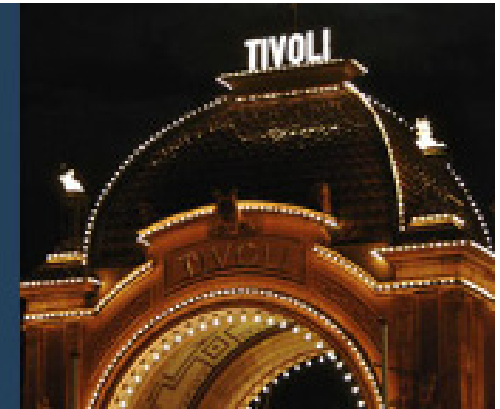


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Milk fat content and fatty acid profile of heat-stressed dairy goats supplemented with soybean oil (Abstr. p. 403)



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Background

According to previous results in dairy goats (Hamzaoui et al., 2013; Salama et al., 2014), **heat stress (HS)**:

- **Decreases feed intake** (−25 to −35%) and **milk yield** (−4 to −10%) according to lactation stage.
- **Reduces milk fat** and **milk protein** contents (−10%).
- The effects vary by breed and are **mitigated** by adaptive mechanisms.

Fat supplementation (+2.4%; Bouattour et al., 2008), as **soybean oil (SBO)** in the diet of dairy goats:

- **Increases fat** (+15%) and **conjugated linoleic acid (CLA)** (+200%) contents in **milk**.

Aims

Question:

Do dairy goats respond to SBO supplementation under thermoneutral (TN) and heat stress (HS) conditions similarly?

- Milk yield and milk composition (fat, protein and lactose contents)
- Fatty acids (FA) profile including conjugated linoleic acid (CLA-rumenic) and trans-vaccenic acid (TVA).



Material & Methods: 1/2

■ Animals:

8 Murciano-Granadina dairy goats (42.8 ± 1.3 kg BW; 99 ± 1 DIM) in a climatic chamber.

■ Experimental design:

4×4 Latin square (12 + 5 d / period)

Treatments:

- **Diet:** Ad libitum as a TMR.
 - **Control (CTR)**
 - **Supplemented SBO 4%**
- **Ambient temperature (40% RH):**
 - **TN** (15-20°C, THI = 59-65)
 - **HS** (12 h day, 37°C, THI = 85; 12 h night, 30°C, THI = 77).

$$\text{THI} = 1.8 \cdot T - [T - 14.3] \cdot [100 - H] / 100 + 32 \quad (T = \text{temp., } ^\circ\text{C}; \text{RH} = \text{relative humidity, } \%)$$



Material & Methods: 2/2

Diet: 60% forage

Ingredient	%, as fed
Alfalfa hay	60.4
Barley grain	15.0
Beet pulp	9.1
Corn grain	7.5
Soybean meal	3.0
Sunflower meal	3.0
Canne molases	1.0
Salt	0.6
Na bicarbonate	0.2
Vit-Min Mix	0.2
Soybean oil	0/4

Experimental design:

1	2	3	4
TN	TN+SBO	HS	HS+SBO
HS+SBO	HS	TN+SBO	TN
TN+SBO	TN	HS+SBO	HS
HS	HS+SBO	TN	TN+SBO

■ Variables measured:

- Milk yield
- Milk composition: fat, protein and lactose
- Milk fatty acids (FA) profile with TVA and CLA.

■ Statistical Analysis:

PROC MIXED for repeated measurements (SAS v.9.1.3)

Effects of heat stress (HS) and soybean oil supplementation (SBO) on dairy goats: 1/2

Ítem	TN		HS		SEM ¹	Effect (<i>P</i> <)	
	CTR	SBO	CTR	SBO		Envir.	Diet
Rectal temperature, °C	38.6 ^a	38.7 ^a	39.6 ^b	39.7 ^b	0.1	0.001	0.351
Respiration rate, b/min	34 ^a	35 ^a	111 ^b	113 ^b	4	0.001	0.705
BW change, kg BW	+3.5 ^a	+2.7 ^a	-2.1 ^b	-2.3 ^b	1.0	0.001	0.597
Intake, kg DM/d							
Water drank, L/d							
Milk yield, L/d							
NEFA blood, mmol/L							

a, b *P* < 0.05

Environment × Diet: *P* > 0.05

Effects of heat stress (HS) and soybean oil supplementation (SBO) on dairy goats: 1/2

