

Effect of Ractopamine Addition on Performance and Digestibility of Beef Cattle: Meta-analysis and *In Vitro* Studies

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Introduction

This study is a meta-analysis of the effects of ractopamine on feedlot performance and *in vitro* study of the different supplemental ractopamine (RAC) levels on basal ration of fistulated beef cattle. The present study was aimed to determine the optimum supplementation ractopamine and to analyze the effects of ractopamine on the feedlot performance, dry matter digestibility (DMD), organic matter digestibility (OMD), and rumen NH₃ concentration.

Materials and methods

This study consisted of two phases; the first phase is a study of meta-analysis and the second phase is an *in vitro* study. The study of meta-analysis used data extracted from 17 articles related to the level of ractopamine supplementation on feedlot performance, such as average daily gain (ADG), ADG on steers, and ADG on heifers. Meta-analysis of data obtained was analyzed using curve estimation regression models in SPSS version 16.0. The *in vitro* study was conducted in Laboratory of Dairy Nutrition, Faculty of Animal Science, Bogor Agricultural University, Indonesia, from March to April 2015. This study used rumen fluid from three fistulated Peranakan Ongol (PO) steers obtain from LIPI, Cibinong-Bogor, Indonesia. The treatments were various ractopamine levels added to a basal ration with the ratio of concentrate and forage (elephant grass) 90:10 as follow: T0, control (0 ppm RAC); T1, supplemented with 10 ppm RAC; T2, supplemented with 20 ppm RAC; T3, supplemented with 30 ppm RAC; T4, supplemented with 40 ppm RAC. Design of this experiment was a randomized complete block design. Data were analyzed using general linear model by employing SPSS software version 16.0. The different among treatments were tested by Post Hoc Multiple Comparison Test. The observed variables were DMD, OMD, and rumen NH₃ concentration.

Results and discussion

The result of meta-analysis showed the effect of ractopamine on feedlot performance tended to increase average daily gain (ADG) ($P < 0.1$; Table 1). The effects of ractopamine significantly influenced ADG of steers ($P < 0.05$) and heifers ($P < 0.01$). Meta-analysis showed to determine optimum supplementation of ractopamine on ADG feedlot performance using mathematic model $Y = 1475 + 0.613 X$ (Figure 1). To determine supplementation of ractopamine in steers using the mathematic model $Y = 1528 - 1.341 X + 0.01 X^2$ and $Y = 1544 + 5.083 X - 9,672 X^3$ in heifers.

Table 1. Mathematics Modeling to Determine the Supplementation Ractopamine with Meta-analysis Method

Outcomes	Number of studies (n)	Curve Estimation Models	P-value	Mathematic Modeling
Average Daily Gain (g/d)	17	Linier	0.063	$Y = 1475 + 0.613 X$
		Quadratic	0.167	
		Qubic	0.307	
ADG Steers (g/d)	17	Linier	0.022	$Y = 1528 - 1.341 X + 0.01 X^2$
		Quadratic	0.021	
		Qubic	0.052	
ADG Heifers (g/d)	17	Linier	0.590	$Y = 1544 + 5.083 X - 9,672 X^3$
		Quadratic	0.006	
		Qubic	0.006	

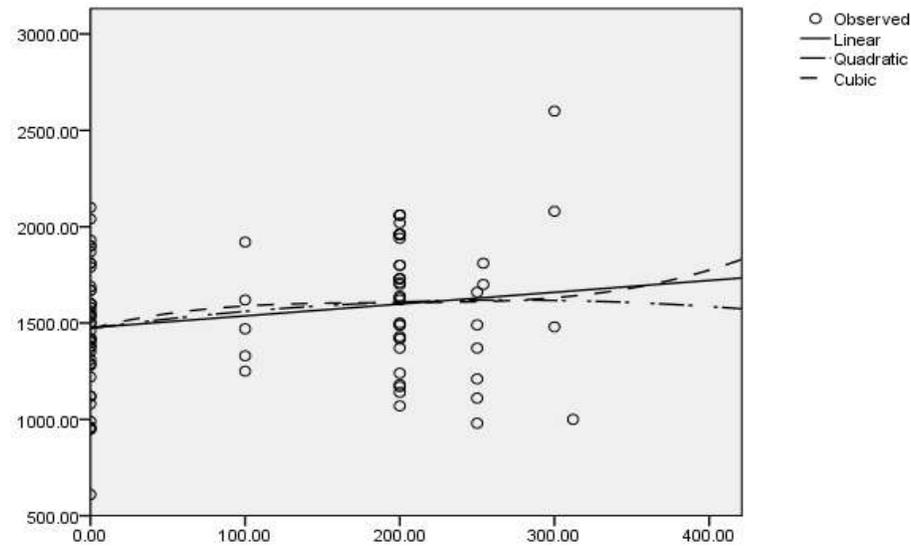


Figure 1. Curve Estimation Regression Models of ADG (g/d), horizontal line is a dose ractopamine supplementation (ppm), vertical line is a average daily gain (ADG) (g/d).

The *in vitro* results showed that supplementation ractopamine in different levels did not cause any influence on dry matter digestibility (DMD) and NH_3 concentration (Table 2). The supplemented ractopamine significantly influenced organic matter digestibility (OMD) ($P < 0.01$). T1 was highest in OMD) while T4 was lowest influence organic matter digestibility (OMD).

Table 2. Effects of Different Supplemented Ractopamine in Digestibility Fistulated Peranakan Ongole (PO) Steers

Observed Variables	Treatment ³					P-value
	T0 0 ppm	T1 10 ppm	T2 20 ppm	T3 30 ppm	T4 40 ppm	
¹ DMD (%)	58.45±1.54	57.97±2.44	61.37±1.23	59.26±3.32	57.86±0.15	0.140
² OMD (%)	54.93±1.84 ^{bc}	59.65±3.48 ^a	57.51±2.39 ^{ab}	59.06±2.93 ^a	54.34±1.57 ^c	0.008
NH_3 (mM)	5.16±1.33	5.79±1.62	5.95±1.86	5.51±3.83	5.77±0.89	0.980

¹DMD : dry matter digestibility, ²OMD : organic matter digestibility, ³Treatment = five rations with ratio of concentrates and forages (elephant grass) 90:10 with supplemented RAC the following : T0 = 0 ppm RAC, T1 = 10 ppm, T2 = 20 ppm, T3 = 30 ppm, T4 = 40 ppm.

Conclusion

The conclusion of this study is that ractopamine addition improves ADG of beef cattle. The response of ADG on heifers and steers is different on ractopamine addition. Apparently ractopamine causes minor influence on digestibility and rumen fermentation.