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O48 Validating the oxygen pulse – Heart rate method: Effect of animal activity and air temperature on the oxygen pulse of lactating Holstein cows

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Keywords: Dairy cattle; Climate respiration chambers; Indirect calorimetry

Introduction

The oxygen pulse and heart rate technique (O_2P-HR) is an alternative method for measuring heat production (HP) which consists of long-term animal heart rate (HR) measurements (24-h period or longer) and short-term measurements (20 min) of oxygen pulse (O_2P (μL of O_2/kg$^{0.75}$ per heartbeat); Brosh, 2007). Subsequently, the long-term O_2 consumption (VO_2) is calculated by multiplying the O_2P with the recorded HR. It is assumed that the variation of HR is the major component of the cardiovascular system response to an increase in the O_2 demand, and that O_2P is stable along the day. Thus, the aim of this work was to evaluate and quantify the effect of air temperature and animal posture and activity on the O_2P.

Material and Methods

Twelve Holstein lactating cows housed inside climate-controlled respiration chambers (Wageningen University and Research, the Netherlands) for 8 days where air temperature was gradually increased from 7 to 23 °C during the night (2100 to –0500 h) and from 16 to 32 °C during the day (0500 to –2100 h) with daily increments of 2 °C for both daytime and nighttime were used. During the 8 days data collection period, HR (BIOHarness 3.0, Zephyr Technology Corporation, USA) and VO_2 (ABB Advance Optima AO2000 systems, ABB, Germany) measurements were performed, and animal posture and activity (RumiWatchSystem, ITIN+HOCH, Switzerland) were recorded continuously. The VO_2 and HR were averaged every 38 min and animal posture and activity were expressed as the proportion of this time that the

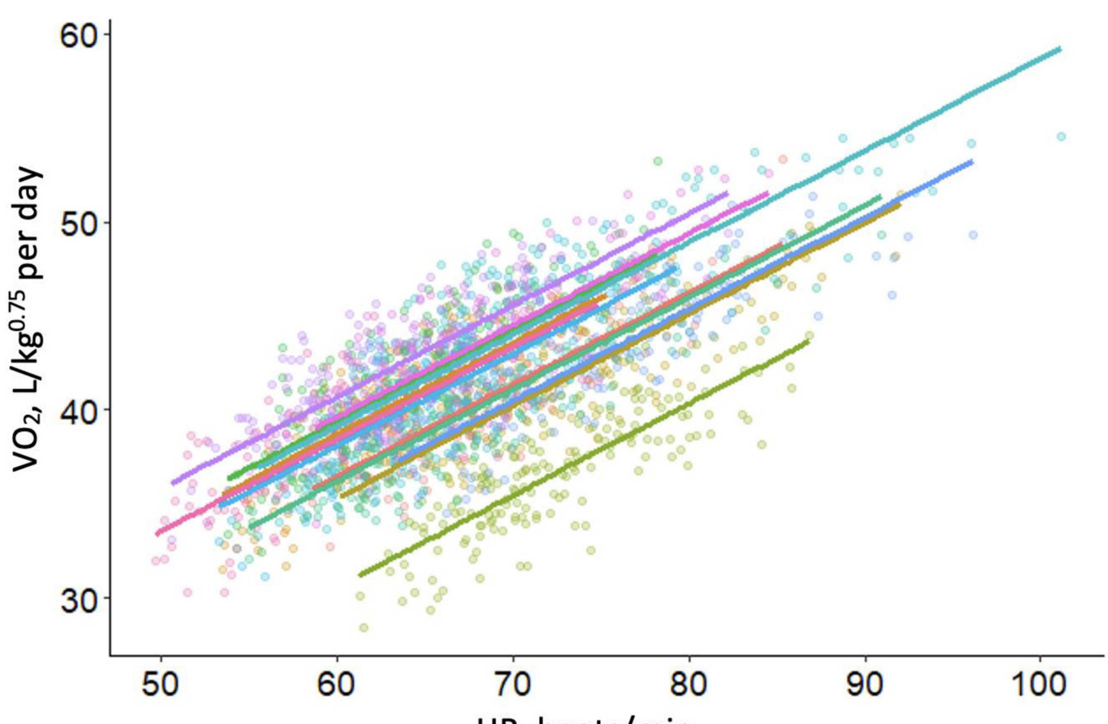

Figure 1. Relationship between heart rate (HR) and oxygen consumption (VO2). Different colors represent different cows (n = 12). Dots represent observed values (n = 1906) while solid lines represent predicted values of the model. VO2 (L/kg$^{0.75}$ per day) = (8.06 ± 0.95) + (0.49 ± 0.008) × HR (beats/min); R^2 = 0.75.

