SHORT-TERM MEASUREMENT OF OXYGEN CONSUMPTION IN THE PIG

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Whilst food intake of growing pigs is reduced at high temperature, the changes in energy expenditure are unclear. Estimates of energy expenditure have previously been made using respiration chambers. This method is unsuitable for monitoring short-term changes in oxygen consumption because of the large volume of air in the chamber. An alternative procedure based on the measurement of cardiac output and the difference in oxygen concentration in the blood leaving and re-entering the lungs (Fick principle) has been developed (Giles et al. 1989). Estimates obtained from this procedure correspond directly to changes in energy expenditure and have been compared with estimates of oxygen consumption using a head box.

Three female pigs (average liveweight, 60 kg) were trained to accept a head box with the air flow adjusted to maintain constant temperature, carbon dioxide and humidity within the box. The pigs were surgically prepared for the measurement of O_2 consumption by the Fick technique. After a recovery period (2 weeks), the O_2 consumption of each pig was measured simultaneously using the head box and Fick technique. The air flow was measured with a gas meter, and the oxygen content of air withdrawn from the head box monitored at 30 sec intervals with an oxygen analyser (Beckman Instruments Inc., USA) over a 2 h period. During this period cardiac output was continuously recorded using transit-time ultrasound (Transonic Systems Inc., Cornell, New York) at 30 sec intervals and changes in arteriovenous (AV) O_2 across the lungs were measured every 30 minutes.

Mean values for O_2 consumption yielded by the head box (378 ml/min) and the Fick procedure (393 ml/min) over the same 2 h periods were not significantly different, as shown below.

Pig		1	2	3	Mean	SEM
Head Box	Air flow rate (l/min)	93.2	92. 2	91. 6	92.3	0.47
	O_2 % (air-head box)	0.46	0.41	0.35	0.41	0.03
	O_2 consumption (ml/min)	428	378	321	378	30.9
Fick	Cardiac output (l/min)	8.80	7.15	6.32	7.42	0.73
	AV O_2 (ml/100 ml blood)	5.27	5.35	5.26	5.29	0.03
	O_2 consumption (ml/min)	464	383	333	393	38.4

Limitations of the head box, apart from the need to use trained animals, include the difficulty of matching conditions within the box to those of the environment at temperatures above thermoneutral. The Fick technique offers an alternative method for the long-term measurement of energy expenditure in high temperature studies with growing pigs.

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