



Comparison of the cytokine profiles after LPS injection between two lines of goats selected for functional longevity

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Hypothesis

There is a diversity of immune responses to an inflammatory challenge, and these strategies are part of the heritable resilience mechanism in the dairy goat



What is resilience?

Animal resilience is defined as the ability to overcome short-term environmental disturbances and quickly return to the pre-disturbance state.



Resilience and immunity

Infectious diseases are one of the major causes of involuntary culling

Mastitis, metritis, respiratory diseases...



Creation of two lines of goats with contrasted resilience levels

Functional longevity = True longevity excluding the culling for productivity reasons. (*Sasaki et al. 2013*)

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Better resilience mechanisms should result, all other things being equal, in longer functional longevity.
(*Friggens et al. 2022*)

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Divergent selection for functional longevity at P3R INRAE experimental facility



The two longevity lines of goats have contrasted resilience related traits



J. Dairy Sci. 105

<https://doi.org/10.3168/jds.2021-21222>

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Selection on functional longevity in a commercial population of dairy goats translates into significant differences in longevity in a common farm environment

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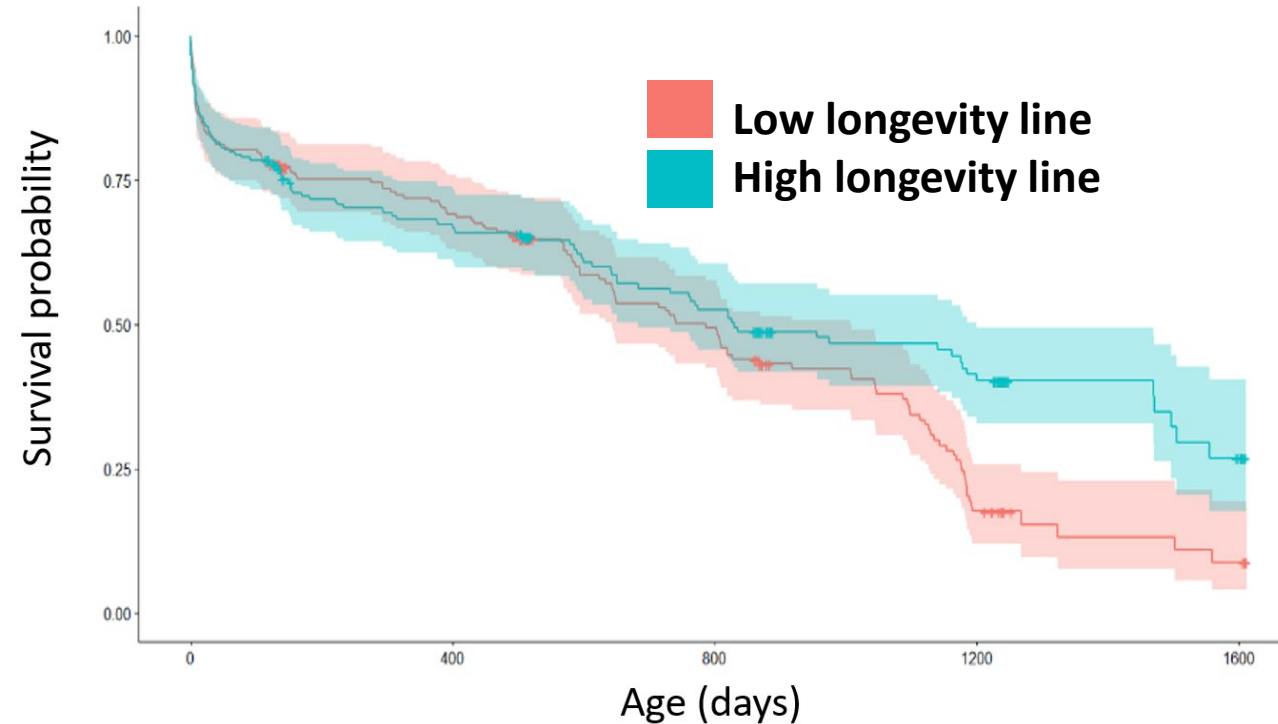
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High longevity line

