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Dairy cows' diet has a marked impact on vitamin content in milk but less in yogurts

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B vitamins : *Description and needs*

Clinical deficiencies in disadvantaged populations
(Allen et al., 2003)

Subclinical deficiencies in the rest of the population
(Cordero et al., 2008)



B vitamins

Metabolic pathways
Coenzyme, Energy, fatty acid, nucleic acid, protein and sugar metabolism
(Graulet, 2014)

Need to be supplied by food for humans



Milk = source of B vitamins

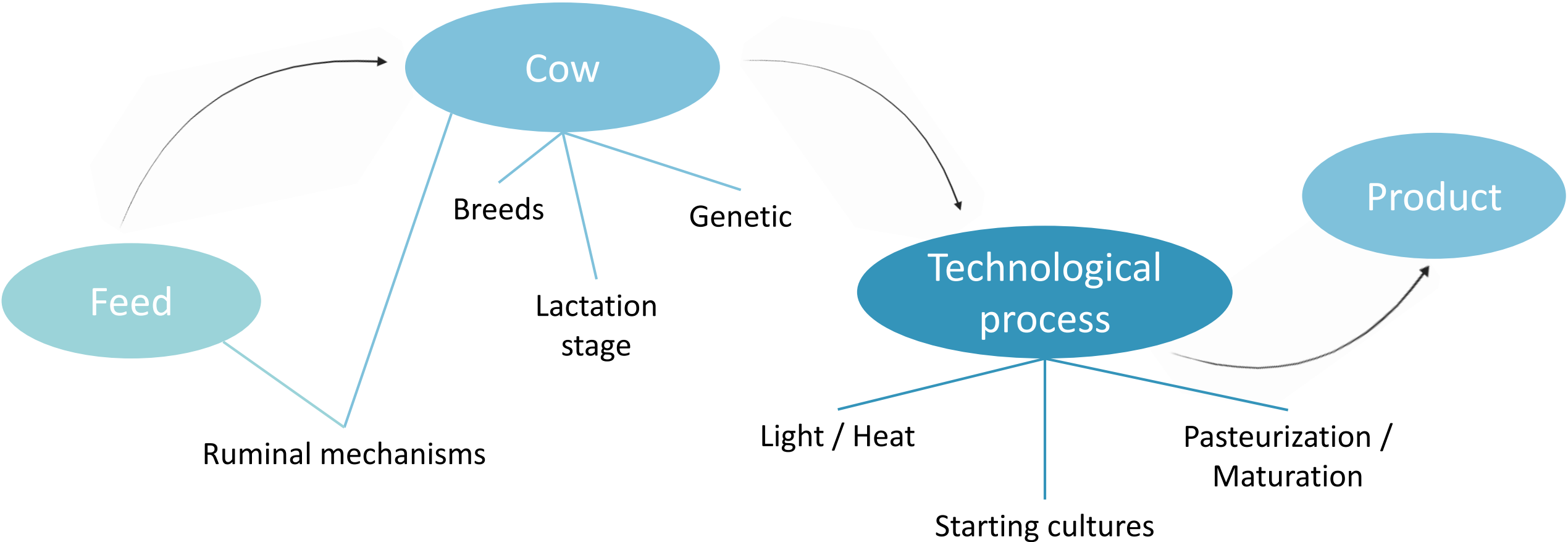
Consumer products
(Coudray et al., 2011)

Nutritional interest
(Graulet, 2014)

Dairy products could improve the status of B vitamins in humans

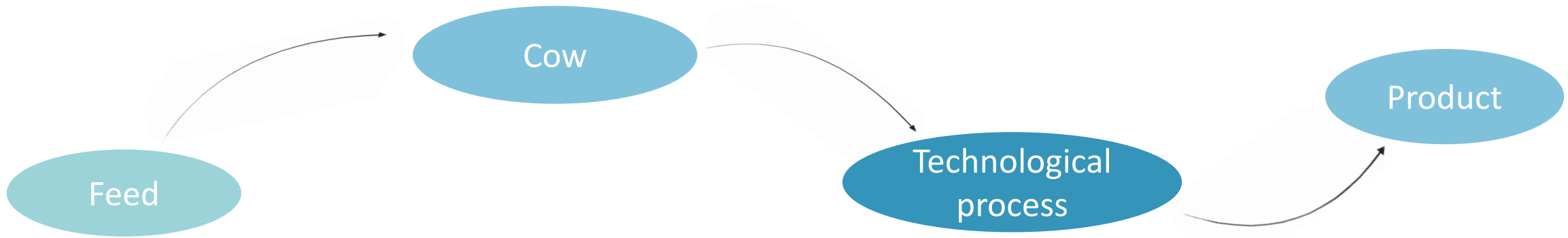
What are the factors impacting B vitamin level in dairy products ?

