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EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

FA 1308

1st DairyCare Conference, 23-24 Aug. 2014, Copenhagen (DK)

DairyCare

Welfare standards and precision livestock measures in dairy sheep and goat farms

UAB Universitat Autònoma de Barcelona

G2R Grup Recerca Remugants

G. Caja & M. Rovai

Group of Ruminant Research (G2R), Department of Animal and Food Sciences, Universitat Autònoma de Barcelona, Bellaterra (Spain).

Welfare standards and precision livestock measures in dairy sheep and dairy goat farms

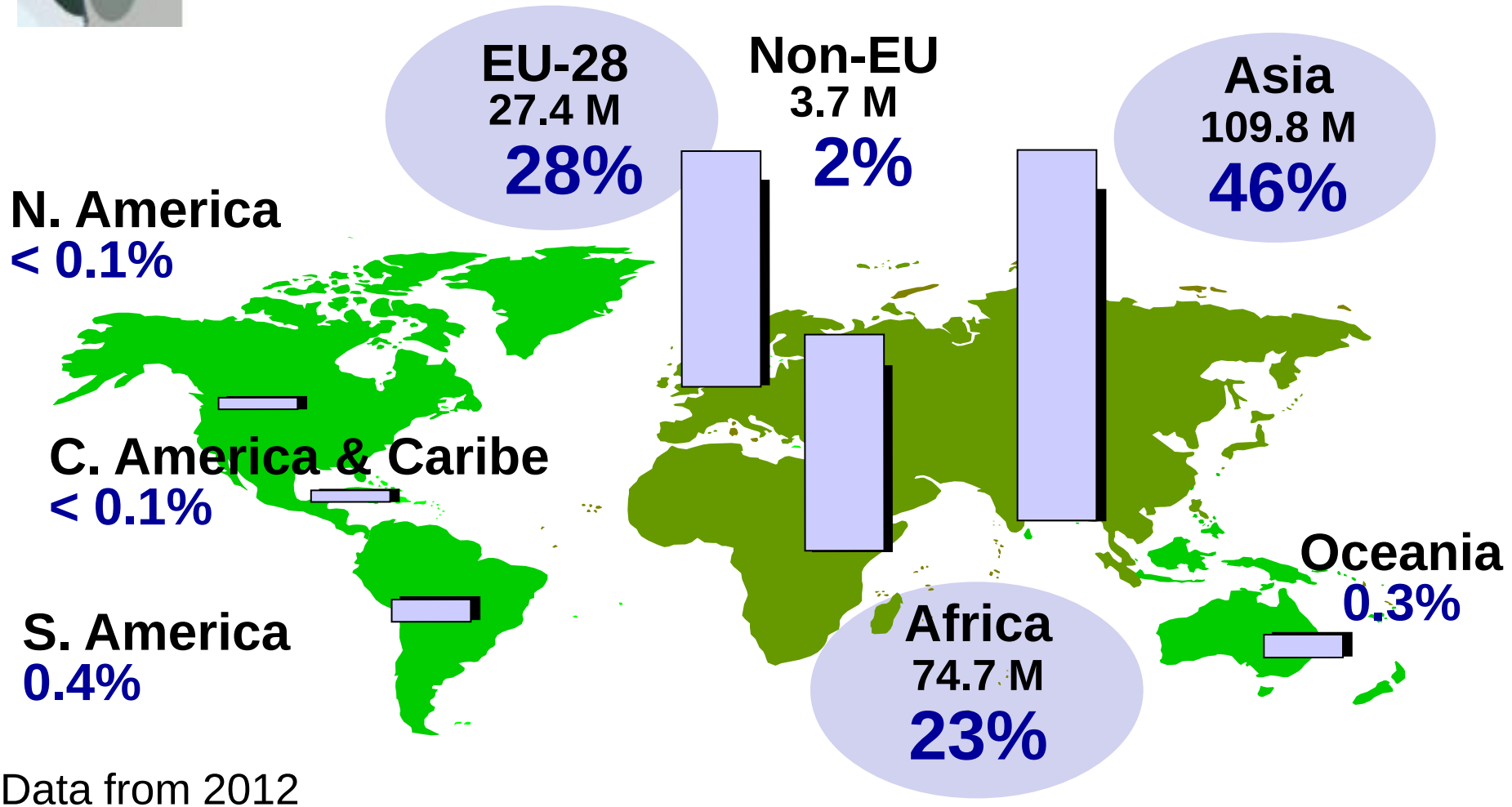
Outline:

- Relevance of dairy small ruminants in the EU-28.
- Available welfare codes and standards for dairy sheep and goats.
- The five freedoms in dairy sheep and goats: Preliminary assessment.
- Repeatability of Welfare Quality indicators in sheep.
- Need of new indicators.
- Precision farming:
  - Milk meters
  - Infrared thermography for mastitis detection
  - Rumen sensors
- Conclusions.

Population of sheep and milk production (FAOSTAT, 2014)

Dairy sheep = 217 Million head (~20% sheep)

Milk = 10.1 Mt (100%)

