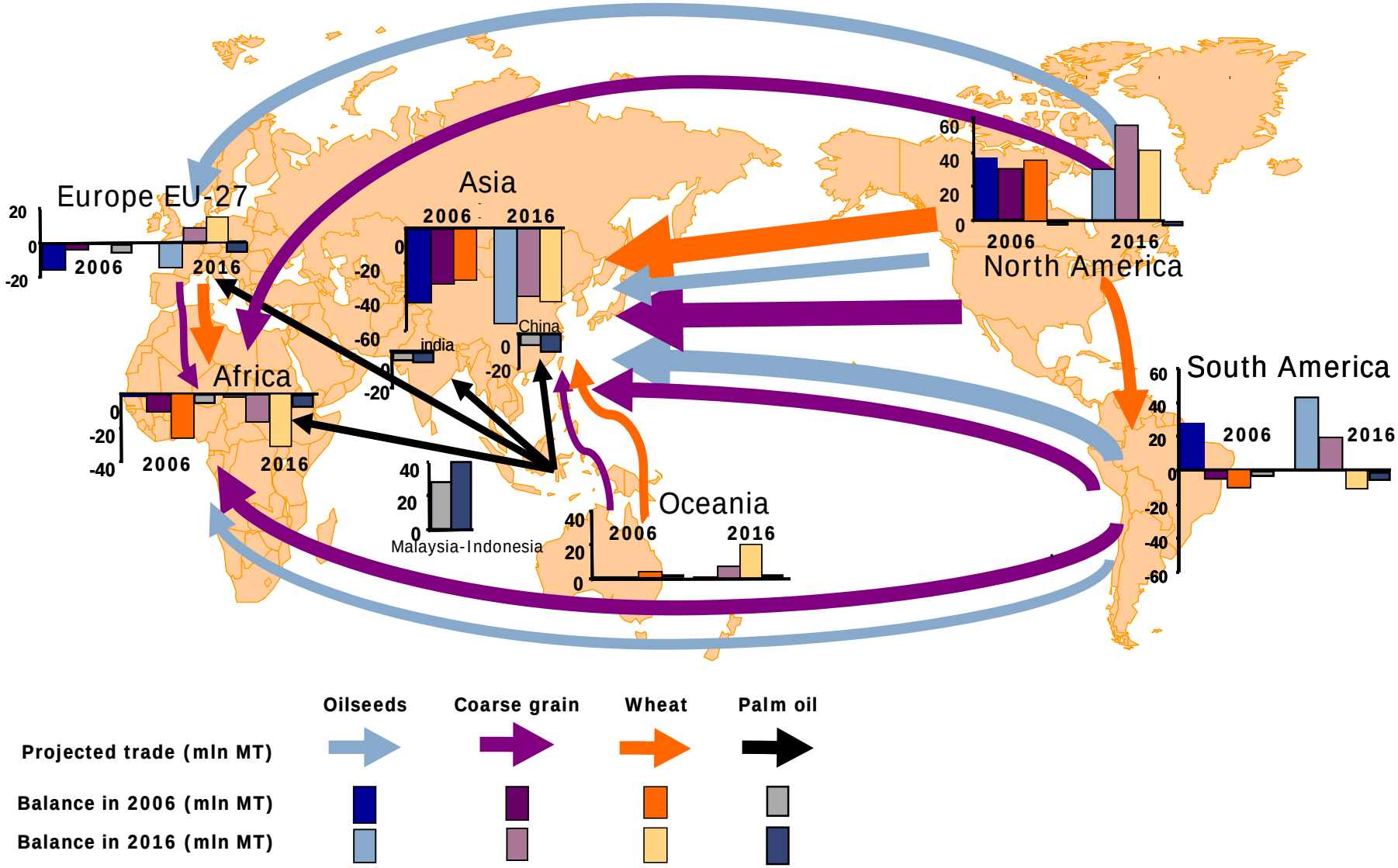


In Asia predominantly Corn and Soybean Meal

Corn: determinant factor


Goldman Sachs expects it to average US$6.25
CBOT corn (US$/bushel)
$6.20
5.80
5.40
5.00
4.60
4.20
3.80
3.40
3.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
USDA cuts crop yield, corn harvest sizes, ethanol content rises to 15% for cars made after 2007
USDA cuts feed demand estimate, corn crashes, farmers refuse to sell, price rebounds
drought cuts Russian, central Asian, EU crops
Russia bans wheat exports
Upward but incorrect USDA inventory revision crashes the rally
USDA revises supply estimate downwards
China starts importing US corn

Asia Remains Net Grain Importer



Source: Rabobank

Issue: Food, Feed and Fuel Competition

Is there sufficient ingredients to feed animals in the world?