B vitamins content variations : *the drivers*



B vitamins content variations : *the questions*

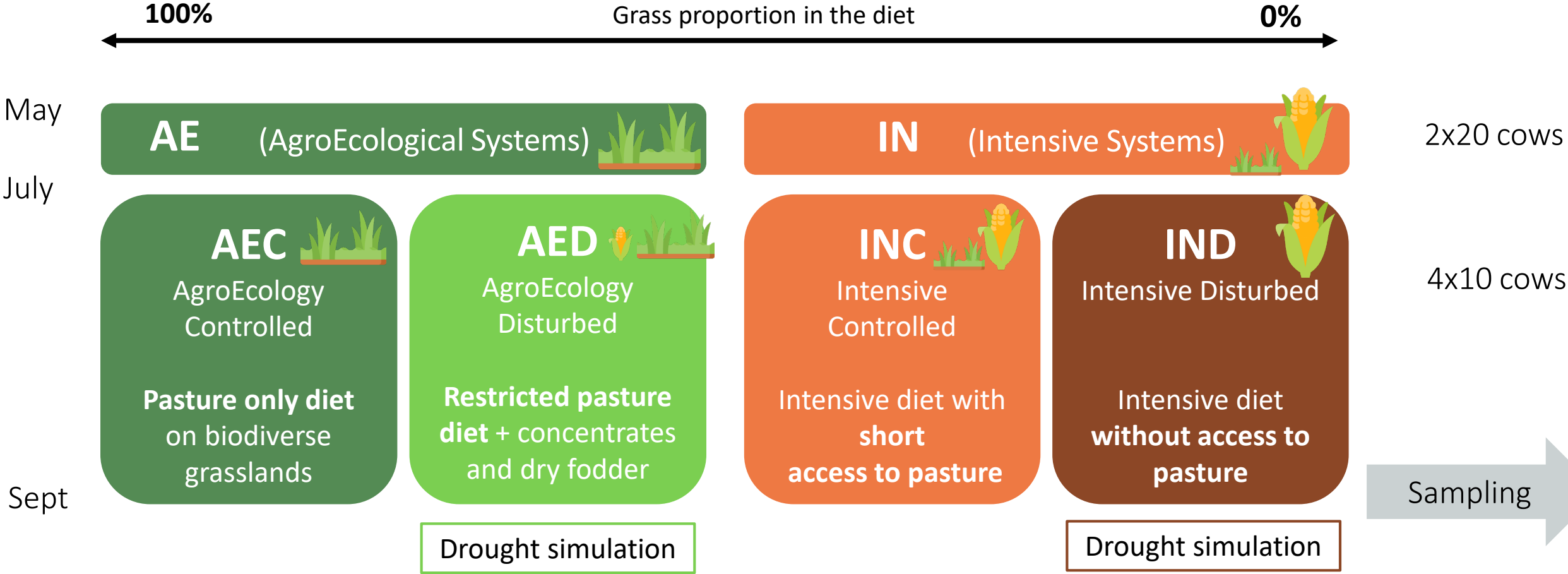
INTRODUCTION



- Does the diet composition of dairy cows can modulate the composition in B vitamins of raw milk ?
- Does the modification observed in raw milk can be seen in the corresponding yogurts ?
- Is it possible to modulate the content of B vitamins with the add of probiotics in yogurt ?