- Better survival
- Heavier during early lactation
- Lower milk fat-to-protein ratio
- Lower Somatic Cell Score



Inflammatory challenge

- Lipopolysaccharide is found in the outer membrane of Gram-negative bacteria, and induces a strong immune responses in animal
- One bolus of lipopolysaccharide of 0.5 $\mu\text{g}/\text{kg}$ live weight was injected in the jugular vein (Salvesen et al. 2016)
- At 73.7 days in milk (sd=9, min=56, max=96)
- 12 blood samples from each goat at -72h, 0h (injection time), 2h, 4h, 6h, 8h, 10h, 12h, 24h, 48h, 72h, and 144h

Year of the inflammatory challenge

		Environment 1 (2021)	Environment 2 (2023)	Total
Longevity line	Low_LGV	18	23	41
	High_LGV	25	17	42
	Total	43	40	83

Two different environments

In January 2022 our goats moved to a brand new experimental facility

Environment 1



Environment 2

Environment 2 offered better air circulation and easier floor cleaning

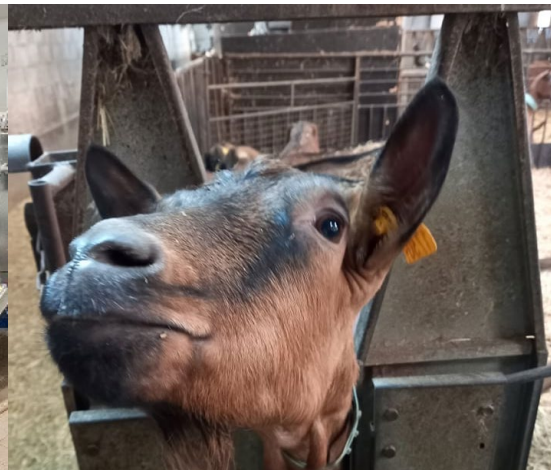
More fractionated distribution of concentrate in Environment 2

