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Factors affecting the serum protein pattern in multi-breed dairy herds

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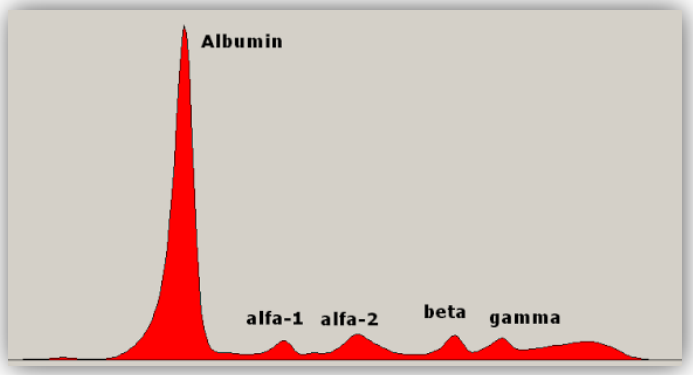
DEPARTMENT OF AGRONOMY FOOD NATURAL RESOURCES ANIMALS ENVIRONMENT

MAPS DIPARTIMENTO DI MEDICINA ANIMALE PRODUZIONI E SALUTE

Introduction

➢ **SERUM PROTEIN PATTERN** as indicator of animal welfare:

- **TOTAL PROTEIN,** given by the sum of
- **ALBUMIN** - indicator of liver function (Burke et al., 2010), and
- **GLOBULIN** - indicator of immune response (Chorfi et al., 2004);
- **ALBUMIN:GLOBULIN RATIO (A:G)** - as indicator of dysproteinaemia (Kaneko, 1997).



➢ Specie-specific reference values (Irfan, 1967)

Motivation

- **Few studies** in literature on the serum protein pattern in **cattle** (Doornenbal et al., 1988; Chorfi et al., 2004; Alberghina et al., 2011; Cozzi et al. 2011; Piccione et al., 2011)

- Most of the reference intervals are reported **for specific ages or physiological stages**, e.g. transition period (Quiroz-Rocha et al., 2009; Ospina et al., 2010)

- Reference values are mainly referred to **Holstein Friesian** cows (Chorfi et al., 2004; Cozzi et al. 2011; Piccione et al., 2011)

- Analysis of a **reduced number of samples** (Piccione et al., 2011)

Aim of the study

Evaluate the effect of different sources of variation

- **herd's production level**
- **herd within production level**
- **breed**
- **stage of lactation (DIM)**
- **parity**
- **somatic cell count (SCC)**

on the **serum protein pattern** of a **large number of samples** collected from **multi-breed dairy herds**




Data collection

- ✓ From March 2013 to December 2013
- ✓ **41** multi-breed herds located in Trentino region (North-East Italy)
- ✓ **1,508** individual milk and blood samples

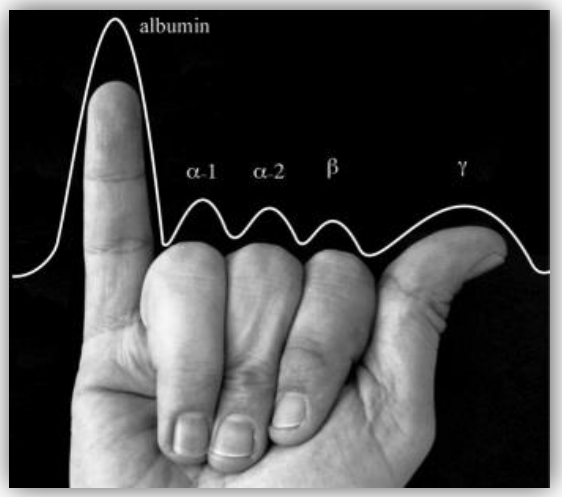
- ✓ **6** breeds: Holstein Friesian (HF, n = 471)
  Brown Swiss (BS, n = 663)
  Jersey (Jer, n = 40)

  Simmental (Si, n = 158)
  Rendena (Ren, n = 103)
  Grey Alpine (GA, n = 73)

- ✓ **2** herd's production levels: High (n = 20) *vs* Low (n = 21) defined according to the average daily milk energy yield of the cows corrected for breed, DIM and parity

