Performance of Heat-Stressed Dairy Goats Supplemented with Rumen-Protected Methionine

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Introduction: Effects of heat stress (HS)

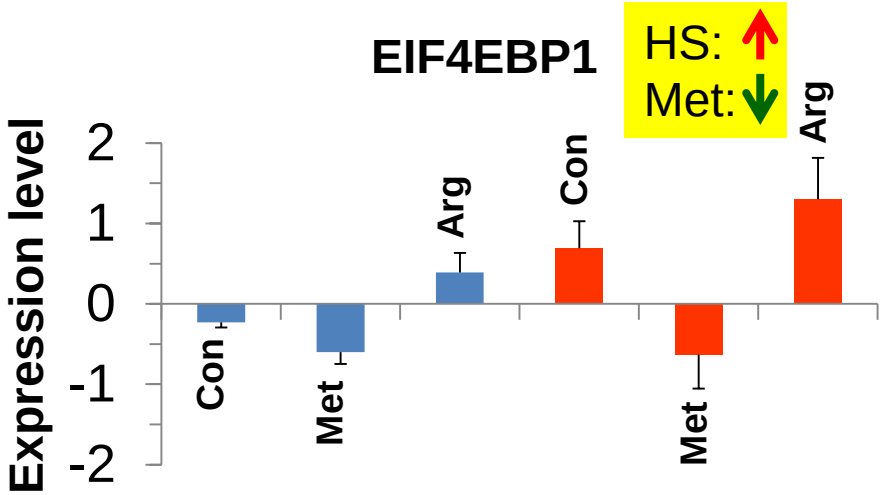
Responses of dairy goats to HS	
Rectal temperature	+0.5 to +1.2ºC
Respiratory rate	+240 to 360%
Water consumption	+200 to 300%
Feed intake	-20 to 30%
Milk yield	-7 to 15%
Milk composition	-5 to 12% in fat and protein contents

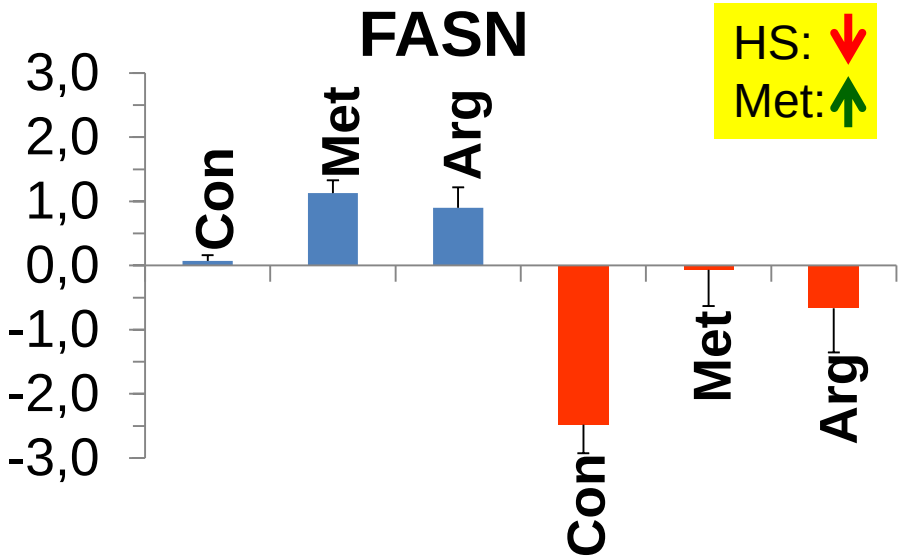
Feed intake ↓ → Protein intake ↓ → Amino acid intake ↓

Why did we choose Methionine (MET)?

Introduction: Effects of methionine

- Limiting factor and increases milk protein (Schwab, 2011).
- Methyl donor (methylation of DNA, RNA, histone).
- Regulates gene expression in HS mammary cells (Salama et al., 2019):





Hypothesis & Objectives

- Supplementation with rumen-protected would improve milk composition (protein and fat) under HS conditions.

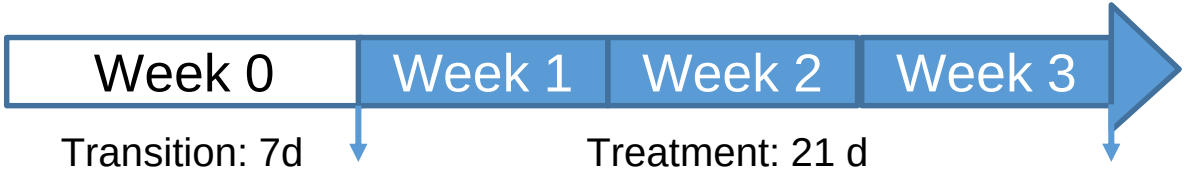
- The effect of **methionine supplementation** in **HS goats** on:
  - **Thermo-physiology**: Rectal temperature & respiratory rate.
  - **Performance**: Intake, milk yield, milk composition.

