



Australian Export Grains Innovation Centre



# How to utilize lupins and wheat DDGS\* in pig diets

**A.C. Edwards**

ACE Livestock Consulting P/L,  
Cockatoo Valley, SA, Australia  
(consultant to AEGIC)

*\*Distiller's dried grains with solubles*



Department of  
Primary Industries and  
Regional Development



**GRDC**  
GRAINS RESEARCH  
& DEVELOPMENT  
CORPORATION

AEGIC is an initiative of the Western Australian State Government and Australia's Grains Research and Development Corporation

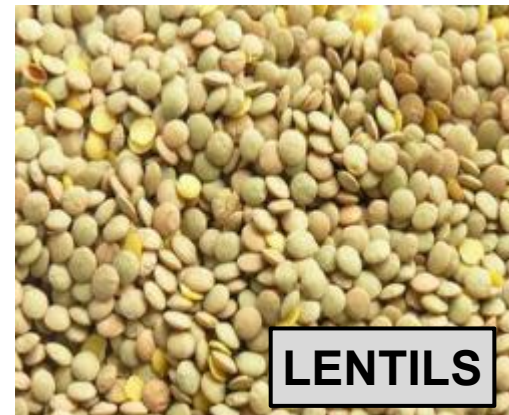
# Introduction

- Pigs are remarkably adaptable omnivores capable of meeting their nutrient requirements from a wide range of feedstuffs
- However, their digestive competence can be limited and so we may need to be aware that some feedstuffs may represent a challenge and may need to be regulated in the diet
- Two materials that fall into this category are lupins and wheat DDGS (dried distillers grains and solubles). They are useful feed components but to use them effectively we need to recognize they are a little different to conventional materials

# Lupins

- Lupins come in many forms, but the most common type are the narrow leaf lupin (*Lupinus Angustifolius*), also known as Australian sweet lupins.
- These are the main variety available for export from Australia and will be the focus of this presentation
- These are classified as grain legumes or pulses and the seeds have a significant fibrous hull ranging in colour from white to speckled brown, covering a yellow endosperm
- They can be dehulled to produce separate hull and kernel fractions but for the most part are milled whole

# Various legumes



# Typical composition and nutritional value of lupins

Nutrient	Unit	Value
Moisture	%	10
Protein	%	30
Fat	%	6
Ash	%	3.5
Crude Fibre	%	15
ADF	%	18
NDF	%	22 (mostly fermentable)
Starch	%	3
Other CHO	%	25 (mainly beta galactan)

Amino acids (% protein) and energy comparisons			
Amino acids	Lupins	Soybeanmeal	Corn
Protein content (%)	30	48	8
Lysine	4.75	6.09	3.00
Methionine	0.68	1.35	2.00
M + C	2.20	2.83	4.25
Threonine	3.60	3.91	3.50
Isoleucine	4.16	4.50	3.25
Tryptophan	0.79	1.33	0.75
Valine	4.10	4.74	4.89
Leucine	7.11	7.61	12.00
Arginine	10.59	7.26	4.75
Histidine	2.49	2.61	2.89
PIG DE <sub>GROW</sub>	14.0	14.9	14.3
PIG DE <sub>SOW</sub>	15.1	15.7	14.9
PIG NE <sub>GROW</sub>	7.88	8.25	11.2
PIG NE <sub>SOW</sub>	8.77	8.8	11.5

# Peculiar features of lupins

- Mid-Protein - Intermediate between grain and oilseed meals
- Protein Quality - Modest biological value
- Energy - High DE but modest NE (fibre/protein)
- Carbohydrate - Very little starch
  - Main storage CHO is beta-galactan
- Fibre - High fibre
  - Good satiety factor in dry sows
  - Source of lactogenic VFA's in lactating sows
  - Energy regulator for finishing pigs
- Milling - Hard on milling equipment
- Storage - Stores very well
- Mycotoxins - Very low

# Wheat ddgs

- Wheat dried distillers grains and solubles is a co-product of the bioethanol industry. Basically it is residue left after the starch component has been fermented to ethanol and CO<sub>2</sub>. Since wheat is approximately  $\frac{2}{3}$  starch once this has been removed the nutrients in the residual DDGS are then magnified about 3 fold.
- However the bioethanol industry also uses other wheat fractions such as wheat bran and since this has considerably less starch the adjustments to the nutrient in the subsequent DDGS is proportionally less.
- Consequently the composition of the DDGS depends on components of the original fermentation substrate.
- E.g.
  - 11 % CP wheat → 33% CP DDGS
  - 7 % CP wheat → 21 % CP DDGS
  - 15 % CP wheat bran → 20 % CP DDGS
- So the final protein content in the DDGS does not necessarily define the nature of the original substrate

## Typical composition and nutritional value of wheat ddgs from two sources

NUTRIENT	WHEAT	WHEAT BRAN
Moisture %	10.0	13.0
Protein %	33.0	20.0
Fat %	5.4	4.5
Ash %	4.5	6.7
Crude fibre %	7.4	12.3
NDF %	30.0	52.8
ADF %	11.0	15.9
ADL %	4.0	4.5
Starch + Sugar %	4.6	1.5
Ca %	0.2	0.19
Total P %	0.78	1.3
Available P %	0.23	0.4



## Typical composition and nutritional value of wheat ddgs from two sources (continued)

Nutrient	Wheat		Wheat bran	
	TOTAL	SID*	TOTAL	SID*
Lysine	0.80	0.45	0.77	0.27
Methionine	0.52	0.42	0.31	0.26
M + C	1.05	0.95	0.72	0.58
Threonine	1.03	0.82	0.63	0.50
Isoleucine	1.10	0.91	0.63	0.55
Tryptophan	0.36	0.28	0.25	0.17
Valine	1.39	1.16	0.89	0.70
DE* <sub>GROW</sub>	12.75		8.43	
DE* <sub>SOW</sub>	13.50		9.65	
NE* <sub>GROW</sub>	7.42		5.32	
NE* <sub>SOW</sub>	7.94		6.09	

\*SOURCE: INRA

## Compromise to nutritive value caused by overheating

- Apart from the variance in nutrient content due to differences in the original fermentation substrates, further damages can occur during the drying of the DDGS. These differences are often reflected in the colour of the final product.