Ítem	TN		HS		SEM ¹	Effect (<i>P</i> <)	
	CTR	SBO	CTR	SBO		Envir.	Diet
Rectal temperature, °C	38.6 ^a	38.7 ^a	39.6 ^b	39.7 ^b	0.1	0.001	0.351
Respiration rate, b/min	34 ^a	35 ^a	111 ^b	113 ^b	4	0.001	0.705
BW change, kg BW	+3.5 ^a	+2.7 ^a	-2.1 ^b	-2.3 ^b	1.0	0.001	0.597
Intake, kg DM/d	2.26 ^a	2.26 ^a	1.47 ^b	1.34 ^b	0.09	0.001	0.490
Water drank, L/d	6.4 ^a	6.0 ^a	10.6 ^b	12.0 ^b	0.1	0.001	0.655
Milk yield, L/d	1.88 ^a	1.99 ^a	1.79 ^b	1.75 ^b	0.11	0.013	0.606
NEFA blood, mmol/L	0.064 ^a	0.108 ^b	0.084 ^a	0.116 ^b	0.017	0.380	0.025

a, b *P* < 0.05

Environment × Diet: *P* > 0.05

Effects of heat stress (HS) and oil supplementation (SBO) on dairy goats: 2/2

Item	TN		HS		SEM	Effect ($P <$)	
	CTR	SBO	CTR	SBO		Envir.	Diet
Milk composition, %	+27%		+33%				
Fat	3.98^a	5.07^b	3.64^a	4.85^b	0.14	0.180	0.001
Protein	3.40^a	3.40^a	2.85^b	2.96^b	0.07	0.001	0.561
Lactose	4.51 ^a	4.66 ^a	4.30 ^b	4.43 ^b	0.05	0.004	0.057
Milk 3.5%, L/d	2.17^a	2.31^a	1.86^b	2.10^{ab}	0.13	0.004	0.035
Milk fatty acids, %FA							
≤C14							
C16 + C16:1							
>C16							
CLA							
TVA							

a, b $P < 0.05$

Environment × Diet: $P > 0.05$

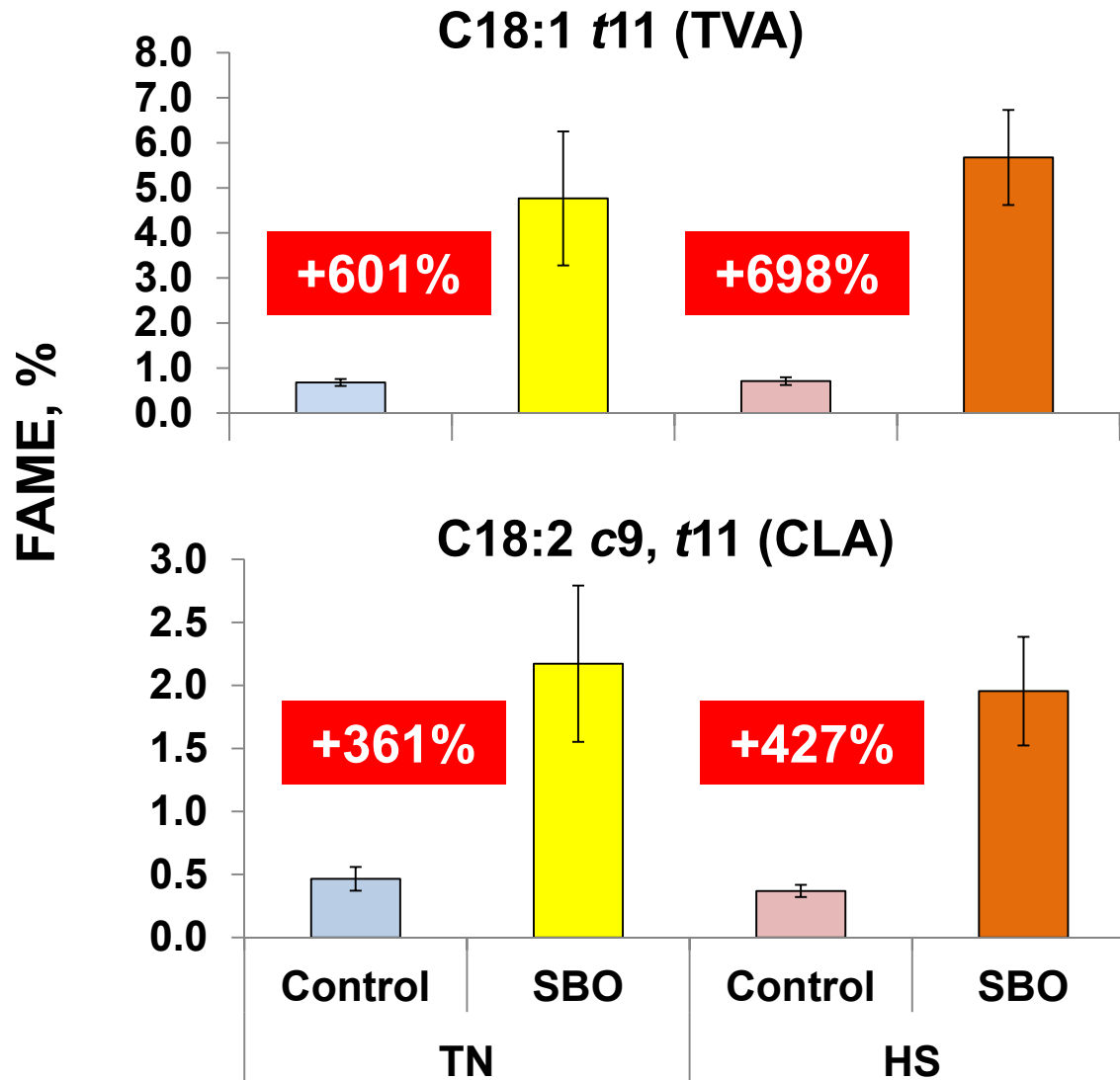
Effects of heat stress (HS) and oil supplementation (SBO) on dairy goats: 2/2