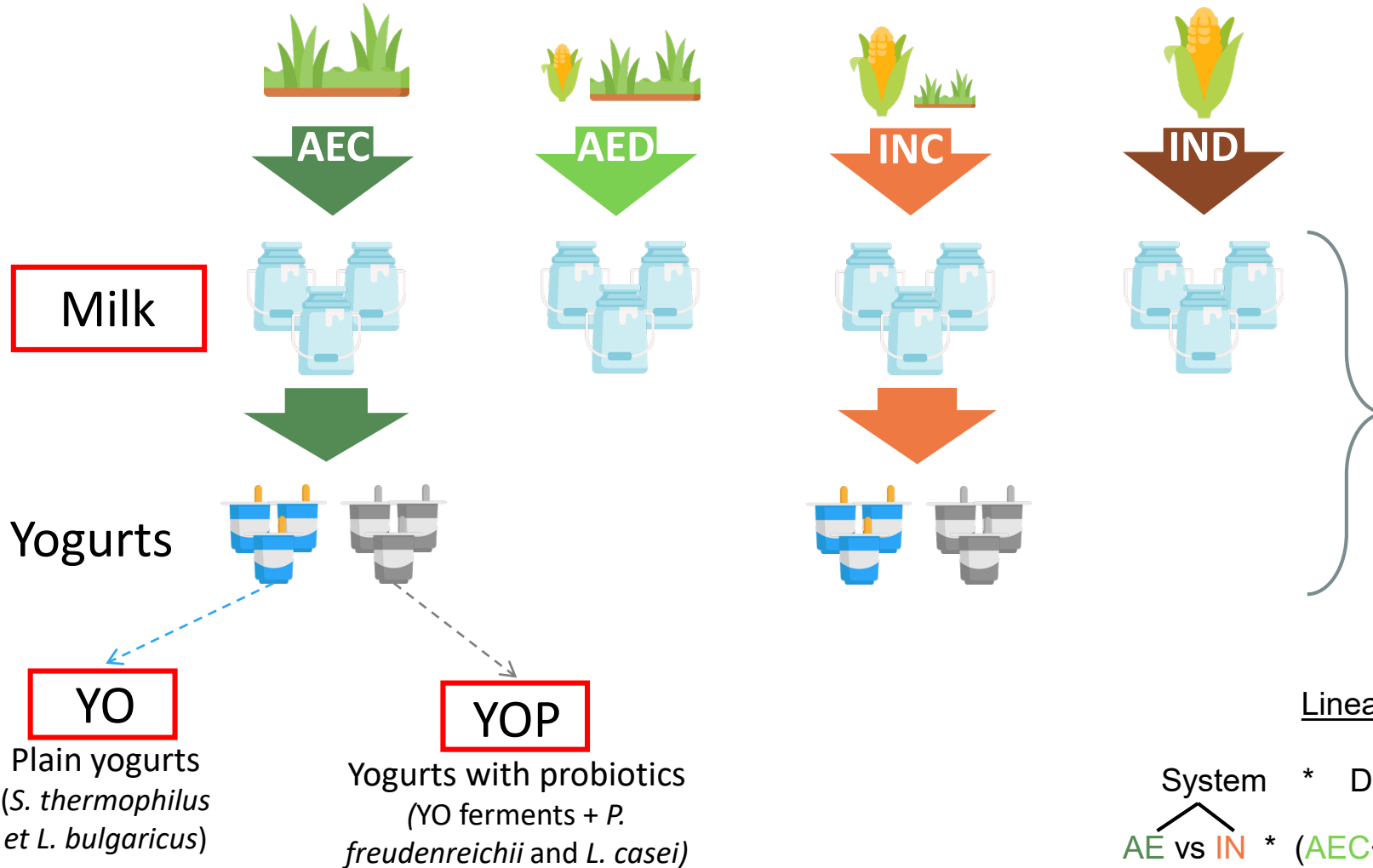
Experimental design

MAT & MED



Experimental design

MAT & MED



Analysis of B vitamin concentration

Vitamins	Methods
B1 – B5	UPLC MS <i>(Auzance et al., 2024, not published)</i>
B2 – B6	UPLC FLR <i>(Laverroux et al., 2020)</i>
B9 – B12	Chimoluminescence assay kit <i>(adapted from Duplessis et al., 2015)</i>

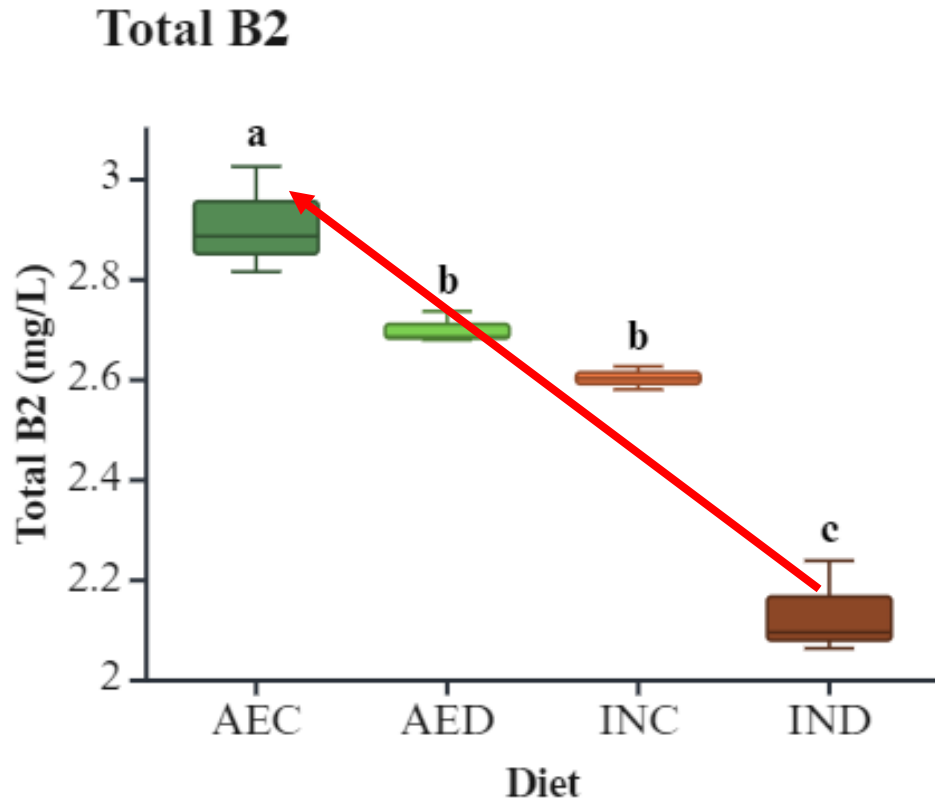
Linear model of 2-way Anova & Tuckey test :

$$\begin{array}{c} \text{System} \\ \swarrow \quad \searrow \\ \text{AE vs IN} \end{array} * \begin{array}{c} \text{Disturbance} \\ \swarrow \quad \searrow \\ (\text{AEC+INC}) \text{ vs } (\text{AED+IND}) \end{array} \quad \text{OR} \quad \begin{array}{c} \text{Dairy pdt} * \text{System} \\ \swarrow \quad \searrow \\ \text{YO vs YOP} * \text{AE vs IN} \end{array}$$

