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**Amino Acids in Rumen Escape Protein**  
***3. Plant and Non-Plant Source Protein Meals***

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Dairy cattle require dietary nitrogen and proteins to meet the requirements of their ruminal populations of microorganisms. If ruminal microorganisms, particularly bacteria, become nitrogen deficient then their growth and fermentative activity can be restricted leading to reduced digestion of structural carbohydrates and declining levels of feed intake. These microorganisms, which die and wash out of the rumen to the small intestine, provide a substantial proportion of the protein which is absorbed from the small intestine of the animal to meet the animal's metabolic requirements for amino acids, which are the building blocks of proteins. However, with the exception of the lowest producing bovines, the microbial contribution alone is seldom sufficient to meet these metabolic requirements making enhancement of intestinally delivered supplies of protein from dietary feed sources critical if the animal is to reach its genetic potential for productivity.

Plant and non-plant source protein meals comprise a portion of most successful rations for lactating dairy cows. These feedstuffs are typically added to the diet primarily to contribute protein, often intestinally absorbable protein, but also contribute variable quantities of non-structural carbohydrates that are available to be fermented by microbes in the rumen. Protein meals containing between 40 and 90% crude protein, of which 20 to 70% escapes the rumen undegraded, that is fed at 5% to 15% of total dry matter intake to high producing dairy cows will supply between 500 and 1000 g of intestinally absorbable amino acids. These quantities represent between 20 and 40% of the animals' total intestinal amino acid requirement. Thus it is important to accurately estimate the amino acid composition of these rumen escape proteins if the amino acid requirements of the animals are to be met, but not exceeded.

***Purpose***

The amino acid profile of the rumen escape protein of a number of feedstuffs commonly fed to dairy cows was determined over a period of several years as the feedstuffs were collected from various commercial sources. This article presents the amino acid profile of several plant and non-plant plant source protein meals. Previous articles presented similar data for forages and plant source by-products, as well as grains and whole seeds.

### ***Methods Used***

Samples of several plant and non-plant source protein meals were collected from several sources. The amino acid composition of the rumen escape protein of these feedstuffs was estimated using a traditional rumen in situ method. Using this procedure, small quantities of various plant and non-plant source protein meals were incubated in small nylon bags in the rumens of two dry cows fed a diet of grass hay and minerals at a maintenance level of energy intake. The undigested feedstuff residues, that were removed from the rumen at predetermined times, were dried and assayed for amino acids utilizing traditional amino acid assay procedures with a separate analysis for cystine and methionine that included oxidation with performic acid. Times of rumen incubation of all protein meals were 16 h (rumen rate of passage (kp) estimated to be 6.25 %/h). No corrections were made for truly indigestible amino acids in the feedstuff residues or microbial amino acid in the feedstuff residues. This may influence interpretation of the data.

### ***Results Available***

The amino acid profiles of the undigested plant and non-plant source protein meals are shown in the Tables. Each of the feedstuff samples represents a different source of that particular feedstuff. There is substantial variation in the amino acid profile of the protein residues among feedstuffs, with differing extents of variation within a feedstuff among amino acids.

### ***Use of the Data***

The data presented in the tables can be utilized in preparing, or evaluating, rations for dairy cattle under situations where the requirements of the animals for intestinally absorbable amino acids have been estimated. The amino acid values in the tables can be directly applied to the estimated rumen escape of digestible crude protein.

### ***Future Perspectives***

This project is ongoing. The author plans to update this article on an annual basis to reflect new sample analyses that have become available during that period of time.

