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References

Bryden, W.L. and Li, X. (2002) Improving the utilisation of dietary amino acids in meat chickens. Rural Industries Research and Development Corporation, Canberra RIRDC Project No. US80A.

NRC (1998) Nutrient Requirements of Swine: 10th Revised Edition National Research Council, Washington DC; National Academy Press.

Perez-Maldonado, R.A. (2003) Canola meal and cottonseed meal in broiler and layer diets. *A report for the Australian Egg Corporation Limited. AECL Publication No. 03/10*

Ravindran, V., Hew., L.I. and Bryden, W.L. (1998) Digestible Amino Acids in Poultry Feedstuffs. Rural Industries Research and Development Corporation, Canberra Publication No. 98/9.

Selle, P.H., A.R. Walker and W.L. Bryden. (2003) Total and phytate-phosphorus contents and phytase activity of Australian-sourced feed ingredients for pigs and poultry. *Aust. J. Exp. Agric. 43,475-479.*

Spragg, J.C. and R.J. Mailer. (2007) Canola Meal Value Chain Quality Improvement. A final report prepared for AOF and Pork CRC. Project Code: 1B-103-0506.

van Barneveld, R.J. (1998) Influence of oil extraction method on the nutritional value of canola meal for growing pigs. *DAS 38/1188 Final Report PRDC and AOF.*

australian canola meal guide for the feed industry

Canola Meal is the product obtained from canola seed oil extraction.

It provides a source of high quality nutrients for use in animal feeds and has become a significant vegetable protein meal used within Australia.

This document provides a summary of relevant nutritional data, together with recommendations on the use of Australian canola meal in animal feeding. The AOF acknowledges the Pork CRC in providing funding which has generated data used within this publication.

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Canola Production

Canola production in Australia has increased significantly over the last 20 years. Canola production is now the largest oilseed crop representing 57% of Australian oilseed production over the past 5 years. In non drought years, Australia produces over 1.5 million tonnes of canola.

Canola seed is high in oil, typically 40-42%. The seed is processed whole with the resulting meal containing protein, fibre, carbohydrates and ash components, together with any residual oil not removed through the oil extraction process.

Australia has canola seed crushing plants operating in New South Wales, Victoria, South Australia and Western Australia.

Oilseed Crushing Processing Systems

Australia has a variety of oilseed crushing systems designed to extract oil from canola seed. Processing plants have generally been designed to optimise the recovery of oil relative to meal as the oil component provides the greatest end use value.

Oilseed processing is reliant upon both mechanical, heat and chemical processing steps.

The key steps in production of canola meal involve:

- Seed handling and cleaning
- Conditioning and flaking
- Expelling → Expeller Plant Finished Meal
- Solvent extraction
- Desolventising and toasting → Solvent Plant Finished Meal

It is estimated that around 73% of canola meal is produced from solvent plants, 25% from expeller and 2% from cold press plants.

Cold press oil extraction - canola seed is not pre-conditioned prior to oil extraction, with temperatures up to 65°C being generated within the expeller due to frictional forces.

Expeller oil extraction – seed is heat conditioned and the expeller press operated to optimise oil extraction, this can generate meal temperatures up to 135°C for the brief period seed cake is passing through the press. Some plants operate double pass systems where seed cake is reprocessed to increase oil recovery.

Solvent extraction – involves a two stage oil extraction process, utilising an initial expeller extraction operating at 100 - 120°C, resulting in the production of a seed cake with approximately 20% oil (equivalent whole soybean cake). This then undergoes solvent oil extraction using hexane, and then a final desolventising and toasting process at temperatures of 100 - 115°C.