Table 1
Differences in heart rate (HR), oxygen consumption (VO_2) and oxygen pulse (O_2P) for eating vs idling, ruminating vs idling, standing vs lying down based on mixed-effect regression models (mean ± SEM).

Item	Activities			*P*-value		
	Eating *vs* idling	Ruminating *vs* idling	Standing *vs* lying down	Eating *vs* idling	Ruminating *vs* idling	Standing *vs* lying down
HR, beats/min	16.4 ± 0.8	1.1 ± 0.5	4.0 ± 0.4	<0.01	0.02	<0.01
VO_2, L/kg$^{0.75}$ per day	8.72 ± 0.49	2.64 ± 0.28	2.81 ± 0.27	<0.01	< 0.01	<0.01
O_2P, μL O_2/kg$^{0.75}$ per beat	−10 ± 4	21 ± 2	4 ± 2	<0.01	<0.01	0.05

cow spent in each posture and performing each activity. The O_2P, was calculated as VO_2/HR ratio. Data were analyzed using SAS software (SAS Institute Inc., USA); the effect of air temperature on HR, VO_2 and O_2P were evaluated through regressions of each variable *vs* air temperature for daytime and nighttime independently in each cow using the REG procedure, and regression slopes were tested for deviance from zero using the MIXED procedure. Mixed-effect regression models considering the cow as a random effect were used to evaluate the relationship between HR and VO_2, and the effect of animal posture and activity on HR, VO_2 and O_2P.

Results and Discussion
The mean value for HR, VO_2 and O_2P was 67.8 ± 4.6 beats/min, 41.2 ± 2.1 L/kg$^{0.75}$ per day and 424 ± 32 μL O_2/kg$^{0.75}$ per day, respectively. The VO_2 was positively associated with HR but this relationship was highly dependent on individual cow variation (Figure 1) suggesting that individual O_2P are necessary to obtain accurate estimation of HP using this technique. Increasing temperature decreased HR (−0.12 beats/min per °C; P = 0.06) and VO_2 (−89 mL/kg$^{0.75}$ per day and °C; $P < 0.01$) only during day probably due to the higher temperatures (16-32 °C) than during night (7-–23 °C), however, O_2P was unaffected. During eating compared to idling, HR increased more than VO_2, thus O_2P was reduced (2.5 ± 0.9%) (Table 1). Similarly, during rumination compared to idling, HR and VO_2 increased but the increment for VO_2 was larger than for HR, hence, O_2P increased (5.1 ± 0.5%) (Table 1), probably because much of this activity occurred during a postprandial state when changes in the cardiovascular system are not only explained by changes in HR, not allowing to differentiate between the heat increment of feeding and heat coming from the muscular activity of ruminating. The effect of posture (standing *vs* lying down) led to differences in HR (6.4 ± 0.7%) and VO_2 (7.5 ± 0.7%), and although the O_2P was higher when cows were standing than when they were lying down (Table 1), the difference (1.0 ± 0.5%) may be considered negligible.

Conclusion and Implications
Heat production estimates based on the O_2P-HR technique were only marginally affected by air temperature within the range of 7–32 °C. Standing and eating slightly affected the O_2P compared to lying down and idling, but these changes do not represent a major bias for HP estimates. However, rumination increased O_2P, hence, caution is needed when interpreting HP estimates for ruminating using the O_2P-HR method.

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O49 Age evolution of fatty acid incorporation into fat depots in growing, fattening pigs

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Keywords: Incorporation rate; Deposition; Pigs; Genotype; Stearic acid

Introduction
Deposition of fatty acids (FA) into adipose tissues throughout the growing-fattening period is driven mainly by direct incorporation from dietary FA and endogenous FA synthesis. To optimize fat deposition and gain further understanding, it is necessary to build a dynamic model including both processes (Kloareg et al., 2007). Our objective was to evaluate the effects of genotype and age on direct FA incorporation into several tissues of growing pigs.

Material and Methods
A total of 48 pigs from three different producing types and two growth phases were used. Sixteen pigs were crossbred boars (3W) [Pietrain sires × (Duroc × Landrace) dams] and 32 were purebred Duroc barrows genotyped for the rs80912566 SCD polymorphism, selected to be