



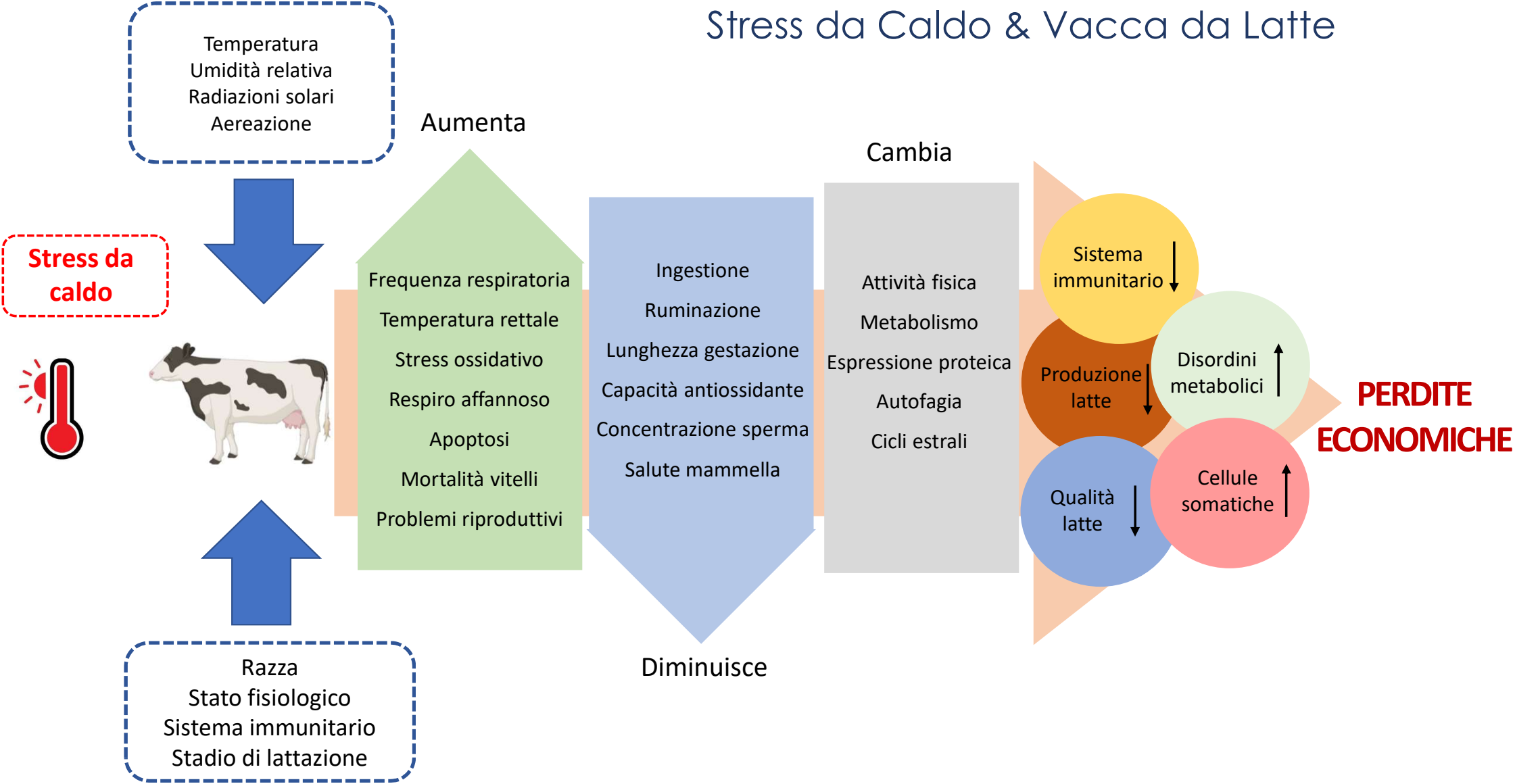
Progetto CoolCow: indicatori per il miglioramento genetico allo stress da caldo nella vacca da latte.

Prof. Massimo De Marchi

Bressanvido (VI) – 12 Ottobre 2024

Stress da Caldo & Vacca da Latte

Stress da Caldo & Vacca da Latte



TEMPERATURE HUMIDITY INDEX (THI)

