How does lamb feeding management during early life and high-cereal finishing affect the rumen *trans* fatty acid profile at weaning and the end of the fattening period?

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RUMINANT FAT

SFA
Saturated Fatty Acids

MUFA
Monoinsaturated Fatty Acids

PUFA
Polinsaturated Fatty Acids

↑ risk of cardiovascular diseases

Trans Fatty Acids

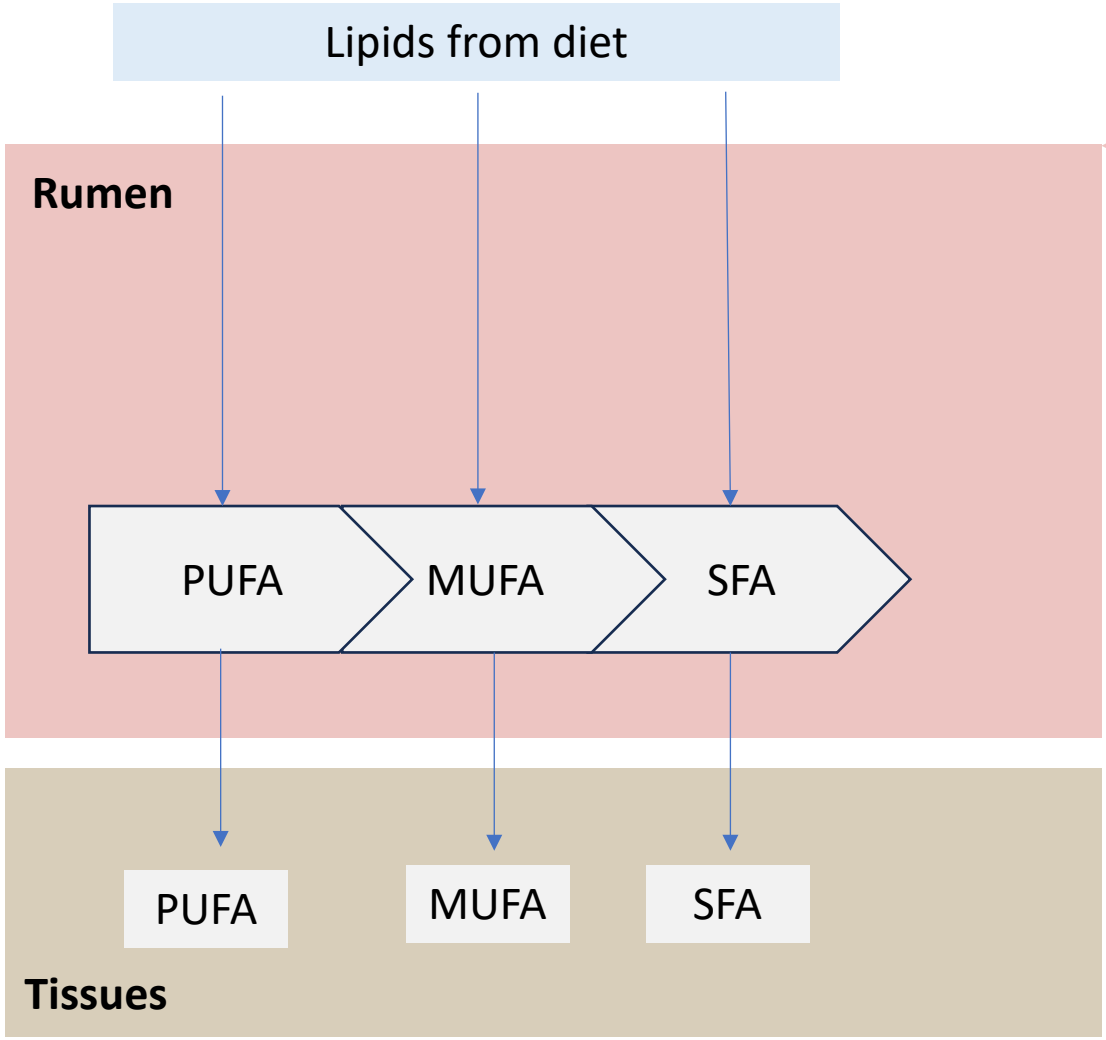
Rumenic Acid (*c*9,*t*11-18:2, CLA)

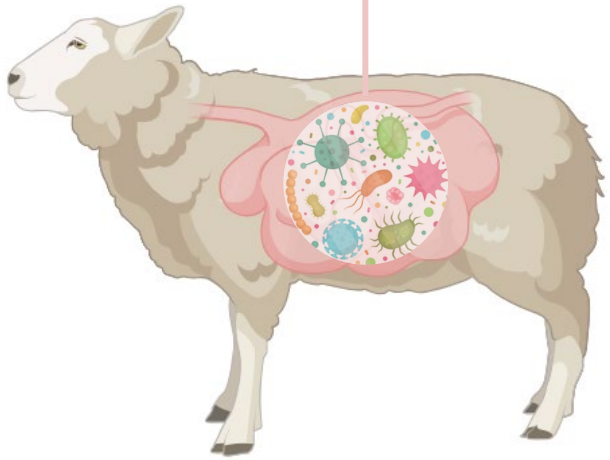
Vaccenic Acid (*t*11-18:1)

Have many properties that may promote human health and wellbeing

Adapted from Francisco, A. E., M. Janicek, T. Dentinho, A. P. V. Portugal, J. M. Almeida, S. P. Alves, L. Fialho, E. Jeronimo, R. J. B. Bessa, and J. Santos-Silva. 2020. Effects of alfalfa particle size and starch content in diets on feeding behaviour, intake, rumen parameters, animal performance and meat quality of growing lambs. Meat Sci 161:107964.

