



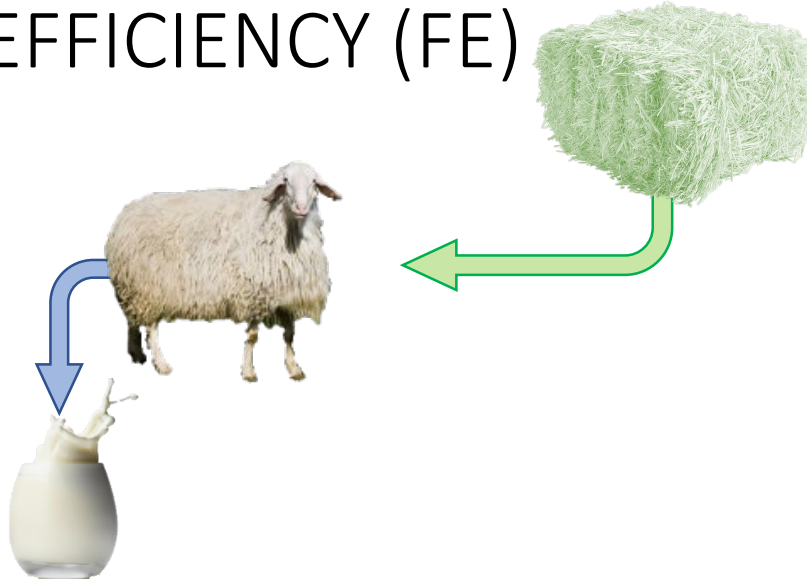
Using milk fatty acids as biomarkers to improve feed efficiency in dairy sheep

H. Marina, G. Hervás, R. Pelayo, P.G. Toral, A. Suárez-Vega, B. Gutiérrez-Gil, C. Esteban Blanco, P. Frutos and J.J. Arranz





FEED EFFICIENCY (FE)



Molecular biomarkers

Useful for the genetic improvement of FE traits



Sustainability



Feed usage Farming costs

Complex phenotype:

- Several traits (RFI, FCR, FEI)

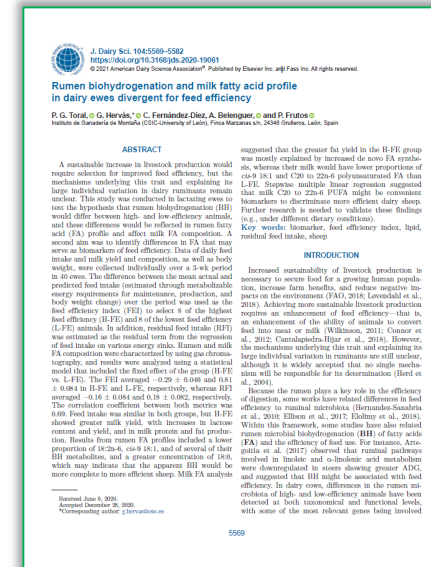
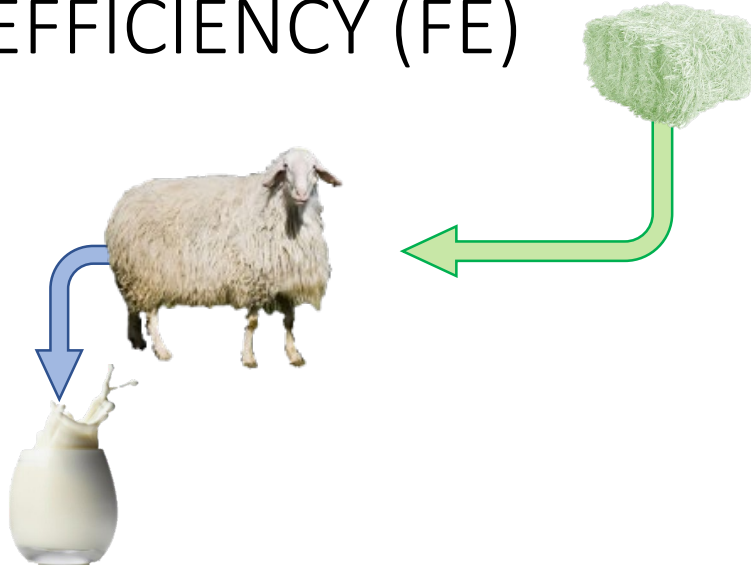
Difficult to measure:

