

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



Chinnadurai Sugumar
Kemin Industries Asia Pte Ltd,
Singapore



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- Alternative Feed ingredients
- Nutritionists point of view
- DDGS and Cassava in poultry diets
- Tools to improve the animal performance with DDGS and Cassava diets
- New trend in feed formulation with partial substitution of fats and oils

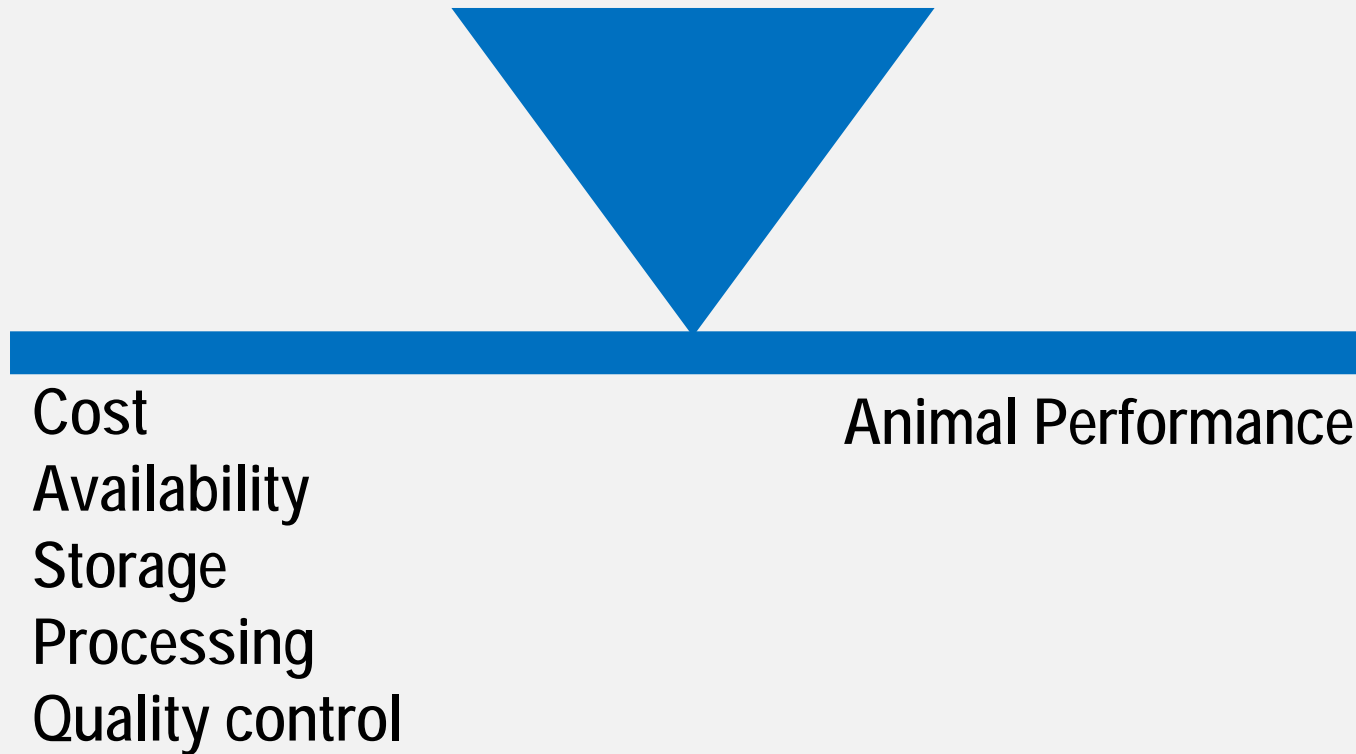


Alternative feed ingredients

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



Alternative feed ingredients



Adopting new ingredients - Risks



Perception of

Risk

versus

Perception of

Reward



Nutritionists point of view

- Price relative to competing ingredient
- Performance in the animal system.
- Consistency of supply
- Ability to source and manage quality
- Physical characteristics (Particle size, flowability etc.,)
- Risk of mycotoxins
- Product consistency and variability



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



Interesting new ingredients and additives for partial substitution for use in poultry diets

