

Screening of Mediterranean agro-industrial by-products on *in vitro* ruminal fermentation

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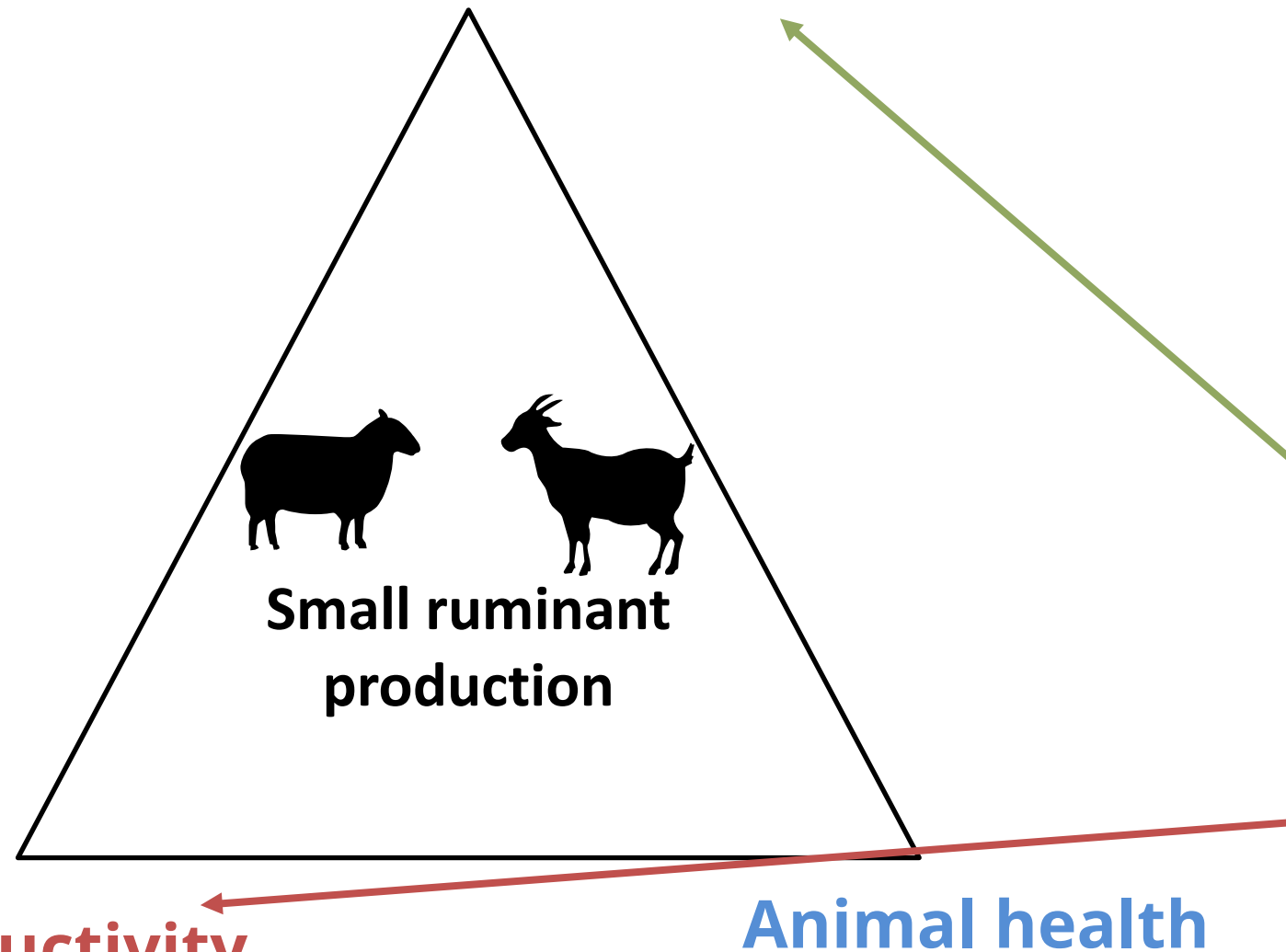
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Pollutants emissions

6% of the global livestock sector's emissions



Animal productivity

Maintain or increase productivity

Animal nutrition

Valorization of agro-industrial **by-products** rich in phenolic compounds

- **Byproducts from the Mediterranean region**
 - To valorize waste
 - To promote the circular and local economy.
 - To reduce the carbon footprint
- **Byproducts rich in phenolic compounds**
 - To minimize the emission of pollutants (CO_2 , CH_4 , NH_3)

Valorization of these byproducts

- To maintain feed assimilation (**DMD**)
- To have energy source (**VFA**)



***In vitro* ruminal fermentation**

Presentation of the 16 by-products

French by-products

Italian by-products

Greek by-products

Mediterranean by-products were selected thanks to a study of their availability in their own countries

Olive
Grapes
Hazelnut
Carob
Pomegranate
Citrus
Tomato



pulp



pomace



skins



pod and pulp



pulp



pulp



pomace



perisperm and shell



peel



peel, pulp and seeds



peel and seeds



pulp

With 2-phase extraction



pulp

With 3-phase extraction



skin and seeds



pod



skin and seeds

Hypothesis

Polyphenol-rich by-products can reduce pollutant production compared to a basic diet