UM = umidità media giornaliera
 TM = temperatura media giornaliera

$$THI = (1.8 * TM) - \left(1.0 - \frac{UM}{100}\right) * (TM - 14.39) + 32$$

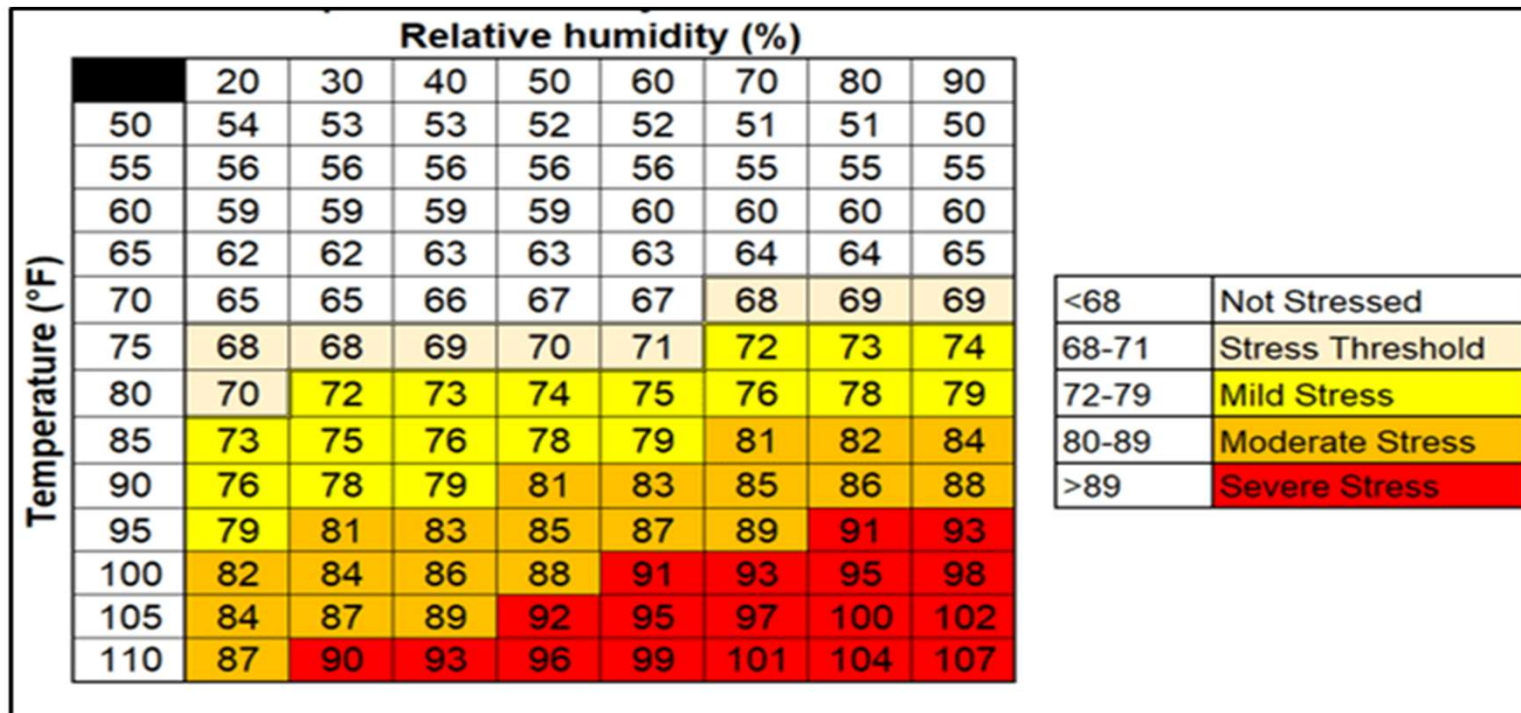


Figure 1. Temperature Humidity Index (THI) for Cattle. Lactating dairy cows are at greater risk for heat stress when the THI exceeds 68.



How heat stress conditions affect milk yield, composition, and price in Italian Holstein herds

S. Sterup Moore,¹ A. Costa,^{2*} M. Penasa,¹ S. Callegaro,³ and M. De Marchi¹

¹Department of Agronomy, Food, Natural Resources, Animals and Environment (DAFNAE), University of Padova, 35020 Legnaro, Italy

²Department of Veterinary Medical Sciences (DIMEVET), Alma Mater University of Bologna, 40064 Ozzano dell'Emilia, Italy

³Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Firenze, 50144 Florence, Italy

- Class A: \leq media – DS;
- Class B: $>$ media – DS e \leq media + DS;
- Class C: $>$ media + DS.

Table 6. Estimated economic losses at farm and regional levels as a result of altered milk composition following exposure to increasing temperature-humidity index (THI) and maximum temperature-humidity index (MTHI)

Change in class	Change in milk value, ¹ \$/100 L of milk		Approximated total daily mean losses, ² \$			
	THI	MTHI	Farm level		Veneto Region	
			THI	MTHI	THI	MTHI
Bulk milk records						
Class A to B	–0.19	–0.32	5.37	9.25	6,069	10,454
Class B to C	–0.48	–0.50	13.73	14.32	15,512	16,186
Class A to C	–0.67	–0.82	19.10	23.57	21,581	26,640
Individual test-day records						
Class A to B	–0.67	–0.64	19.31	19.91	21,833	22,504
Class B to C	–0.80	–0.83	24.66	24.07	27,878	27,208
Class A to C	–1.46	–1.47	43.98	43.98	49,712	49,712

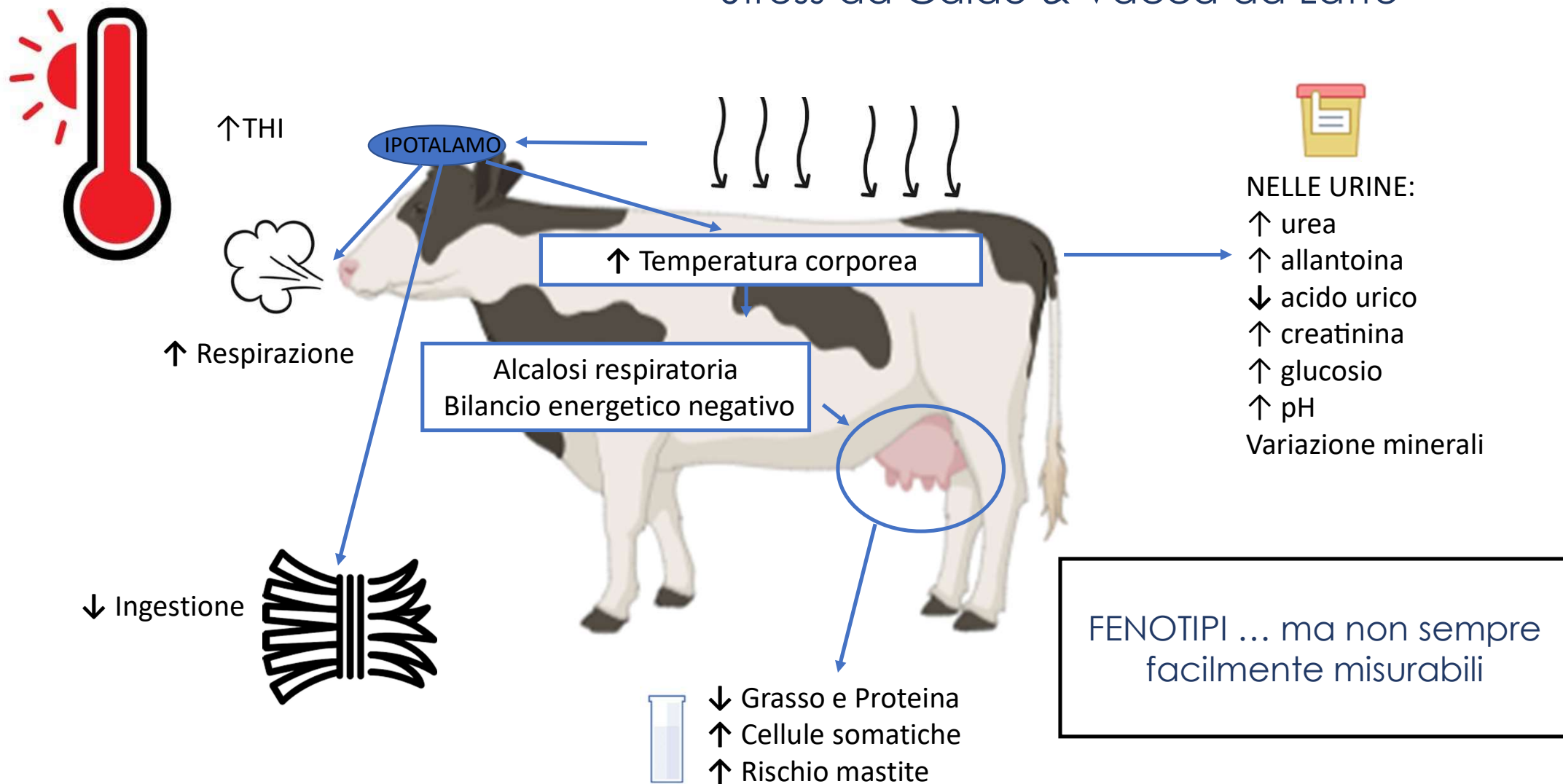
- 0,55 euro / 100 l latte

- 1,35 euro / 100 l Latte

¹Estimates are based on changes in LSM of fat and protein content and SCS between the indicated classes. The base pay of \$45.09 per 100 L was used, on which premiums and penalties were introduced based on fat, protein, and SCS thresholds commonly implemented in the Lombardy milk payment system.

