“Characterization of physiological responses in Rasa Aragonesa ewes under water restriction”

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CENTRO DE INVESTIGACIÓN Y TECNOLOGÍA AGROALIMENTARIA DE ARAGÓN

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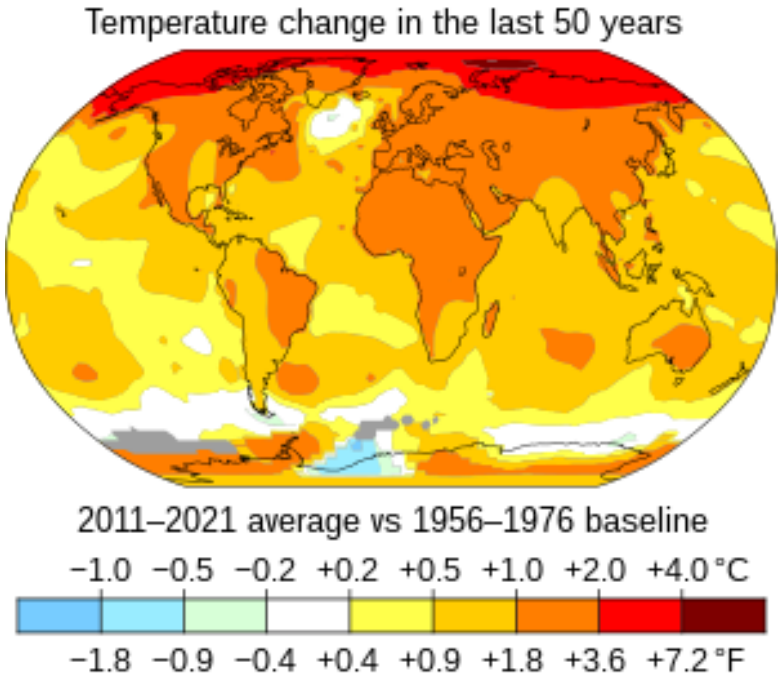
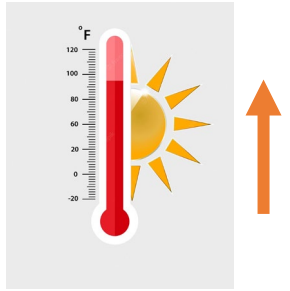
INTRODUCTION

Global climate change





INTRODUCTION

- Water → Limiting factor in semi-arid regions

↓

Stress response

↓

Negative effects on immunity and reduced welfare

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- Mediterranean countries → autochthonous breeds → well-adapted to the environment.

- Aragón (Spain) → Rasa Aragonesa.

OBJECTIVE

- Characterize the stress response of Rasa Aragonesa ewes subjected to total water restriction for 5 days.

MATERIALS AND METHODS

- Total water restriction for 5 days (n= 202 ewes).

Blood

(0d, 5d)

Wool

(0d, 28d)

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- Temperature and relative humidity → THI index

(Marai et al., 2007)

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- Dry matter intake (DMI), body weight (BW) and body condition score (BCS)

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- Stress biomarkers
  - Classical haematological measurements (n=15)
  - Biochemical measurements → total proteins, glucose & NEFAs
  - Cortisol
  - Dehydroepiandrosterone (DHEA) & its sulphate (DHEA-S)

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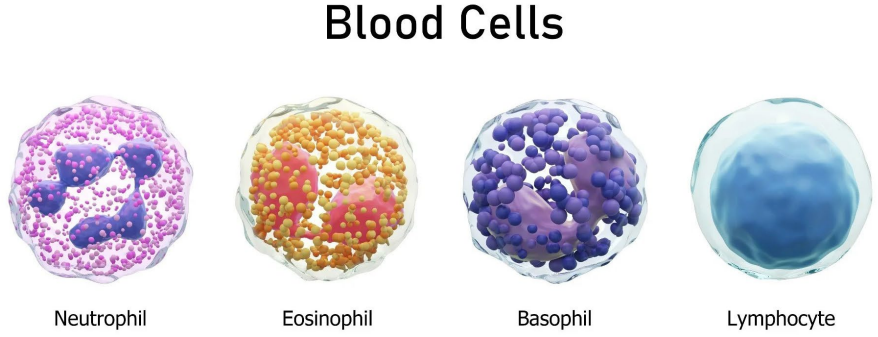

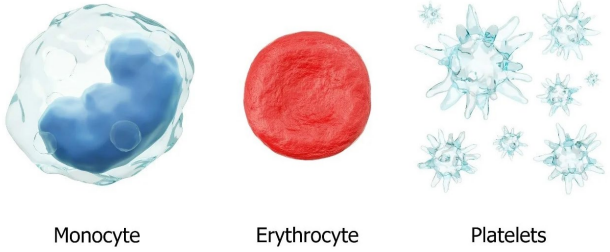

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- Mixed model → lme4 package :

  Phenotype = μ + sample day + initial BW + initial BCS + Age + e

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- Variation traits (5-0 in blood; 28-0 in wool) in % from basal values.

