Bulk milk and farms characterization in the Parmigiano Reggiano Consortium area: the INTAQT project

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Introduction

Parmigiano Reggiano

- One of the main dairy chains in Italy
- Under the PDO regulation of a specific Consortium
- Strong relationship between animals, forages from local territory and cheese-making operations

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→ Increasing efforts to support product quality, its traceability and global sustainability

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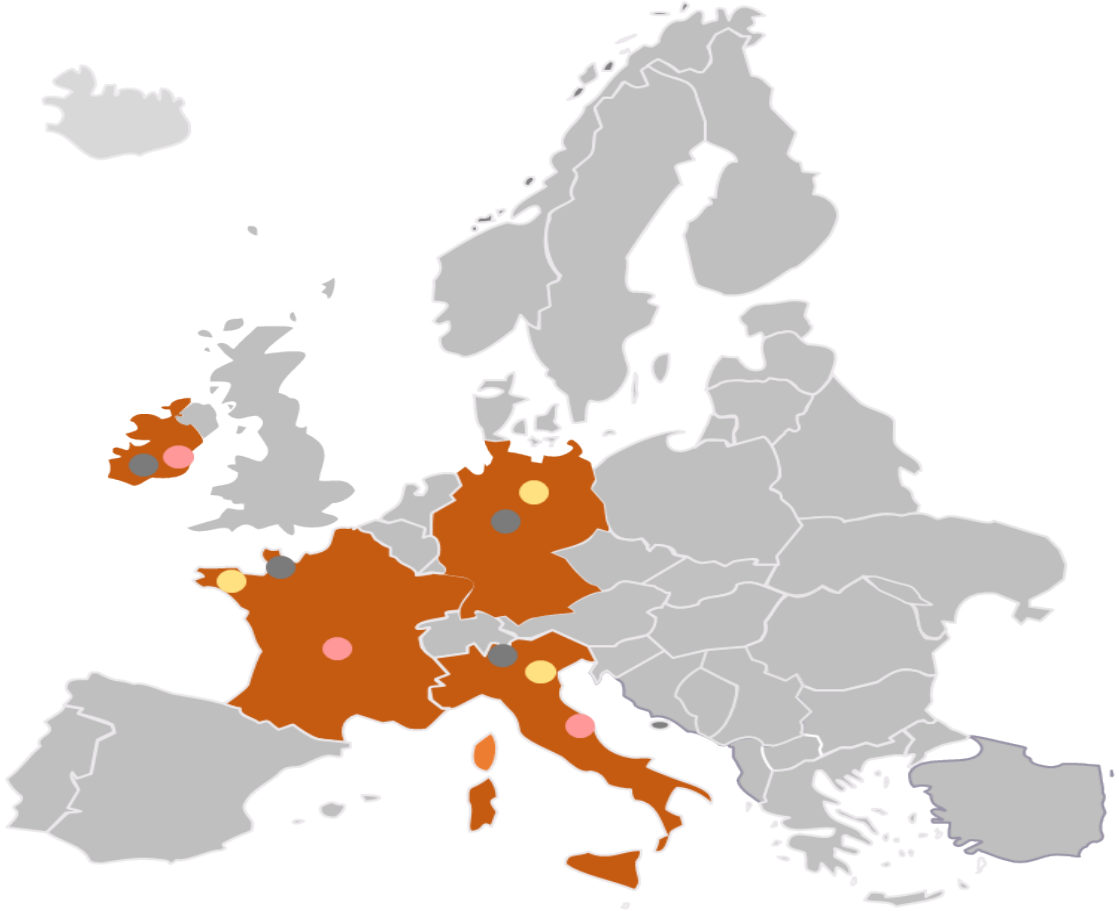
Introduction

INTAQT PROJECT (INnovative Tools for Assessment and Authentication of chicken meat, beef and dairy products' QualiTies)



to perform an in-depth multi-criteria assessment of the relationships between livestock husbandry systems and intrinsic quality traits of animal-sourced products.

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Aim

to assess the effects of farms characteristics and animal welfare scores on milk traits (i.e., milk yield, protein and fat contents) of the Parmigiano Reggiano-producing farms enrolled in the INTAQT project

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This characterization is preparatory for the subsequent study on the use of milk infrared spectra for the discrimination of farms characteristics, with traceability and quality reporting aims

"Potential of milk infrared spectroscopy to discriminate farm characteristics: the INTAQT project", scheduled at 17:00 in this section

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Data collection

Farm dataset (936 farms)

- Altitude
- Herd size
- Housing system (tie vs free stall)
- Feeding programs (TMR vs traditional)
- Genetic group (Holstein, Brown Swiss, local breeds – Reggiana, Modenese, ….)
- Concentrate inclusion level in diet fed to lactating cows
- Animal welfare scores (Italian CREnBA system); range: 0 (worst) – 100 (best)
  - A: management
  - B: structure and equipment
  - C: animal-based measures

Test-day dataset

- 4631 test-day records (bulk milk, from January to October 2022)
- Bulk milk yield (kg / cow / day)
- Bulk milk protein content (%)
- Bulk milk fat content (%)

Merge

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Statistical analysis

Milk yield, milk protein and fat contents → response variables

Analysis: one-way ANOVA $y = \mu + \text{fixed effect} + 1|\text{farm(fixed effect)} + \varepsilon$

