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Composition and fatty acids profile of colostrum, transition milk, and mature milk in dairy ewes fed grape byproduct during late gestation

S. Carta, M. F. Caratzu, A. Fenu, A. Mazza, G. Cadau, A. Nudda

Silvia Carta
Sezione di Scienze Zootecniche
scarta2@uniss.it

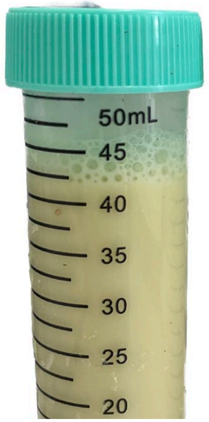
1. Introduction: **Colostrum**, **Transition** and **Mature milk**

- Colostrum is **the first milk** secreted by mammals after parturition
- The composition of colostrum deeply and quickly changes in the postpartum
- Based on the change in fatty acids profile, some authors identified (O'Callaghan et al., 2020):

Lambing

Colostrum

Day 1



Transition milk

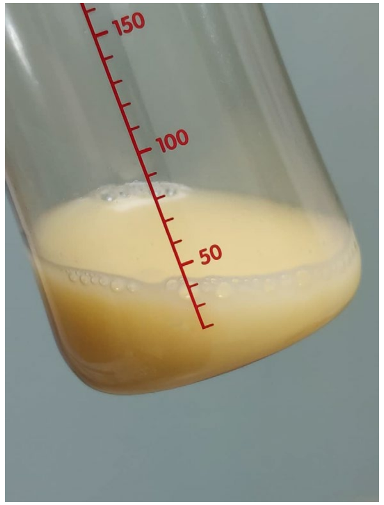
D2 and D3

Mature milk

D4 and D5

- Understanding the changes that occur during the first days of lactation could improve the knowledge about physiology and needs of newborns

1. Introduction: Factors affecting Colostrum and Milk quality



- Species
- Breed
- Parity
- Diseases
- Season
- **Pre-partum nutrition**

Use **of byproducts**, **algae extracts** and **feed additives** to improve the quality of colostrum

1. Introduction: **Grape pomace**

✓ Grape pomace is a by-product of the wine industry that contains polyphenols and fatty acids that could improve the animal product quality

✓ Diets supplemented with dried grape pomace lead to modifications in the fatty acid profile in the milk (Correddu et al., 2022):

- Decreased the saturated fatty acids (SFA)
- Increased the monounsaturated fatty acids (MUFA)
- Increased the PUFA in milk

✓ The inclusion of dietary grape seed polyphenols in the diet of sows during the late gestation and lactation increased the IgM and IgG content in colostrum (Wang et al., 2019)

2. Objectives

The objectives of this study were:

- ❖ to evaluate the effect of the inclusion of GP in the diet of sheep in the late gestation on IgG content, main composition, and FA profile of the secretion from the lambing to the first 9 days of lactation

- ❖ to check the evolution of the milk composition and FA profile during the first days after lambing

3. Material and Methods

- The study was conducted at the experimental farm of the Dipartimento di Agraria, University of Sassari

- Ewes were kept together in a barn equipped with 10 individual automatic feeding systems (Biocontrol AS, Rakkestad, Norway), and the **individual feed intake** was daily recorded

3. Material and Methods

- **22 Sarda dairy sheep** in late gestation (15 ±6 days from partum) were used for the experiment
- The animals were allocated to two groups homogeneous for:

❖ **Body condition score** (BCS, 3.4 ± 0.1)

❖ **Body weight** (BW, 62.2 ± 0.7 kg, mean ± SD)

CTR group

- 11 ewes
- Fed basal diet
- 0 g/d of GP

GP group

- 11 ewes
- Fed basal diet
- **50 g/d of GP**

3. Material and Methods

Sampling time

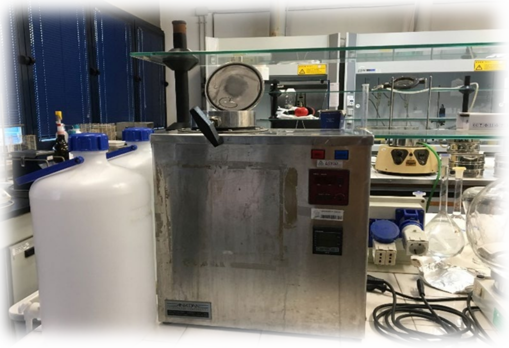
Colostrum	Transition milk	Mature milk
Day 1	Day 2	Day 9
Manually collected within **12 hours** from the lambing	Manually collected within **48 hours** from the lambing	Manually collected after **9 days** from the lambing

3. Material and Methods

Laboratory analysis

Feed samples were analyzed for:

- Dry matter intake
- Crude protein
- NDF
- ADF
- ADL
- Ash



Colostrum
Transition milk
Mature milk
samples were analyzed for:

- Composition
- FA

Colostrum samples were analyzed for:

- Composition
- IgG
- FA

4. Statistical Analysis

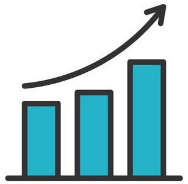
The main composition and the FA profile of milk were analyzed with a mixed model, using the PROC MIXED of SAS version 9.2 (SAS Institute, 2008), in which:

$$Y_{ijkl} = \mu + G_i + S_j + (G \times S)_{ij} + P_l + e_{ijkl}$$

- ✓ Y = investigated trait
- ✓ μ = mean
- ✓ G_i = fixed effect of the group (i=2)
- ✓ S_j = fixed effect of the sampling (j=3 for FAME analysis)
- ✓ $(G \times S)_{ij}$ = interaction group × sampling
- ✓ P_l = Animal as random effect
- ✓ e_{ijkl} = error

5. Results and Discussion

Effect of diet on colostrum and milk composition



	Diet		Sampling			SEM	P-value		
	CTR	GP	Day 1	Day 2	Day 9		Group	Sampling	G*S
Intake, g/d	1026.45	1065.25	816.41	885.89	1430.11	63.46	0.73	<0.001	0.99
Milk composition									
Fat, %	7.87	8.30	10.42	8.34	5.43	0.42	0.55	<0.001	0.98
Protein, %	8.63	8.91	14.63	6.23	5.42	0.64	0.72	<0.001	0.32
Casein, %	4.63	4.61	5.48	4.42	3.96	0.22	0.96	0.014	0.35
Lactose, %	4.22	4.01	3.03	4.35	5.0	0.12	0.30	<0.001	0.23
Urea, mg/100 ml	52.69	50.32	68.56	56.99	29.28	3.24	0.67	<0.001	0.42
pH	6.31	6.29	5.71	6.48	6.721	0.06	0.70	<0.001	0.66
NaCl, mg/100 ml	284.48	302.12	595.20	164.65	117.65	28.95	0.52	<0.001	0.81