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  Phenotype = μ + sample day + initial BW + initial BCS + Age + e

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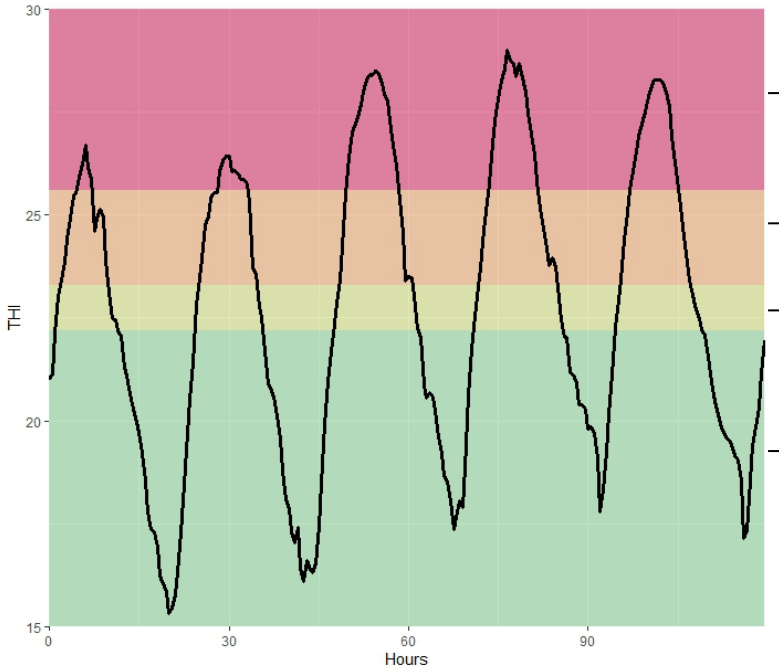
- Correlation matrix, PCA and hierarchical clustering (HCPC) → FactoMineR package.

RESULTS

- Heat stress → 55% (66 hours)



→ Extreme heat stress (27.5%; 33 h)

→ Severe heat stress (18.33%; 22 h)

→ Moderate heat stress (9.17%; 11 h)

→ Non heat stress (45%; 54 h)

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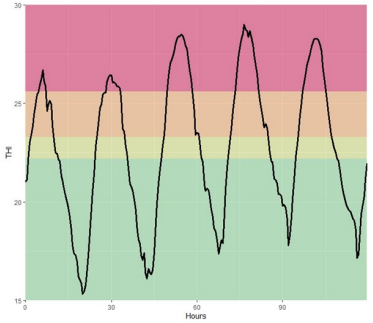

- DMI, BW and BCS decreased significantly during heat and water stress.

Day of sampling	day 0	day 1	day 2	day 3	day 4	day 5	SE[1]
Dry matter intake (kg/ewe)	1.86^{a}	1.53^{b}	0.67^{c}	0.22^{d}	0.08^{e}	0.03^{f}	0.004
BW (kg)	62.5^{a}	59.3^{b}	56.8^{c}	55.1^{d}	53.8^{e}	53^{f}	0.48
BCS	2.86^{a}	2.72^{b}	2.66^{c}	2.59^{d}	2.48^{e}	2.45^{e}	0.014

→ Almost zero

→ 15.2%

[1]Standard error. Different letters in a row indicate significant differences between days ($P < 0.05$).

RESULTS

- Significant differences in all haematological and biochemical measurements except plasma cortisol and plasma cortisol:DHEA-S ratio.

	Day of sampling			
Variable	day 0	day 5	day 28	S.E.
Haematocrit (%)	37.4^{b}	45.8^{a}		0.28
Erythrocytes [10^6/µl]	9.5^{b}	10.6^{a}		0.07
Haemoglobin [g/dl]	10.7^{b}	12^{a}		0.07
Leucocytes [/mm^3]	5831^{b}	6251^{a}		102
Neutrophils [/mm^3]	2236^{b}	3130^{a}		71.2
Lymphocytes [/mm^3]	3093^{a}	2618^{b}		53
NLR	0.8^{b}	1.3^{a}		0.03
Platelets [10^3/mm^3]	414^{a}	323^{b}		9.45
Total proteins [g/dl]	8.1^{b}	9.4^{a}		0.04
Glucose [mg/dl]	69.6^{a}	59.7^{b}		0.72
NEFAs [mmol/L]	0.2^{b}	1.6^{a}		0.03
Plasma cortisol [ng/ml]	9.3	8.9		0.66
Plasma DHEA [ng/ml]	4^{b}	7.5^{a}		0.2
Plasma DHEA-S [ng/ml]	1.4^{b}	1.6^{a}		0.05
Plasma cortisol:DHEA ratio	3.2^{a}	1.7^{b}		0.42
Plasma cortisol:DHEA-S ratio	7.7	7.5		0.64
Wool cortisol [ng/ml]	3.5^{b}		9.1^{a}	0.14
Wool DHEA [ng/ml]	0.8^{b}		2^{a}	0.05
Wool DHEA-S [ng/ml]	9.4^{b}		21.1^{a}	0.36
Wool cortisol:DHEA ratio	7.6^{a}		5.4^{b}	0.35
Wool cortisol:DHEA-S ratio	0.4^{b}		0.4^{a}	0.01

Different letters indicate significant differences between days of sampling in each measurement ("a, b"; $p < 0,05$).
NLR: neutrophil-to-lymphocyte ratio, **NEFAs**: non-esterified fatty acids.