- DDGS
- Cassava
- Partial substitution of oil / fat

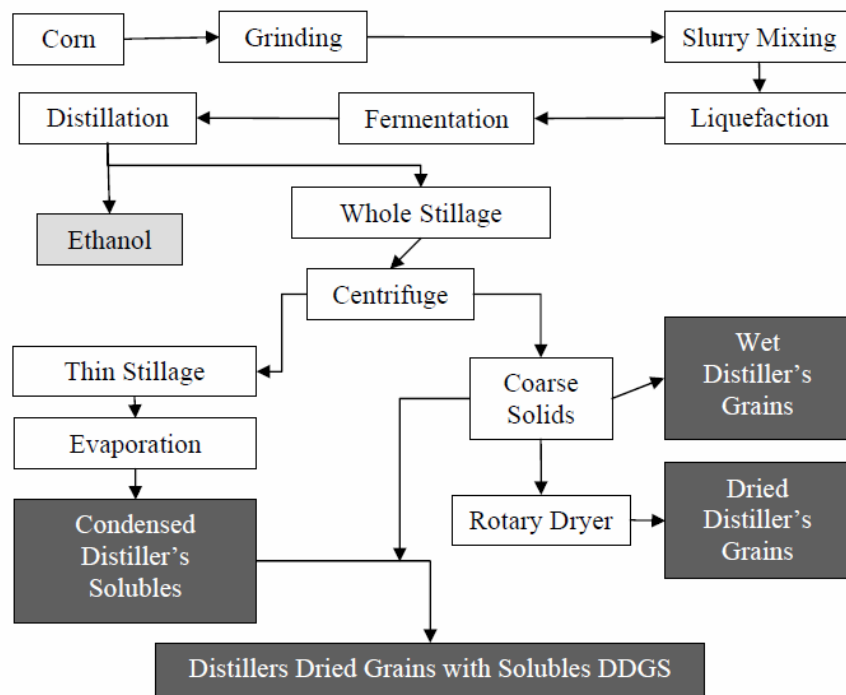


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Dried Distiller's Grain with Soluble (DDGS) from Corn



Ethanol Production process



Each bushel of corn (25.4 kg) fermented in a dry mill ethanol plant will produce

10.2 liters of ethanol,
8.2 kg of carbon dioxide and
8.2 kg of DDGS.



Major nutrients of interest from DDGS for Poultry diets

1. Energy (ME)
2. Amino acids
3. Phosphorus
4. Xanthophylls (Pigments)
5. Fiber (NSPs)
6. Mycotoxins



Nutrients composition of DDGS

S No	Nutrients	Levels
1	Dry matter	88-90%
2	Crude Protein	25-32%
3	Crude Fat	08-10%
4	Crude fiber	5.4-10.4%
5	Ash%	03-9.8%
6	ME Value for poultry*	2480 Kcal
7	Lysine %	0.61-1.06%
8	Phosphorus %	0.42-0.99%



Variability in nutrients composition of DDGS

S No	Nutrients	Co-efficient of variation
1	Dry matter	<5%
2	Crude Protein	5-10%
3	Crude Fat	5-10%
4	Crude fiber	5-10%
5	Lysine*	17.3%
6	Methionine*	13.6%
6	Phosphorus*	11.7%

Nutrient content of DDGS can vary among and within ethanol plants¹



Nutrients composition of DDGS

1. Metabolisable Energy (ME)

Species	Energy type	Value (Kcal/kg)	Source
Turkeys	AME	2865	Noll et al., 2004
Broilers	TME	2905	Lumpkins et al 2004
Layers	TME	2805	Lumpkins et al 2005
Roosters	TME	2831	Batal and Dale 2004
Broilers	AME	2480	NRC 1994

ME value of DDGS ranges between 2480 Kcal to 2905 Kcal per kg.



Nutrients composition of DDGS

2. Protein

- Protein in DDGS is limiting in Lysine, Arginine and Tryptophan (Parsons et al 1983, Noll, 2003)
- Important to formulate with minimum for Arginine, Lysine and Tryptophan

Apparent ileal digestible amino acid composition of DDGS (NRC 1998)

Amino acids %	Level %
Arginine	0.88
Histidine	0.45
Isoleucine	0.73
Leucine	2.10
Lysine	0.31
Methionine	0.39
Phenylalanine	1.09
Threonine	0.56
Tryptophan	0.14



Nutrients composition of DDGS

3. Phosphorus

Ingredients	P %	Phytate P%	P avail %	% P Avail
Corn	0.28	0.16	0.08	28
SBM	0.62	0.35	0.22	35
DDGS	0.72	0.23	0.39	54

DDGS is an excellent source of available phosphorus.



Nutrients composition of DDGS

4. Xanthophylls

- Xanthophylls are very fragile
- Sensitive to heat and oxidation
- Light colour DDGS may be a good source of pigmentation
- DDGS contain up to 40 ppm xanthophylls.
- Significantly improve egg yolk colour.
- Increase the skin colour of broilers when included @ 10% level.



Nutrients composition of DDGS

5. NSP fiber components

Component	Level %	Range, %
Rhamnose	0.08	0.05-0.09
Ribose	0.11	0.06-0.20
Fucose	0.06	0.01-0.18
Arabinose	4.98	4.09-6.08
Xylose	6.42	4.81-7.78
Mannose	1.62	1.16-2.44
Glucose	7.86	6.72-9.68
Galactose	1.61	1.19-2.08

Values reported on dry matter basis

- DDGS contain 21% of total NSP
- Arabino-xylans and cellulose are two primary NSP components in corn DDGS.
- Enzymes supplementation is highly beneficial



Inclusion levels of DDGS in Poultry diets

Broiler diets

- Inclusion level of 15% possible
 - Starter diet 6%
 - Grower/Finisher 15%
- Adjustment for lysine and energy level