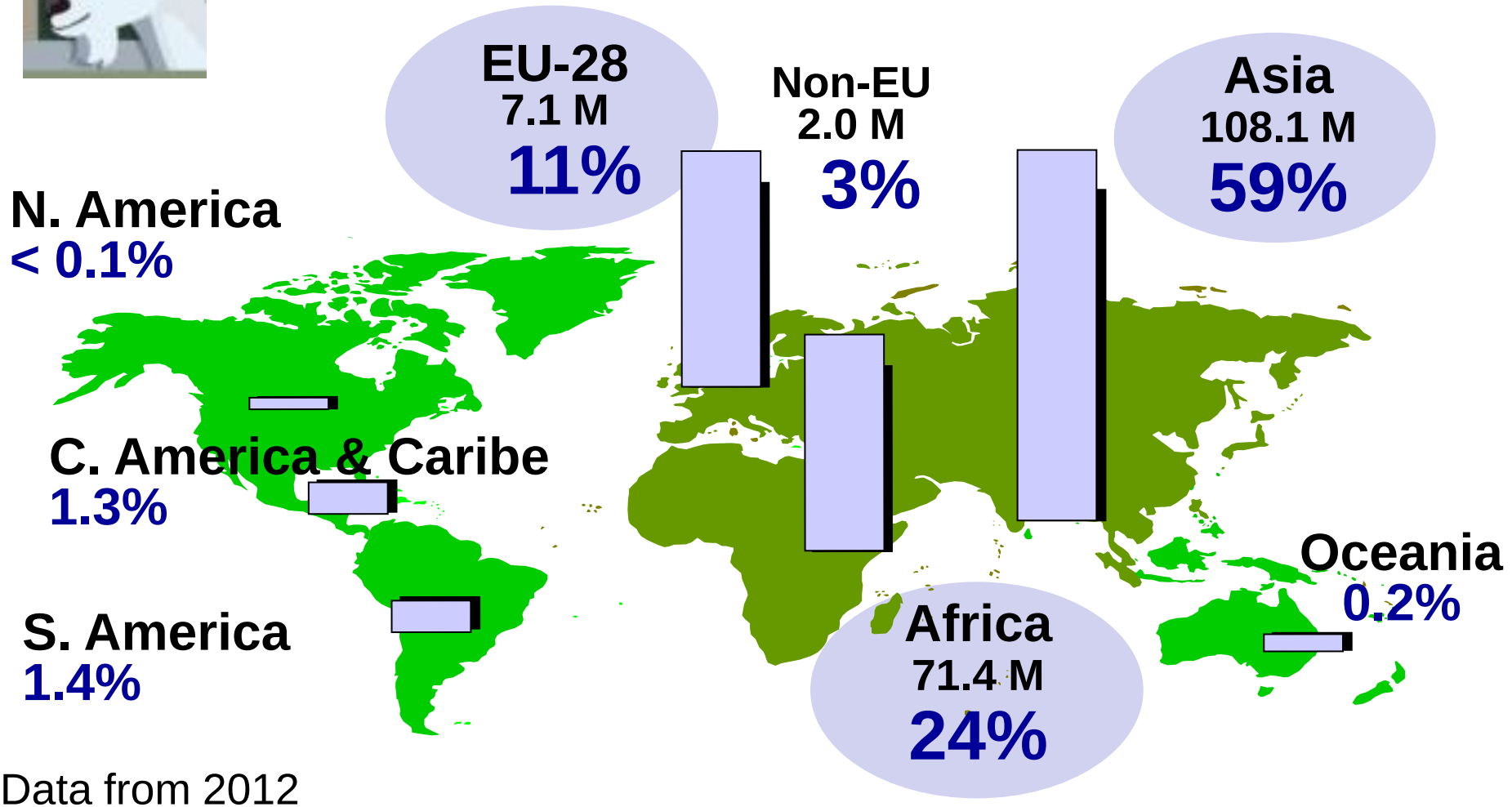


Data from 2012

Population of goats and milk production (FAOSTAT, 2014)

Dairy goats = 198 Million head (~20% goats)

Milk = 17.9 Mt (100%)



Data from 2012

Welfare references for dairy sheep and goats

Organization	Country	Type	Dairy sheep	Dairy goats
DEFRA (2000, 2003)	UK	Code	Yes	Yes
RSCPA (2001)	UK	Standard	Yes	Yes
SCARM-CSIRO (2003)	AU	Code	-	Yes
MAGRAMA (2007)	ES	Code	Yes	Yes
GBPO (2011)	FR	Standard	Yes	-
MPI-NAWAC (2012)	NZ	Code	-	Yes
AW Approved (2014)	USA	Standard	Yes	Yes
AEBA (n/a)	AR	Standard	-	Yes

RSPCA Royal Soc. Protection from Cruelty Animals.

Animal Welfare APPROVED

The “Five Freedoms”

Freedoms:

1. **From hunger and thirst** by ready access to fresh water and a diet to maintain good health and vitallity;
2. **From discomfort** by providing an appropriate environment including shelter and a comfortable resting area;
3. **From pain, injury and disease** by prevention or rapid diagnosis and treatment;
4. **To express normal behavior** by providing sufficient space, proper facilities and company of the animals’ own kind;
5. **From fear and distress** by ensuring conditions and treatment to avoid mental suffering.

Welfare assessment of sheep and goat dairy farms in Spain (n = 67)

Dairy species	Freedom accomplishment				
	Feed	Shelter	Health	Behavior	Fear
Sheep (n = 52)	50	25	15	30	17
%	96.2	48.1	28.9	57.7	32.4
Goats (n = 15)	12	7	6	10	11
%	80.0	46.6	40.0	66.7	73.3

Preliminary conclusions:

- Sheep have better welfare quality than goats.
- Feeding was the more satisfactory indicator in both species.
- Health was unsatisfactory in sheep and goats.
- Goats showed less fear than sheep.
- All farms were electronically identified but only 3 farms (4.5%) had automatic milk meters.

The “Five Freedoms”

Freedom’s assesment:

1. **From hunger and thirst** by ready access to fresh water and a diet to maintain full health and vigor;
2. **From discomfort** by providing appropriate environment including shelter and a comfortable resting area;
3. **From pain, injury or disease** by prevention or rapid diagnosis and treatment;
4. **To express normal behavior** by providing sufficient space, proper facilities and company of the animals’ own kind;
5. **From fear and distress** by ensuring conditions and treatment to avoid mental suffering.

Repeatability of welfare measurements in sheep: WelfareQuality (Mialon et al., 2011)

Measurements	Intra-observer	Inter-observer
Individual:		
Condition scoring	0.82-0.83[1]	0.99-1[1]
Wool humidity	0.04-0.09[2]	0.66-1[2]
Foot shape	0.81-0.84[2]	0.97-0.98[2]
Lameness	0.65-0.81[2]	0.97[2]
Wool cleanness	0.69-0.72[2]	0.98-0.99[2]
Group:		
Position-activity	–0.20-0.66[2]	0.62-1[2]
Reactivity to events	–0.25-0.60[1,2]	0-1[1,2]
Reactivity to humans	–0.11-0.34[2]	1[2]

[1]Intra-class coefficient; [2]Kappa coefficient.

The ear-eye language of sheep

Sheep:

- Do not like being alone.
- **Show stress by ear and eyes** (Pilcher, 2004).
- Are able to recognize and are attracted by **individual faces**: 50 sheep and 10 humans over a period of 2-year (Kendrick et al., 2001).
- **Unstressed after being exposed to head pictures of calm sheep** (better) **or goats** (Pilcher, 2004).

Dairy sheep and goat precision

Ongoing research on:

- Electronic identification: Secondary benefits
- Automatic milk meters
- Sorting gates
- Estrus detectors
- Infrared technology for mastitis detection
- Rumen sensors: pH and temperature

Automatic milk meters approved by ICAR for dairy sheep and goat milk recording

Model	Manufacturer	Device	Species
Afifree	Afikim (IR)	-	Goat
Afifree	Afikim (IR)	AfiFree 155	Goat
Afifree	Afikim (IR)	AfiFree 155i	Goat
Afifree	Afikim (IR)	-	Sheep
Afifree	Afikim (IR)	AfiFree 155i	Sheep
MM25 SG	De Laval (SD)	SCR Engineers	Sheep
Lactocorder	WMB AG (SW)	-	Goat

ICAR Approved

AfiFree 155i milk meter for sheep

De Laval MM25 SG milk meter for dairy sheep and goats

Inconsistent measures and not user-friendly software (partially adapted version from cows)

IR thermography for mastitis detection in dairy sheep: 1

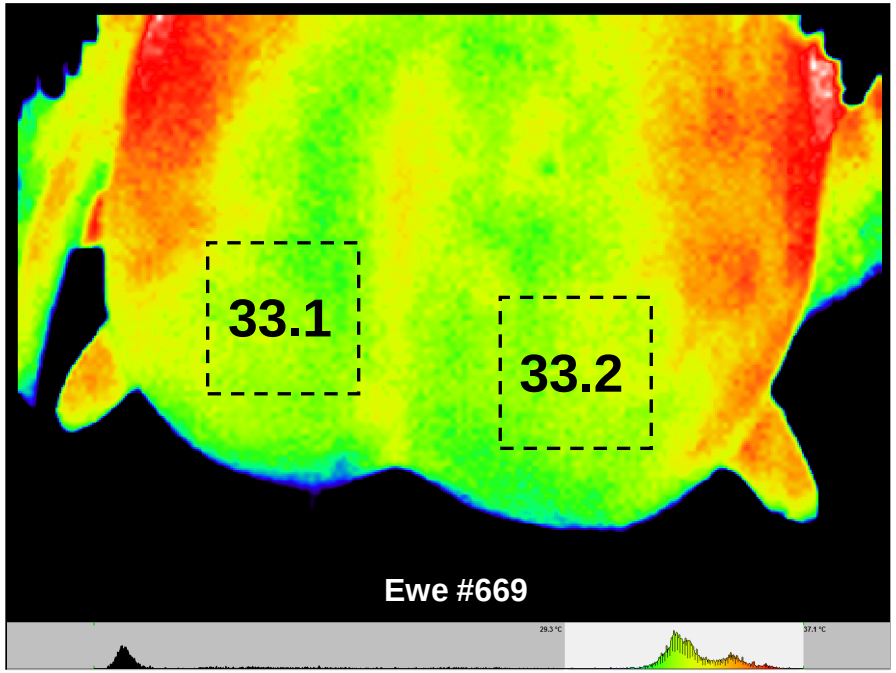
Udder temperatures of dairy sheep according to the studied variables (Castro-Costa et al., 2014)