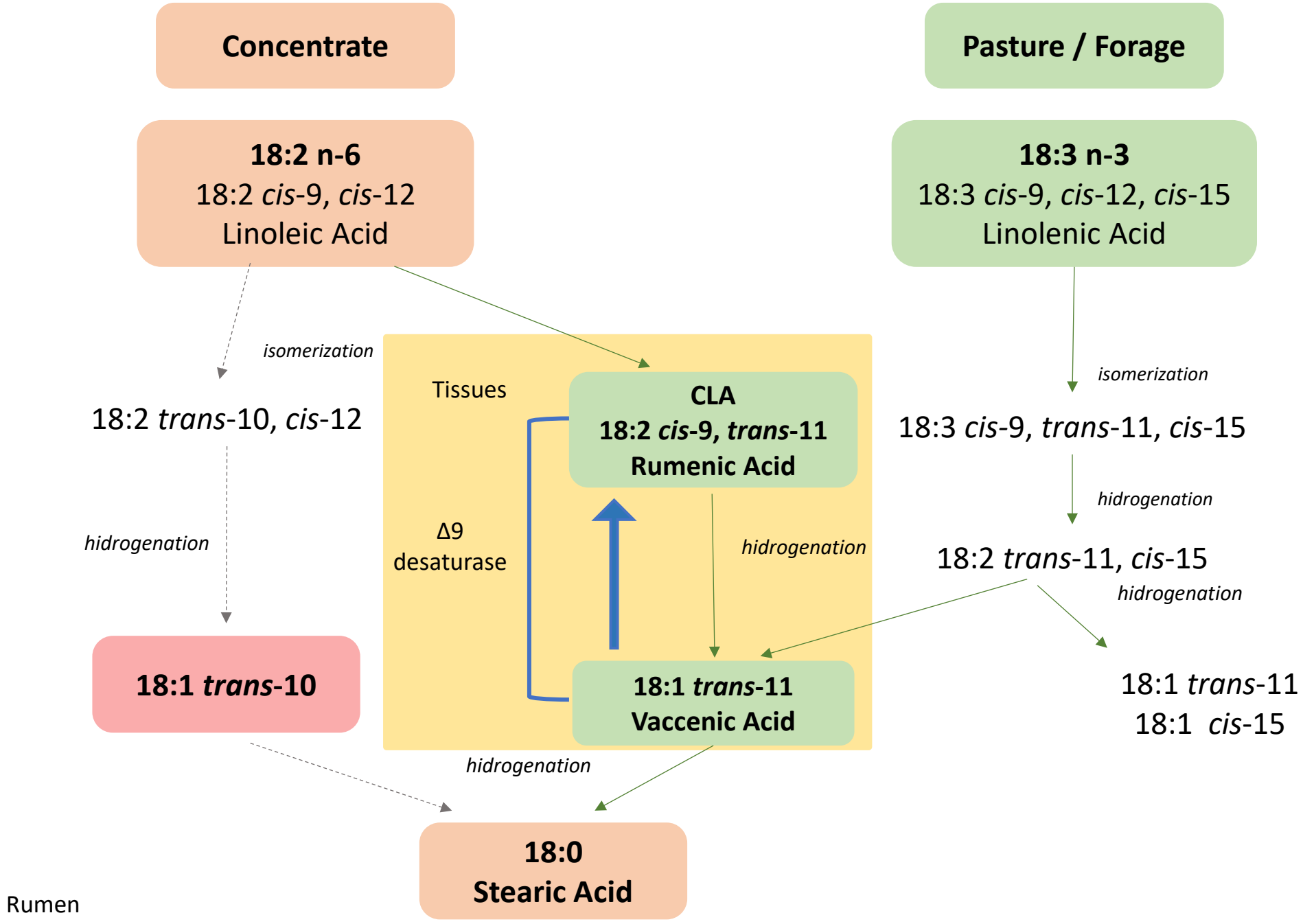
RUMINAL BIOHYDROGENATION





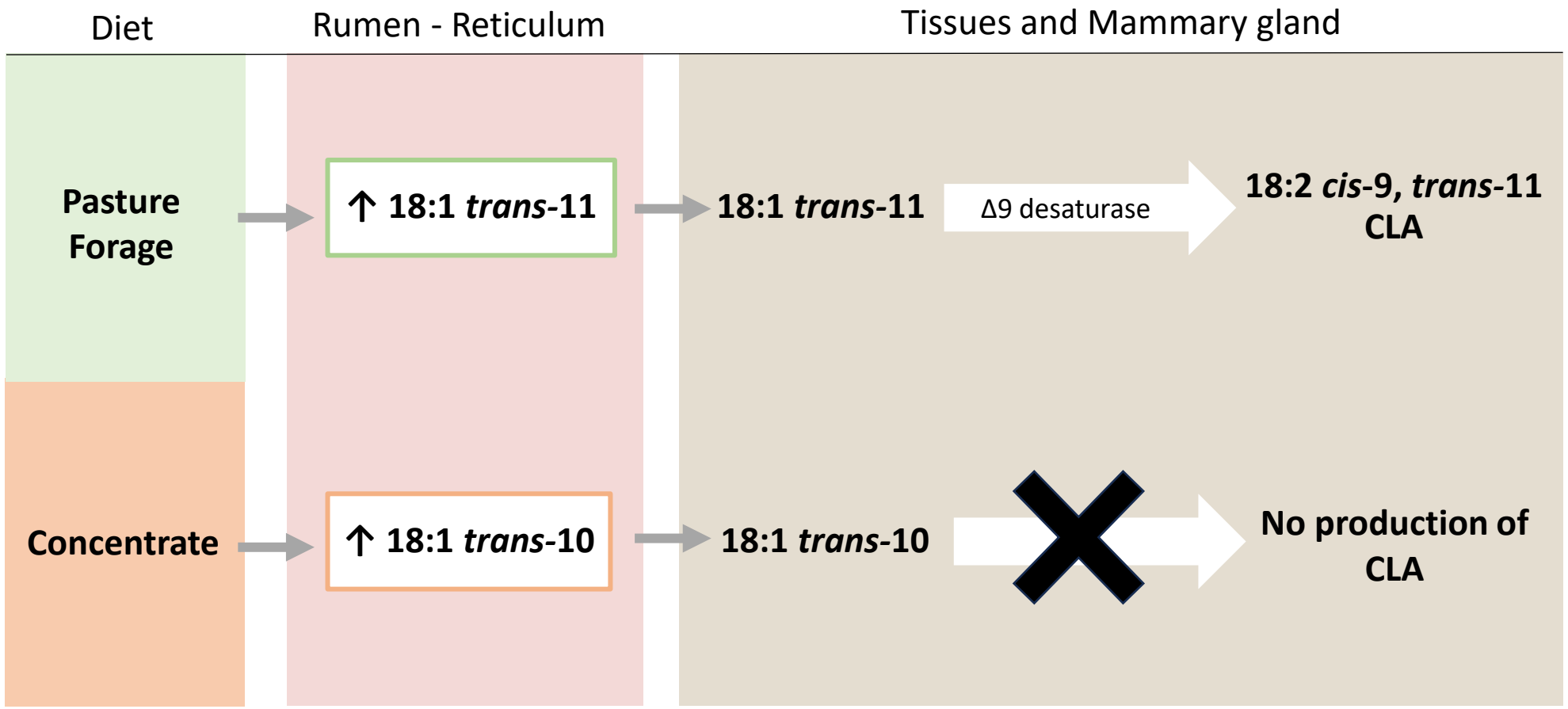
Determinant process for fatty acid profile present on milk and tissues of ruminant