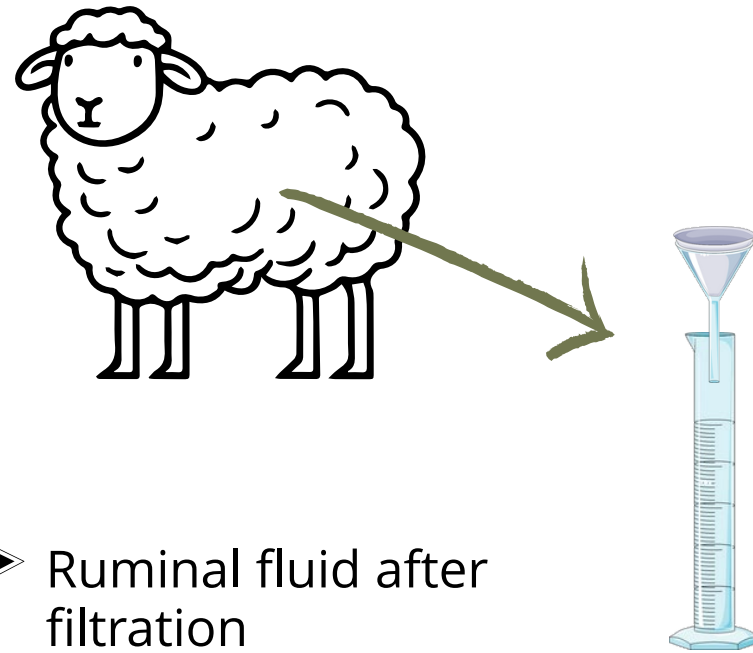
Objectives

- To evaluate **the effect of 16 agro-industrial by-products** from the Mediterranean agro-industry on *in vitro* ruminal fermentation.
 - Dry matter degradability (DMD)
 - Gas production (CH_4 , CO_2)
 - Volatile fatty acids (VFAs)
 - Ammonia (NH_3) concentration
- To **Identify the most promising byproducts** to include them in an innovative feed.

In vitro ruminal fermentation protocol

16 by-products of hazelnuts (2), olives (4), grapes (3), pomegranate (2), carob (3), tomato (1) and citrus (1)

Dose = 10%

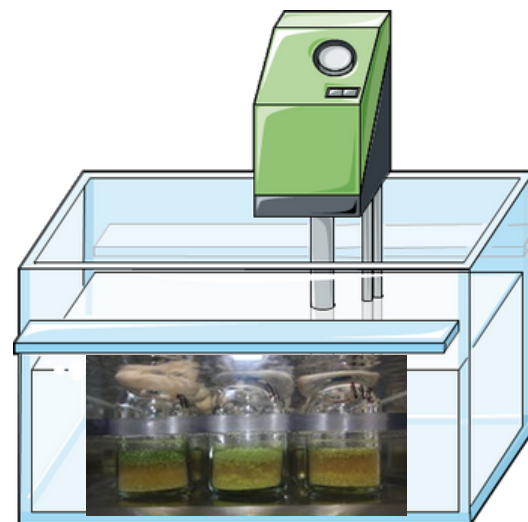


Duplicate

3 repetitions

- Ruminal fluid after filtration
- Buffer solution (artificial saliva)
- Basal diet : 70% forage and 30% concentrate
- 10% of level of inclusion, reported on dry matter

Incubation 24h at 39°C with agitation



MEASUREMENTS	TIME
Dry matter degradability (DMD)	24h
Volatile fatty acids (VFA)	
Ammonia (NH ₃)	
Gas production (CH ₄ , CO ₂)	

Statistical analysis

Byproducts x Byproducts
Byproducts x control
Byproducts x country

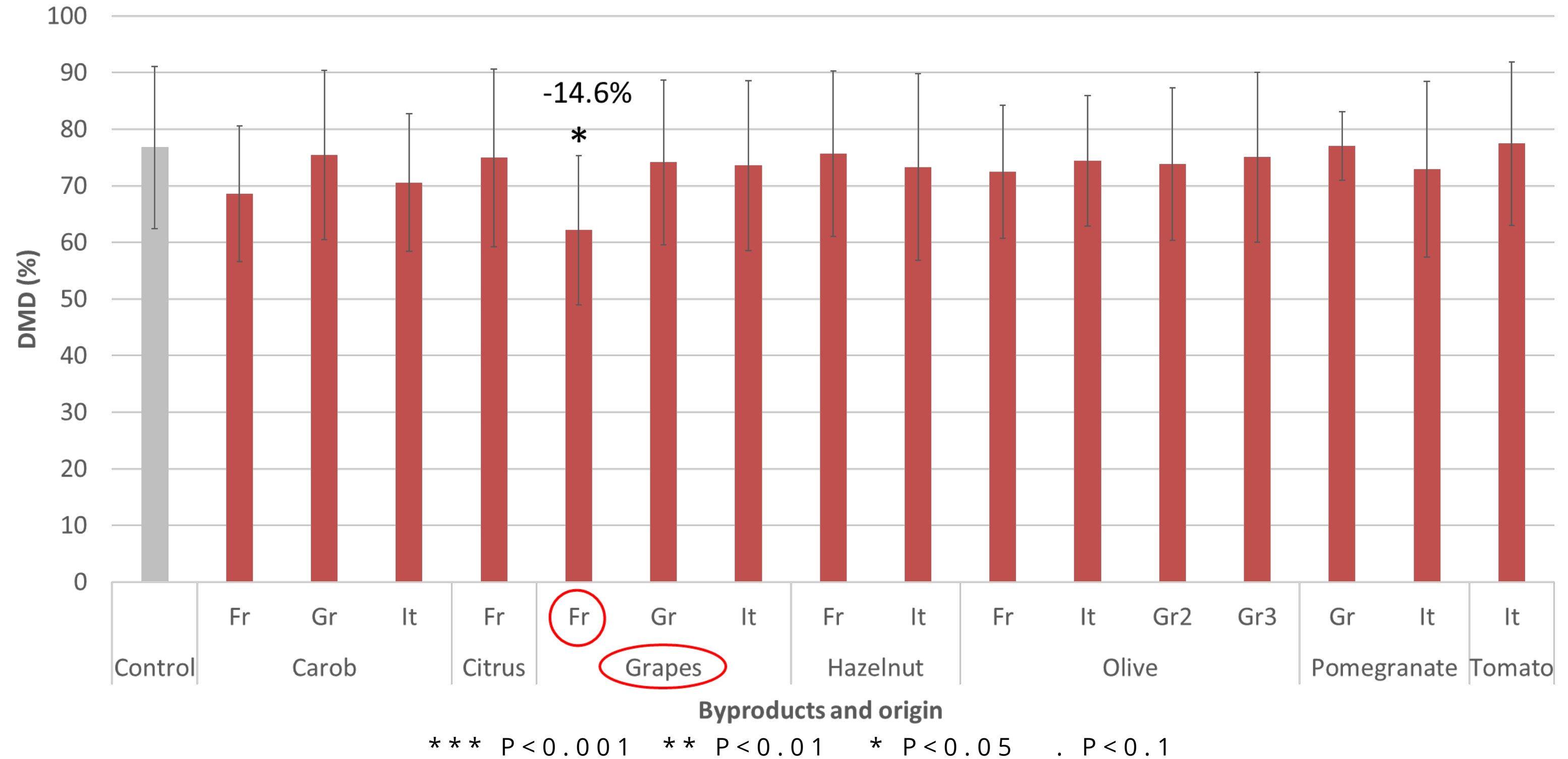
Byproducts x control :