Layer diets

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



Effect of KEMZYME® Top Dry on the growth of broilers fed on diets Containing DDGS

Bangkok Animal Research Centre
Bangkok, Thailand

Trial design

Treatments	DDGS Inclusion %	Enzyme
1.	0%	No enzyme
2.	16%	No enzyme
3.	16%	KEMZYME® Top Dry @ 500 g per ton



Feed Formulation – Starter Feed (0-21days)

Ingredients (%)	0% DDGS	16% DDGS
Corn	51.56	43.26
SBM	38.18	29.78
DDGS	0	16
Soya oil	5.12	5.70
MCP	1.70	1.55
Limestone	1.16	1.29
Salt	0.48	0.38
DL-Methionine	0.26	0.26
L-Lysine	0.16	0.37
L-Threonine	0.07	0.11
Premix	0.2	0.2
Pellet binder	1	1
Mycotoxin binder	0.05	0.05
Coccidiostat	0.05	0.05
Total	100	100



Feed Formulation – Grower Feed (21-35 days)

Ingredients (%)	0% DDGS	16% DDGS
Corn	55.60	47.30
SBM	33.54	25.15
DDGS	0	16
Soya oil	6.01	6.59
MCP	1.59	1.44
Limestone	1.19	1.32
Salt	0.40	0.31
DL-Methionine	0.21	0.20
L-Lysine	0.11	0.32
L-Threonine	0.04	0.09
Premix	0.2	0.2
Pellet binder	1	1
Mycotoxin binder	0.05	0.05
Cocciostat	0.05	0.05
Total	100	100



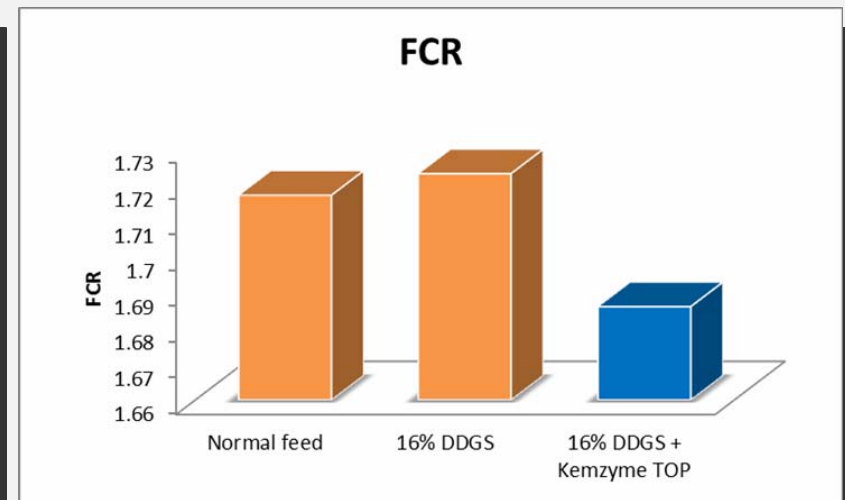
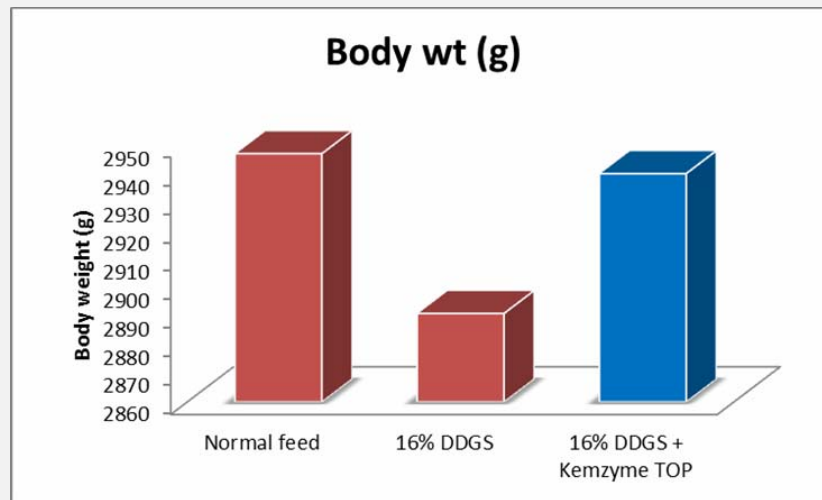
Feed Formulation – Finisher Feed (35-42 days)

Ingredients (%)	0% DDGS	16% DDGS
Corn	55.65	47.35
SBM	33.54	25.15
DDGS	0	16
Soya oil	6.01	6.59
MCP	1.59	1.44
Limestone	1.19	1.32
Salt	0.40	0.31
DL-Methionine	0.21	0.20
L-Lysine	0.11	0.32
L-Threonine	0.04	0.09
Premix	0.2	0.2
Pellet binder	1	1
Mycotoxin binder	0.05	0.05
Coccidiostat	-	-
Total	100	100



Effect of enzyme supplementation on growth performance of broilers fed on diets containing DDGS (0 - 42 days of age)

Group	DDGS level %	Treatment	Body wt (g)	Feed intake (g)	FCR
1.	0%	No enzyme	2947	5058	1.717
2.	16%	No enzyme	2891	4978	1.723
3.	16%	KEMZYME® Top Dry @ 500 g per ton	2940	4957	1.686



Enzyme supplementation did improve FCR , at 21 -35 days by 5.8 points (P<0.05)



Conclusion

- Corn DDGS is included in poultry diets up to 15%
- Lesser inclusion levels for chicks
- DDGS is poor source of Lysine, Arginine and Tryptophan
- 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
- Enzymes supplementation can improve performance from animals fed with DDGS diets.