Consider Agri-industrial co-products?

Agriculture Waste

- Waste or residue: rice straw, palm frond, sugar cane bagasse, cassava waste, saw dust, fruit waste, animal excreta
- Characteristics: high fiber, low ME for monogastric, low protein, bulky
- USES: feed mainly for ruminant or source of fuel
- It will not be discussed in this presentation

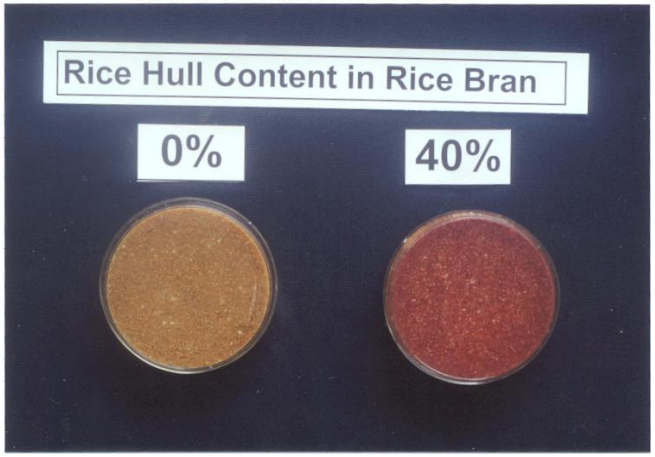
Agriculture co-products or by-products

- Locally available at relatively cheaper price
- It is not a waste, it generates income from the agriculture industries
- May provide reasonable revenue for main products such as oil, ethanol, starch
- Available from industries, therefore can be collected easily
- Generally, non competitive with human food

Types of Agro Industrial co-products

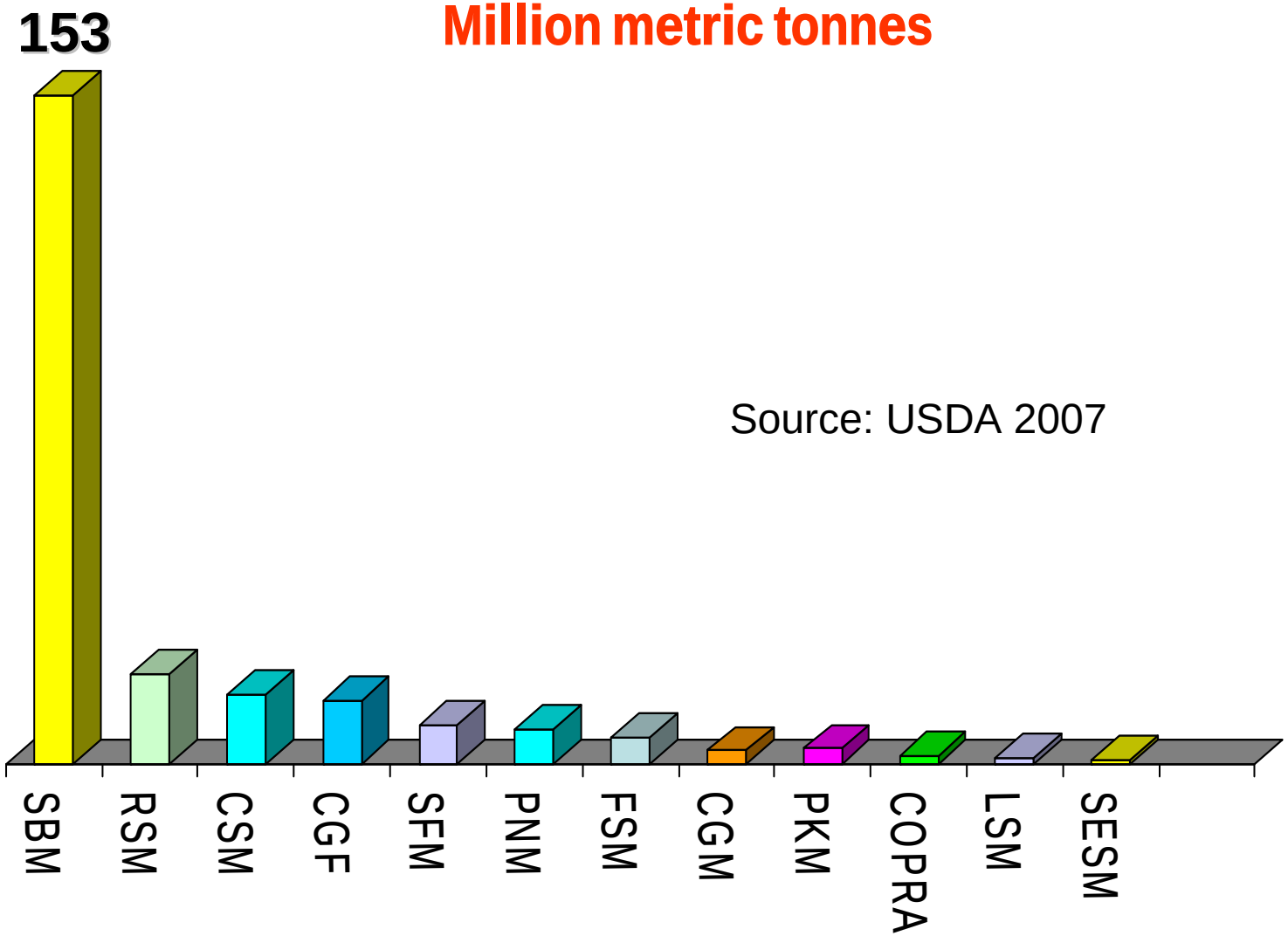
- **Oils industries** meal: PKE, Copra, SBM, rapeseed, peanut, cotton, sunflower seed.
- **Milling industries**: rice bran, wheat bran/pollard, hominy, CGM, CGF
- **Food industries**: bakery, noodle
- **Sugar industries**: molasses
- **Starch Industries**: hominy, cassava waste
- **Confectionaries**: coccoa meal, coffee skin
- **Ethanol industries**: DDGS, brewery waste
- **Fish industries**: fish meal, solubles, oil
- **Rendering industries**: MBM, PBM, Feather Meal, Blood meal, grease