Variable	Contrasts			
	Category 1	Category 2	± SEM	*P* =
Breed (1, Man.; 2, Lac.)	32.88	33.23	0.11	0.003
Udder side (1, Left; 2, Right)	33.05	33.06	0.11	0.879
Milking schedule (1, a.m.; 2, p.m.)	32.66	33.45	0.06	0.001
Milking moment (1, Before; 2, After)	32.99	33.12	0.05	0.014
Udder health (1, Healthy; 2, Mastitis)	33.11	33.00	0.16	0.484

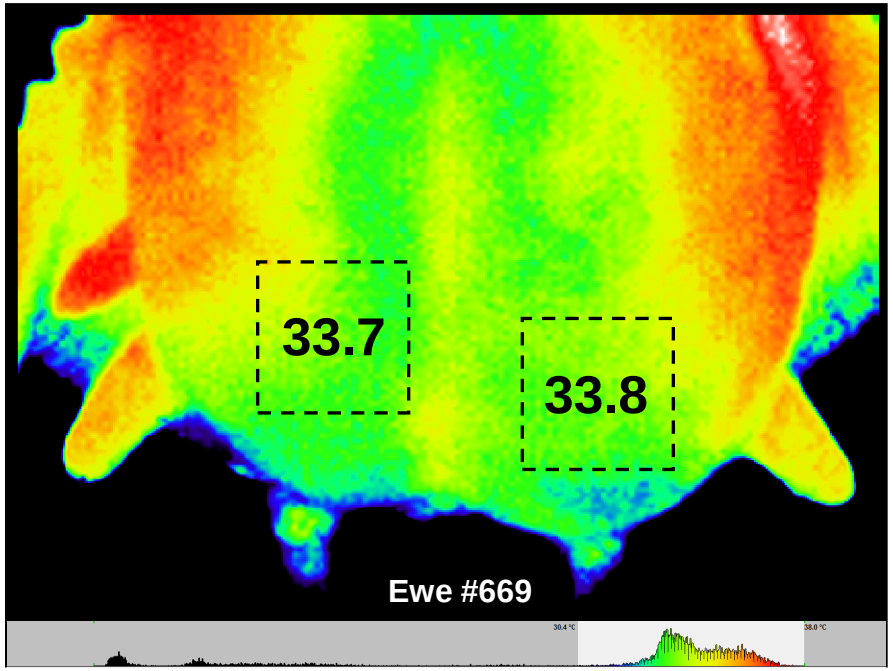
IR thermography for mastitis detection in dairy sheep: 2

- **Healthy udders** (Castro-Costa et al., 2014):
  - T ranged between 28 (cistern) and 39ºC (leg side)
  - T increased after milking ($P < 0.001$).

Before (29.3 to 37.1ºC)



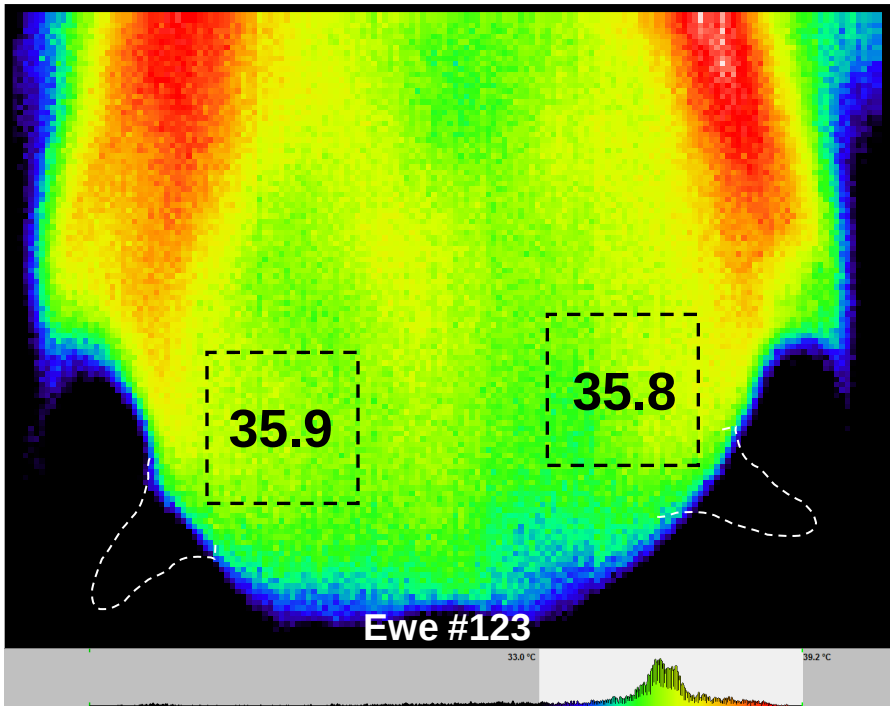
After (30.4 to 38.0ºC)



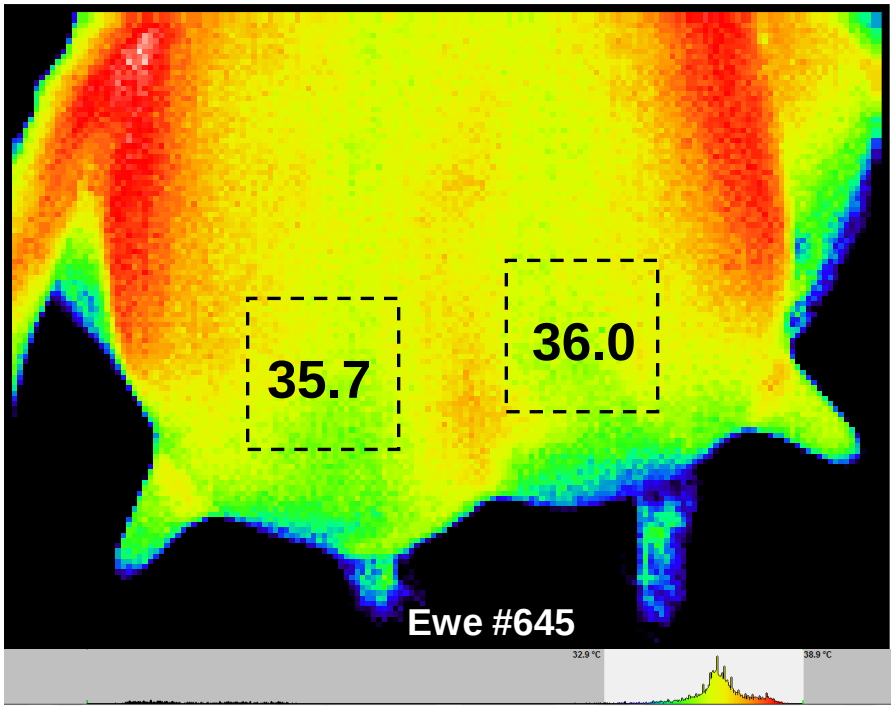
IR thermography for mastitis detection in dairy sheep: 3

- **Infected udders** (Castro-Costa et al., 2014):
  - Similar range of temperatures as healthy udders.
  - No differences between healthy and (sub)clinical mastitis (P = 0.484).