Phenotyping – traits analysis

Serum protein pattern:



- **Total protein** and **albumin** by means of a BT1500 automated photometer analyzer (Biotecnica Instruments S.p.A., Roma, Italy)
- **Globulin** = total protein – albumin
- **A:G** = albumin / globulin

Milk traits:

- **SCC** (10^3/mL) from a Fossomatic Minor (Foss, Hillerød, Denmark) and log-transformed to somatic cell score **(SCS)**
- Protein, casein, fat, lactose (%) and urea (MUN, mg/100g) using a Milkoscan FT6000 (Foss, Hillerød, Denmark)
- Milk pH using a Crison Basic 25 electrode (Crison Instruments SA, Barcelona, Spain)

Statistical analysis

$$y_{ijklmno} = \mu + PL_i + Breed_j + DIM_k + Parity_l + SCS_m + Herd_n(PL)_i + e_{ijklmno}$$

$y_{ijklmno}$ = phenotypic measure (serum protein pattern)
μ = overall mean
PL_i = 2 levels (high or low production level)
$Breed_j$ = 6 levels (HF, BS, Jer, Si, Ren and GA)
DIM_k = 6 classes of 60-d intervals, from 5 to >305 d
$Parity_l$ = 4 classes, from 1 to ≥ 4
SCS_m = 7 classes, calculated on the basis of the SD
$Herd_n (PL)_i$ = random effect of the herd (41 levels) within the herd's production level
$e_{ijklmno}$ = residual error

Orthogonal contrasts ($P < 0.05$) were estimated between least-squares means (LSMs) of traits for all the effects included in the model