Choice of AICP



World Oil Meal Production

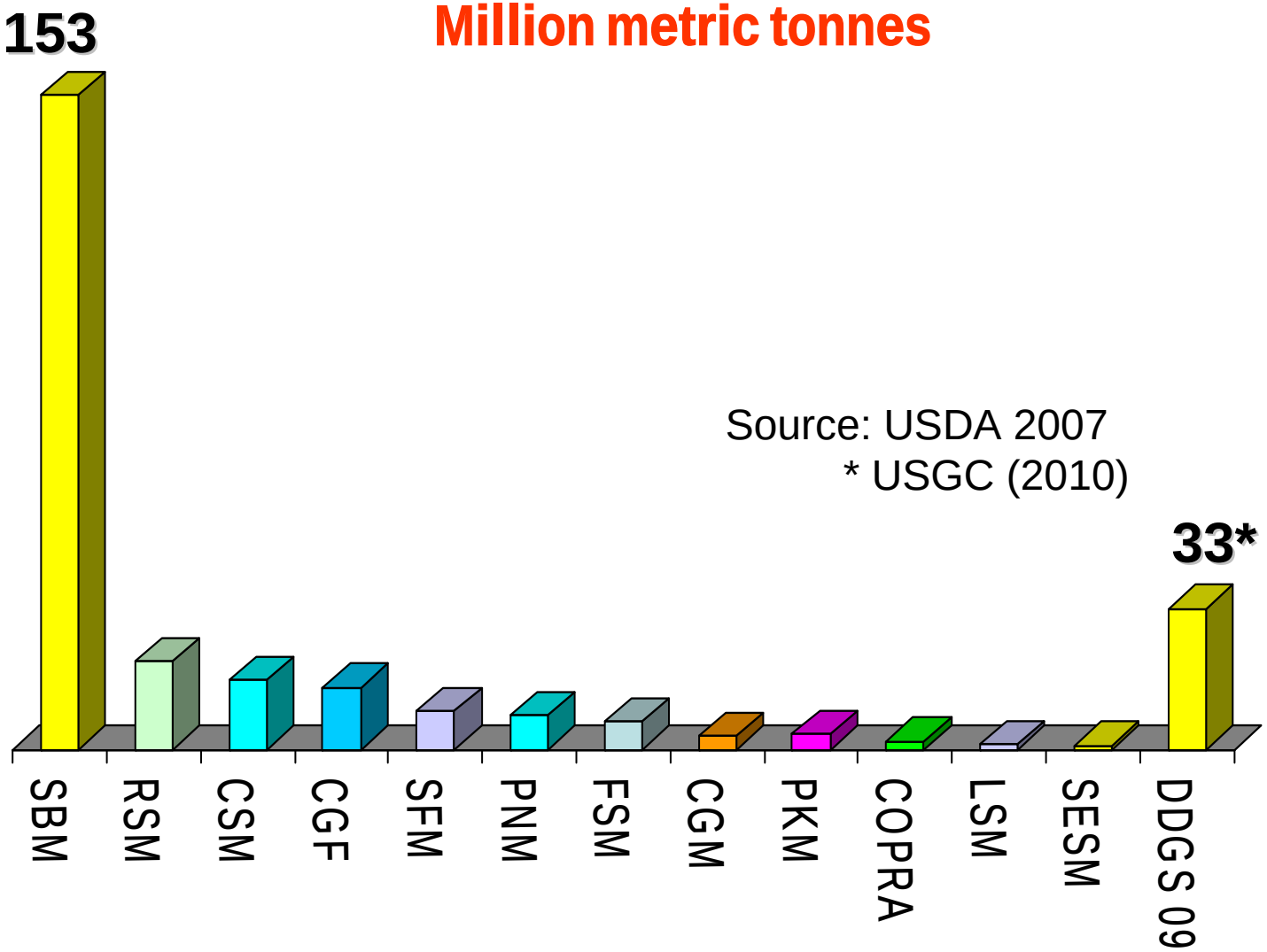
Million metric tonnes



Source: USDA 2007

World Oil Meal Production

Million metric tonnes



Source: USDA 2007
* USGC (2010)

Current Innovation and technology to utilize Agro-Industrial Co-Product (AICP)

- Quality Assurance: NIRS on line
- Feed Production: extrusion, sterilization
- Nutrition: feed formulation, precise digestibility, nutritional tool, additives