Mortality during first weeks of life has been sharply decreased

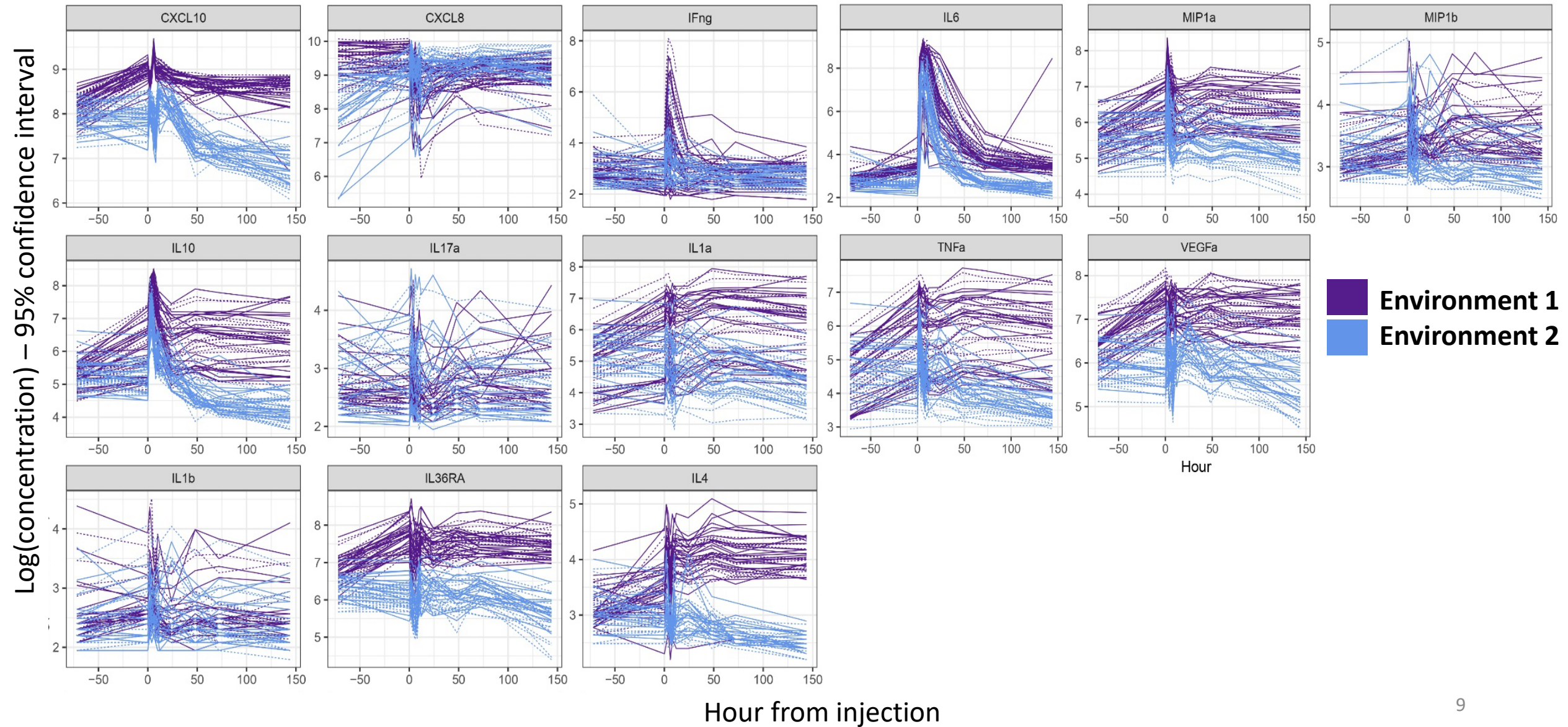
Less coughing registered in Environment 2

Milk yield increased significantly (2.1 vs 1.7 kg before challenge)