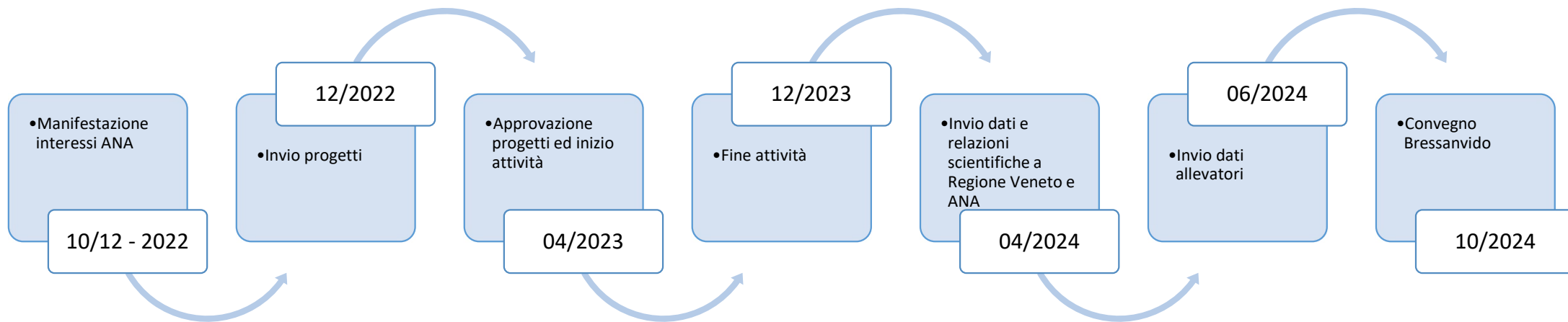
²Farm-level losses were estimated based on the average Italian dairy herd size and the mean milk yield of the current study. Veneto regional loss was estimated based on the regional annual milk production in 2021.

Stress da Caldo & Vacca da Latte



Progetto Aggiuntivo

CoolCow: indicatori per il **miglioramento genetico**
allo **stress da caldo** nella vacca da latte