- Animal production: liquid feeding, computer control feeding

Problems in Utilization

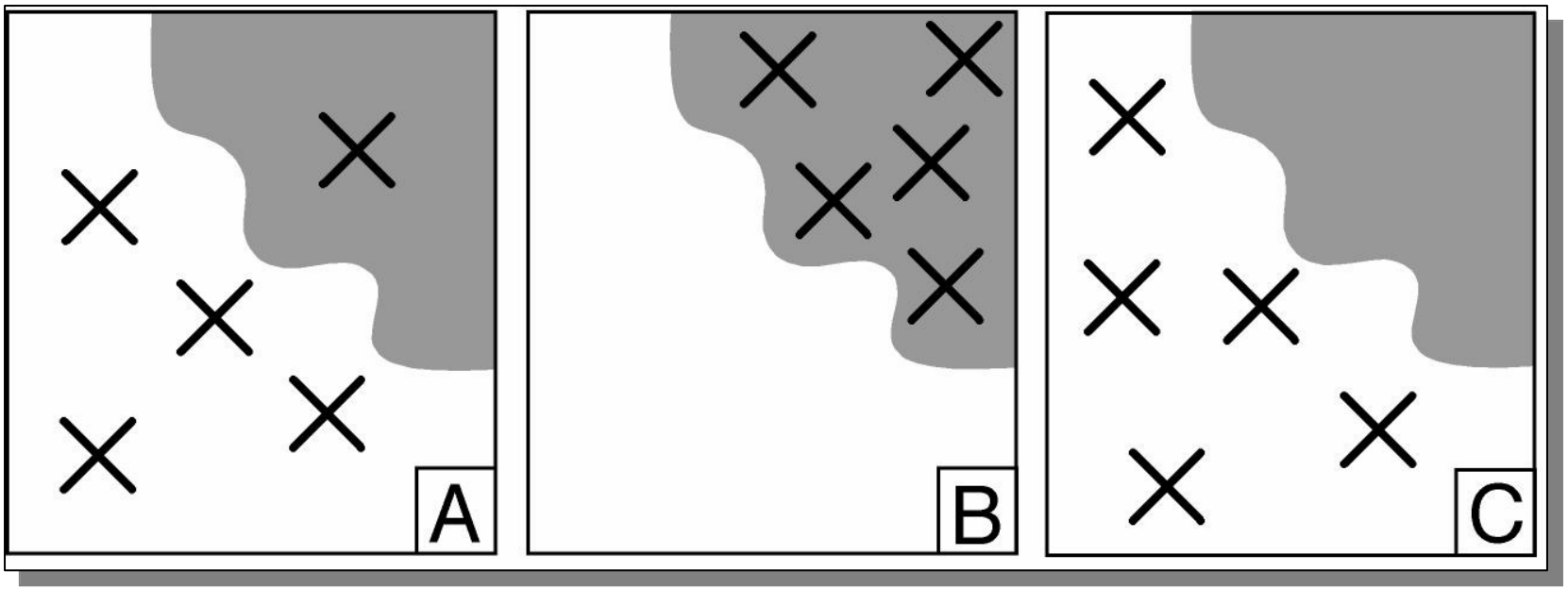
- Variability : Quality and quantity
- Seasonal
- Quality concern:
  - Physical: bulkiness, color, smell, texture
  - Chemical
    - Contaminant: Mycotoxin, pesticides, pathogen
    - Adulterant
  - Biological
    - Digestibility
    - ANF
- Handling and processing
  - Sampling
  - Milling, mixing and pelleting/extruding