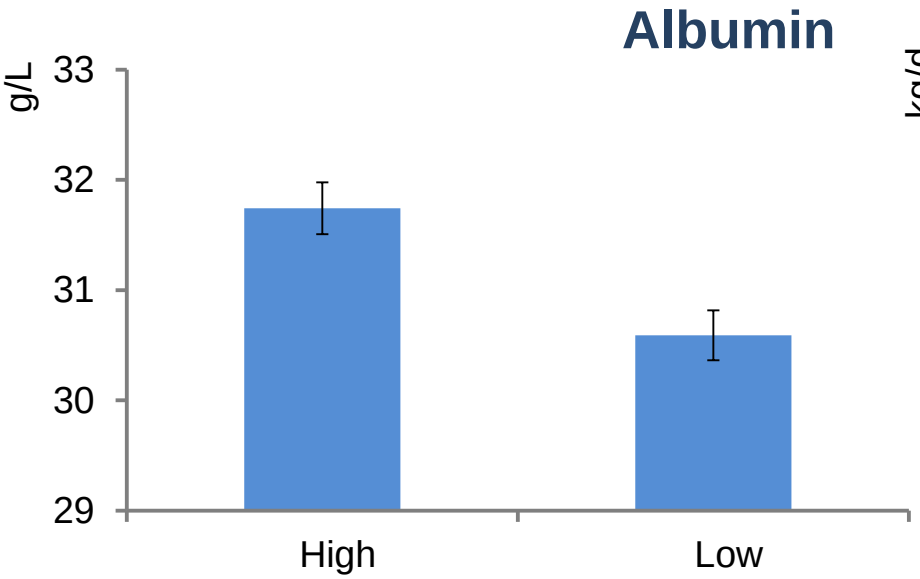

Results

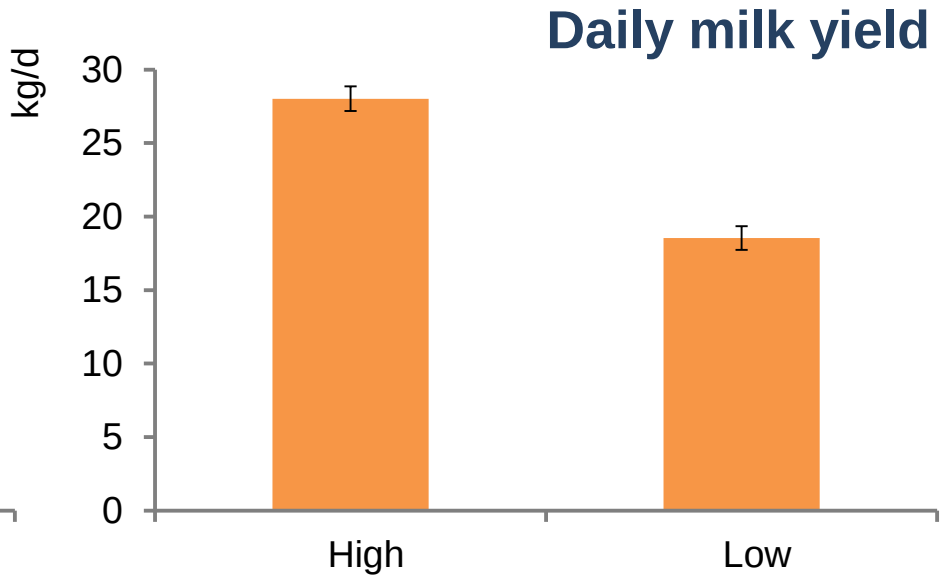
Descriptive statistics

Trait	Mean	SD	Min	Max
Total protein, g/L	74.1	5.3	57.8	89.8
Albumin, g/L	30.8	2.0	24.6	36.6
Globulin, g/L	43.2	5.4	28.3	60.9
Albumin:Globulin	0.72	0.11	0.39	1.03
SCS[1]	2.9	1.9	-2.1	8.2

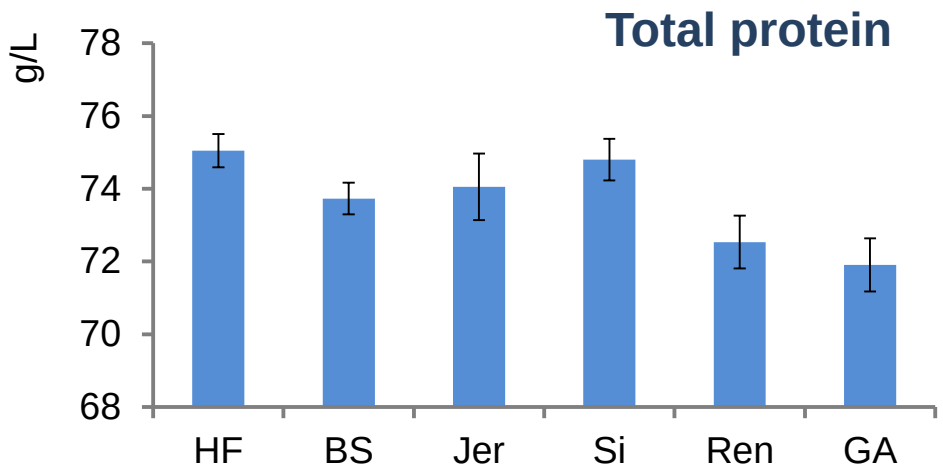
[1] SCS = $\log_2$ (SCC/100,000) + 3

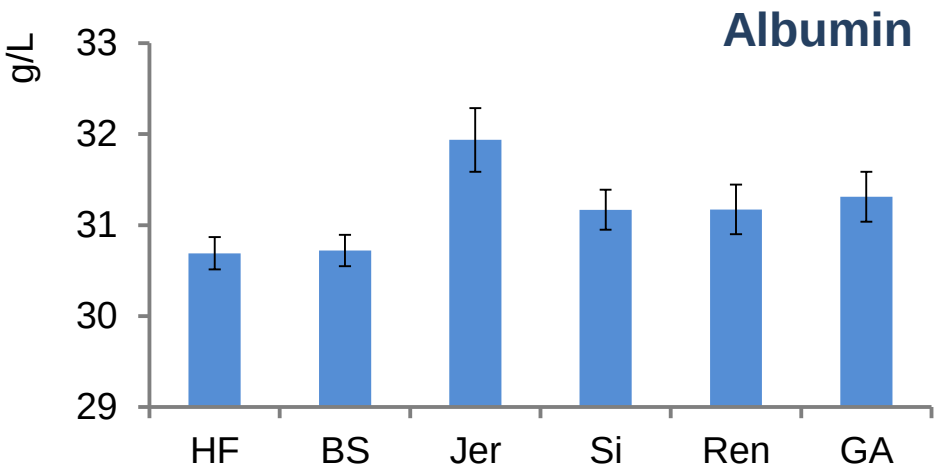
Effect of herd's Production Level ($P < 0.001$)