Coordinamento & Piano attività ARAV – Supervisione scientifica UNIPD

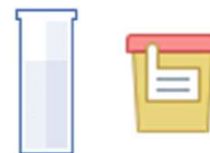




CAMPIONAMENTO

Aprile 2023

Novembre 2023



1.787 Vacche Campionate

26 allevamenti

74 giornate di campionamento

Frisona
Pezzata rossa
Rendena

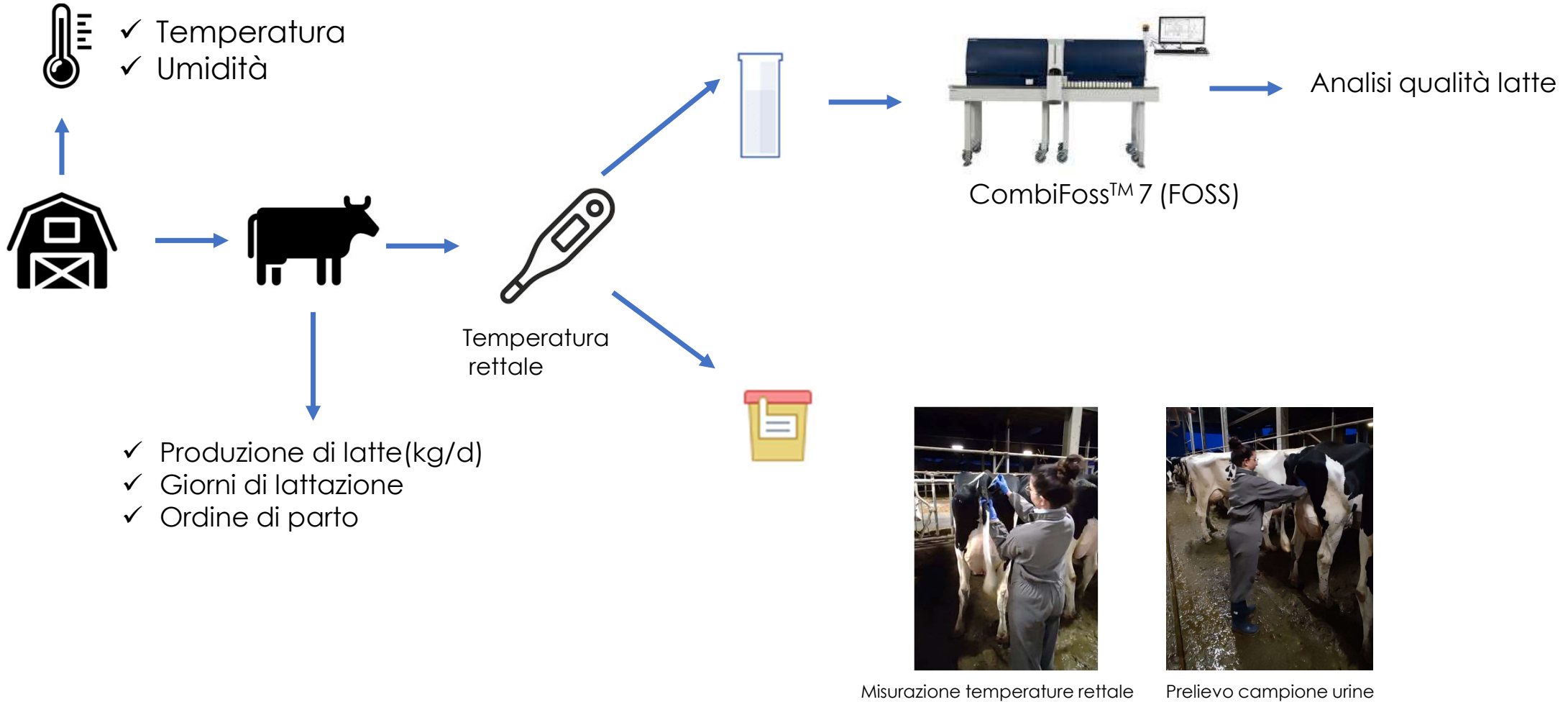


Misurazione temperature rettale



Prelievo campione urine

RACCOLTA DATI



ANALISI

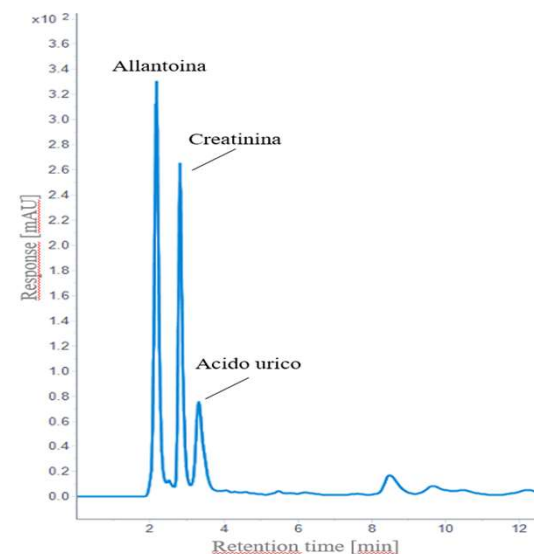
ESAMI URINE:

- Proteine urinarie, creatinina, PU/CU
- Urea
- Glucosio
- Peso specifico
- pH
- Sedimento urinario



Reversed-phase HPLC
(Agilent Technologies)

- ✓ Allantoina
- ✓ Creatinina
- ✓ Acido urico



Laboratori della Associazione
Regionale Allevatori Veneto



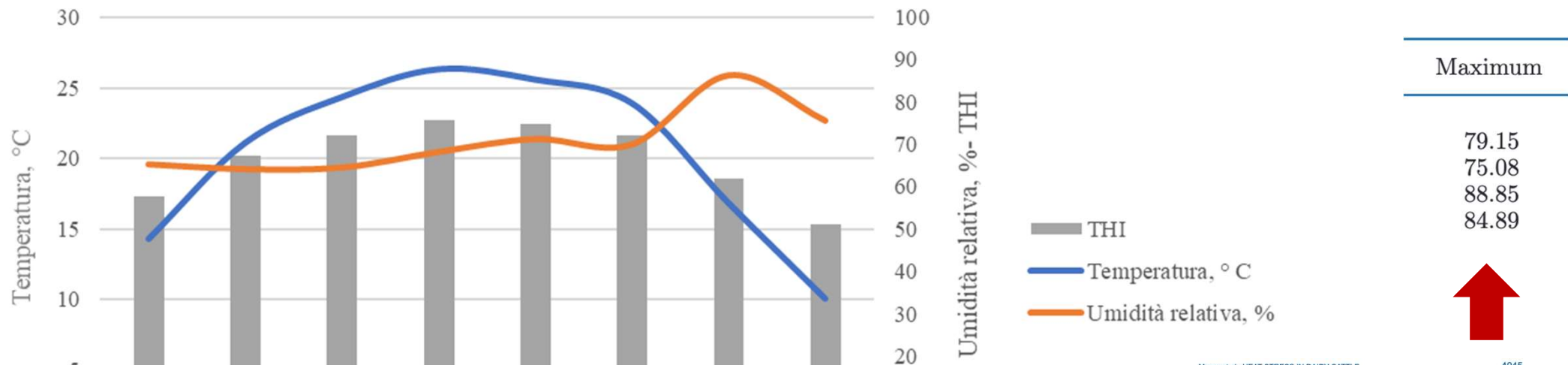
ED-XRF Spectro Xepos 5P (Ametek)

- ✓ Sodio
- ✓ Magnesio
- ✓ Potassio
- ✓ Calcio
- ✓ Fosforo
- ✓ Zolfo
- ✓ Cloro

RISULTATI

RISULTATI - THI

TEMPERATURE HUMIDITY INDEX (THI) - 2023



Moore et al.: HEAT STRESS IN DAIRY CATTLE 4045

Table 1. Descriptive statistics of temperature-humidity index (THI), weekly average THI (wTHI), maximum temperature-humidity index (MTHI), weekly average MTHI (wMTHI), and milk traits

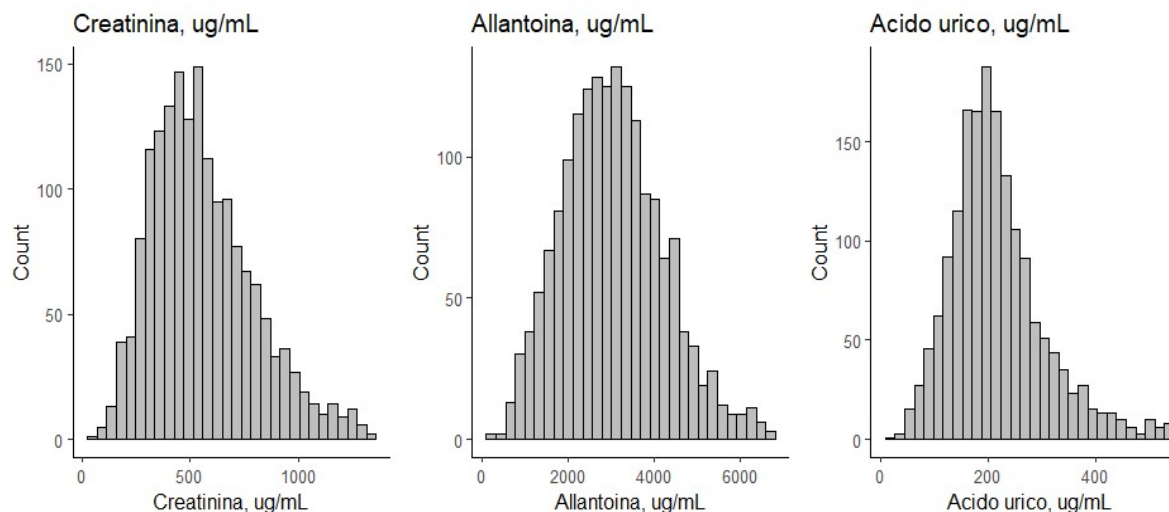
Item ^a	Missing, n	Mean	SD	CV, %	Minimum	Maximum
Daily weather (n = 623)						
THI	0	52.09	12.71	24.40	15.66	79.15
wTHI	0	52.37	12.44	23.75	16.29	75.08
MTHI	0	60.62	12.89	21.26	30.56	88.85
wMTHI	0	61.03	12.71	20.83	28.96	84.89
Bulk milk records (n = 700)						
Fat, %	75	3.83	0.28	7.31	2.84	4.91
Protein, %	66	3.40	0.15	4.41	2.96	3.97
Lactose, %	69	4.79	0.08	1.67	4.49	4.99
SCS	66	4.04	0.84	20.79	0.82	6.39
Individual test-day records (n = 46,338)						
Yield, kg/d	158	32.94	9.83	29.84	3.80	63.10
Fat, %	700	3.88	0.80	20.62	1.09	6.77
Protein, %	303	3.42	0.38	11.11	2.21	4.85
Lactose, %	424	4.81	0.21	4.37	3.35	5.53
Urea, mg/dL	96	22.77	8.10	35.57	0.01	47.40
SCS	18	2.91	1.97	67.70	-3.64	9.64
DSCC, %	12,912	64.35	16.03	24.91	15.90	97.20
DSCC ₂	12,912	5.95	2.23	37.48	-0.81	13.06

