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European Federation of Animal Science

Assessment of mineral composition in sheep milk: which effects should we include?

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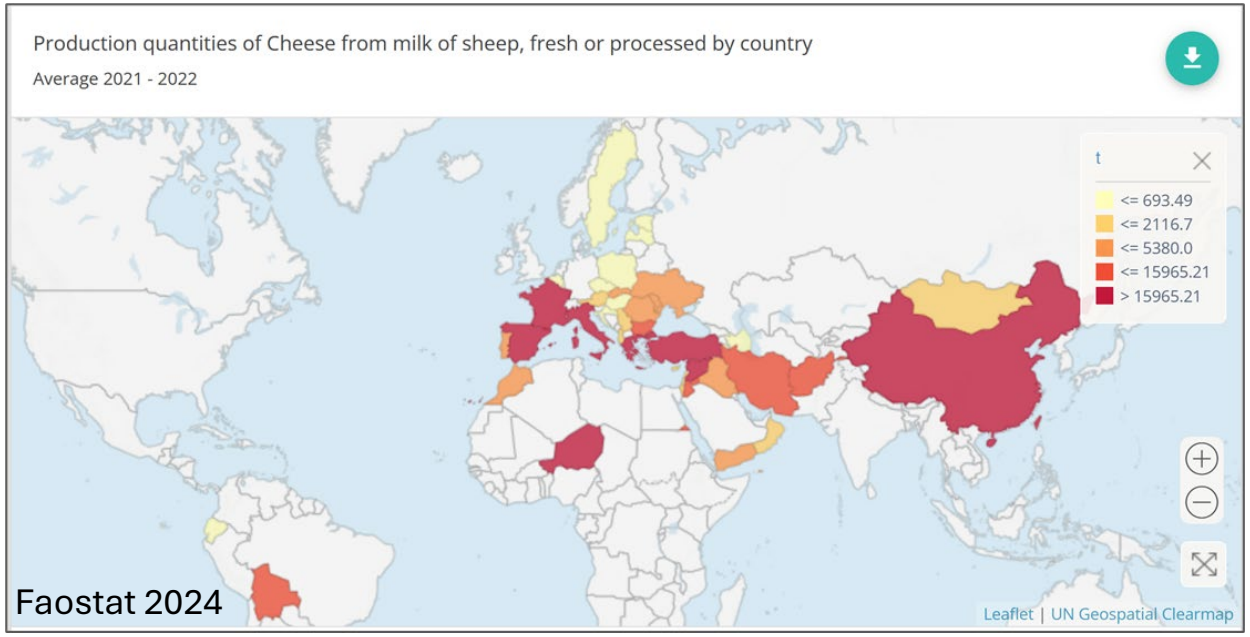
INTRODUCTION

Cheese Industry

- The global dairy sheep cheese production reached 1.5 million metric tons in 2021-2022

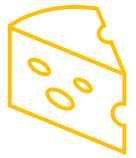


- The sheep cheeses production in Italy in 2022 was approximately 37 tonnes

Rural context and development

The sheep production systems:

- Importance in the rural context: Challenges to produce other species
- Nutritional composition and taste of dairy products
- Higher quality composition



INTRODUCTION

Average values of sheep milk composition:

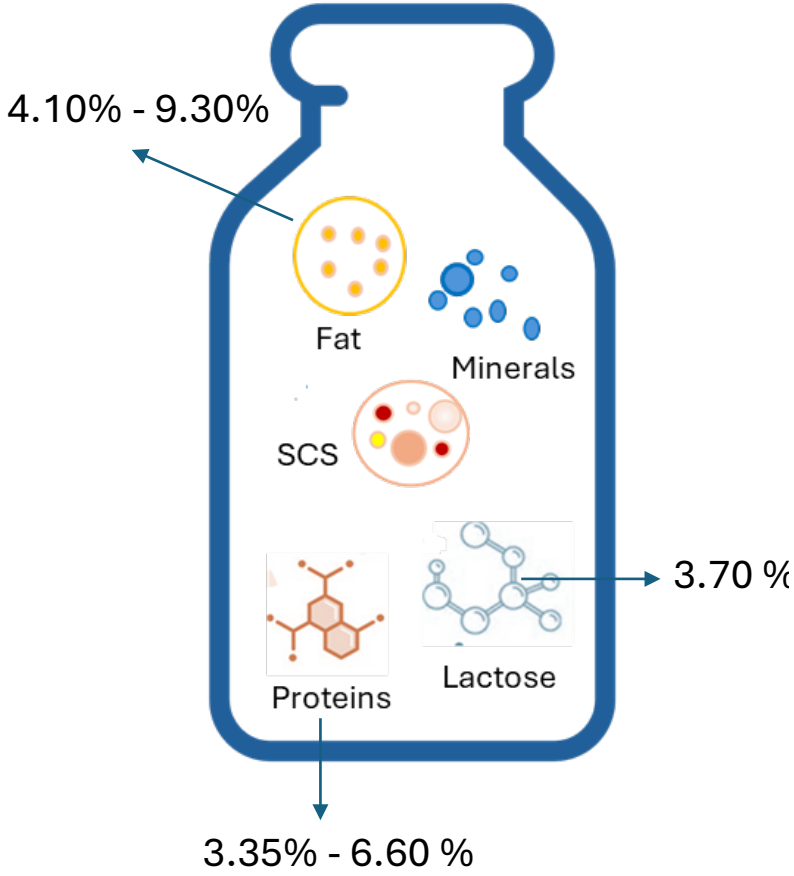
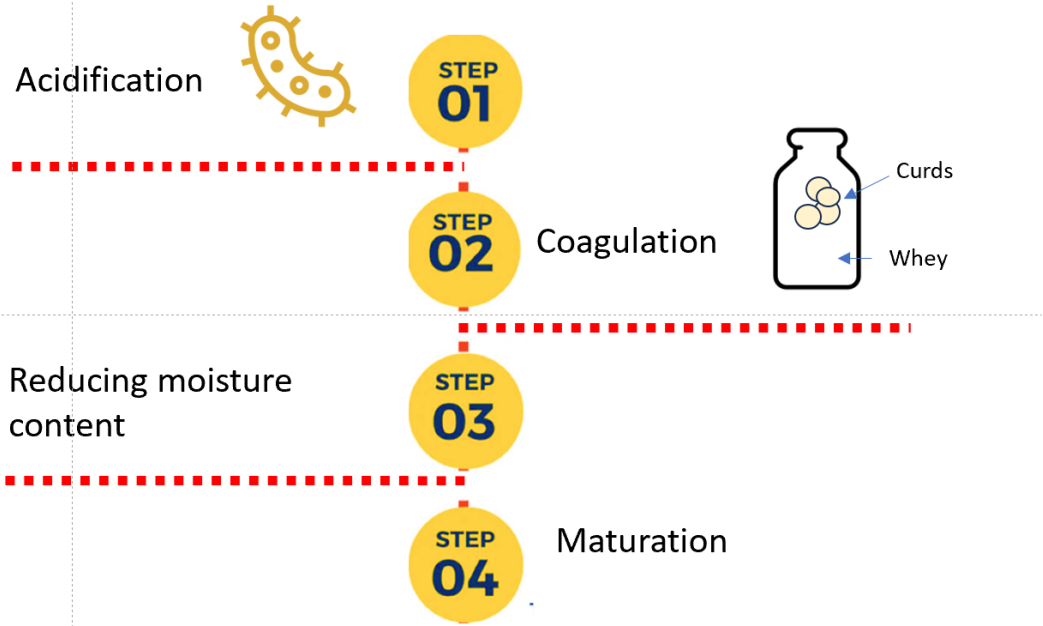


Table 5–Concentration of minerals in milk from vario

	Cattle[e]	Sheep[g]
(mg/100 g)		
Calcium	122	195 to 200
Phosphorus	119	124 to 158
Potassium	152	136 to 140
Magnesium	12	18 to 21
Sodium	58	44 to 58
(μg/100 g)		
Zinc	530	520 to 747
Iron	80	72 to 122
Copper	60	40 to 68
Manganese	20	5.3 to 9
Iodine	2.1	10.4
Selenium	0.96	3.1

[a]Schryver and others (1986); [b]Mehaia and others (1995); [c]Salimei and ot
Haj and Al Kanhal (2010).

