

Comparison of ileal endogenous amino acid measurements in growing broilers fed an N-free diet or a diet containing a source of highly digestible protein

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Introduction

Measuring basal endogenous AA secretions at the terminal ileum often involves feeding diets that are effectively protein-free. There are several well documented criticisms of this technique summarized in Moughan et al. (2000). A central criticism is that catabolic state induced by such diets alters gut metabolism and therefore endogenous secretions. Further, the behavior and physical appearance of birds fed N-free diets suggests potential welfare concerns that could bring this technique under increased scrutiny by institutional research ethics committees.

An alternative to feeding N-free diets might be instead to include a single source of highly digestible protein that could be assumed to be 100% digestible. Any AA recovered at the terminal ileum therefore could be assumed to be of endogenous origin

The objective of this experiment therefore was to compare the flow and composition of basal endogenous AA (EAA) flow at the terminal ileum in was compared between 21-d old broilers fed an N-free (NF) diet or a diet that included enzymatically hydrolyzed casein (EHC) as a source of highly digestible protein (HDP).

Methods and Materials

Broiler chicks (Ross 308; n=156) were distributed among 12 cages on the day of hatch and fed a commercial starter diet to 14 d of age. From d 14 to 21, birds were fed 1 of 2 test diets containing 0.5% chromic oxide (Table 1) in a RCB design with 6 replicate cages per treatment.

Table 1. Ingredient composition of test diets.

Ingredient	NF diet	EHC diet
Corn starch	76.47	56.47
Enzymatically hydrolyzed casein	---	20.00
Dextrose	8.00	8.00
Canola oil	5.00	5.00
Cellulose	3.00	3.00
Dicalcium phosphate	2.20	2.20
Potassium carbonate	1.73	1.73
Limestone	1.60	1.60
Vitamin Mineral premix	0.50	0.50
Choline chloride premix	0.50	0.50
Chromic oxide	0.50	0.50
Salt	0.50	0.50

On d 21, birds were euthanized and ileal digesta collected to produce a pooled

specimen for each test cage. Flow and composition of EAA were calculated for each diet using the equation below (Ravindran et al., 2004):

$$\text{AA flow (mg/kg DM intake)} = \text{AA concentration in ileal digesta (mg/kg)} \times \left(\frac{\text{diet Cr (mg/kg)}}{\text{ileal Cr (mg/kg)}} \right)$$

Data were analyzed using the MIXED procedure of SAS with diet (NF, EHC) as a fixed effect and block as a random term.

Results

There was no difference in ADFI between NF and EHC diets ($P > 0.31$), however birds fed the NF diet lost 1.2 g/d compared to an ADG of 29.2 g/d for birds fed the EHC diet ($P < 0.01$, Table 2).

Table 2. Ileal endogenous amino acid flow (mg/kg of DM intake) resulting from feeding an N-free diet compared to a diet containing enzymatically hydrolyzed casein as the sole source of protein to 21-d-old broilers.

	NF diet	EHC Diet	SEM	P - value
ADFI, g/bird/d	71.1	73.3	1.7	0.308
ADG, g/bird/d	-1.2	29.2	1.7	< 0.001
Arginine	258	526	36	0.003
Histidine	148	407	24	< 0.001
Isoleucine	292	959	40	< 0.001
Leucine	437	1089	67	< 0.001
Lysine	303	1165	31	< 0.001
Methionine	75	216	15	< 0.001
Phenylalanine	255	547	42	0.003
Threonine	448	1065	38	< 0.001
Tryptophan	53	145	10	< 0.001
Valine	352	1149	46	< 0.001
Total AA	6435	17908	698	< 0.001

Flow of EAA (mg of AA/kg of DM intake) resulting from the EHC diet was 1.2 to 2.9 times greater (PHE and LYS, respectively) compared to that resulting from the NF diet for all essential AA ($P < 0.01$).

Amino acids made up a greater proportion of CP in digesta (in g AA/kg ileal CP) resulting from the EHC compared to NF diet (Table 3). Except for ARG, PHE and THR, for which there was no difference between treatments ($P > 0.33$), the proportion of all other essential AA in digesta as a proportion of CP was higher in EHC than NF ($P < 0.01$).

Table 3. Effect of feeding a N-free diet or a diet containing enzymatically hydrolyzed casein as the only source of protein on composition of amino acid flow at the terminal ileum (g/kg of CP) in 21-d old broilers.

	NF diet	EHC diet	SEM	P - value
Arginine	27.6	25.5	1.2	0.263
Histidine	15.8	19.7	0.7	0.008
Isoleucine	31.5	47.0	2	0.003
Leucine	46.9	52.6	1.3	0.004
Lysine	32.6	57.3	2.3	< 0.001
Methionine	8.0	10.4	0.4	< 0.001
Phenylalanine	27.2	26.3	1	0.512
Threonine	49.2	52.1	1.9	0.335
Tryptophan	5.9	7.0	0.5	0.002
Valine	38.2	55.9	1.4	< 0.001
Total AA	696.8	873.2	19.7	< 0.001

Conclusions

The present study indicates that using diets containing EHC will result in both higher flow of EAA (mg/kg of DM intake) and a higher content of AA in digesta (g AA/kg ileal CP) compared to an NF diet. Calculated SID AA content of feeds therefore could be expected to be higher when EAA flow at the terminal ileum is determined with diets containing HDP sources compared to NF diets.

References

- Hodgkinson, S. M., P. J. Moughan. 2000. Amino acids - The collection of ileal digesta and characterization of the endogenous component. *Pp. 105 - 124* in P.J. Moughan, M.W.A. Verstegen and M.I. Visser-Reyneveld (Eds.) *Feed Evaluation - Principles and Practice*. Wageningen Pers, Wageningen, The Netherlands.
- Ravindran, V., L.I. Hew, G. Ravindran and W.L. Bryden. 2004. Endogenous amino acid flow in the avian ileum: quantification using three techniques. *Brit. J. Nutr.* 92: 217-223

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