^awTHI = average THI measured 7 d (6 to 0) before the milk sampling date; wMTHI = average MTHI measured 7 d (6 to 0) before the milk sampling date; DSCC = the ratio of polymorphonuclear leukocytes and lymphocytes to total SCC; DSCC₂ = logarithmic transformation of the DSCC, expressed as cells per milliliter.

RISULTATI – Analisi IZS

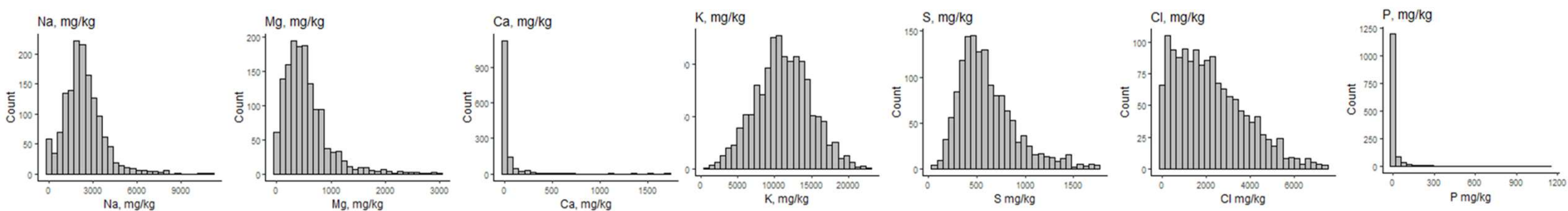
	Frisona italiana		Pezzata Rossa		Rendena	
	Media	DS	Media	DS	Media	DS
Urea, mmol/L	182.05	69.12	182.68	65.41	141.52	55.08
Creatinina, $\mu\text{mol/L}$	5421.45	1875.30	8621.28	2622.28	8164.53	2502.70
Proteine urinarie, mg/dL	9.30	18.34	9.80	11.18	7.53	2.83
PU/CU	0.17	0.52	0.10	0.13	0.08	0.02
Peso specifico	1.03	0.01	1.03	0.02	1.03	0.01
pH	8.99	0.10	8.96	0.21	8.98	0.14

RISULTATI - HPLC



	Frisona		Pezzata Rossa		Rendena	
	Media	DS	Media	DS	Media	DS
Creatinina, µg/mL	505.91	209.80	819.75	300.86	703.14	275.57
Allantoina, µg/mL	3071.07	1273.86	3280.86	1085.20	2592.23	690.50
Acido urico, µg/mL	225.05	105.27	231.61	120.03	210.77	87.12

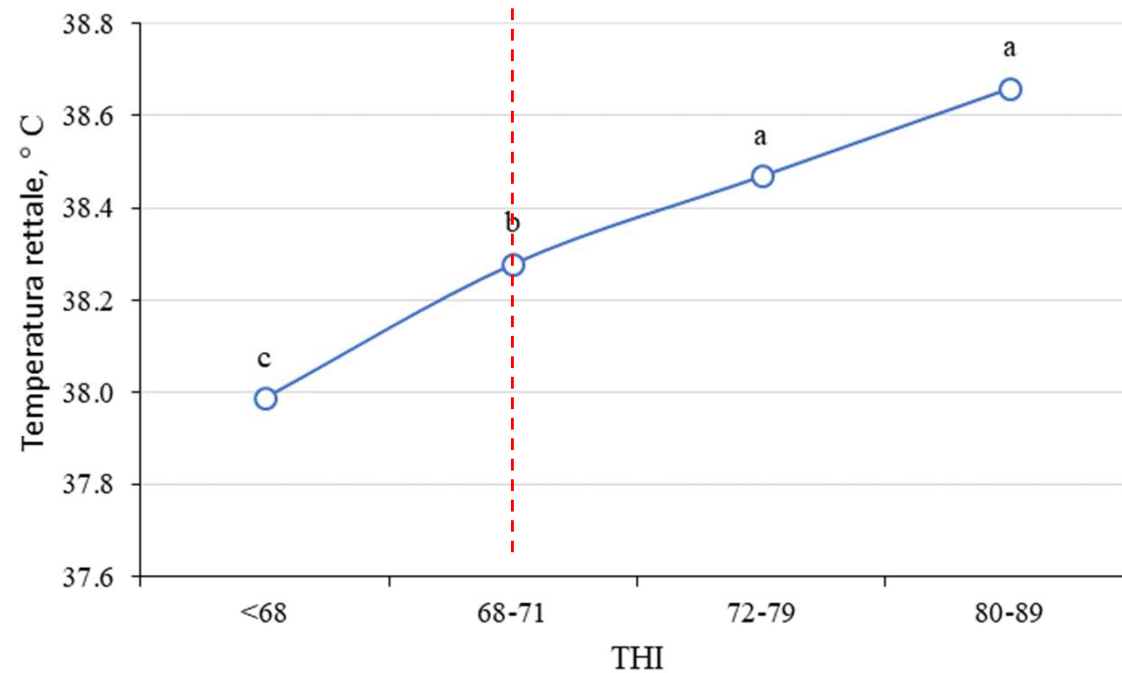
RISULTATI - XRF



	Frisona		Pezzata Rossa		Rendena	
	Media	DS	Media	DS	Media	DS
Na, mg/kg	2624.05	1245.24	1221.16	944.00	2278.33	1702.72
Mg, mg/kg	482.61	390.51	773.66	472.33	444.53	316.63
P, mg/kg	34.86	126.90	46.34	155.04	1.86	4.92
S, mg/kg	611.46	295.31	548.30	276.40	799.20	365.99
K, mg/kg	10443.13	3401.92	13363.95	3804.39	14574.05	3138.56
Ca, mg/kg	38.89	134.44	63.68	157.69	236.61	413.49
Cl, mg/kg	1810.48	1385.44	3625.44	1596.36	3220.81	1185.12