- Specialized infrastructure

Introduction



FEED EFFICIENCY (FE)



Feed efficient ewes:



Milk de novo fatty acids



Polyunsaturated fatty acids

Molecular biomarkers
Useful for the genetic improvement of FE traits

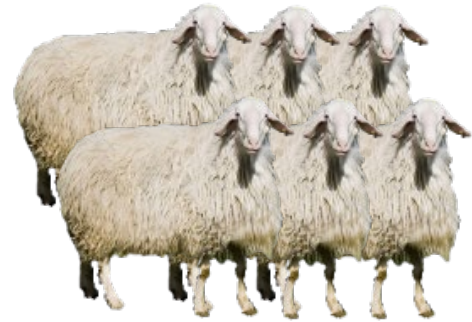
(Toral et al. 2021)



To identify potential biomarkers for FE in milk and validate those proposed in the previous study

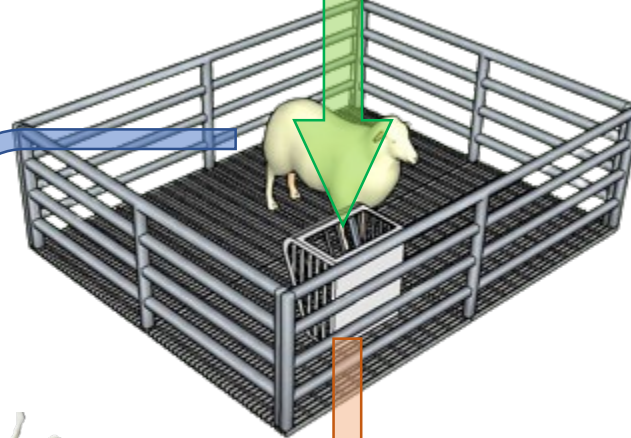
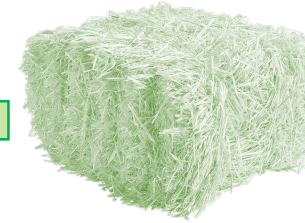


Methods



39 Spanish Assaf ewes

Dry matter intake (DMI)

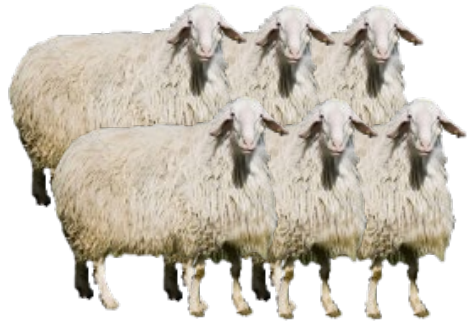


Energy-corrected milk (ECM)

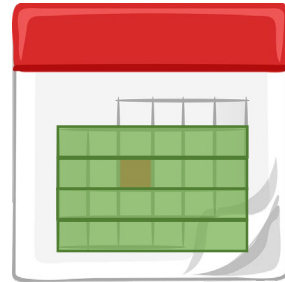
$$\text{Feed Conversion Ratio (FCR)} = \frac{\sum_{i=1}^d \left(\frac{DMI_i}{ECM_i} \right)}{d}$$