Sampling can be a problem

- Size and scheme
- Equipment
- Preparation and retention
- Frequency
- Purpose
  - nutritional
  - health
  - sensory
- Nature of sample

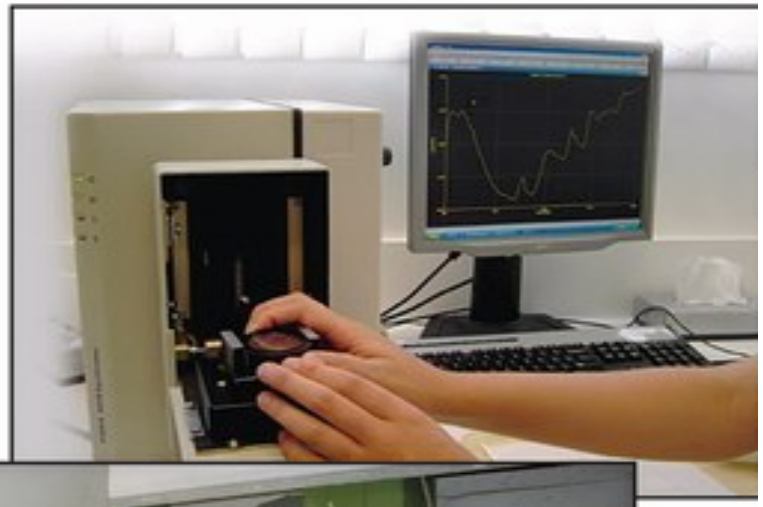
All procedures should be in company quality manual

Sampling Pattern for Bulk Carriers Containing Damaged Product



New directions for near-infrared reflectance spectroscopy

As it moves into the feed mill as an online process, the role of NIR spectroscopy offers ever-more possibilities.



Photos: AusScan, top; Perten Instruments, bottom

NIR technology is being applied in Australia, top, to determine the available energy content in different grains used for livestock feed.

Online NIR equipment, above, installed in the grain conveyor at a mill.

Five decades have passed since the earliest attempts to assess cereals by spectral analysis and the first predictive equations were derived from reflectance spectra. It is already more than 40 years ago that research showed how to employ spectroscopy in estimating the quality and digestibility of forages for feeding to ruminants. Yet new applications in feed manufacturing still continue to appear for the spectroscopic technique known as near-infrared reflectance (NIR).

Those most closely involved in developing these novel applications quickly dismiss any suggestion that the NIR story is almost complete. They say that its recent move from the laboratory into the feed mill for online scanning promises to revolutionise the way in which mills operate, and insist that the value of the technique will be extended beyond its current role.

While the flour industry most often uses NIR to determine the milling characteristics

Pellet Quality and DDGS

- All diets included a pellet binder and were pelleted with steam.
- Diets with 15% DDGS pelleted reasonably well but not with 30% DDGS

Expander or Extruder for sterilization of feed

An expander is a good device in controlling salmonella, but requires a lot of energy.

Raw Materials usage limits for Poultry

Ingredient Number	Raw materials	Limit for broilers		Limit for layers		
		Starter	Grower	Starter	Grower	Laying
6	Broken rice	20	30	20	30	40
7	Rice Bran (10 hull)	10	15	10	20	25
8	Rice Bran (20 hull)	5	10	5	15	15
9	Wheat Pollard	10	15	10	20	20
10	Wheat Bran	5	10	5	15	15
11	Soybean Meal (dehulled 48)	100	100	100	100	100
12	Soybean Meal (hulled 44)	100	100	100	100	100
13	Fullfat Soybean Meal	100	100	100	100	100
14	Peanut Meal	5	10	5	10	10
15	Sesame Meal	4	6	4	6	6
16	Rapeseed Meal	3	3	3	3	3
17	Canola Meal	5	10	5	10	10
18	Cottonseed Meal	2	3	2	3	3
19	Sunflower Meal (semi hulled)	5	5	5	5	5
20	Sunflower Meal (dehulled 42)	6	8	6	6	6
21	Corn Gluten Feed (40)	3	5	3	5	5
22	Corn Gluten Meal (60)	5	8	5	8	5
23	Coconut Meal	5	5	5	5	5
24	Palm Kernel Meal	3	5	3	5	5
25	Kapokseed Meal	2	3	2	0	0
27	Feather Meal	2	2	2	2	2
28	Blood Meal	2	2	2	2	2
29	Poultry Byproduct Meal	3	3	3	3	3
30	Meat Bone Meal	4	5	4	5	5
31	Fish Meal (dig. 90)	5	8	5	8	5
32	Fish Meal (dig. 80) No2	2	3	2	3	3
33	Skimmed milk	5	10	5	10	10
34	Molasses	1	2	1	2	2
36	Fish Oil (grade 1)	3	4	3	3	3
37	Fish OIL (grade 2)	1	2	1	1	1
39	Bone Meal	3	2	3	2	2