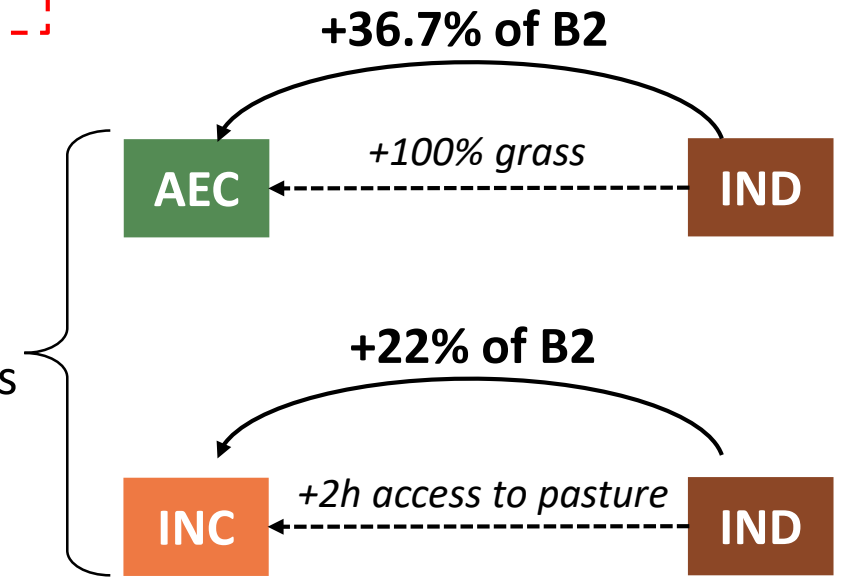
Milk : *the more grass, the more B2*

RESULTS

P value **System x Disturbance** < 0.05



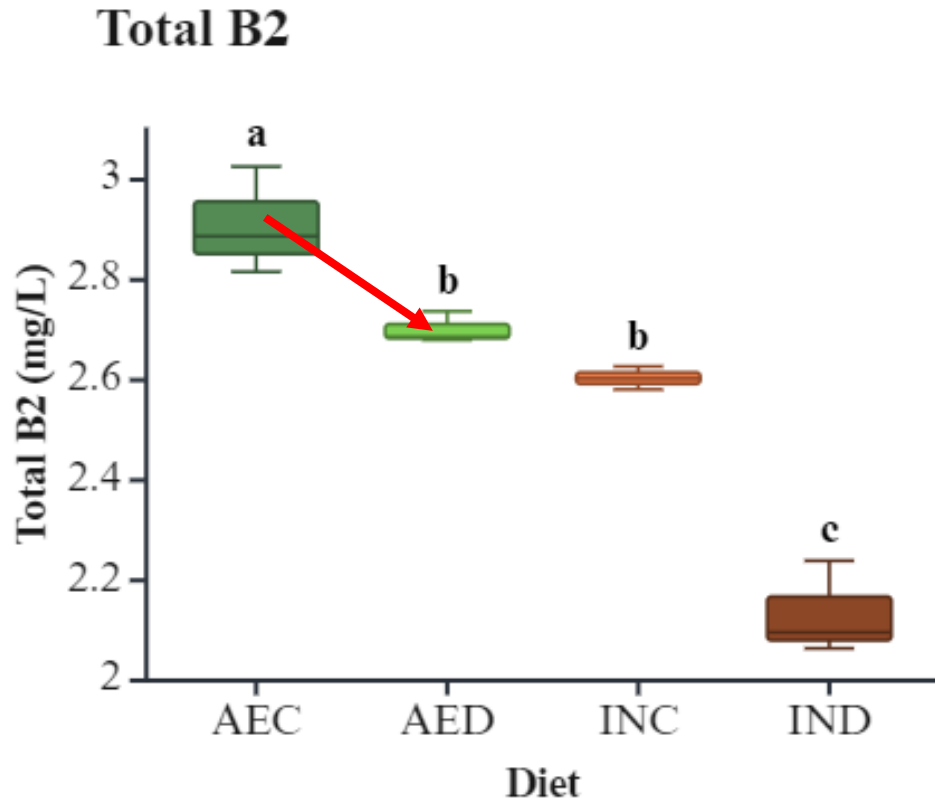
Grazing-based production systems