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Cassava / Tapioca



NUTRIENT COMPOSITION OF CASSAVA

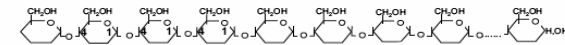
Parameters	Pellets	Chips	Corn
DM basis(%)	88	88	89
AME(k.cal/kg)	2900	3100	3350
Starch(%)	55-62	50-69	65
CP%	2.5	2.5	8.8
Ether Extract	0.7	0.7	3
CF	5.2	3.7	2.2
Lysine	0.09	0.09	0.26
Methionine	0.03	0.03	0.18
M+C	0.06	0.05	0.2
Calcium	0.5	0.2	0.1
Phosphorus	0.12	0.14	0.1



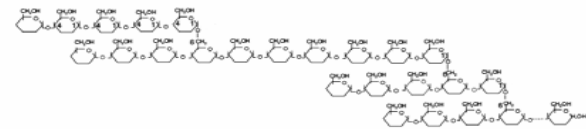
Cassava – High in starch content

- 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 digested as compared with highly branched amylopectin

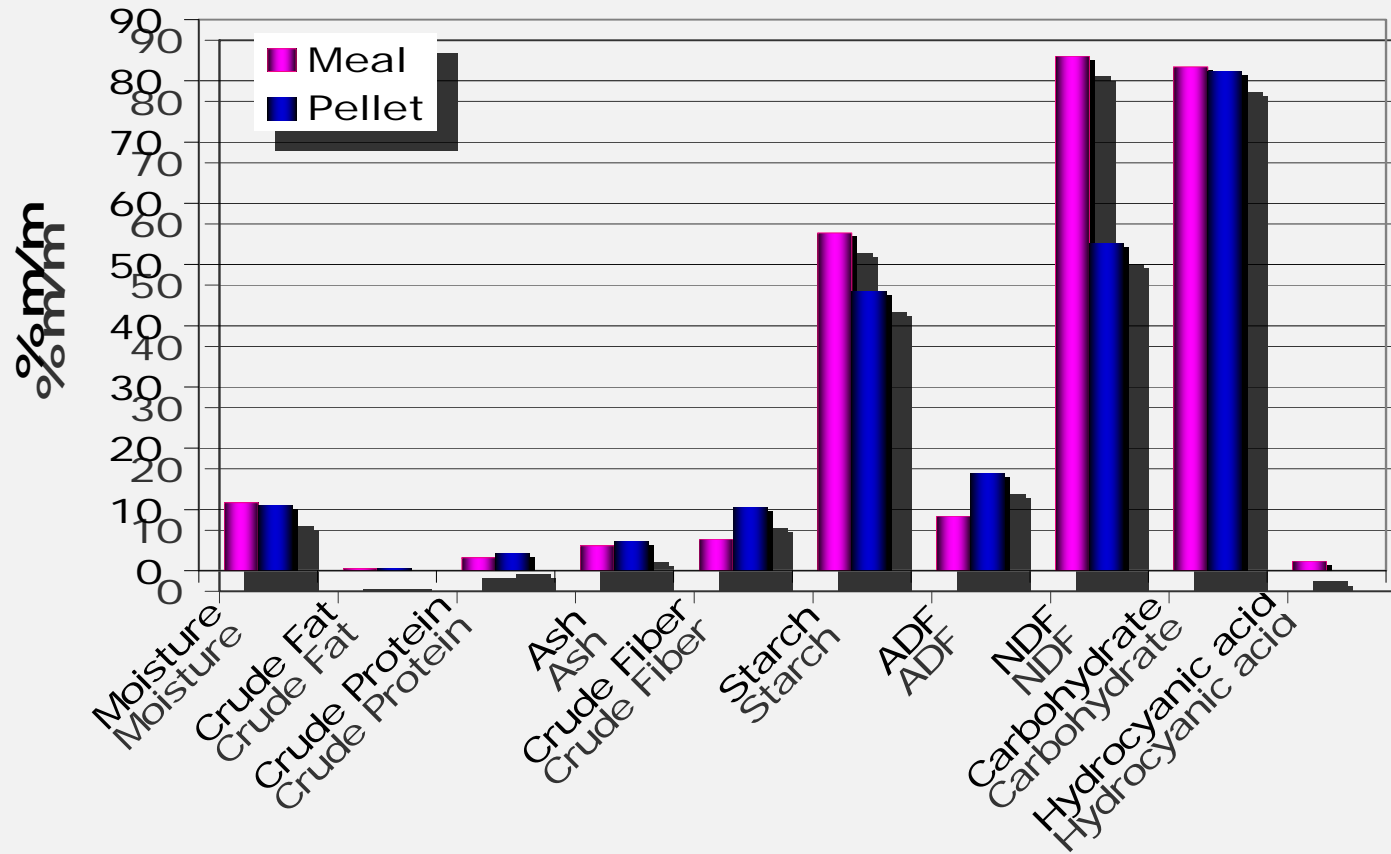
Amylose



Amylopectin



Composition of Cassava meal/pellet



Mean Retention Time in intestine

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

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



Gross Energy vs. AME

GE: 4040 Kcal



ME: 3220 Kcal

20%

GE: 4190 Kcal



ME: 3380 Kcal

19%

GE: 4100 Kcal



ME: 3210 Kcal

22%



AME : Apparent Metabolizable Energy



NSP levels in Cassava

- **Total NSP – 13.5%**