mixed-model ANOVA with Dunnett's test

Fixed factor : byproducts

Random factor : repetitions

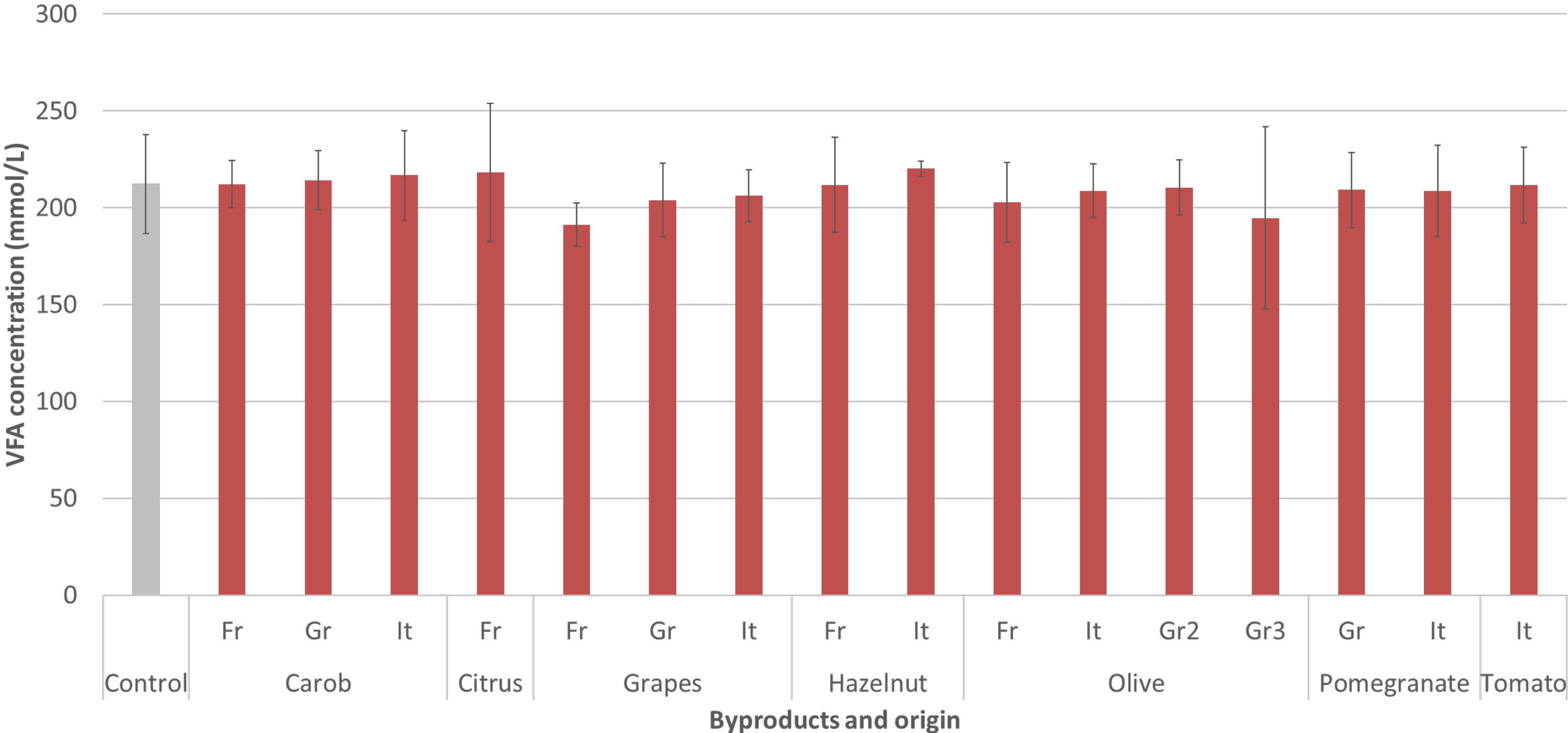
In vitro DMD after 24h (%)



No significant difference
Grapes byproducts (Fr) → 14.6% reduction of DMD

Results
Discussion

In vitro VFA concentration after 24h (mmol/L)

