

Hair cortisol concentration in finishing pigs: variability between pigs, batches, and farms

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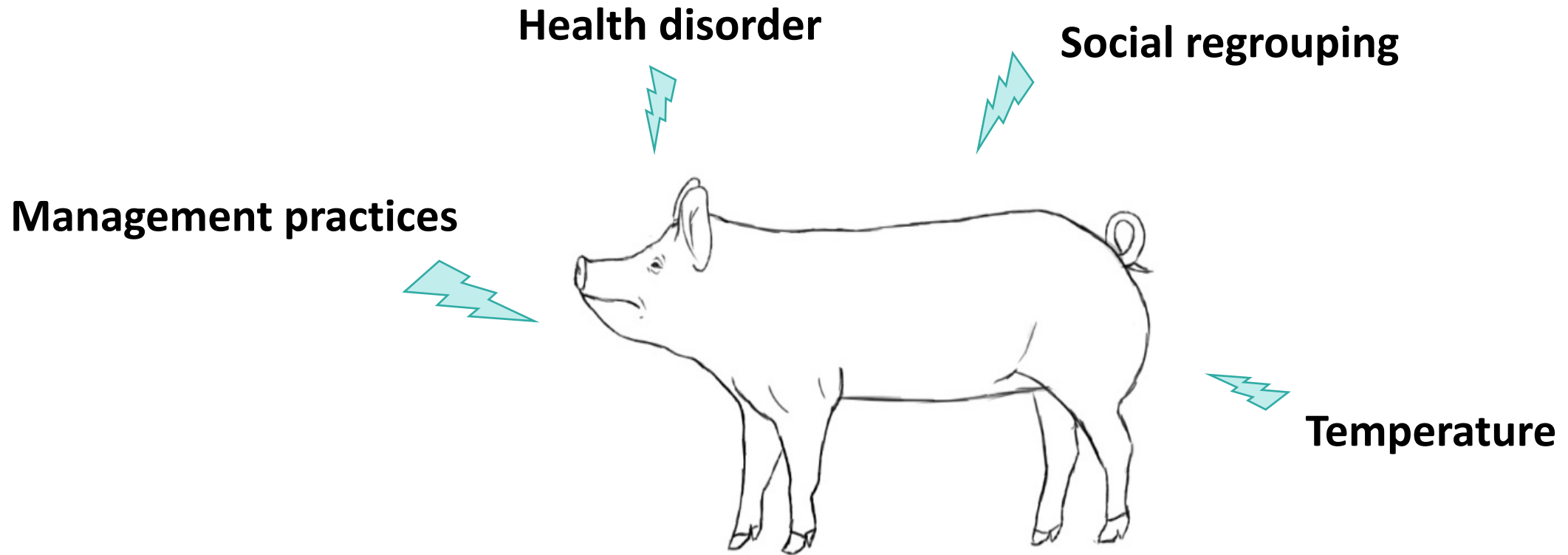
Pig hair..



Pig hair.. cortisol



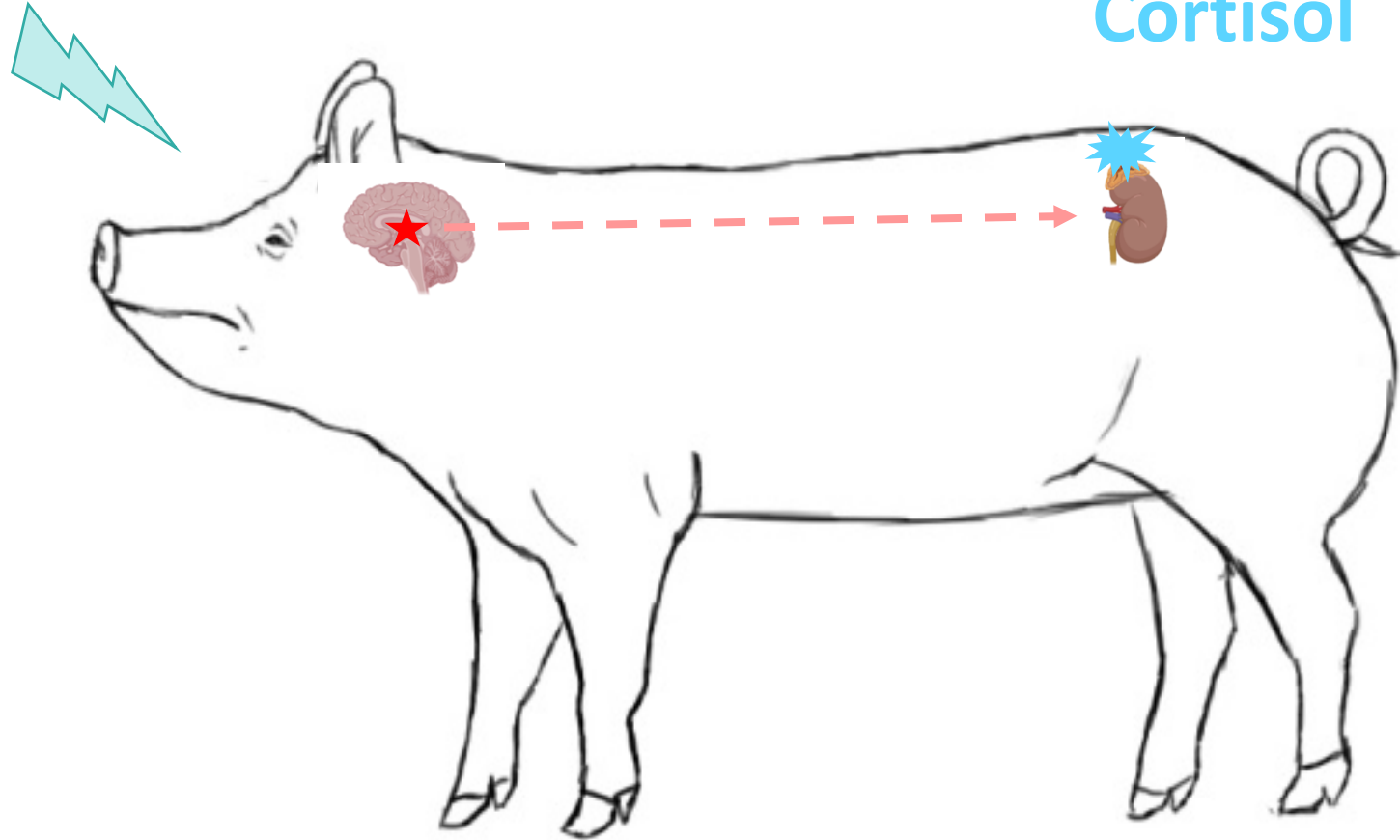
Stressors, stress, and welfare on pig farms



Cortisol is an indicator of stress

Stressor

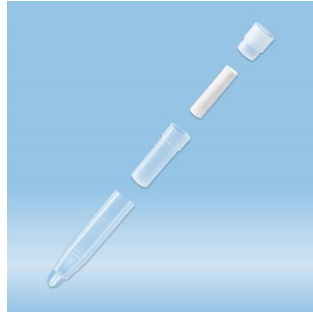
Cortisol



Cortisol can be measured in several matrices



Serum (via blood)



Saliva



Urine



Feces

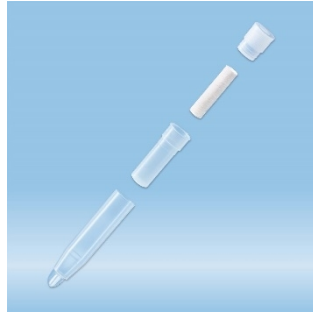


Hair

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Hair

Different time windows studied ~ matrice

From a moment (acute stress) to several months (chronic stress)

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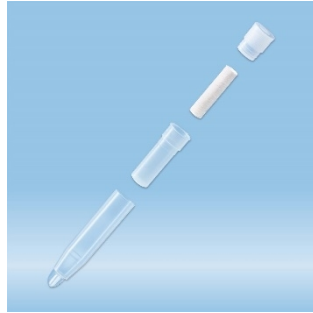
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Different time windows studied ~ matrice

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Interest of pig hair cortisol?

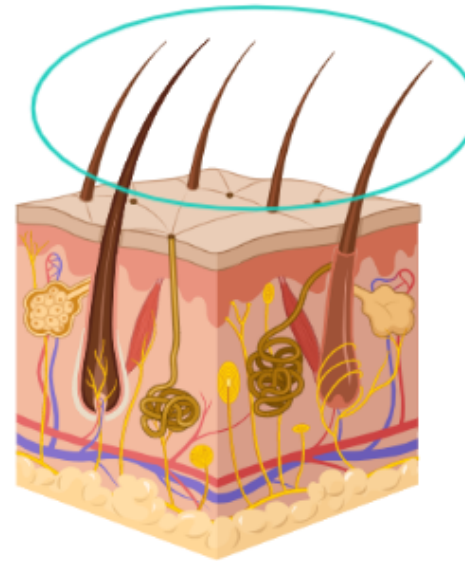
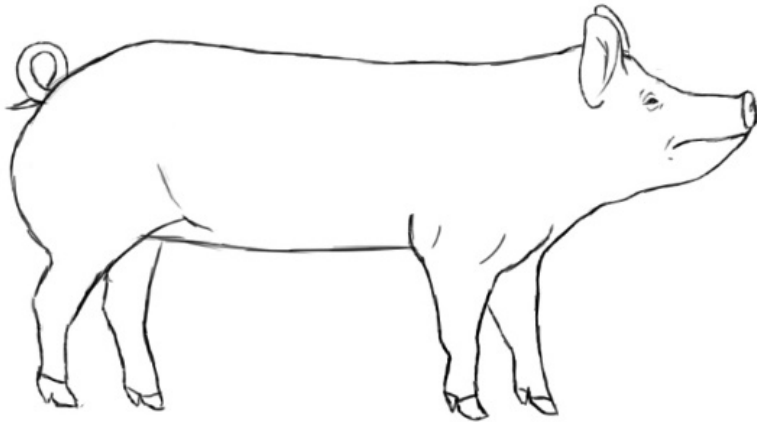
Information provided by pig hair cortisol?

