Opportunities for Ingredient Substitutions in Asian Feeds + New Trends in Formulation of Poultry Diets

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Alternative feed ingredients

Alternative ingredients represent a way to manage feed costs, offering more options and therefore more control over the future

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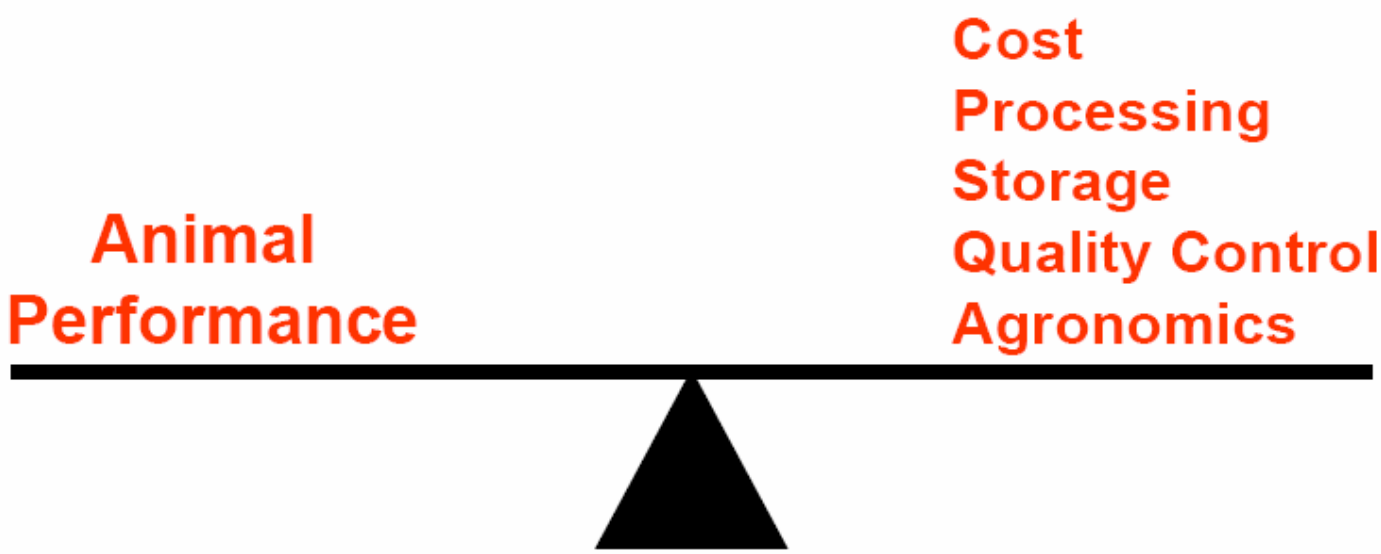
Alternative Feed ingredients



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An incomplete list of ingredients used in Asian poultry diets

- **Corn**
- Wheat
- Milo
- Titicale
- Sorghum
- **Soybean meal**
- Full fat soybeans
- Mustard cake
- Poultry grease
- Etc..

- Blood meal
- Sunflower cake
- Guar meal
- Niger cake
- Corn gluten meal
- Safflower meal
- Lupins
- Bakery by-product
- AV blend
- Canola oil
- Tallow

- Sprouted grains
- DDGS
- Tapioca / Cassava
- Rice bran
- Wheat bran
- **Fish meal**
- Hatchery waste
- **Soya oil**
- Rice bran oil

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Risks Associated with Adopting New Ingredients

Perception of

Risk

versus

Perception of

Reward

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Risks Associated with Adopting New Ingredients

- Accuracy and consistency of nutrient profile (data)
- Palatability
- Risk to performance, chicken quality and safety
- Presence of anti-nutritional factors
- Impact on gastrointestinal health, or other biological system
- Risk of contamination: endogenous or exogenous
- Quantity and consistency of supply
- Ease of handling

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Nutritionists make the decisions on feed ingredient use

1. Price relative to competing ingredient
2. Consistency of supply
3. Ability to source and manage quality
4. Physical characteristics (Particle size, flowability etc.,)
5. Risk of mycotoxins
6. Product consistency and variability

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List (incomplete) of new ingredients for use in animal feeds

1. DDGS
2. Cassava
3. Guar meal
4. Banana Meal
5. Feather meal

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Dried Distiller's Grain with Soluble (DDGS)

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What does corn-derived DDGS contribute to Poultry diets?