Canola meal nutrient content

Effectiveness of Oil Extraction

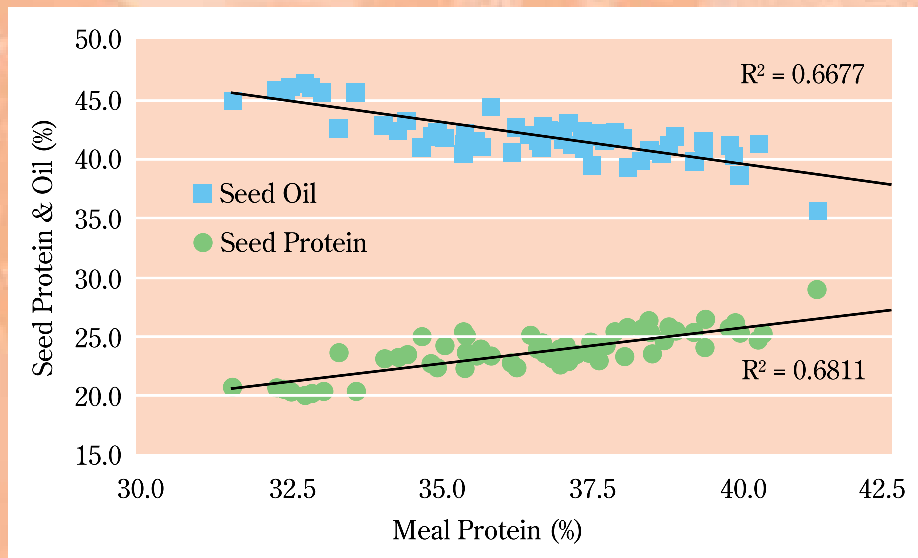
Solvent processing plants remove 96%+ of the oil, with approximately half being extracted within the expeller and half in the solvent processing stages. In contrast, expeller plants are being operated to remove approximately 75% of the canola seed oil content through the expeller processing stage. Oil extraction through expeller plant processing is increased where double pressing is practiced.

Both solvent and expeller plant operators commonly add gums back to the meal stream. Although processors vary in their level of oil refining and method of adding gums back to the finished meal, the addition rate is in the range 0 - 2%. This addition results in a higher finished meal fat content and energy value. The addition also reduces the level of dust within dry meals.

Canola Seed and Resulting Meal Quality

Australia has an active canola breeding program which has resulted in the production of higher oil and protein varieties with thinner seed coats. This has resulted in the fibre content of Australian canola meal declining over recent years. The fibre levels identified in the following table are considerably lower than those previously reported for either Canadian or Australian canola meal. This lower fibre content will be resulting in higher available energy levels for animal feeding.

Crude protein in the finished meal is positively correlated with canola seed protein content and negatively correlated with oil content. Climatic growing conditions significantly impact upon canola seed production and the composition of resulting canola seed.



Source: Spragg and Mailer 2007

Chemical Composition of expeller and solvent extracted canola meal (as received)

Nutrient	Units	Expeller Meal Mean	Expeller Meal Min.	Expeller Meal Max.	Expeller Meal SD	Solvent Meal Mean	Solvent Meal Min.	Solvent Meal Max.	Solvent Meal SD
Moisture[a]	%	7.1	3.9	11.9	2.15	10.7	9.3	12.0	0.86
Crude Protein[a]	%	36.3	31.6	41.7	2.62	37.3	33.3	42.5	1.87
Crude Fat[a]	%	11.1	8.5	17.0	1.55	3.4	1.8	4.8	0.7
Linoleic Acid[a]	%	2.4	1.9	3.5	0.31	0.9	0.5	1.2	0.16
Crude Fibre[a]	%	10.6	9.6	13.2	0.98	9.85	9.1	10.2	0.39
NDF[a]	%	24.1	20.9	28.1	1.88	24.1	21.7	27.2	0.90
ADF[a]	%	16.9	15.8	19.3	0.88	16.4	14.6	17.2	0.81
Free Sugars[a]	%	9.8	8.8	10.5	0.54	10.5	10.0	11.1	0.47
Non-starch Polysaccharides[b]	%	13.7	na	na	na	10.7	na	na	na
Ash[a]	%	6.3	5.5	7.1	0.47	7.3	6.7	8.7	0.60
Glucosinolates[a]	µmoles/g	5.3	2.4	8.9	1.72	1.7	0.5	3.1	0.79
Sinapine[a]	g/kg	9.7	8.2	11.0	0.87	7.9	6.8	9.3	0.83
Bulk Density[a]	kg/hl	59.2	54.0	66.5	2.39	52.4	47.5	52.5	2.61