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	Day of sampling			
Variable	day 0	day 5	day 28	S.E.
↑ Erythrocytes [10^6/µl]	9.5^b	10.6^a		0.07
↑ Neutrophils [/mm^3]	2236^b	3130^a		71.2
↑ NLR	0.8^b	1.3^a		0.03
↑ NEFAs [mmol/L]	0.2^b	1.6^a		0.03
↑ Plasma DHEA [ng/ml]	4^b	7.5^a		0.2
↑ Plasma DHEA-S [ng/ml]	1.4^b	1.6^a		0.05
↑ Wool cortisol [ng/ml]	3.5^b		9.1^a	0.14
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↓Lymphocytes [/mm^3]	3093^a	2618^b		53
↓Platelets [10^3/mm^3]	414^a	323^b		9.45
↓Glucose [mg/dl]	69.6^a	59.7^b		0.72

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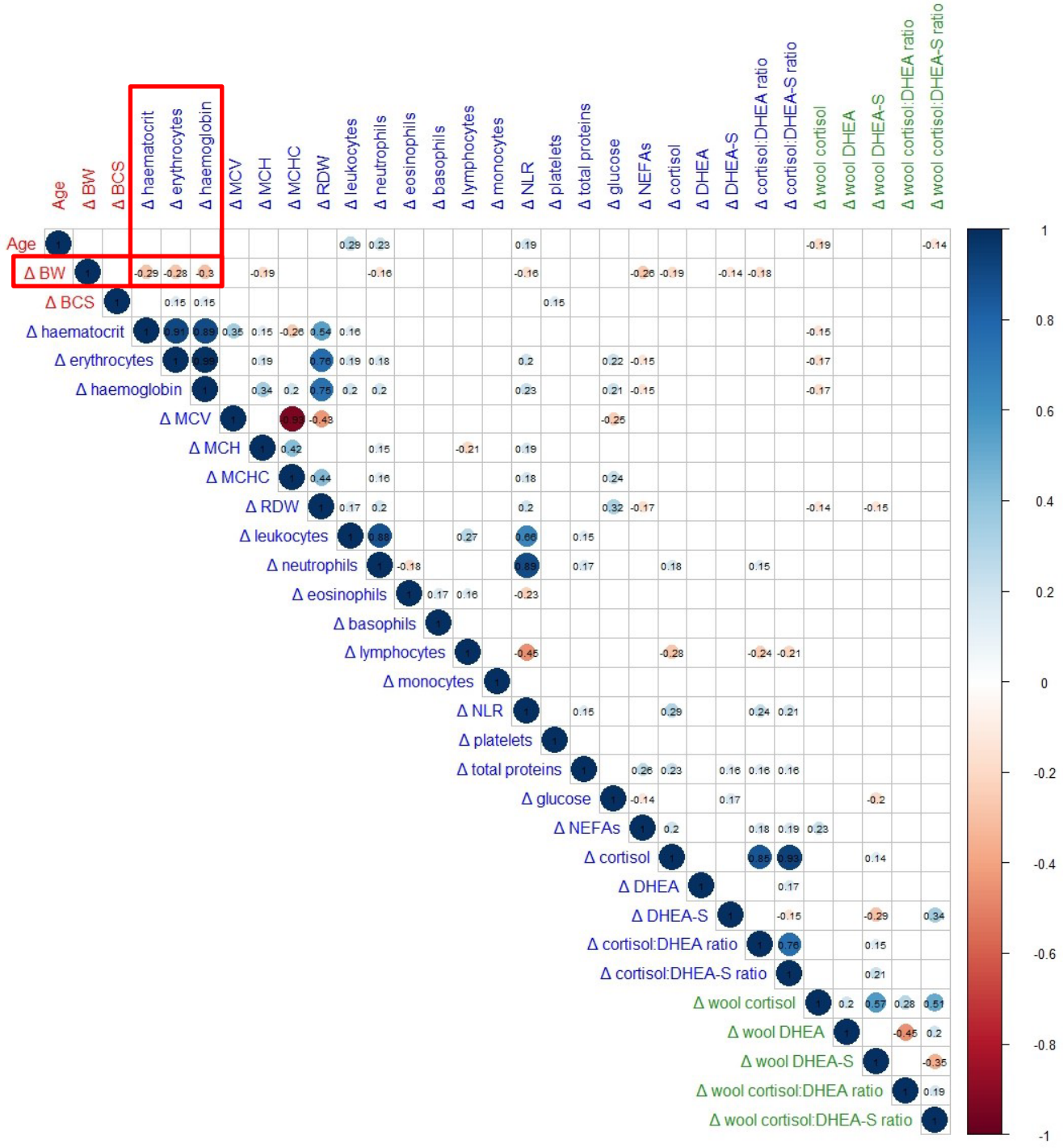
- Correlations (31 variables)



