

Barley and sorghum for chickens



Tim Walker
Consultant to AEGIC



THE AUSTRALIAN GRAINS
INDUSTRY CONFERENCE
ASIA 2019



Australian Export Grains Innovation Centre

World barley and sorghum

- Barley and sorghum rank 4th and 5th respectively in world cereal production after corn, wheat and rice
- Large proportion of each fed to animals, including poultry



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



Australia top 6 cereal grains - average production last 5 years¹

Grain	Mmt ²
Wheat	23.207
Barley	9.477
Sorghum	1.591
Oats	1.354
Corn	0.423
Triticale	0.123

¹ABARES Crop Report December 2018

²Mmt = million metric tonne



Australian grain quality

- Consistent quality by adherence to industry-adopted standards and rigid testing for trade
- Typically dry conditions at harvest (low grain moisture)
- High quality storage facilities and management (effective insect and mould control)
- Mycotoxin contamination low / minimal risk to poultry



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, triticale, oats and other grains use is minor
- Poultry performance is world-class (corn not needed for high performance)

Grains for poultry

– major value considerations

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



Barley and sorghum compared to corn and wheat for poultry

- In this presentation, Australian barley and sorghum are compared to typical yellow corn and feed wheat, the world's no.1 and 2 poultry grains
- Assume many here today are not familiar with poultry nutrition and feed formulation
- Some technical information in this presentation is for future reference, not for discussion today



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 content of
 - Energy (ME)
 - Protein / digestible amino acids



Energy (ME for poultry)

- Grain metabolisable energy (ME) comes from
 - Starch (digested to glucose)
 - Oil (digested to fatty acids)
 - Protein (digested to amino acids)
- Total and digestible content of these ME components varies between grains
- ME measured by bioassay or predicted by NIR (book values and estimation from chemical analysis not sufficiently accurate / reliable)



Protein / digestible amino acids

- Poultry do not need protein, they need amino acids in protein
- All proteins are formed from 22 amino acids (AA), 10 - 13 of these are 'essential' (EAA)
 - EAA must be supplied in the feed (intact protein and synthetic amino acids)
- 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 all 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



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

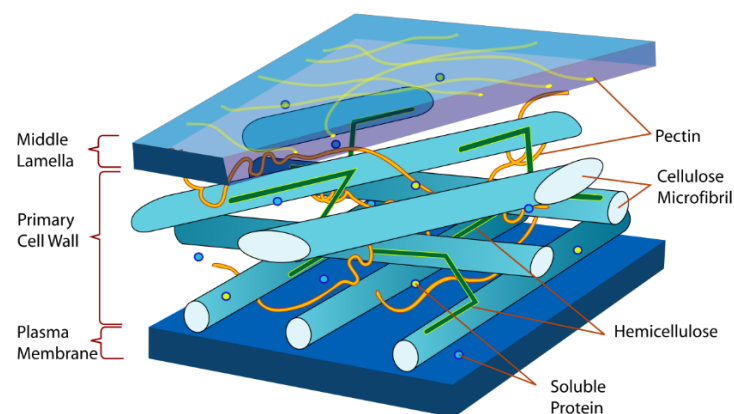
		Corn	Barley	Sorghum	Wheat
Protein	%	8.0	10.0	10.0	11.0
SID EAA					
Lysine	%	0.22	0.31	0.20	0.27
Methionine	%	0.16	0.15	0.16	0.16
M+C	%	0.32	0.35	0.30	0.39
Threonine	%	0.25	0.25	0.28	0.27
Arginine	%	0.33	0.40	0.34	0.46
Isoleucine	%	0.27	0.29	0.35	0.35
Valine	%	0.35	0.40	0.44	0.43

¹Evonik AminoDat 5.0



Fibre

- Grains differ in fibre level and type
- Fibre = NSP (non-starch polysaccharides) + lignin
 - NSP: soluble and insoluble
 - Lignin: insoluble
- Fibre in grains is present in complex cell wall structure as NSP (cellulose, pectin, hemicelluloses) and lignin
- Fibre is important for nutrition of poultry