Alternative vs conventionnal practices at
suckling and weaning periods

Gavaud et al. (2023)

Tail biting

Carroll et al. (2018)



• Cortisol

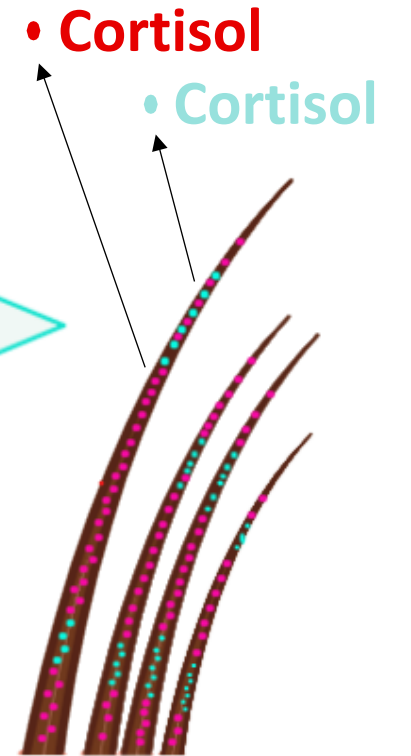
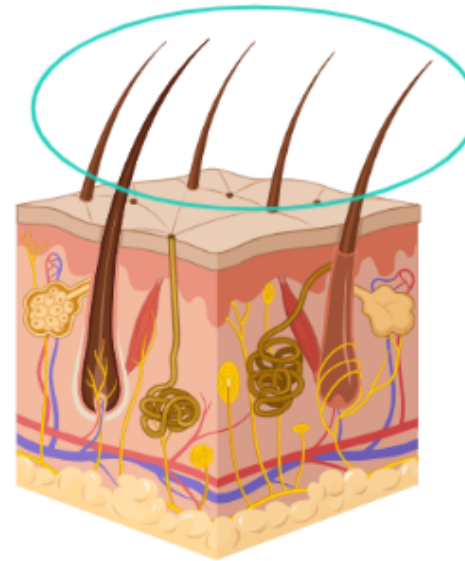
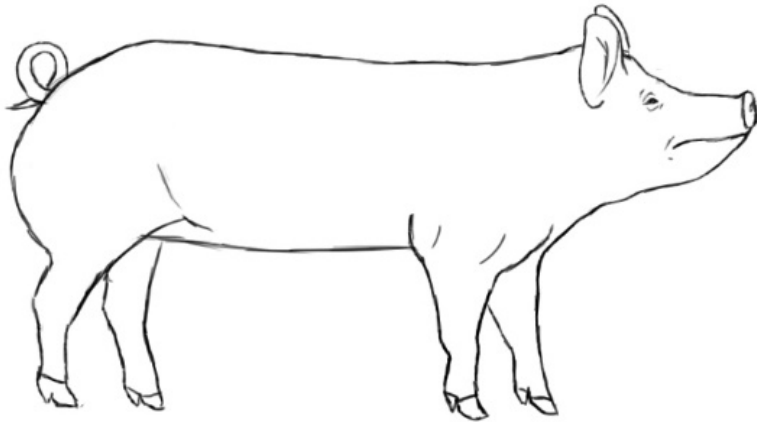
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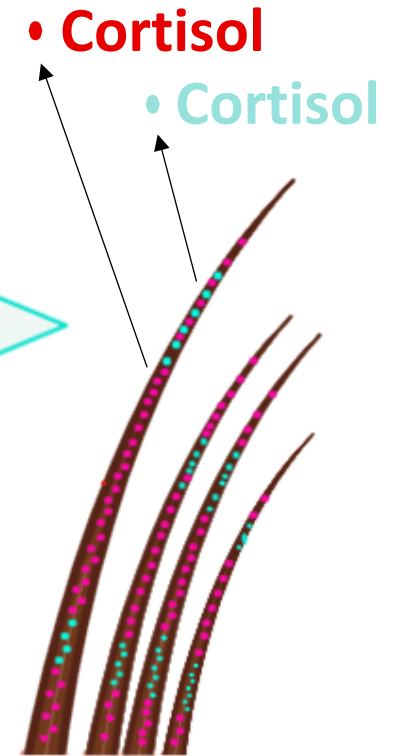
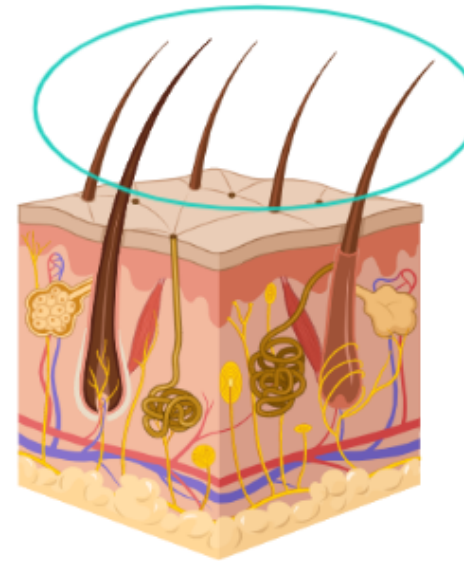
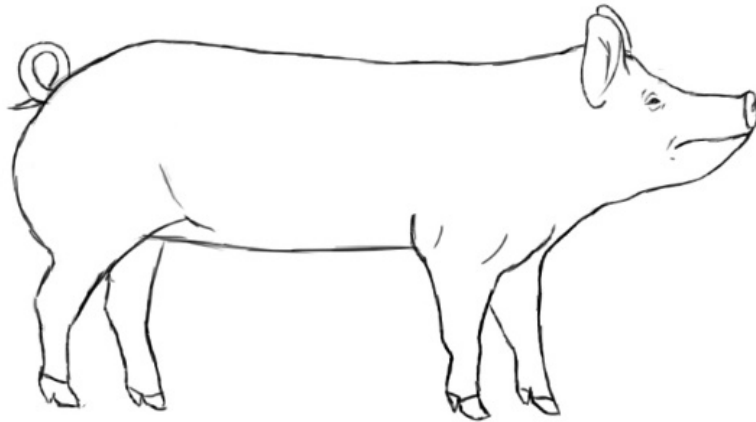
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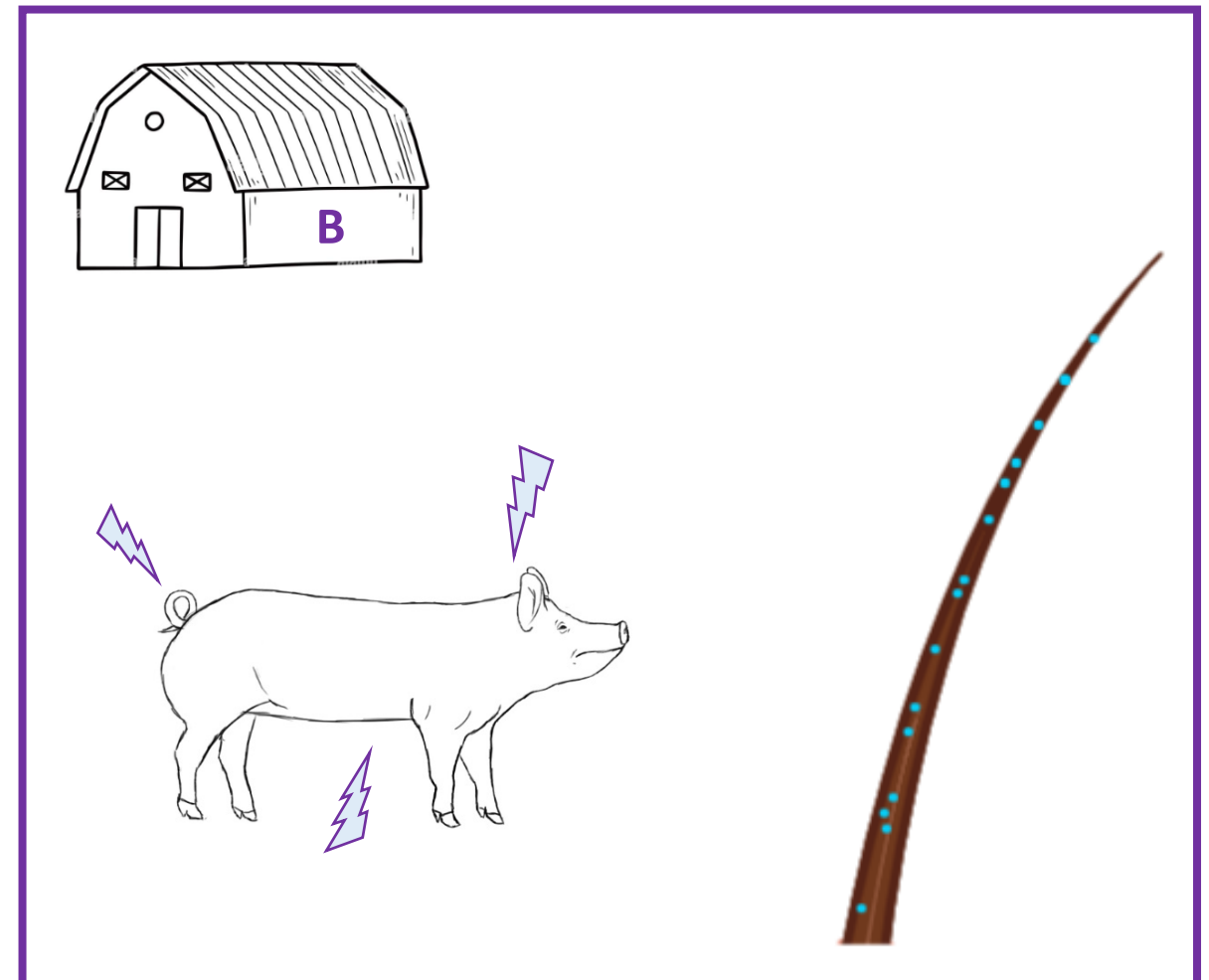
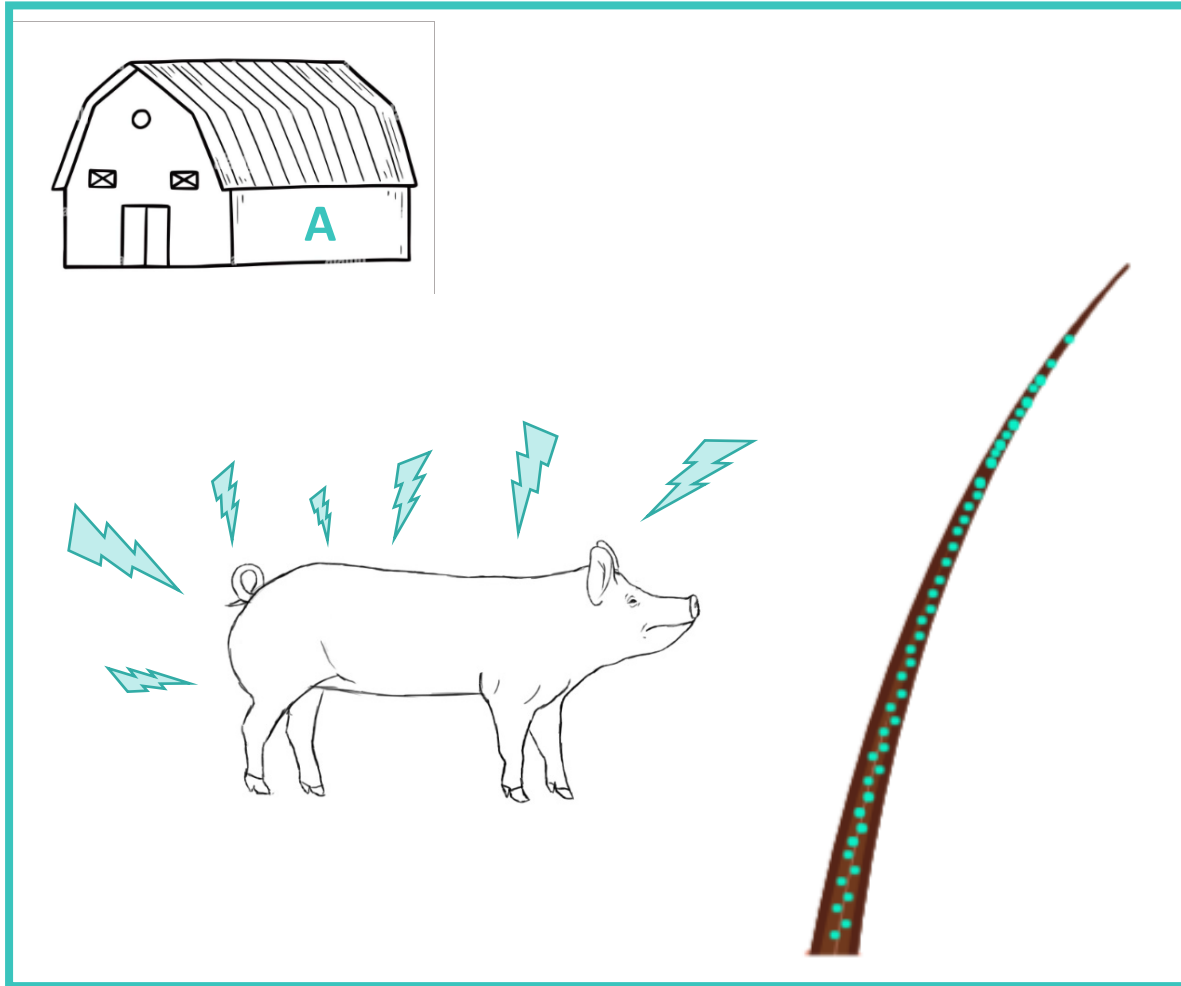
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At the end of the finishing period?