Methods



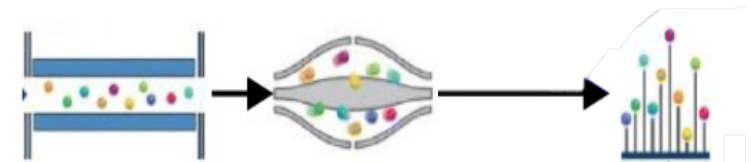
39 Spanish Assaf ewes



4 weeks



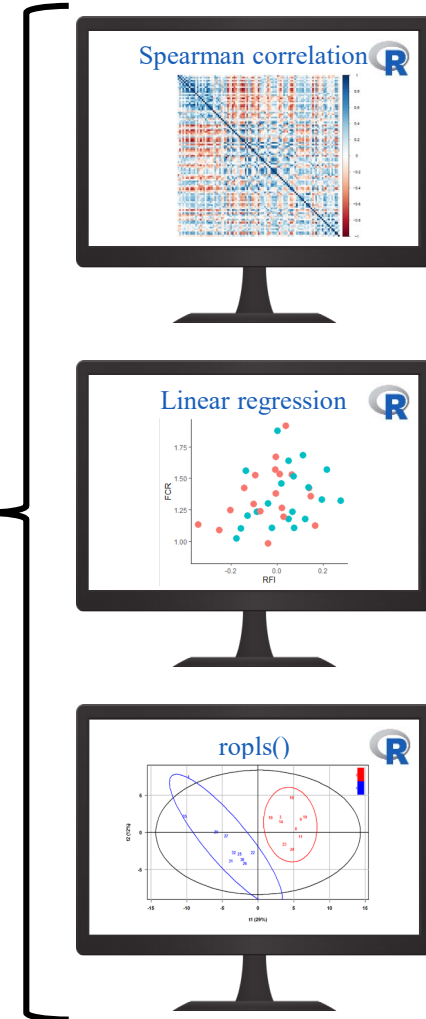
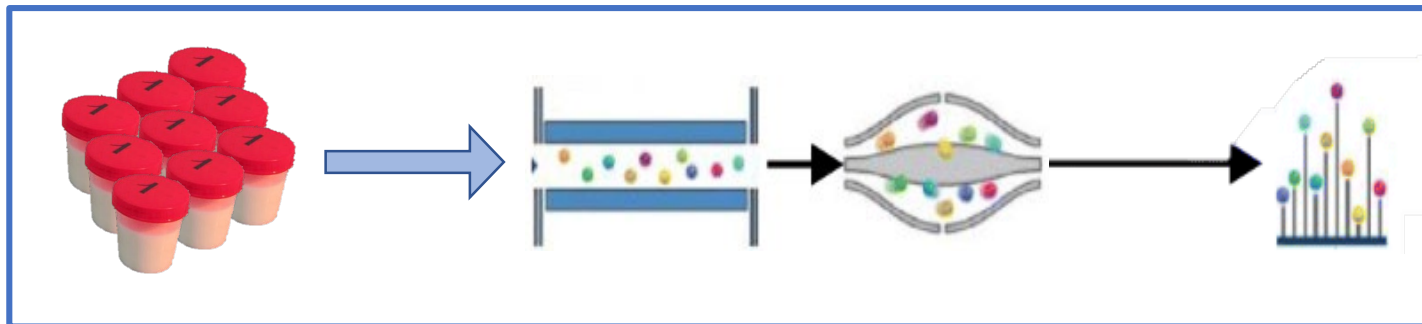
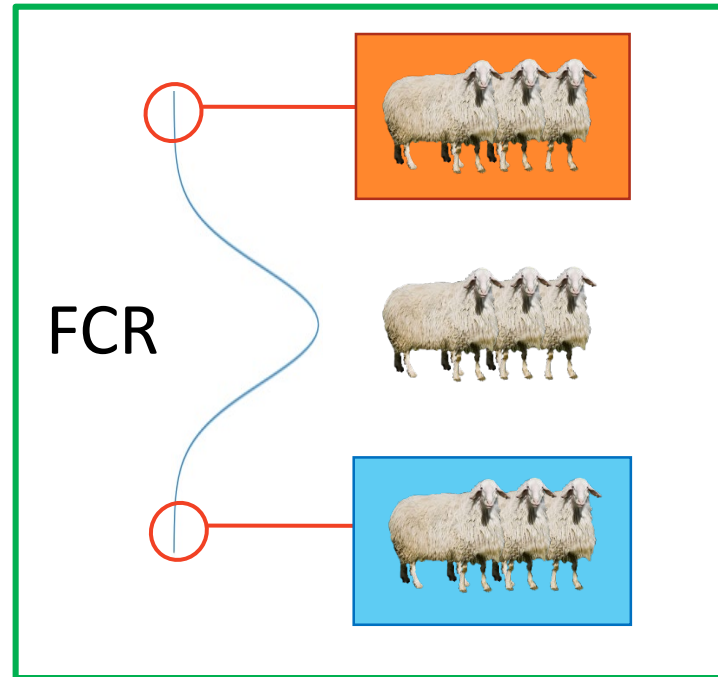
Energy-corrected milk (ECM)
Fatty acid profile