Barłowska et al., 2011



Ca, Na, K and S -> Dairy Cattle

INTRODUCTION

Limited and almost non-existent in local breeds -> Cheese production -> environmental adaptation, traditions and cultural heritage

NEW ZEALAND JOURNAL OF AGRICULTURAL RESEARCH
https://doi.org/10.1080/00288233.2024.2368505

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RESEARCH ARTICLE

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Estimation of genetic parameters for production, composition and processability of milk from dairy sheep in a New Zealand flock

Ana Carolina Marshall [a,b], Nicolas Lop
Mike Weeks[d] and Warren McNabb[b]

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Scientific and Industrial Research Organisation (C
Foods & Bioproducts Group, AgResearch Ltd, Mas

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Detailed mineral profile
cheese from cows, buffa
and dromedary camels, and efficiency of recovery of minerals in their cheese

Nicolò Amalfitano [1], Nageshvar Patel [1], Mohamed-Laid Haddi [2], Hamida Benabid [3], Michele Pazzola [4], Giuseppe Massimo Vacca [4], Franco Tagliapietra [1], Stefano Schiavon [1], Giovanni Bittante [1]

710. Heritability and genomic analysis of coagulation event in sheep milk

G. Gaspa, A. Cesarani, F. Correddu, M. Congiu, C. Dimauro, A. Pauciullo, N.P.P. Macciotta

Pages: 2928 - 2931

OPEN ACCESS

https://doi.org/10.3920/978-90-8686-940-4_710

Published Online: February 09, 2023

Abstract | References | Full-text

Research

Estimation of genetic parameters for cheese-making traits in Spanish Churra sheep

R. Pelayo [1], B. Gutiérrez-Gil [1], A. Garzón [2], C. Esteban-Blanco [1], H. Marina [1], J.J. Arranz [1]

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PMID: 34014003

lerlying milk production traits in Valle del Belice
bility mapping

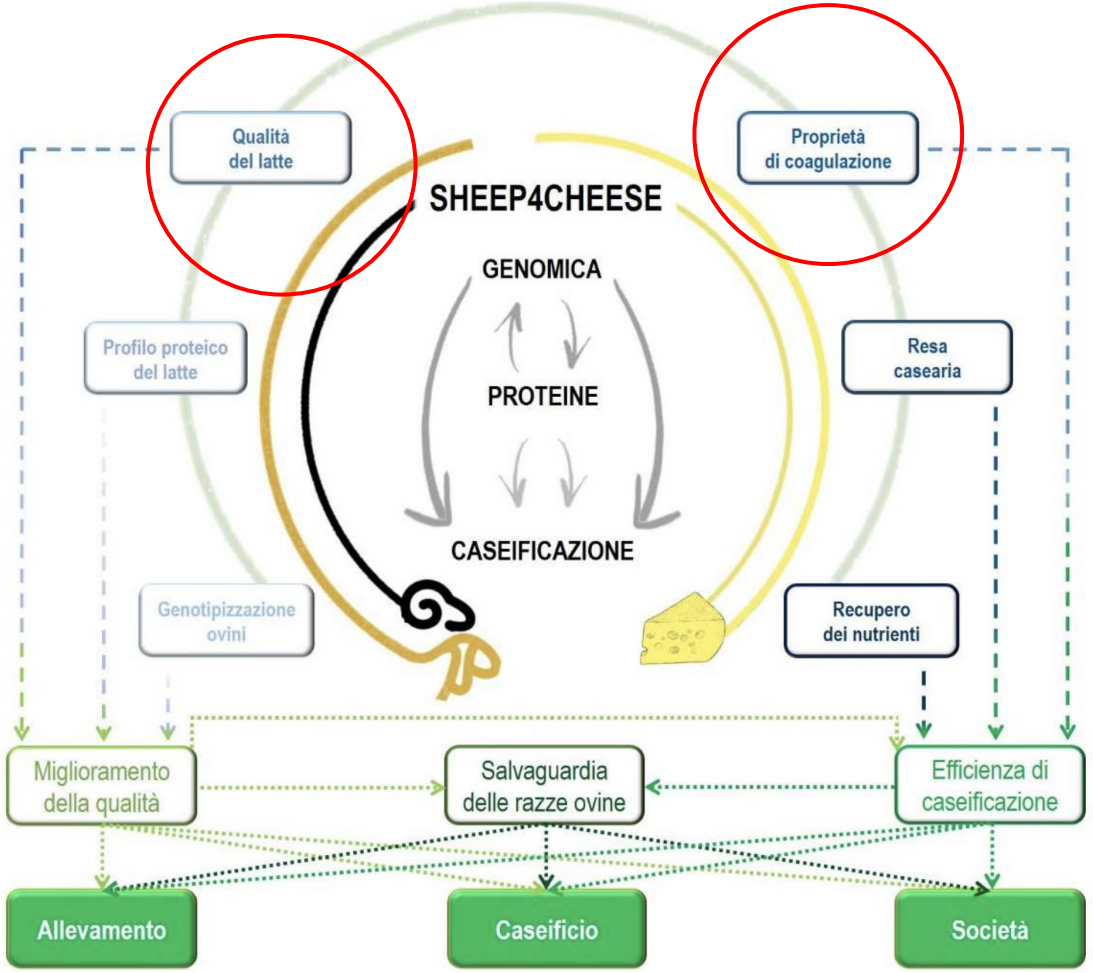
Anna Maria Sutera, [1] Marco Tolone, [2] Salvatore Mastrangelo, [2] Rosalia Di Gerlando, [2] Maria Teresa Sardina, [2] Baldassare Portolano, [2] Ricardo Pong-Wong, [3] and Valentina Riggio [3,4]

