

The Role of Rendered Products in Diets for Monogastric Animals

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OVERVIEW

- Rendered products are used widely in Australia in monogastric diets
 - Poultry: Broiler, Layer (breeder and table egg)
 - Swine: all ages including breeding pigs
 - Pet: dog and cat
 - Diets for all these animals use meat and bone meal, blood meal and tallow.



Advantages of Meat and Bone Meal

- Traditional Advantages:
 - High Protein
 - Reasonable source of digestible amino acids
 - Good source of macro minerals – Ca, P.
 - Freedom from mycotoxins
- Recently Recognized Advantages:
 - Carnitine
 - Creatine
 - Conjugated linoleic acid



Meat and Bone Meal as a Protein Source

- Only soybean meal surpasses MBM as a source of amino acids relative to its crude protein level.
- Meat and bone meal complements soybean meal very well in pig and poultry diets
- Protein meals are evaluated according to:
 - Total amino acid content
 - Digestible amino acid content
- Amino acid digestibility is a major determinant of economic value
- Using Regression Equations we can predict amino acid values from crude protein



Predicting Amino Acid levels

Meat and bone meal
n = 377

CP% 48.09 Act. DM 91

AA	%AA in Feed Ingredient				Reg. Equations				
	Mean	CV(%)	Min	Max					
LYS	2.34	25.8	1.24	3.81	%CP *	0.0697	-	1.012	r=0.88
MET	0.64	33.9	0.29	1.30	%CP *	0.0246	-	0.544	r=0.87
CYS	0.44	50.4	0.11	1.21					
M+C (376)	1.08	34.8	0.43	2.25	%CP *	0.0450	-	1.085	r=0.92
THR	1.51	28.2	0.76	2.67	%CP *	0.0524	-	1.004	r=0.94
TRP (279)	0.28	48.7	0.07	0.67	%CP *	0.0150	-	0.429	r=0.90
ARG	3.31	14.8	2.25	4.88	%CP *	0.0571	+	0.564	r=0.89
ILE	1.32	32.0	0.58	2.48	%CP *	0.0517	-	1.164	r=0.94
LEU	2.81	27.6	1.37	4.82	%CP *	0.0948	-	1.751	r=0.94
VAL	1.97	26.2	0.99	3.35	%CP *	0.0630	-	1.062	r=0.94
HIS	0.88	34.8	0.38	1.75	%CP *	0.0339	-	0.749	r=0.85
PHE	1.61	25.1	0.90	2.71	%CP *	0.0495	-	0.767	r=0.94
TYR (54)	1.33	10.5	1.00	1.78					

Source: Degussa AminoDat 3.0 Platinum

Mineral content

- Adequate supplies of Ca and P are essential for bone development in all species.
- A traditional advantage of MBM is that it is an important and bioavailable source of Ca and P.
- Meat and bone meal also contributes significant amounts of Na (0.7%), Cl (0.65)% and Mg (1.1%).
- Meat and bone meal is a good source of Fe, Typical levels are about 600 mg/kg.
- Meat and bone meal contains about 70 mg/kg of Zn.

Macro-mineral content

- Van Barneveld *et al* showed that
 - Ca = Ash X 0.37
 - P = Ash X 0.18
 - Ca : P = 2 : 1
- Very high correlation between ash and Ca and P (0.9)
- Ash is a very reliable guide to Ca and P content of MBM
- Ash is a much easier and cheaper assay

Functional Nutrients

- Carnitine – important for fertility in all species.
 - meat and bone meal is a good source and contains 10-20 times the level in soybean meal.
- Creatine – important for energy release in muscles.
 - Although all animals can synthesize creatine the stress of high production often means that young animals cannot synthesize enough.
 - Meat and bone meal contains significant amounts of creatine.
- Conjugated linoleic acid (CLA) – involved in the immune response and in carcass quality
 - Meat and bone meal is a natural source of CLA.