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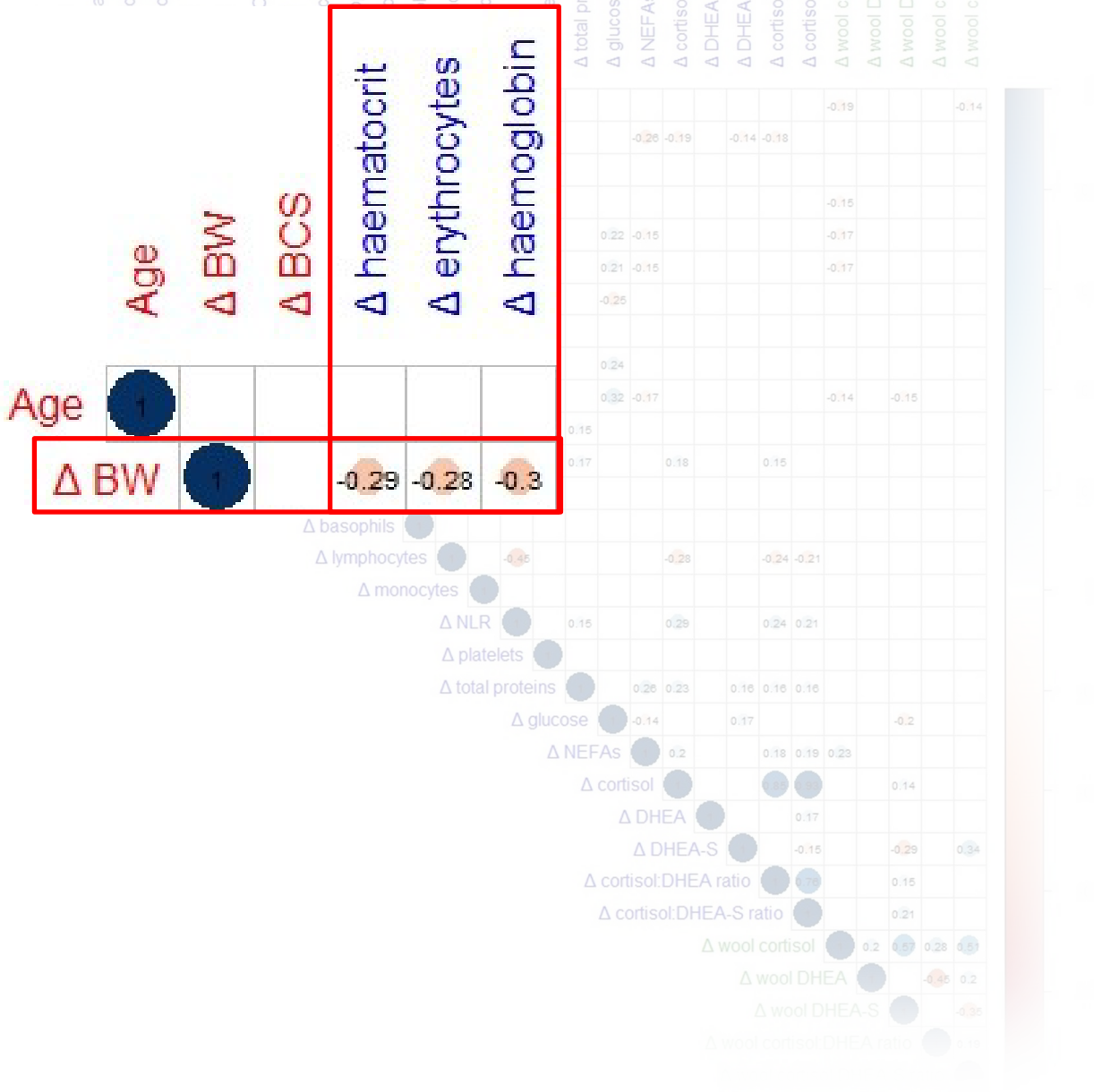

