Plasmatic and ruminal metabolomes of lambs divergently selected on residual feed intake

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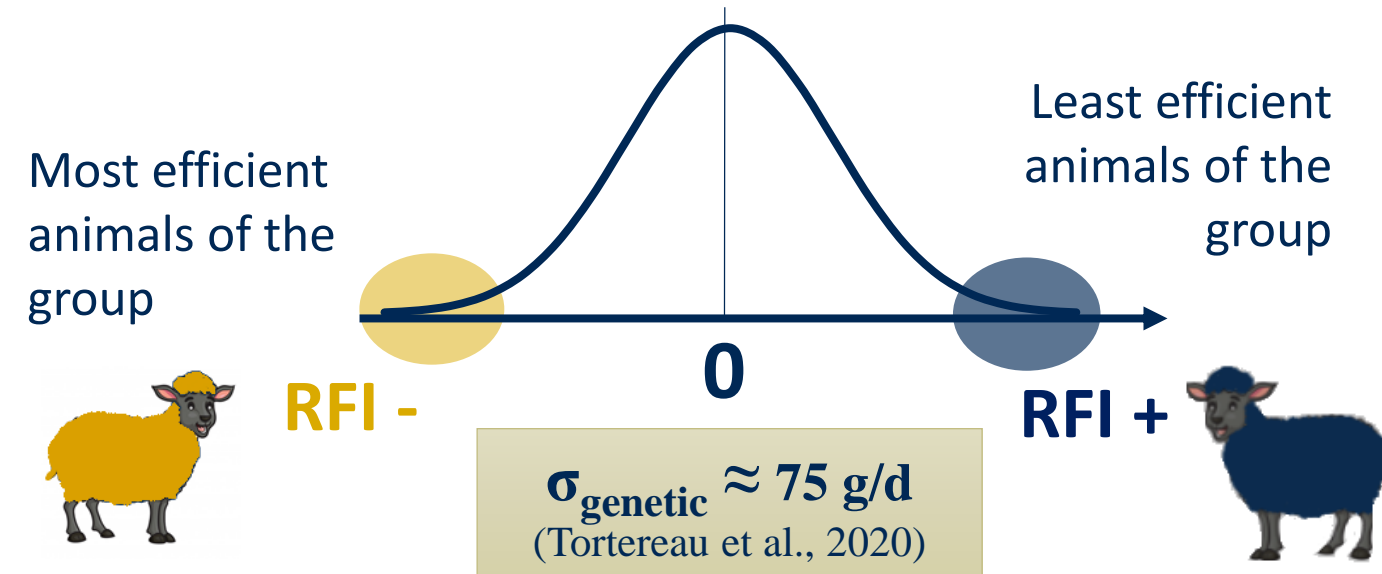
[1] : INRAE, INPT-ENVT, INPT-ENSAT, GenPhySE – Castanet-Tolosan, France

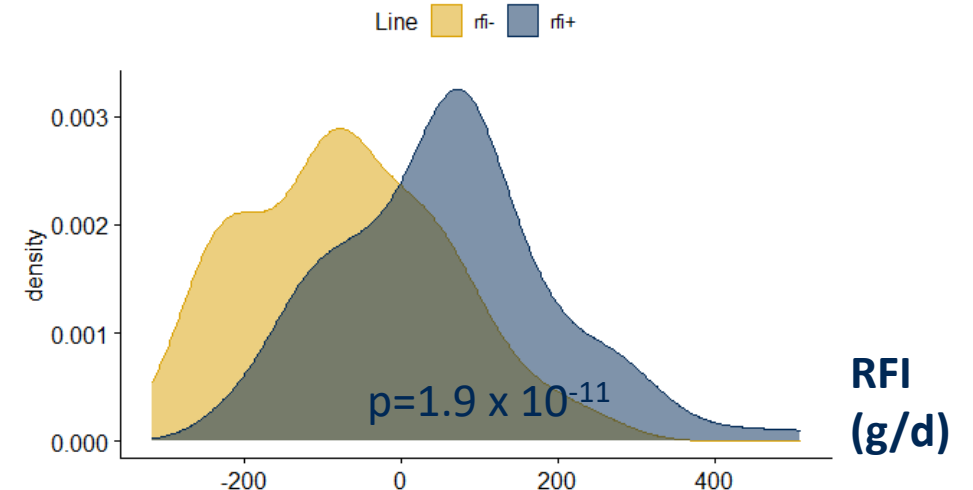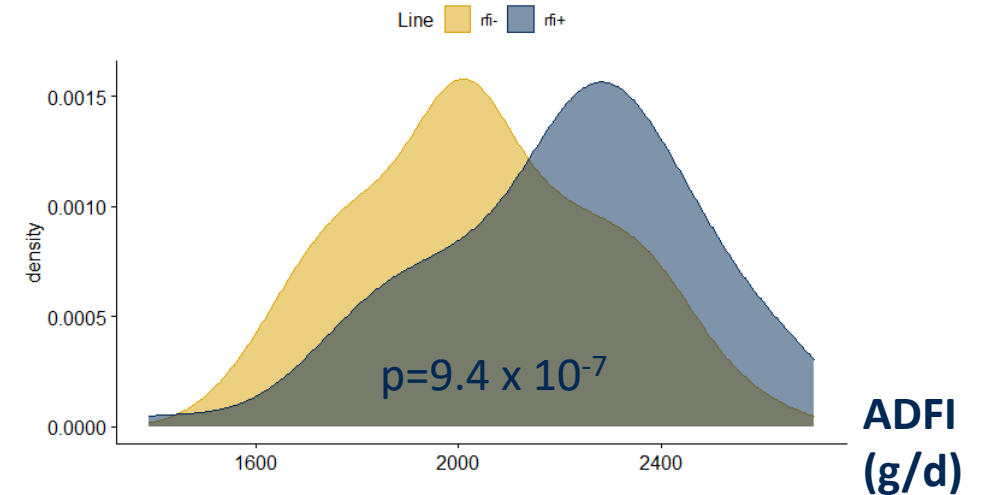[2]: INRAE, UR875 MIA-T – Castanet-Tolosan, France