Healthy (33.0 to 39.2ºC)

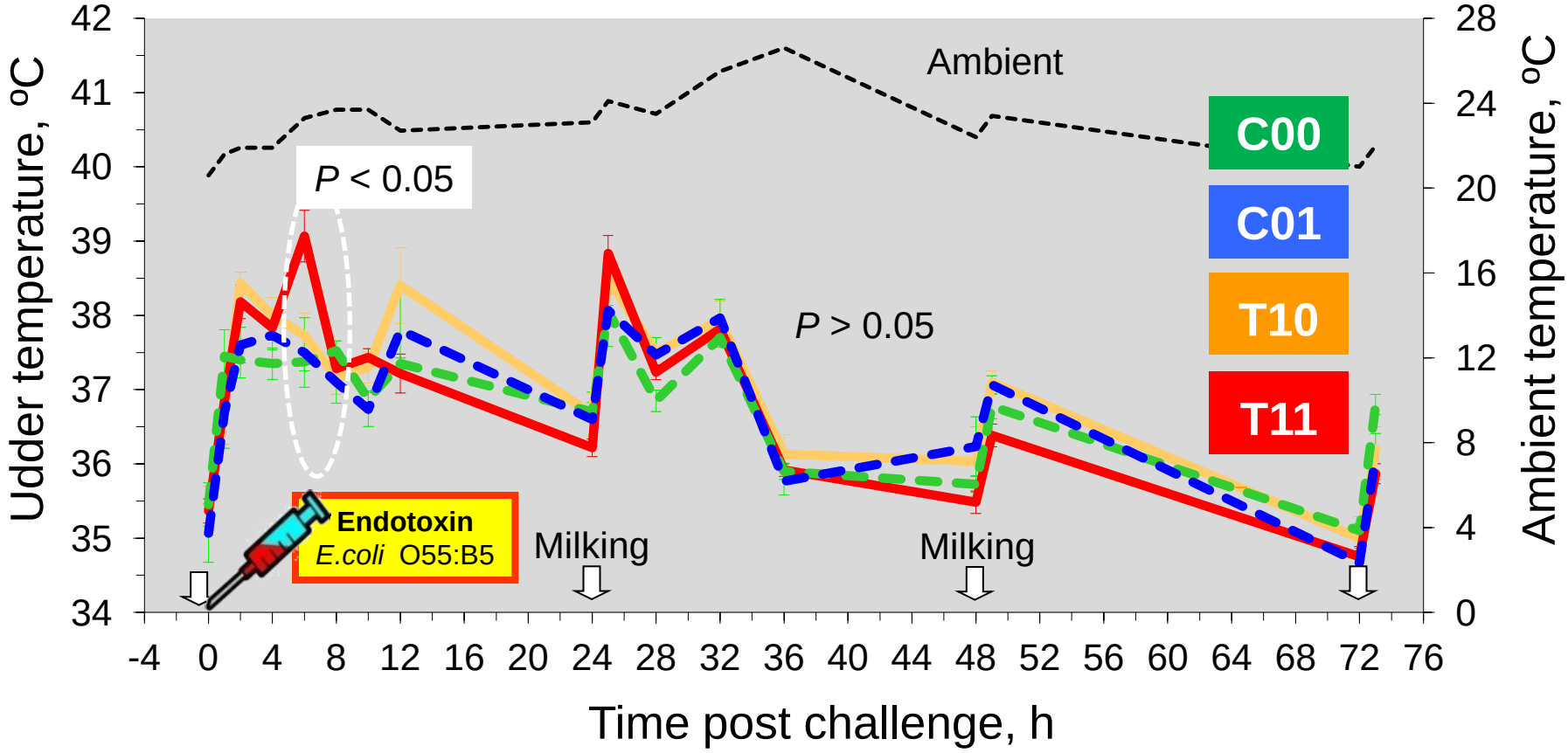


Clinical IMI (32.9 to 38.9ºC)



IR thermography for mastitis detection in dairy sheep: 4

***E. coli* O55:5 endotoxin infusion in the udder of dairy ewes (C = control, T = infused)**(Castro-Costa et al., 2014)



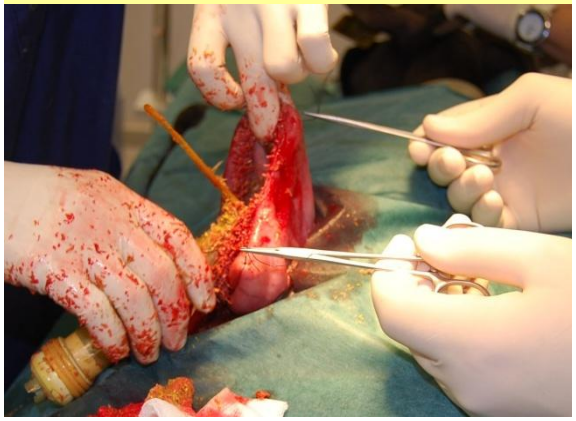
Udder temperatures increased after milking ($P < 0.001$), but not by effect of treatment ($P = 0.752$), except for T11 at 6 h ($P < 0.05$).

Rumen sensors (T & pH) in dairy goats

Castro-Costa et al. (2014): KB1001 bolus sensor (Kahne, Auckland, NZ)

Item	Value
Temperature range	0 to 45ºC
Temp. resolution	0.01ºC
Temp. accuracy	± 0.08ºC
pH range	4 to 8
pH resolution	0.01
pH accuracy	± 0.02
Dimensions	145 mm long 27 mm diameter
Weight	70 g
System software	Kahne Data Processing System
Record data	1-59 s, 1–255 min

Rumen ventral sac



Rumen sensors in dairy goats fed extreme diets: 1

Castro-Costa et al. (2014): Dry goats fed forage to concentrate diets of 70:30 (HF; n = 8) or 30:70 (LF; n = 8)

Item	Dietary treatment			
	HF-70%	LF-30%	± SED	*P* =
Feed intake, kg DM/d	0.83	0.79	0.08	0.323
Water intake, L/d	3.72	4.07	0.96	0.728
Rectal temperature, ºC	38.22	38.16	0.13	0.660
Rumen temperature, ºC	38.82	38.92	0.12	0.396
Rumen pH	6.56	6.25	0.06	0.001
Urine pH	7.65	7.67	0.20	0.923