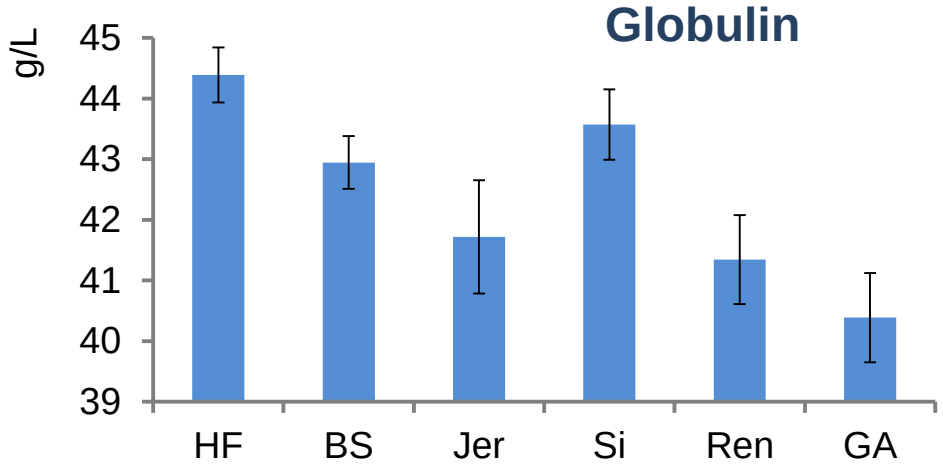


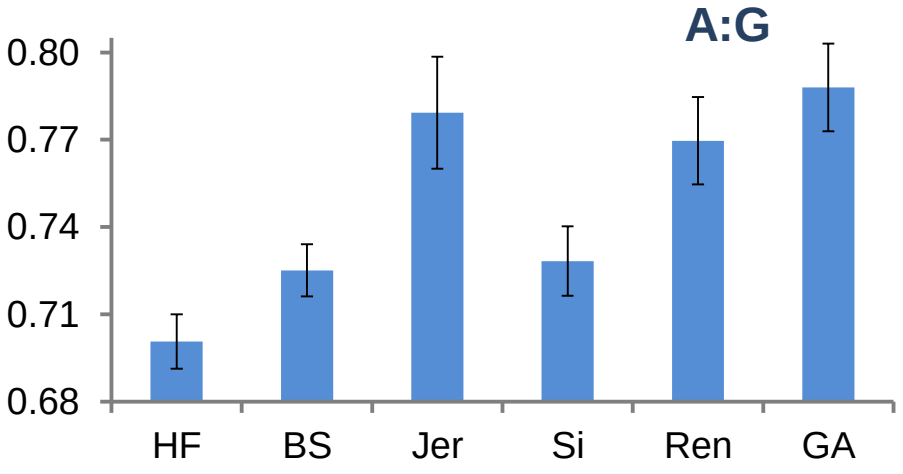


Effect of Breed ($P < 0.001$)