Pig hair cortisol concentration in farms and batches



Objectives

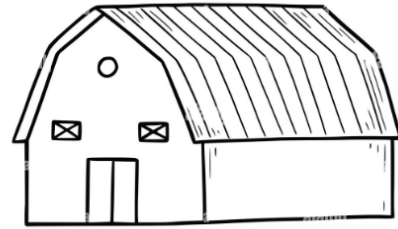
**Describe the variability of hair cortisol concentration
in finishing pigs**

- 1) Between pigs of a same batch**
- 2) Between farms**
- 3) Between batches of a same farm**

Farms and animals

Diversity of management practices
and herd health

N = 20 farms



Western France



On average 244 sows



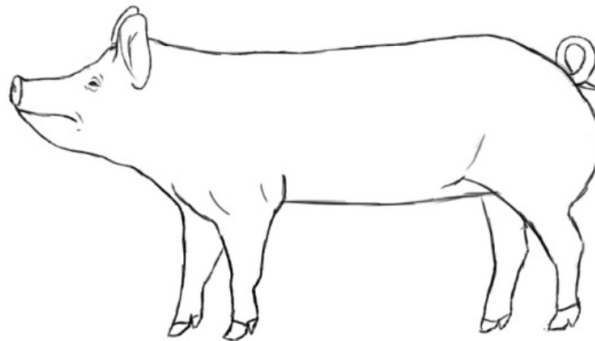
2 Organic, 4 Label Rouge,
6 no castrations



Health : from no clinical expression
to mortality

Clipped end of finishing period : cortisol accumulated during life in farm

N = 960 pigs

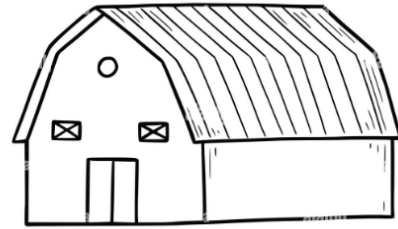


165 ± 10 days old

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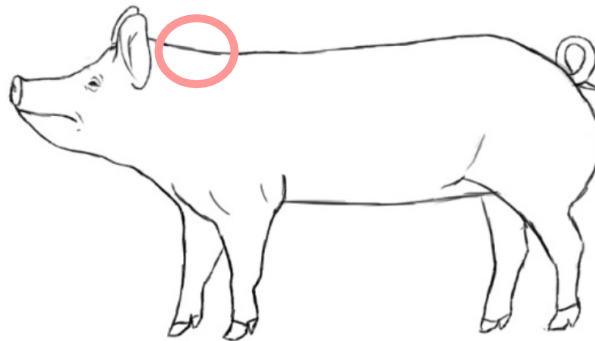


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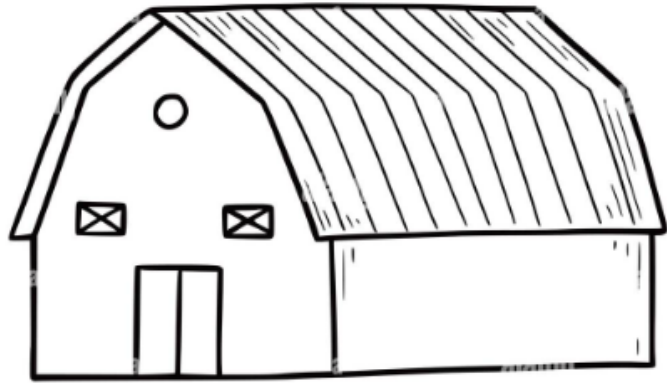
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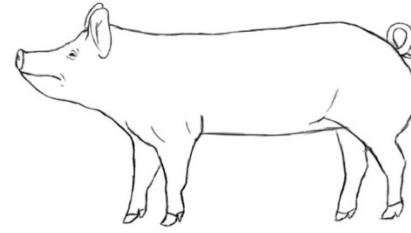
Sampling in 20 farms, 2 batches/farm, 24 pigs/batch



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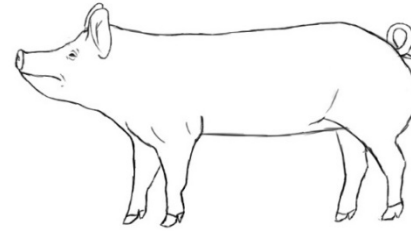
960 pigs sampled

V1 :



N = 24

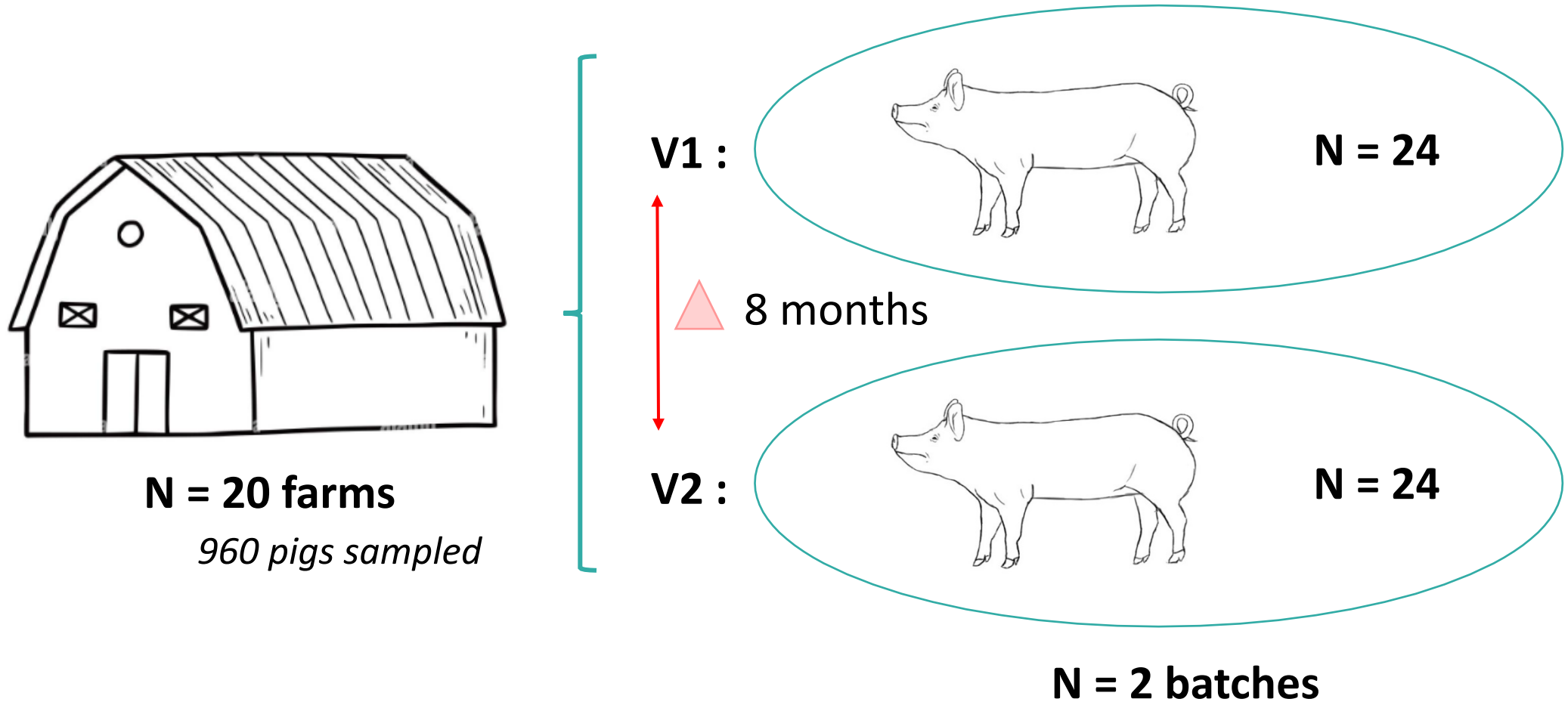
V2 :