- Season: 3 classes (Winter: January-February-March; Spring: April-May-June; Summer: July-August)
- Altitude: 3 classes (Plain, Hill, Mountain)
- Housing system: 2 classes (tie vs free stall)
- Feeding system: 2 classes (TMR vs traditional)
- Genetic group: 2 classes (Specialized: Holstein, Brown Swiss; not specialized: Reggiana, Modenese)
- Concentrate inclusion level: 2 classes, low (<40%) vs high (>40%)
- Animal welfare scores A, B and C: 3 classes, lower <70, intermediate 71-80, higher >80%

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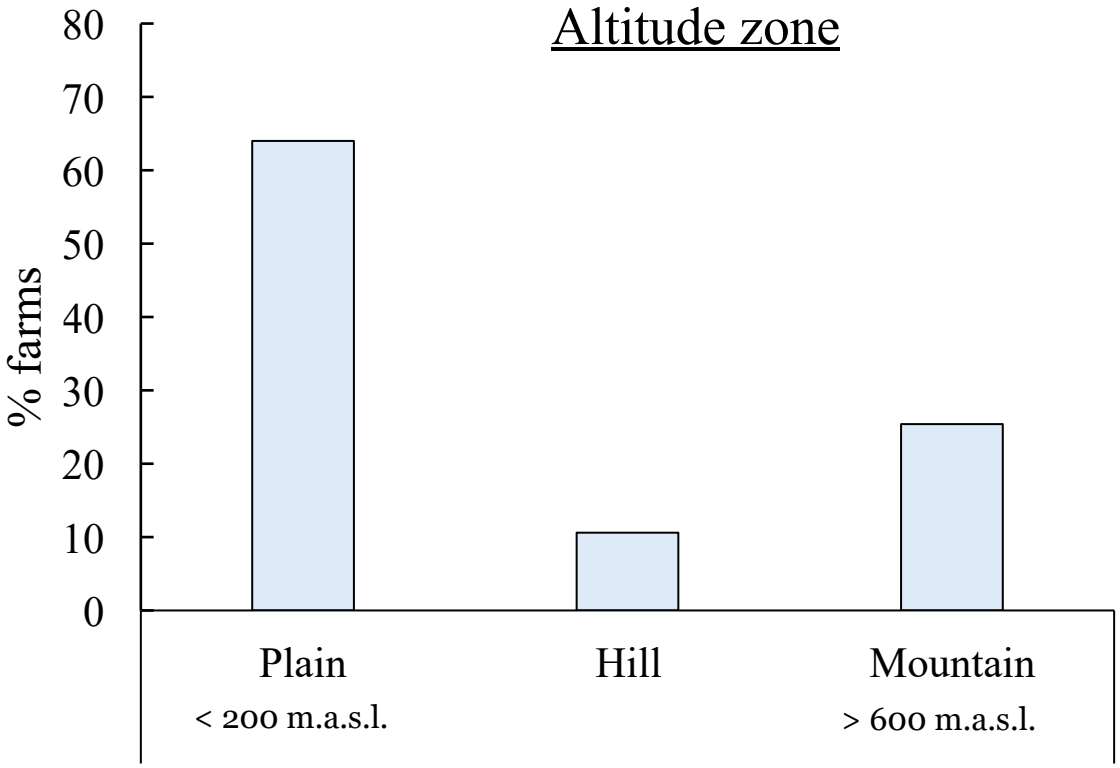
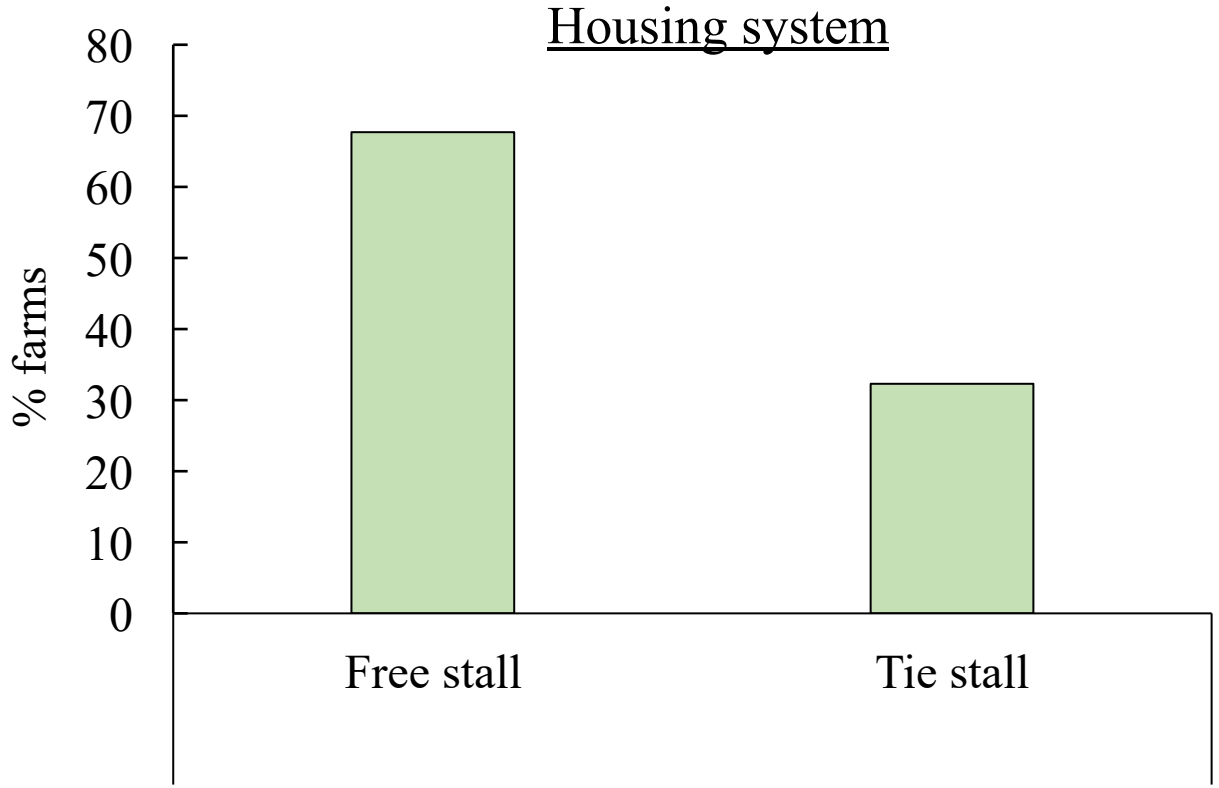
Results: frequency