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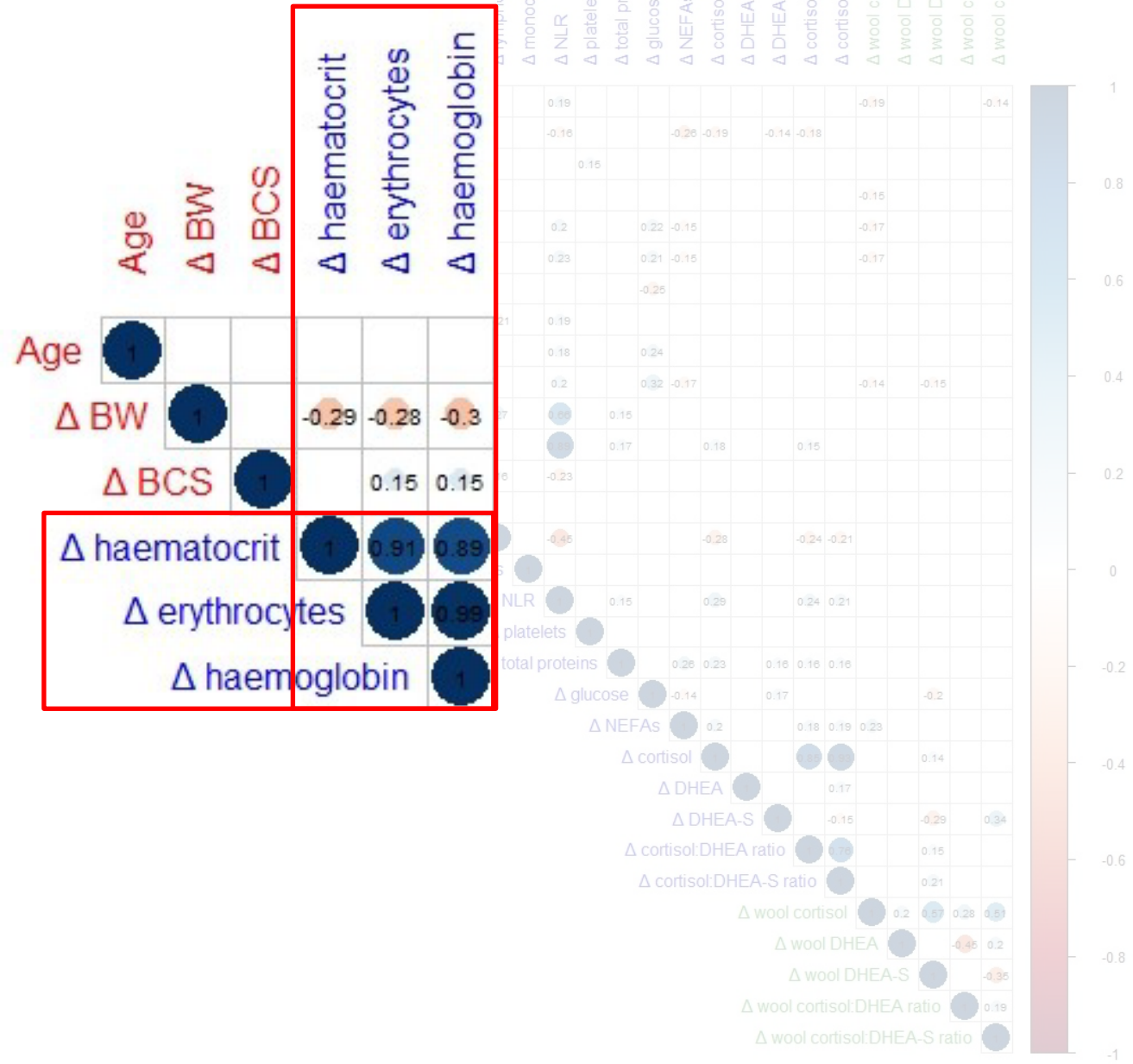