 - Cellulose – 7.2%
 - Hemicellulose – 5.3%
 - Lignin – 1.0%
- Cassava contain 13% of total NSP
 - Cellulose and Hemicellulose are two primary NSP components
 - Enzymes supplementation is highly beneficial



Effect of KEMZYME® TOP in improving performance of broilers

- Conducted at Bangkok Animal Research Centre (BARC)

Trial design

Treatments	Energy level	Enzyme Dosage g/ton
Positive Control diet (PC)	Normal	-
Negative control diet (NC)	Less 100 Kcal	-
NC + KEMZYME TOP	Less 100 Kcal	500



Effect of KEMZYME® TOP in improving performance of broilers

Feed formulation

Ingredient*	Positive control%	Negative control %
Corn	50.47	32.54
Soybean meal	23.43	19.78
Full fat soybean	15.00	12.66
Fish meal	3.00	3.00
Cassava		12.00
Rice bran (defatted)		5.00
DDGS 27%		4.00
Canola meal		3.00
Palm oil	3.74	3.74
ME (Kcal/kg)	3000	2900
Crude protein	23.00	22.43

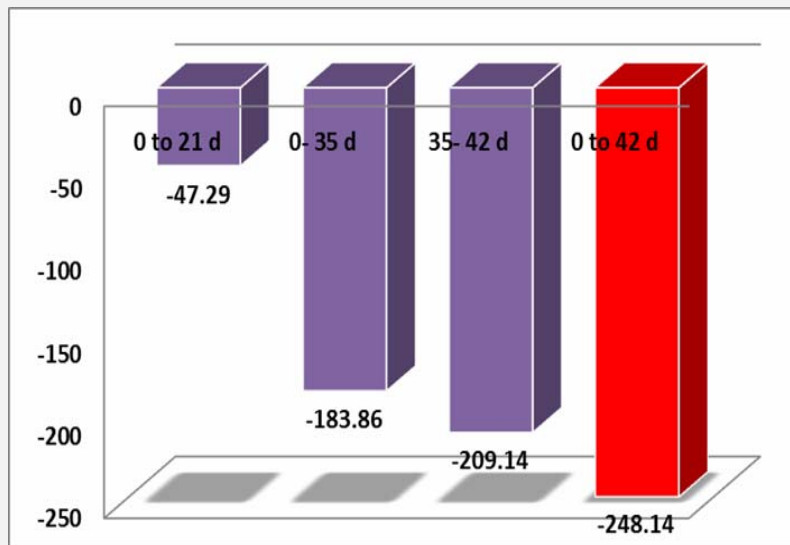
* Amino acid content of NC was 2.5% lower than PC



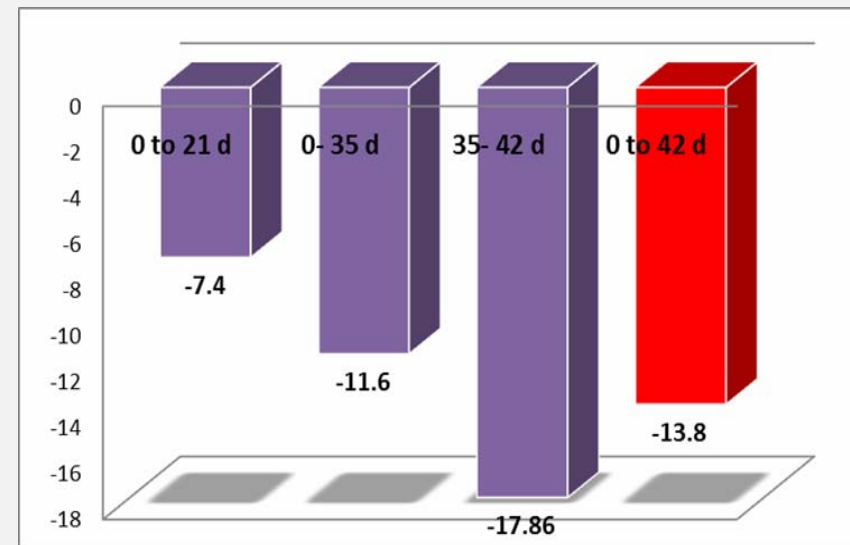
Effect of KEMZYME® TOP in improving performance of broilers