RISULTATI

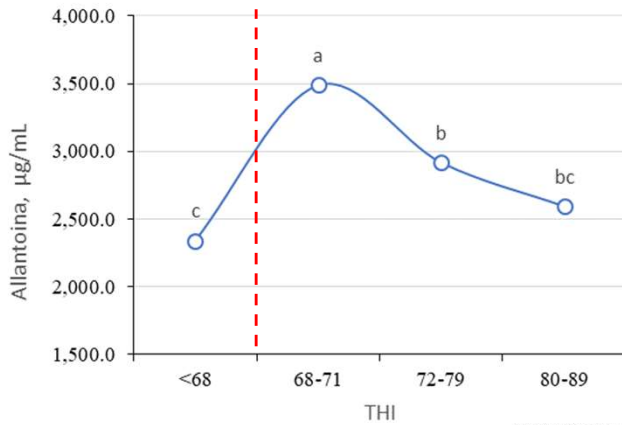
TEMPERATURA RETTALE e TEMPERATURE HUMIDITY INDEX (THI)



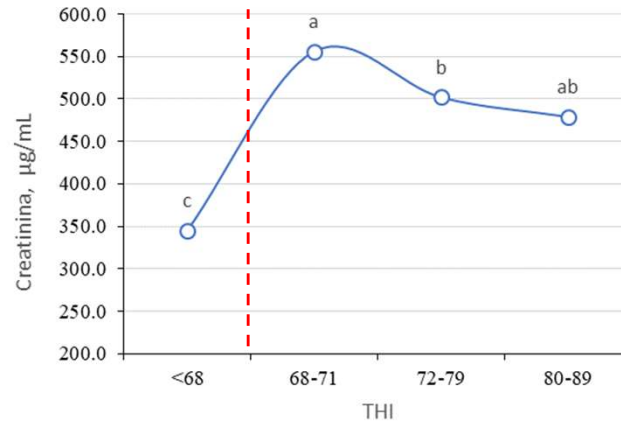
RISULTATI - HF



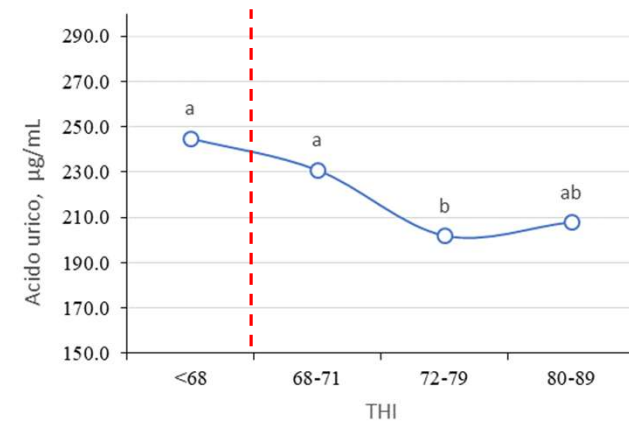
ALLANTOINA



CREATININA



ACIDO URICO



ALLANTOINA e ACIDO URICO

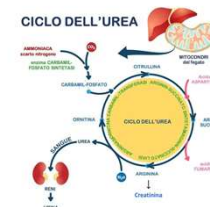
- Sono i prodotti finali del metabolismo delle proteine, derivanti dalla scissione delle purine
- L' allantoina è il prodotto finale dell'ossidazione dell'acido urico



Prof. Massimo De Marchi – massimo.demarchi@unipd.it – Bressanvido, 12 Ottobre 2024

UREA e CREATININA

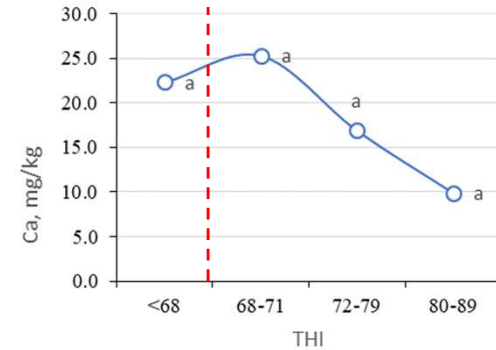
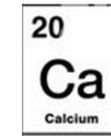
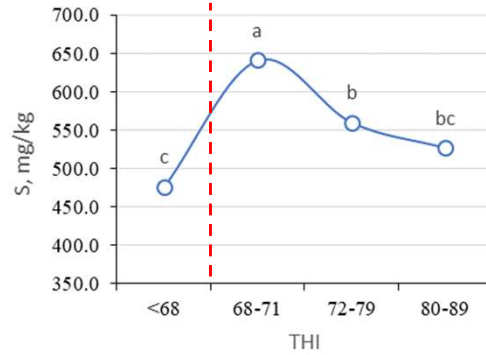
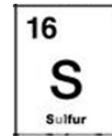
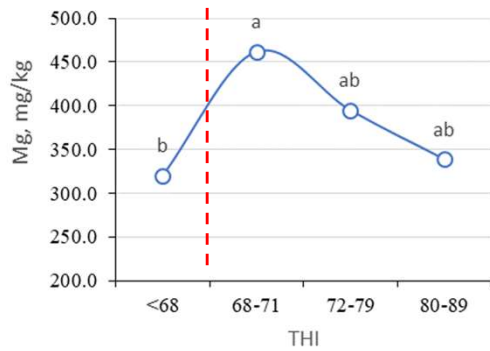
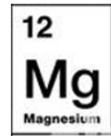
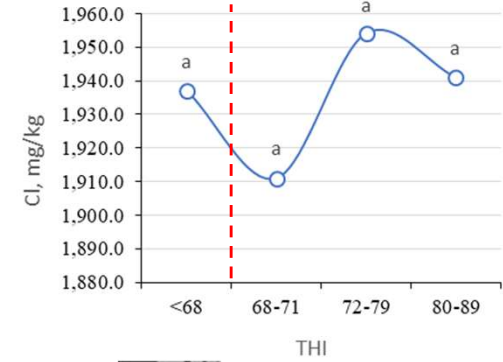
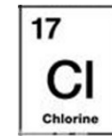
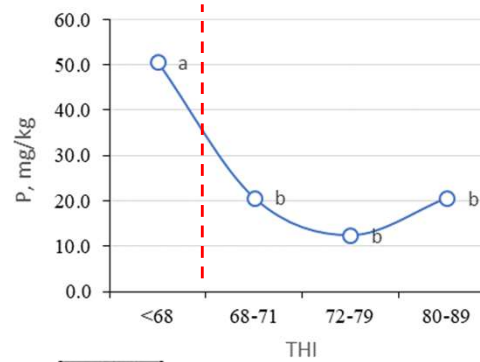
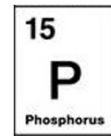
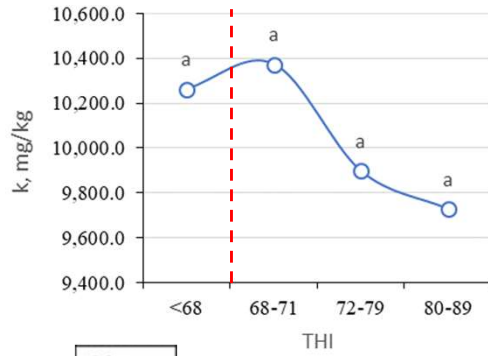
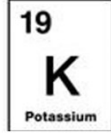
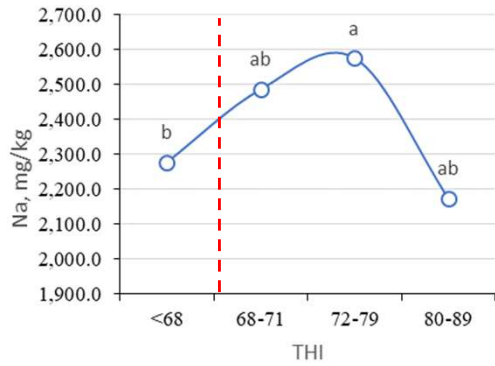
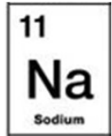
- L'utilizzo della frazione muscolare provoca il rilascio di aminoacidi con conseguente produzione di urea epatica eliminata poi con le urine.
- La creatinina è una sostanza chimica che è originata dallo scarto del metabolismo della fosfocreatinina, la quale è una proteina che contribuisce alla produzione di energia necessaria per far funzionare i muscoli.