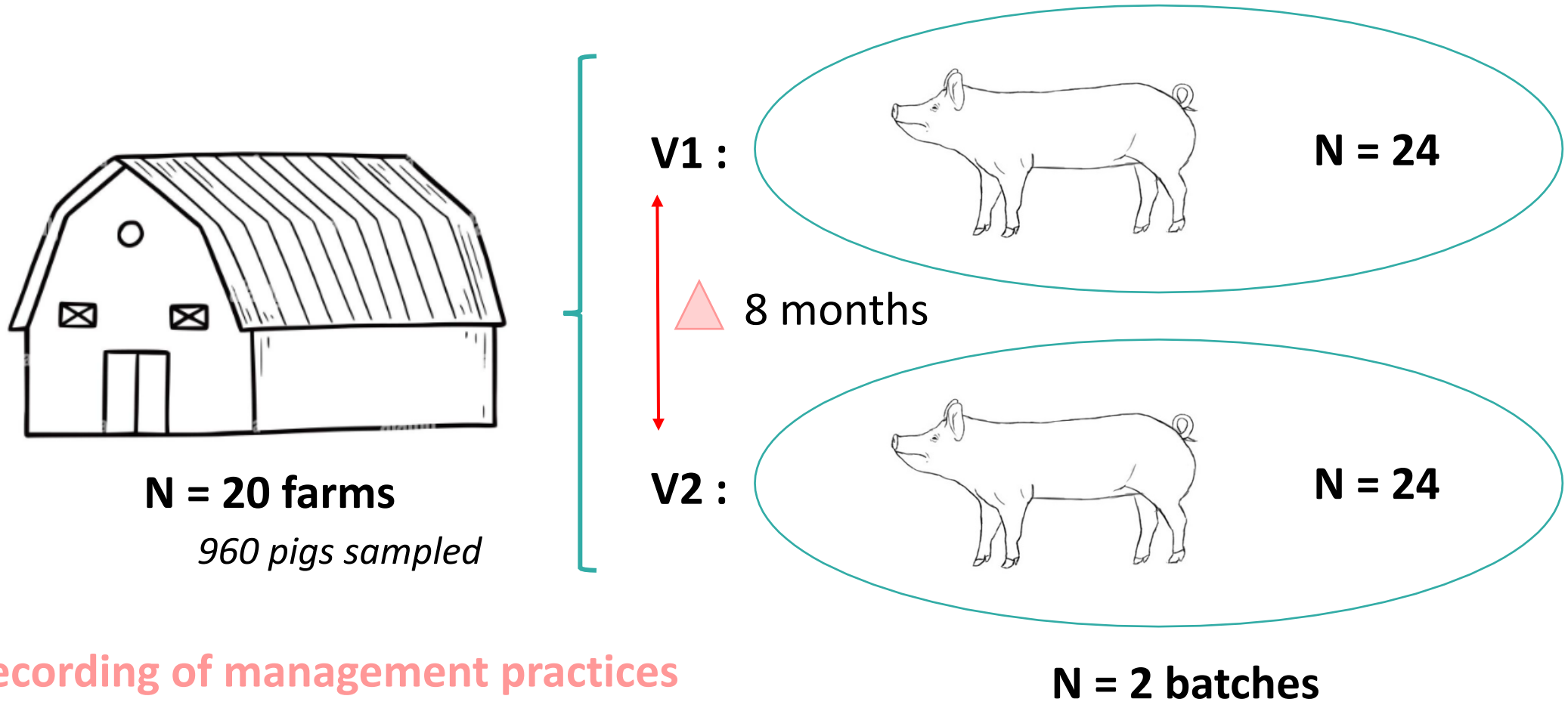
N = 24

N = 2 batches

Sampling in 20 farms, 2 batches/farm, 24 pigs/batch



Sampling in 20 farms, 2 batches/farm, 24 pigs/batch



- + Recording of management practices
- + Identification of health disorders at each visit

Data analysis

(1) Hair cortisol concentration ~ batch + farm + batch:farm + ϵ

$$\eta^2 = \frac{\text{Sum of squares of a predictor}}{\text{Total sum of squares}}$$

ELISA test → Hair cortisol concentration



(2) PCA + HCPC

- 4 active
- Means of batch 1 and 2
 - Standard deviations of batch 1 and 2
- 17 supplementary
- *Management practices + herd health information*

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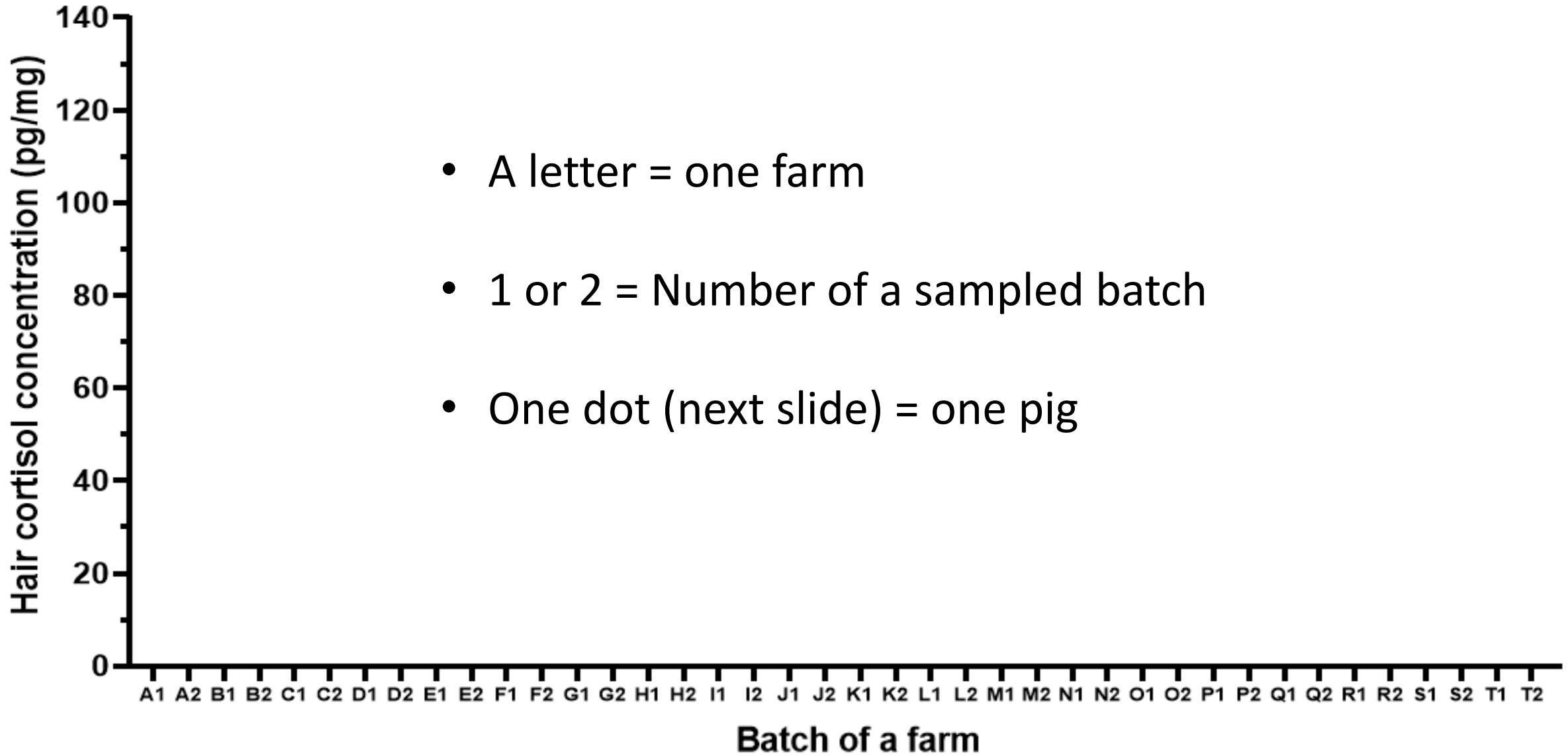
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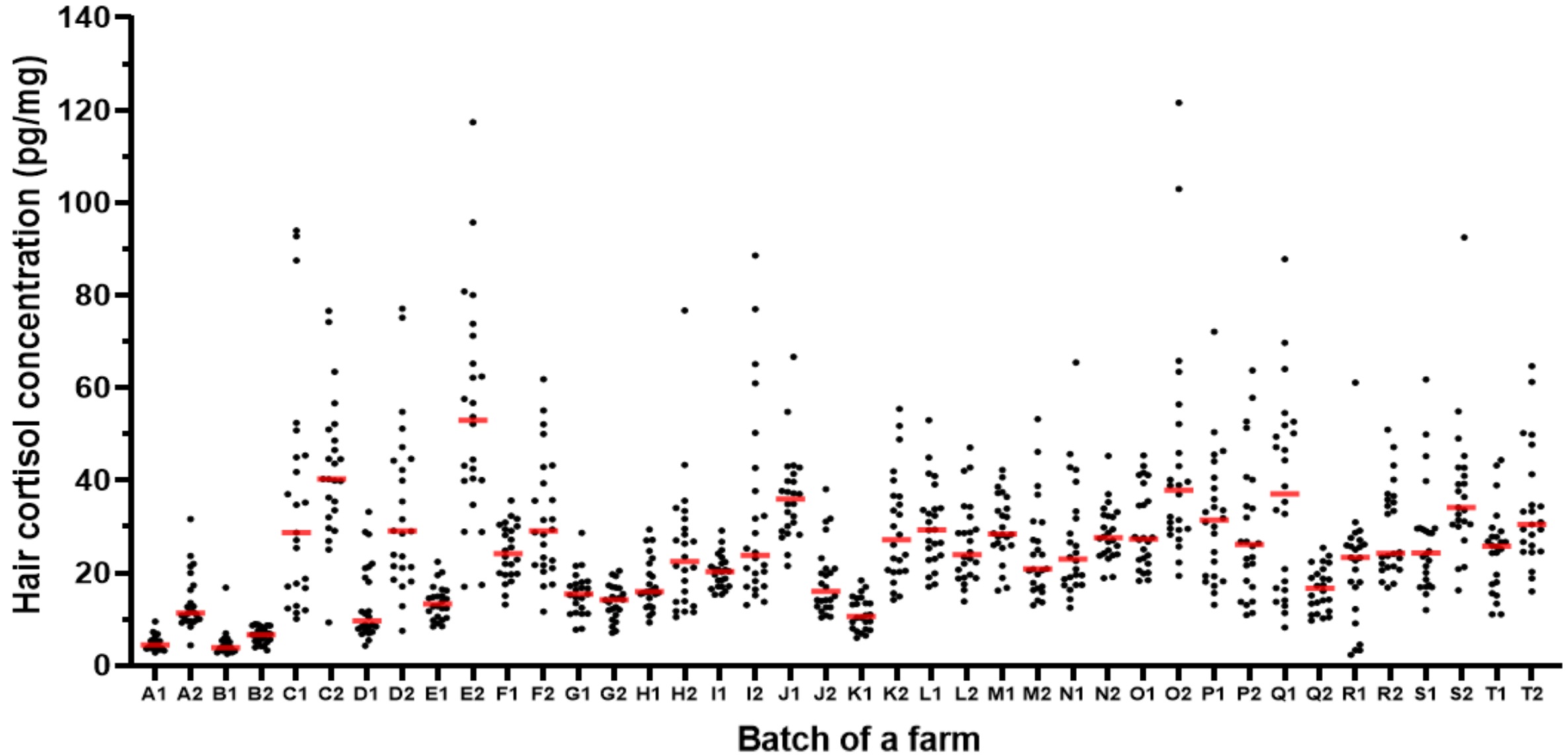
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Hair cortisol concentration