Ruminal Biohydrogenation Pathways



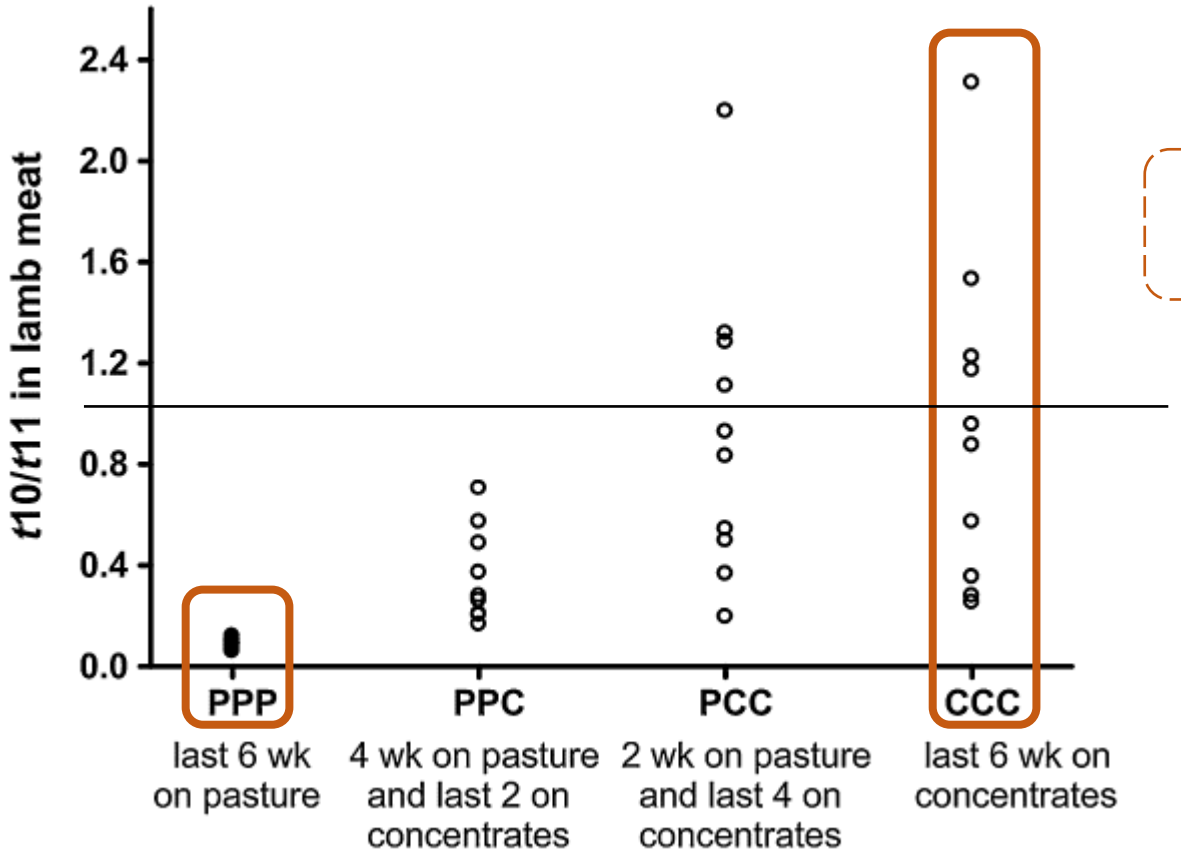
Adapted from Harfoot, C., G. Hazlewood, P. Hobson, C. J. e. H. P. Stewart, C. Stewart CS, and L. Hall. 1997. Lipid metabolism in the rumen. In C. S. Hobson P. N. and Stewart (Ed.):382-426.

BIOHYDROGENATION PATHWAYS



Adapted from Bessa, R. J. B., S. P. Alves, and J. Santos-Silva. 2015. Constraints and potentials for the nutritional modulation of the fatty acid composition of ruminant meat. Eur. J. of Lipid Sci. Technol. v. 117,1325–1344.

RATIO 18:1 *trans*-10/18:1 *trans*-11

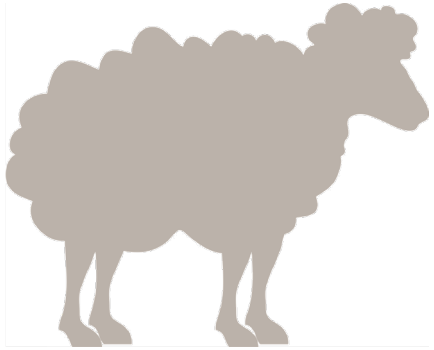


Shift 18:1 *trans*-10
Ratio 18:1 *trans*-10/18:1 *trans*-11> 1

Adapted from Bessa, R. J. B., S. P. Alves, and J. Santos-Silva. 2015. Constraints and potentials for the nutritional modulation of the fatty acid composition of ruminant meat. Eur. J. of Lipid Sci. Technol. v. 117,1325–1344.

Feed Management During Lactation Phase

Ewe´s milk **or** **Milk Replacer** **+** **Solid Feed**



Pasture

Forage

Concentrate feed adapted to the productive phase

Fatttening Phase

Concentrate + Forage

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Hypothesis

The early life management and the high cereal finishing influences the rumen *trans* fatty acid profile at weaning and the end of fattening period?

Objective

Evaluate the effect of early life management in lambs fed with a high cereal diet during fattening phase on fatty acid profile of ruminal digesta, with emphasis on *trans* fatty acids.

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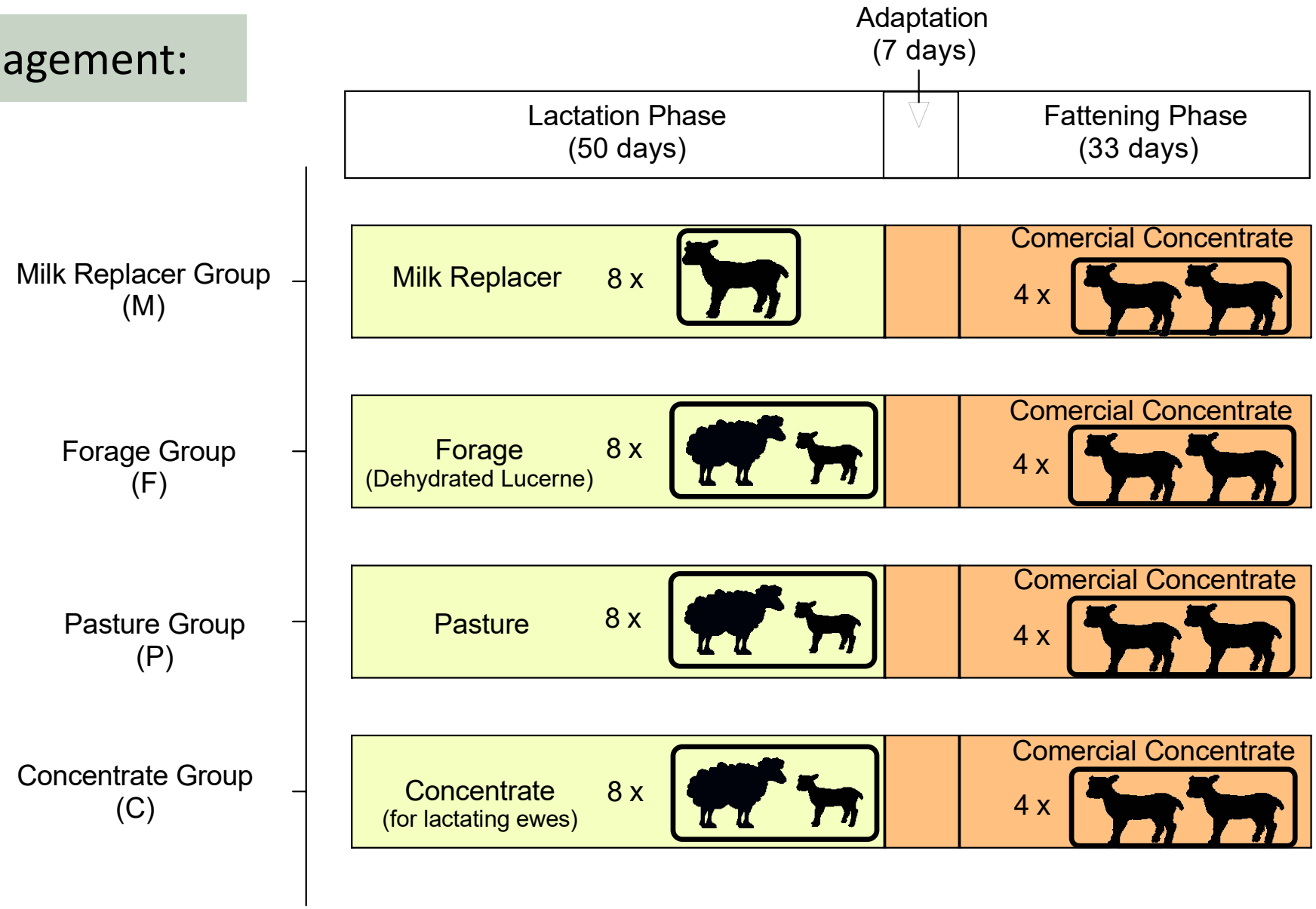
Material and Methods