Performance depression for negative control diet

Body wt (g)



FCR



Effect of KEMZYME® TOP in improving performance of broilers

Growth Performance

Treatment	T1	T2	T3
Diet	PC	NC	NC + KEMZYME
Body weight gain (g)	2930 ^a	2681.86 ^b	2788.5 ^{ab}
FCR ²	1.703 ^a	1.841 ^c	1.79 ^b

Effect of
KEMZYME® TOP
addition to NC

BWG – 106g
FCR: 5 points

^{a,b} Means with unlike superscripts within a row differ, $P < 0.01$

² Feed conversion ratio corrected for mortality and culls.



Conclusion

- High starch content of cassava makes it ideal replacement for corn
- Cassava is low in amylose but high in amylopectin.
- NSP component of Cassava necessitates the supplementation of enzymes to improve animal performance.
- Cassava can be included in the broiler diets up to 15% with supplementation of enzymes



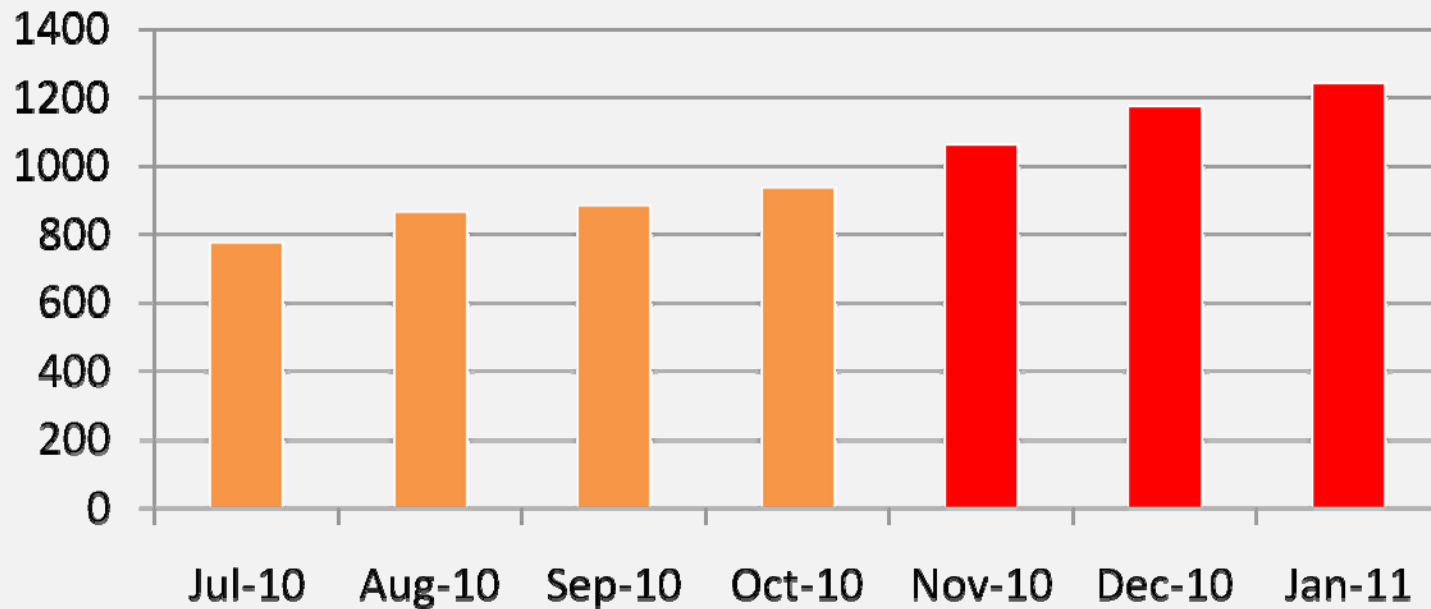
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Bio-surfactants for partial substitution of oils / fats in poultry diets



Increasing Oil Prices

Palm oil - Monthly Price USD / MT



Oil / Fat level in animal feed

- 🔥 Broiler Feed : 6-8%
- 🔥 Added Oil @ 1.5 to 3.5%
- 🔥 Full Fat Soya contributes to 1-1.5%



Oil in Feed: Cost Component

- 🔥 Cost of Broiler feed US\$ 500 / ton
- 🔥 Oil percentage in feed
 - 🔥 Broiler feed 6 to 8%
 - 🔥 Oil Equivalent 60 to 80 Kg
 - 🔥 Latest oil price US\$ 1.6 per kg
 - 🔥 Cost of Fat @ US\$ 96 - 128
 - 🔥 Oil cost Component 19 to 25 %
 - 🔥 Average Fat Digestibility 75 - 80%

GAIN 75-80%
US\$ 72 to 76 per ton

LOSS 20-25%
US\$ 20 to 24 per ton



Role of Bio-surfactants to improve fat digestibility



Influence of Biosurfactant on the AME of diets containing three fat sources

Monogastric Research Centre
Massey University
New Zealand



Trial protocol

- This AME trial was done in Broiler birds fed with Corn soy bean meal with different oils as fat source
- The ME of these normal diets maintained at 3050 k.cal/kg and reduction of 1% fat level was replaced by fine sand in the reduced ME diets
- LYSOFORTE® was added at recommended inclusion level.