Source: [a]Spragg and Mailer 2007; [b]Perez-Maldonado 2003

Amino acid content of expeller and solvent canola meal (g/kg, as received)

Amino Acid	Expeller Meal Mean	Expeller Meal Min.	Expeller Meal Max.	Expeller Meal SD	Solvent Meal Mean	Solvent Meal Min.	Solvent Meal Max.	Solvent Meal SD
Methionine	7.0	6.2	7.6	0.50	7.2	6.7	7.7	0.26
Cystine	8.6	7.7	9.4	0.53	8.7	8.2	9.4	0.39
M+C	15.6	14.0	17.0	0.95	16.0	15.0	17.3	0.64
Lysine	19.7	17.7	21.1	1.05	20.2	19.5	21.4	0.58
Threonine	15.0	13.7	16.1	0.71	15.6	14.9	16.5	0.46
Tryptophan	4.9	4.2	5.4	0.40	5.1	4.8	5.4	0.18
Arginine	21.5	18.6	23.9	1.67	22.1	20.8	24.0	0.92
Isoleucine	13.9	12.5	14.9	0.80	14.3	13.5	15.2	0.45
Leucine	24.3	21.5	26.4	1.54	25.3	23.7	27.4	1.03
Valine	17.9	16.4	19.0	0.88	18.6	17.5	19.5	0.53
Histidine	9.5	8.5	10.2	0.51	9.9	9.3	10.5	0.36
Phenylalanine	14.1	12.3	15.4	1.00	14.6	13.7	15.6	0.50

Source: Spragg and Mailer 2007

Amino acid content of expeller and solvent canola meal (% in crude protein)

	Expeller Meal	Solvent Meal	All Meal
Methionine	1.98	1.94	1.96
Cystine	2.44	2.36	2.41
M+C	4.43	4.33	4.39
Lysine	5.59	5.46	5.55
Threonine	4.25	4.23	4.24
Tryptophan	1.37	1.37	1.37
Arginine	6.09	5.98	6.05
Isoleucine	3.92	3.87	3.91
Leucine	6.88	6.85	6.87
Valine	5.08	5.03	5.06
Histidine	2.68	2.67	2.68
Phenylalanine	3.99	3.95	3.98

Source: Spragg and Mailer 2007

Canola meal supply of nutrients in animal feeding

Energy

Canola meal acts as both a valuable source of energy and amino acids for animal feeding. The amount of energy supplied is directly related to the residual oil; the higher the oil content, the higher the DE content. Method of oil extraction has a minimal impact upon DE content of meal other than through the influence associated with the residual oil level.

Energy levels within the table opposite may under estimate energy available to the animal as changes in plant breeding has resulted in lower fibre meals which will have higher digestibility. Energy values used in feed formulations should be adjusted for higher than average meal residual oil levels.

Protein & Amino Acids

Protein digestibility is influenced by heat processing and the removal of oil via both expeller and solvent meal processing is achieved by applying heat. Attention has been given to this issue by oilseed crushers, with recent research work indicating higher lysine availability in canola meal than in previous years. The canola industry is conducting further work to improve protein quality for pig and poultry feeding and better define amino acid availability.

Heat processing, whilst negative for monogastric feeding, results in increased protein undegradability for ruminants. A portion of the protein in canola meal remains undigested in the rumen and passes to the lower gut for digestion and amino acid absorption. Heat processing has been demonstrated to increase the bypass protein content of vegetable protein meals.