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Divergent selection on residual feed intake

Heritability = 0,45 ± 0,08 in Romane Sheep (Tortereau et al., 2020)
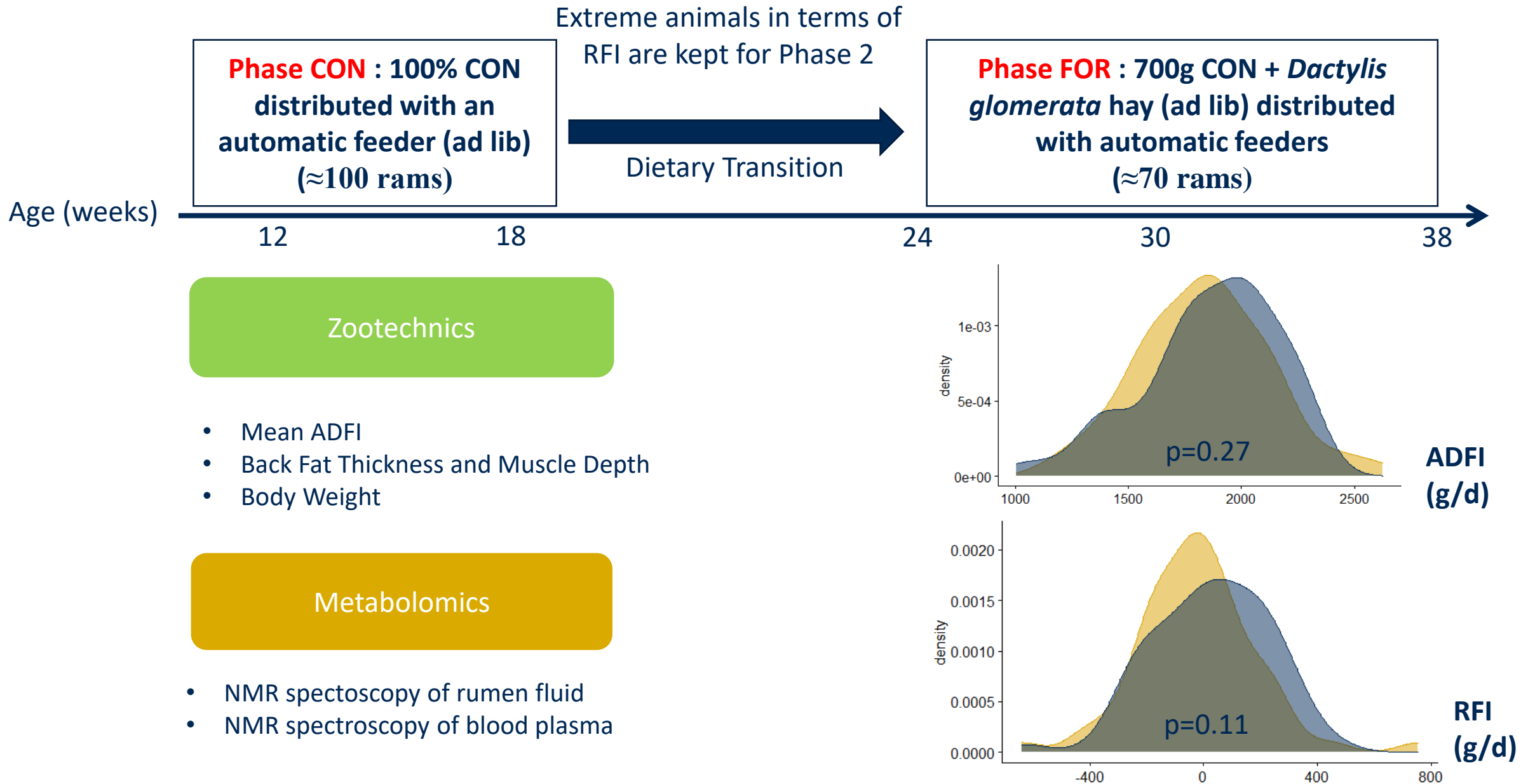→ Divergent genetic selection for feed efficiency under **a 100% concentrate diet**