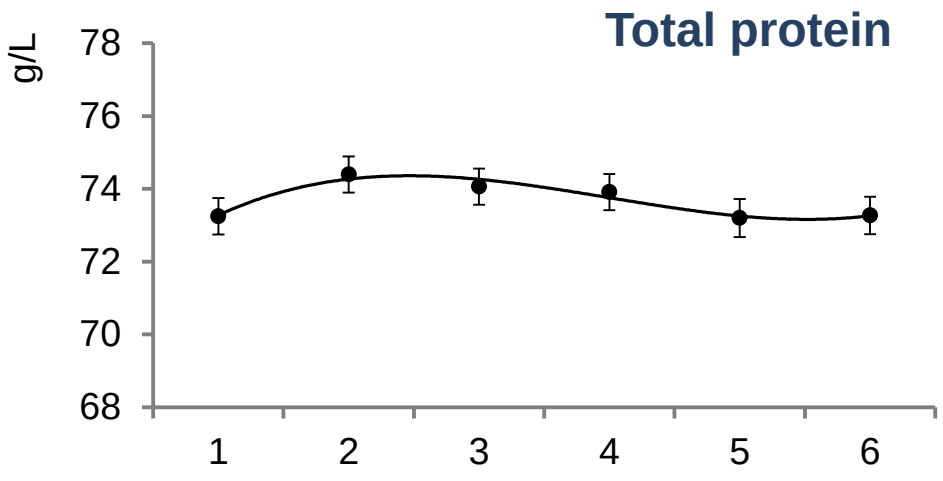


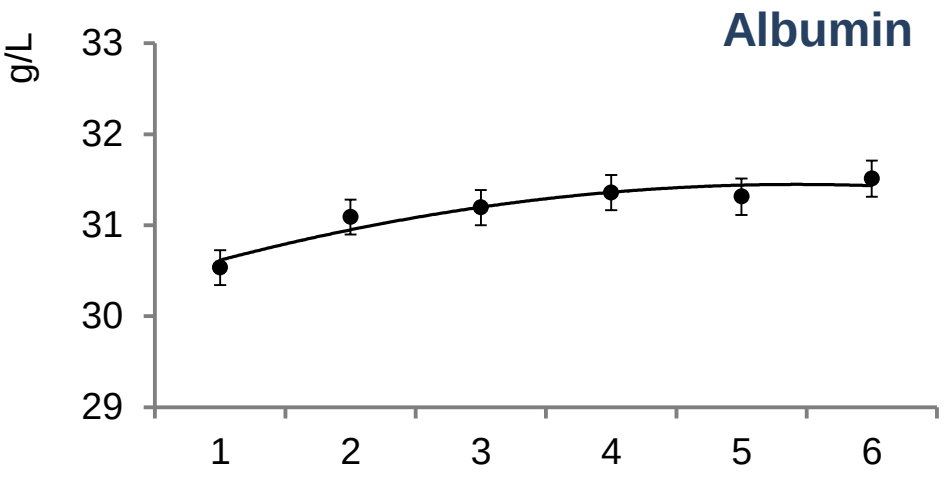


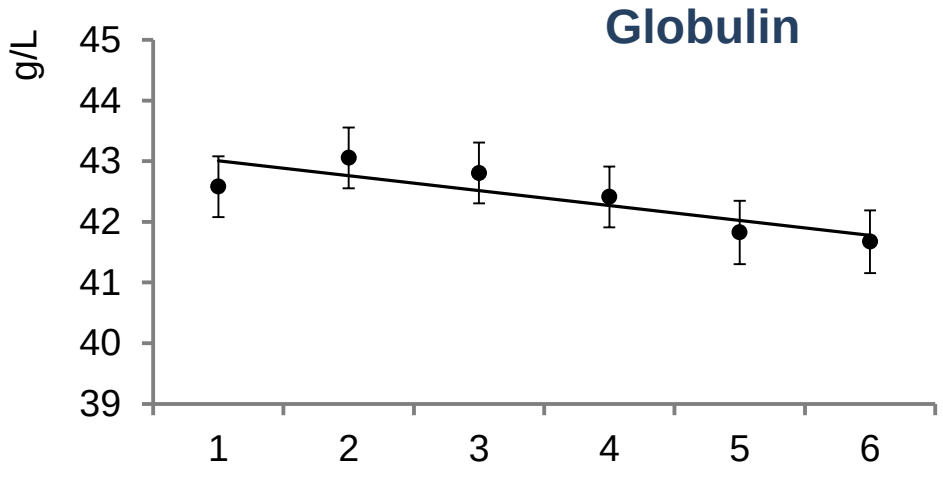


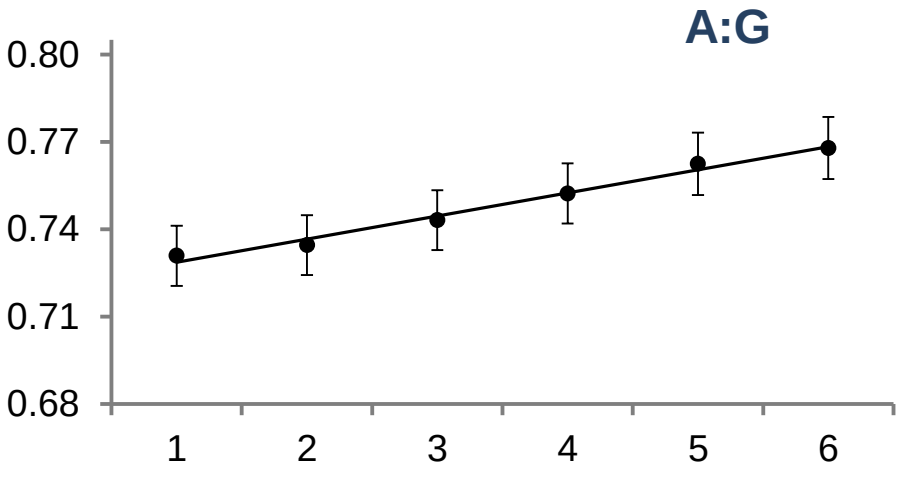
Holstein Friesian (HF), Brown Swiss (BS), Jersey (Jer), Simmental (Si), Rendena (Ren) and Grey Alpine (GA)

Effect of DIM ($P < 0.05$)