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**Table 1. Amino Acids in Rumen Escape Protein of Plant Source Protein Meals (% CP)**

Feedstuff	#		Lys	His	Arg	Thr	Gly	Val	Ile	Leu	Tyr	Phe	Cys	Met
Canola meal (solvent)	4	Min	4.46	2.33	4.74	4.41	4.81	4.51	3.35	6.84	2.89	4.51	1.90	1.65
		Max	4.89	2.52	4.52	4.77	5.40	5.31	4.46	7.73	4.30	4.97	2.22	2.28
		Avg	4.69	2.40	5.16	4.51	5.10	4.95	3.97	7.35	3.35	4.69	2.09	1.91
Corn gluten meal	4	Min	1.00	2.10	2.88	3.08	2.76	3.91	3.12	12.72	5.03	6.56	1.56	2.09
		Max	1.79	2.33	3.41	3.41	3.02	4.56	4.05	15.64	5.35	6.99	1.90	2.72
		Avg	1.55	2.21	3.19	3.25	2.91	4.22	3.64	14.11	5.19	6.80	1.73	2.43
Linseed meal (solvent)	2	Min	2.72	1.77	5.35	2.98	5.69	2.63	1.47	4.66	3.21	3.86	1.94	1.79
		Max	2.84	1.99	5.40	3.17	5.97	2.68	1.58	5.08	3.28	3.97	1.95	2.16
		Avg	2.78	1.88	5.38	3.07	5.83	2.66	1.53	4.87	3.24	3.91	1.95	1.97
Soybean meal (solvent)	6	Min	4.93	2.54	5.32	3.78	4.39	3.53	3.11	7.84	3.65	5.08	1.57	1.39
		Max	5.64	2.70	6.44	4.40	4.64	4.41	4.06	8.69	4.10	5.78	1.78	1.62
		Avg	5.41	2.64	5.94	4.00	4.52	3.97	3.60	8.16	3.90	5.42	1.67	1.51
Soybean meal (solvent, chem. treated)	2	Min	4.85	2.56	6.11	3.48	3.97	3.35	3.22	7.32	3.58	5.01	1.47	1.32
		Max	5.26	2.70	6.52	3.65	4.14	3.62	3.49	7.51	3.91	5.17	1.54	1.42
		Avg	5.05	2.63	6.32	3.57	4.05	3.49	3.35	7.42	3.75	5.09	1.50	1.37
Sunflower meal (solvent)	2	Min	2.90	1.71	5.20	3.56	5.53	4.02	2.83	6.39	2.30	4.54	1.84	2.63
		Max	3.02	1.97	5.37	3.71	5.60	4.23	3.25	6.96	2.57	4.76	2.19	3.18
		Avg	2.96	1.84	5.29	3.63	5.56	4.13	3.04	6.67	2.44	4.65	2.02	2.90

**Table 2. Amino Acids in Rumen Escape Protein of Non-Plant Source Protein Meals (% CP)**

Feedstuff	#		Lys	His	Arg	Thr	Gly	Val	Ile	Leu	Tyr	Phe	Cys	Met
Blood meal (ring dried)	4	Min	7.17	5.81	3.86	3.29	4.17	4.31	1.03	9.86	3.08	6.65	1.32	0.84
		Max	8.17	6.29	5.22	4.25	4.54	6.24	2.24	11.30	3.36	6.78	1.67	1.28
		Avg	7.70	6.00	4.64	3.84	4.34	5.54	1.62	10.60	3.17	6.70	1.49	1.07
Feather meal	2	Min	1.74	0.65	5.99	3.76	6.03	4.30	3.06	6.55	3.04	4.78	3.95	0.75
		Max	2.04	0.66	6.75	4.18	6.59	5.46	3.95	7.42	3.11	4.96	4.00	0.76
		Avg	1.89	0.66	6.37	3.97	6.31	4.88	3.51	6.98	3.07	4.87	3.97	0.76
Fish meal	4	Min	5.60	2.16	6.03	3.09	6.15	2.47	1.63	5.69	3.03	3.40	1.11	3.43
		Max	5.99	2.21	6.72	3.44	8.24	2.95	2.41	6.23	4.02	3.88	1.25	4.00
		Avg	5.78	2.20	6.34	3.26	7.09	2.64	2.03	5.95	3.44	3.66	1.17	3.66
Meat meal	4	Min	5.22	1.75	6.56	3.10	10.18	3.65	2.36	6.92	2.46	3.87	0.91	1.37
		Max	6.28	2.64	7.44	4.70	13.78	4.90	2.98	8.10	3.39	5.00	1.07	2.38
		Avg	5.86	2.11	6.84	3.71	11.89	4.42	2.75	7.37	2.85	4.40	0.97	1.69