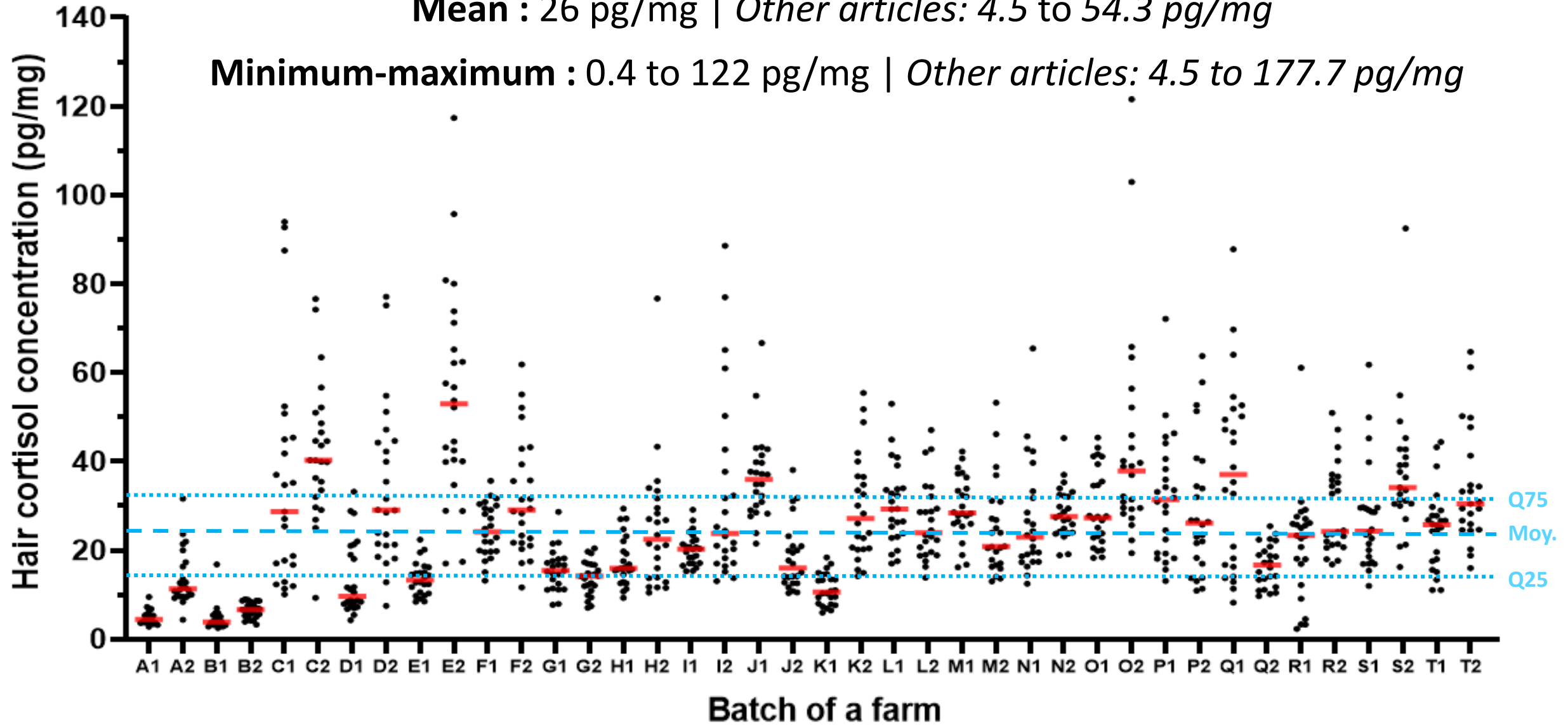
Hair cortisol concentration



Hair cortisol concentration

Mean : 26 pg/mg | *Other articles: 4.5 to 54.3 pg/mg*

Minimum-maximum : 0.4 to 122 pg/mg | *Other articles: 4.5 to 177.7 pg/mg*



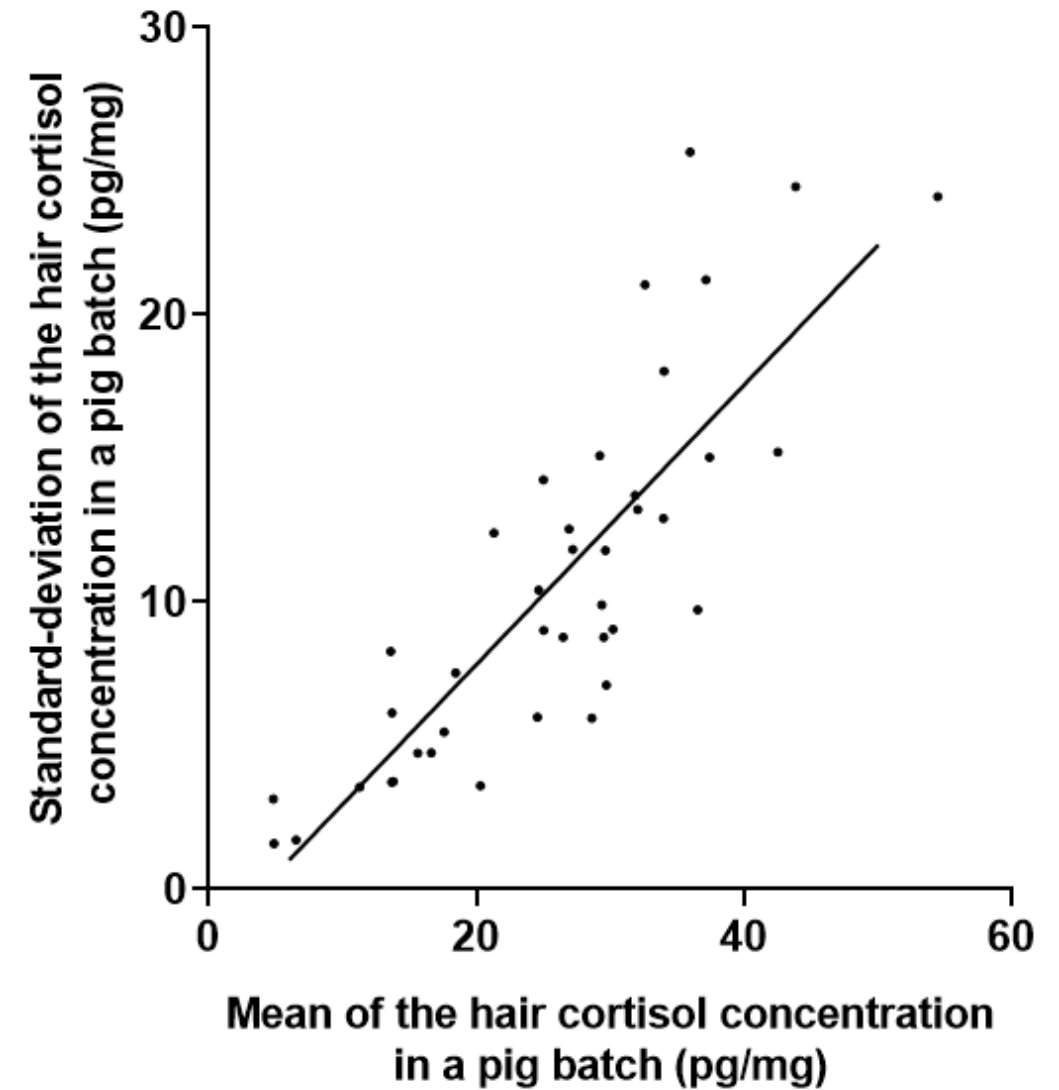
Differences between individuals explained most of the concentration variability

Model: Hair cortisol concentration $\sim$ batch + farm + batch:farm + ε

Predictor variable	Percentage of variance explained (η^2)
Batch	3
Farm	24
Batch : Farm	16
Residuals	57
Total	100