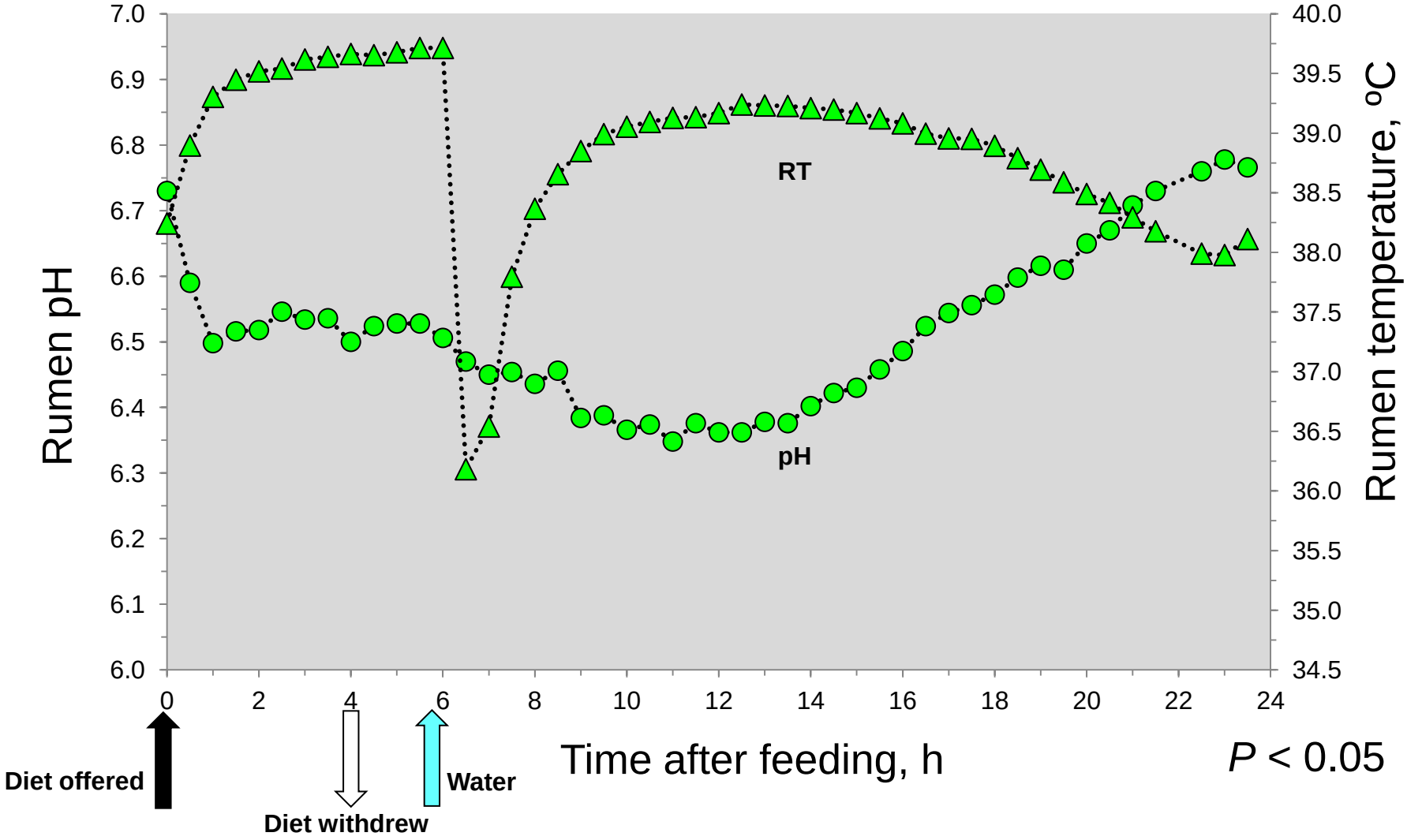
r = 0.91

Rumen temperatures were 0.68 ± 0.06ºC greater than rectal

Low correlation between rumen temperature and pH (r = 0.1 to 0.3)

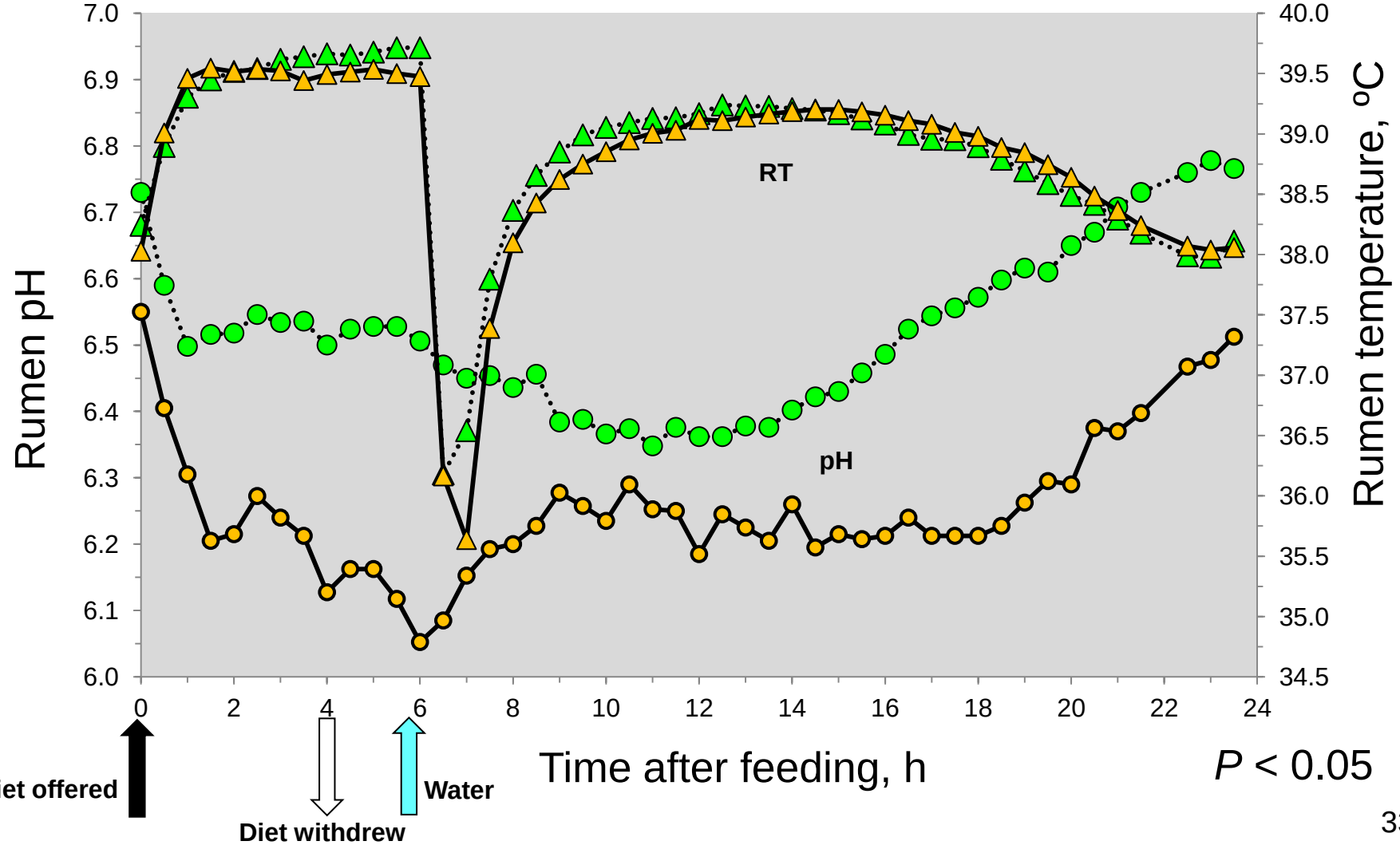
Rumen sensors in dairy goats fed extreme diets: 2