936 farms





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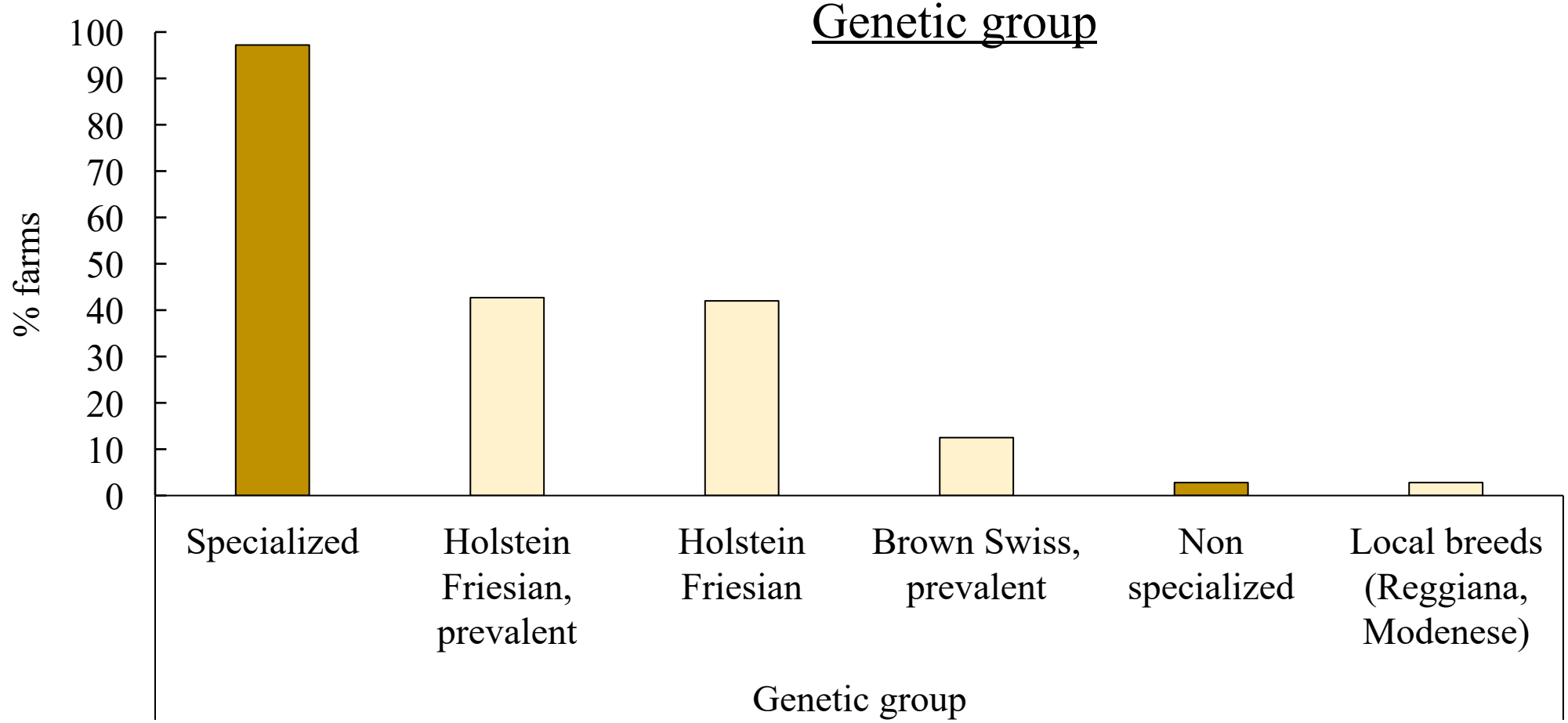