NUTRIENT	LIGHT	DARK (OVERHEATED)
Protein %	33.9	33.0
NDF %	26.6	25.1
ADF %	9.5	13.3
ADL %	3.1	7.2
Lysine – Total %	0.76	0.33
Lysine – Digest. %	0.52	0.08
DE <sub>GROW</sub>	13.48	8.43
DE <sub>SOW</sub>	14.24	9.65
NE <sub>GROW</sub>	7.66	5.32
NE <sub>SOW</sub>	8.04	6.09

SOURCE: EVAFIG

## Aspects that require attention when using wheat ddgs

- Monitor primary specifications (protein, fibre, fat, moisture) – need information of the plant of origin and substrates employed
- Monitor protein quality – Amino acid content, Reactive lysine assays
- Take mycotoxin insurance – Mycotoxins like other nutrients are magnified three-fold by the process and grains used for ethanol may not be scrutinized
- Provide adequate enzyme support – NSP levels and phytate phosphorus are also three times higher than wheat (use xylanase,  $\beta$ -glucanase + phytase and possibly protease + mannanase)
- Monitor sodium and sulphur levels as these may be elevated depending on the process employed
- Be aware of the elevated oil content and its unsaturated nature – may affect W6:W3 ratio in final diets (though not as much as corn DDGS)

## Nominal usage levels of lupins and wheat ddgs in pig diets

Max inclusion (%)	Lupins	Wheat ddgs*
Weaners	15	5
Growers	25	15
Finishers	30	20
Lactating Sows	20	15
Dry Sows	25	20

\*Refers to good quality product

– If quality is uncertain more conservative values should be adopted

# Example diets using lupins and wheat ddgs

PRICE US \$ / t	RAW MATERIAL	GROWER			LACTATION		
		CORN/SOY	+ LUPINS	+ W. DDGS	CORN/SOY	+ LUPINS	+ W. DDGS
380	Corn	30.05	26.23	29.10	33.07	34.21	29.28
370	White Broken Rice	10.0	10.0	10.0	6.5	2.5	8.0
280	Cassava	15.0	15.0	15.0	10.0	10.0	10.0
320	Wheat Bran	-	-	-	10.0	5.0	10.0
240	Rice Bran Ext	10.0	9.5	9.0	5.8	7.2	6.4
290	Copra	10.0	2.0	2.0	5.0	-	-
590	Soybeanmeal 46%	19.7	11.9	15.6	23.2	14.6	16.2
400	Lupins	-	20.0	-	-	20.0	-
280	Wheat DDGS 33%	-	-	14.0	-	-	13.5
1310	Soya oil	2.5	2.6	2.4	2.7	3.0	3.0
130	Salt	0.45	0.45	0.45	0.45	0.50	0.45
2000	MSG	-	-	-	0.5	0.2	-
20	Lime	1.2	1.2	1.3	1.7	1.6	1.7
370	DCP	0.2	0.2	0.2	0.5	0.6	0.5
-	Amino acids	0.65	0.69	0.69	0.23	0.28	0.41
-	Pmx + Enz + Chol	0.25	0.23	0.26	0.35	0.31	0.56
		100	100	100	100	100	100

## Example diets using lupins and wheat ddgs (continued)

Nutrient	Grower			Lactation		
	Corn/soy	+ Lupins	+ W. DDGS	Corn/soy	+ Lupins	+ W. DDGS
DE <sub>GROW</sub> MJ/kg	14.0	14.27	14.10	14.0	14.21	14.0
NE <sub>GROW</sub> MJ/kg	10.0	10.0	10.0	9.8	9.8	9.8
Protein %	16.5	17.0	17.5	18.0	18.1	18.0
Fat %	5.4	5.6	5.2	5.5	6.2	5.9
Fibre %	4.5	6.0	4.2	4.5	6.0	4.5
Ca %	0.85	0.85	0.88	1.01	1.01	1.01
Av P %	0.41	0.41	0.41	0.40	0.41	0.40
Lysine %	1.11	1.12	1.13	1.05	1.04	1.06
SID LYS / DE gm/MJ	0.70	0.70	0.70	0.63	0.63	0.63
Cost \$/t	416	414	401	437	429	409

## Conclusions

- Both lupins and wheat DDGS have value as feed ingredients when priced appropriately
- As mid range proteins, they have the potential to partially replace soybeanmeal
- They have useful levels of functional fibre and compete readily with other fibrous materials in this regard
- However they do have some peculiarities which need to be understood otherwise production in the animals could be compromised
- Of particular concern is the variability in the composition and quality of wheat DDGS due to source and process effects, requiring attentive QA monitoring



Australian Export Grains Innovation Centre



[acelive@acelive.com.au](mailto:acelive@acelive.com.au)



Department of  
Primary Industries and  
Regional Development



**GRDC**  
GRAINS RESEARCH  
& DEVELOPMENT  
CORPORATION

AEGIC is an initiative of the Western Australian State Government and Australia's Grains Research and Development Corporation

[aegic.org.au](http://aegic.org.au)