Milk : *the more grass, the more B2*

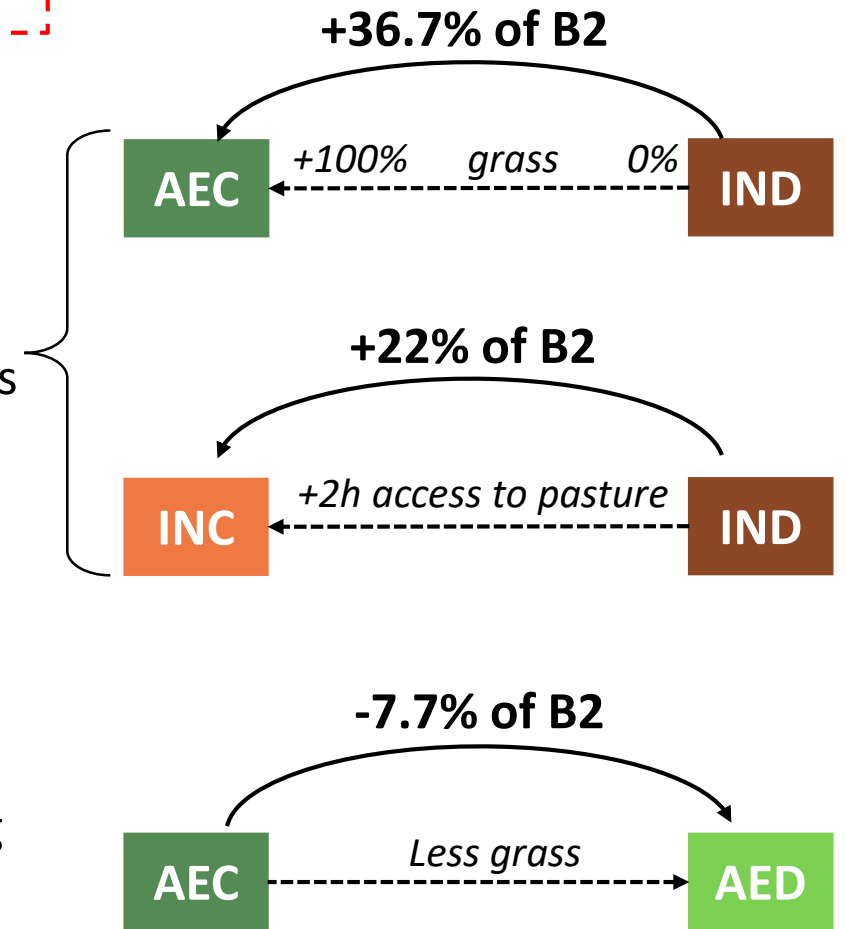
RESULTS

P value **System x Disturbance** < 0.05



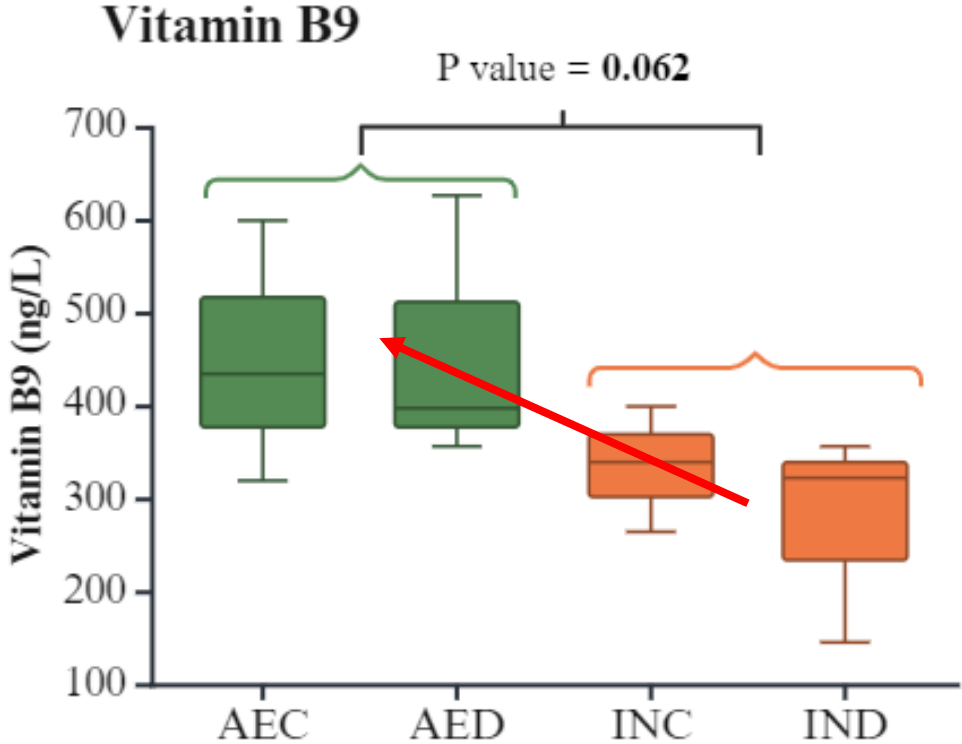
Grazing-based production systems