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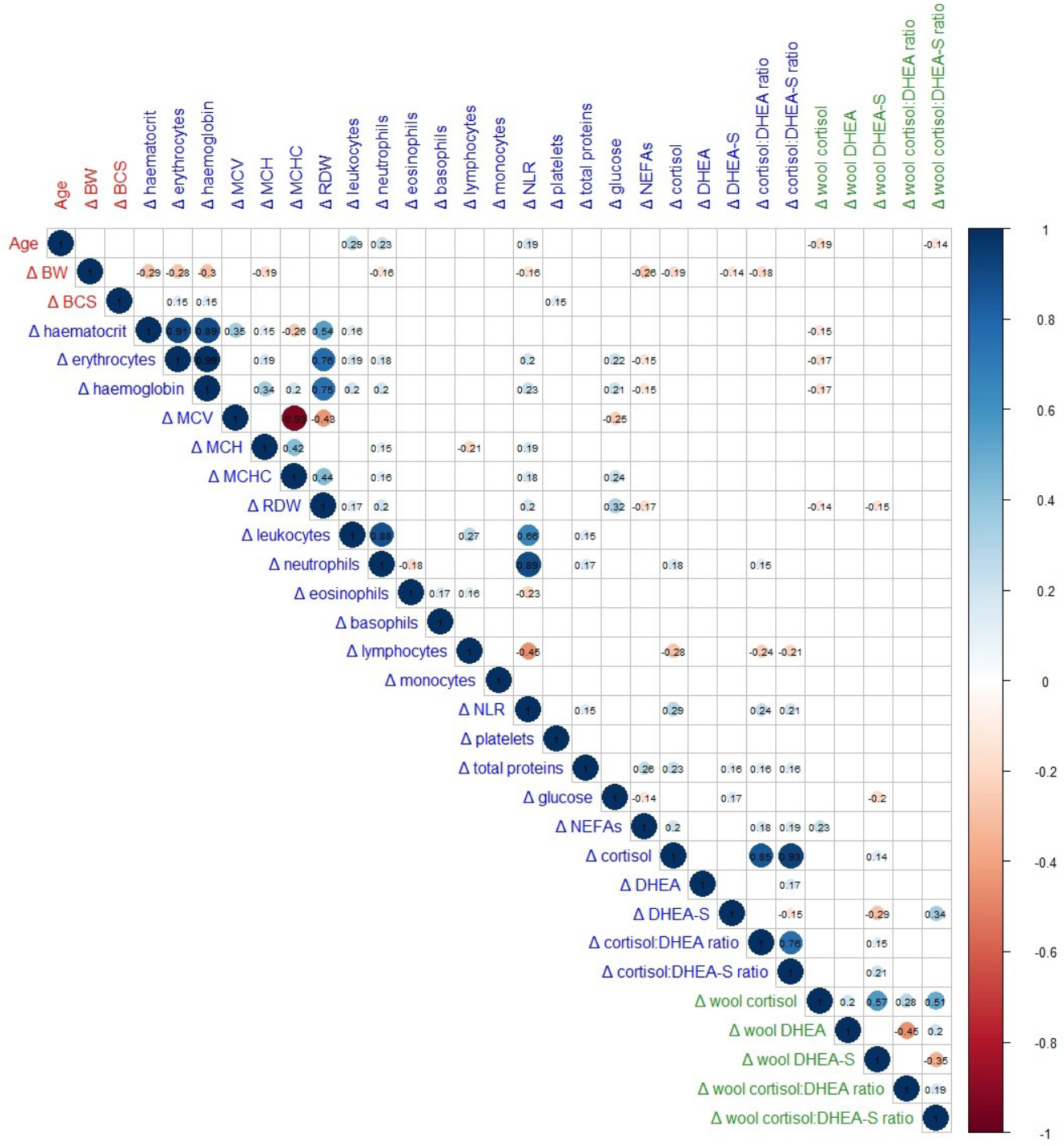
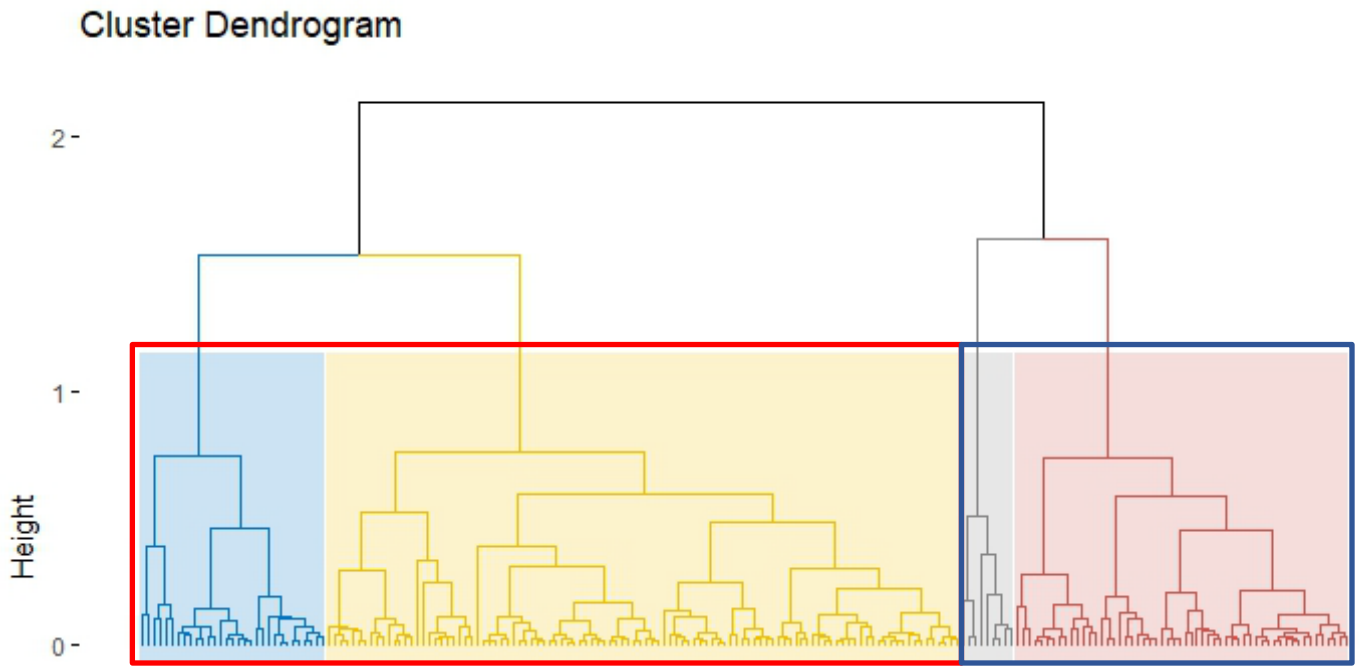


RESULTS

- Hierarchical clustering (31 variation traits).