Treatments	Fat source	Dietary ME level	LYSOFORTE®
A	Tallow	Normal ME	-
B	Tallow	Reduced ME	-
C	Tallow	Reduced ME	+
D	Palm oil	Normal ME	-
E	Palm oil	Reduced ME	-
F	Palm oil	Reduced ME	+
G	Rice bran oil	Normal ME	-
H	Rice bran oil	Reduced ME	-
I	Rice bran oil	Reduced ME	+



Results

The influence of Bio-surfactant on the AME of diets containing tallow, Palm oil and Rice bran oil are as follows

Treatments	Tallow based	Palm oil based	Rice Bran oil based
	AME, kcal/kg	AME, kcal/kg	AME, kcal/kg
Normal AME diet	3085 ^a	3073 ^a	3076 ^a
Reduced AME diet	2982 ^b	2937 ^b	2964 ^b
Reduced AME diet + LYSOFORTE®	3069 ^a	3035 ^a	3045 ^a



Bio-Surfactant AME VALUES

Oil type	AME value of LYSOFORTE® kcal/kg of diet	Equivalent oil substitution(kg) per ton of feed
Tallow (7200 kcal/kg)	87	12.1
Palm oil (8300 kcal/kg)	98	11.8
Rice Bran oil (7900kcal/kg)	81	10.3



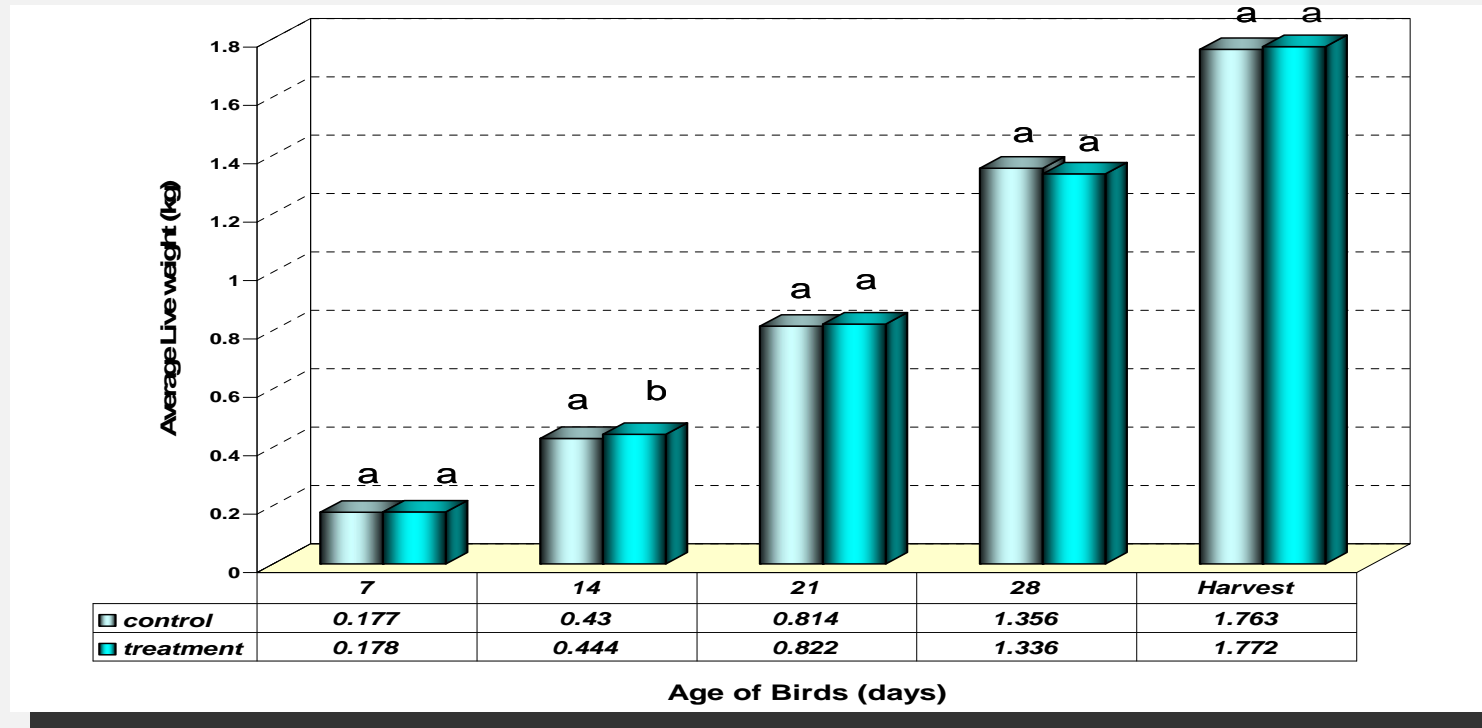
Effect of Bio-surfactant on broiler performance after replacing 10 kg of coconut oil in broiler diets