There is a limit in using Agro-industrial co-products

Challenges in Formulation

- Be careful when using maximum level of different agro-industrial co-product
- If rice bran can be included at max 15% and wheat pollard at 15% in a diet, performance may decrease when using in combination at max level.
- Nutritional density, digestibility and fiber level may influence the performance

Diet formulation methods

- Old system
  - Common formulations
    - variety of production conditions
  - Metabolizable energy
  - Total amino acids
  - Total phosphorus
- New system
  - Customized formulations
    - specific farm conditions
  - Net energy
  - Digestible (SID) amino acids
    - Ideal protein amino acid balance
  - Available phosphorus

Nutritional "tools" to estimate digestible nutrient content and value of feed ingredients

- Examples:
  - Cargill - Reveal®
  - Value Added Science and Technology - Illuminate®
  - Evonik - Aminored®

- Benefits
  - Obtain better value in ingredient purchasing
    - Purchasing on a CP and fat basis does not reflect actual feeding value
  - Differentiate value among feed ingredient sources
  - Use more precise nutrient loading values in feed formulation
    - More predictable pig performance, often at lower feed cost

FEEDLOGIC™ Computer system

- Wireless communications network
  - Local Area Network (LAN)
    - Connects the on-board computer to the barn computer
  - Wide Area Network (WAN)
    - Connects the barn computer to a home office computer
- Computer software
  - Accurately records amount of feed delivered
  - Allows real time data collection

"Tools" for estimating nutrient requirements

- NRC (1998) models are used to estimate requirements for specific farm conditions
  - Gestating sows
  - Lactating sows
  - Grower-finisher pigs
- NRC (1998) being revised
- National Swine Nutrition Guide (2010)

Feed Additives

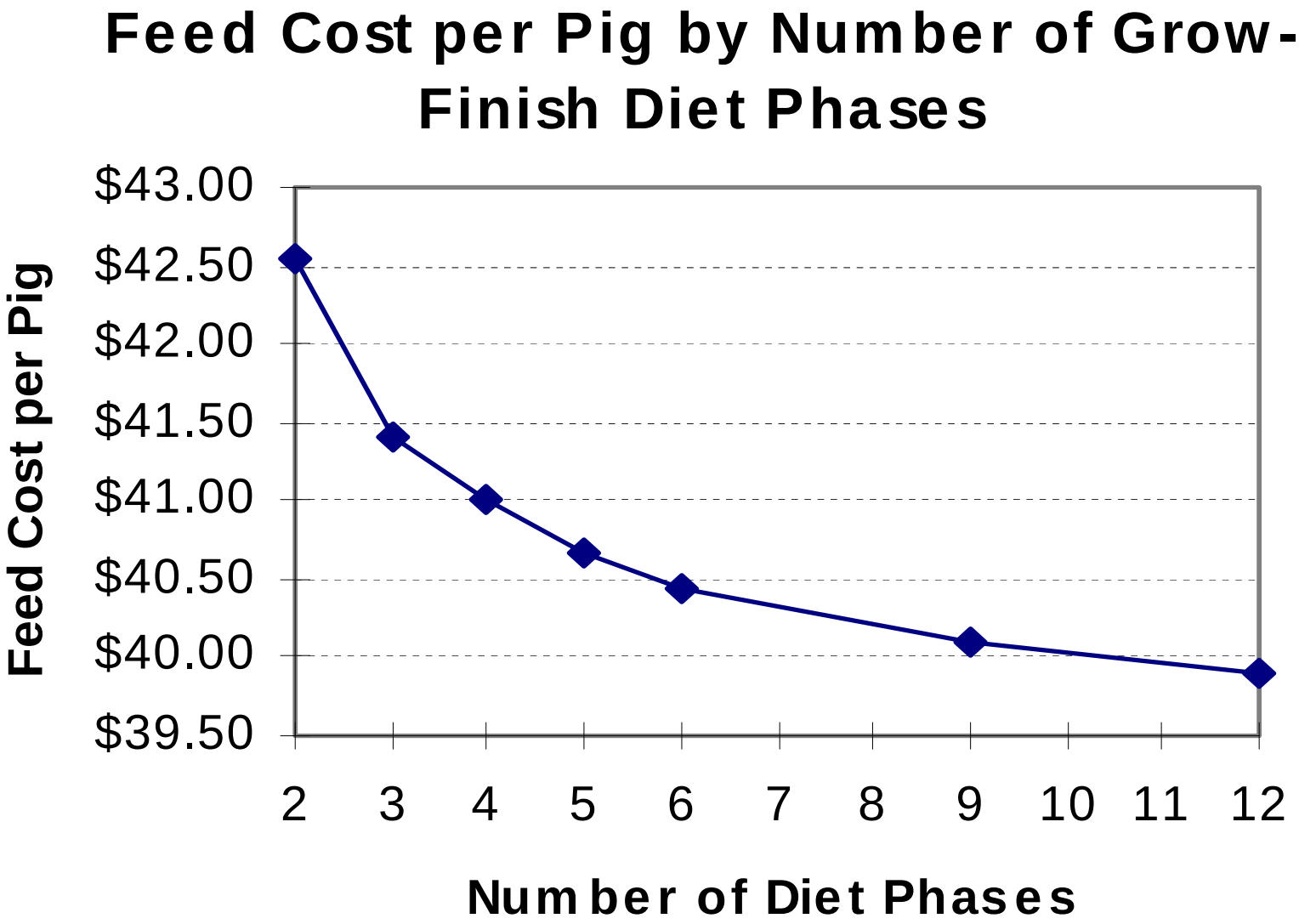
- Ractopamine for swine
- Enzymes either single or cocktails
- Conjugated Linoleic Acid (CLA)
- Herbals
- etc