Amino Acid Digestibility of Meat and Bone Meal in Poultry

	Chick Assays			Adult Cockerel Assays	
	Syd Uni.	NZ Ileal	NZ Faecal	Depussa	NRC
Lysine (%)	76	77.4	85.4	81	79
Methionine (%)	79	88	88.1	85	85
Cysteine (%)				58	58
Met + Cys (%)				74	
Threonine (%)	68	69.2	85.9	79	79
Tryptophan (%)				76	
Isoleucine (%)	75	71	78.3	84	83
Leucine (%)	76	72.6	81.2	85	84
Valine (%)	73	79.7	74.6	83	82
Histidine (%)	73	73.3	76.9	80	80
Arginine (%)	76	81.9	81.2	84	85
Glycine (%)	73	70.2	80.2		
Serine (%)	67	70.9	78.2		
Phenylalanine (%)	75	75.3	73.1	83	84
Tyrosine (%)	73	69.6	77.4		
Aspartic acid (%)	60	68.6	82.7		
Glutamic acid (%)	73	70.2	80.2		
Proline (%)		76.4	81.3		
Alanine (%)	76	71.7	84.7		

Australian MBM Technical Review – Meat and Livestock Australia (2003)

Energy Values of Meat and Bone Meal

➤ Poultry

- TME Broilers: 2450 kcal/kg (Dale 1997)
- 2536 kcal/kg (Wang and Parsons 1998)

Recommended: 2500 kcal/kg (broilers),
2700/kcal/kg (layers)

{Australian MBM Technical Review – Meat and Livestock Australia (2003)}

Bioavailability of P

➤ A very thorough study comparing the bioavailability of meat and bone meal for promoting bone growth in broilers concluded that there was no significant difference from that of monocalcium phosphate. (Waldroup, P.W. and M.H. Adams, 1994. Evaluation of the phosphorus provided by animal proteins in the diet of broiler chickens. J. Appl. Poult. Res., 3: 209-216.)

➤ In practical terms Bioavailability of P can be considered 100%.

Pigs



Amino Acid Digestibility of Meat and Bone Meal in Pigs

	NRC Meat Meal	NRC Meat Meal with bone	Degussa	Adisseo
Lysine (%)	83	74	77	65-84
Methionine (%)	85	79	77	69-85
Cysteine (%)	55	55	51	50-59
Met + Cys (%)			67	
Threonine (%)	79	70	74	67-81
Tryptophan (%)	73	60	73	
Isoleucine (%)	82	74	78	67-80
Leucine (%)	82	76	78	57-82
Valine (%)	79	74	76	57-80
Histidine (%)	82	75	76	63-86
Arginine (%)	88	81	85	75-87
Phenylalanine (%)	83	76	78	62-83
Tyrosine (%)	79	71		64-88



Australian MBM Technical Review – Meat and Livestock Australia (2003)

Energy Values of Meat and Bone Meal

➤ Pigs

- DE: 12.1 mj/kg (Edwards 1995)
- ME: 2225 kcal/kg (NRC 1998)

{Australian MBM Technical Review – Meat and Livestock Australia (2003)}



Bioavailability of P

- Various studies done over the years but recent studies suggest that bioavailability is high and can be considered as 90-100% for practical formulation purposes.

S. L. Traylor, G. L. Cromwell and M. D. Lindemann **Bioavailability of phosphorus in meat and bone meal for swine.** *J Anim Sci* 2005. 83:1054-1061.



Companion Animals



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Companion Animals

- Meat and bone meal was once widely used in pet foods in the US but is not as popular today.
- This is not for nutritional reasons and is perhaps more to do with perceived consumer choices.
- Digestibility of meat and bone meal has been shown to be comparable to other popular pet food ingredients such as poultry meal and lamb meal (Johnson *et al*, 1998. J. Anim. Sci.76:1112–1122.)
- According to Dr Greg Aldrich (Petfood Industry Magazine, January 2005) it has been underestimated by US pet food manufacturers.