Most efficient animals of the group

Least efficient animals of the group

RFI -

0

RFI +

$$\sigma_{genetic} \approx 75 \text{ g/d}$$
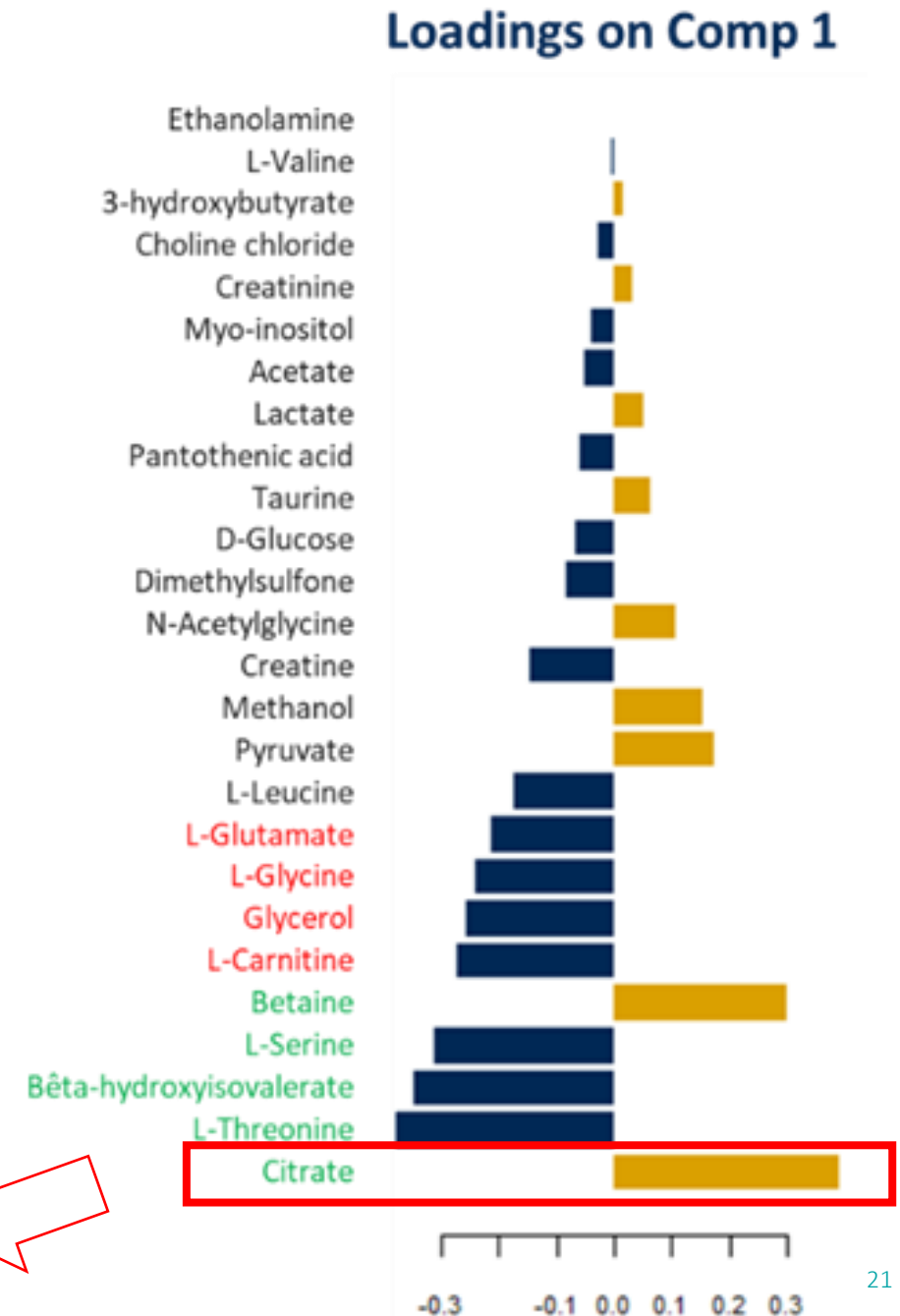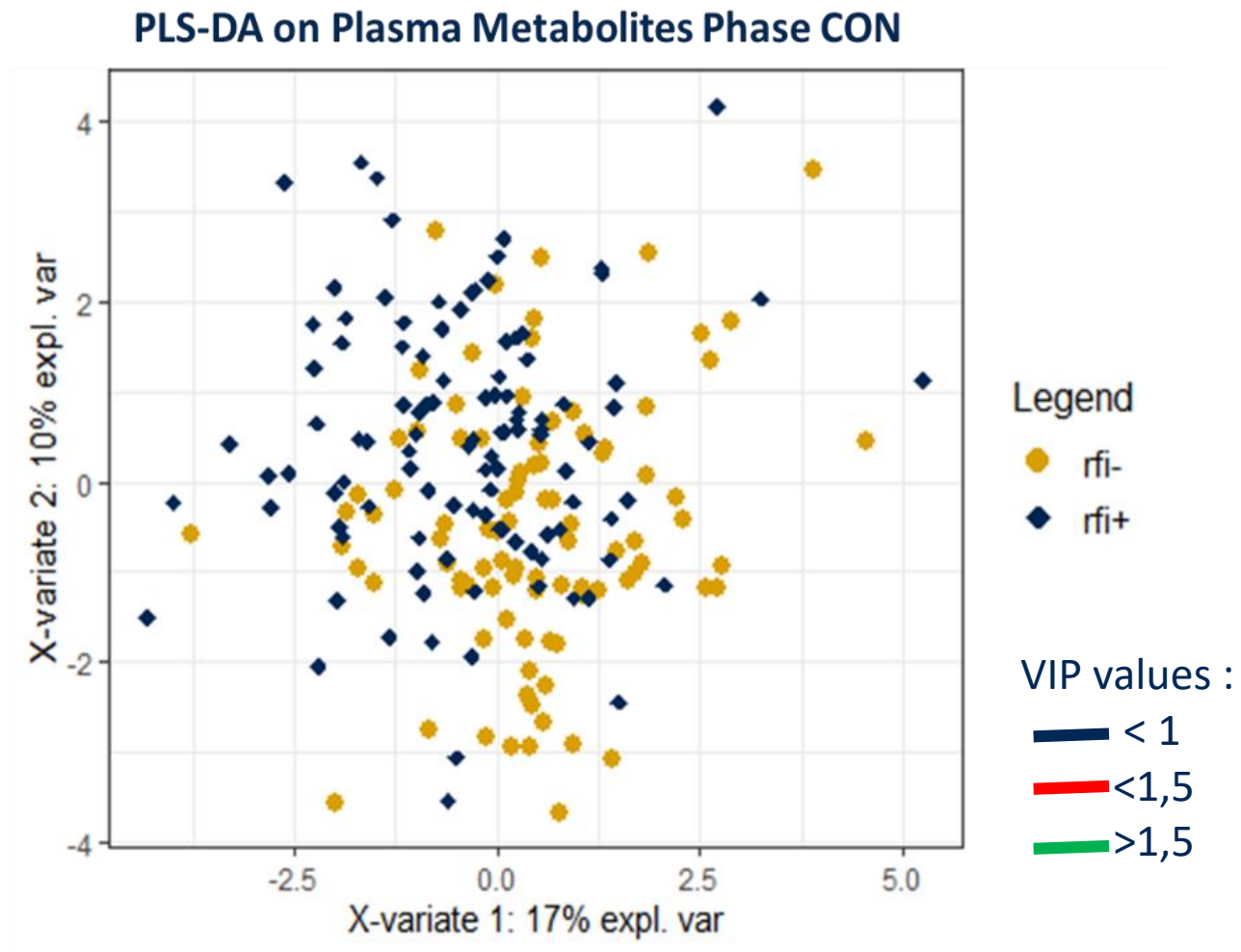(Tortereau et al., 2020)

- **Are RFI differences linked with different plasmatic and/or ruminal metabolomes?**

- **What happens at the metabolomic level when animals are fed with a diet enriched in forage?**
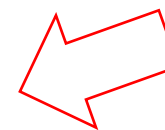
Line rfi- rfi+