Animal management:



Material and Methods

Collection and analysis:

Collection of ruminal digesta

- Weaning → Samples were collected via stomach tube (Ramos-Morales et al., 2014)
- End of fattening period → Samples were collected immediately after slaugther

→ Determination of fatty acids on ruminal digesta

(Adapted from Jenkins (2010))

Statistical Analysis:

- Proc Mixed of SAS
- Evaluation of effects:
  - Pre-weaning management (D)
  - Phase (P, Weaning or end of fattening period)
  - Interaction D x P
- Animal as experimental unit
- Significance level established as $P < 0.05$.

Adapted from Jenkins, T. C. 2010. Technical note: Common analytical errors yielding inaccurate results during analysis of fatty acids in feed and digesta samples. J. Dairy Sci. 93(3):1170-1174.

Ramos-Morales, E., A. Arco-Pérez, A. I. Martín-García, D. R. Yáñez-Ruiz, P. Frutos, and G. Hervás. 2014. Use of stomach tubing as an alternative to rumen cannulation to study ruminal fermentation and microbiota in sheep and goats. Anim. Feed Sci. Technol. 198:57-66.

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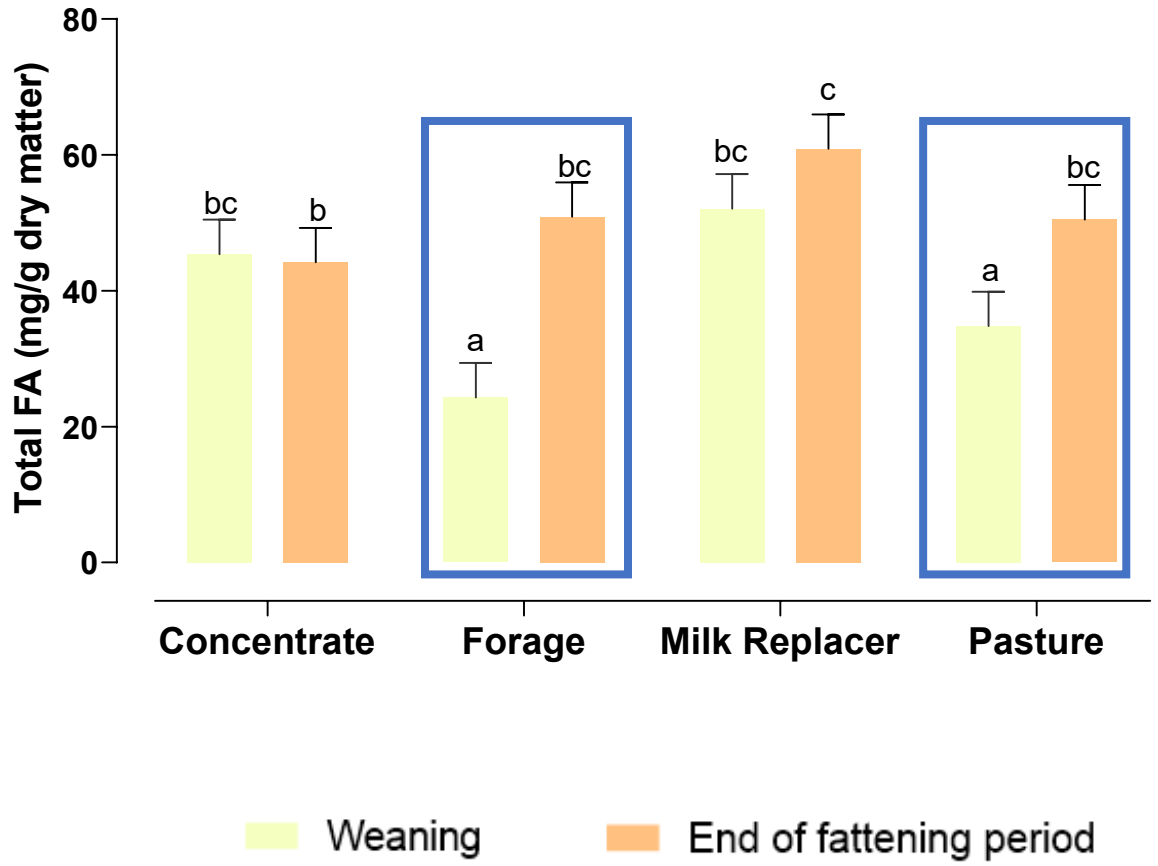
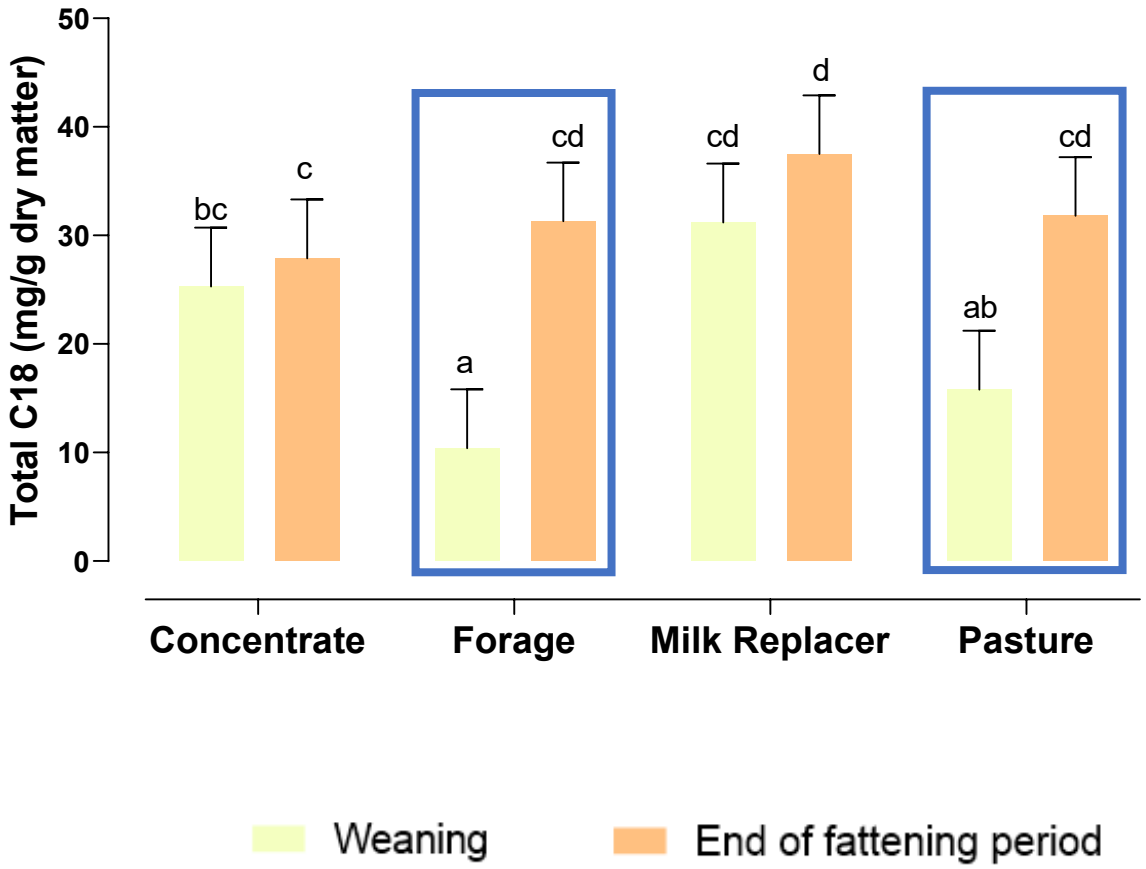
TOTAL FATTY ACIDS