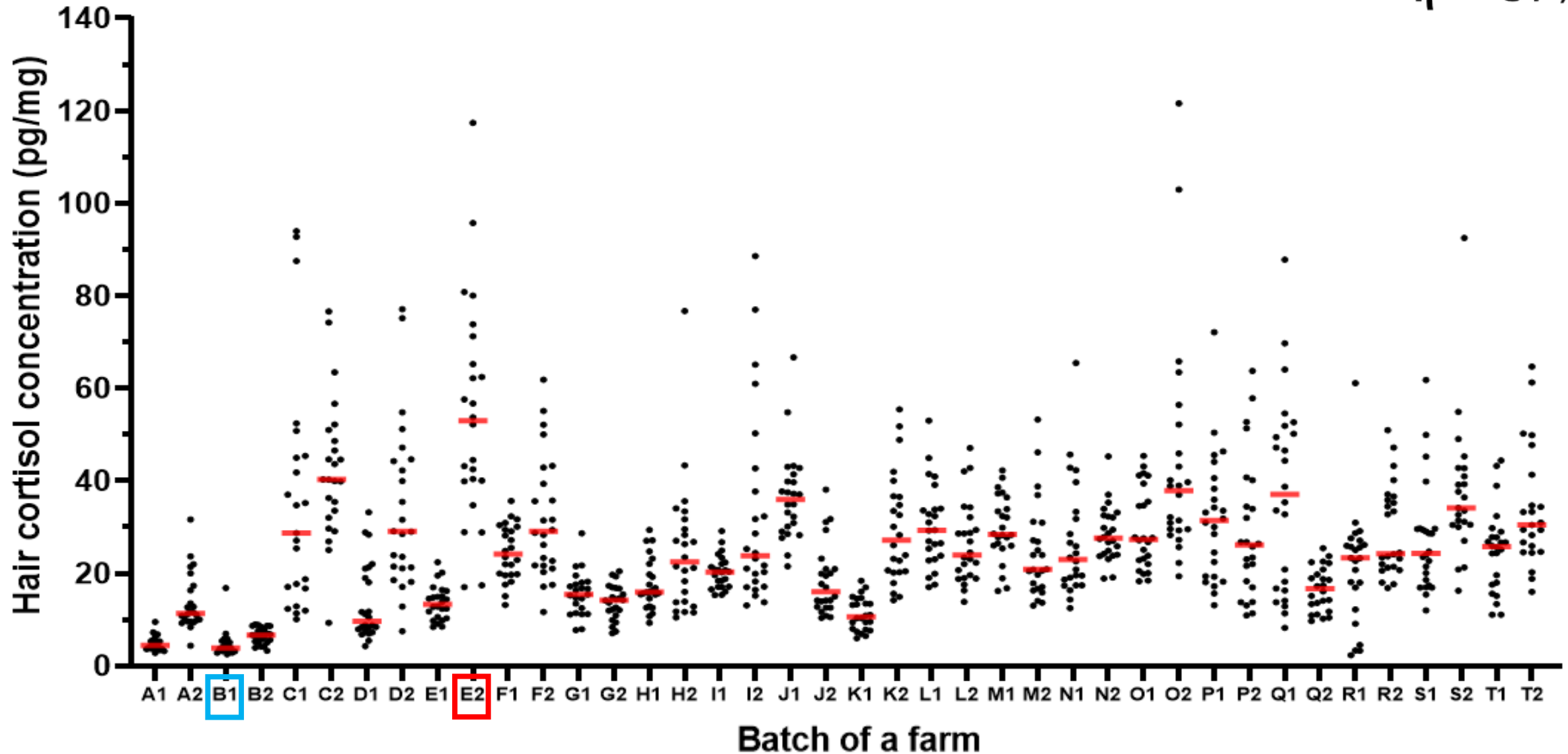
Interindividual differences within a batch

- Coefficient of variation : 17 to 71%
- Pearson correlation :
 - *coefficient* = 0.83
 - $P < 0.001$



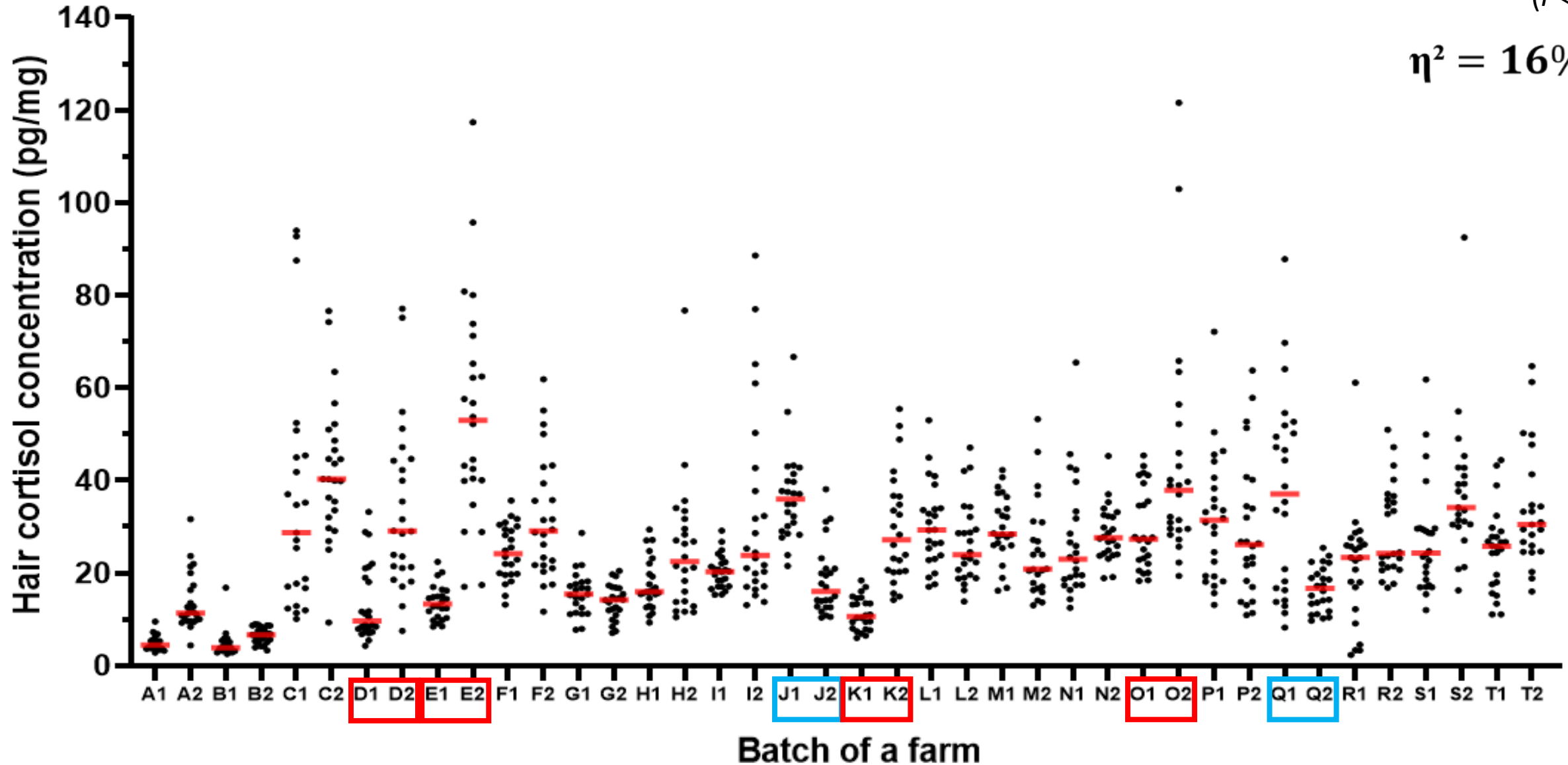
Differences between individuals: **low** or **high**

$\eta^2 = 57\%$



Differences between batches of a same farm: **4 higher** and **2 lower**

($P < 0.001$)



Three clusters of farms ~ means and standard-deviations of batches 1 and 2

	Cluster 1	Cluster 2	Cluster 3
Number of farms	3	7	10
Variable			
Mean 1			
Mean 2			
Standard-deviation 1			
Standard-deviation 2			

Three clusters of farms ~ means and standard-deviations of batches 1 and 2

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Mean 1	8,4*	20,3	31,2*
Mean 2	11,3*	35,7*	27,0
Standard-deviation 1	3,2	6,7	13,9*
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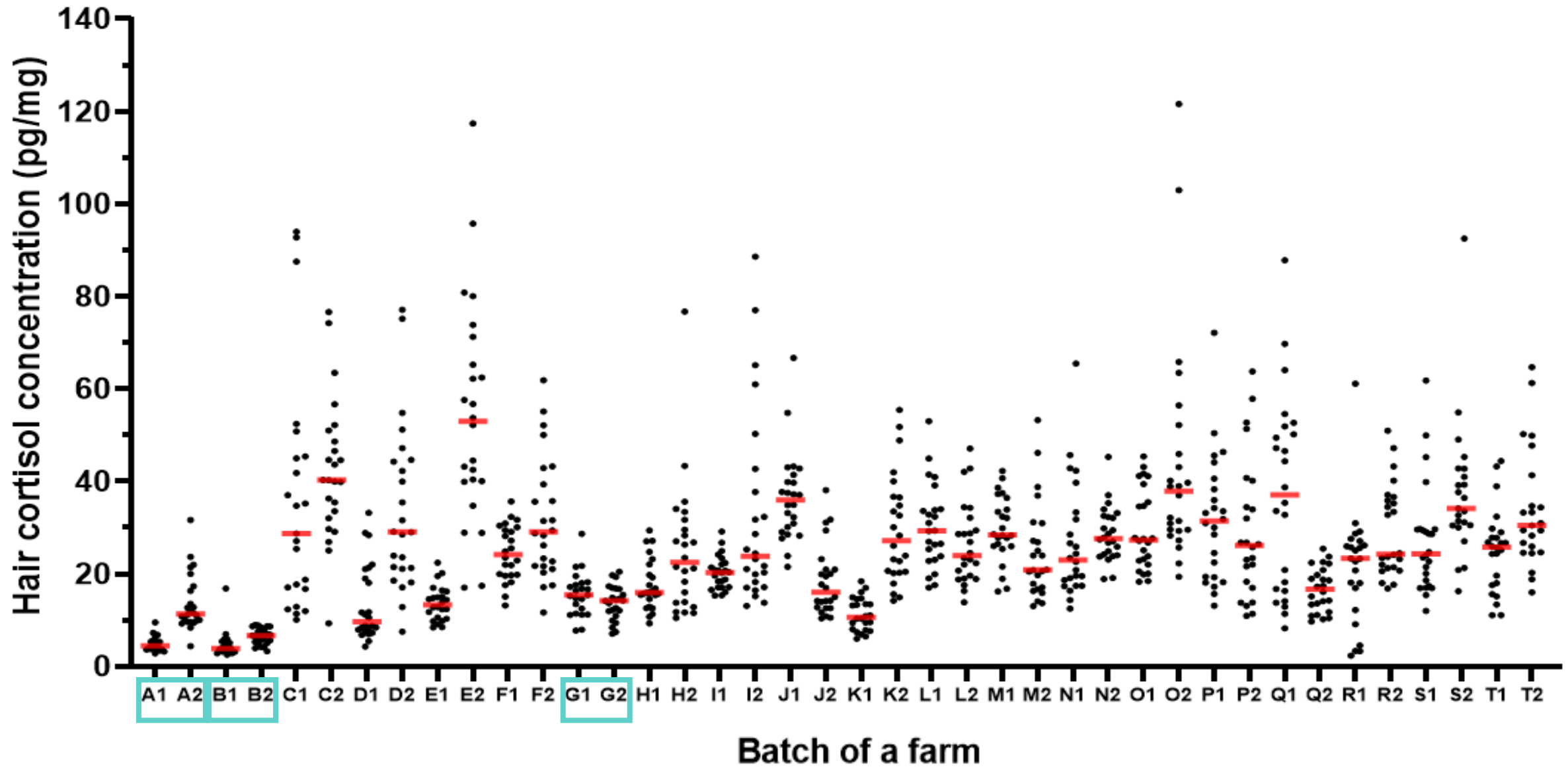
**Variable significantly associated to a cluster*