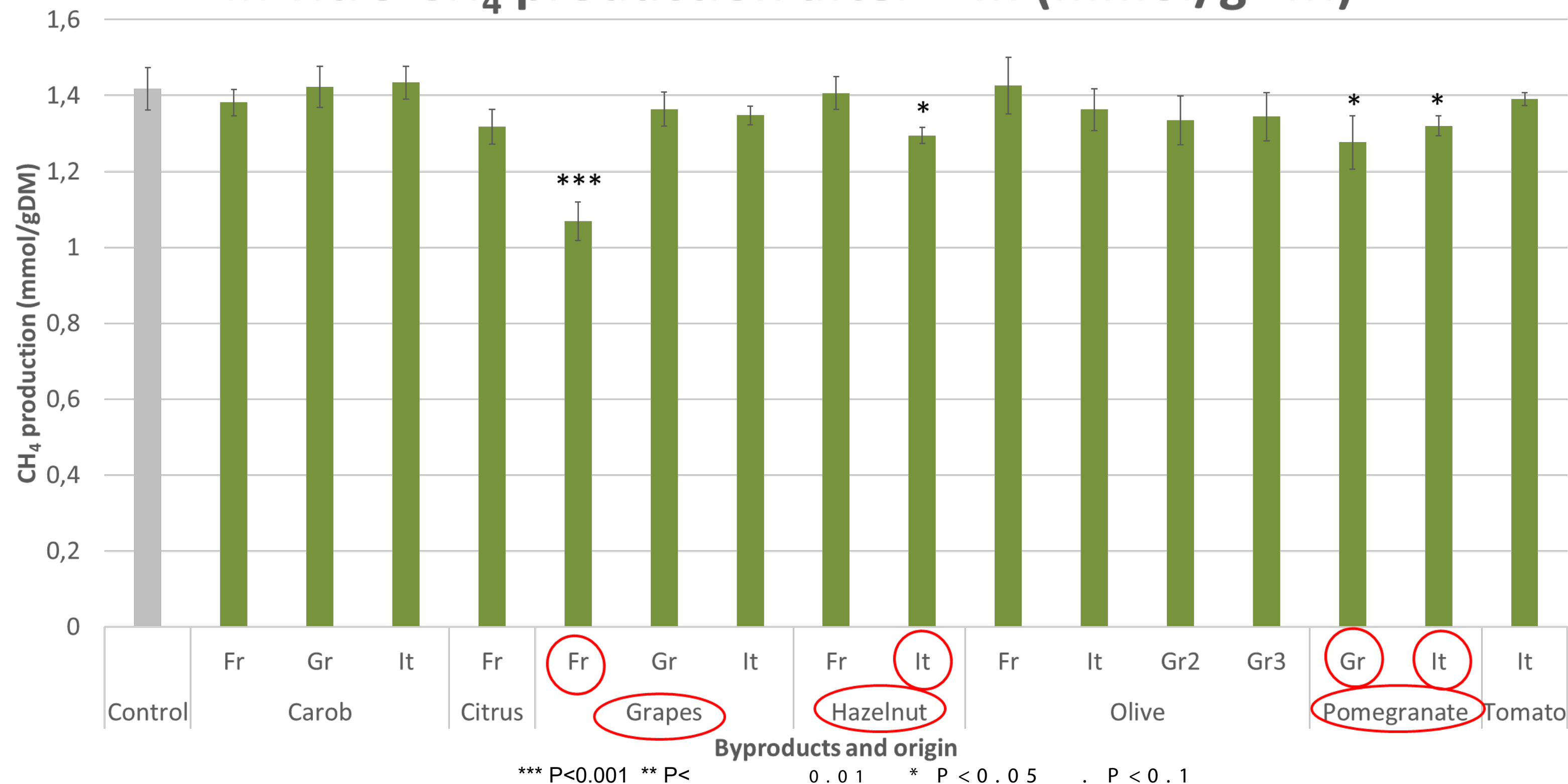


*** P<0.001 ** P<0.01 * P<0.05 . P<0.1

No significant difference
For grapes by-products (Fr) : ↓ DMD = VFA

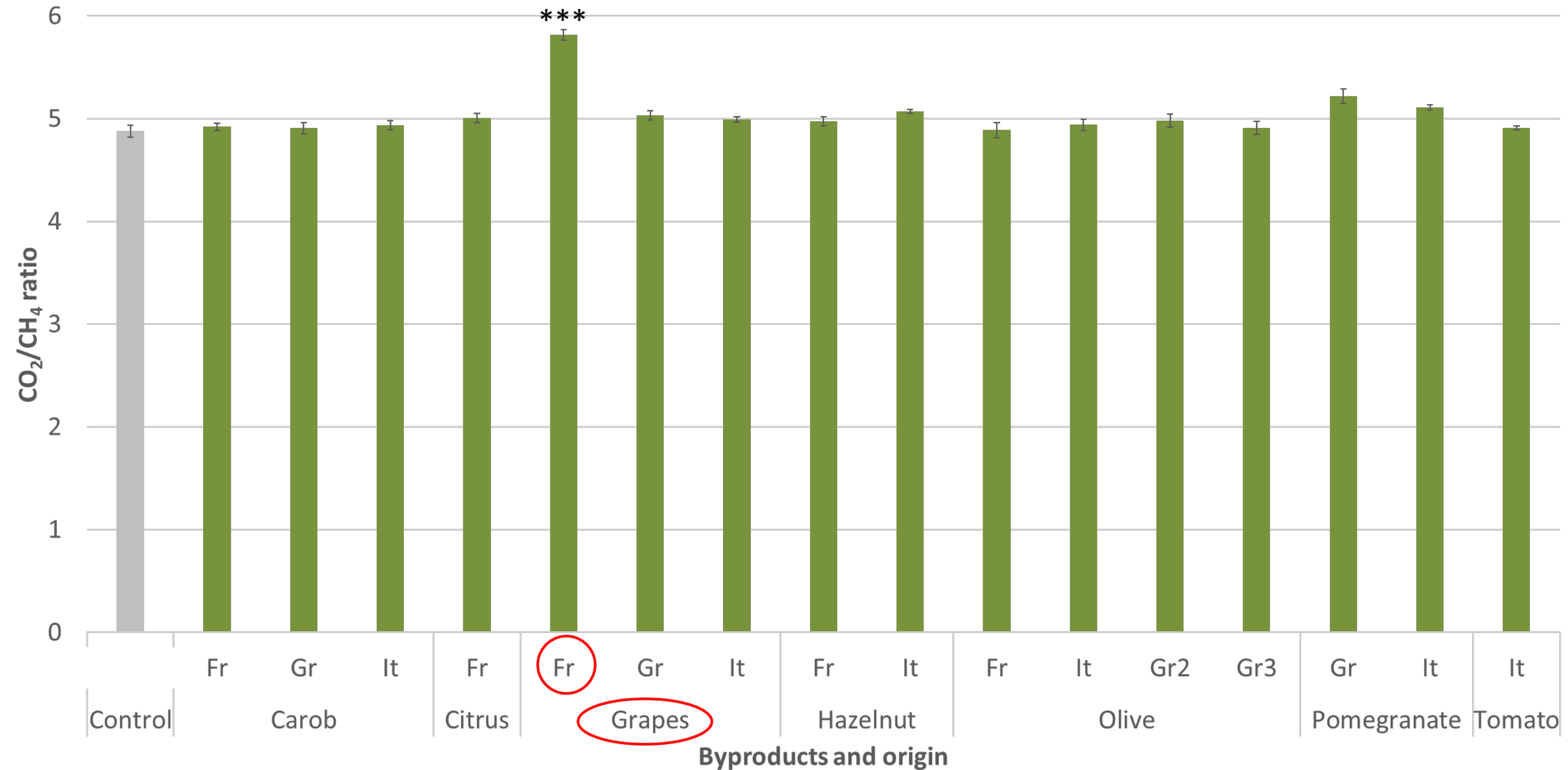
Results
Discussion

in vitro CH₄ production after 24h (mmol/gDM)



Hazelnut (It), Pomegranate (It, Gr) light significant decrease in CH₄ production
Significant difference for Grapes (Fr)
High phenol concentration

CO₂/CH₄ ratio after 24h



*** P < 0.001 ** P < 0.01 * P < 0.05 . P < 0.1

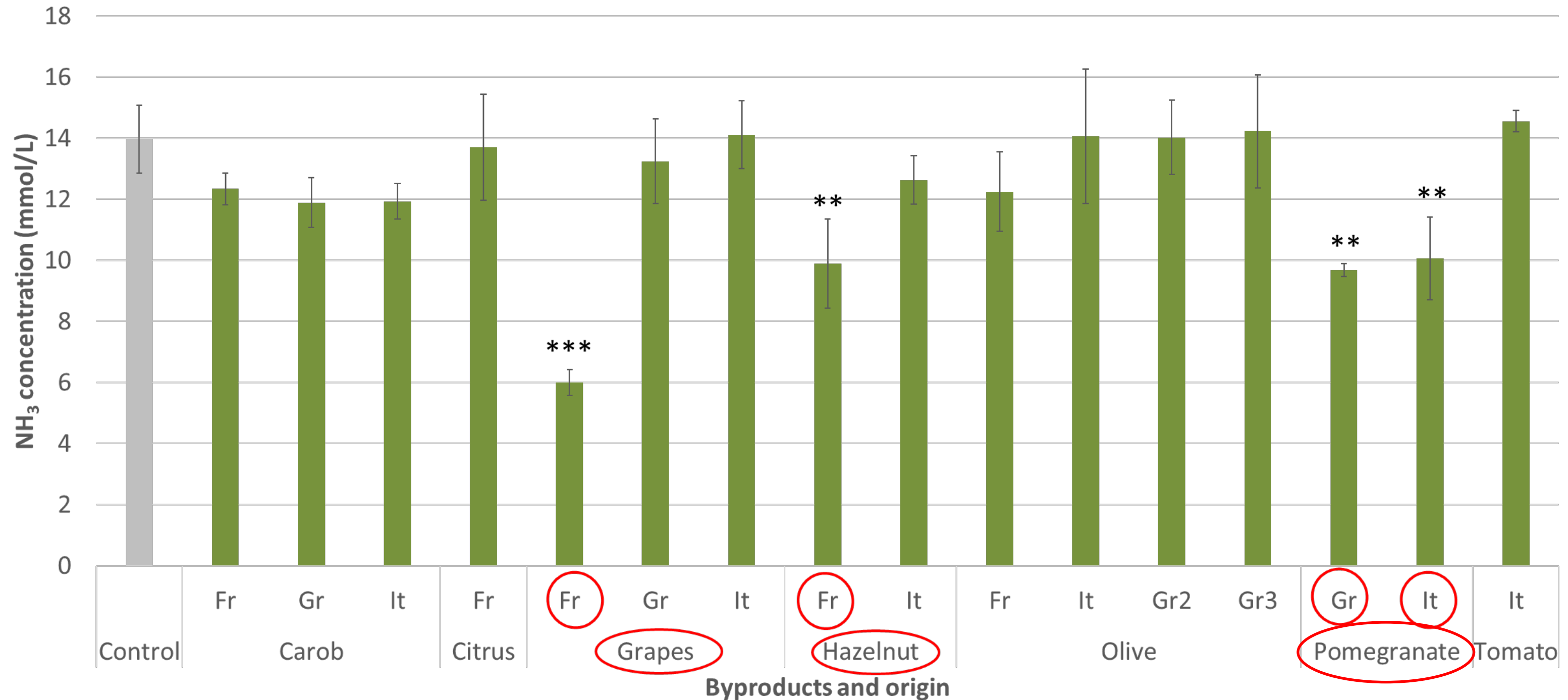
↗ CO₂/CH₄ ratio: metabolic pathway change for grapes (Fr)

Not for the others byproducts

Global warming potential : CH₄ > CO₂

Results
Discussion

In vitro NH₃ concentration (mmol/L)



*** P<0.001 ** P<0.01 * P<0.05 . P<0.1

Grapes (Fr), Hazelnut (Fr), Pomegranate (Gr, It) byproducts significantly reduced NH₃ concentration : **byproducts rich in tannins**
NH₃ = urinary nitrogen indicator and NH₃↓ ... N₂O↓

Conclusion

The potential of **grapes (Fr), hazelnut (It, Fr) and pomegranate (It, Gr) by-products** to reduce CH₄ and NH₃ production, and maintain VFA concentration has been identified.