Interaction D x P → P = 0.010



TOTAL OF C18 FATTY ACIDS

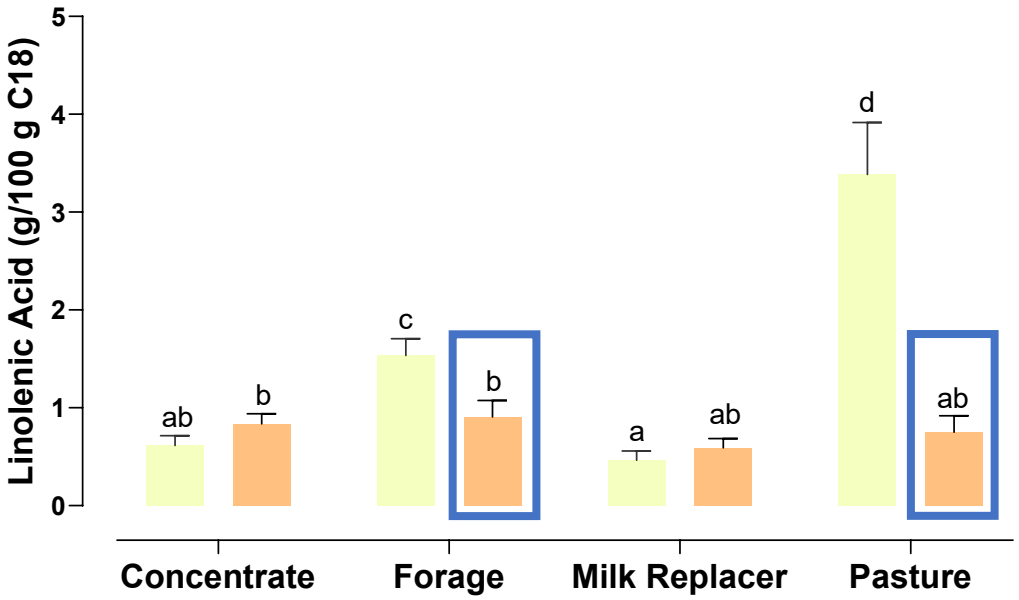
Interaction D x P → P = 0.030



RUMINAL BIOHYDROGENATION

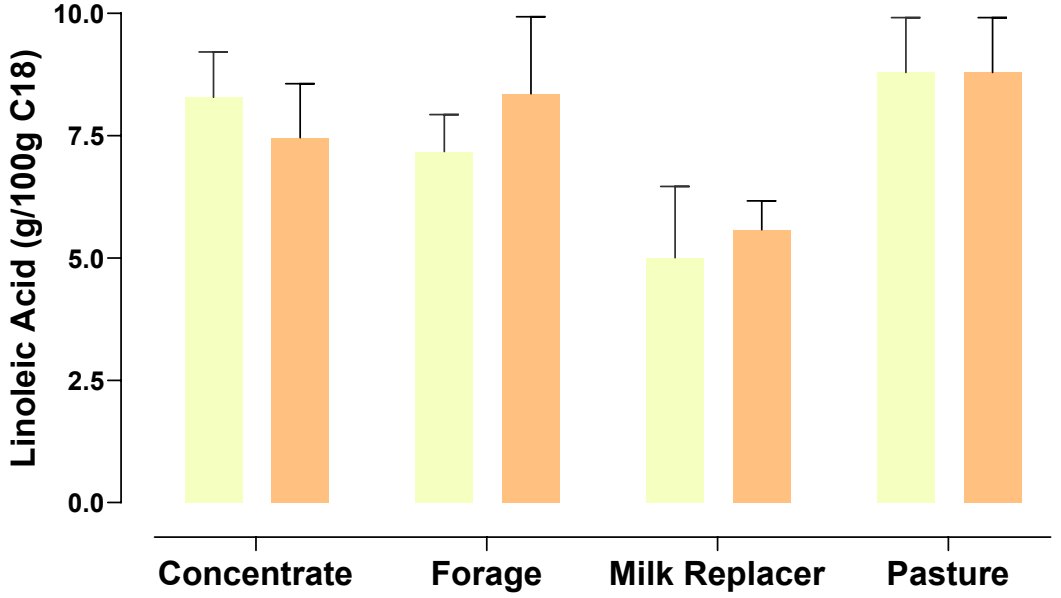
Linolenic Acid (18:3 *n*-3)

Interaction D x P → P < 0.001



Linoleic Acid (18:2 *n*-6)

