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Calf Note #240 – Amino acids for young calves, Part 3. Amino acids in calf starters

Introduction

This is part 3 of my series on amino acid nutrition for young calves. I've summarized the essential amino acid (**EAA**) concentrations of feed ingredients commonly used in calf starters. These EAA form the basis for the ruminally undegraded protein (RUP) fraction that reaches the intestine after rumen function becomes mature. Early in life when there is a limited amount of ruminal fermentation, proteins in starter ingredients will not be extensively fermented, so the EAA composition of these ingredients makes up a greater proportion of the EAA reaching the abomasum compared to EAA from microbial protein.

EAA Variation within Ingredients

Tables 1-6 contain EAA profile from six ingredients commonly used in calf starters and growers. Within each ingredient, the variation among EAA is generally small as indicated by the standard deviation (SD) from the average (Avg). In most cases, the greatest variation occurs among different authors – for example, the Histidine concentration in soybean meal is consistently 2.6% to 2.8% of total CP, except for means reported by Kudelka et al. (2021), who reported an average of 3.5% of CP in their samples. This is most likely due to differences in laboratory methods used in preparation and analysis of samples. Measuring amino acid composition in feed samples is a complex process and differences in methodology may affect the results reported by researchers.

EAA Variation among Ingredients

Figure 1 shows the variation among feed ingredients. Here we see greater differences. For example the concentration of lysine is sunflower meal and distillers grains are only about 50% of the concentration in soybean meal or canola meals. Thus, a 1:1 replacement of the protein from soy to sunflower will result in a marked reduction in the amount of lysine coming from the RUP fraction. Wheat midds are a common feed ingredient used in calf starers and the valine concentration in midds is very low; there are few studies that have evaluated the effects of low valine on calf performance, so the influence of high midds starter formulations is unclear.

Summary

The EAA composition of calf starter ingredients, which relatively consistent within feed ingredient, can vary markedly among ingredients used in calf starters and growers. Thus, changes in starter formulations will result in significant changes in EAA supply from the RUP fraction. We'll use these EAA concentrations in calculations of EAA supply to the intestine of calves in future Calf Notes.

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Item	Soy grain	Soy grain2	US SBM	Arg SBM	Brazil SBM	ARG SBM2	BRAZIL SBM2	India SBM	China SBM	Dehull SBM	FF SBM	Soy grain3	SPC	SPI	Avg	SD
Author	Kudelka	Kudelka	USSEC	USSEC	USSEC	USSEC	USSEC	USSEC	USSEC	Crom	Crom	Crom	Crom	Crom		
CP	33.0%	35.3%	47.8%	47.2%	48.8%	44.7%	46.7%	46.6%	44.2%	43.9%	47.7%	37.6%	64.0%	85.8%	48.10%	
Arginine			7.2%	7.3%	7.1%	7.3%	7.4%	7.2%	7.6%	7.2%	7.2%	6.9%	9.0%	8.0%	7.47%	0.55%
Histidine	3.5%	3.5%	2.6%	2.6%	2.7%	2.8%	2.7%	2.7%	2.6%	2.9%	2.7%	2.6%	2.8%	2.6%	2.80%	0.29%
Isoleucine	5.0%	5.2%	4.4%	4.5%	4.3%	4.5%	4.6%	4.4%	4.5%	4.5%	4.5%	4.3%	5.2%	5.0%	4.62%	0.31%
Leucine	8.4%	8.6%	7.5%	7.7%	7.5%	7.7%	7.6%	7.6%	7.6%	7.8%	7.6%	7.3%	8.3%	7.5%	7.76%	0.37%
Lysine	6.9%	7.1%	6.3%	6.1%	6.0%	6.1%	6.1%	6.0%	6.1%	6.3%	6.2%	5.9%	6.6%	6.1%	6.26%	0.36%
Methionine	1.9%	0.0%	1.4%	1.4%	1.3%	1.3%	1.3%	1.3%	1.3%	1.4%	1.4%	1.4%	1.4%	1.2%	1.28%	0.39%
Phenylalanine	5.5%	5.8%	4.9%	5.1%	4.9%	5.1%	5.2%	5.0%	5.0%	5.1%	5.0%	4.9%	5.3%	5.1%	5.15%	0.26%
Threonine	4.0%	4.2%	3.9%	3.8%	3.8%	3.9%	3.8%	3.9%	3.9%	4.0%	3.9%	3.8%	4.4%	3.7%	3.92%	0.17%
Valine	5.1%	5.2%	4.7%	4.9%	4.5%	4.7%	4.8%	4.7%	4.7%	4.4%	4.8%	4.5%	5.3%	4.9%	4.81%	0.26%