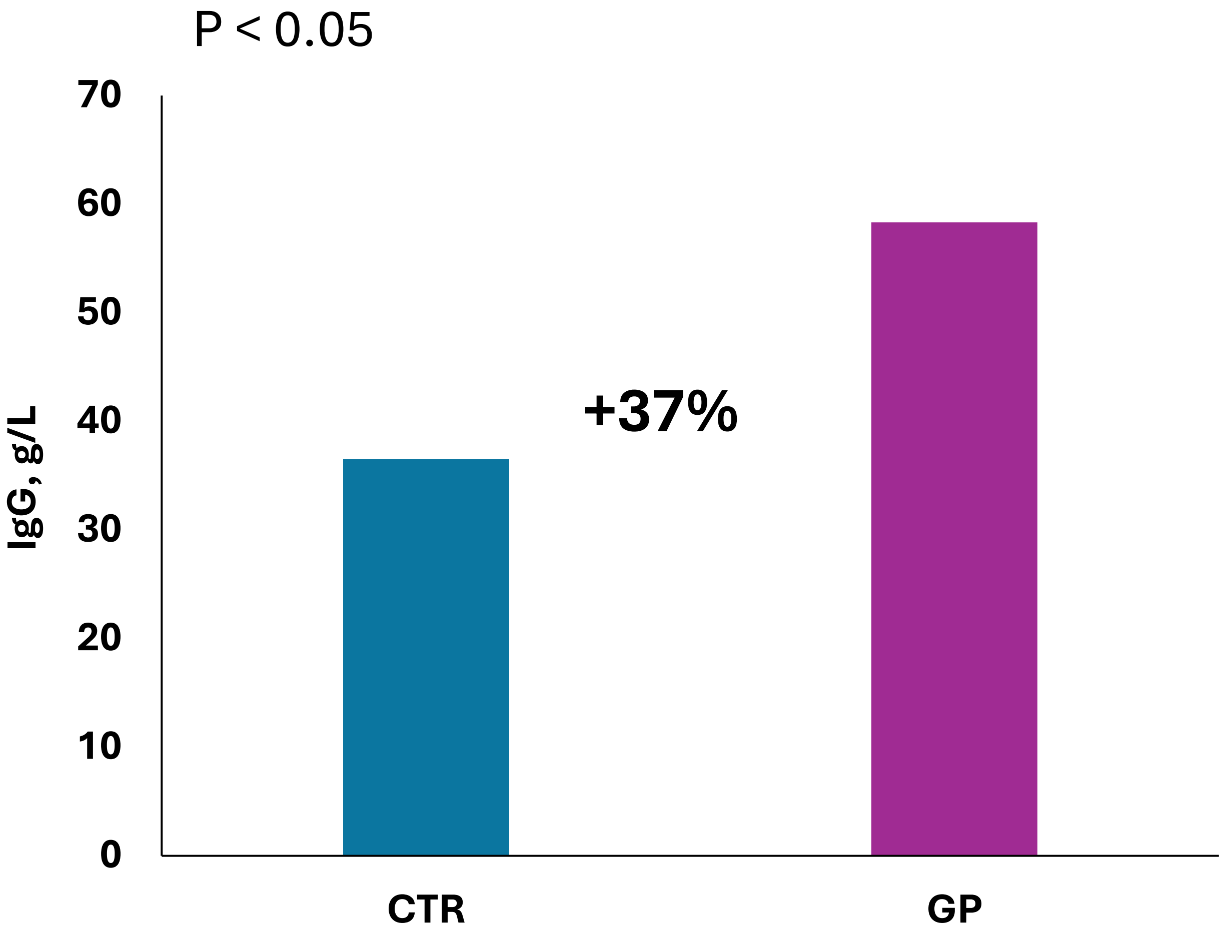
5. Results and Discussion

Effect of treatment and sampling time on individual fatty acids

FAME	Group		Sampling			SEM	P- value		
	CTR	GP	Day	Day 2	Day 9		Group	Sampling	G*S
C4:0	2.43	2.36	2.01	2.42	2.76	0.06	0.60	<0.001	0.07
C6:0	1.40	1.26	0.84	1.20	1.97	0.07	0.30	<0.001	0.20
C8:0	1.23	1.11	0.63	0.98	1.92	0.08	0.40	<0.001	0.47
C10:0	4.03	3.74	2.13	3.08	6.47	0.30	0.60	<0.001	0.88
C12:0	3.00	2.88	2.37	2.37	4.08	0.16	0.78	<0.001	0.65
C14:0	11.41	10.41	13.29	9.33	10.24	0.38	0.30	<0.001	0.45
C16:0	29.46	28.60	32.85	27.57	26.79	0.59	0.53	<0.001	0.27
C17:0	0.91	0.99	0.82	1.11	0.92	0.03	0.43	<0.001	0.80
C18:0	8.50	9.03	6.38	9.83	10.01	0.36	0.49	<0.001	0.36
C18:1 cis-9	24.78	26.9	26.05	29.36	21.83	0.92	0.40	<0.001	0.98
C18:2 n6- (LA)	2.33	2.39	2.14	2.40	2.54	0.06	0.69	0.02	0.15
C18:3 n-6	0.18	0.16	0.17	0.17	0.18	0.00	0.06	0.71	0.51
C18:3 n-3 (LNA)	0.45	0.47	0.40	0.51	0.48	0.01	0.34	<0.001	0.41
CLA cis-9, trans-11 (RA)	0.40	0.35	0.37	0.37	0.40	0.01	0.19	0.53	0.10
C20:4 n-6	0.26	0.24	0.24	0.27	0.25	0.01	0.20	0.39	0.76
C22:5 n-3 (EPA)	0.05	0.06	0.05	0.06	0.05	0.00	0.52	0.27	0.06
C22:5n-3 (DPA)	0.13	0.14	0.16	0.13	0.11	0.00	0.37	<0.001	0.11
C22:6n-3 (DHA)	0.05	0.05	0.05	0.05	0.05	0.00	0.23	0.37	0.44