Interaction D x P → P = 0.703

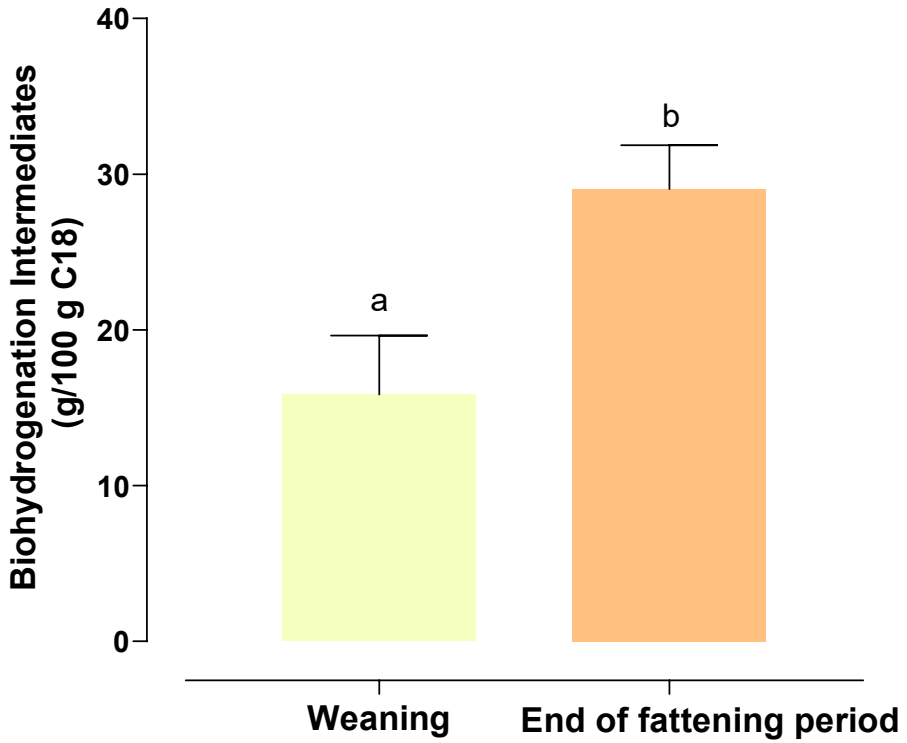


Weaning End of fattening period

RUMINAL BIOHYDROGENATION

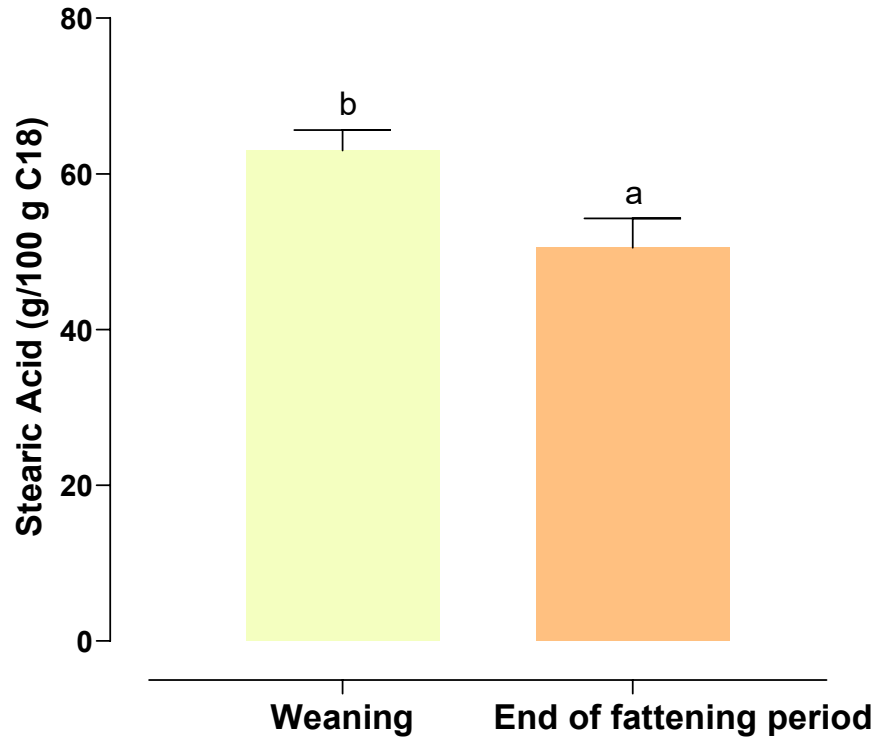
Biohydrogenation Intermediates

Phase Effect → P = 0.009



***Stearic Acid* (18:0)**

Phase Effect → P = 0.010

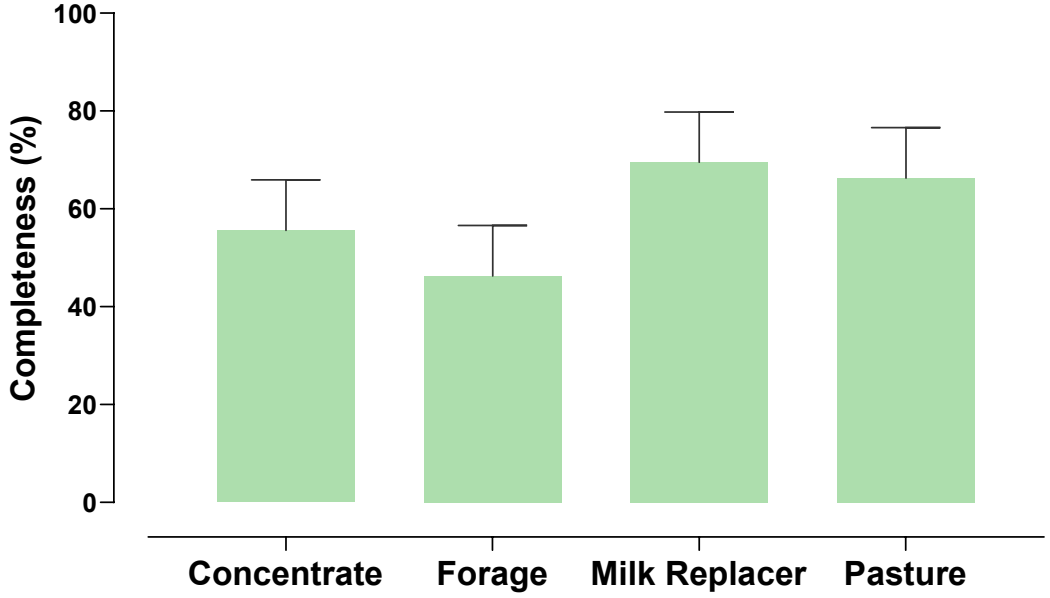


Weaning End of fattening period

RUMINAL BIOHYDROGENATION

Completeness

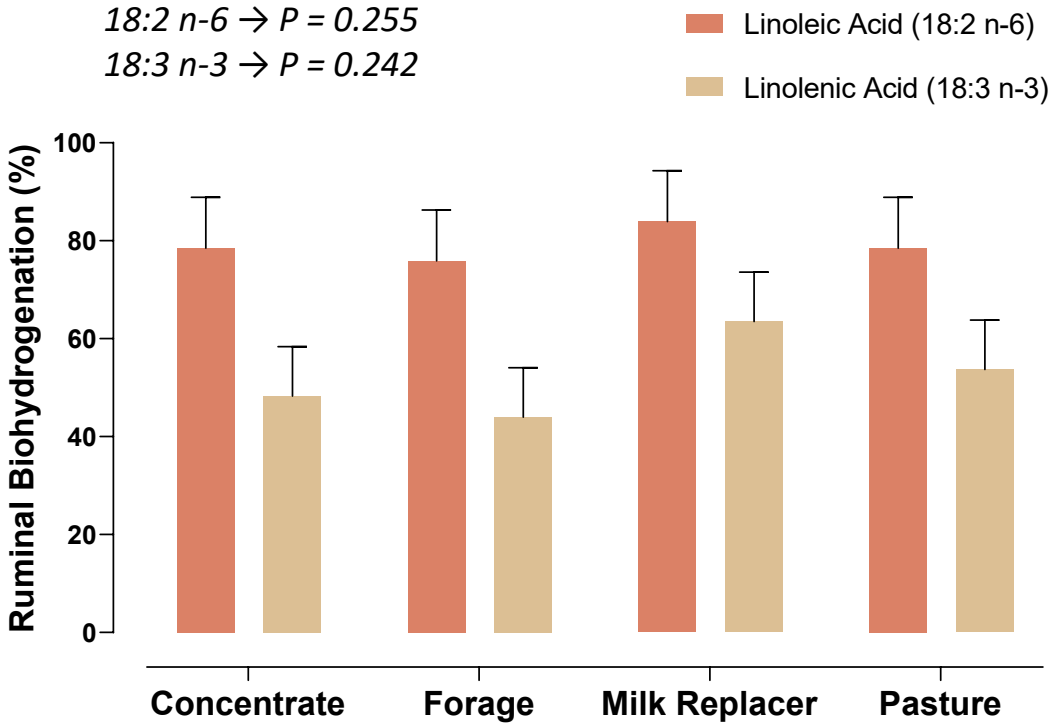
Pre-weaning management effect → P =0.372