4 (n=31). High dehydration	3 (n=106). High dehydration
2 (n=9). Low dehydration	1 (n=56). Low dehydration

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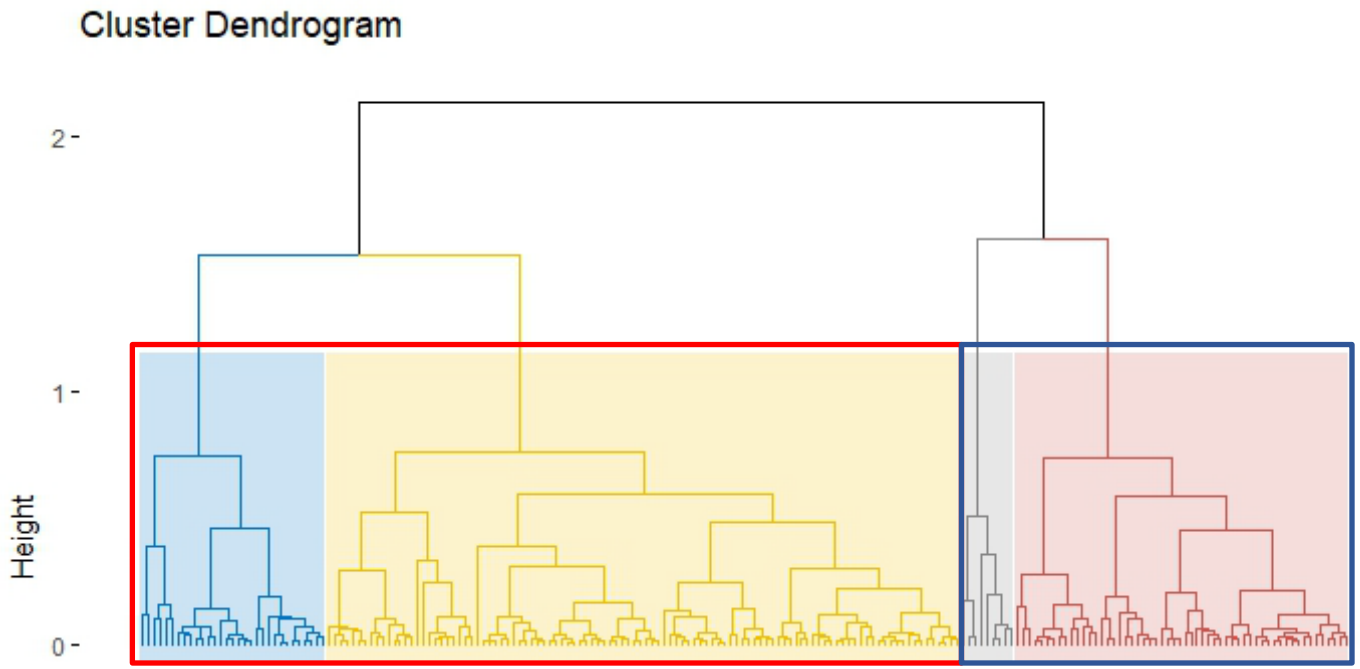

4 (n=31). High dehydration & low tolerant (↑NLR).	3 (n=106). High dehydration & high tolerant (↓NLR & ↓blood cortisol).
2 (n=9). Low dehydration & low tolerant (↑blood cortisol).	1 (n=56). Low dehydration & high tolerant (↓NLR). ↑NEFAs