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Disadvantages of Meat and Bone Meal

- Variability – there are many sources and types in the market.
 - The industry takes a lot of care to assess the quality of different sources
- Biogenic Amines – the end products of bacterial degradation of muscle protein.
 - Extensive testing of sources by poultry companies revealed that high levels result from offal left for longer times before rendering
- Salmonella – present in meat and bone meal.
 - Pelleting drastically reduces levels
 - Testing by customers and communication with suppliers has proved to be the best way to reduce levels in meat and bone meals

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Blood Meal

- Commercial blood meal is dried whole blood from cattle, sheep or pigs.
- It is produced in one of 3 ways:
 - Spray dried low temperature (fluidized bed)
 - Spray dried higher temperature (ring dried)
 - Batch dried
- Most blood meal offered to the Australian feed industry is ring dried.

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Blood Meal

- Blood meal is characterized by a high protein level and a high amino acid bioavailability
- Of the 3 production methods low temperature spray drying results in the highest amino acid digestibility.
- Ring dried blood meal is still very high in bioavailability



Blood meal
n = 53

AA	%AA in Feed Ingredient				Digestibility of AA			
	Mean	CV(%)	Min	Max	Swine Coef.	Swine Conc.	Poultry Coef.	Poultry Conc.
LYS	7.98	6.3	7.01	9.02	94	7.50	86	6.86
MET	1.13	12.2	0.81	1.36	88	0.99	91	1.03
CYS	0.91	19.6	0.46	1.16	99	0.90	76	0.70
M+C	2.04	11.9	1.44	2.36	88	1.80	83	1.70
THR	4.29	6.6	3.64	4.87	89	3.82	88	3.77
TRP (13)	1.49	3.6	1.35	1.57	91	1.36	85	1.27
ARG	3.66	7.5	3.05	4.21	95	3.48	87	3.19
ILE	1.04	42.6	0.60	2.24	75	0.78	78	0.81
LEU	10.75	4.7	9.43	11.80	93	10.00	90	9.68
VAL	7.23	6.4	6.13	8.19	93	6.73	88	6.37
HIS	5.16	5.2	4.54	5.89	95	4.90	84	4.33
PHE	6.19	5.3	5.30	6.76	92	5.69	88	5.44
TYR								
ALA	6.85	4.4	6.24	7.48				
ASP	8.97	4.9	8.02	9.90				
GLU	7.95	5.0	7.11	8.81				
GLY	3.66	4.6	3.36	4.26				
PRO (40)	3.37	6.3	2.95	4.02				
SER	4.47	6.6	3.70	5.06				
CP	88.43	3.1	82.05	92.26				

Source: Degussa AminoDat 3.0 Platinum



Blood Meal

- Blood meal is widely used in monogastric diets. Typical inclusions are:
 - Broiler feeds at 1-2%
 - Layer feeds at up to 1%
 - Pig feeds at up to 3%



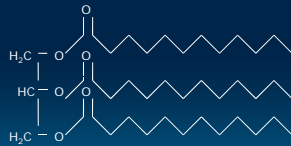
Tallow

- Animal fats are an economic source of energy for both pigs and poultry.
- Pure tallows are largely made up of saturated fats.
- Some lower grade fats may contain some recycled vegetable oils as well



Tallow

- Tallow is animal fat present largely in the form of tri glycerides.



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Tallow

- Tallow quality is influenced by 10 factors:
 - free fatty acid, colour, moisture, insoluble impurities, unsaponifiables, titre, iodine value, peroxide value, stability and polyethylene.
- The relative importance of these measurements in the overall assessment of tallow quality depends on the intended use of the tallow.

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Tallow

- The most important quality measures from a feed viewpoint are:
- Free fatty acids – the level of free fatty acids is a measure of the amount of hydrolysis of triglycerides that have taken place.
 - Hydrolysis is the result of enzyme activity prior to rendering and so may indicate the freshness of the offal rendered.
 - A free fatty acid level that is too high may make feed unpalatable
- Stability – the ability of tallow to resist oxidation.
 - This is important in feed tallows as oxidized tallow is unpalatable and causes loss of performance due to intracellular oxidative damage. Antioxidant can be used to stabilize tallows but is not permitted in some markets.

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Summary

- Rendered products present a valuable formulation tool for nutritionists to lower feed costs offering cost effective, bioavailable sources of
 - Amino acids
 - Minerals
 - Energy

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