SHEEP4CHEESE

Aim:

Improving the milk quality and efficiency of cheese-making process

To improve the quality of the sheep milk through genetic selection of the animals



SHEEP4CHEESE

European Commission

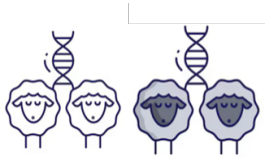
PRIORITIES

1. Fostering knowledge transfer and innovation
2. Enhancing competitiveness
3. Promoting food chain organization and risk management
4. Restoring, preserving and enhancing ecosystems
5. Promoting resource efficiency
6. Promoting social inclusion, poverty reduction and economic development

SHEEP4CHEESE

✓ To evaluate the genetic variability and effects that influence the milk and mineral composition:

Genotyping

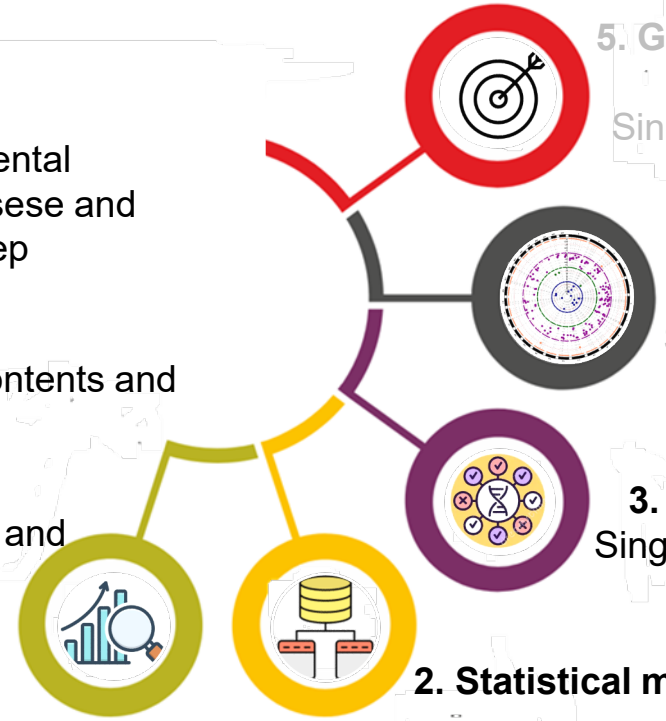


Genomic and Parental information from Massese and Comisana Sheep

Phenotyping

Evaluations of Mineral contents and milk composition

Evaluation of coagulation and cheese making process



1. Data analysis

2. Statistical modelling

Focus on define the fixed and Random effects

3. Genetic parameters
Single and multitrait models

4. GEBVs and EBVs estimation
Selection to economical important traits and genetic gain prediction

5. Genome wide association analyses
Single, multitrait models and pleiotropic effects

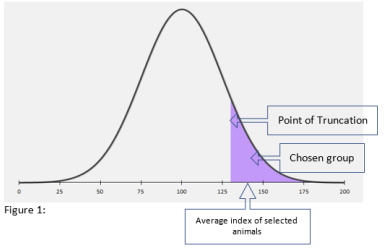


Figure 1:

