Ractopamine Effects β-1 and β-2 Adrenergic Receptor Gene Expression in Fat and Muscle Tissue of Boars and Gilts

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Dietary ractopamine (RAC) reduces fat mass due to direct activation of β-adrenergic receptors (βAR) in adipocytes promoting triglyceride hydrolysis and decreasing fatty acid and triglyceride synthesis leading to less lipid accumulation (Mills, 2002). Fat accretion in pigs fed RAC is not consistently reduced (Dunshea, 1993) which may result from irregularities in βAR down-regulation. Dietary RAC consistently improves lean deposition in pigs in the first two weeks of treatment after which response begins to decline, this may be because down-regulation of βAR in skeletal muscle is either not significant or delayed (Mills, 2002). It is not clear whether down regulation of the βAR in fat or muscle tissue is affected by dose of RAC and whether there are notable sex differences. The aim of the experiment was to determine the effect of RAC dose, duration of treatment, or sex effect on βAR gene subtype expression in fat or muscle tissue.

The experiment involved three groups (blocked by time) of 36 pigs in a 2 x 3 factorial design with the factors being sex (boars and gilts) and dose (0, 5 and 20ppm Paylean®, Elanco Animal Health, West Ryde, NSW) for 28 days. All 108 pigs were *ad libitum* fed and kept in individual pens. Muscle (*Gluteus maximus*) and subcutaneous fat biopsies were taken from three separate replicates on d 1, 15 and 29 for each treatment. Using real-time polymerase chain reactions (PCR), the mRNA levels for the transcripts of individual β1 and β2-adrenergic receptor (β1AR and β2AR, respectively) were normalized relative to three multiple reference genes TPB, RPL19 and UCHL5. A linear mixed model was fitted to the data using REML procedure in Genstat (Release 11.1, VSN International Ltd, Hemel Hempstead).

Table 1. *The effect of sex and dietary ractopamine dose (RAC) on β1 and β2 adrenergic receptor (AR) gene expression[1] in fat and muscle tissue as a percentage of controls (0 mg/kg RAC) for d 15 and d 29 samples.*

			Day 15 RAC (mg/kg)			Day 29 RAC (mg/kg)				Probability	
Gene	Tissue	Sex(S)	0	5	20	0	5	20	SED	RAC	Sex
β1AR	Fat	Boar	100.0	75.7	71.4	100.0[a]	64.2[b]	60.9[b]	15.19	0.020	0.554
		Gilt	100.0	76.8	88.4	100.0	84.0	96.9	14.36		
	Muscle	Boar	100.0[a]	228.4[b]	44.6[a]	100.0	100.4	83.3	38.3	0.044	0.429
		Gilt	100.0[a]	225.7[ab]	340.4[b]	100.0[a]	298.5[b]	147.7[a]	58.4		
β2AR	Fat	Boar	100.0	92.9	91.3	100.0	65.2	65.5	17.9	0.418	0.226
		Gilt	100.0	94.7	90.9	100.0[ab]	83.6[a]	118.1[b]	16.2		
	Muscle	Boar	100.0	90.8	69.2	100.0	120.8	78.4	16.8	0.069	0.050
		Gilt	100.0	97.1	71.2	100.0[a]	78.8[a]	68.5[b]	15.9		

[1]β1 and β2 adrenergic receptor expression has been normalized to UHCL5, RPL19 and TBP. [ab]Means with different superscripts within each row and day differ significantly (P<0.05); SED, standard error of difference

Significant down regulation of the β1AR gene in fat tissue of boars fed RAC was observed at d 29. The β2AR expression was not affected by RAC (P>0.05) indicating that lipolysis may be mediated through both β1AR and β2AR. In muscle tissue, β1AR expression was increased by 5 mg/kg RAC at d 15 for both sexes and remained elevated in gilts at d 29. Gilts fed 20 mg/kg RAC had increased β1AR expression at d 15 and reduced β2AR expression at d 29. These results suggest that in muscle, dietary RAC stimulates β1AR activity in both sexes and the reduced response to lean gain maybe controlled by β2AR down regulation particularly at the 20 mg/kg dose.

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