Item	TN		HS		SEM	Effect ($P <$)	
	CTR	SBO	CTR	SBO		Envir.	Diet
Milk composition, %	+27%		+33%				
Fat	3.98^a	5.07^b	3.64^a	4.85^b	0.14	0.180	0.001
Protein	3.40^a	3.40^a	2.85^b	2.96^b	0.07	0.001	0.561
Lactose	4.51 ^a	4.66 ^a	4.30 ^b	4.43 ^b	0.05	0.004	0.057
Milk 3.5%, L/d	2.17^a	2.31^a	1.86^b	2.10^{ab}	0.13	0.004	0.035
Milk fatty acids, %FA							
<C14	37.4^a	29.7 ^b	34.0^c	23.4 ^d	0.8	0.001	0.001
C16 + C16:1	39.2 ^a	26.3 ^b	31.2 ^c	22.6 ^d	1.4	0.001	0.001
>C16	22.9 ^a	43.6^b	34.0 ^c	53.6^d	1.4	0.001	0.001
CLA	0.47 ^a	2.17^b	0.37 ^a	1.95^b	0.38	0.694	0.001
TVA	0.68 ^a	4.76^b	0.71 ^a	5.68^b	1.49	0.614	0.001

^{a, b} $P < 0.05$

Environment × Diet: $P > 0.05$

Effects on milk FA methyl esters (FAME)

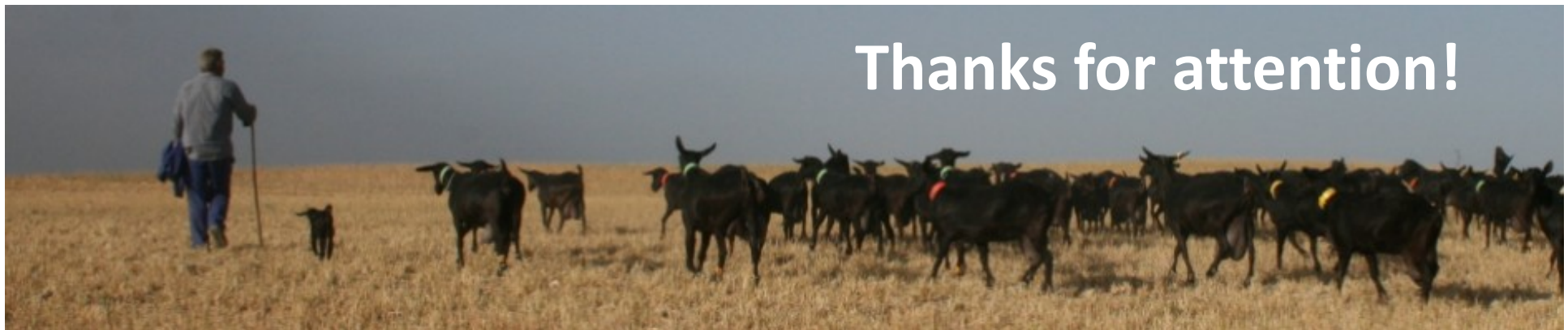


Summary of effects

Item	Heat stress	Soybean oil
Intake	-38%	NS
Milk yield	-9%	NS
Fat, %	-9%	+30%
Protein, %	-15%	NS
FA ≤ C14 (Synthesized)	-21%	-26%
FA = C16 & C16:1	-25%	-31%
FA > C16 (Transferred)	+46%	+71%
CLA	NS	+400%
TVA	NS	+650%

Conclusions

- **Heat stress decreased milk yield and milk composition** in dairy goats.
- Supplementation with **soybean oil (SBO) increased milk fat and CLA similarly** in thermoneutral and in heat stressed goats.
- No negative effects of SBO were observed on milk protein.
- Use of **moderate SBO (~4% as fed) is recommended** for the diet of heat stressed goats in practice .



Thanks for attention!

Objectives

- To measure the lactational response of dairy goats to soybean oil supplementation under heat stress conditions.
- To identify the potential metabolite markers in the urine of dairy goats in response to:
 - Heat stress (HS)
 - Feed supplementation ^{-38%} with soybean oil (SBO)