	DMD	VFA total	CH ₄ production	CO ₂ /CH ₄	NH ₃ production
French grapes byproduct					

Grapes by-product (Fr) emerges as the best candidate for reducing pollutant emissions, while maintaining the energy supply

What's next ?

In vivo study **to measure CH₄ and nitrogen balance** on growing lambs parasitized and not parasitized by gastrointestinal nematodes (NGIs) to evaluate a feed composed with the **best promising by-products**.

→ In the European project : interaction between pollutant emissions and parasitism with polyphenolic-rich feed.

Conclusion
Perspective

Thank you, any question ?

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Collaborations and partnerships

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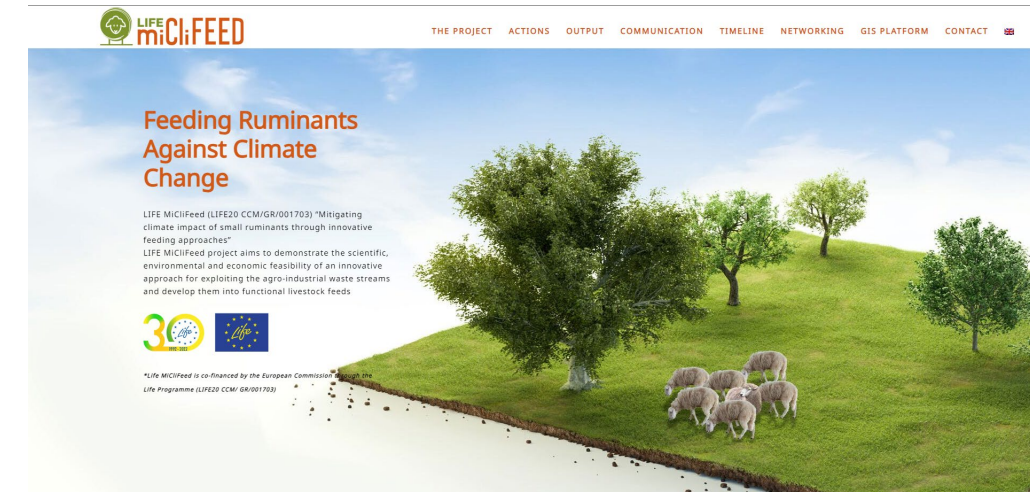
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Annex

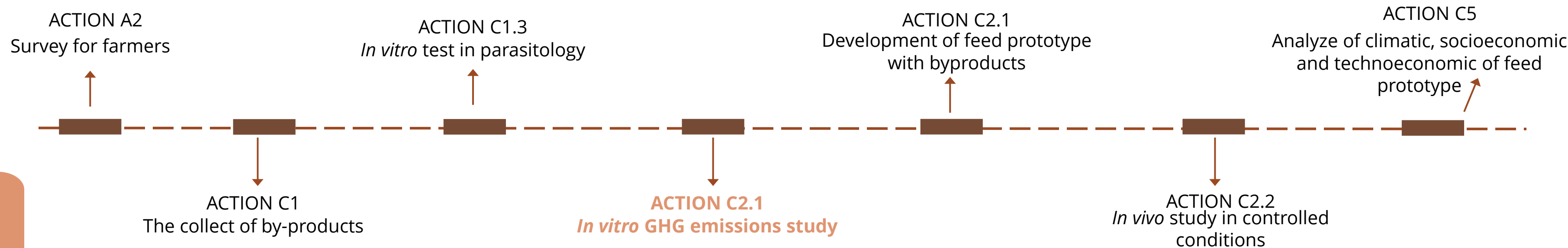
1. Project LIFE MiCliFeed

- Support for innovative projects in the fields of environment and climate
- Mitigating climate impact of small ruminants through innovative feeding approaches



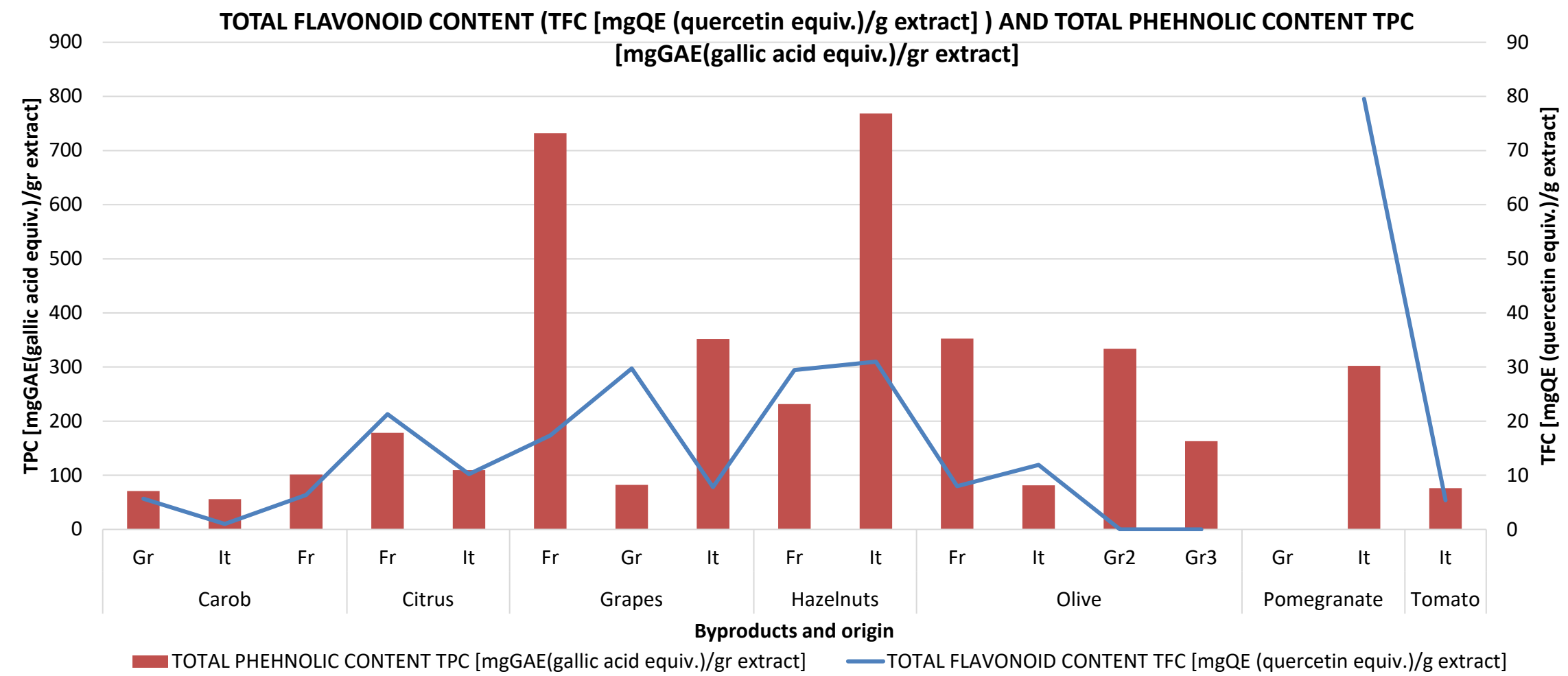
Valorise by-products of the Mediterranean agro-industry with bioactive compounds for more circularity, decrease GHG emissions and parasitism in small ruminant farms