$p = 9.4 \times 10^{-7}$

ADFI (g/d)

Line rfi- rfi+

$p = 1.9 \times 10^{-11}$

RFI (g/d)

Experimental protocol

Extreme animals in terms of RFI are kept for Phase 2

Phase CON : 100% CON distributed with an automatic feeder (ad lib) (≈100 rams)	→ Dietary Transition →	**Phase FOR : 700g CON + *Dactylis glomerata* hay (ad lib) distributed with automatic feeders (≈70 rams)**

Age (weeks) 12   18   24   30   38

Zootechnics

- Mean ADFI
- Back Fat Thickness and Muscle Depth
- Body Weight

Metabolomics

- NMR spectoscopy of rumen fluid
- NMR spectroscopy of blood plasma

p=0.27 — ADFI (g/d)

p=0.11 — RFI (g/d)

Plasma metabolites (Phase CON)

PLS-DA on Plasma Metabolites Phase CON

X-variate 2: 10% expl. var vs X-variate 1: 17% expl. var

Legend
- rfi− (gold)
- rfi+ (dark blue)

VIP values :
- ▬ < 1
- ▬ <1,5
- ▬ >1,5

> 1,5 when optimal number of components was taken into account

Loadings on Comp 1

Ethanolamine
L-Valine
3-hydroxybutyrate
Choline chloride
Creatinine
Myo-inositol
Acetate
Lactate
Pantothenic acid
Taurine
D-Glucose
Dimethylsulfone
N-Acetylglycine
Creatine
Methanol
Pyruvate
L-Leucine
L-Glutamate
L-Glycine
Glycerol
L-Carnitine
Betaine
L-Serine
Bêta-hydroxyisovalerate
L-Threonine
Citrate

-0.3 -0.1 0.0 0.1 0.2 0.3

Plasma metabolites (Phase FOR)

PLS-DA on Plasma Metabolites Phase FOR
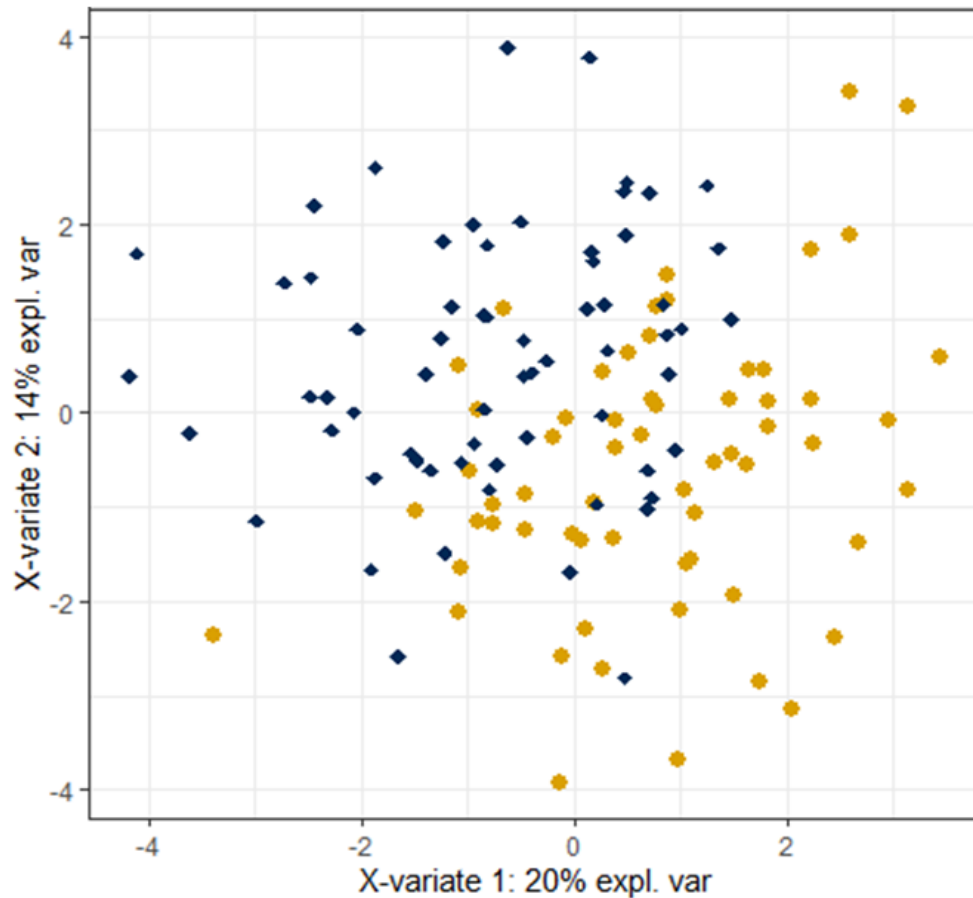
Legend
- rfi-
- rfi+