Table 1. Essential amino acids in soybean meals from selected references.

		High temp	Low Temp							
Item	Hi Pro CM	CM	CM	Conv. CM	CM	Toast CM	NT CM	CM2	Avg	SD
Author	Stein	Stein	Stein	Stein	Canola	Newkirk	Newkirl	Alashi		
CP, %	44.7%	36.0%	37.0%	34.2%	36%	39.5%	38.8%	36.0%	37.8%	3.1%
Arg	5.6%	5.7%	5.8%	5.5%	6.1%	5.9%	6.7%	5.8%	5.9%	0.4%
His	2.5%	2.6%	2.6%	2.5%	3.0%	3.1%	3.1%	2.7%	2.8%	0.2%
Ile	3.8%	4.1%	4.1%	3.9%	3.8%	4.4%	4.4%	4.0%	4.1%	0.2%
Leu	6.6%	6.8%	6.9%	6.7%	6.6%	7.1%	7.1%	7.0%	6.8%	0.2%
Lys	5.4%	5.6%	5.7%	5.3%	5.7%	5.9%	5.6%	5.8%	5.6%	0.2%
Met	1.9%	1.9%	1.9%	2.0%	1.9%	1.9%	2.1%	1.9%	1.9%	0.1%
Phe	3.7%	3.8%	3.9%	3.8%	3.7%	3.9%	3.9%	3.8%	3.8%	0.1%
Thr	3.8%	3.9%	4.0%	4.2%	4.0%	4.4%	4.4%	4.5%	4.1%	0.2%
Val	4.9%	5.1%	5.2%	5.0%	4.5%	5.5%	5.5%	5.0%	5.1%	0.3%

Table 2. Essential amino acids in canola meals from selected references.

Item	Feedipedia	Shing	Shing2	Tom	Tom3	Rosa	Rosa4	Liu	Avg	SD
CP, %	32.4%	37.8%	37.2%	33.0%	40.0%	36.2%	32.1%	33.5%	35.3%	2.7%
Arg	8.1%	5.9%	5.6%	5.1%	4.8%	5.9%	6.7%	7.8%	6.2%	1.1%
His	2.4%	1.6%	1.5%	2.8%	2.1%	1.8%	2.0%	2.8%	2.1%	0.5%
Ile	4.1%	3.1%	3.3%	5.5%	5.1%	3.1%	3.5%	4.0%	4.0%	0.8%
Leu	6.2%	5.1%	4.8%	8.0%	7.7%	4.6%	5.1%	6.2%	6.0%	1.2%
Lys	3.5%	2.6%	2.7%	2.5%	2.9%	3.3%	3.7%	4.4%	3.2%	0.6%
Met	2.3%	1.6%	1.2%	5.3%	5.1%	1.6%	1.8%	2.2%	2.6%	1.5%
Phe	4.4%	4.1%	4.5%	5.5%	5.1%	3.5%	4.0%	4.1%	4.4%	0.6%
Thr	3.6%	3.1%	1.5%	4.1%	4.3%	2.7%	3.0%	3.7%	3.2%	0.8%
Val	4.9%	3.8%	3.7%	7.0%	6.1%	3.6%	4.1%	5.3%	4.8%	1.2%

Table 3. Essential amino acids in sunflower meals from selected references.