Potential Benefits of Enzyme Supplementation

- Reduce effects of anti-nutritional factors
  - Such as Phytase and fiber, impair endogenous enzyme activity and digestive competence
  - Increase efficient use of endogenous compounds
- Increase nutrient availability/utilization
  - Assist with breakdown of the non-digested fiber
- Increase energy value of feed ingredients
- Decrease (minimize) nutrient excretion
- Allow for greater flexibility in feed formulation
  - Reduce nutrient variability
  - Improve accuracy of feed formulation

Efficacy of an Enzyme Product

- Enzyme needs to match the substrates in the diet
- Assigning valid nutrient values to the product for feed formulation
- Stability of the enzyme (heat stable)
- Proper dosing
- Formulating with enzymes


Feed Cost per Pig by Number of Grow-Finish Diet Phases
Feed Cost per Pig
$43.00
$42.50
$42.00
$41.50
$41.00
$40.50
$40.00
$39.50
2
3
4
5
6
7
8
9
10
11
12
Number of Diet Phases

Other Challenges in using AICP

- AICP can be cheaper as locally available
- Transportation cost might be higher due to bulky
- Quantity may not be consistent as affected by season and location
- Ability to control and segregate based on quality
- Identify effective additive to improve AICP such as enzymes
- Opportunity to use at higher level for older animals

Prove to reduce cost production (1kg meat or egg)

Value of Ingredient Based on?

Purchasing Agent View of Current Prices

	Bht/kg	%CP	Bht/%CP
SBM NDH	17.1	45	0.38
SBM DH	17.5	48	0.36
DDGS	9.1	27	0.34
Fish ml	29.7	55	0.54
Meat Bone ml	21.7	50	0.43