VIP values :
- < 1
- <1,5
- >1,5

Loadings on Comp 1
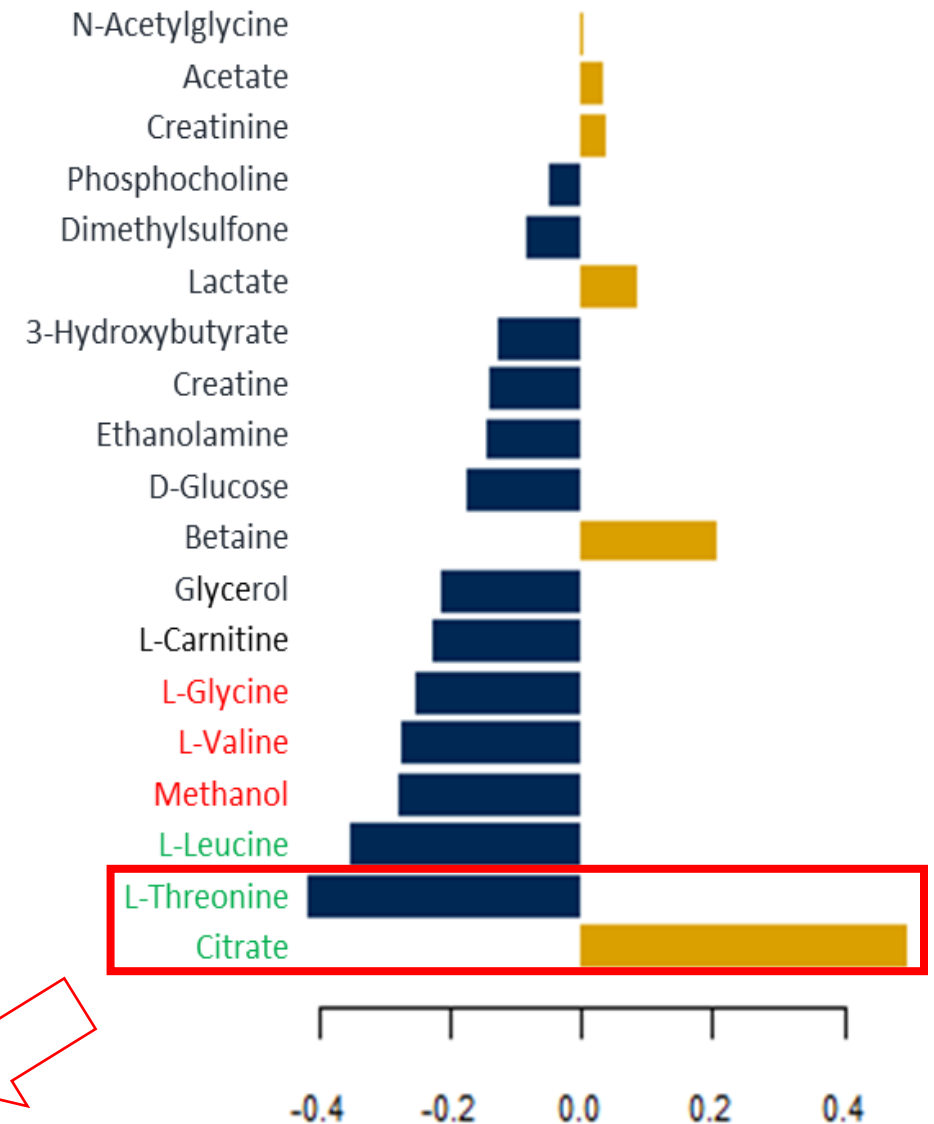
> 1,5 when optimal number of components was taken into account

Plasma metabolites

RFI - (more efficient)

Citrate
Betaine

RFI + (less efficient)