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**Variable significantly associated to a cluster*

Cluster 1: Two organic farms... and a conventional farm



Variability of pig hair cortisol concentration in finishing pigs:

Differences 1) between individuals, 2) between farms and 3) between batches of a same farm

**Variability of pig hair cortisol concentration in finishing pigs:
Differences 1) between individuals, 2) between farms and
3) between batches of a same farm**

**Potential interest in measuring hair cortisol to assess the long-term
stress in pigs on commercial farm**

More details in a paper that will be submitted in September

Acknowledgements



Co-funded by
the European Union

and



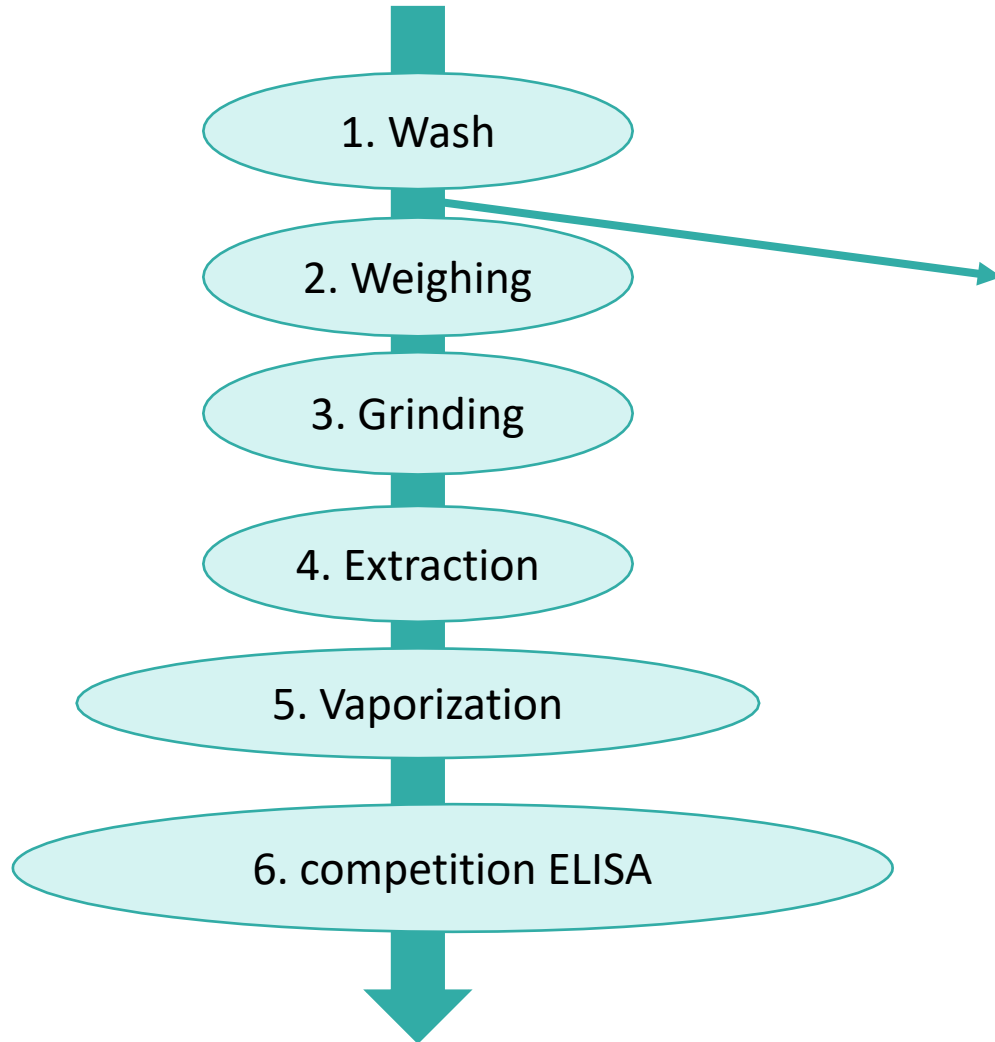
Veterinarians
and
Farmers



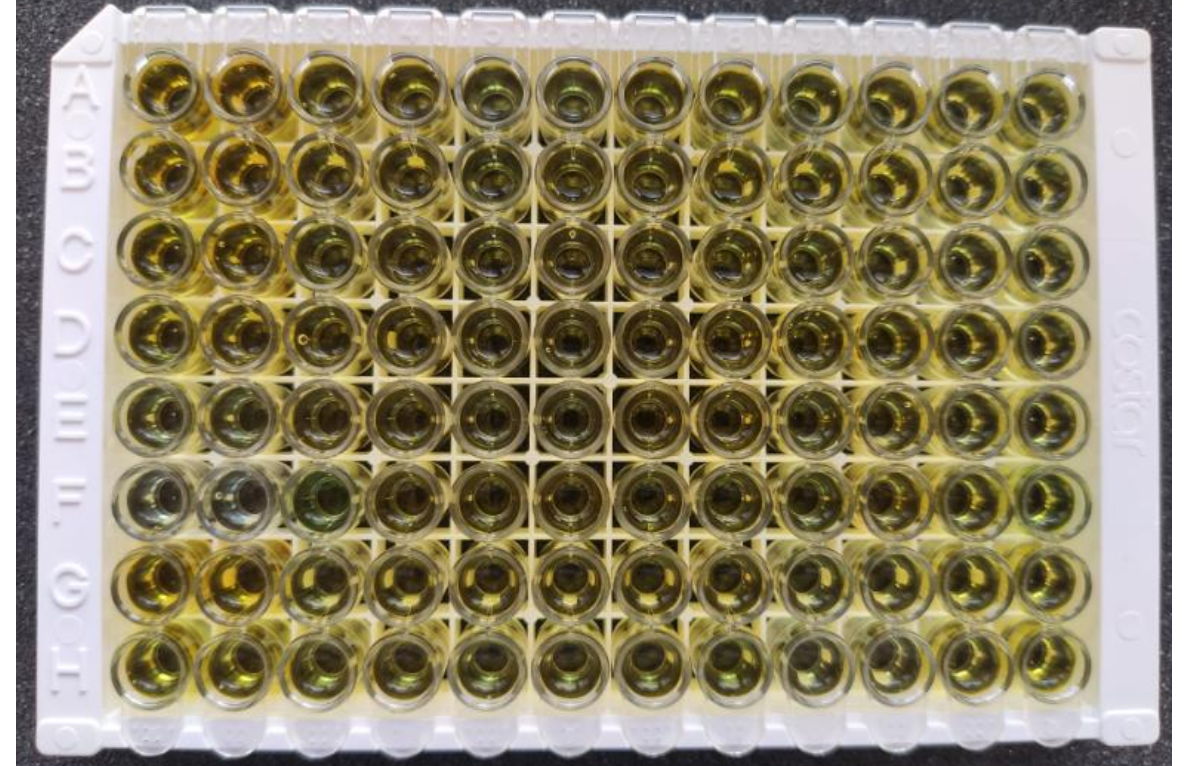
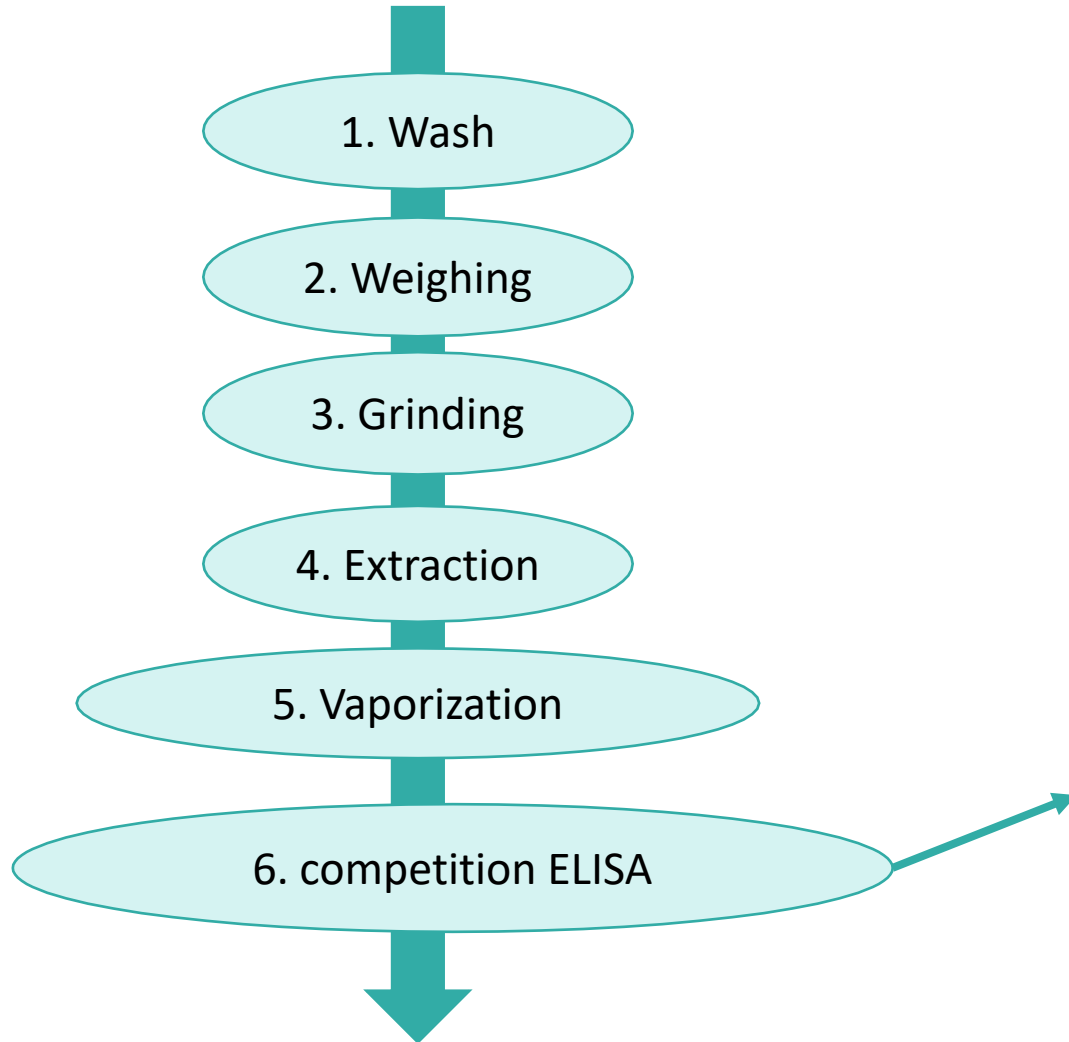
BIOEPAR