- Protein
  - Amino acid content
  - Amino acid digestibility
- Energy (ME)
  - Proximate composition
- Phosphorus
  - Availability
- Xanthophylls (Yolk and Carcass pigmentation)
- Fiber

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DDGS varies with nutrient content, digestibility, color and particle size

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DDGS varies with nutrient content, digestibility, color and particle size

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DDGS nutrients profile

Nutrient	Average	Range
Dry matter, %	89.3	87.3 – 92.4
Crude protein, %	30.9 (4.7)	28.7 – 32.9
Crude fat, %	10.7 (16.4)	8.8 – 12.4
Crude fiber, %	7.2 (18.0)	5.4 – 10.4
Ash, %	6.0 (26.6)	3.0 – 9.8
Swine ME, kcal/kg	3810 (3.5)	3504 – 4048
Lysine, %	0.90 (11.4)	0.61 – 1.06
Phosphorus, %	0.75 (19.4)	0.42 – 0.99

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DDGS contribution to Poultry diets

Protein

- Protein in DDGS is limiting in Lysine, Arginine and Tryptophan (Parsons et al1983, Noll, 2003)
- Source of threonine and sulfur amino acids (Noll 2003)
- Important to formulate with minimus for Arginine, Lysine and Tryptophan

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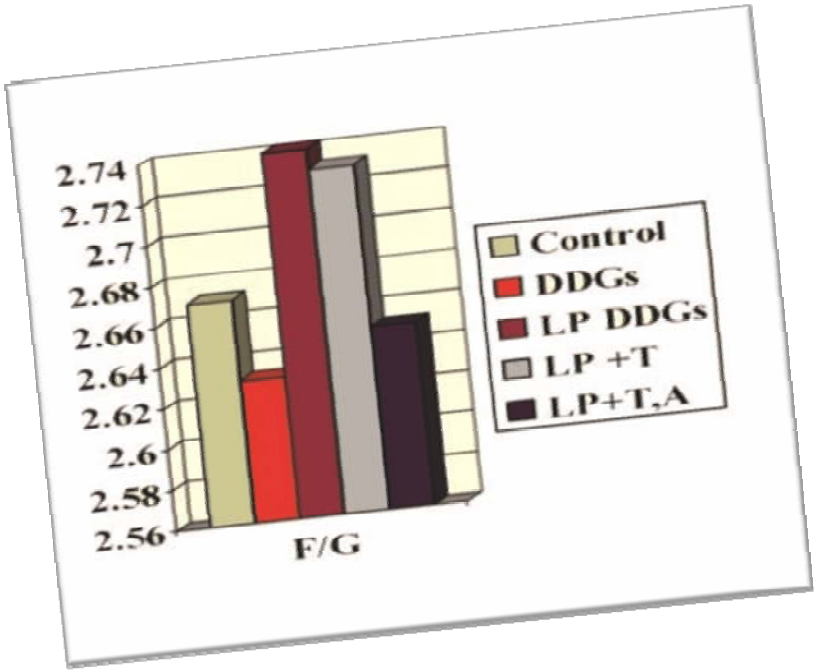
Limiting nature of Tryptophan and Arginine in Turkeys



- Trial conducted in University of Minnesota
- No performance difference – Control diet & 10% DDGS
- Lowered Protein Diet (LP) with 10% DDGS resulted in poorer F/G
- F/G restored with Tryptophan and Arginine

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Lysine content and digestibility

Source	No. of Samples	Lysine Content (%)		Lysine Digestibility Coefficient (%)	
		Ave.	Range	Ave.	Range
Ergul et al. 2003[1]	**20**	**.73**	**.59-.89**	**72**	**59-84**
Batal and Dale 2006[2]	8	.71	.39-.86	70	46-76
Fastinger et al. 2006[1]	5	.64	.48-.75	76	65-82

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DDGS contribution to Poultry diets

Metabolisable Energy

Source	AMEn (Kcal/kg)	TMEn
NRC 1994	2480	
Potter 1996	2880	
Noll 2004	2810-2850	2833
Roberson 2004	2760	
Batal & Dale 2006		2820

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DDGS contribution to Poultry diets

Availability of Phosphorus

Ingredients	P %	P avail %	%P Avail
Corn	.28	.08	28
SBM	.62	.22	35
DDGS	.72	.39	54

NRC 1994

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DDGS contribution to Poultry diets

Xanthophylls

Ingredients	Level mg/kg
Corn	15-25
Corn Gluten	130170
DDGS	15-20

Text book values

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DDGS contribution to Poultry diets

