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Value of Australian feed grains - application in poultry rations

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Cereal grains produced in Australia

■ Major

- ☐ Wheat (winter crop)
- ☐ Barley (winter crop)
- ☐ Oats (winter crop)
- ☐ Sorghum (summer crop)

■ Minor

- ☐ Corn and triticale

- Production is dominated by wheat followed by barley then sorghum

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Australia top 6 cereal grains - average production last 5 years¹

Grain	Mmt ²
Wheat	25.387
Barley	9.831
Sorghum	1.553
Oats	1.439
Corn	0.436
Triticale	0.153

²Mmt = million metric tonne

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Australian grains high quality

- Rigid quality standards and testing for trade
- Typically dry conditions at harvest (low moisture)
- High quality storage facilities and management
- Mycotoxin contamination low / minimal risk to poultry

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Grains used in Australian poultry feeds

- Sorghum, wheat and barley are the major grains for Australian poultry feeds
 - Wheat highest use, then sorghum, then barley
 - Used in all poultry feeds (broiler, layer, breeder, turkey and duck)
 - Corn and other grains use is minor
- Poultry performance is world-class (corn not needed for high performance)

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Grains for poultry

– major value considerations

- Nutrients supplied, particularly
 - Energy (ME)
 - Protein / digestible amino acids
- Other characteristics
 - Anti-nutritional factors
 - Mycotoxin and other toxin contamination
 - Physical features (grain size, structural fibre, pellet durability)

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Australian grains compared to corn for poultry

- How do Australian barley, sorghum and wheat compare to corn, the world's no.1 poultry grain?
- In this presentation, Australian barley, sorghum and wheat are compared to typical yellow corn
- Australian poultry feed formulas are flexible, grains (and meals) are routinely substituted as supply / price changes

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First, some basic poultry nutrition

■ Digestion / digestibility

- ❑ Poultry must digest chemical components of grains to supply energy and nutrients
- ❑ Digestibility of grain components varies
- ❑ Digestibility of some grains can be improved economically by feed enzymes

■ Most value in grains from

- ❑ Energy (ME)
- ❑ Protein / digestible amino acids



Energy (ME for poultry)

- Metabolisable energy (ME) is supplied by digested
 - Starch (→ glucose)
 - Oil (→ fatty acids)
 - Protein (→ amino acids)
- Grains differ in digestible content of these ME components
- ME measured by bioassay or predicted by NIR (e.g. AusScan)



Protein / digestible amino acids

- Poultry do not need protein, they need amino acids in protein
- All proteins are formed from 22 amino acids, 10 - 13 of these are 'essential' (eaa)
 - eaa must be supplied in the feed
- Protein must be digested to release amino acids
- Different levels of amino acids are needed in feeds for different types and stages of poultry production



Protein / digestible amino acids

- Each grain type has different
 - Protein content
 - Amino acid composition of protein
 - Digestibility of protein (but high in grains, usually lower and more variable in meals)
- Value of protein in grain largely due to digestible eaa content (e.g. standardised ileal digestible or 'SID' eaa)
- Use digestible eaa values for feed formulation

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Digestible (SID) eaa content¹ of 4 grains for typical protein content

		Corn	Barley	Sorghum	Wheat
Protein	%	8.0	10.0	10.0	11.0
SID essential amino acid					
Lysine	%	0.22	0.31	0.20	0.27
Methionine	%	0.16	0.15	0.16	0.16
M+C	%	0.32	0.35	0.30	0.39
Threonine	%	0.25	0.25	0.28	0.27
Arginine	%	0.33	0.40	0.34	0.46
Isoleucine	%	0.27	0.29	0.35	0.35
Valine	%	0.35	0.40	0.44	0.43

¹Evonik AminoDat 5.0

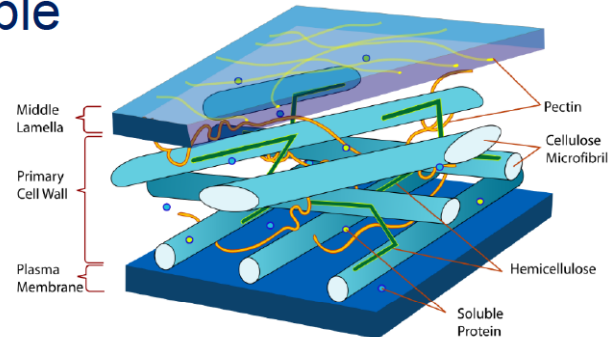
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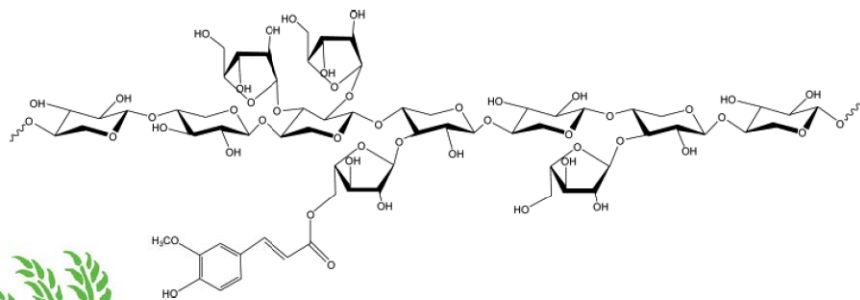
Fibre

- Grains differ in fibre content and type
- Fibre present in complex cell wall structure
- Fibre has nutritional implications for poultry
- Fibre = NSP (non-starch polysaccharides) + lignin
 - NSP: soluble and insoluble
 - Lignin: insoluble