$$\text{Completeness} = \frac{\text{18:0 rumen}}{(\text{18:1 } cis\text{-9 diet} - \text{18:1 } cis\text{-9 rumen}) + (\text{18:2 } n\text{-6 diet} - \text{18:2 } n\text{-6 rumen}) + (\text{18:3 } n\text{-3 diet} - \text{18:3 } n\text{-3 rumen}) + \text{18:0 diet}} \times 100$$

Ruminal Biohydrogenation

Pre-weaning management effect
18:2 n-6 → P = 0.255
18:3 n-3 → P = 0.242

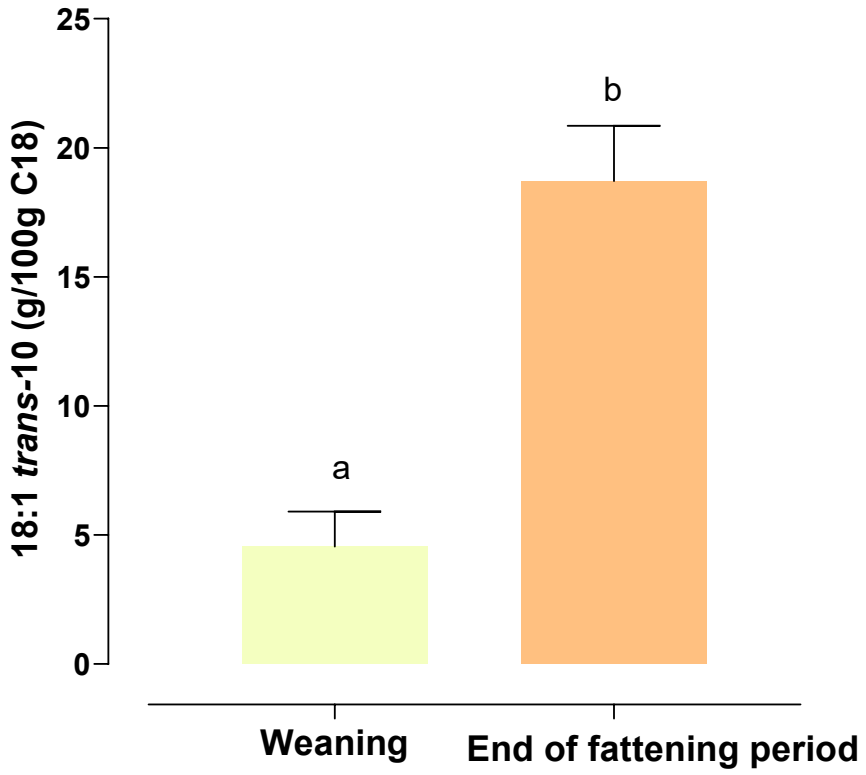


$$\text{FA Biohydrogenation} = \frac{(\text{FA diet} - \text{FA rumen})}{\text{FA diet}} \times 100$$