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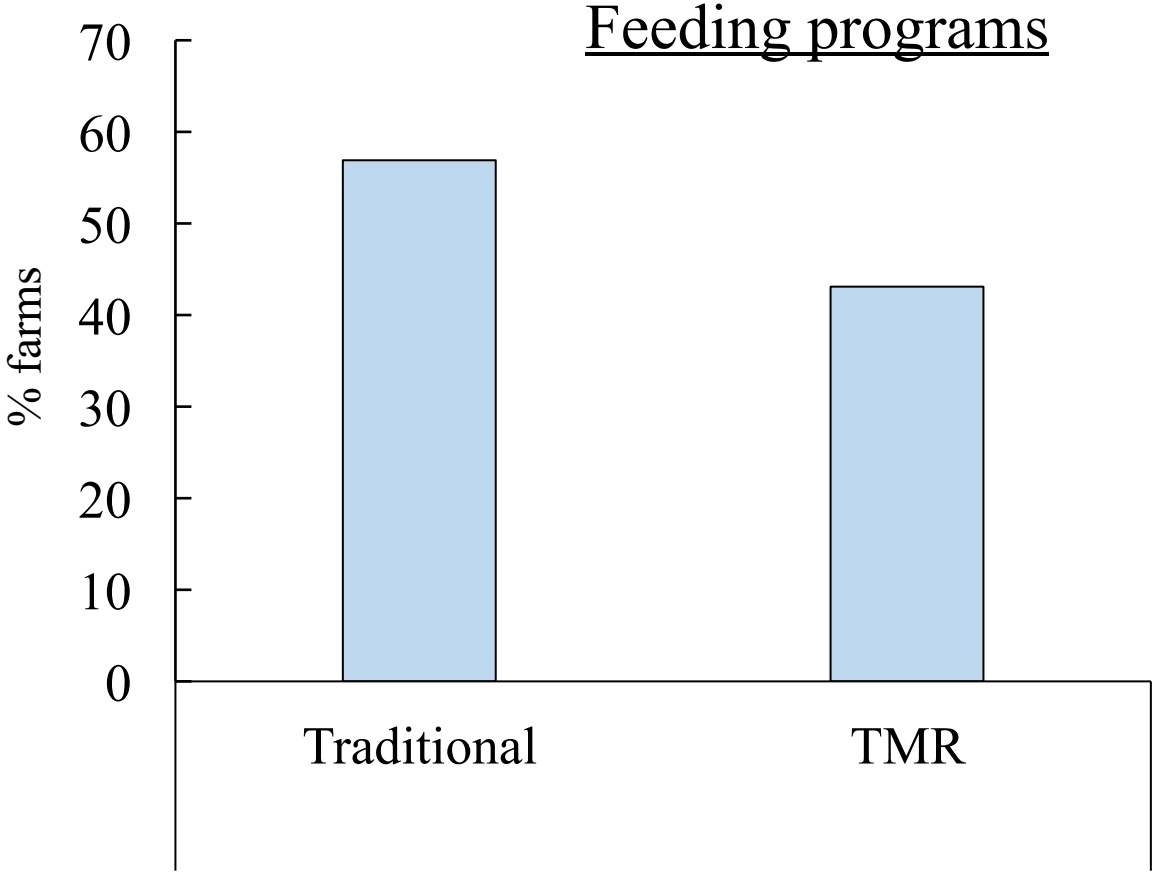
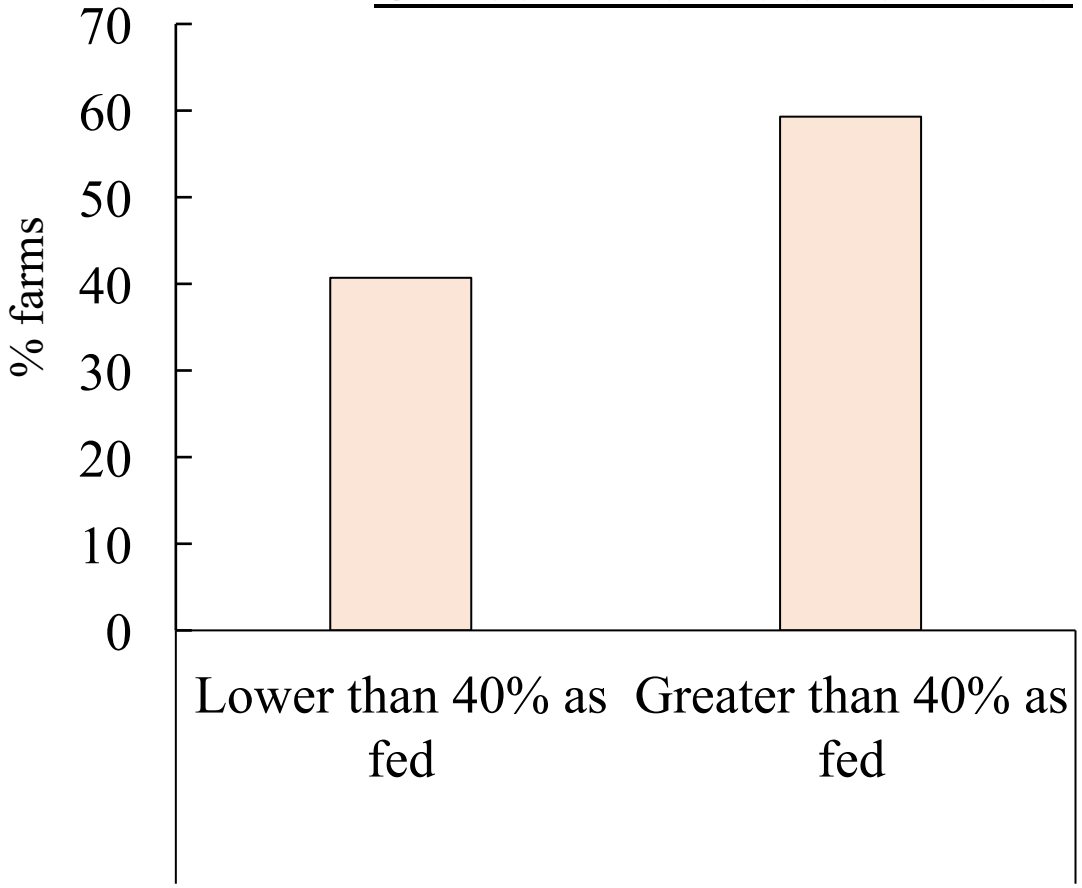
Results: frequency

