Precision Livestock Farming in farmers practice

Precision livestock farming for dairy cows in a Protected Designation of Origin (PDO) system: a case study-application

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66th EAAP Meeting
31 AUGUST – 4 SEPTEMBER 2015
WARSAW, POLAND
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Introduction

CREA and PLF: from automatic milking to heat stress monitoring

Welfare Assessment Based on Metabolic and Endocrine Aspects in Primiparous Cows Milked in a Parlor or with an Automatic Milking System

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J. Dairy Sci. 88:3542–3552

Milk Quality and Automatic Milking: Fat Globule Size, Natural Creaming, and Lipolysis

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J. Dairy Sci. 88:3519–3529

Effect of Automatic Milking Systems on Milk Yield in a Hot Environment

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J. Dairy Sci. 91:3372–3384
doi:10.3168/jds.2008-1639

Evaluation of Milk Enzymes and Electrolytes, Plasma Metabolites, and Oxidative Status in Twin Cows Milked in an Automatic Milking System or Twice Daily in a Conventional Milking Parlor

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J. Dairy Sci. 89:4687–4693
Main tools for dairy cattle PLF (Hady et al., 1994; Borchers and Bewley, 2015; Titler et al., 2015)

- Days to first service: \(80 \rightarrow 60\) d
- Efficiency of detected estrus: \(50 \rightarrow 60\) %
- Conception rates: \(35 \rightarrow 50\)%

(detecting estrus is the major limitation to achieving a pregnancy) + Conception rates: \(35 \rightarrow 50\)% = In a 300-cow dairy herd \(\rightarrow\) increased net income $18,485
Introduction

Heat stress and PLF in dairy cattle (Christopherson and Kennedy, 1983; Soriani et al., 2013)

Aim

To report a case-study on the application of PLF to manage heat stress related problem in PDO dairy farming.

Figure 5. Relationship between daytime rumination time (% of day-nighttime rumination time) and maximum temperature-humidity index (THI) ($r = 0.84$; $P < 0.01$). Each symbol represents the average value of the percentage in classes of THI according to 2-unit intervals of THI.
Material and Methods

**Location and animals: barn and management**

Herd: 58 lactating dairy cows

«Baroncina» experimental farm, Lodi; 87 m a.s.l., Lat. 45°18'52"20 N, Lon. 09°30'14"04 E

Free stall barn, with forced ventilation

**Tools: the meteorological station**
Material and Methods

Tools: the TMR on-line analysis system (Dinamica Generale + Sgariboldi)
Material and Methods

Tools: the SCR-SIVAM system
Material and Methods

The conceptual framework

Diet formulation

Climate data

Cow data
- rumination
- activity

NIR forage analyzer

Feed management software
Material and Methods

Location and animals: the data set

3 groups selected according to DIM at the beginning of summer:

a. Early lactation (15-84 DIM)

b. Around peak of lactation (85-154 DIM)

c. Plateau phase (155-224 DIM)

For each record:
Calving date – Parity – Reproductive stage (open, inseminated, pregnant)

Rumination data: minutes/2 h; total day-time rumination minutes (from 08:00 to 20:00); total night-time rumination minutes (from 20:00 to 08:00)

Activity data: activity acts/2 h; total day-time activity acts (from 08:00 to 20:00); total night-time activity acts (from 20:00 to 08:00)

Statistical analysis

2 ANOVA

\[ Y_i = \mu + a(\text{day}) + b(\text{lactation stage}) + c(\text{day} \times \text{lactation stage}) + A[\text{cow}(\text{day} \times \text{lactation stage})]_i + e_i \quad \text{(for daily records)} \]

\[ Y_i = \mu + a(\text{day}) + b(\text{lactation stage}) + c(\text{time of the day}) + d(\text{day} \times \text{lactation stage}) + e(\text{day} \times \text{time of the day}) + f(\text{lactation stage} \times \text{time of the day}) + A[\text{cow}(\text{day} \times \text{lactation stage})]_i + e_i \quad \text{(for hourly records)} \]
Results and Discussion

Rumination data

Total daily rumination time

- Stage of lactation:
  - a (15-84 DIM)
  - b (85-154 DIM)
  - c (155-224 DIM)

- Total daily rumination time:
  - 14/06/2015: P < 0.001
  - 06/07/2015: P < 0.001

Graph showing the comparison of total daily rumination time across different stages of lactation.
Results and Discussion

Rumination data

Day-time rumination time

- a (15-84 DIM) $P < 0.001$
- b (85-154 DIM) $P < 0.001$
- c (155-224 DIM) $P < 0.001$

<table>
<thead>
<tr>
<th>Stage of lactation</th>
<th>14/06/2015</th>
<th>06/07/2015</th>
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</thead>
<tbody>
<tr>
<td>a (15-84 DIM)</td>
<td></td>
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<tr>
<td>b (85-154 DIM)</td>
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<tr>
<td>c (155-224 DIM)</td>
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</tbody>
</table>

P < 0.001
Results and Discussion

**Rumination data**

Night-time rumination time

- **a** (15-84 DIM) with $P < 0.001$
- **b** (85-154 DIM) with $P < 0.001$
- **c** (155-224 DIM) with $P < 0.001$

Data presented for stages of lactation:
- **14/06/2015**
- **06/07/2015**

Stage of lactation:
- a (15-84 DIM)
- b (85-154 DIM)
- c (155-224 DIM)
Results and Discussion

Rumination data

Daily distribution of rumination activity (min/2 h intervals)

Max discomfort
Results and Discussion

1. Climate effect on rumination
   • ~30% reduction in all the stages of lactation during heat stress vs. thermoneutrality
   • Reduction concentrated in day-time, less severe in night-time
     • Confirming Soriani et al. (2013)

2. Climate effect on production
   • ~15% reduction during heat stress vs. thermoneutrality
Conclusion

• From a PLF perspective, we can try to differentiate 2 TMR in a day: one for the night-time (higher rumination) and one for the day-time (lower rumination)

• Further PLF tools would aid us to reduce the negative impact of heat stress on summer milk production, namely for PDO cheeses requiring a higher milk quality for the curd forming process
Acknowledgments

Dr. Antonio Bruni ("Baroncina" Farm manager)

Dairy Farm project

SIVAM + SCR

Sgariboldi

Dinamica Generale

OmniGen-AF

FIS