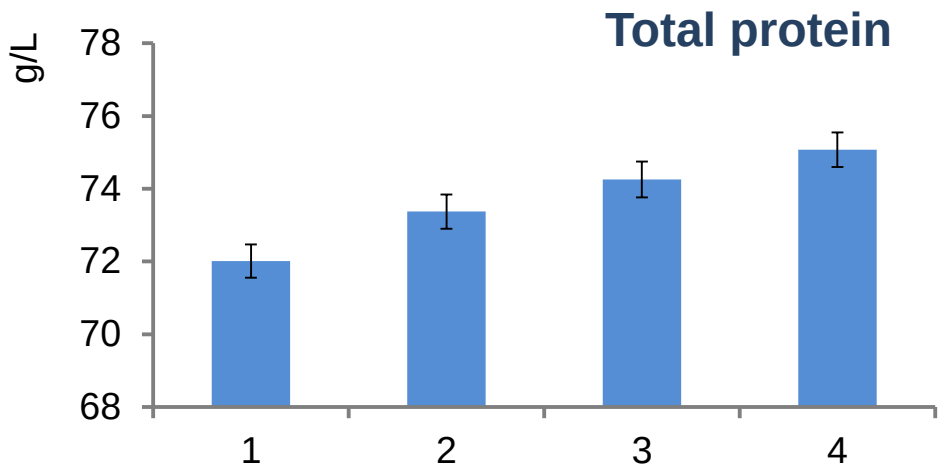


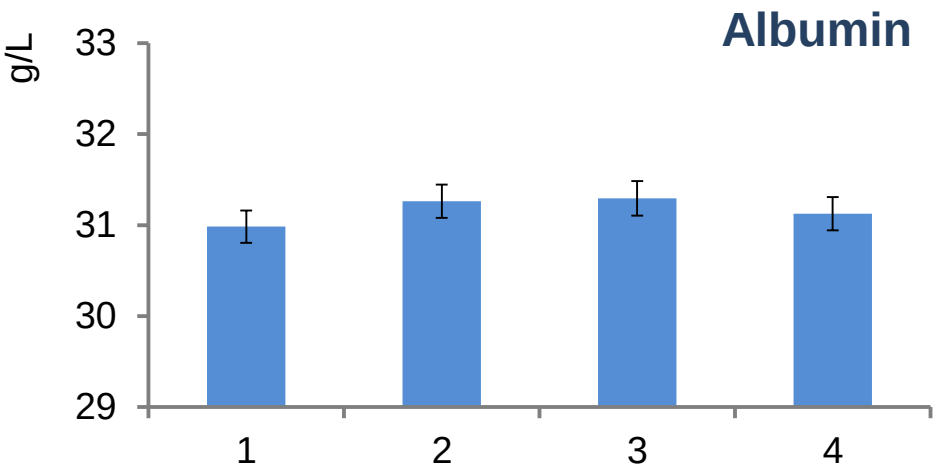


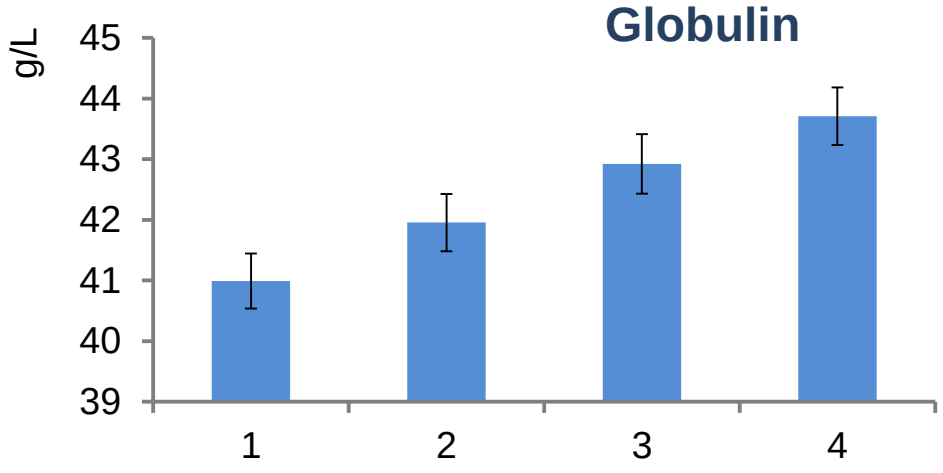