Prof. Massimo De Marchi – massimo.demarchi@unipd.it – Bressanvido, 12 Ottobre 2024

$$y = \mu + \text{stadio di lattazione} + \text{ordine di parto} + \text{classi THI} + \text{allevamento} + e$$

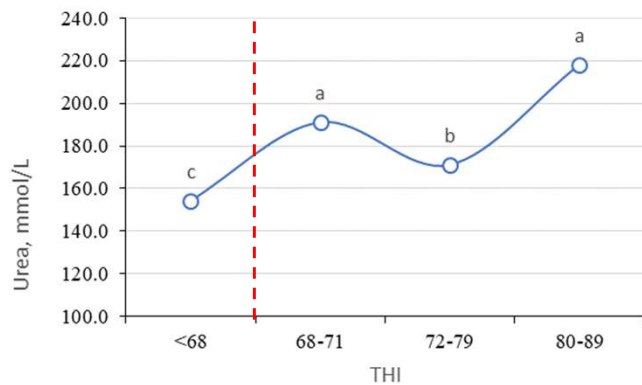
RISULTATI - HF



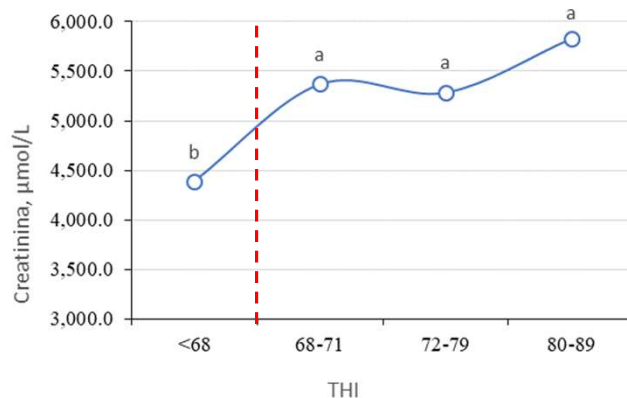
$$y = \mu + \text{stadio di lattazione} + \text{ordine di parto} + \text{classi THI} + \text{allevamento} + e$$

RISULTATI - HF

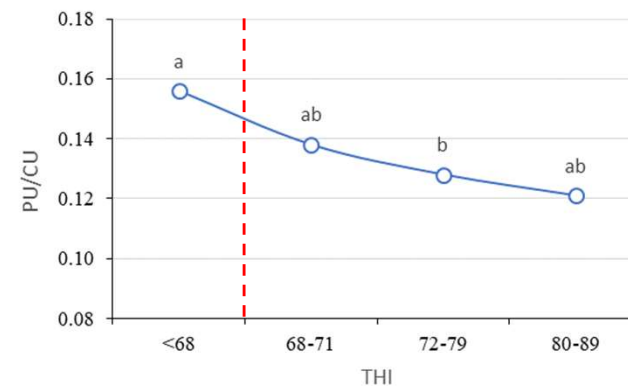
UREA



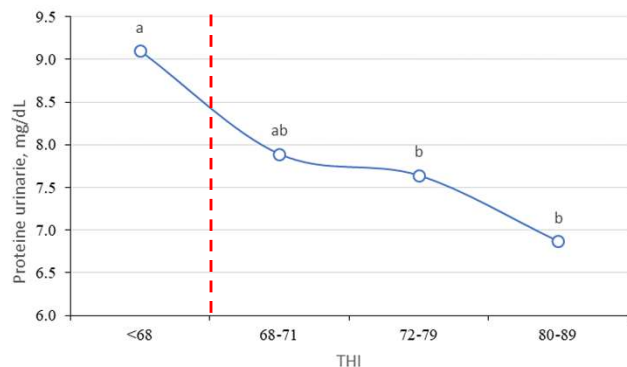
CREATININA



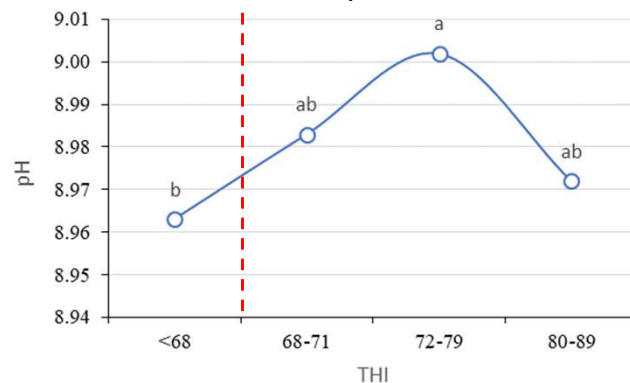
PU/CU



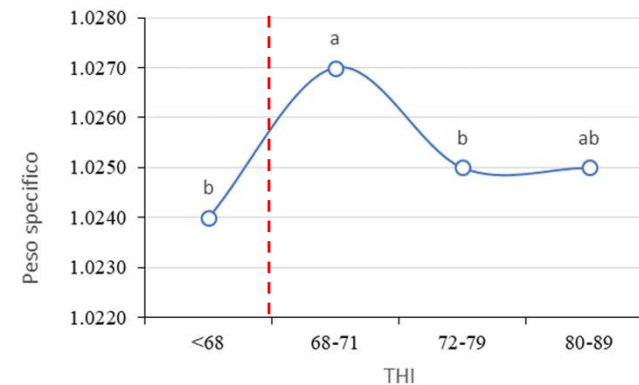
PROTEINE URINARIE



pH



PESO SPECIFICO



$$y = \mu + \text{stadio di lattazione} + \text{ordine di parto} + \text{classi THI} + \text{allevamento} + e$$