- ECONOMISTS
- PRIVATE COMPANIES
- PARASITOLOGY RESEARCHERS
- ANIMAL NUTRITION RESEARCHERS

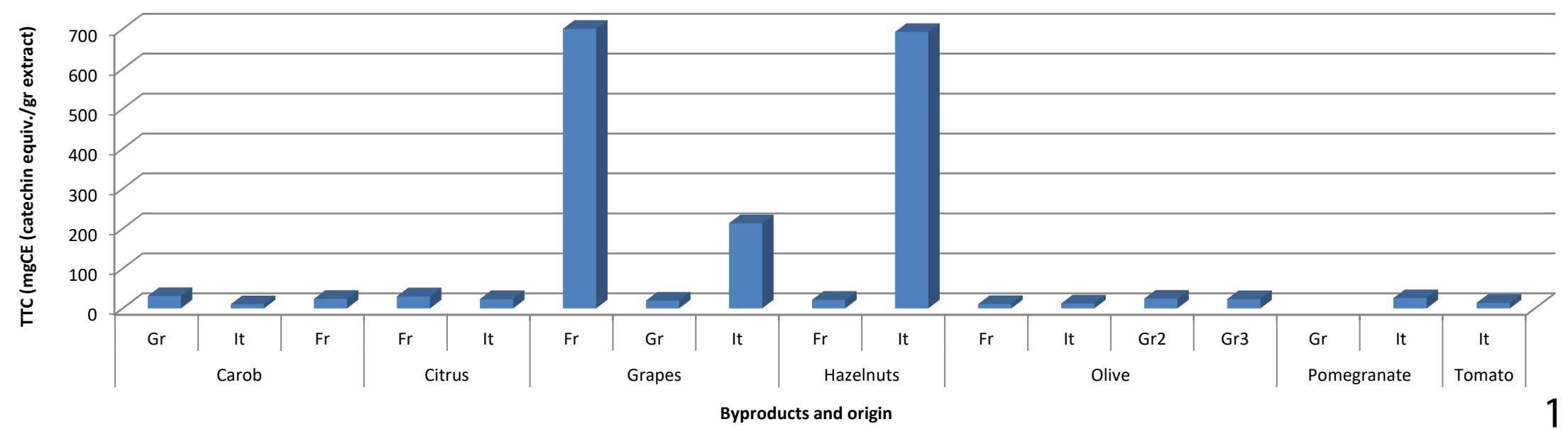


Annex

2. Biochemistry composition



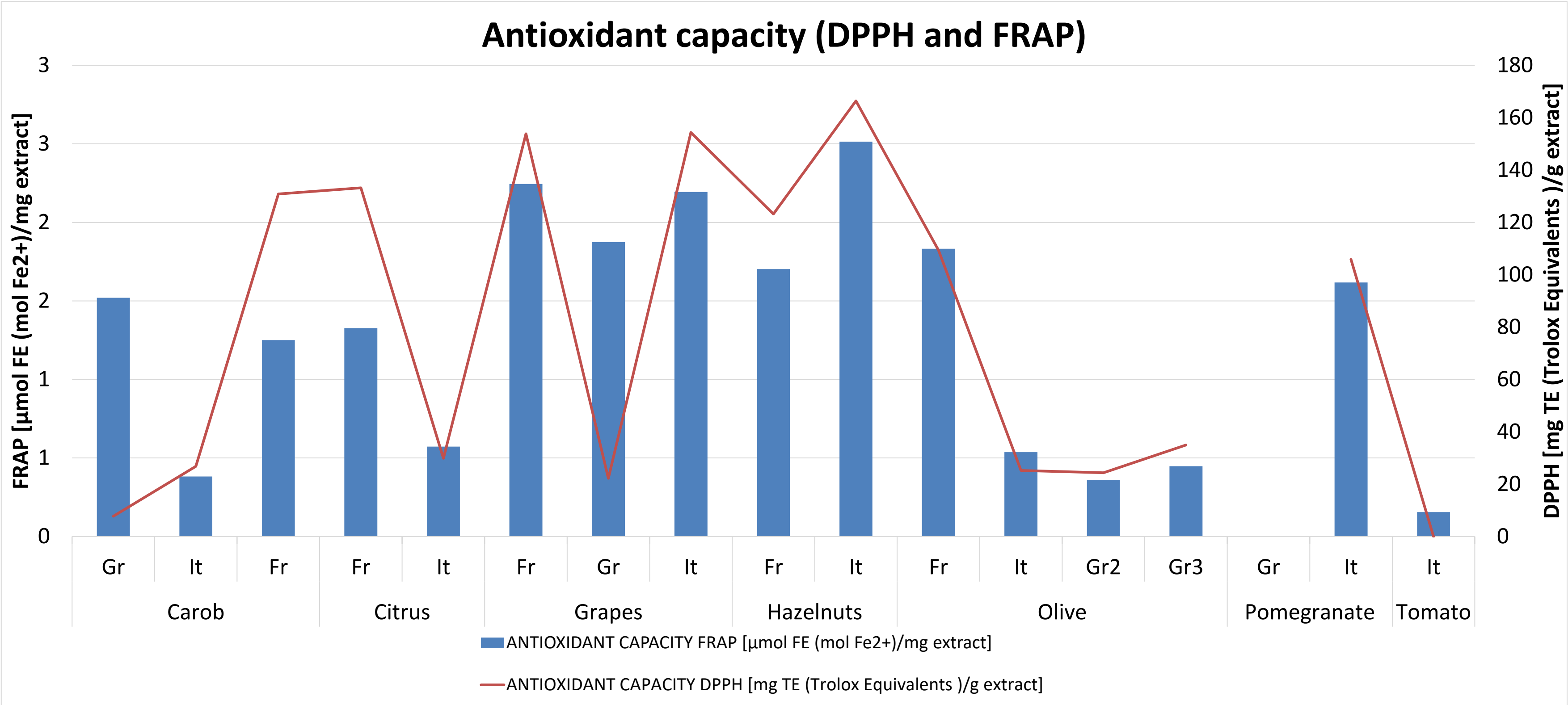
TOTAL TANIN CONTENT TTC [mgCE (catechin equiv./gr extract)]



