Heart rate variability measured at milking in primiparous and multiparous cows

CRA CONSIGLIO PER LA RICERCA E LA SPERIMENTAZIONE IN AGRICOLTURA

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INTRODUCTION

▪Increasing interest in measuring heart rate variability (HRV) in animal welfare studies:

▪Healthy individuals show a high degree of HRV, that is a good indicator of emotional and physical adaptability to different situations;

▪increased HR and reduced HRV following a particular challenge can indicate that welfare is threatened;

▪Early lactation, critical period especially for primiparous cows.

METHODS

❖17 dairy cows:

✓9 primiparous (P) and 8 multiparous (M);

✓average days in milk: 38 d (range 32-48, sd=3.6);

✓double-8 herringbone parlour;

✓two milkings/day, at 0500 and 1400 h.

❖Period: March–June 2009

❖Each cow monitored for two consecutive days at the afternoon milking

❖HRV data:

✓Measured by a commercial heart rate monitor (Polar Equine, S810i™, POLAR®;

✓data concerning the first 5 minutes of milking analysed by Kubios HRV 2.0 software (Dep. Of Physics, Univ. of Kuopio, Finland);

✓automatic correction for artefacts;

✓ analysis of thacograms 5 min long and with a corrected fault rate of less than 5%;

✓HRV measures computed by: Time Domain, Frequency Domain and Non-linear methods;

✓range of frequency of HF band: 0.20 – 0.58 Hz (von Borell et al., 2007, Physiology and Behaviour, 293-316).

❖Data averaged per cow used for statistical analysis; means by parity compared using T-test for two independent sample means.

OBJECTIVE

▪To better understand the effect of the parity on HRV

▪To use HRV as welfare indicator

The study is part of a larger research [*] aiming to use physiological and behavioural measures as tools to phenotype traits related to coping style in dairy cattle.

Definition of HRV measures calculated in this study for the analysis of short-term recordings (5 min)

Method	Measure	Units	Definition
Time-domain	Mean R-R	ms	mean RR interval (R-R interval: interval between two consecutive heart beats)
	STD RR	ms	Standard deviation of the RR intervals
	Mean HR	beats/min	Mean Heart Rate
	STD HR	beats/min	Standard deviation of the mean heart rate
	RMSSD	ms	Square root of the mean squared differences between successive R-R intervals
Frequency domain	LF norm	n.u.	Power of LF band in normalized units LF$[ms^2]$/(total power $[ms^2]$ -VLF $[ms^2]$)*100
	HF norm	n.u.	Power of HF band in normalized units HF$[ms^2]$ / (total power $[ms^2]$ -VLF $[ms^2]$)*100
	LF/HF		Ratio of low to high frequency power
Non-linear (Poincaré plot)	SD1	ms	Short- term component, mainly due to respiratory sinus arrhythmia
	SD2	ms	Long- term component

DISCUSSION

Primiparous cows showed higher mean HR, lower mean RR, RMSSD and SD1, than multiparous cows:

• higher Mean HR can result from a higher sympathetic activity, a reduced vagal regulation or both;

•instantaneous changes in RR intervals are mediated by vagal efferent activity;

•RMSSD taking into account short-term high frequency components of HRV reflects vagal tone;

• SD1 is an index for the heart rate modulation by vagal efferent activity.

RESULTS

	Primiparous	Multiparous	P
Mean HR	93.0 ± 2.0	86.3 ± 2.0	<0.05
STD HR	23.3 ± 5.0	25.2 ±2.2	NS
Mean RR	648.5 ± 13.6	699.4 ± 14.4	<0.05
STD RR	14.8 ± 1.3	19.6 ± 2.8	NS
RMSSD	3.8 ± 0.5	5.7 ± 0.6	<0.05
LF	91.34 ± 1,7	93.03 ± 1.07	NS
HF	8.6 ± 1.8	6.9 ± 1.1	NS
LF/HF	15.9 ± 3.3	19.6 ± 4.1	NS
SD1	2.7 ±0.3	4.3 ± 0.3	<0.05
SD2	20. 8 ± 1.9	27.3 ± 4.0	NS

CONCLUSIONS

The results indicate a lower vagal tone in primiparous than in multiparous cows, suggesting that:

-**primiparous cows in early lactation were less adapted to stress at milking;**

-**HRV was effective in discriminating between the groups.**

NEXT STEPS

Next steps will be to measure both baseline and challenging values of HRV in order to study internal and external factors affecting changes when cows pass from a baseline (resting) condition to a challenging situation (e.g. milking, handling, fear, feeding)