L-Threonine
L-Serine
L-Glycine
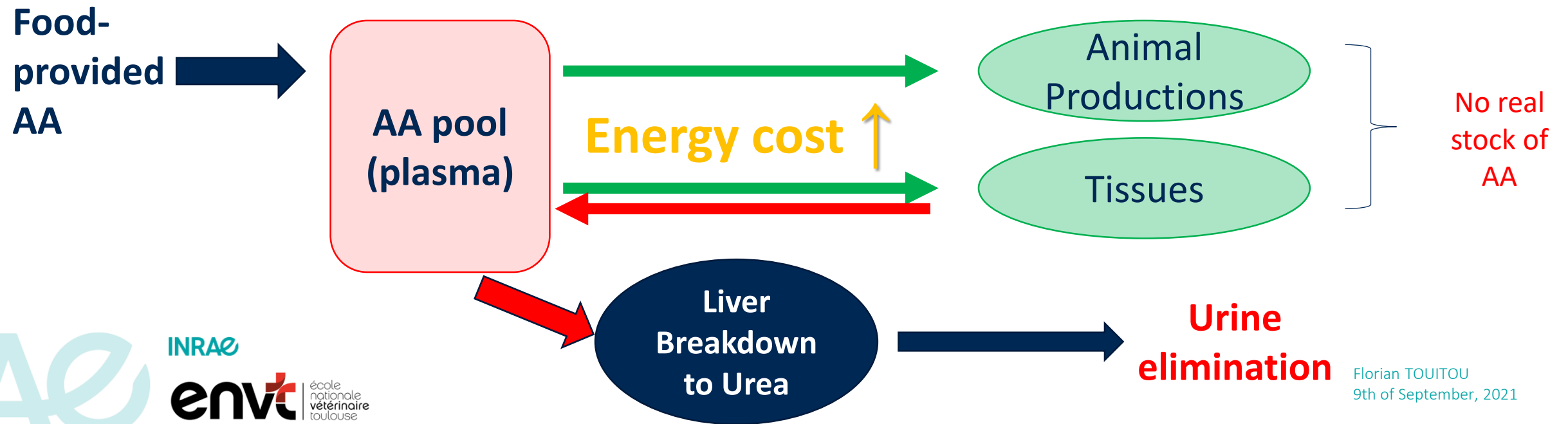L-Leucine
L-Valine
Beta-Hydroxyisovalerate

→ Very weak correlations between Genetic or Phenotypic RFI and metabolites identified by PLS-DA except for beta-Hydroxyisovalerate and phenotypic RFI (r = 0.35)

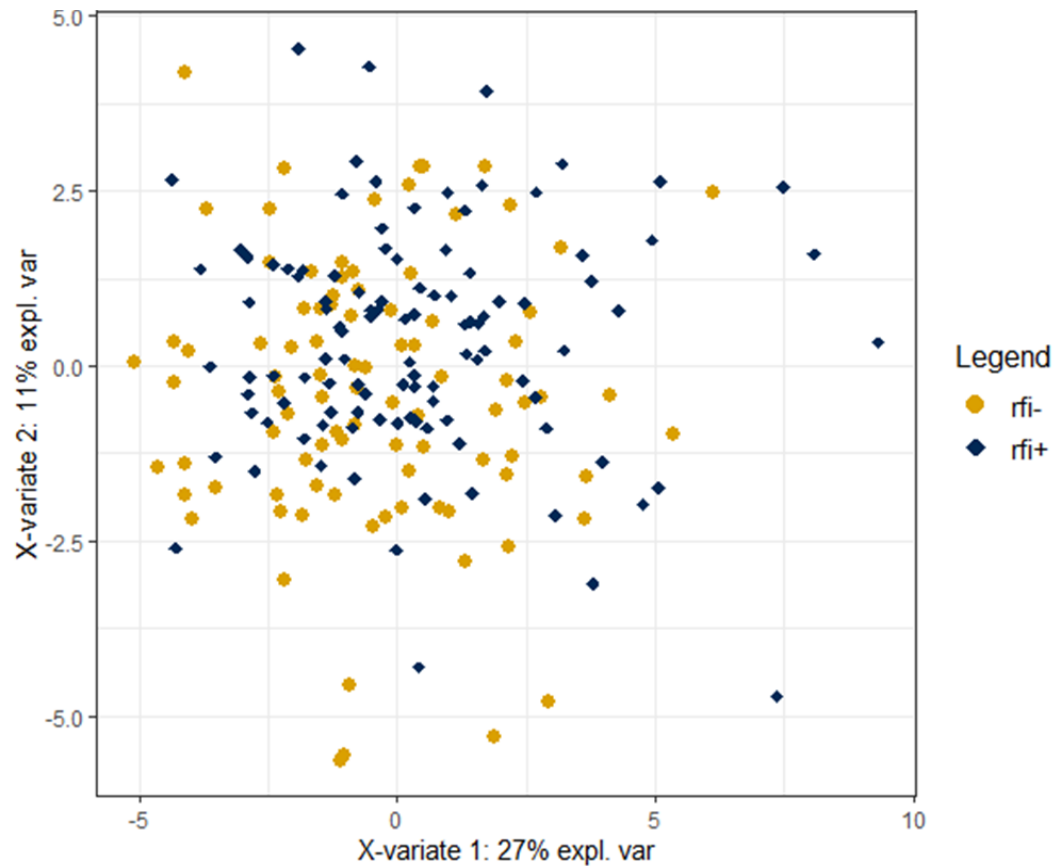→ Strong positive correlations (> 0.5) between aminoacids

Plasma metabolites

Hypothesis :

→ Less protein degradation/turnover in animals from line RFI – than RFI +

* Already identified in cattle : Herd et al. 2004, Richardson et al. 2004.