Egg yolk pigmentation

Ingredients	Level mg/kg
Roberson 2004	10% 2 weeks fed 5% at 3 weeks
Lumpkins 2005	No change
Shurson 2003	Slight change in yolk colour (10.6 v 10.8)

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DDGS contribution to Poultry diets

Roberson Experiment (9 weeks)

DDGS	L*	a*	b*	Roche
0%	77.9	2.70	88.1	8.63
5%	75.9	4.19	86.7	8.98
10%	76.2	4.74	87.5	9.02
15%	75.9	6.11	87.7	9.22

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DDGS contribution to Poultry diets

Broiler Performance

Level of DDGS	Gain 42 days (Kg)	G:F 0-42 d
0%	2.31a	566
6%	2.29a	554
12%	2.29	565
16%	2.24	554

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Inclusion levels of DDGS in Poultry diets

Broiler diets

- Adjustment for lysine and energy level
  - Lowered level of use without adjustment
- Inclusion level of 15% possible
  - Starter diet 6%
  - Grower/Finisher 15%

Layer diets

- Roberson 2004 up to 15%
- Lumpkins 2005 up to 15% in commercial density diets

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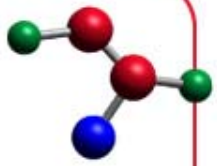

Recommendations

- Corn DDGs can be fed to chicken layer and broilers up to 15%
- Lower levels in diets of young poultry
- Formulate with minimus for tryptophan and arginine to those for Lysine, TSAA and threonine
- Formulate on basis of digestible amino acid content
- Lower maximum level of use in low density or low protein diets
- Consider AME value of 2750 to 2850 Kcal/kg

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Cassava / Tapioca

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NUTRIENT COMPOSITION OF CASSAVA& CORN

Parameters	Pellets	Chips	Corn
DM basis(%)	88	88	89
AME(k.cal/kg)	2900	3100	3350
Starch(%)	55-62	50-69.5	65
CP%	2.5	2.5	8.8
Ether Extract	0.7	0.7	3
CF	5.2	3.7	2.2
Lysine	0.09	0.09	0.26
Methionine	0.03	0.03	0.18
M+C	0.06	0.05	0.2
Calcium	0.5	0.2	0.1
Phosphorus	0.12	0.14	0.1

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Cassava – High in starch content

- High starch content – ideal replacement for corn
- Corn: high in amylose but low in amylopectin
- Cassava: low in amylose but high in amylopectin
- Linear amylose is easier to be digest as compared with highly branched amylopectin

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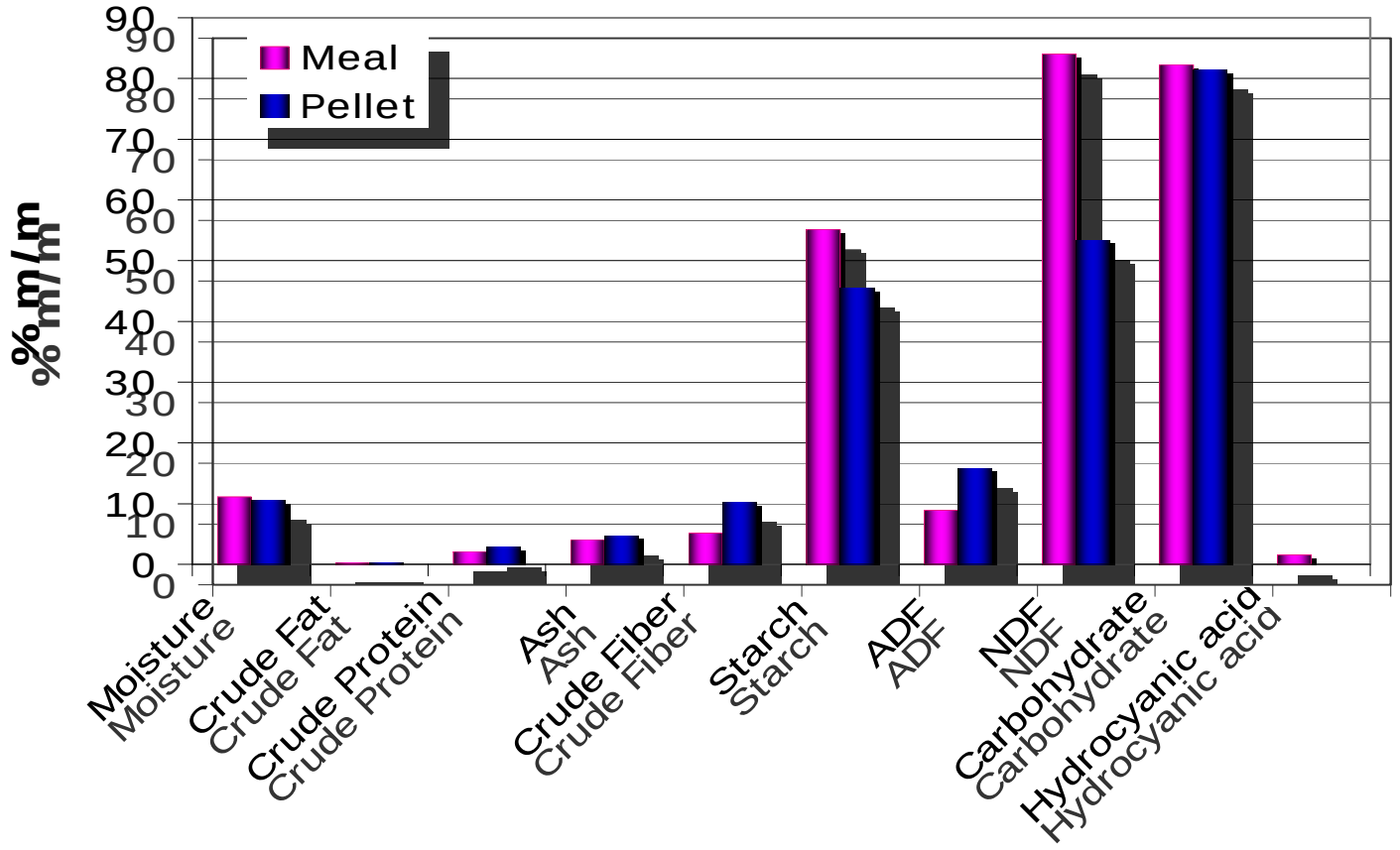
Composition of Cassava meal/pellet