NSP (non-starch polysaccharides)

- Soluble NSP are anti-nutritional
 - Increase digesta viscosity, decrease digestibility
 - Alleviated or eliminated by appropriate feed enzymes
- Insoluble NSP are inert, sometimes beneficial
 - For gut development and function
 - For bird behaviour (less pecking)



Typical fibre content (% of grain, DM) of corn, barley, sorghum and wheat

		Arabino-xylan	β -Glucan	Cellulose	Other NSP ¹	Lignin	Total fibre
Corn	Soluble	0.10					0.10
	Insoluble	5.10		2.00	0.80	1.10	9.00
	Total	5.20		2.00	0.80	1.10	9.10
Barley	Soluble	0.80	3.60		0.10		4.50
	Insoluble	7.10	0.70	3.90	0.50	3.20	15.40
	Total	7.90	4.30	3.90	0.60	3.20	19.90
Sorghum	Soluble	0.10	0.10				0.20
	Insoluble	2.00	0.10	2.20	0.25	1.10	5.65
	Total	2.10	0.20	2.20	0.25	1.10	5.85
Wheat	Soluble	1.80	0.40		0.20		2.40
	Insoluble	6.30	0.40	2.00	0.30	1.80	10.80
	Total	8.10	0.80	2.00	0.50	1.80	13.20

¹NSP = non-starch polysaccharides. other NSP = Mannans + Galactans + Uronic Acid

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Australian barley



- Winter crop (harvest October to December)
- Predominantly 2-row, spring type (grown in mild Australian winter)
- Medium grain size, white with hull
- Low mycotoxin contamination
- No yellow pigment
- Viscous (high soluble NSP)
- NSP enzymes used (β -glucanase and xylanase)

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Australian barley



- Pelletability similar to corn, same FPQF
(Feed Pellet Quality Factor, Borregaard LignoTech)
- Insoluble fibre in hull may have nutritional benefits
- Lower ME (energy) than other the 3 grains
 - Due to hull and lower starch
 - ME increased with NSP enzymes
- Protein typically higher than corn (+2%?)
- Higher value for layers and breeders (and pigs) than broilers

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Australian barley



- Suitable for mash and whole grain feeding
- Proven, reliable grain for poultry
- When economic, commonly used in poultry feeds in Australia (Spain, UK and elsewhere)
 - Up to 30% in commercial broiler feeds
 - Above 30% (up to 60%) in commercial layer feeds
- Not well understood or accepted in Asia?

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Australian sorghum



- Summer crop (harvest February to May)
- Small grain size, no hull
- Seed coat colour typically yellow, brown, red
- Tannin-free (nil condensed tannins)
 - Seed colour not indicator of tannins or phenolic compounds
- No yellow pigment
- Difficult to pellet (low FPQF)



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Australian sorghum



- Non-viscous (low soluble NSP)
- NSP enzymes not commonly used
- Low mycotoxin contamination
- Nutritionally similar to corn except
 - No yellow pigment
 - Higher protein
- High energy (ME), similar to corn

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Australian sorghum



- Protein typically higher than corn (+2%?)
 - Protein digestibility lower than corn (kafirin protein)
- Proven, reliable grain for poultry
- Suitable for mash feeds (coarse milling)
- Often used at high levels in poultry feeds
 - Sometimes used as only grain, but usually with some wheat (for higher PDI)
- Not well understood or accepted in Asia?



Australian wheat



- Winter crop (harvest October to December)
- Spring varieties (but grown through mild Australian winter, harvested late spring / early summer, October to December)
- Medium grain size, no hull
- No yellow pigment
- Easy to pellet (high FPQF)
- Viscous (high soluble NSP)
- NSP enzyme used (xylanase)

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Australian wheat



- High energy (ME) with xylanase enzyme
- Protein typically higher than corn (+3%?)
- Low mycotoxin contamination
- Often used as only grain for poultry
- Commonly used and well understood in Asia
- Limited export to Asia for feed, lower feed grades absorbed by domestic market
 - Some years large quantities of feed grades produced because of weather damage (sprouting) at harvest



Indicative features of 4 grains

Feature	Unit	Corn	Barley	Sorghum	Wheat
ME broiler	kcal/kg	3,350	2,900 ¹	3,300	3,200 ¹
Protein	%	8	10	10	11
Starch	%	64	50	62	58
Oil	%	3.5	1.9	2.8	1.9
Fibre total	%	9.1	19.9	5.9	13.2
Pigment	yellow	present	nil	nil	nil
NSP enzyme	added in feed	nil	β -glucanase + xylanase	nil	xylanase
Mycotoxin	risk	?	low	low	low
Pelletability	FPQF ²	5	5	4	8

¹with NSP enzyme

²FPQF = Feed Pellet Quality Factor (Borregaard LignoTech)



Concluding comments

- Values in this presentation are indicative only
 - Values should not be used for purchase assessment or feed formulation
- Poultry need nutrients not ingredients
- Barley, sorghum and wheat are suitable for all poultry feeds
 - Used successfully in Australia (and elsewhere)
 - Can and should be used everywhere when economic

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Concluding comments

- Preferable to have more than grain in poultry feeds (reduce variation, lower risk)
- Understand characteristics of each grain and be ready to use when opportunities arise
- Be flexible with feed formulas, use 'alternative' grains when economic
 - Act quickly (opportunities may not last long)

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