Minerals

The minerals contained in canola meal is shown in the table opposite. Phytate phosphorus levels have been determined through HPLC analyses, these being higher than the average value (0.67%) obtained by Selle et al. (2001) using ferric chloride precipitation.

Anti-nutritionals

Canola is low in glucosinolates, less than 10μmoles/g, when compared to former rapeseed varieties. There is a decline in glucosinolate content with increasing levels of heat during processing, with both expeller and solvent extracted meals showing reduced glucosinolate levels compared to cold press meals. Canola meal produced within Australia is lower in glucosinolate than those reported for Canadian meal, this being due to canola breeding programs which have successfully reduced glucosinolate content. The levels of glucosinolates found in Australian canola meal are below levels which will impact upon pig or poultry performance even with high inclusion rates in feed rations.

Levels of sinapine are similar to those reported for Canadian canola meal. Sinapine levels can limit maximum inclusion rates of canola meal in feeds for brown egg laying hens due to resulting "fishy taints" in eggs produced.

Available Energy for expeller and solvent canola meal

		Expeller Meal		Solvent Meal	
		Mean	Range	Mean	Range
Poultry Layer[a]	AMEn (MJ/kg) as is	12.3	11.5-13.3	10.0	9.5-10.4
	AMEn (kcal/kg) as is	2940	2750-3180	2390	2270-2490
Broiler[a]	AMEn (MJ/kg) as is	9.8	8.9-10.7	8.0	7.7-8.3
	AMEn (kcal/kg) as is	2340	2130-2560	1910	1840-1980
Pig[b]	DE (MJ/kg) as is	13.9	13.4-15.1	12.4	12.1-12.7
Cattle[c]	ME (MJ/kg) DMB	13.2	12.4-14.0	11.7	11.2-12.4
	NEl (MJ/kg) DMB	8.7	8.0-9.2	7.4	7.1-7.5
	NEm (MJ/kg) DMB	9.3	8.6-9.8	7.9	7.6-8.0
	NEg (MJ/kg) DMB	6.2	5.7-6.6	5.3	5.1-5.4

Adapted from: [a]Perez-Maldonado 2003; [b]van Barneveld 1998; [c]NRC 2001, FeedTest

Poultry and pig amino acid digestibility of canola meal

	Poultry apparent Ileal digestibility[a] (%)	Pig true ileal digestibility[b] (%)
Arginine	76	85
Cystine	75	83
Histidine	79	85
Isoleucine	72	87
Leucine	76	88
Lysine	75	85
Methionine	86	86
M+C	81	85
Phenylalanine	76	83
Threonine	67	83
Tryptophan	71	75
Valine	71	88

Source: [a] Bryden & Li 2002; Perez-Maldonado 2003; Ravindran et al. 1998 [b] NRC 1998 and Van Barneveld 1998

Mineral content of canola meal (as received)

		Canola Meal			
Mineral	Units	Mean	Min.	Max.	SD
Calcium	%	0.56	0.45	0.67	0.056
Phosphorus	%	0.96	0.79	1.19	0.116
Phytate-P	%	0.83	0.63	1.01	1.084
Phytate-P in Total-P	%	85.9	67.0	95.0	-
Chlorine	%	0.10	0.06	0.13	0.019
Potassium	%	1.26	1.05	1.44	1.010
Sulphur	%	0.62	0.50	0.70	0.057
Magnesium	%	0.47	0.38	0.55	0.052
Copper	mg/kg	3.9	3.0	4.7	0.39
Iron	mg/kg	138	78	457	78.4
Manganese	mg/kg	52	40	61	6.5
Zinc	mg/kg	45	36	54	4.9

Source: Spragg and Mailer 2007

Canola meal protein degradability for cattle

	Expeller Meal	Solvent Meal
Crude Protein (%)	36.0	37.0
Rumen Bypass (% of protein)	30.0	35.0
Undegradable Protein (%)	10.8	13.0