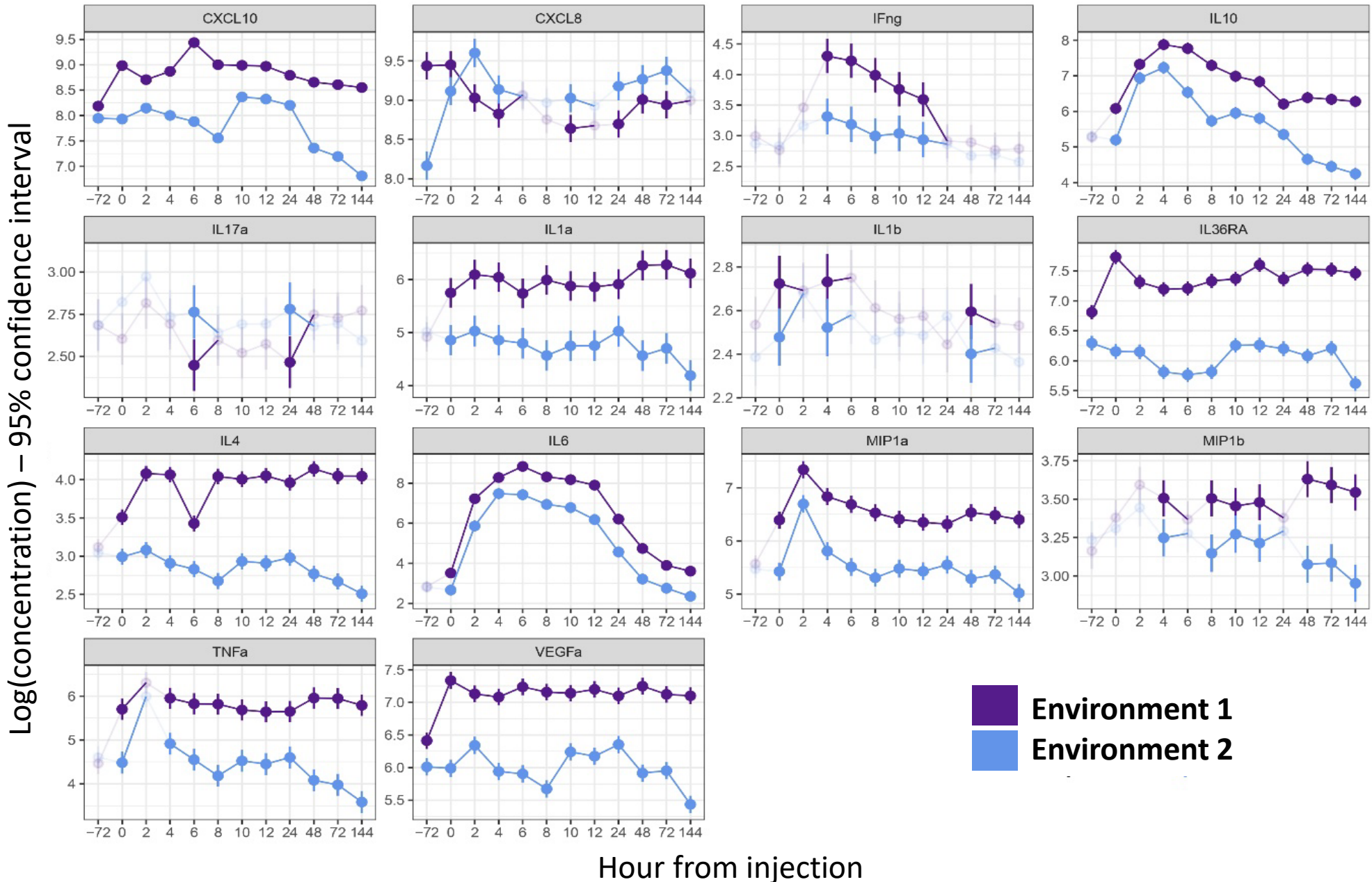
New INRAE experimental facility of Bourges – P3R