5. Results and Discussion

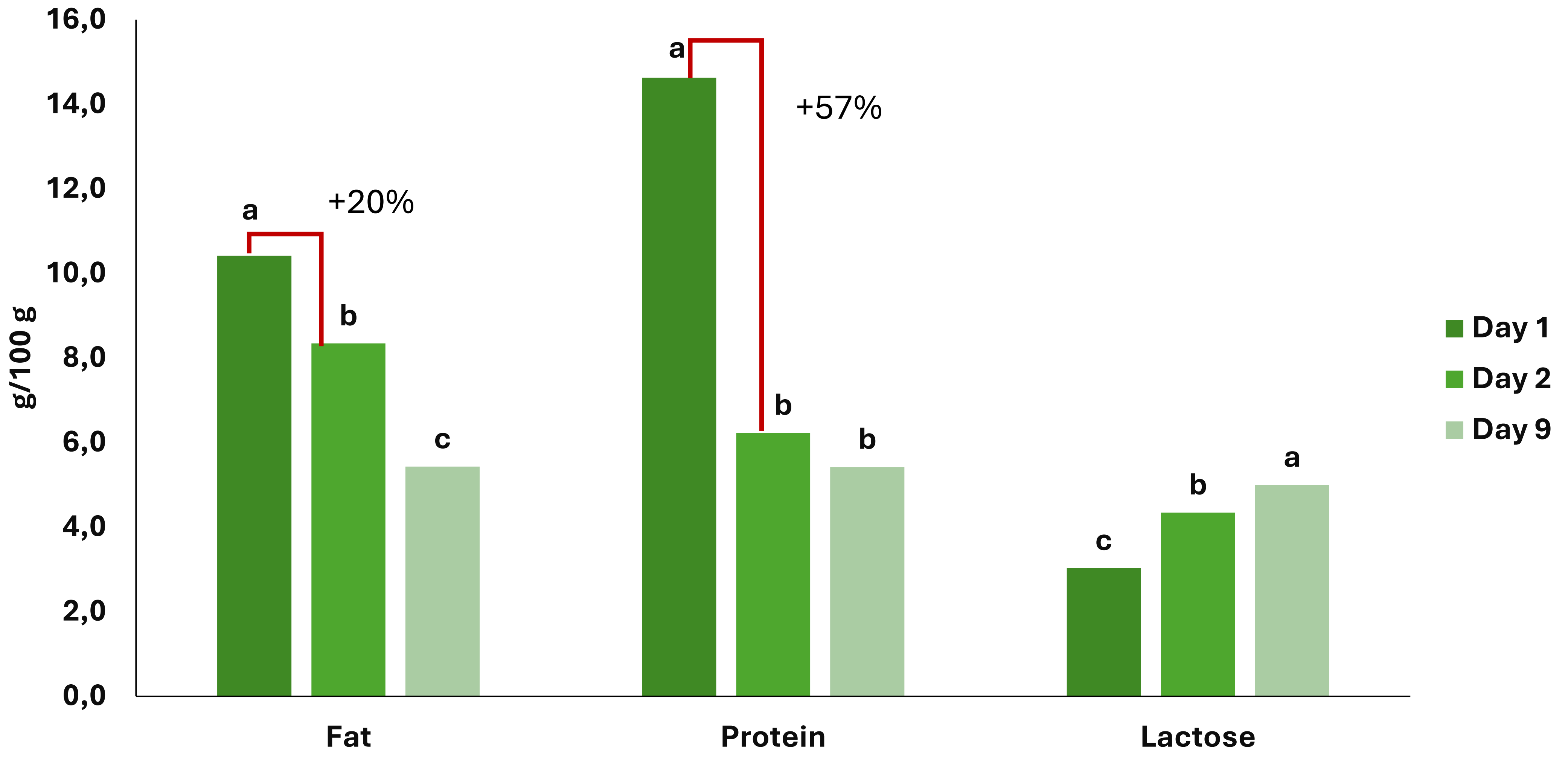
IgG concentration in colostrum



CTR: 36.5 g/L

GP: 58.3 g/L

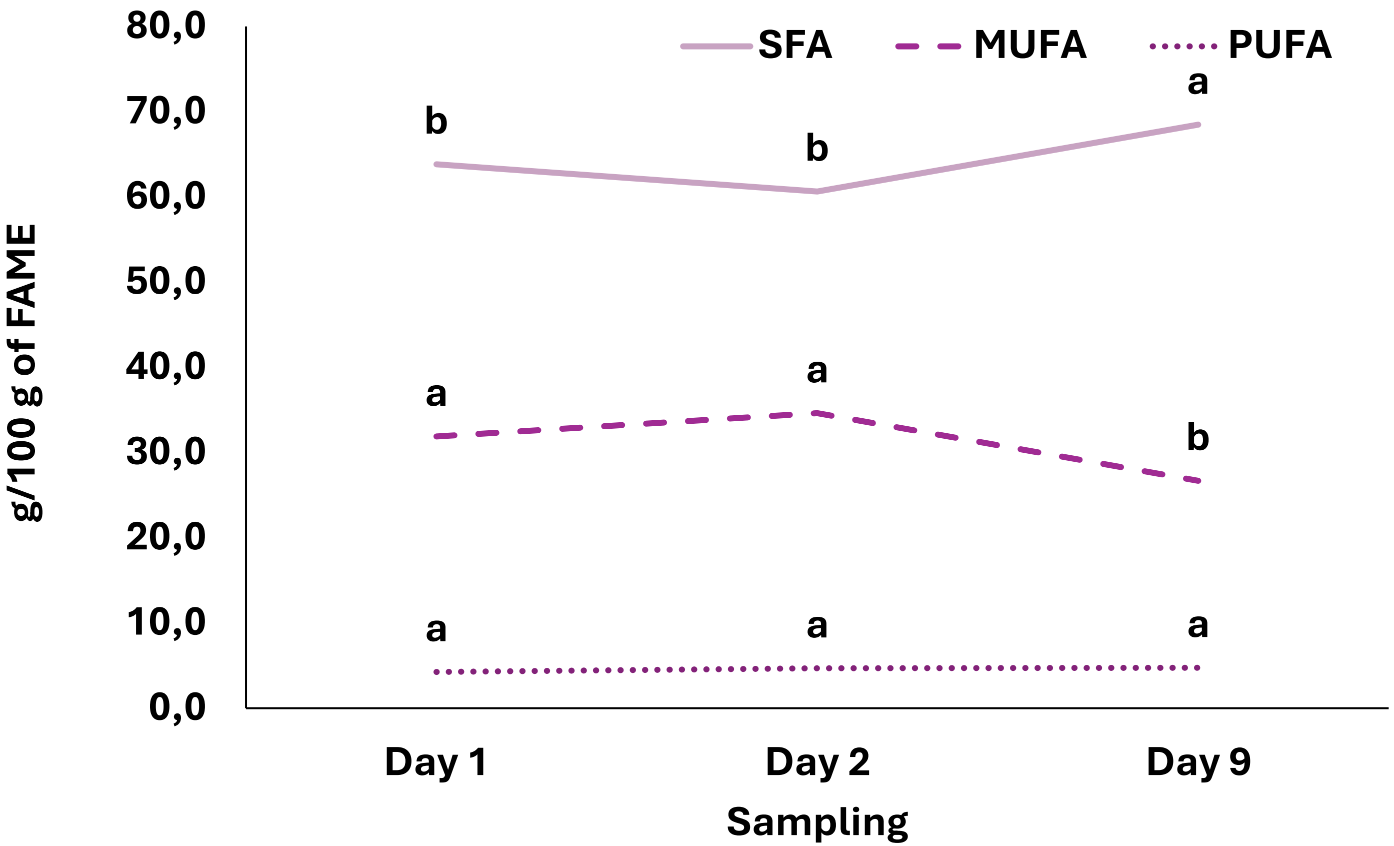
The concentration of fat, protein and lactose is deeply different on colostrum (Day 0), transition milk (Day 2), and mature milk (Day 9)