Rumen pH (●) and temperature (▲) of goats fed 70% forage
(Castro-Costa et al., 2014)



Rumen sensors in dairy goats fed extreme diets: 3

Rumen pH (●,●) and temperature (▲,▲) of goats fed 70% forage (●,▲) or 30% forage (●,▲) (Castro-Costa et al., 2014)

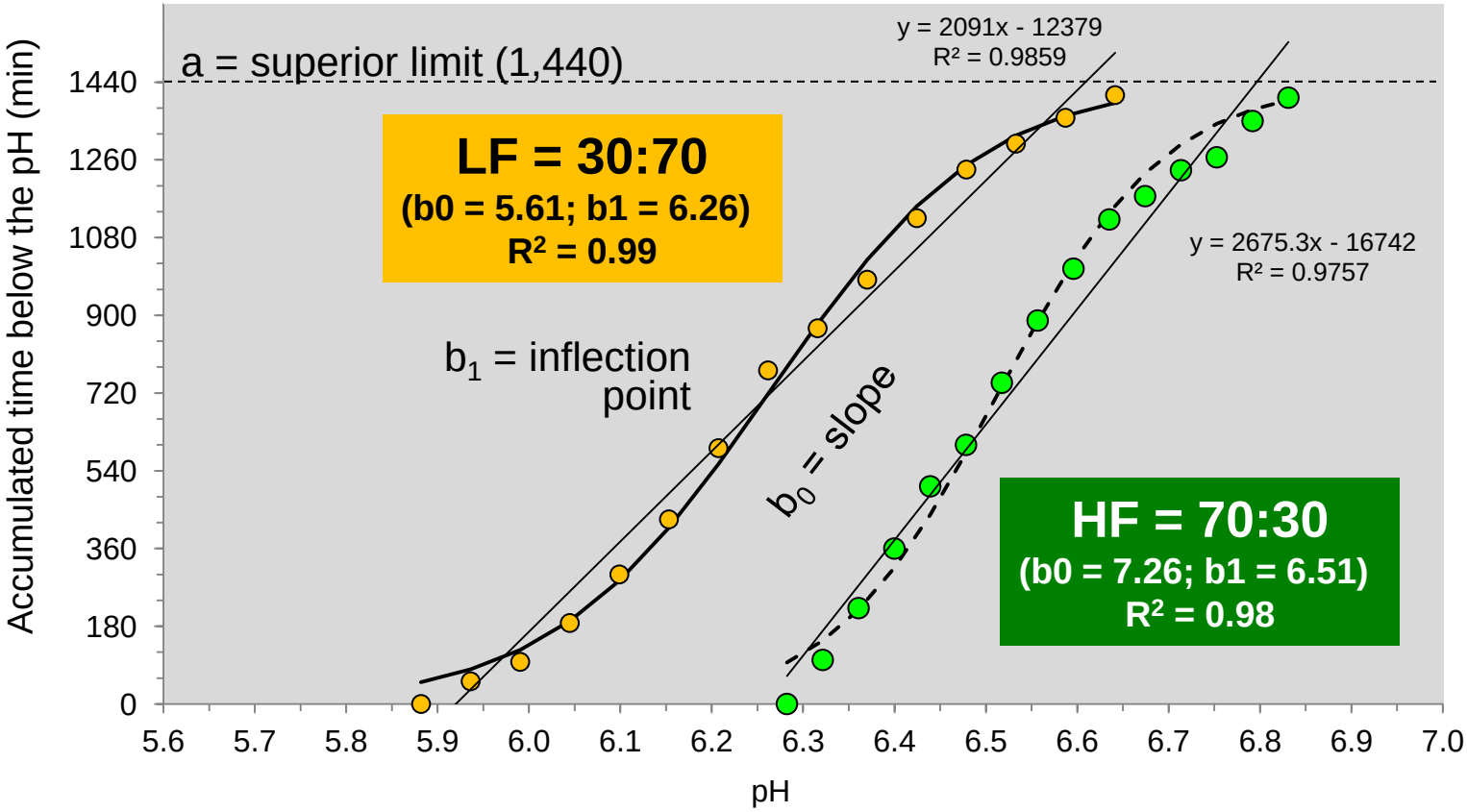


$P < 0.05$

Rumen sensors in dairy goats fed extreme diets: 3

Ruminal pH for low (●) and high (●) forage diets in dry goats according to the logistic function:

$$y = a/(1 + e^{-(b_0 + b_1 x)})$$



Rumen sensors in dairy goats under heat stress: 1

Dry goats fed diets at thermoneutral (TN, n = 8) or heat stress (HS, n = 8) (Castro-Costa et al., 2014)

Item	Environmental treatment			
	TN	HS	± SED	*P* =
Feed intake, kg DM/d	1.13	0.98	0.10	0.183
Water intake, L/d	2.2	5.4	0.7	0.002
Respiration rate, breaths/min	28	105	5	0.001
Rectal temperature, ºC	38.6	39.0	0.1	0.001
Rumen temperature, ºC	39.6	39.9	0.1	0.004
Rumen pH	6.55	6.43	0.04	0.003