Drought limiting grazing

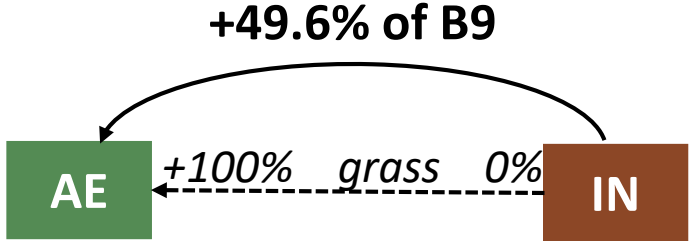


Milk : *increase of B9 with extensive system*

RESULTS

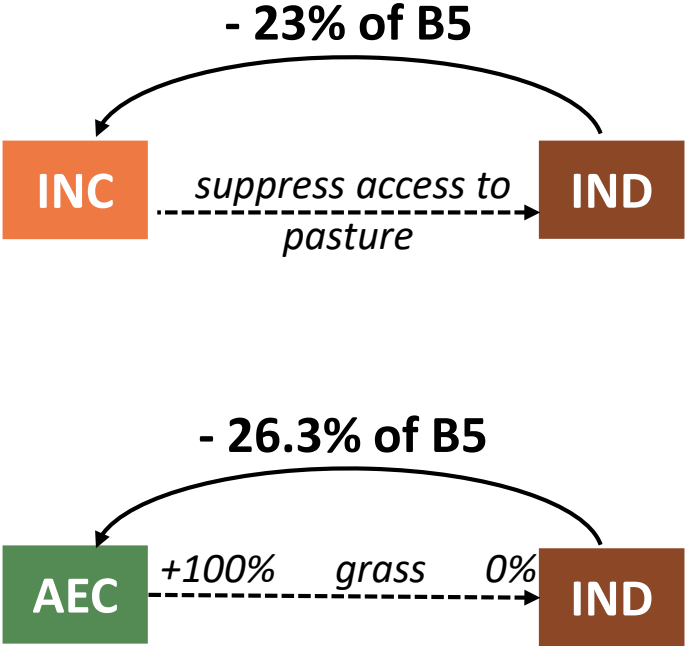
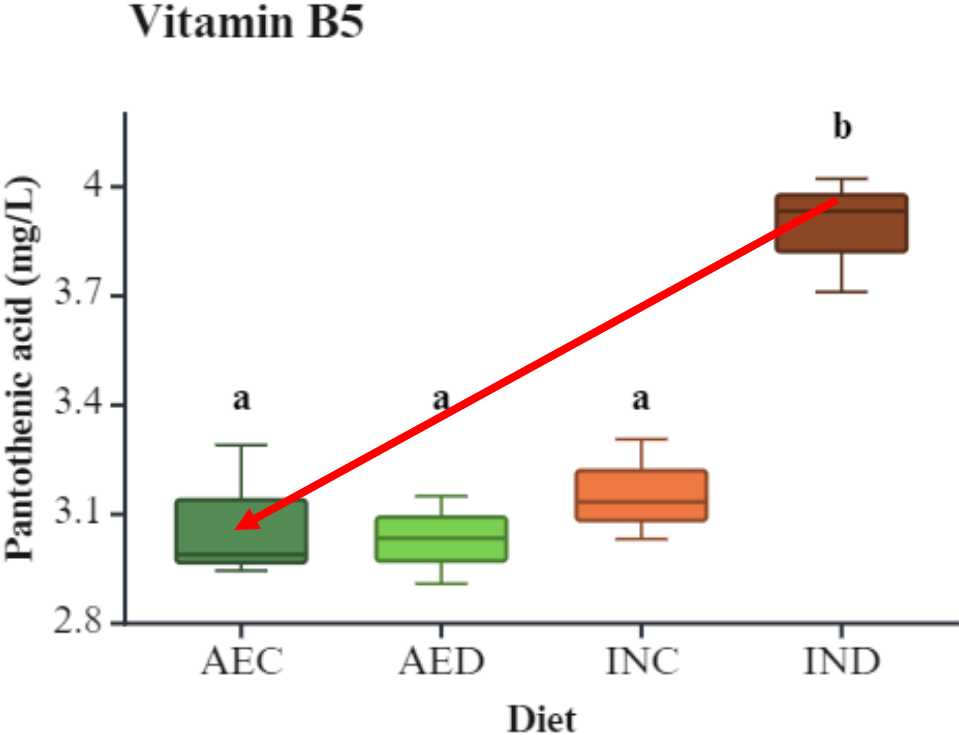