NSP (non-starch polysaccharides)

- Soluble NSP are anti-nutritional
 - Increase digesta viscosity, decrease digestibility
 - Barley and wheat are 'viscous' grains
 - Sorghum and corn are 'non-viscous' grains
 - Viscosity effects reduced or eliminated by appropriate feed enzymes
- Insoluble NSP are inert, sometimes beneficial for gut development and function, and for bird behaviour (less pecking)
 - Barley has high insoluble NSP content



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



Australian barley

- Winter crop (harvest October to December)
- Varieties mainly 2-row, spring type (grown in mild Australian winter)
- Medium grain size, white with hull
- Low mycotoxin contamination
- No yellow pigment
- Viscous (may have high levels of the soluble NSPs β -glucan and arabinoxylan)
- NSP enzymes used (β -glucanase and xylanase)



Australian barley

- Pelletability similar to corn, same FPQF¹ = 5
(¹Feed 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 content
 - ME increased with NSP enzymes
- Protein typically higher than corn (+2%?)
- Higher value in layer and breeder than broiler feeds



Australian barley

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



Australian sorghum

- Summer crop (harvest February to May)
- Small grain size, no hull
- Tannin-free (nil condensed tannins)
- Phenolic compounds present, some moderately anti-nutritional
- Seed coat colour typically yellow, brown, red
- Seed colour does not indicate levels of tannins or phenolic compounds



Australian sorghum

- No yellow pigment
- Non-viscous (low soluble NSP content, like corn)
- Low mycotoxin contamination
- Nutritionally similar to corn but higher protein (and no yellow pigment)
- High energy (ME), similar to corn
- Protein typically higher than corn (+2%?)
 - Protein digestibility lower than corn (kafirin protein)

Australian sorghum

- Suitable for mash feeds
- Difficult to pellet (low FPQF = 4, lower than corn = 5)
- Proven, reliable grain for poultry
- Commonly used in poultry feeds in Australia, Americas, Africa and elsewhere
 - Often at high levels, sometimes as only grain
- Not well understood or accepted for poultry feeds in Indonesia?



Sorghum and corn look different



.... but are nutritionally similar for poultry

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)

Barley and sorghum use in Australian commercial poultry feeds

- Australian poultry feed formulas are flexible
 - Various grains (and meals) are routinely substituted as supply / prices change
- Barley replaces other grains when available at economic prices
 - Up to 30% in commercial broiler feeds
 - Above 30% (up to 60%) in commercial layer feeds
- Higher levels of fats / oils added to maintain feed energy (ME)



Barley and sorghum use in Australian commercial poultry feeds

- Seasonal substitution between sorghum (summer crop) and wheat / barley (winter crops) is normal and routine in some areas
- Sorghum often used at high levels in poultry feeds
 - Sometimes the only grain
 - More usually with some wheat (for higher PDI = better pellet quality)
- Poultry performance is maintained when major changes are made to level and type of grain in formulas



Concluding comments

- Nutritional values in this presentation are indicative only and should not be used for purchase assessment or feed formulation
- Poultry need nutrients not ingredients (corn not necessary for high performance)
- Preferable to have more than grain in poultry feeds (reduce variation, lower risk)
- Feed formulas should be flexible, use 'alternative' grains when economic

Concluding comments

- Barley and sorghum are suitable for all poultry feeds
 - Used successfully in Australia (and elsewhere)
 - Can and should be used everywhere when economic
- Understand characteristics of each grain and be prepared to use when economic in your feeds
 - Be ready to act quickly, opportunities may not last for long



Acknowledge support of



Australian Export Grains Innovation Centre

The end
Thank you

THE AUSTRALIAN GRAINS
INDUSTRY CONFERENCE
ASIA 2019



Australian Export Grains Innovation Centre