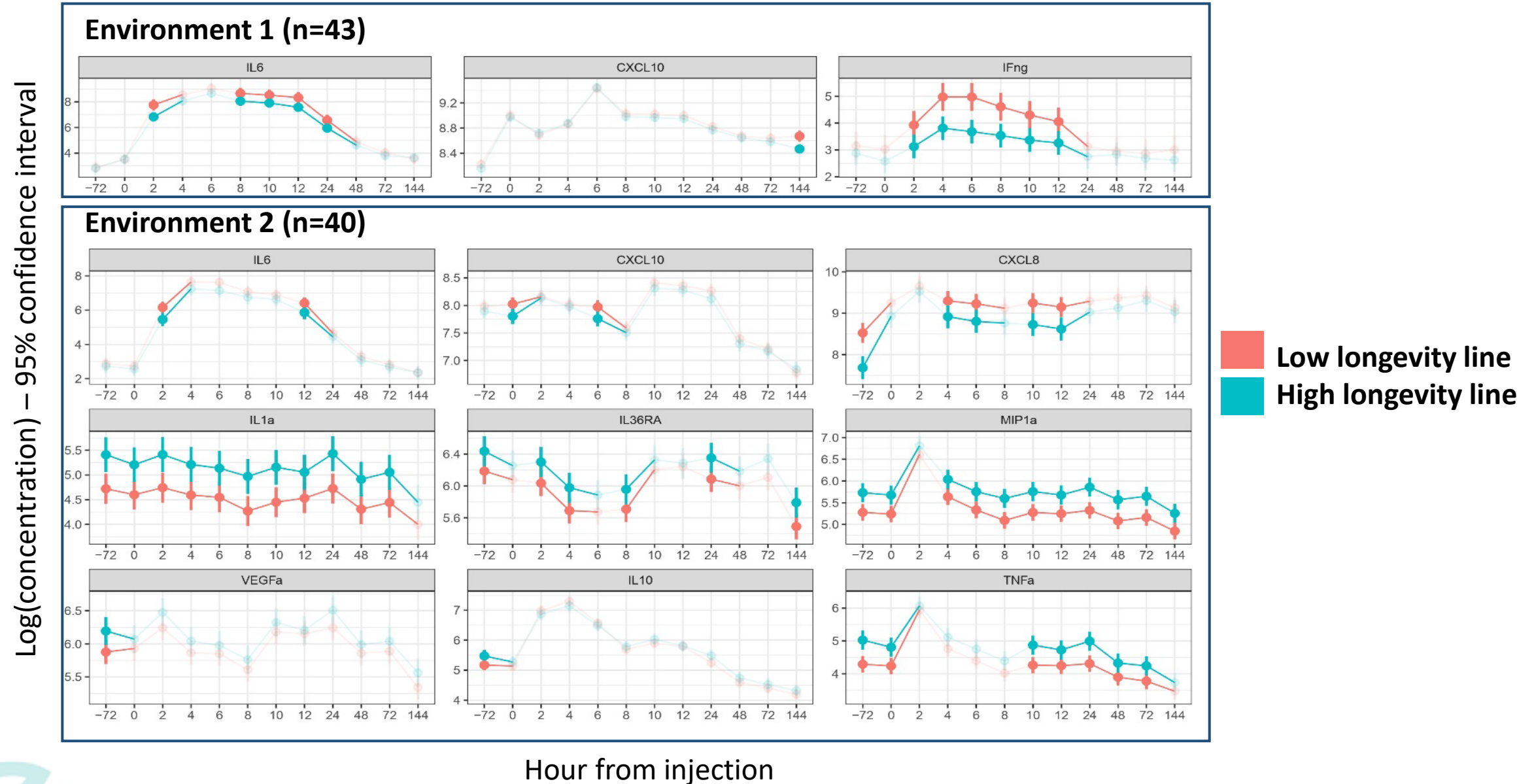
Measurement of 14 cytokines concentration



Different immune reactions between the two environments



The difference between lines depends on the environment



Conclusion

- Intravenous injection of lipopolysaccharide changed the blood cytokine concentration in goats
- This study backs innate immunity's role in heritable resilience and longevity
- Interleukin-6 surged notably in low-longevity goats in both environments
- Disparities between longevity genetic lines vary across environments, indicating genetic x environment interaction
- If using cytokines for resilience phenotyping, the environment should be considered carefully





Thank you for your attention

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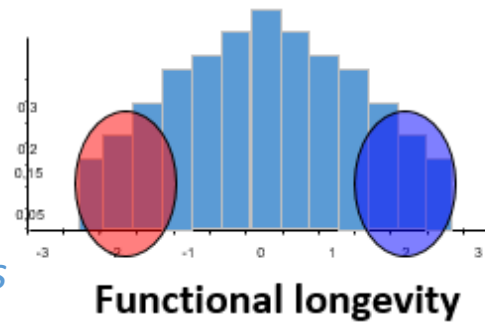
INRAE



Creation of two longevity lines of goats

Length of productive life of Alpine goats in commercial farms

Genetic evaluation of **8,787 Alpine AI bucks** (frozen semen)
(Palhière et al. 2018)



♂
19 Low_LGV
bucks
EBV = -109 days

♂
16 High_LGV
bucks
EBV = +85 days

Low_LGV line

High_LGV line

♀ Goats from the
experimental facilities

♀ Goats from the
experimental facilities

♀ Low_LGV G1

♀ Low_LGV G2

♀ Low_LGV G3

High_LGV G1 ♀

High_LGV G2 ♀

High_LGV G3 ♀

*Overlapping generation
selection*

The difference between lines depends on the environment

In challenging environment, the low longevity line responded stronger to the inflammatory challenge for several cytokines.

In non challenging environment, most of the differences between lines pre-existed before the challenge, and the low longevity goats had most of the time lower cytokines concentrations