936 farms

Feeding programs



Concentrate inclusion level



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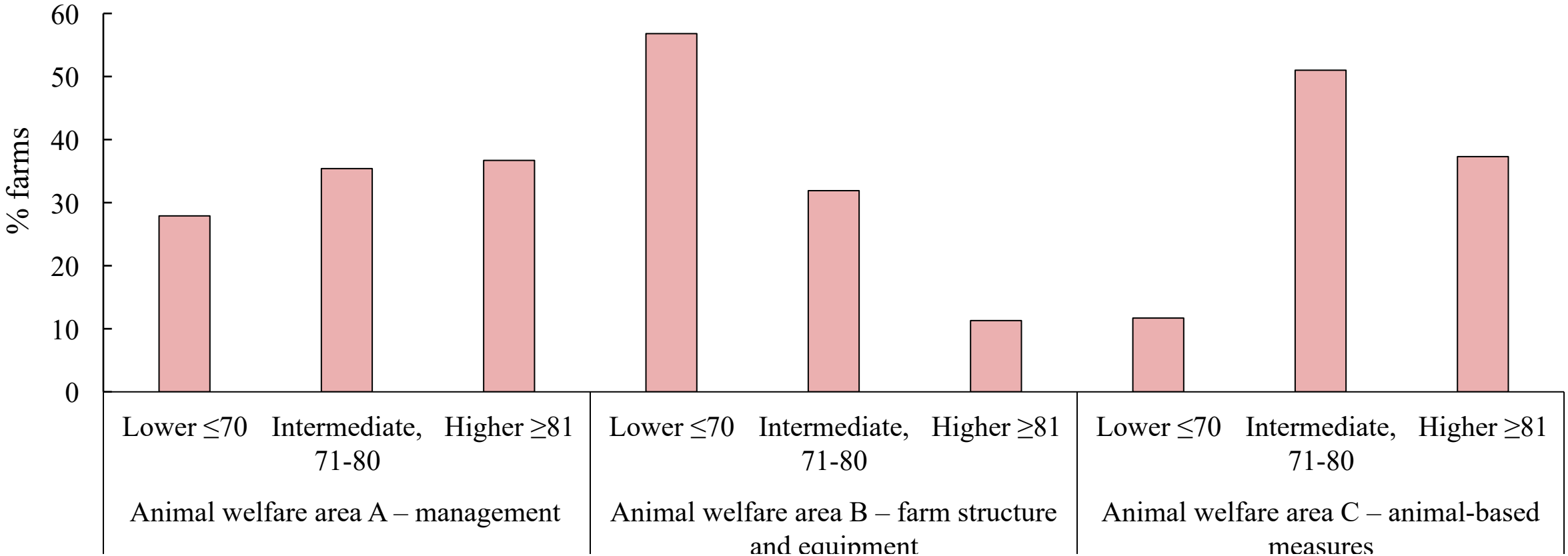
Results: frequency

936 farms
Range: 0-100



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Results: ANOVA

Item	Milk yield (kg/cow/y)		Milk protein content (%)		Milk fat content (%)	
	F	P	F	P	F	P
Season	204.0	<0.001	106.4	<0.001	226.5	<0.001
Altitude, m.a.s.l.	33.7	< 0.001	0.9	0.43	7.9	< 0.001
Structure						
Housing system	250.1	<0.001	11.4	<0.001	38.0	<0.001
Genetic group	108.4	<0.001	0.1	0.75	0.02	0.9
Feeding practices						
Feeding programs	169.3	<0.001	50.3	<0.001	0.3	0.59
Concentrates, % as fed	219.0	<0.001	1.8	0.19	12.6	<0.001
Animal welfare scores[4]						
Area_A	84.2	<0.001	1.98	0.14	2.1	0.12
Area_B	36.6	<0.001	0.52	0.59	1.0	0.36
Area_C	16.5	<0.001	5.0	0.007	4.9	0.008

