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Short communication

Relative bioavailability of DL-methionine compared with L-methionine fed to nursery pigs

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ABSTRACT

The objective of the present study was to estimate the bioavailability of DL-methionine (Met) relative to L-Met for nursery pigs using the slope-ratio assay. A total of 35 crossbred barrows with an initial body weight of 13.4 kg (standard deviation = 0.5) were randomly allotted to 5 dietary treatments in 7 replicates for a nitrogen (N) balance study. The basal diet (BD) was formulated to contain 2.1 g/kg Met. Dietary treatments included (1) BD, (2) BD + 0.3 g/kg DL-Met, (3) BD + 0.6 g/kg DL-Met, (4) BD + 0.3 g/kg L-Met, and (5) BD + 0.6 g/kg L-Met. The experiment consisted of a 5-day adaptation period and 5 days of total but separate collection of feces and urine. The amounts of feed consumed by pigs were similar across treatments. A linear decrease was observed for the urinary N output with increasing concentration of DL- or L-Met ($P < 0.001$) and consequent linear increase in retained N was observed for both Met sources ($P < 0.001$). In addition, N retention (% of intake) also linearly increased ($P < 0.001$) as the concentration of both Met isomers increased. With the slope-ratio assay using retained N or retention of N (% of intake) as dependent variables and supplemental intake of Met isomers as independent variable, the estimates of relative bioavailability of DL-Met compared to L-Met were 87.9 or 89.3%, respectively. However, the differences in the bioavailability between 2 Met isomers were not significant. In conclusion, with the slope-ratio assay using N balance as the response, we did not find the difference between DL- and L-Met in bioefficacy.

1. Introduction

Methionine (Met) is one of the important indispensable amino acids (AA) for protein synthesis of pigs (Courtney-Martin et al., 2012) and is generally second or third limiting AA in a practical corn-soybean meal swine starter diet. To improve growth of pigs, Met is often supplemented as DL-Met which is a racemic mixture of D- and L-Met (Hoehler et al., 2005). Because only L-Met can be incorporated into naturally occurring proteins, D-Met must be converted to L-Met prior to protein synthesis in pigs. This conversion requires two-step enzymatic process which includes oxidative deamination followed by transamination and the rate-limiting enzyme of this process is D-AA oxidase (Dibner and Knight, 1984; Chung and Baker, 1992). Thus, the possibility that there may be difference in the bioefficacy between D- and L-Met for pigs has been suggested. Several research have been conducted to compare the bioefficacy of 2 Met isomers for pigs (Reifsnyder et al., 1984; Chung and Baker, 1992; Shen et al., 2014) but the results have been controversial when the growth rates and feed conversion

Abbreviations: AA, amino acid; BD, basal diet; BW, body weight; Met, methionine; N, nitrogen.

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Table 1
Ingredient and nutrient composition of experimental diets, as-fed basis[a].

Item	BD	Supplemental DL-Met, g/kg		Supplemental L-Met, g/kg	
		0.3	0.6	0.3	0.6
Ingredient composition, g/kg					
Ground corn	708.4	708.4	708.4	708.4	708.4
Soybean meal	40.0	40.0	40.0	40.0	40.0
Dried whey	100.0	100.0	100.0	100.0	100.0
Spray dried animal plasma	70.0	70.0	70.0	70.0	70.0
Cornstarch	30.0	29.7	29.4	29.7	29.4
Soybean oil	20.0	20.0	20.0	20.0	20.0
DL-Met	–	0.3	0.6	–	–
L-Met	–	–	–	0.3	0.6
L-Lys·HCl	4.0	4.0	4.0	4.0	4.0
L-Thr	0.7	0.7	0.7	0.7	0.7
L-Trp	0.4	0.4	0.4	0.4	0.4
L-Ile	1.0	1.0	1.0	1.0	1.0
Dicalcium phosphate	8.0	8.0	8.0	8.0	8.0
Ground limestone	10.5	10.5	10.5	10.5	10.5
Salt	2.0	2.0	2.0	2.0	2.0
Vitamin-mineral premix[b]	5.0	5.0	5.0	5.0	5.0
Calculated nutrient composition					
Metabolizable energy, kcal/kg	3438	3437	3436	3437	3436
Crude protein, g/kg	149.8	150.0	150.2	150.0	150.2
Ether extract, g/kg	51.2	51.2	51.2	51.2	51.2
Calcium, g/kg	7.2	7.2	7.2	7.2	7.2
Available phosphorus, g/kg	3.4	3.4	3.4	3.4	3.4

[a] BD = basal diet; Met = methionine; Lys = lysine; Thr = threonine; Trp = tryptophan; Ile = isoleucine.
[b] Provided the following quantities per kg of complete diet: vitamin A, 25,000 IU; vitamin D_3, 4000 IU; vitamin E, 50 IU; vitamin K, 5.0 mg; thiamin, 4.9 mg; riboflavin, 10.0 mg; pyridoxine, 4.9 mg; vitamin B_{12}, 0.06 mg; pantothenic acid, 37.5 mg; folic acid, 1.10 mg; niacin, 62 mg; biotin, 0.06 mg; Cu, 25 mg as copper sulfate; Fe, 268 mg as iron sulfate; I, 5.0 mg as potassium iodate; Mn, 125 mg as manganese sulfate; Se, 0.38 mg as sodium selenite; Zn, 313 mg as zinc oxide; butylated hydroxytoluene, 50 mg.

efficiencies in pigs were used as responses. Nitrogen (N) balance has been used as the classical metabolic indicator of protein metabolism (Haymond, 1999) and may provide more sensitive and straightforward responses for protein metabolism than growth performance. However, to the author's knowledge, there are no reports in the literature on the bioavailability of Met isomers for pigs using N balance as response criteria. Therefore, the objective of the present study was to determine the relative bioavailability of DL-Met compared to L-Met in nursery pigs using the slope-ratio assay with N balance as response criteria.

2. Materials and methods

All protocols for the experiment were reviewed and approved by the Institutional Animal Care and Use Committee of Konkuk University.

2.1. Animals and experimental design

Thirty five crossbred barrows with an initial body weight (BW) of 13.4 kg (standard deviation = 1.1) were used to investigate the relative bioavailability of Met isomers. The pigs were individually placed in metabolism cages, and allotted to 5 dietary treatments with 7 replicates in a randomized complete block design based on initial BW.

2.2. Diets

The five dietary treatments consisted of one basal diet (BD), two reference diets, and two test diets. The BD contained corn, soybean meal, dried whey, spray dried animal plasma, and crystalline AA including L-lysine, L-threonine, L-tryptophan, and L-isoleucine as the N sources (Table 1). The content of nutrients for the BD met or exceeded NRC (1998) requirements for 10–20 kg pigs with the exception of Met, which was 2.1 g/kg. For the two reference diets, the BD was supplemented with 0.3 or 0.6 g/kg of L-Met at the expense of cornstarch, and the same concentrations of DL-Met were added to the basal diet for the two test diets.

The daily amount of feed allowance was calculated as 3.5% of the initial BW of pigs in same replicate and an equal amount of feed was provided at 0900 and 1700 h. After each meal, water was added to the metabolism cage feeder to allow ad libitum access to water between meals.