5. Results and Discussion

Evolution of some groups of FA during the time

P < 0.05



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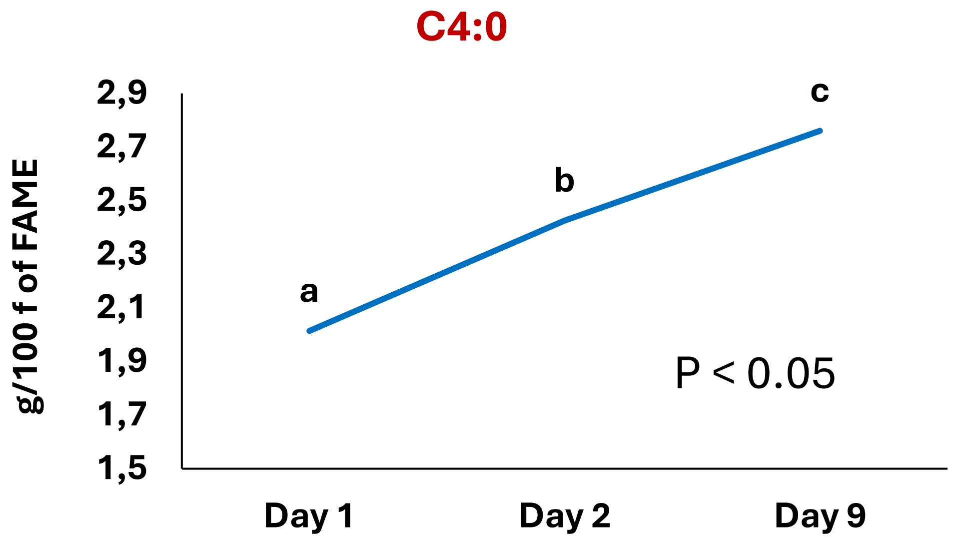
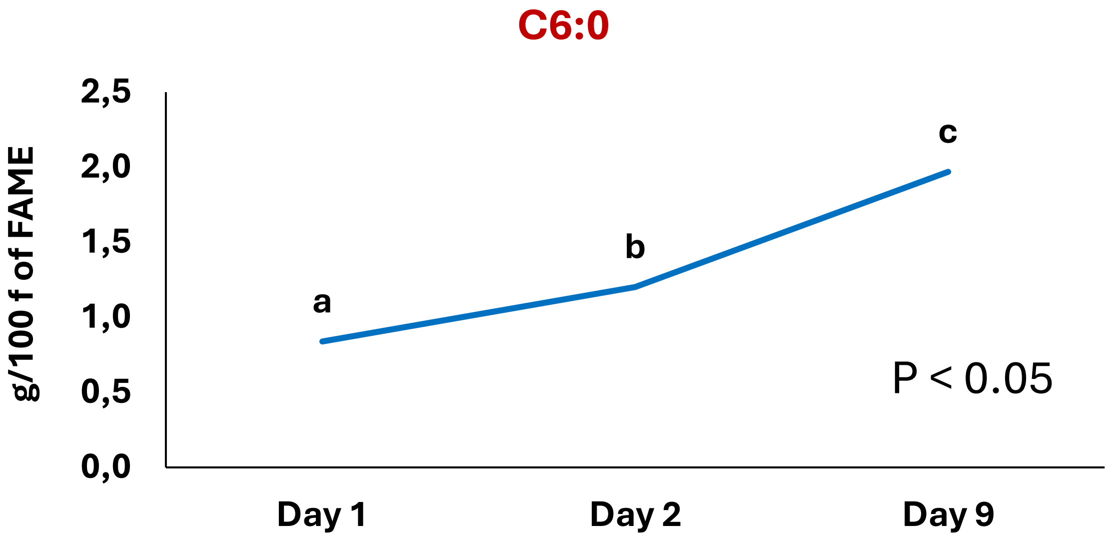
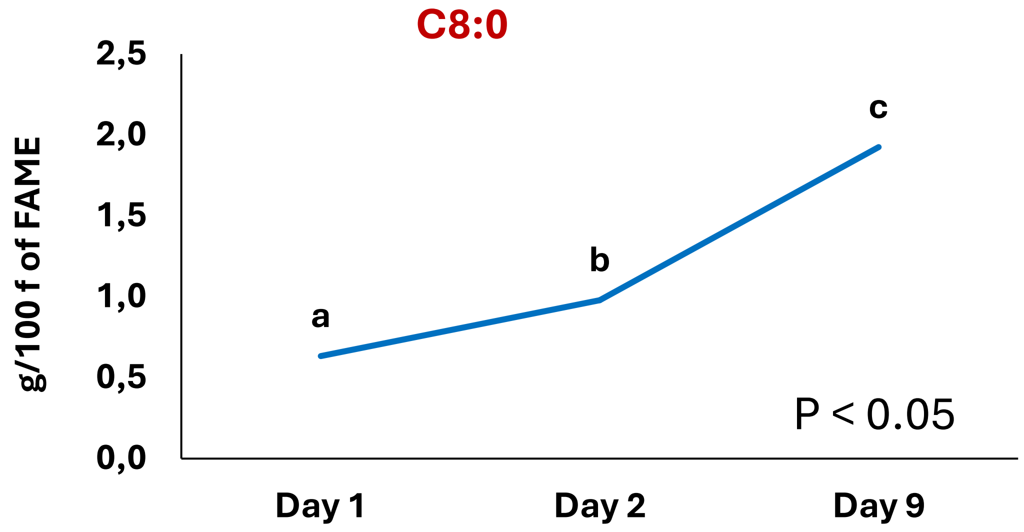
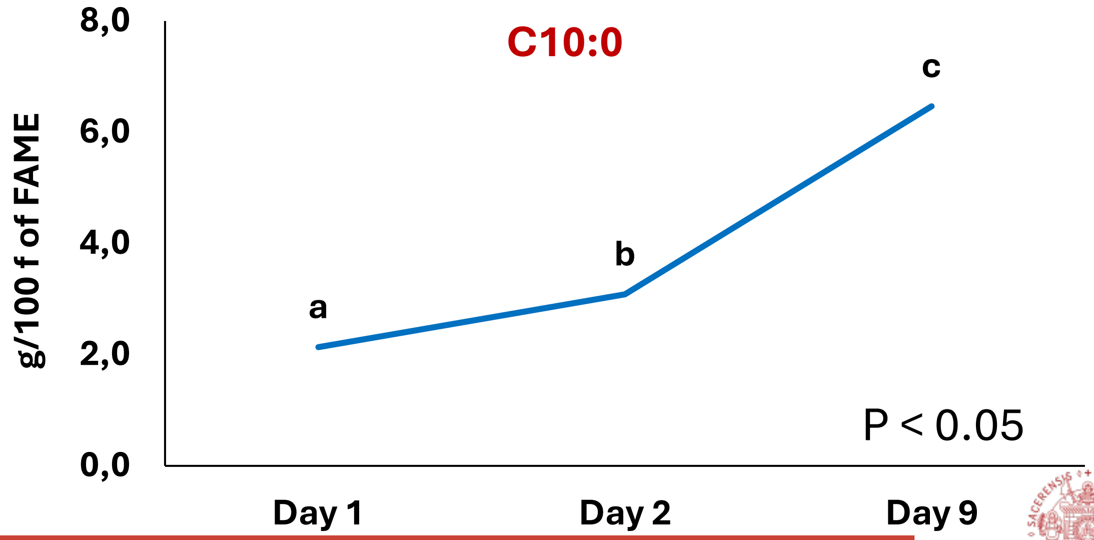
5. Results and Discussion