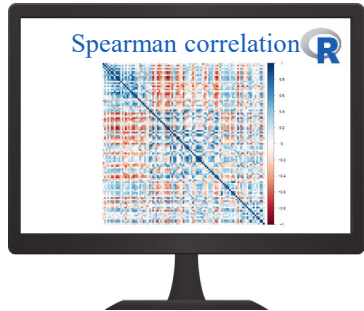
Methods



39 Spanish Assaf ewes

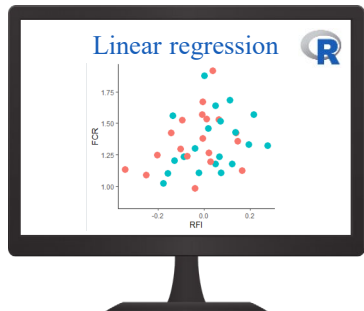


Results and Discussion



Spearman correlation:

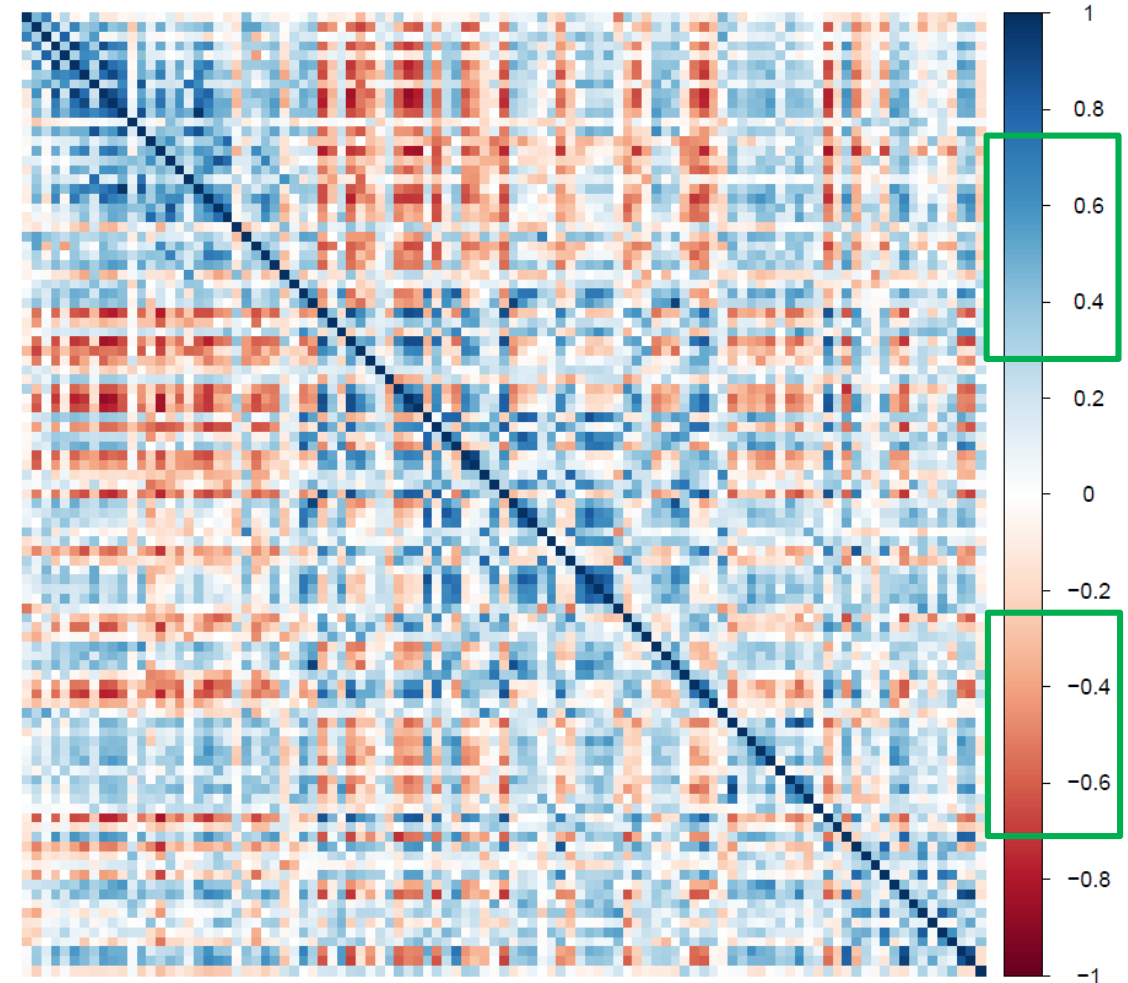
- 50 significant correlations
- Ranged from 0.32 to 0.70



Linear regression:

- 38 significant associations
- Adjusted R^2 values ranged from 0.08 to 0.31

36 common Milk Fatty Acids (MFAs) associated with the FCR parameter



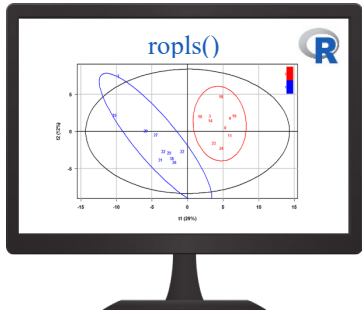
Results and Discussion



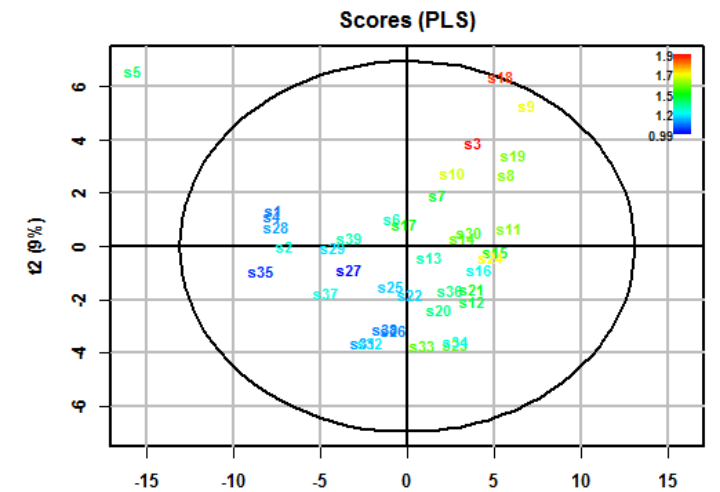
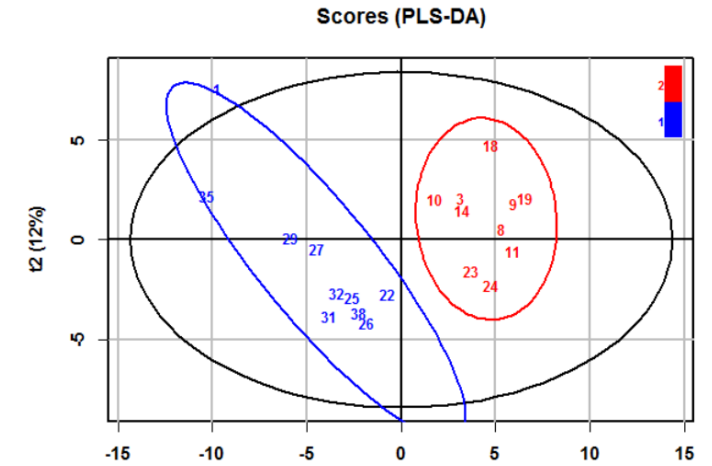
Milk Fatty Acids	Spearman Coef. ¹ (P-value)	R ² Adjusted ² (P-value)	Milk Fatty Acids	Spearman Coef. ¹ (P-value)	R ² Adjusted ² (P-value)
7:0	0.403 (0.011)	0.081 (0.044)	9:0	0.465 (0.003)	0.119 (0.018)
11:0	0.539 (0.001)	0.182 (0.004)	12:0	0.553 (0.001)	0.153 (0.008)
15:0	0.494 (0.001)	0.172 (0.005)	17:0	-0.585 (0.001)	0.194 (0.003)
22:0	0.687 (0.001)	0.277 (0.001)	24:0	0.704 (0.001)	0.294 (0.001)
16-oxo-18:0	-0.577 (0.001)	0.303 (0.001)	18:3n-3	0.458 (0.003)	0.15 (0.008)
18:3n-6	0.345 (0.032)	0.091 (0.035)	20:5n-3	0.393 (0.013)	0.127 (0.015)
cis-11 18:1	-0.434 (0.006)	0.101 (0.027)	cis-11 20:1	-0.492 (0.001)	0.155 (0.008)
cis-12 14:1	0.418 (0.008)	0.113 (0.021)	cis-12 18:1	0.521 (0.001)	0.203 (0.002)
cis-13 18:1	-0.428 (0.007)	0.117 (0.019)	cis-16 18:1	0.63 (0.001)	0.313 (0.001)
cis-7 14:1	0.376 (0.019)	0.084 (0.041)	cis-9 12:1	0.429 (0.006)	0.128 (0.015)
cis-9 17:1	-0.61 (0.001)	0.264 (0.001)	cis-9 18:1	-0.544 (0.001)	0.159 (0.007)
cis-9 trans-11 trans-15 CLnA	0.365 (0.022)	0.076 (0.049)	cis-9 trans-13 18:2	0.364 (0.023)	0.124 (0.016)
iso 15:0	0.399 (0.012)	0.105 (0.025)	iso 17:0	0.505 (0.001)	0.267 (0.001)
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trans-11 trans-13 CLA	0.479 (0.002)	0.219 (0.002)	trans-12 18:1	0.375 (0.019)	0.129 (0.014)
trans-15 18:1	0.466 (0.003)	0.258 (0.001)	trans-4 18:1	-0.435 (0.006)	0.183 (0.004)
trans-9 cis-11 CLA	-0.478 (0.002)	0.143 (0.010)	trans-9 trans-12 cis-15 + cis-9	0.527 (0.001)	0.157 (0.007)
			cis-12 trans-15 18:3		