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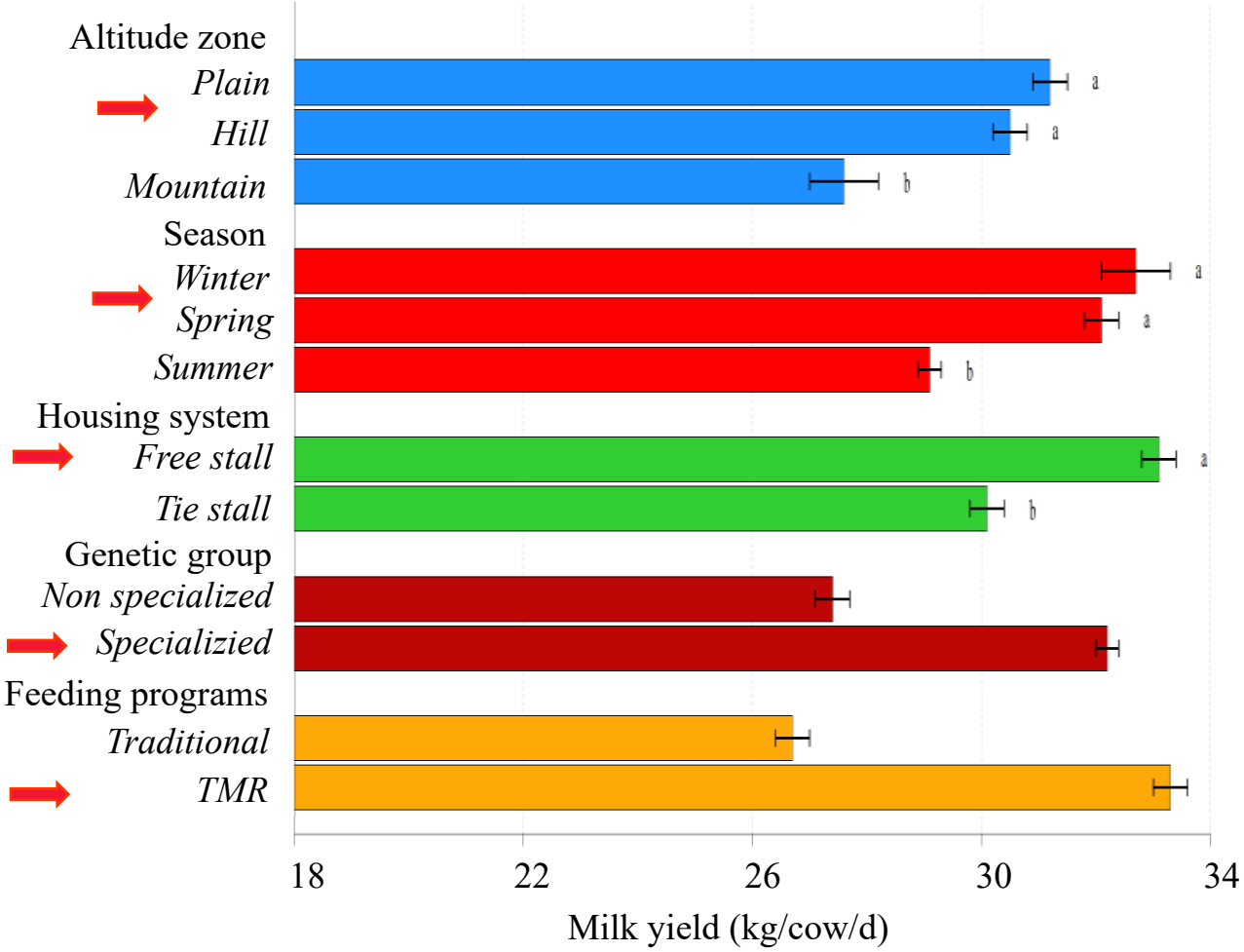
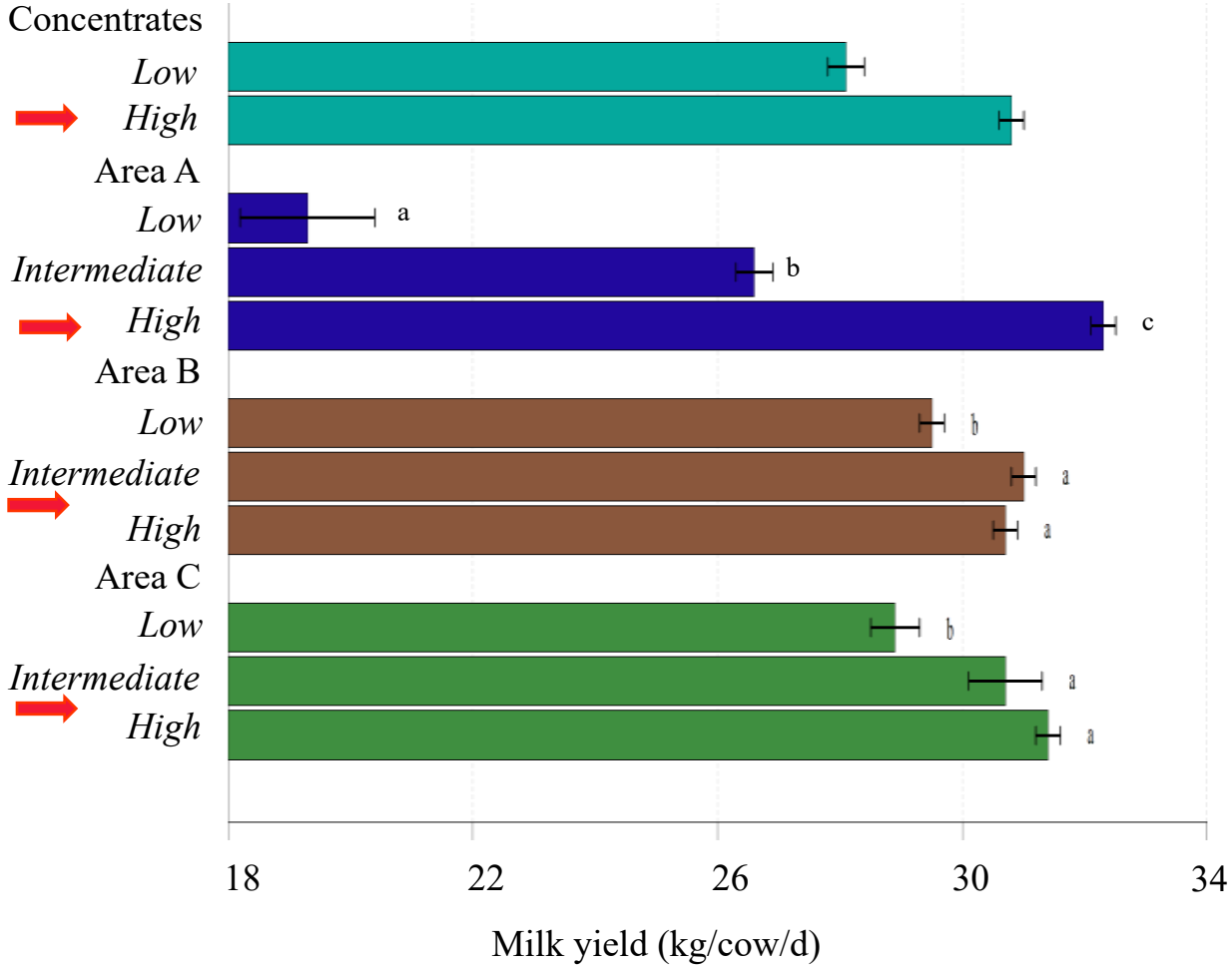
Results: Milk yield