MATERIAL

Italian Apenines

Massese sheep
n = 311

Comisana sheep
n = 429

Central and Southern Italy

Milk samples
Morning milking
11 sampling season

Laboratory analysis

%Fat, %Protein, %Caseina, %Lactose
MilkoScan FT3 infrared analyser

+

Somatic Cell Score
Fossomatic DC7 somatic cell counter

+

pH
Crison Basic 25 portable pH meter

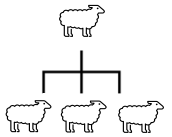
+

Ca, P, Na, K, Mg, S, Cl
Wavelength Dispersive X-ray fluorescence

To explain this:

Inclusion of environmental factors: animal status, sampling and other traits

Inclusion of genetic information



Pedigree:
Comisana: 742,851 animals
(sires: 15033 and 172,481 dams)
Massese: 132,685
(sires: 3014 and 45626 dams).

METHODS

The question was: can the composition of milk affect the mineral content of milk?

$$y = X\beta + Zu + e$$

Fixed Effects

Genetic Effects

Random error

$$y_{minerals} = X\beta + Wc + Zu + e$$

Sampling

Genetic effects

METHODS

Which effects keep on the final model?

Stepwise regression: to identify the subset of variable that produces the best model performance for each trait

$$y_{minerals} = X\beta + Wc + Zu + e$$

Parity Order:
1;2;3;4; > 5

DIM:
Class 1: 8 -30d ,
Class 2: 31 -50d ;
Class 3: 51-70d ;
Class 4: 71-90d ;
Class 5: 91-110d;
Class 6: 111 -130d ;
Class 7: 131-148d

Milk Yield
class 1: 0.3 – 0.55 kg;
class 2: 0.6 – 0.79 kg;
class 3: 0.8 – 0.97 kg;
class 4: 1 – 2.33 kg