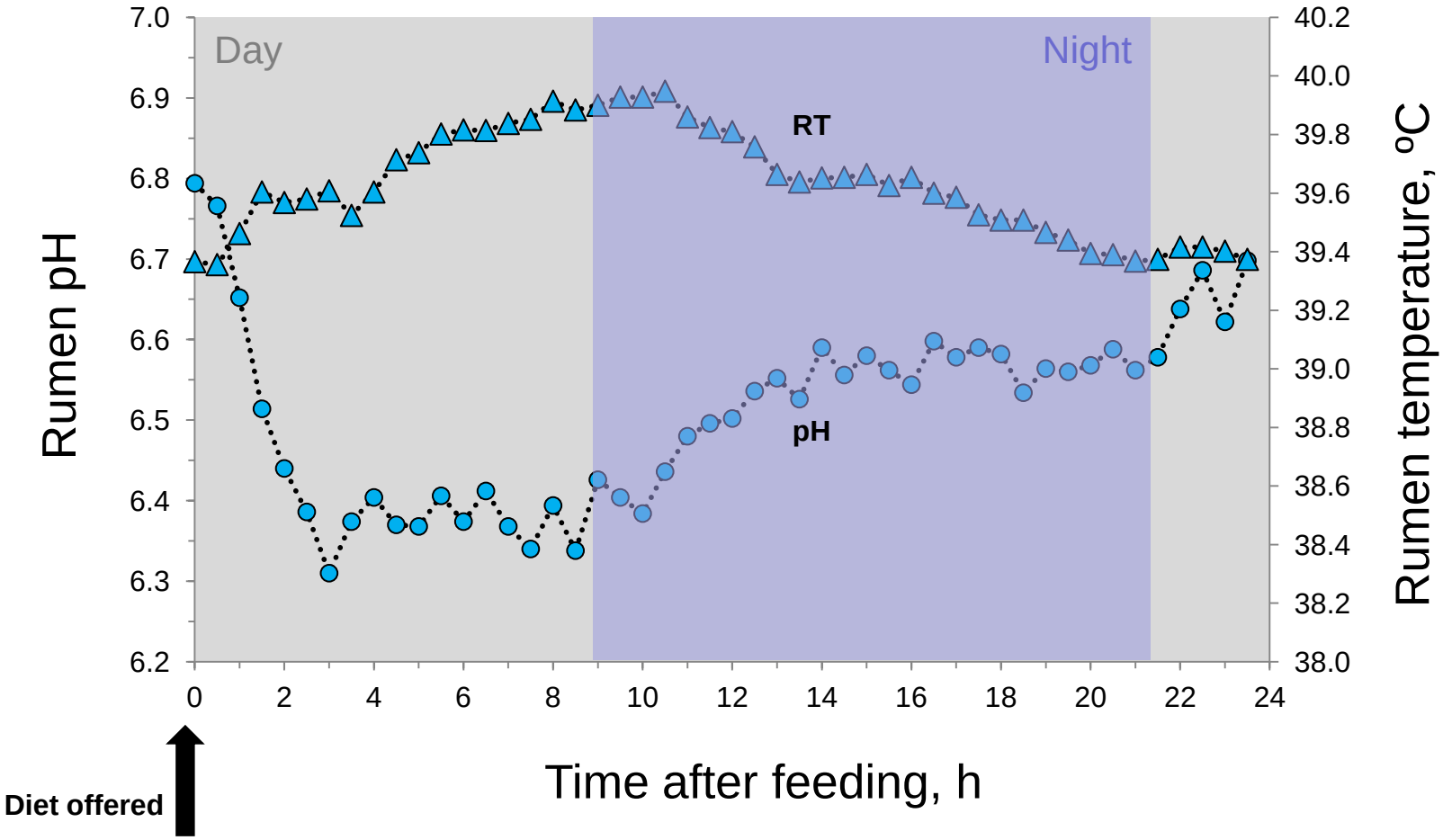
r = 0.79

Low correlation between rumen temperature and pH (r = 0.12)

Rumen temperatures were 0.95 ± 0.11 ºC greater than rectal temperatures

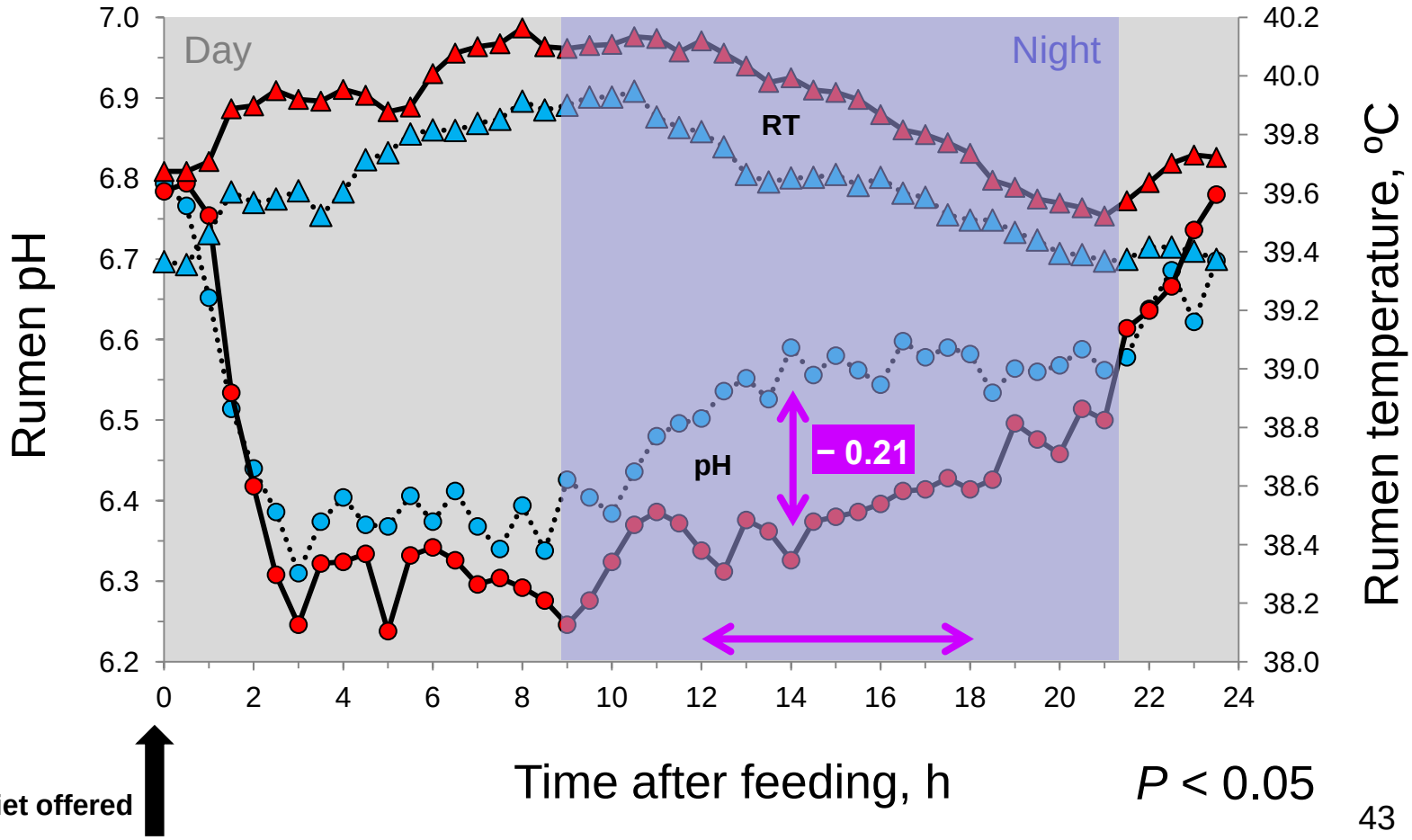
Rumen sensors in dairy goats under heat stress: 1

Rumen pH (●) and temperature (▲) of goats under termo neutral (TN) conditions (Castro-Costa et al., 2014)