* Compatible with the release of amino acids in the plasma
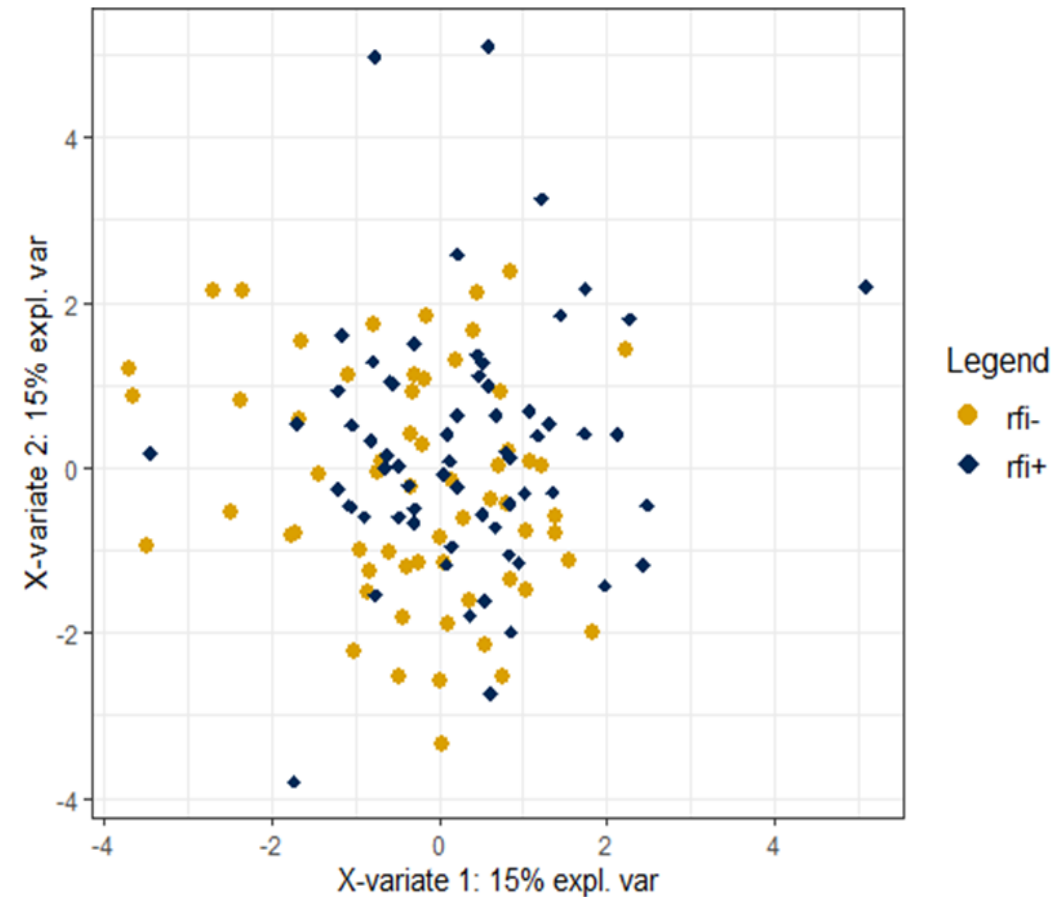
* Less consumption of betaine for methionine production ?

Food-provided AA → AA pool (plasma)

Energy cost ↑

Animal Productions

Tissues

No real stock of AA

Liver Breakdown to Urea → Urine elimination

INRAe

école nationale vétérinaire toulouse

Rumen fluid metabolites

No VIP values higher than 1.5 when optimal number of components was taken into account.

Poor discrimination

Conclusion

→ Plasma metabolites seem to be more discriminant than rumen fluid metabolites

- Difference in feed efficiency is more likely to stem from host metabolism than from ruminal digestion
- Microbial population (see *Le Graverand et al.* Session 66)
- Other metabolites unidentified with NMR could be involved in the difference.

→ **Protein turnover seems to be involved in the difference**

Thank you very much for your attention !

Questions ?
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> ## Acknowledgements

INRAE

envt
école
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