Cortisol analysis: from wash to ELISA

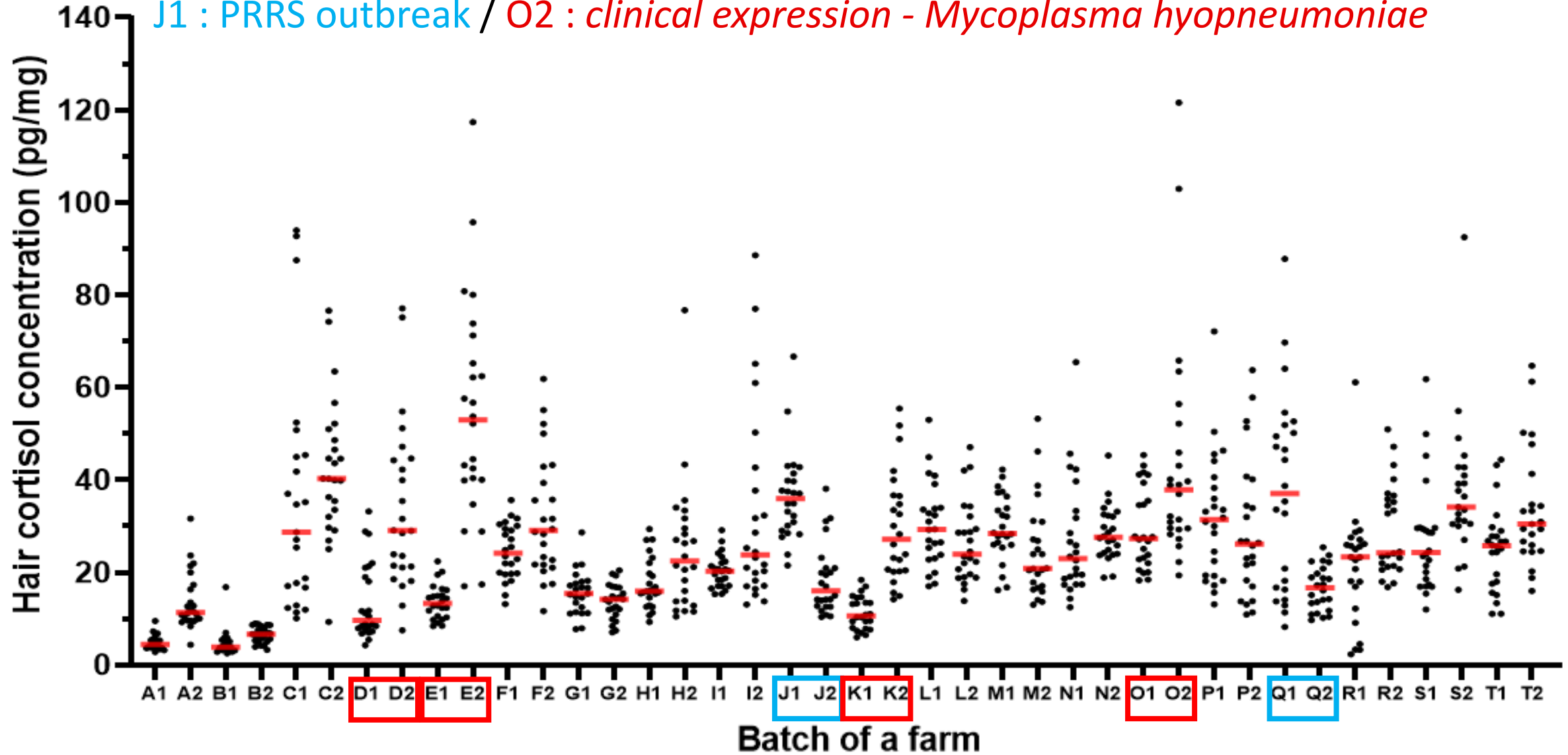


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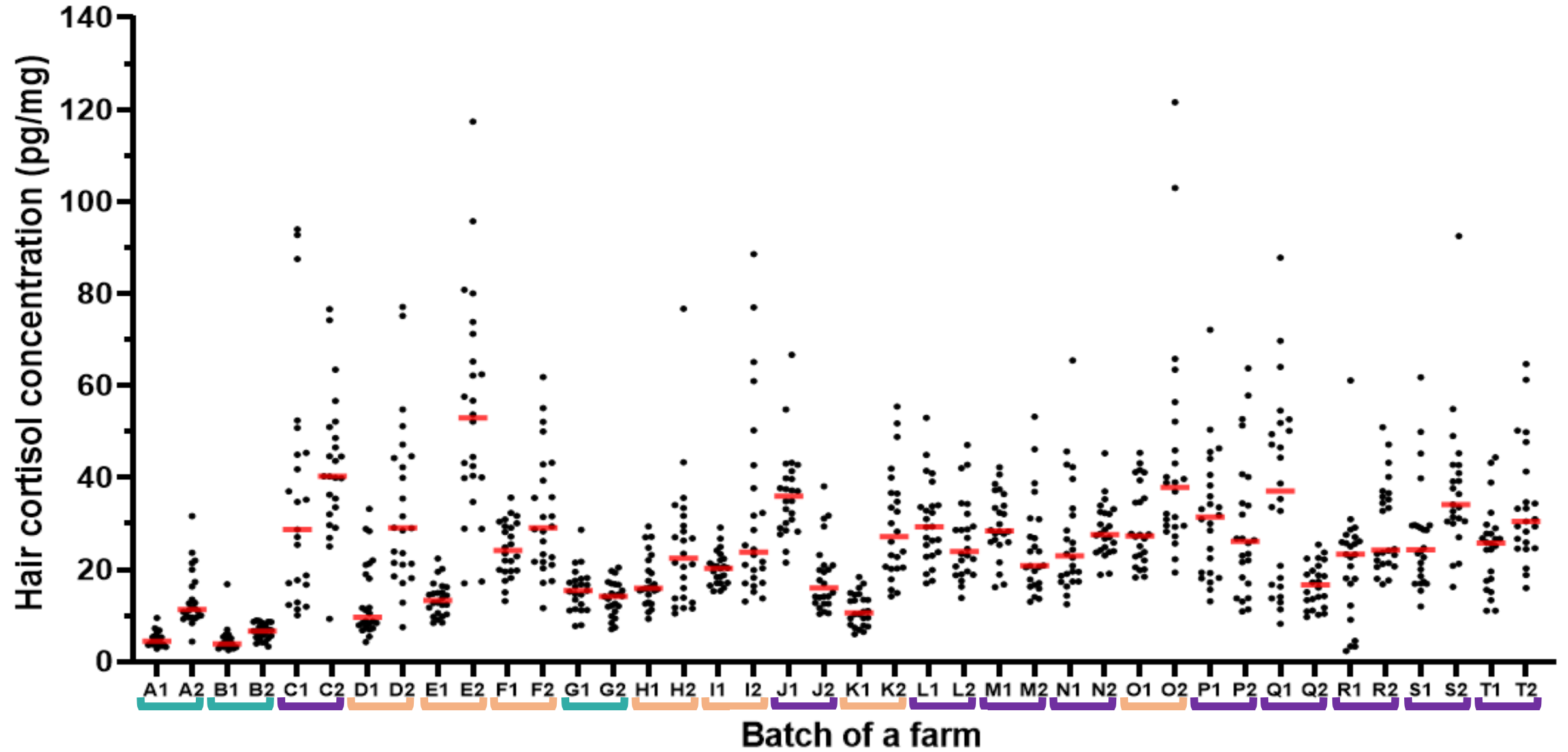


Differences between batches related to health?

J1 : PRRS outbreak / O2 : *clinical expression - Mycoplasma hyopneumoniae*



Three clusters of farms ~ means and standard-deviations



Supplementary variables?

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Number of farms	3	7	10
Variable			
Mean 1	8,4*	20,3	31,2*
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Standard-deviation 1	3,2	6,7	13,9*
Standard-deviation 2	3,9*	15,6*	9,7
Supplementary variables	7 management practices related to organic farms	Weight as a decision criterion to house animals in pens in fattening units	None