Fat %

Casein %

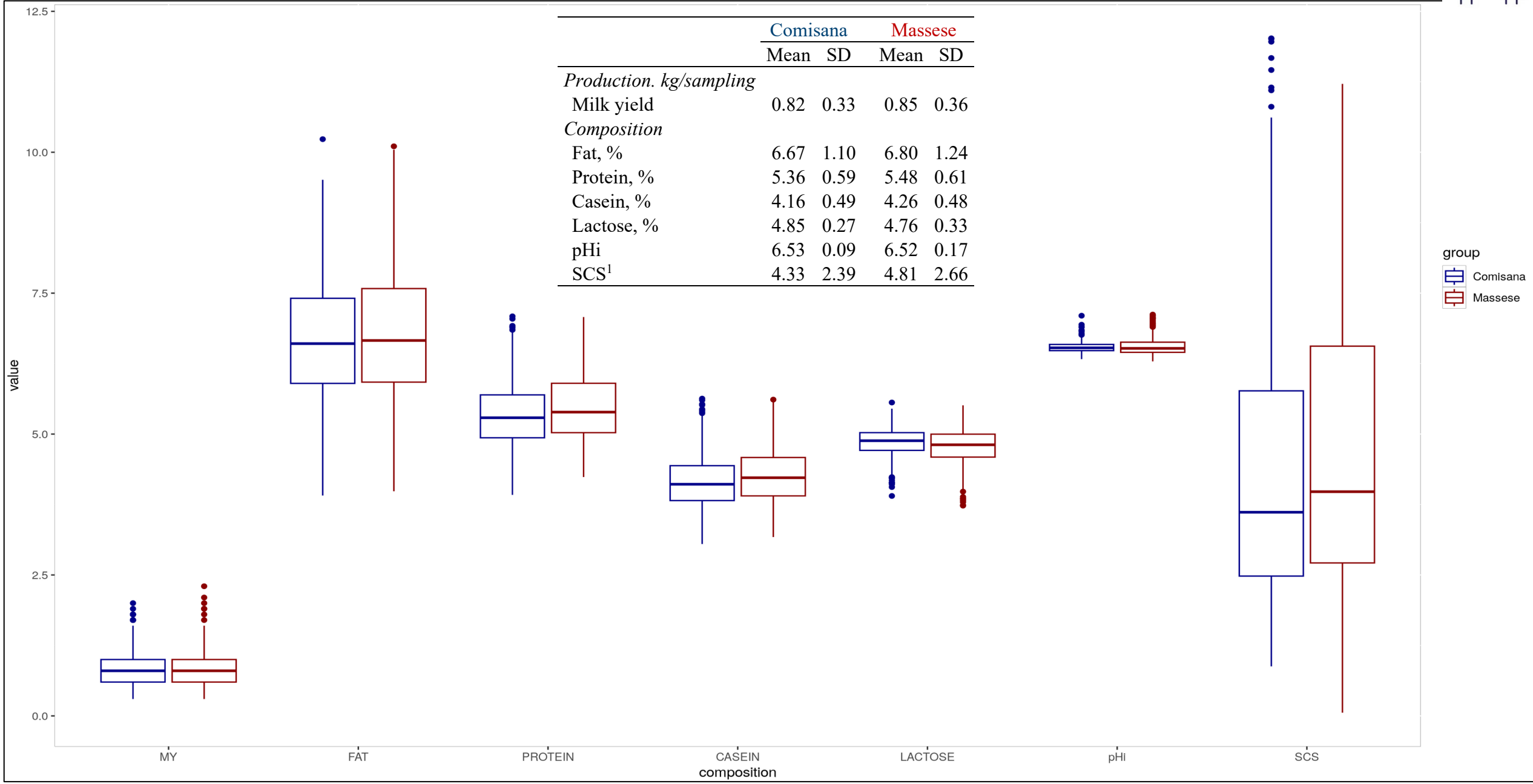
Lactose %

pH

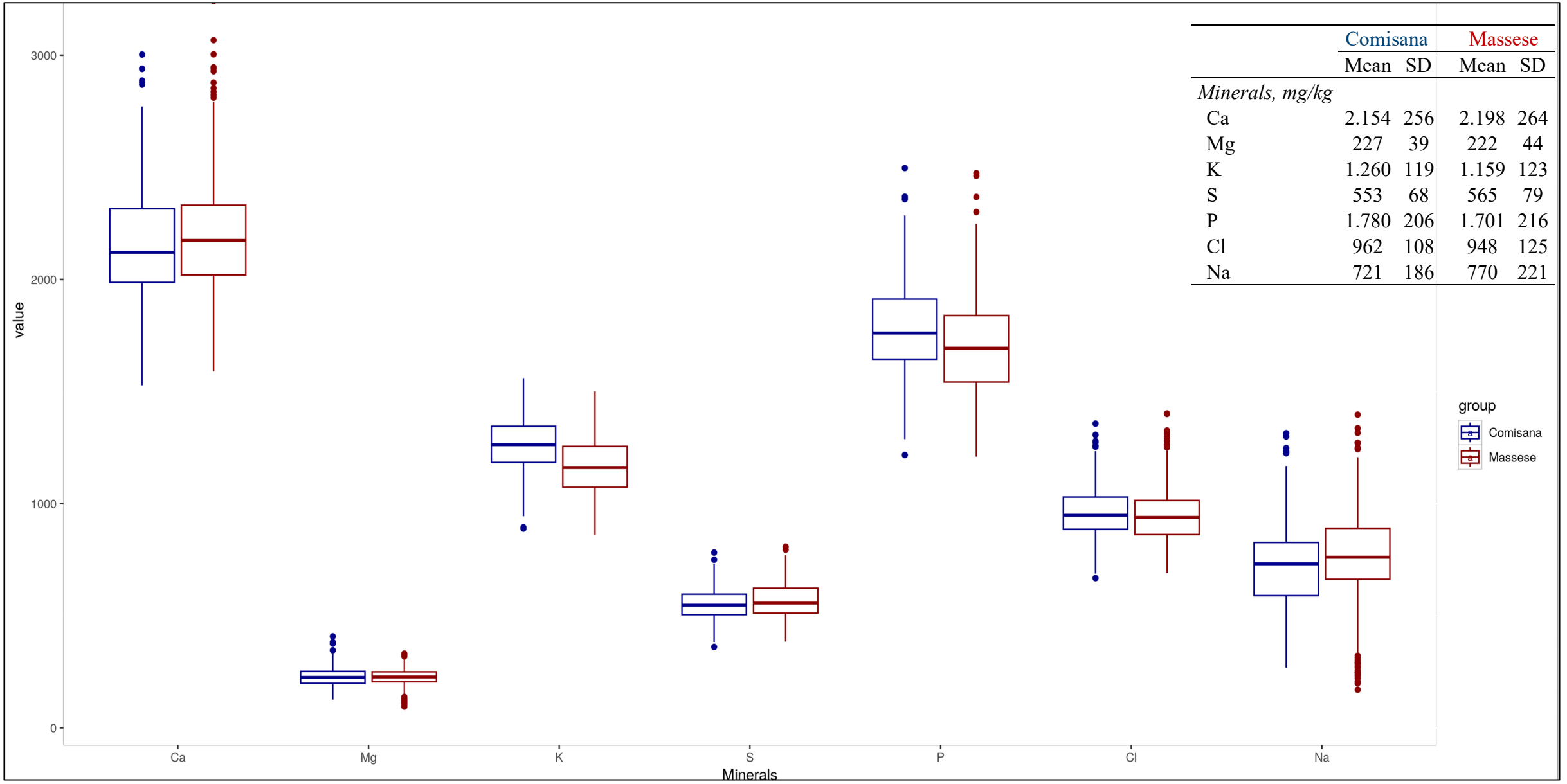
SCS

RESULTS

	Comisana		Massese	
	Mean	SD	Mean	SD
Production. kg/sampling				
Milk yield	0.82	0.33	0.85	0.36
Composition				
Fat, %	6.67	1.10	6.80	1.24
Protein, %	5.36	0.59	5.48	0.61
Casein, %	4.16	0.49	4.26	0.48
Lactose, %	4.85	0.27	4.76	0.33
pHi	6.53	0.09	6.52	0.17
SCS[1]	4.33	2.39	4.81	2.66



