Statistical Methods to Compare the Efficacy of Methionine Sources in Broilers

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Application This study recommends statistical methods to determine the bio-efficacy of methionine sources in commercial broiler feeds.

Introduction Methionine (Met) is available under different forms: DL-Methionine (DL-Met), L-Methionine (L-Met) and DL-Hydroxy-Methionine (OH-Met). For decades, there has been debate regarding the efficacy but only few studies emphasized on methodological aspects of this comparison (e.g. Vazquez-Anon et al. 2006; Kratzer and Littell 2006). This work aims to determine the appropriate statistical method to compare the efficacy of Met sources.

Materials and methods Two experiments were performed using male Ross PM3 broiler chickens that were reared for 36 days, divided into three feeding phases: 0-10 d, 11-24 d and 25-35 d. Experimental treatments consisted of a basal deficient diet in sulfur amino acids and diets supplemented at three equimolar doses with either L-Met or DL-Met (Trial 1) and L-Met or OH-Met (Trial 2). Body weight gain from each feeding phase in each of the two experiments were fitted to different models: (i) linear plateau, (ii) quadratic plateau and (iii) exponential models. Three explanatory variables were used in each model: the theoretical Met doses, the analyzed Met doses and the analyzed Met intake. The effect of the Met sources was tested on the different parameters of the models. The best models were selected using the Bayesian Information Criteria (BIC).

Results In the two trials, there was no effect of the Met sources on the different parameters for all models, which indicated no difference between the efficacies of the Met sources. The BIC values were similar between statistical models when using the same explanatory variables. However, the lowest BIC were obtained with the models based on Met intake (Table 1). In the starter phase of the second trial, the use of theoretical and analyzed doses did not allow convergence of the models. This was possibly due to the lack of data on the curve, before the maximum performance was reached.

Table 1. Parameters of the best performing models applied on the body weight gain of broilers fed L-Met, DL-Met, or OH-Met

Broiler age	Model	Trial 1: L-Met vs. OH-Met			Trial 2: L-Met vs. DL-Met		
		Theoretical Met	Analyzed Met	Met intake	Theoretical Met	Analyzed Met	Met intake
0-10 d	Exponential plateau	226; 53; 14.7; BIC = 378.3	226; 54; 17.8; BIC = 375.7	-1220; 1502; 3.96; BIC = 351.6	No convergence	No convergence	-7853; 8123; 6.25; BIC = 371.1
11-24 d	Quadratic-plateau	515; 3457; 0.22; BIC = 482.4	515; 4002; 0.19; BIC = 478.6	-183; 318 6.81; BIC = 461.5	521; 3919; 0.18; BIC = 485.1	521; 4314; 0.16; BIC = 484.5	-226; 353; 6.21; BIC = 472.3
25-35 d	Linear-plateau	745; 5040; 0.09; BIC = 492.8	748; 5334; 0.08; BIC = 503.1	264; 140; 6.62; BIC = 492.0	701; 5479; 0.08; BIC = 519.1	701; 5479; 0.08; BIC = 519.1	217; 147; 6.44; BIC = 505.2
25-35 d	Exponential plateau	745; 449; 21.6; BIC = 491.4	746; 447; 23.6; BIC = 494.7	-1532; 2748; 0.51; BIC = 484.1	701; 464; 33; BIC = 519.3	701; 465; 25; BIC = 519.4	-2049; 3233; 0.58; BIC = 507.5

Linear-plateau: $y = ax + b$ if $x < x_0$; $y = y_{max}$ if $x \geq x_0$; Quadratic-plateau: $y = y_0 + ax + bx^2$ if $x < x_0$; $y = y_{max}$ for $x \geq x_0$; Exponential plateau: $y = a + b_1(1-e^{-c_1 x_1}) + b_2(1-e^{-c_2 x_2})$

Conclusion This work demonstrates that if appropriate explanatory variables are used, the choice of statistical models have little impact in estimating the bio-efficacy of methionine sources. The best explanatory variable allowing to compare Met sources is the Met intake. In most of the cases, the best performing model is the exponential model.

References

Kratzer DD, Littell RC, 2006. Poultry Science, 85(5), 947–954.
Vazquez-Anon M, Kratzer D, Gonzalez-Esquerra R, Yi IG, Knight CD. 2006. Poultry Science, 85(4), 693–705.