Results and Discussion



oPLS					
FCR	Number of animals	Number of MFA	Explained variation in X	Explained variation in Y	Predictive Performance
Groups	10+10	101	0.41	0.91	0.82
Values	39	101	0.48	0.82	0.46



Results and Discussion



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Results and Discussion



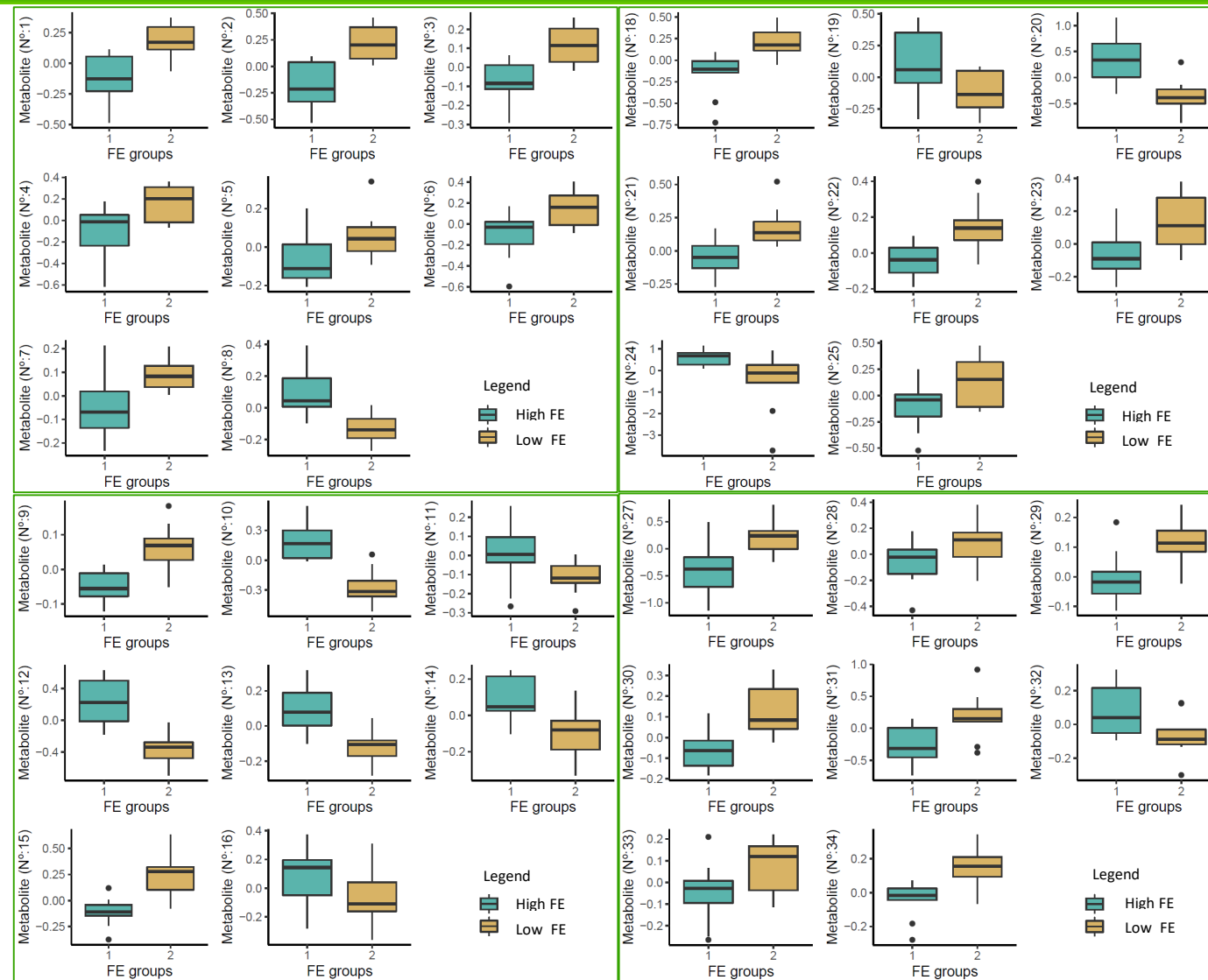
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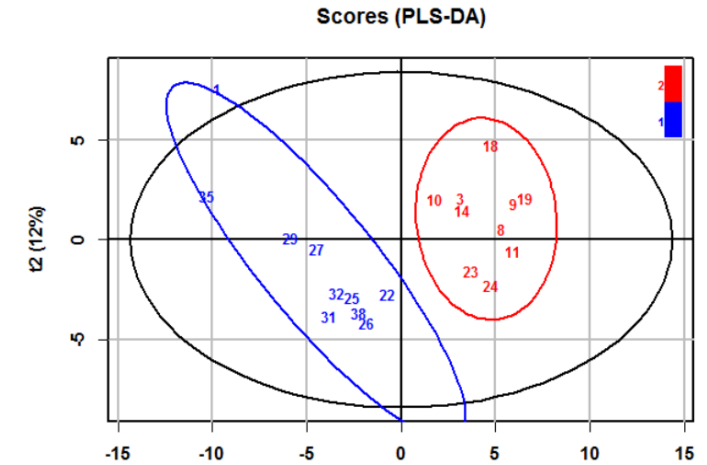
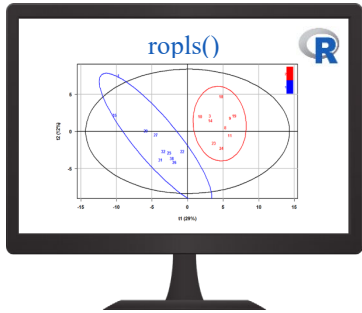
(Toral et al. 2021)