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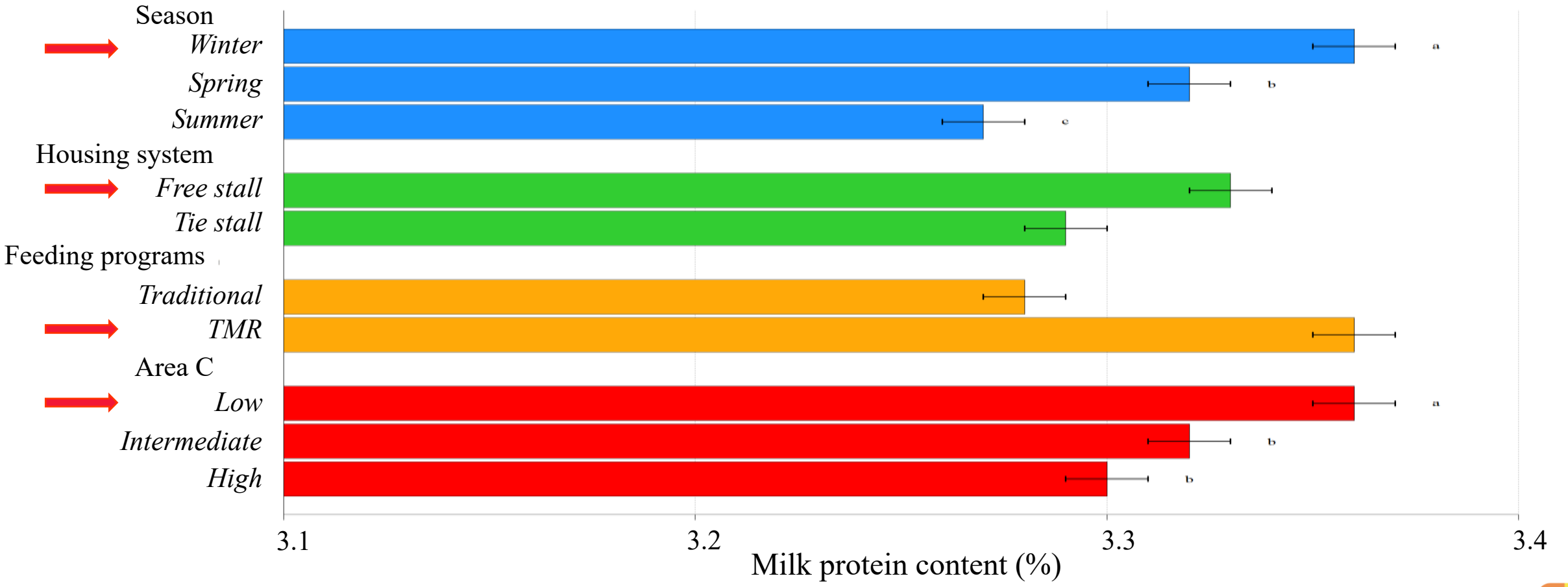
Results: protein content



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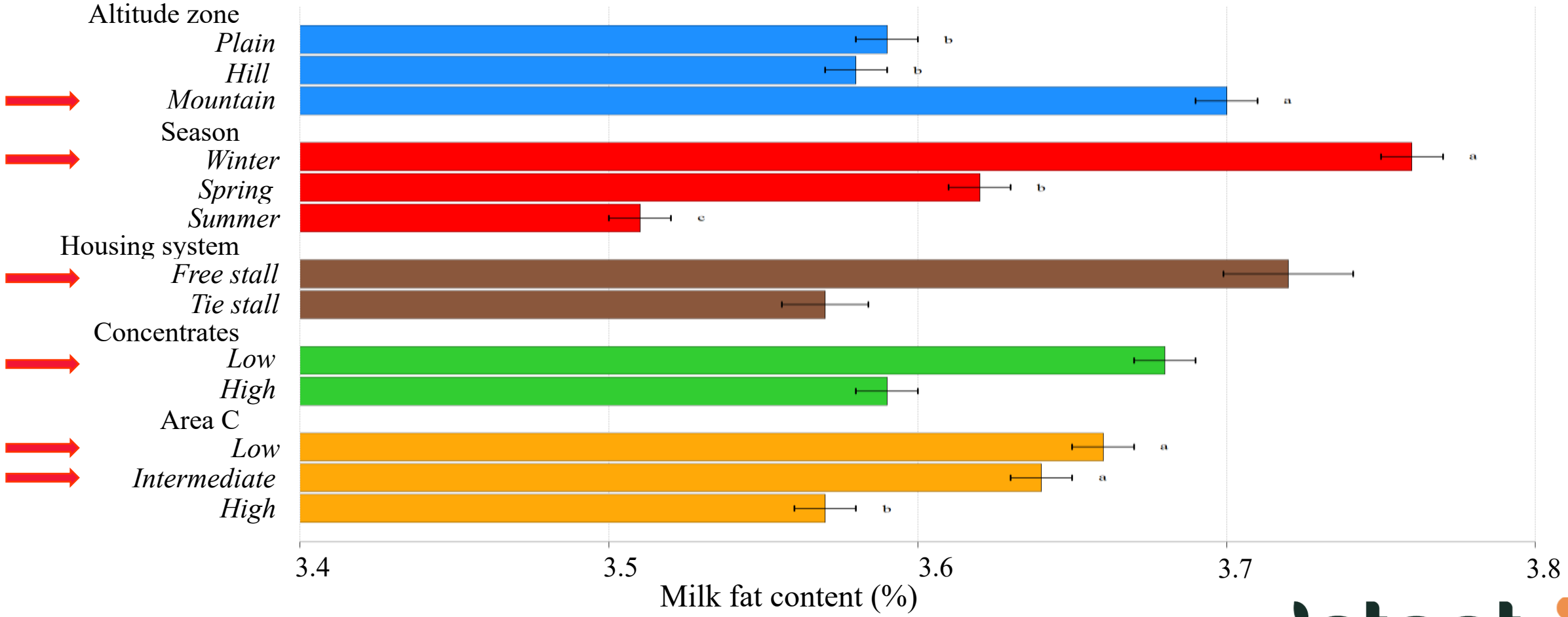
Results: fat content