Treatments	Fat source	Biosurfactant
Booster¹		
Control diet	Coconut oil	-
Treatment	- 8 kg Coconut oil	LYSOFORTE [®] (500g/t)
Starter²		
Control diet	Coconut oil	-
Treatment	- 10kg Coconut oil	LYSOFORTE [®] (500g/t)
Finisher³		
Control diet	Coconut oil	-
Treatment	- 10 kg Coconut oil	LYSOFORTE [®] (500g/t)



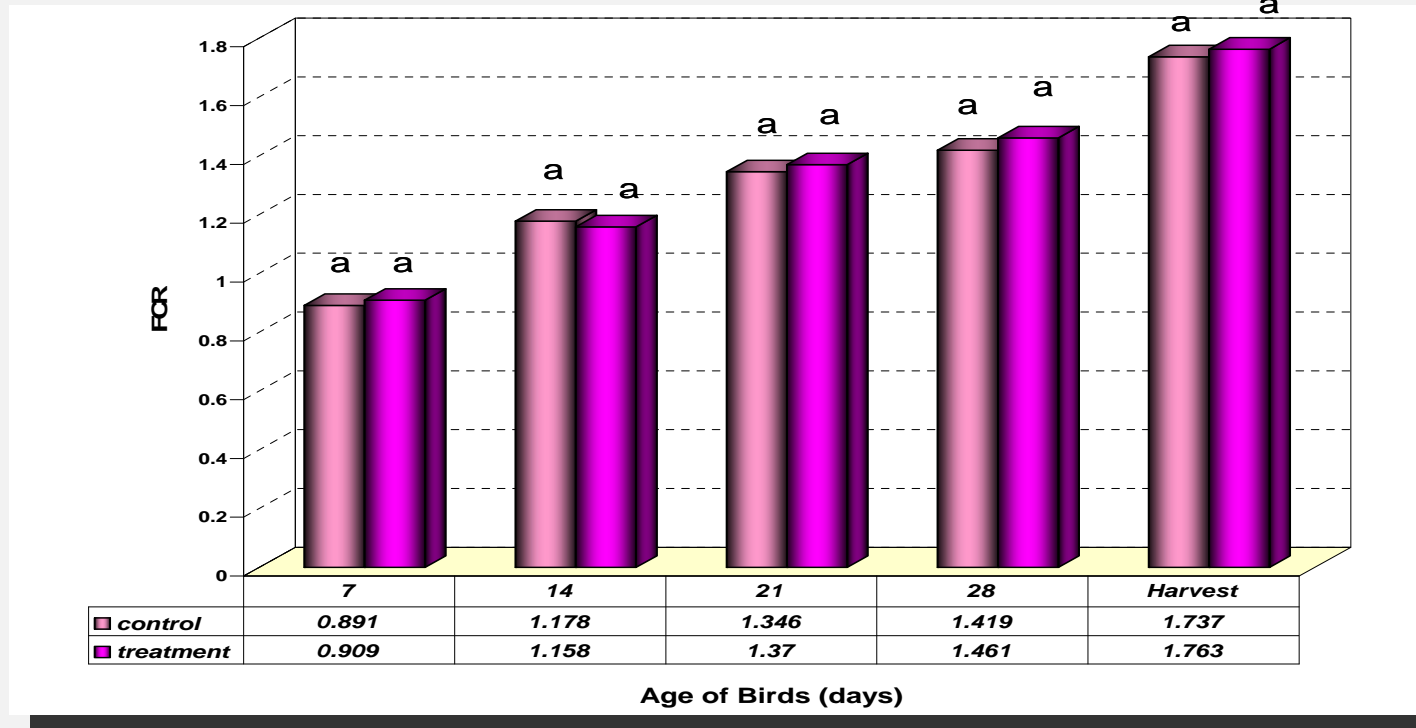
Effect of Bio-surfactant on broiler performance after replacing 10 kg of coconut oil in broiler diets

Body weight



Effect of Bio-surfactant on broiler performance after replacing 10 kg of coconut oil in broiler diets

FCR



Conclusion

- Bio-surfactants improve the fat digestibility
- Supplementation of Bio-surfactants can increase the AME value of fats and oils.
- Partial substitution of oils/fats with Bio-surfactant can help to manage increasing oil prices.



Interesting new ingredients and additives for partial substitution for use in poultry diets

- DDGS
- Cassava
- Partial substitution of oil



Thank you