Annex

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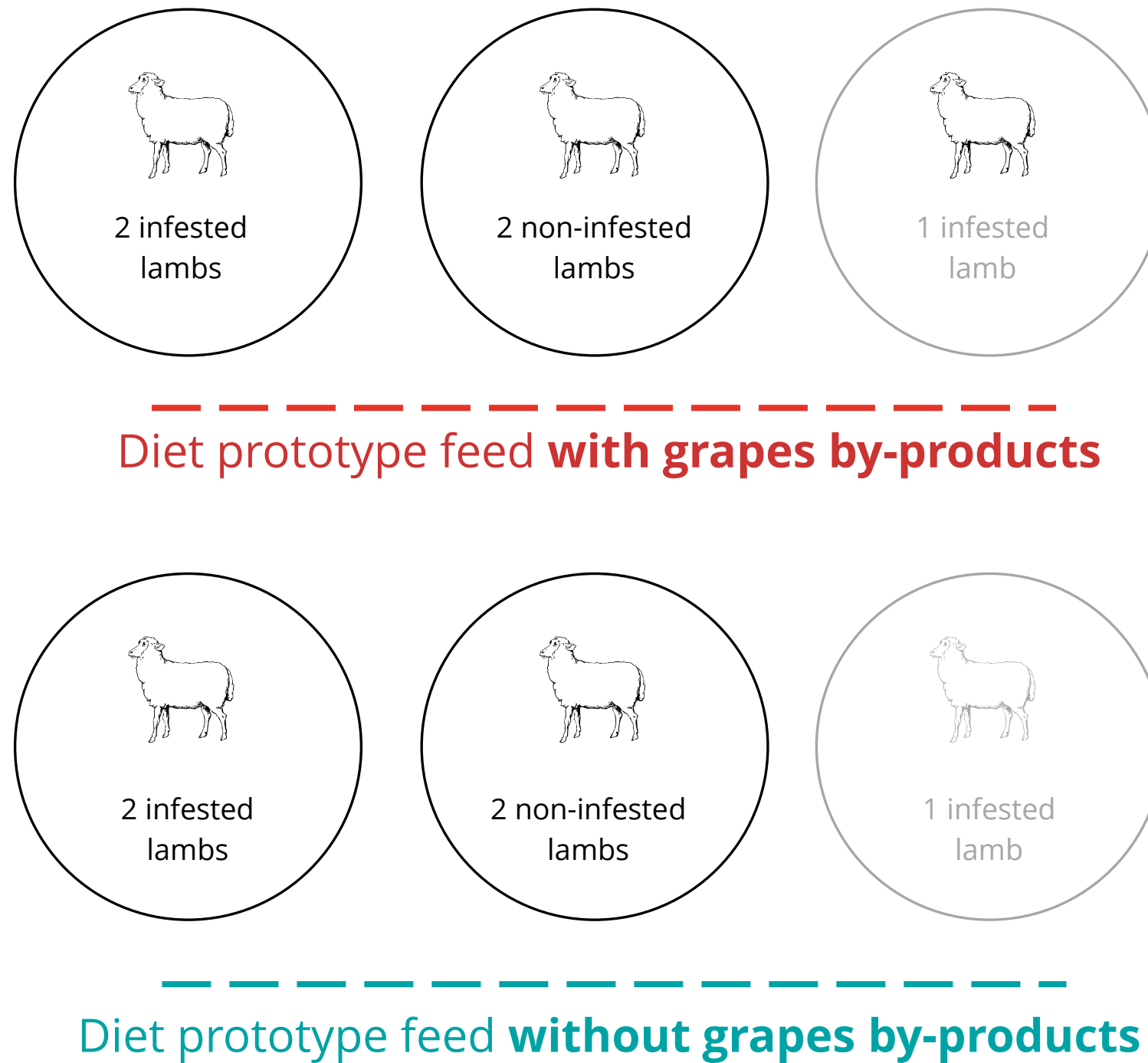
2. Biochemistry composition



Annex

Annex

3. *In vivo* study



MEASUREMENTS

Feed intake

Digestibility

Nitrogen balance

Pollutants emissions

Parasitism analyses

x 4 experimental period = 40 lambs