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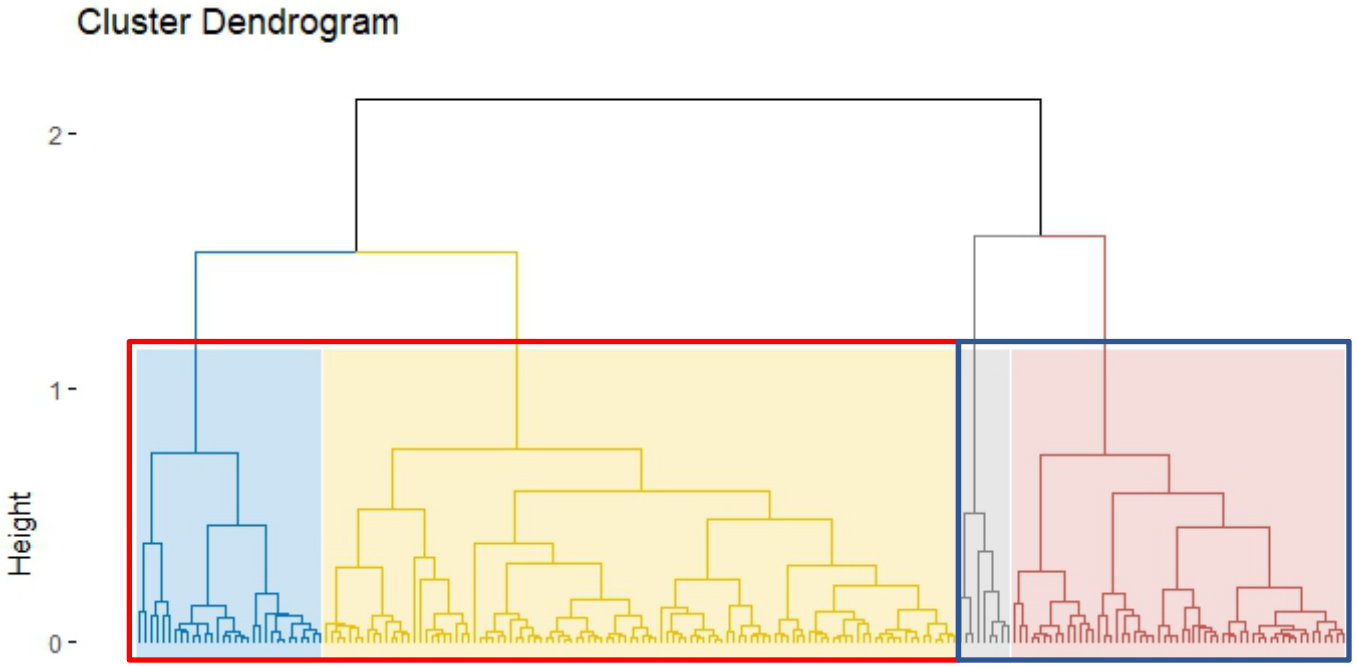

Rasa Aragonesa

↓

High tolerant to heat and water stress (162 ewes → C1 & C3)

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CONCLUSIONS

Reduced DMI, BW and BCS.

Impact in haematological and biochemical parameters: immune system activation, haemoconcentration, and a high mobilization of NEFAs.

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Reduced DMI, BW and BCS.

Impact in haematological and bi… …stem activation, haemoconcentration…

- Most Rasa Aragonesa ewes are well-adapted to heat and water stress, but there is still scope for genetic selection of some of these animals to further improve fitness.

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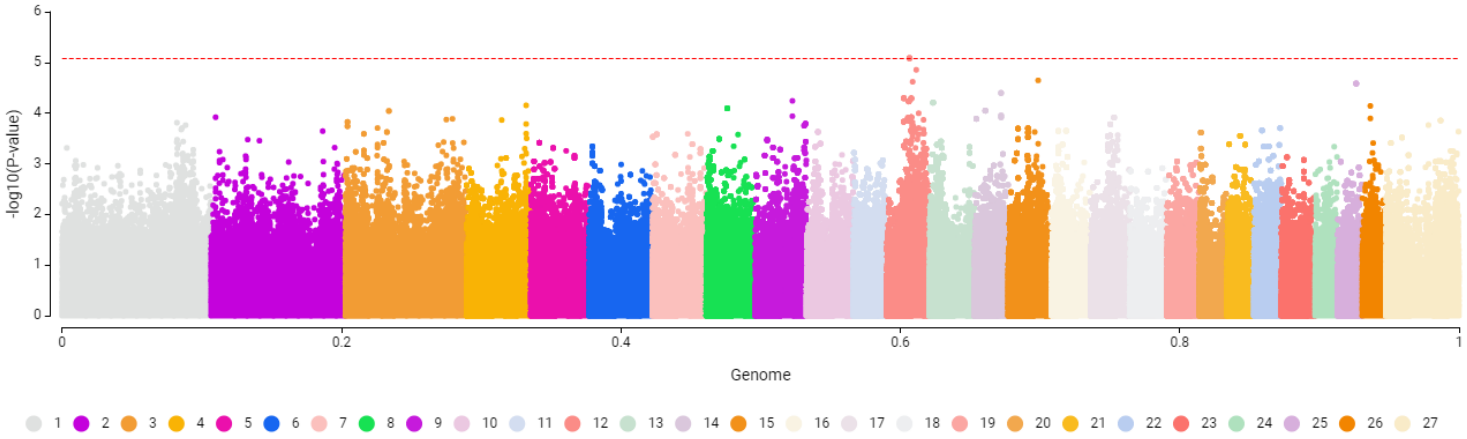

… heat and wat… …ress, but there is still …mals to furth… …prove fitness.

- Genetic basis of this adaptation for selecting more tolerant ewes to cope with these conditions.

Acknowledgements: Travel bursary granted by:

Thank you for listening!

Any doubts?

https://ewestress.cita-aragon.es/