Animals & Treatments

Ambient conditions	Diets	
	CON	MET 2.6 g/d (Smartamine)
TN	TN-CON	TN-MET
HS	HS-CON	HS-MET

- 8 multiparas goats: replicated 4 × 4 Latin Square
- **TN**: 19.4 ± 0.02ºC; humidity 58 ± 5%; **THI = 65**
- **HS**: Day: 35.0 ± 0.5ºC; 45 ± 5% humidity; **THI = 83**
  Night: 28.0 ± 0.5ºC; 45 ± 5% Humidity; **THI = 76**

Measurements & Sampling



- DM intake and water consumption: *Daily*.
- Rectal temperature & Respiratory rate: *Daily at 0800, 1200, 1700 h*.
- Milk yield: *Daily*.
- Milk Composition: *Weekly, MilkoScan*.
- Somatic cell count: *Fossomatic*.
- Body weight: *Start & end of each period*.

Statistical Analyses

PROC MIXED of SAS v.9.4 (repeated measurements):

- Fixed effects:
  - Ambient temperature (*TN vs. HS*).
  - Supplementation (*CON vs. MET*).
  - Period (1 to 4).
  - Interactions among fixed effects.
- Random effects:
  - Animal.
  - Residual error.

Physiological responses

Rectal temperature and respiratory rate under thermal-neutral **(TN)** or heat stress **(HS)**, without supplementation (**CON**) or supplemented with methionine **(MET)**

Item	TN		HS		ESM	Effect (*P* <)		
	CON	MET	CON	MET		Temp	MET	T × M
Rectal Temperature, ° C						0.001	0.19	0.21
08:00	38.4	38.4	39.3	39.2	0.04		**-0.06°C**	
12:00	38.6	38.6	39.7	39.6	0.04		**-0.09°C**	
17:00	38.8	38.8	40.0	39.9	0.04		**-0.11°C**	
Respiratory rate, r/min						0.001	0.25	0.23
08:00	28	28	98	92	2		**-6 r/min**	
12:00	32	32	140	135	2		**-5 r/min**	
17:00	35	36	162	161	2			

Productive responses

Feed intake, body weight variation, and milk production under thermal-neutral **(TN)** or heat stress **(HS)**, without supplementation (**CON**) or supplemented with methionine **(MET)**

Item		TN		HS		SEM	Effect (*P* <)		
		CON	MET	CON	MET		Temp	MET	T × M
Intake, kg/d	-10%	2.40	2.31	2.08	2.17	0.09	0.001	0.96	0.11
Water, kg/d	+43%	4.7	4.4	6.3	6.7	0.5	0.001	0.77	0.16
BW, kg/21d	-69%	0.10	0.29	-0.37	0.04	0.17	0.04	0.09	+90%
Milk, kg/d	-8%	2.04	1.98	2.03	2.18	0.15	0.14	0.52	0.12
FCM 3.5%, kg/d		2.43	2.45	2.09	2.40	0.17	0.01	0.03	+15%

Productive responses

Milk composition under thermal-neutral **(TN)** or heat stress **(HS)**, without supplementation (**CON**) or supplemented with methionine **(MET)**

Item	TN		HS		SEM	Effect (*P* <)		
	CON	MET	CON	MET		Temp	MET	T × M
Fat, %					0.11	0.001	0.08	0.50
Protein, %	3.59	3.60	3.24	3.25	0.10	0.001	0.84	0.97
Casein, %	3.27	3.34	2.98	3.00	0.10	0.001	0.20	0.41
Lactose, %	4.47	4.43	4.33	4.35	0.05	0.001	0.54	0.21
SCC, log_{10}	5.54	5.70	5.73	5.82	0.20	0.21	0.31	0.77

-14%

+0.08

+0.19

-10%

-10%

-2.5%

Conclusions

- Heat stress **negatively** affected **milk composition** (fat, protein, lactose).
- MET supplementation **tended to reduce BW losses** under HS conditions.
- MET supplementation **tended to improve milk fat content** with **no effect on milk protein**.
- Probably **one single amino acid** is **not enough** to improve milk protein in HS animals.

Thank you for the attention!