Short Chain SFA

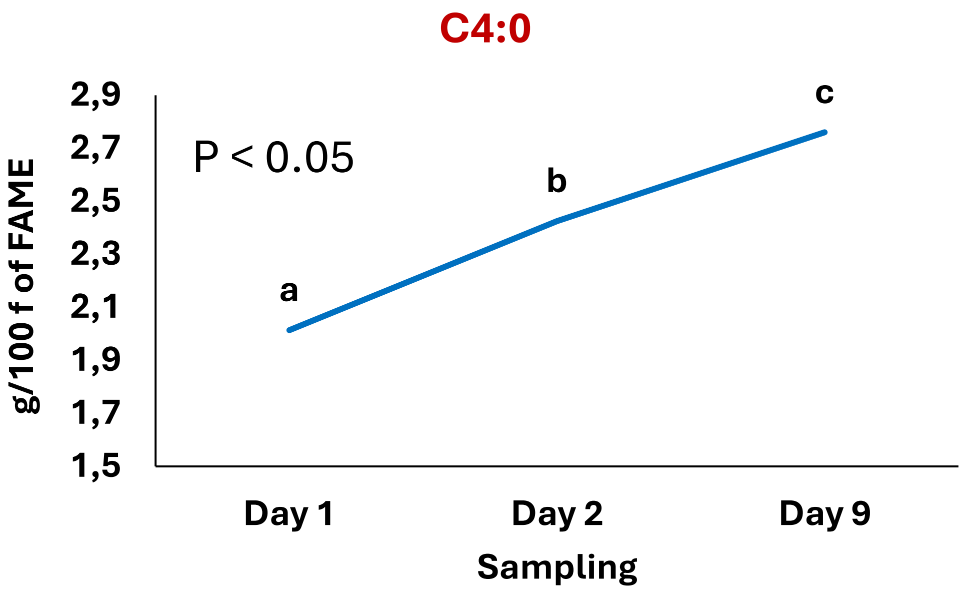








5. Results and Discussion



The role of butyric acid

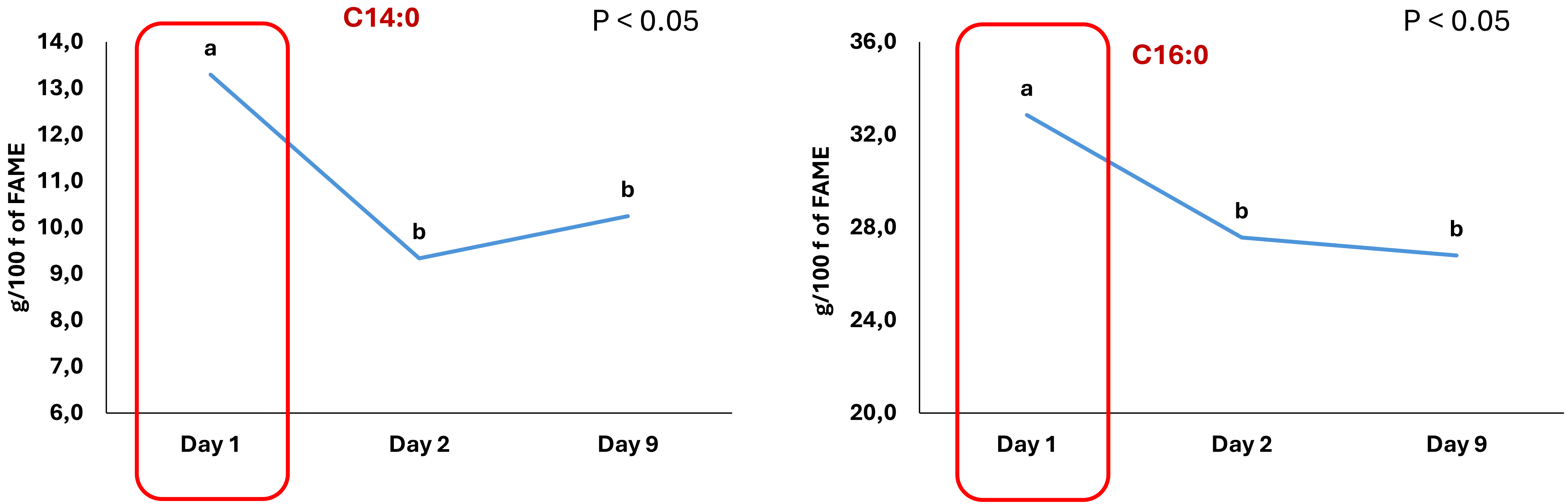
Important nutrient for newborns due to its role as a cellular mediator, regulator of gut function, immune modulation and oxidative stress in neonates (Bedford and Gong, 2018)

Despite this the butyric acid is low in colostrum

Butyric acid stimulates the epithelial differentiation and may reduce paracellular permeability during the process of gut closure

The lower proportion of this FA in colostrum may prolong the period of intestinal permeability, promoting the transfer of immunoglobulins (Hiltz and Laarman, 2019; Wilms et al., 2022)