Item	Lim	Lim2	Park	Mjoun	Mjoun3	Widy	Anony	Han	Avg	SD
CP, %	29.2%	29.4%	28.0%	30.8%	34.0%	30.3%	30.0%	29.5%	30.1%	1.7%
Arg	4.1%	3.7%	4.6%	4.7%	4.7%	4.4%	4.1%	4.5%	4.3%	0.3%
His	2.3%	2.2%	2.6%	3.0%	3.1%	2.7%	2.5%	3.4%	2.7%	0.4%
Ile	3.7%	3.4%	4.1%	4.0%	4.3%	3.8%	3.6%	3.1%	3.8%	0.4%
Leu	10.4%	9.6%	11.0%	11.7%	12.5%	11.6%	10.7%	11.6%	11.1%	0.8%
Lys	3.0%	3.3%	3.1%	3.5%	3.2%	2.7%	3.0%	3.7%	3.2%	0.3%
Met	1.9%	1.7%	1.9%	2.0%	2.0%	2.0%	1.7%	2.6%	2.0%	0.3%
Phe	4.4%	2.2%	4.9%	4.5%	4.7%	5.0%	4.3%	4.7%	4.3%	0.8%
Thr	3.4%	1.1%	3.8%	3.8%	3.8%	3.6%	3.4%	4.0%	3.4%	0.9%
Val	4.9%	4.4%	5.1%	5.3%	5.3%	5.0%	4.7%	5.0%	5.0%	0.3%

Table 4. Essential amino acids in distillers grains with solubles from selected references.

Item	Stein	Stein2	Stein3	Stein4	Stein5	Stein6	Stein7	Stein8	Avg	SD
CP, %	17.8%	18.4%	17.2%	18.8%	18.1%	17.0%	17.1%	18.0%	17.8%	0.6%
Arg	6.0%	6.2%	6.4%	5.9%	6.1%	6.2%	6.1%	6.0%	6.1%	0.1%
His	2.5%	2.4%	2.6%	2.4%	2.4%	2.6%	2.6%	2.5%	2.5%	0.1%
Ile	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%	3.2%	3.1%	0.1%
Leu	6.0%	5.9%	6.0%	5.7%	5.7%	6.2%	6.3%	6.0%	6.0%	0.2%
Lys	3.9%	4.0%	4.0%	3.8%	4.0%	4.4%	4.3%	3.9%	4.0%	0.2%
Met	1.5%	1.3%	1.5%	1.3%	1.4%	1.4%	1.3%	1.4%	1.4%	0.1%
Phe	3.8%	3.6%	3.8%	3.6%	3.6%	3.8%	3.9%	3.8%	3.7%	0.1%
Thr	3.0%	2.9%	3.0%	2.9%	2.9%	3.1%	3.1%	3.0%	3.0%	0.1%
Val	1.1%	0.8%	0.9%	0.8%	0.9%	0.8%	0.8%	0.9%	0.9%	0.1%

Table 5. Essential amino acids in wheat midds from Stein et al. (2008).

Item	Barb	Feed	Jack	Jack2	Chee	NASEM	Avg	SD
CP, %	12.3%	12.8%	17.5%	13.3%	11.1%	11.9%	13.1%	2.1%
Arg	5.3%	4.9%	5.4%	5.7%	6.8%	5.2%	5.5%	0.6%
His	2.5%	2.5%	2.6%	2.8%	2.3%	2.6%	2.5%	0.1%
Ile	3.9%	3.6%	4.1%	4.3%	2.6%	3.7%	3.7%	0.5%
Leu	6.7%	6.2%	6.8%	7.2%	4.5%	6.3%	6.3%	0.9%
Lys	7.0%	6.4%	6.7%	7.4%	6.0%	6.3%	6.6%	0.5%
Met	1.3%	1.2%	1.2%	1.4%	1.6%	1.1%	1.3%	0.2%
Phe	4.4%	3.8%	4.1%	4.2%	1.5%	3.9%	3.6%	1.0%
Thr	3.9%	3.6%	3.5%	3.9%	3.5%	3.6%	3.7%	0.2%
Val	4.5%	4.2%	4.6%	4.8%	4.1%	4.4%	4.4%	0.3%

Table 6. Essential amino acids in soybean hulls from selected references.