0.05 < P value **System** < 0.1



Milk : *the more grass, the less B5*

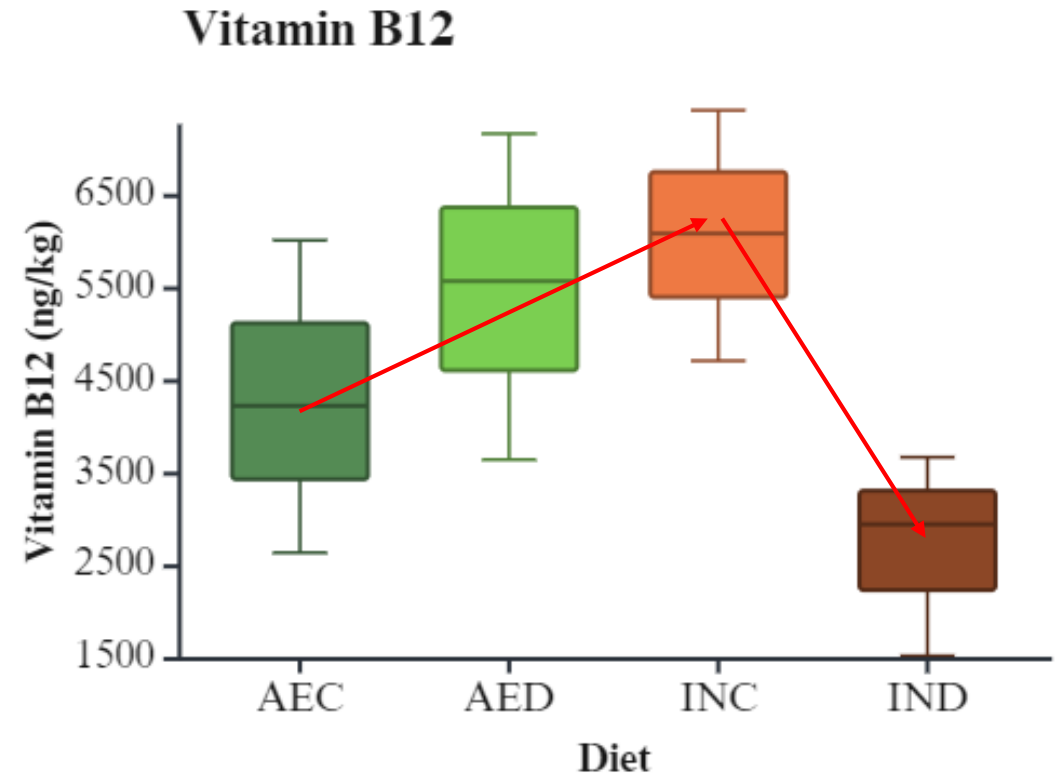
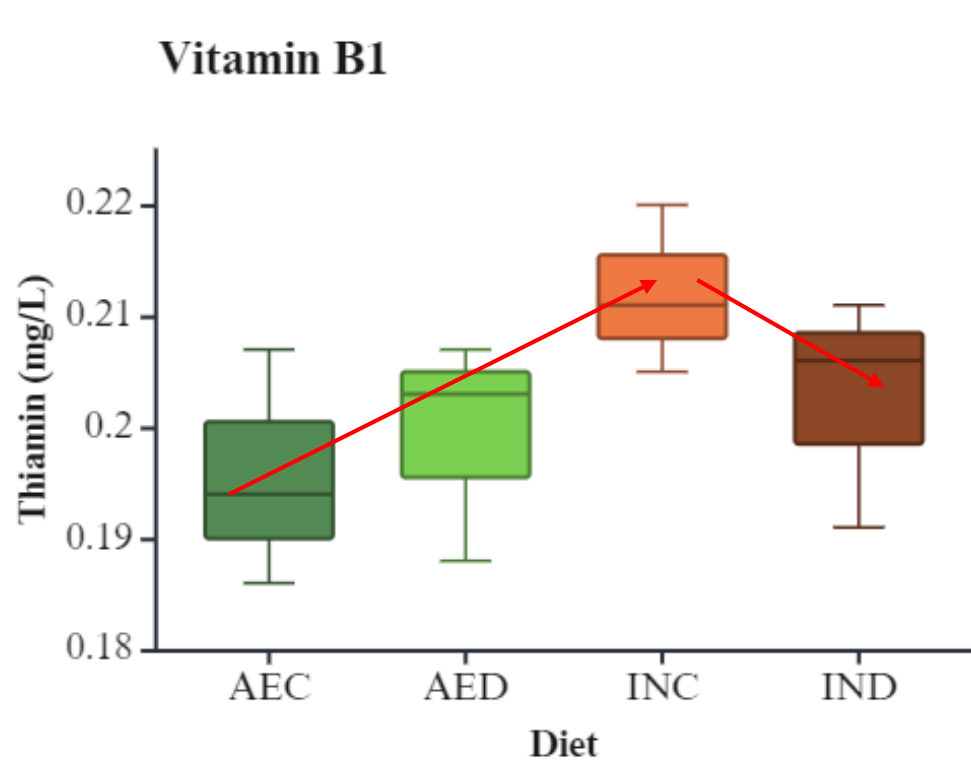
P value **System x Disturbance** < 0.05



Milk : optimum for B1 and B12 with INC

RESULTS

Same samples ≠ analysis methods



P value **System * Disturbance** < 0.05

Milk : the concentration of B vitamins does vary

DISCUSSION

Does the diet composition of dairy cows can modulate the composition in B vitamins of raw milk ?



B2 : Confirm the previous results (*Laverroux et al., 2014*)

B9 : Seems to follow a pattern already observed (*Chassaing et al., 2011*)