5. Results and Discussion

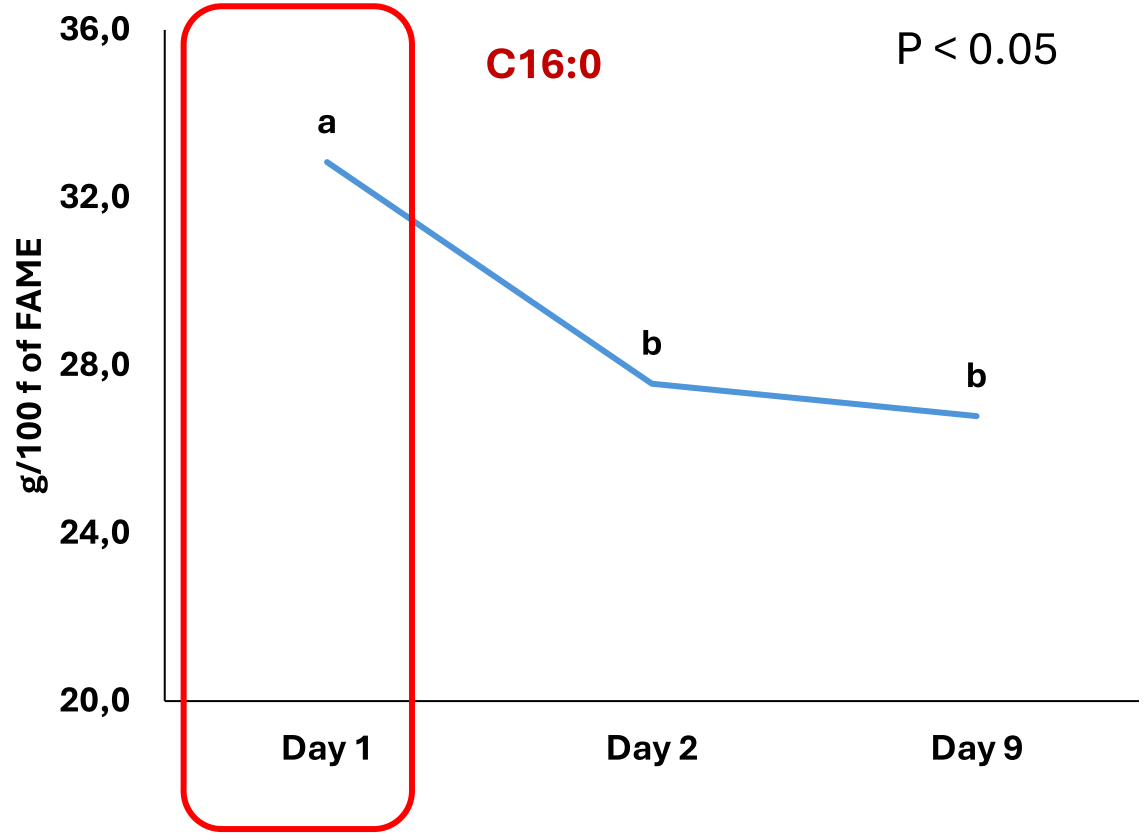


- ✓ These two FA were found higher in colostrum than transition milk and mature milk
- ✓ Myristic and palmitic acids allow for increased colostrum intake and result in the highest appetitive response in newborns (Gutiérrez- Garcia et al., 2017; Wilms et al., 2022)

5. Results and Discussion

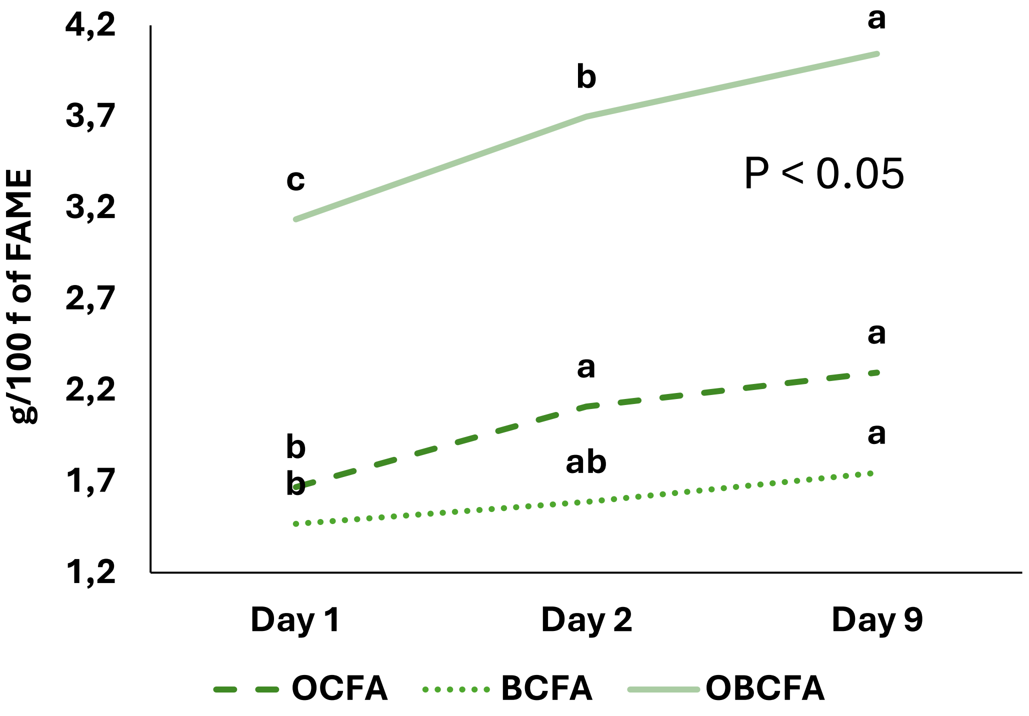
The important role of Palmitic acid for the newborn

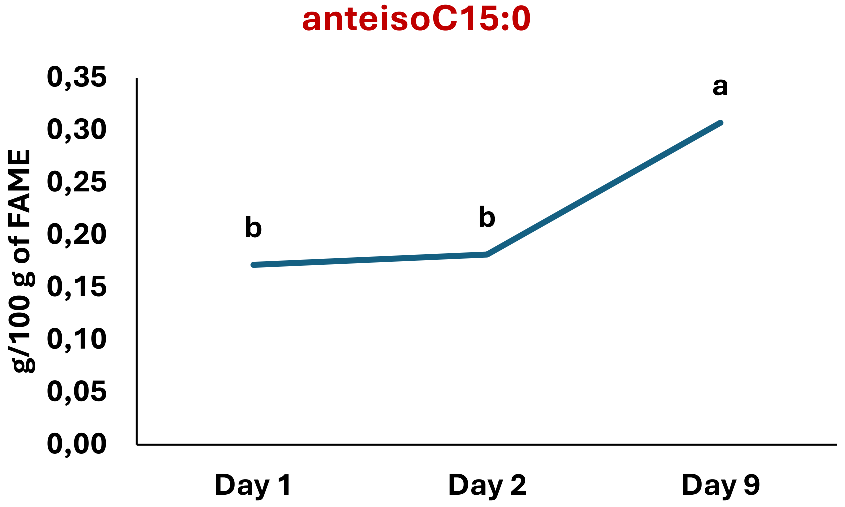
- ✓ The location of palmitic acid at the 2-sn position on the glycerol backbone makes it easier to be absorbed
- ✓ This specific configuration has positive effect on intestinal mucosal homeostasis, gut microbiome and immune response (Jiang et al., 2018)
- ✓ It is a substrate for the de novo ceramide synthesis, that can be used for synthesizing sphingomyelin
- ✓ Ceramide and sphingomyelin are both implicated in several cellular functions and in brain and immune system development in newborn animals (Dei Cas et al., 2020)