Applicazioni nei laboratori ARAV

PREDIZIONI PARAMETRI URINE CON INFRAROSSO:



Carattere	N totali	N	% outliers	SE _C	R ² _C	SE _{CV}	R ² _{CV}	LF	RPD _{CV}
Urea (mmol/L)	1721	1540	10.52%	6.18	0.99	6.223	0.99	11	10.46
Creatinina (μmol/L)	1725	1540	10.72%	223.34	0.99	231.27	0.99	11	9.32
Proteine urinarie (mg/dl)	1624	1459	10.16%	2.31	0.40	2.36	0.37	11	1.26
PU/CU	1623	1483	8.63%	0.04	0.36	0.04	0.35	9	1.24
Allantoina (μg/ml)	1672	1542	7.78%	865.74	0.44	869.88	0.43	9	1.32
Creatinina(μg/ml)	1672	1545	7.60%	119.523	0.74	121.87	0.73	9	1.93
Acido urico (μg/ml)	1672	1517	9.27%	64.50	0.31	65.44	0.29	9	1.18

PREDIZIONI PARAMETRI URINE CON INFRAROSSO:



Minerali, mg/kg	Database di calibrazione		Database di validazione	
	r	SE	r	SE
Na	0.91	363.96	0.89	423.85
Mg	0.90	106.35	0.86	122.31
Ca	0.96	8.01	0.87	11.59
P	0.93	50.35	0.99	19.29
K	0.91	1482.57	0.86	1962.49
S	0.95	86.93	0.89	131.15
Cl	0.98	268.93	0.99	175.67

CONCLUSIONI

Aumento THI (> 68)

- aumenta la concentrazione di urea, allantoina e creatinina e diminuisce la concentrazione di acido urico nelle urine
- pH delle urine più basico e aumenta il peso specifico
- Diminuisce il rapporto PU/CU nelle urine
- Variazione della concentrazione dei minerali nelle urine es: \uparrow Na ; \downarrow K



Aumento THI (> 68)

- aumenta la concentrazione di urea, allantoina e creatinina e diminuisce la concentrazione di acido urico nelle urine
- pH delle urine più basico e aumenta il peso specifico
- Diminuisce il rapporto PU/CU nelle urine
- Variazione della concentrazione dei minerali nelle urine es: \uparrow Na ; \downarrow K



Possibili indicatori per il miglioramento genetico allo stress da caldo nella vacca da latte.



Prof. Massimo De Marchi

massimo.demarchi@unipd.it

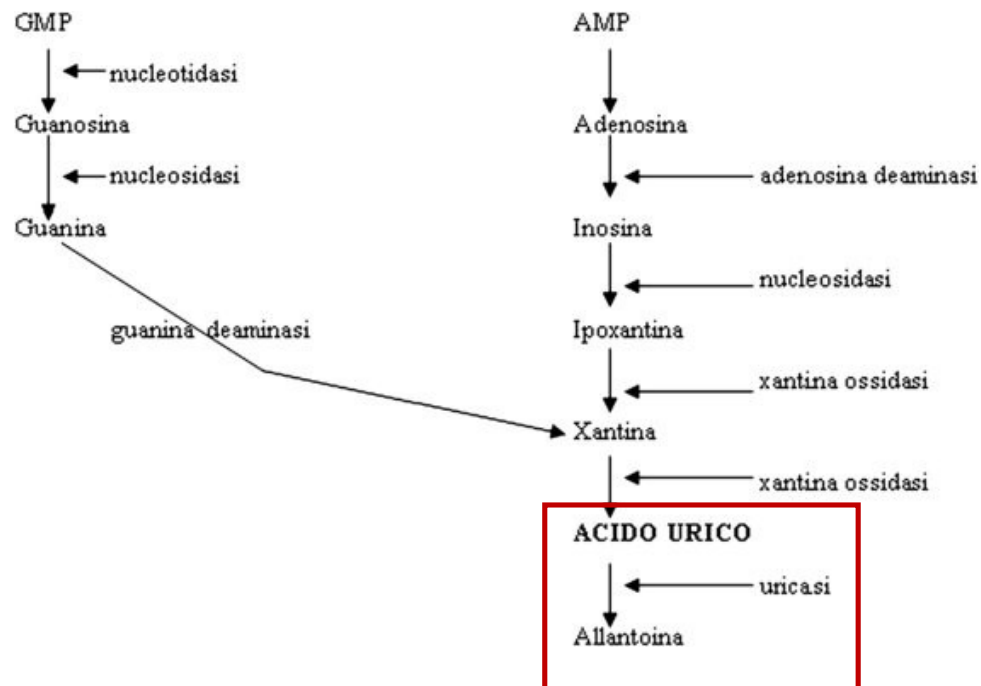
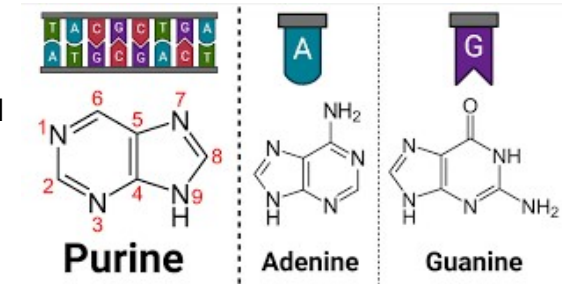


Prof. Massimo De Marchi

massimo.demarchi@unipd.it

ALLANTOINA e ACIDO URICO

- Sono i prodotti finali del metabolismo delle proteine, derivanti dalla scissione delle purine
- L' allantoina è il prodotto finale dell'ossidazione dell'acido urico



UREA e CREATININA

- L'utilizzo della frazione muscolare provoca il rilascio di aminoacidi con conseguente produzione di urea epatica eliminata poi con le urine.
- La creatinina è una sostanza chimica che è originata dallo scarto del metabolismo della fosfocreatinina, la quale è una proteina che contribuisce alla produzione di energia necessaria per far funzionare i muscoli.