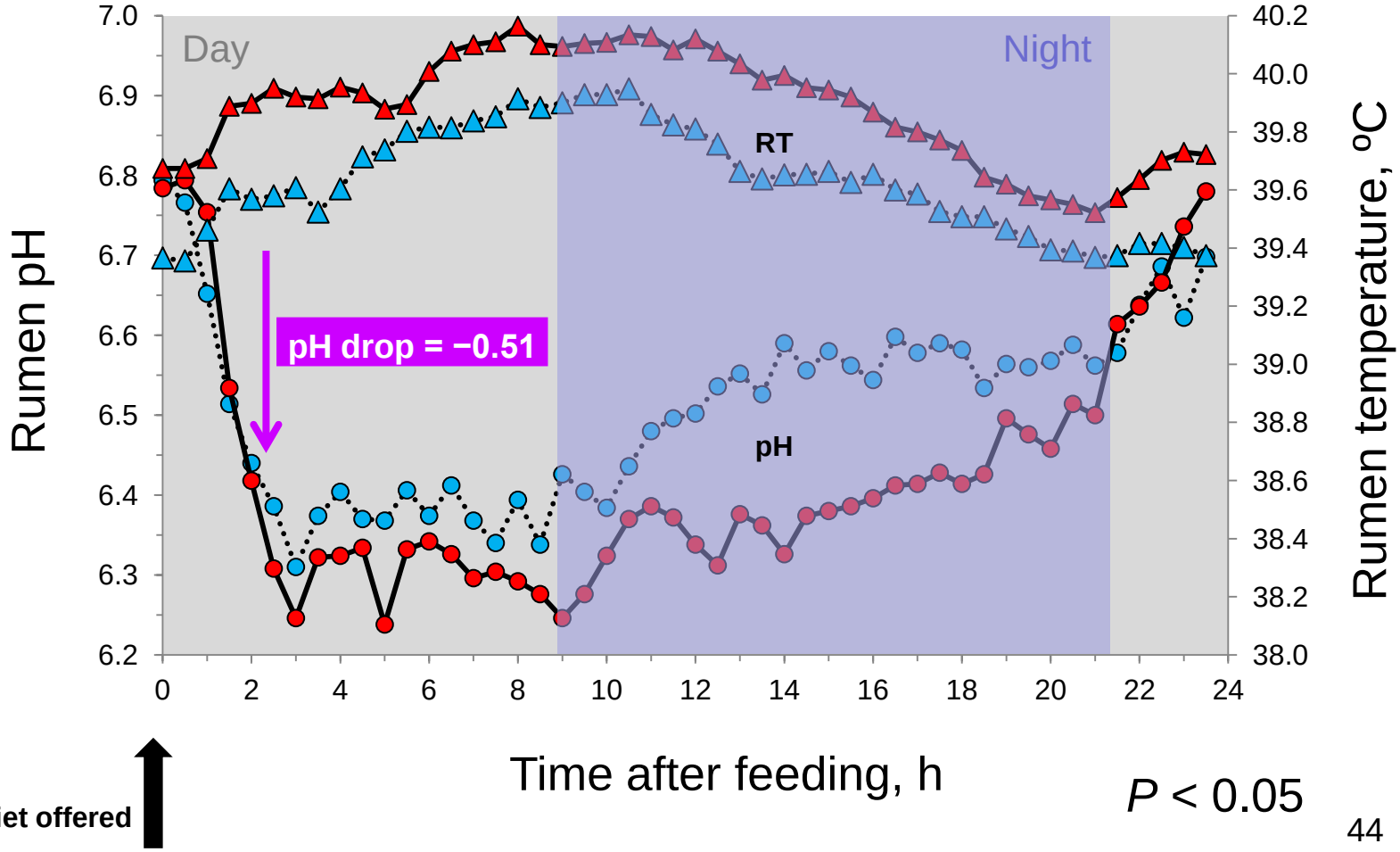
Rumen sensors in dairy goats under heat stress: 2

Rumen pH (●,●) and temperature (▲,▲) of goats under termoneutral (●,▲) or heat stress (●,▲) conditions



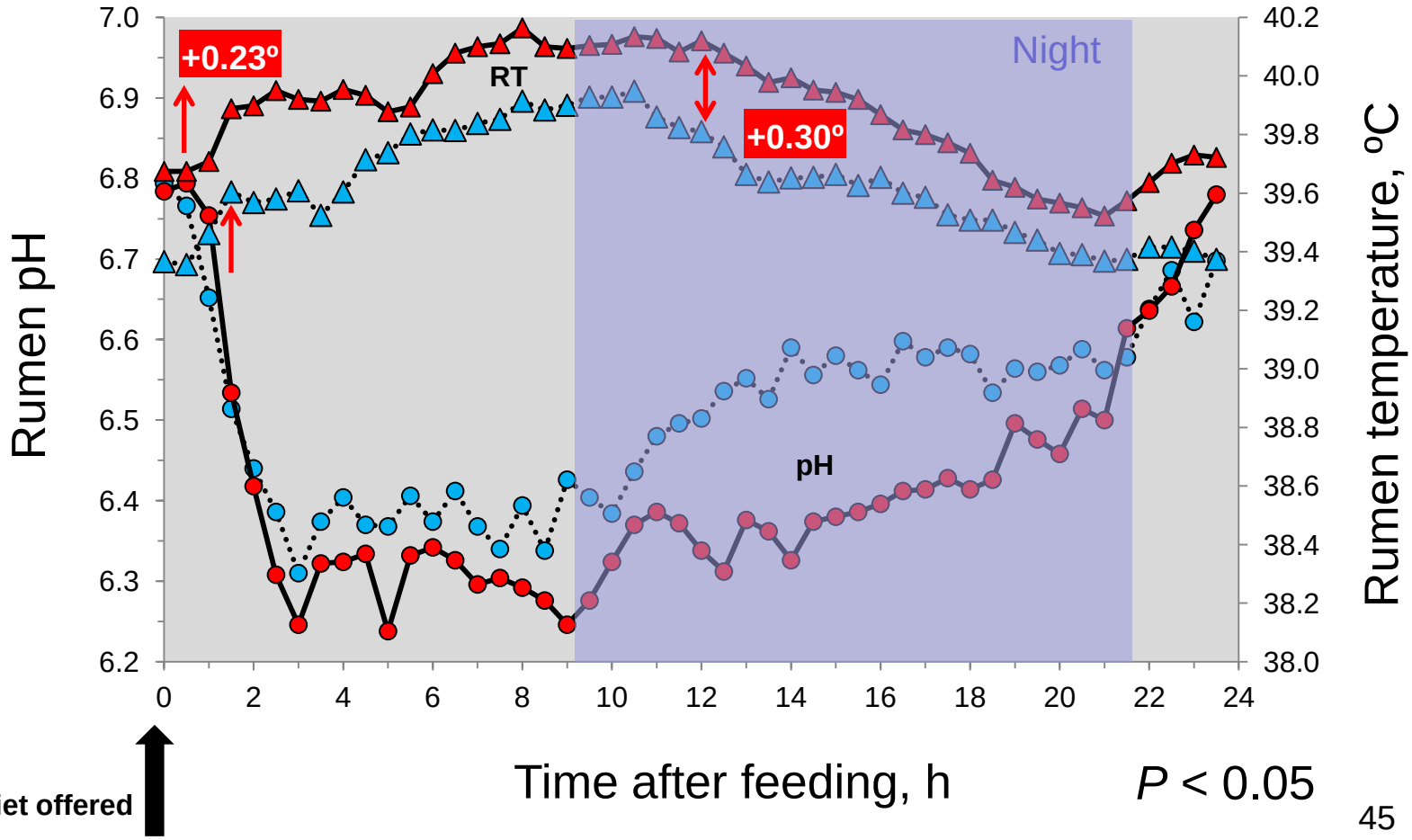
Rumen sensors in dairy goats under heat stress: 3

Rumen pH (●,●) and temperature (▲,▲) of goats under termoneutral (●,▲) or heat stress (●,▲) conditions



Rumen sensors in dairy goats under heat stress: 4

Rumen pH (●,●) and temperature (▲,▲) of goats under termoneutral (●,▲) or heat stress (●,▲) conditions



Conclusions

- Lack of adapted welfare indicators for dairy sheep and goats.
- Preliminary results showed partially unsatisfactory welfare assessment for dairy small ruminants.
- New welfare indicators are needed.
- Despite being electronically identified, few farms had automatic milk recording or management practices.
- Use of infrared thermography was unable to detect (sub)clinical mastitis.
- Data obtained by rumen sensors reflected dietary and behavior changes (feeding and drinking bouts).
- Heat stressed animals showed lower rumen pH than thermoneutral, indicating a shift in rumen fermentation.

Thanks for attention!

Andreia Castro-Costa
Ahmed Salama
Adel Ait-Saidi
Xavier Such
Elena Albanell
Ramón Casals
Menchu Manuelian
Raúl González

DairyCare

UAB
Universitat Autònoma de Barcelona

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