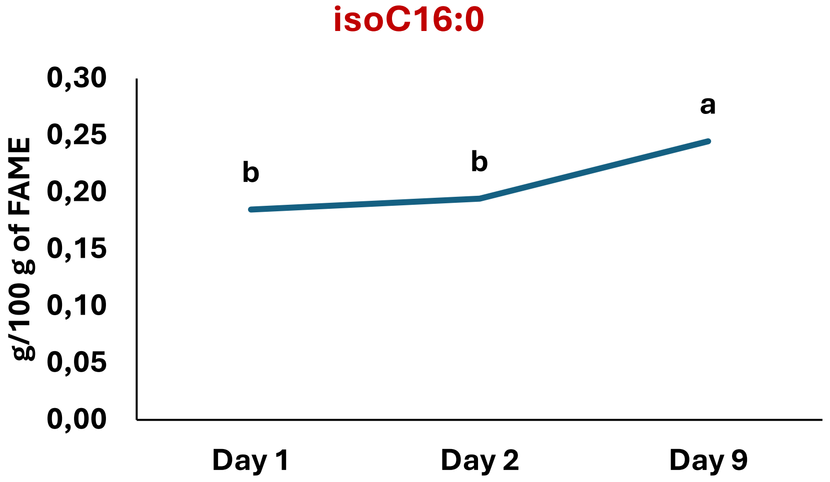


5. Results and Discussion

Odd and Branched Chain Fatty Acids



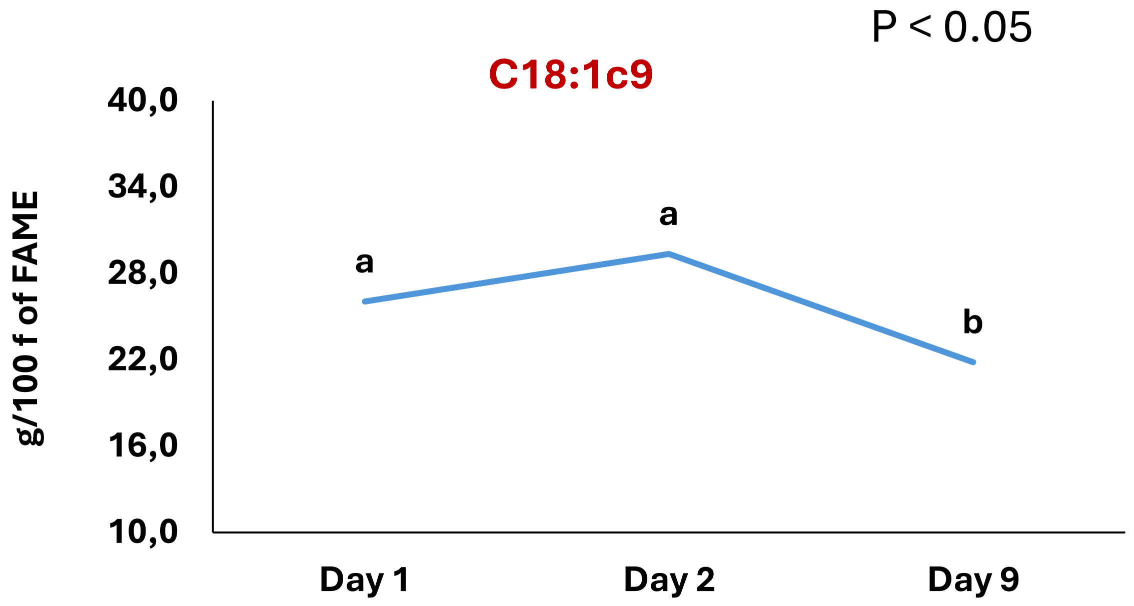


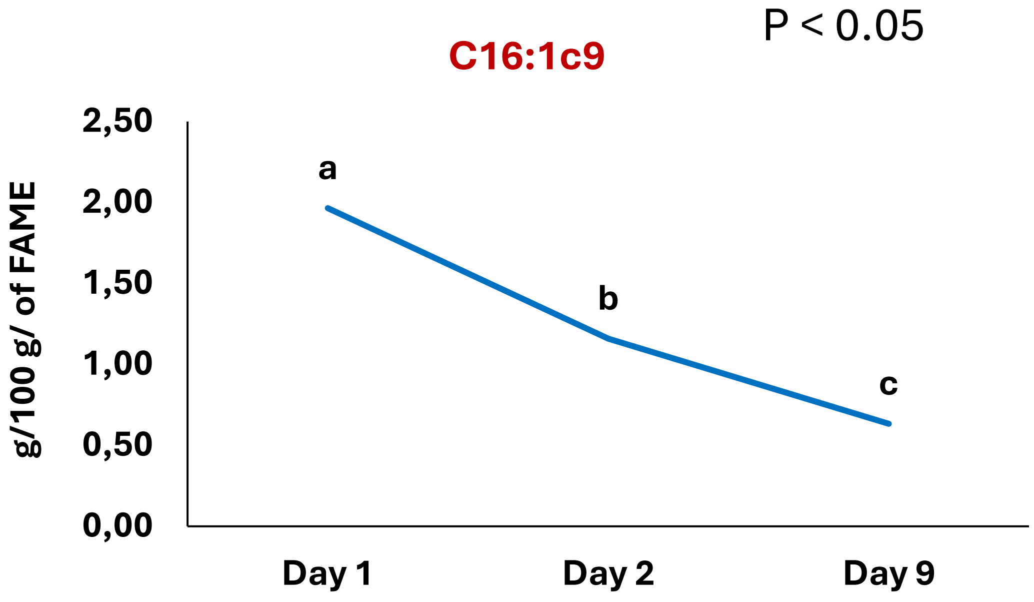


✓ The lower concentration of BCFA in colostrum than mature milk is attributed to the decline in postpartum DMI which could lead to lower substrate availability for rumen synthesis of these FA (Xin et al., 2020)