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Conclusions

- This contribution is a first step in the characterization of Parmigiano Reggiano farms aiming at supporting product quality, traceability and global sustainability.
- Bulk milk yield was affected by
  - Season
  - Farm structure and diet management
  - Animal welfare management → in a positive way
- Bulk milk quality traits (protein, fat) effectively reflects variation associated with the farm traits → usable with discriminant purpose through infrared spectra analysis.
- These results could contribute to drawing interventions aiming at improving both intrinsic quality of milk destined for cheese production and farm global sustainability.

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Thank you for your attention

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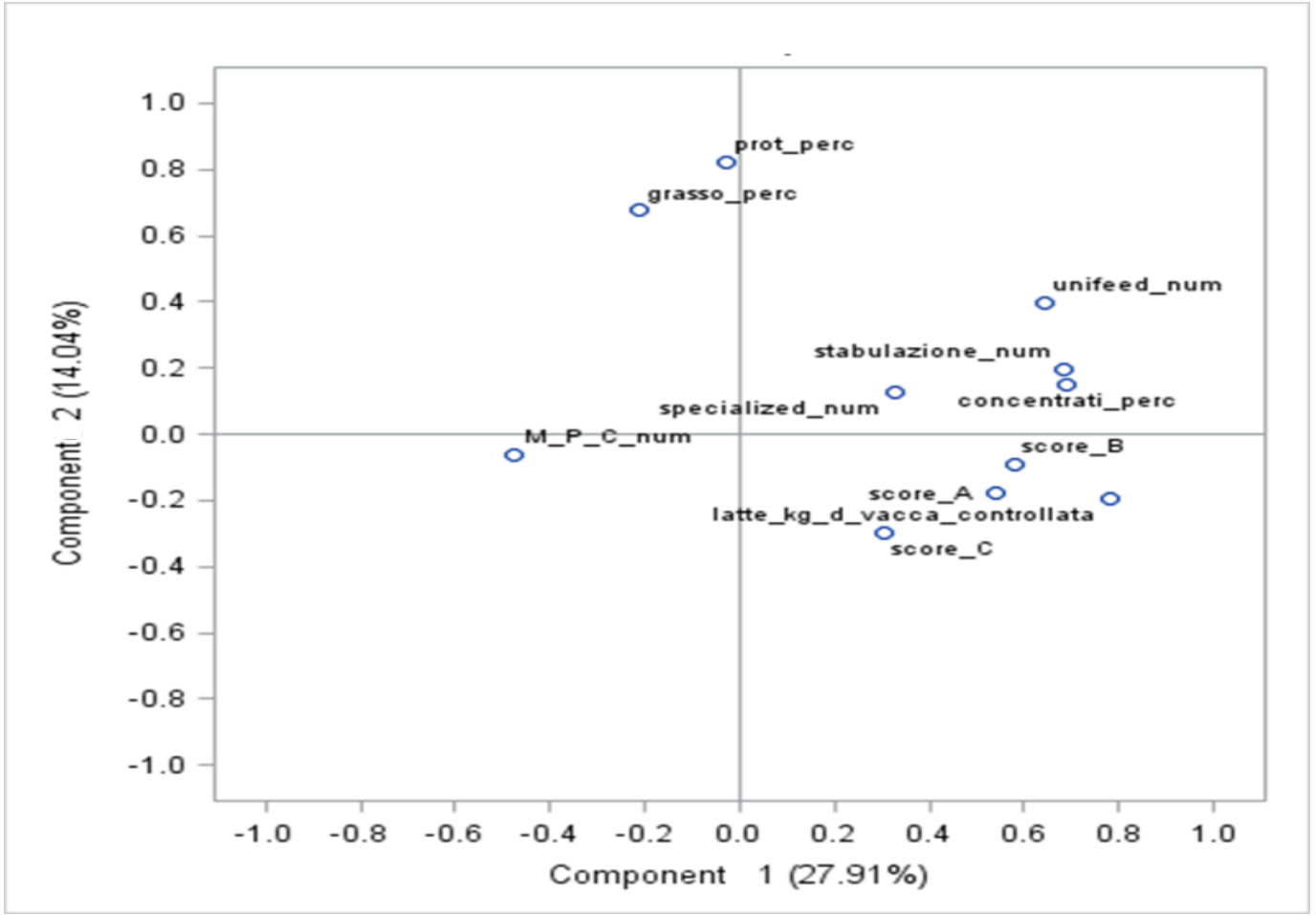
Variable relationship

Variance Inflation Ratio → <2
for all the analysed variables

Principal components analysis



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