RUMINAL BIOHYDROGENATION

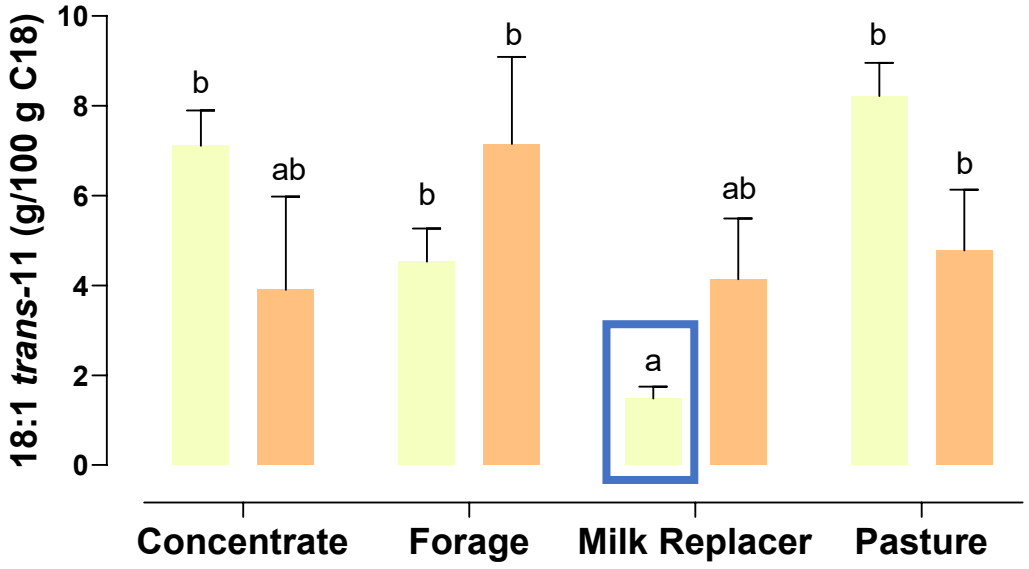
18:1 *trans*-10

Phase Effect → P < 0.001



18:1 *trans*-11

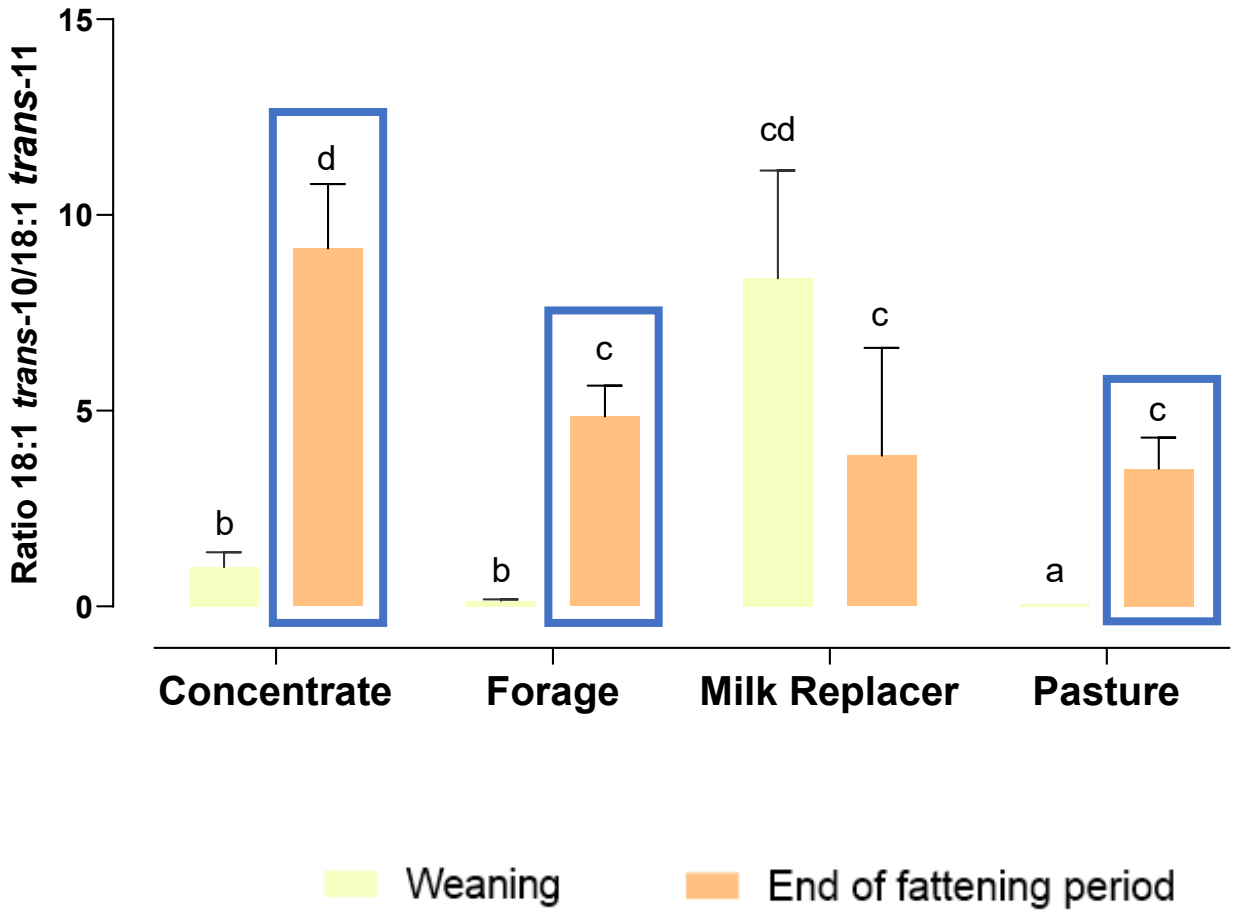
Interaction D x P → P = 0.018



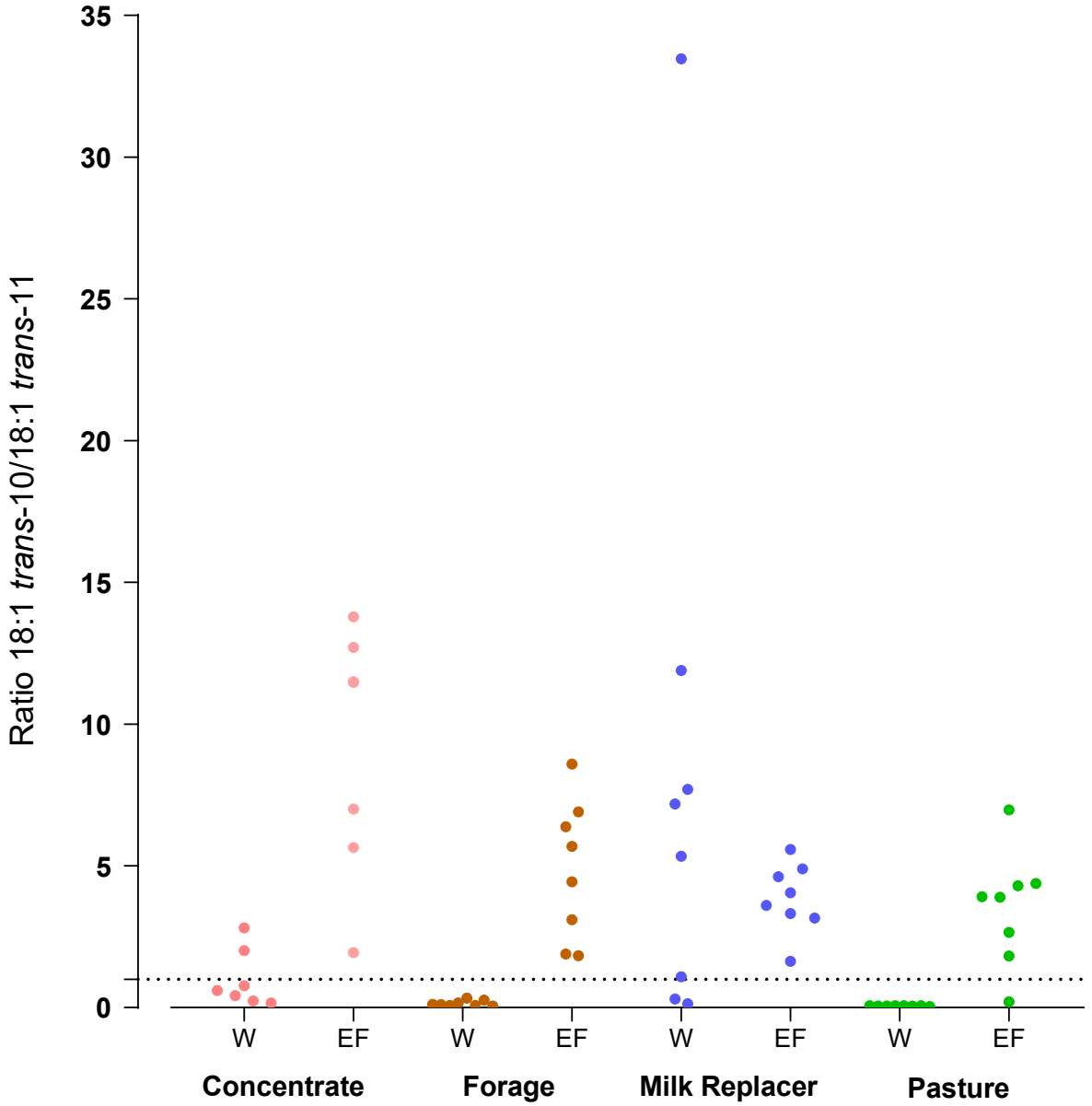
Weaning End of fattening period

RATIO 18:1 *trans*-10/18:1 *trans*-11

Interaction D x P → P = 0.043



RATIO 18:1 *trans*-10/18:1 *trans*-11



W – Weaning
EF – End of fattening period

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CONCLUSION

- Independently of pre-weaning management, the proportion of biohydrogenation intermediates increased between weaning and the end of fattening, while the stearic acid decreased.
- At the end of the fattening phase, the completeness and ruminal biohydrogenation of 18:3n-3 and 18:2n-6 were not affected by the pre-weaning management.
- The ratio 18:1 *trans*-10/18:1 *trans*-11 increased between weaning and the end of fattening for the concentrate, forage and pasture groups, while the milk replacer group maintained their ratio during the two phases.
- At the end of the fattening period, all animals, except one from the pasture group, showed "*t*10 shift".

The utilization of cereals during the fattening period of lambs promote the occurrence of "*t*10 shift" independently of the management applied in the pre-weaning period.

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