RESULTS



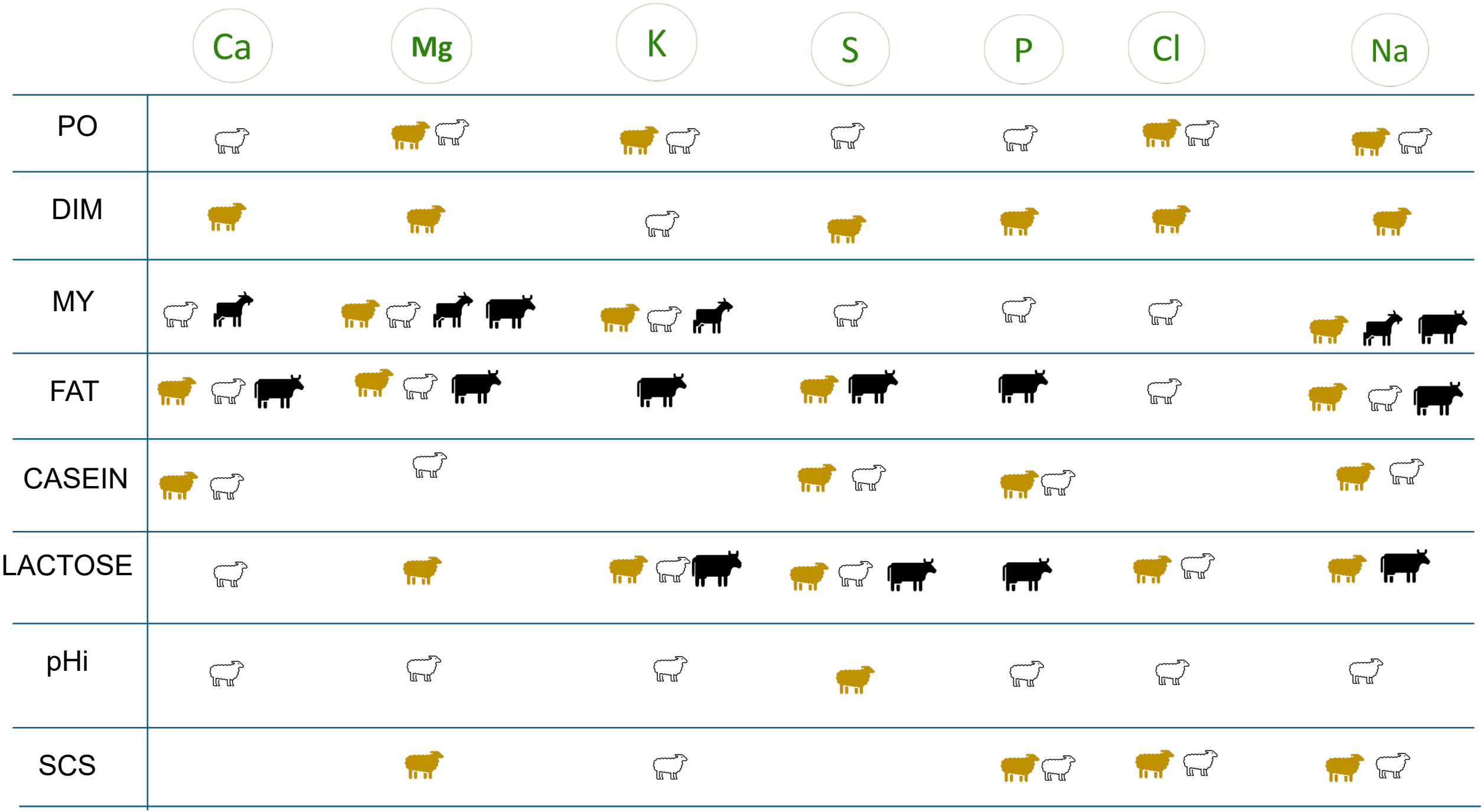
	Comisana		Massese	
	Mean	SD	Mean	SD
Minerals, mg/kg				
Ca	2.154	256	2.198	264
Mg	227	39	222	44
K	1.260	119	1.159	123
S	553	68	565	79
P	1.780	206	1.701	216
Cl	962	108	948	125
Na	721	186	770	221

RESULTS

	Co	Ma	Co	Ma	Co	Ma	Co	Ma	Co	Ma	Co	Ma	Co	Ma
	Ca		**P**		**Mg**		**S**		**Na**		**K**		**Cl**	
Systematic effects														
Parity Order		*		*	*	*		*	*		*	*	*	*
DIM	*		*		*		*		*			*	*	
MY		*	*	*		*		*	*	*	*	*		*
Fat	*	*			*	*	*		*	*				*
Casein	*		*	*		*	*	*	*	*				
Lactose		*			*		*	*	*		*	*	*	*
pH		*		*		*	*	*		*		*		*
SCS[1]			*	*	*				*	*		*	*	*
Random Effects														
Direct additive genetic effects	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Sampling	*	*	*	*	*	*		*	*	*		*	*	*
Residual	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Co: Comisana
Ma: Massese
*p > 0.05

The specific significant effects on individual minerals were not exactly the same!!!


Ca
Mg
K
S
P
Cl
Na
PO
DIM
MY
FAT
CASEIN
LACTOSE
pHi
SCS

CONCLUSIONS

- The differences across breeds highlight the need for breed-specific investigations to characterize the complex relationships between milk composition and mineral content. The synthesis of minerals in milk depends on several factors, including diet and nutrition, stress and illness, hormonal levels, as well as genetic factors that can determine the absorption, transport, and metabolism of these minerals.

- In addition to the "typical" effects, evaluating the percentages of protein, casein, fat, pH, and SCS could provide a more comprehensive understanding of the factors influencing the mineral composition of sheep's milk.

CONCLUSIONS

This study provides new insights on the milk composition of the Comissana and Massese sheep breeds but is necessary to increase the number of records to characterize the variability of the mineral content indifferent sheep breeds and environments.

Thank you for your attention