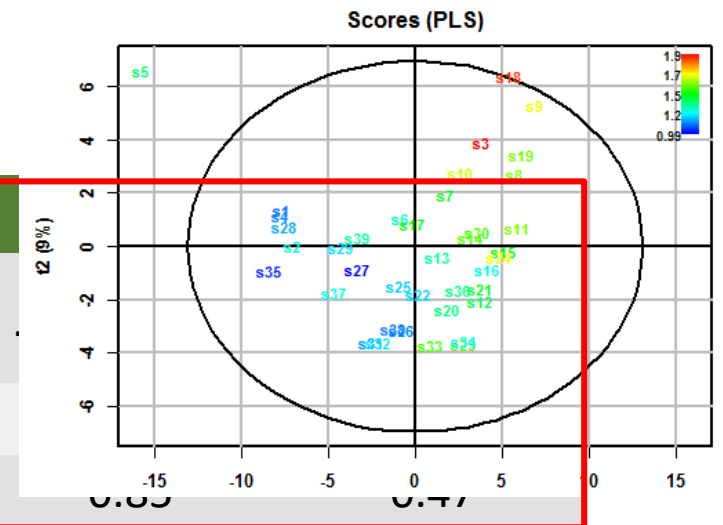
Results and Discussion



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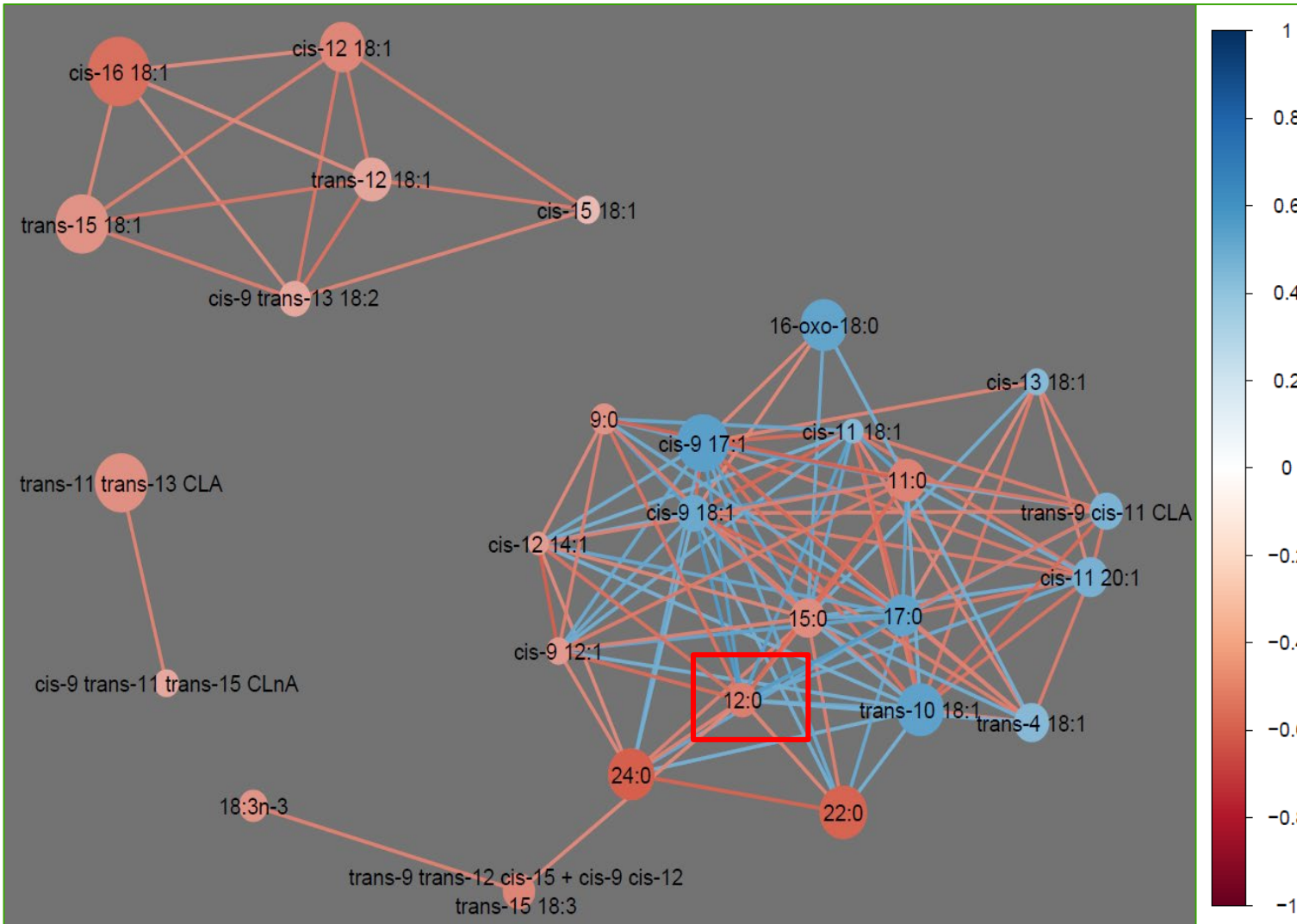
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Groups	10+10	101	0.41	0.91	0.82
Values	39	101	0.48	0.82	0.46



Cross Validated oPLS					
FCR	Number of animals	Number of MFA	Explained variation in X	Explained variation in Y	Predictive Performance
Groups	10	33	0.72	0.94	0.83
Values	20	33	0.66	0.65	0.10



Results and Discussion



Particularly, the FCR index showed a significant correlation with the lauric acid (C12:0), fatty acid highly studied in relation to **human health**

Ten long-chain MFAs out of the 33 MFAs highlighted in this study showed **negative correlations with FCR**, suggesting that **selecting for higher FE would modify their concentration in the milk**



Conclusions and *Perspectives*

- The **MFA profile has proven to be useful for predicting FCR**
- This study has validated in an independent population the results obtained by Toral *et al.* 2021
- *Further studies should:*
 - *Analyse the 33 MFAs highlighted in this work in a larger population*
 - *Consider different approaches (i.e. ML) to assess their accuracy and usefulness*
 - *Study the pros and cons of implementing FE as a breeding target on the technological and organoleptic characteristics of dairy sheep products*



Acknowledgments



www.smarterproject.eu



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Acknowledgments



Thank you!