5. Results and Discussion

cis-Monounsaturated Fatty Acids

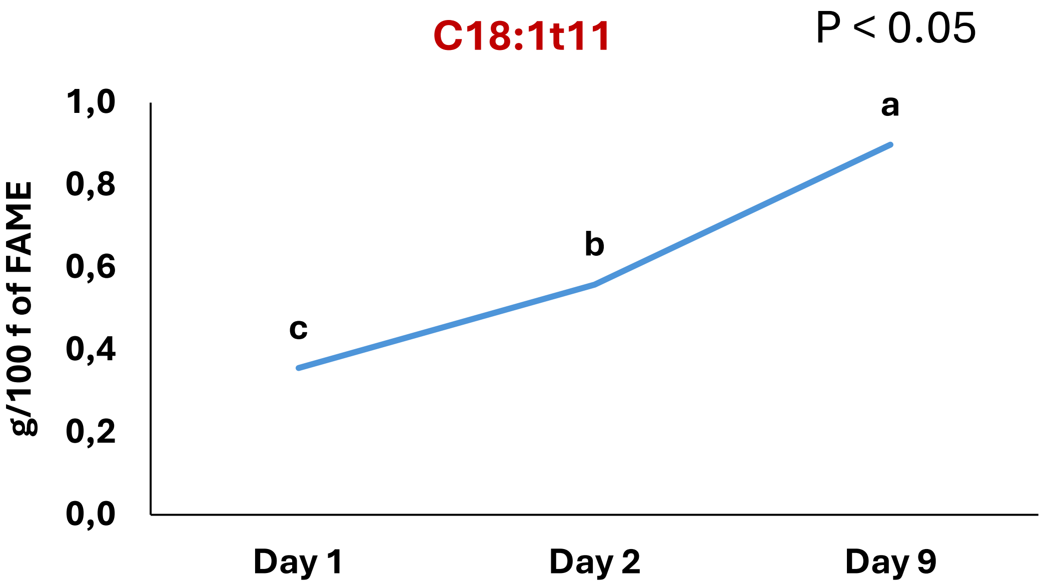


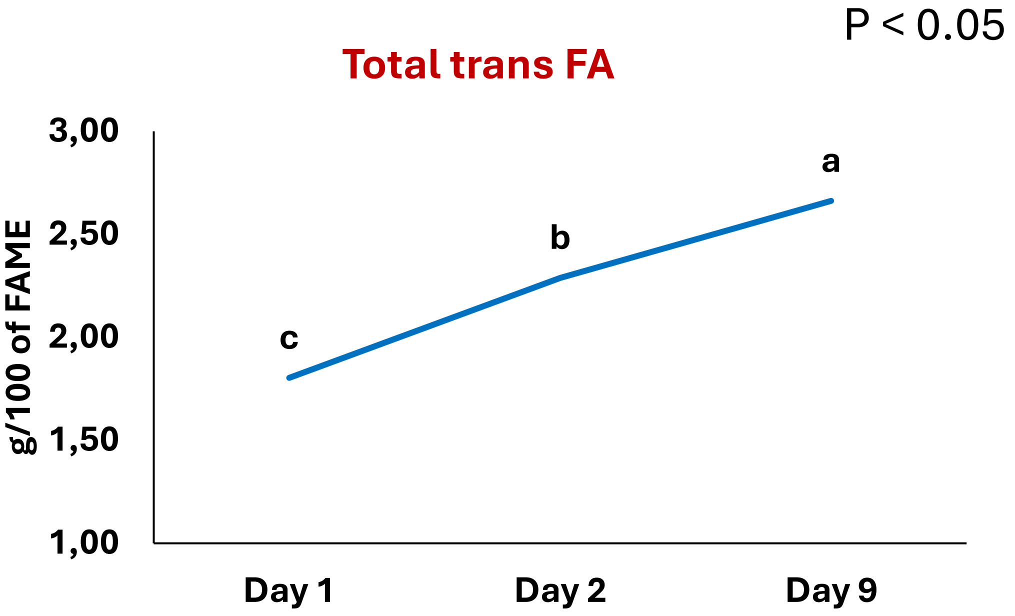


- ✓ The *cis*-MUFA were higher in colostrum compared to mature milk
- ✓ The C18:1 cis-9 is associated to the fat mobilization during the first days after lambing

5. Results and Discussion

Trans-monounsaturated Fatty Acids and Total Trans-FA



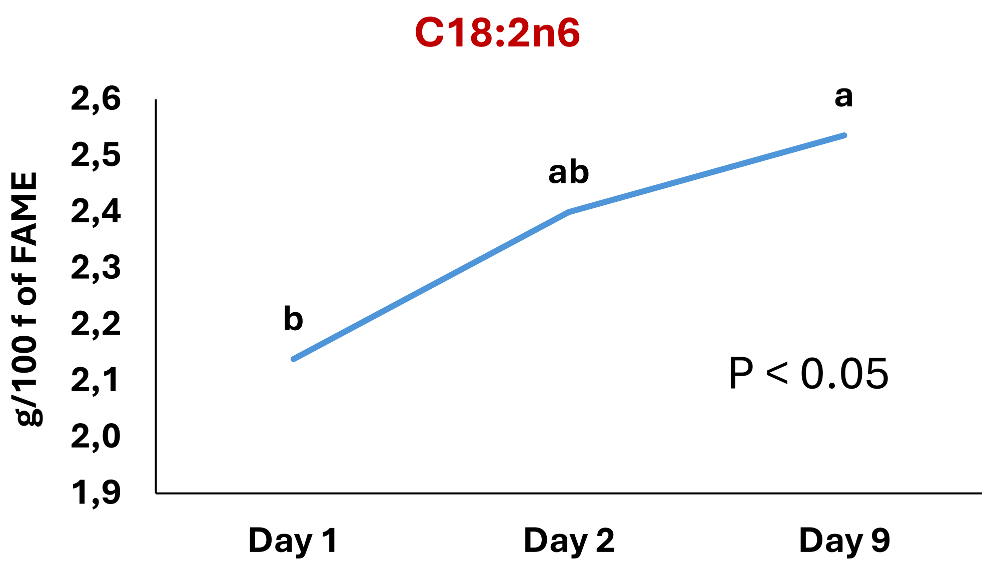


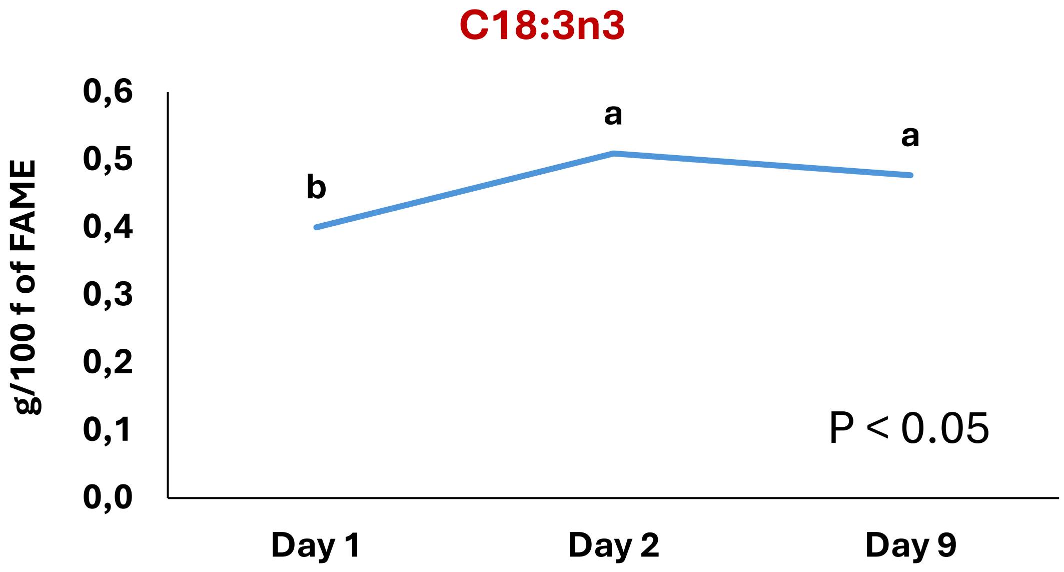
- ✓ The *trans*-MUFA and the total trans FA were lower in colostrum compared to mature milk
- ✓ This is probably due to the reduction of the rate of biohydrogenation
- ✓ Similar results were found in cow (Wilms et al., 2022)

5. Results and Discussion

Polyunsaturated FA

- ✓ The total Polyunsaturated FA did not change among sampling times
- ✓ However, some individual PUFA, such as Linoleic and Linolenic acids were higher in mature milk than colostrum
- ✓ This is in line with results found in sheep (Martini et al., 2011), but in contrast with other studies on cattle (O'Callaghan et al., 2020, Wilms et al., 2022)





6. Conclusion

✓ The inclusion of 50 g/head/d of grape pomace in the diet of ewes in late gestation:

- did not influence the main composition and the FA profile of colostrum and milk
- increased the IgG concentration of colostrum

✓ The increase of IgG concentration suggests the potential use of this byproduct to improve the passive immunity of the colostrum

✓ The FA profile of colostrum, transition milk and mature milk is deeply different and strongly reflect the metabolic status of the animals after parturition

✓ The difference on composition and FA profile found between colostrum and transition milk highlights the importance of the quickly administration of colostrum to the newborn

✓ However, more studies will be necessary to confirm the effect of grape pomace on the increase of IgG content and to better understand the complex physiology of the ewes after the lambing

Thank you for your attention!

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