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Mean Retention Time in intestine

1) Different digestibility values for cassava and corn along the digestive tract of growing pigs

2) Mean retention time (MRT) in the small intestine of broiler chickens containing different starch sources

	Jejunum		Ileum		Total
	Anterior	Posterior	Anterior	Posterior	
Wheat	21	43	42	51	157
Cassava	20	38	41	56	155
Corn	13	35	41	51	140

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AME VARIATION

RAW MATERIALS	AME (MJ/KG)	% VARIATION
Corn	13.4 - 14.1	5.2
Cassava	11.14 - 14.5	31.5
Wheat	11.2 - 14.0	25
Sorghum	13.3- 14.9	12

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Gross Energy vs. AME - Swine

GE: 4040 Kcal	GE: 4190 Kcal	GE: 4100 Kcal
		
ME: 3220 Kcal	ME: 3380 Kcal	ME: 3210 Kcal
20%	19%	22%

AME : Apparent Metabolizable Energy

NRC 1994

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Indigestible portion - Cassava

- **Total NSP – 13.5%**

- **Cellulose – 7.2%**
- **Hemicellulose – 5.3%**
- **Lignin – 1.0%**

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Effect of cassava inclusion level in pigs performance

Growth Parameter	Corn-soy diet	Corn-soy diet with 30% cassava	Corn-soy diet with 50% cassava
Daily weight gain (g/pig/day)	672 ± 5 [a]	638 ± 5[b]	625 ± 3[c]
Feed intake (g/pig/day)	1901 ± 10[a]	1861 ± 9[b]	1859 ± 7[b]
FCR	2.83 ± 0.01[a]	2.92 ± 0.01[b]	2.98 ± 0.01[c]

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Effect of Enzymes to improve the digestibility of Cassava

Growth Parameter	Corn-soy Diet and KEMZYME® TOP Dry	Diet with 30%cassava and KEMZYME® TOP Dry	Diet with 50%cassava and KEMZYME® TOP Dry
Daily weight gain (g/pig/day)	686 ± 5a	668 ± 6b	649 ± 5c
Feed intake (g/pig/day)	1918 ± 10a	1899 ± 8b	1878 ± 6c
FCR	2.80 ± 0.01a	2.84 ± 0.03b	2.89 ± 0.02c

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Recommendations

- Cassava is potential alternative feed ingredient for making least cost feed formulation.
- Cassava can be included at lower levels in diets of young pigs
- Addition of commercial enzyme preparations ensures better utilization of Cassava
- Enzyme supplementation helps to increase the inclusion levels up to 50%.

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Thank you