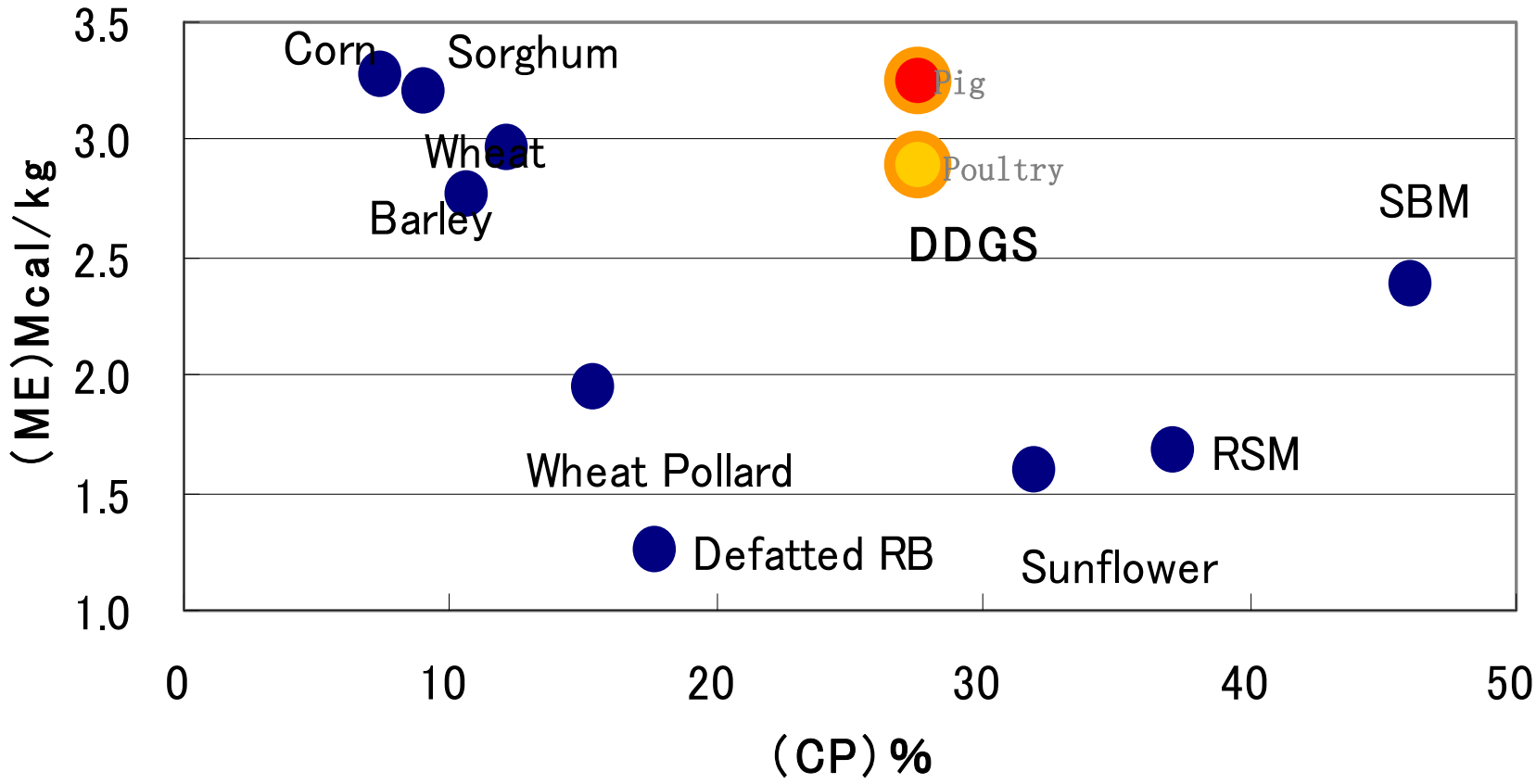
Price in Thailand Oct 2009

Among the nutrients required for poultry

Three the most expensive:

1. Energy
2. Amino acids (protein)
3. Available phosphorus

Protein and ME of ingredients for poultry and pig



出典：日本標準飼料成分表2001年版
DDGSは試験使用したものの成分値

Advanced formulation

- *Parametric analyses* to look at change in cost of nutrient and raw materials
- *Multiple optimization* for several formulas, ingredient allocations, production limitations
- *Stochastic formulation* to consider the variability of raw materials
- *In time formulation*, link data from QC to Feed Formulation and transfer to production

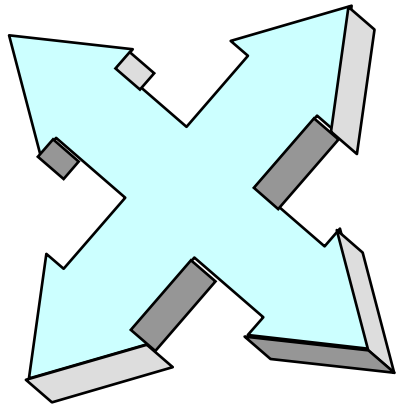
Factors to consider when using AICP

Price

- **Supply**
- **Supplier**
- **Contract terms**
- **Shipping**

Nutrition

- **Nutrient levels**
- **Variation**
- **Bioavailability**
- **Anti-nutritional factors**



Processing

- **Pelletability**
- **Grinding**
- **Storage**
- **Handling**

Animals

- **Performance**
- **Disease**
- **Palatability**
- **Profit!**

Conclusion

- Grains can be limited as feed production continue to grow
- AICP can be alternative ingredients to fed animals
- Advance technologies in QC, Production, Nutritional, Formulation and Feeding are available
- Final aim should be: to reduce cost of feed and feeding to produce animal products

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Thank You
Questions?

U.S. Grains Council Southeast Asia
Budi Tangendjaja, Technical Director
c/-: Suite 3B-7-3A
Plaza Sentral
Jalan Stesen Sentral 5
50470 Kuala Lumpur
Malaysia

Email: budtang@telkom.net