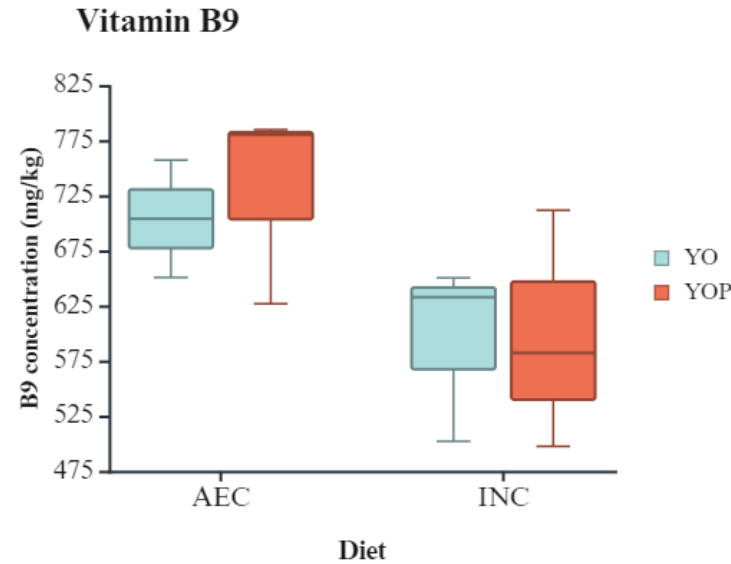
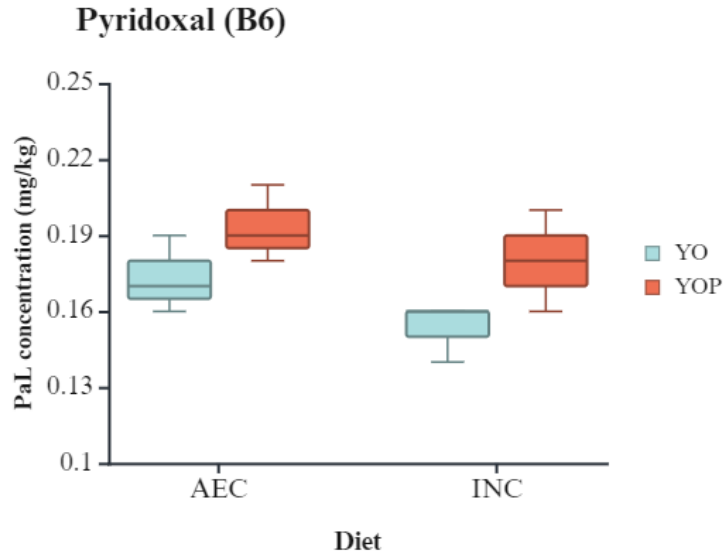
B5 : Complete the previous results on forage proportion increase (*Ragaller et al., 2011*)

B12 : Similar to what observed by *Chassaing et al., (2011)*; but not in every study (*Duplessis et al., 2019*)

B1 : Pattern never observed before

Can these results be transferred to yoghurt ?

Yogurts : *the more grass, the more B6 & B9 (trends)*



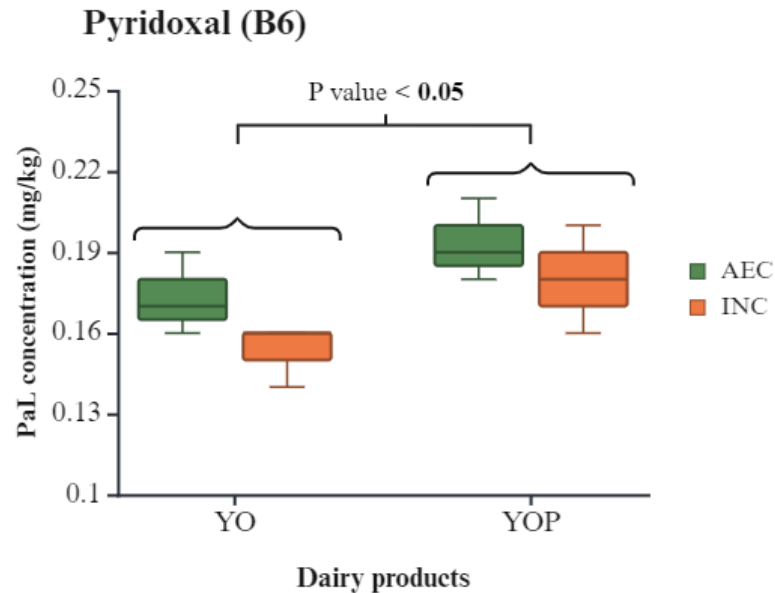
0.05 < P value **Diet** < 0.1

Does the modification observed in raw milk can be seen in the corresponding yogurts ?



- The effects of diet visible in milk are not translated into yoghurts → interaction and loss during process
- Matrix different from milk, so impact of ferment synthesis (*Walthers et al., 2017, Leblanc, et al., 2015*)

Yogurts : *probiotics increase vitamin B6*



Effect of probiotics only on pyridoxal (B6)

P value Dairy product < 0.05

Is it possible to modulate the content of B vitamins with the add of probiotics in yogurt ?



- De novo synthesis of B6 seems possible with this couple of probiotics (*P. freudenreichii* and *L. casei*)
- Synthesis of B2 has been demonstrated with other probiotics (*Leblanc et al., 2006*)

Take home messages

CONCLUSION

- Not ONE best milk but SEVERAL type of milk

↗ B1 – B5 – B12



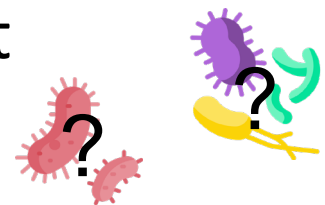
↗ B2 – B9



- Modulation seen in milk does not transfer in yogurts



- Synthesis of B vitamins with probiotics seems possible with different couple of probiotics



Thank you !

SUPERVISION & PARTNERSHIPS



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