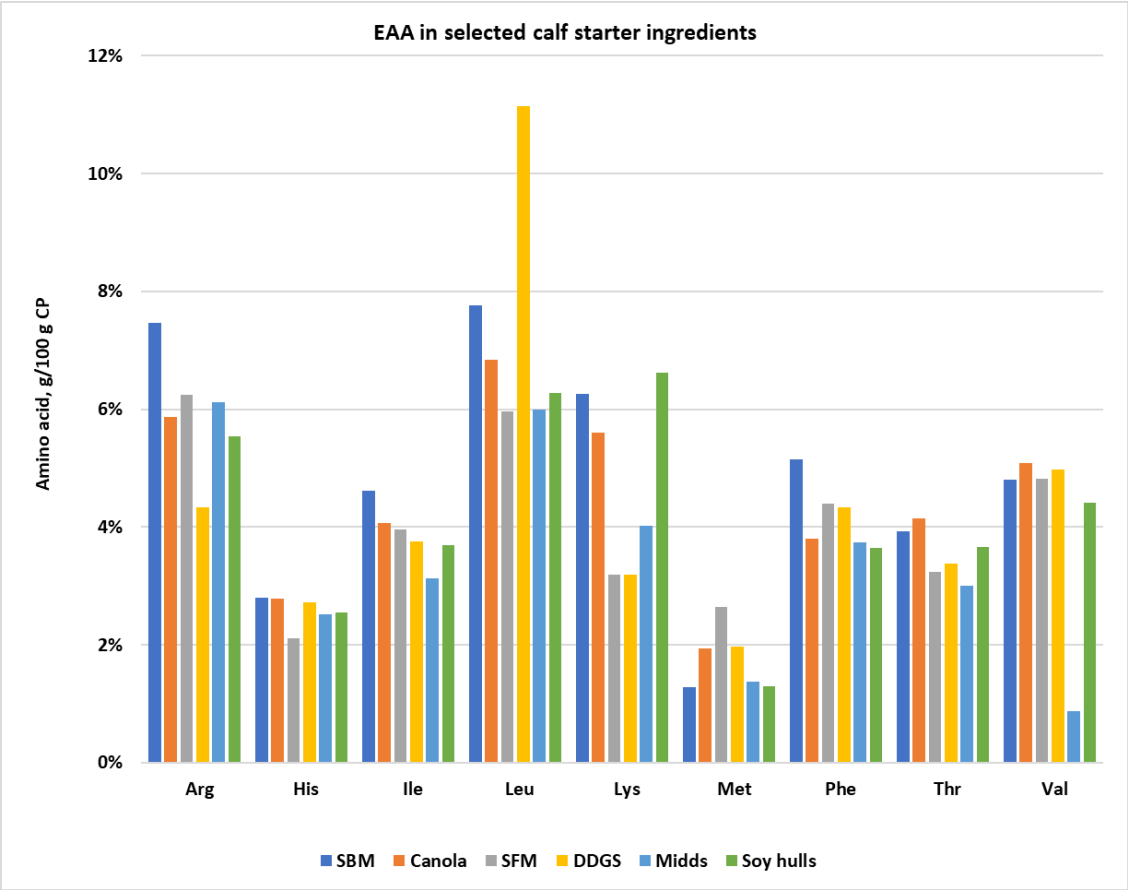

Figure 1. Essential amino acids in feed ingredients.