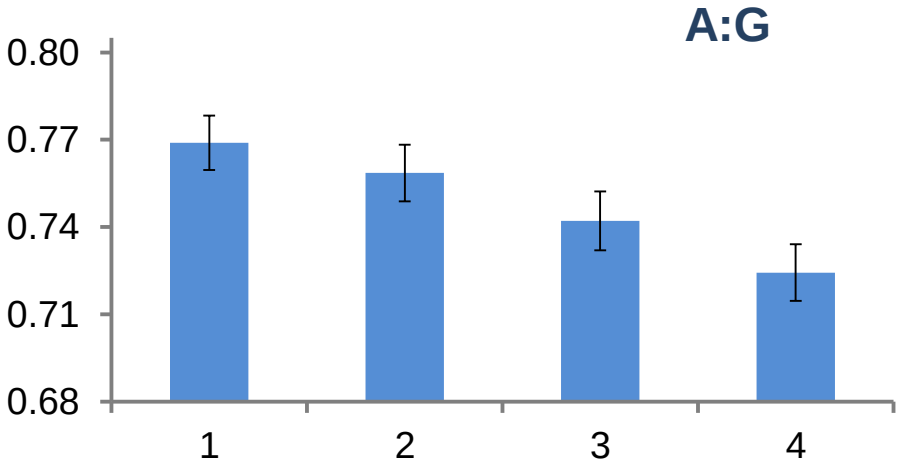
Days in milk, classes of 60-d intervals

Effect of Parity ($P < 0.05$)



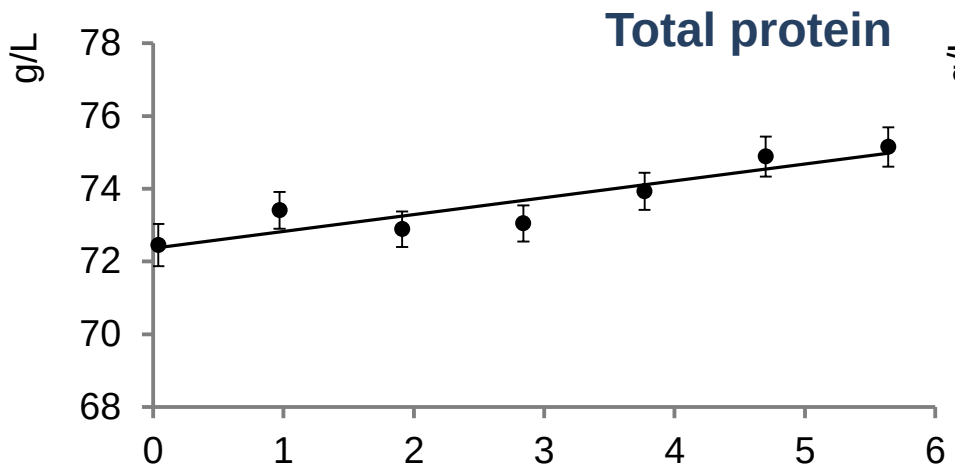


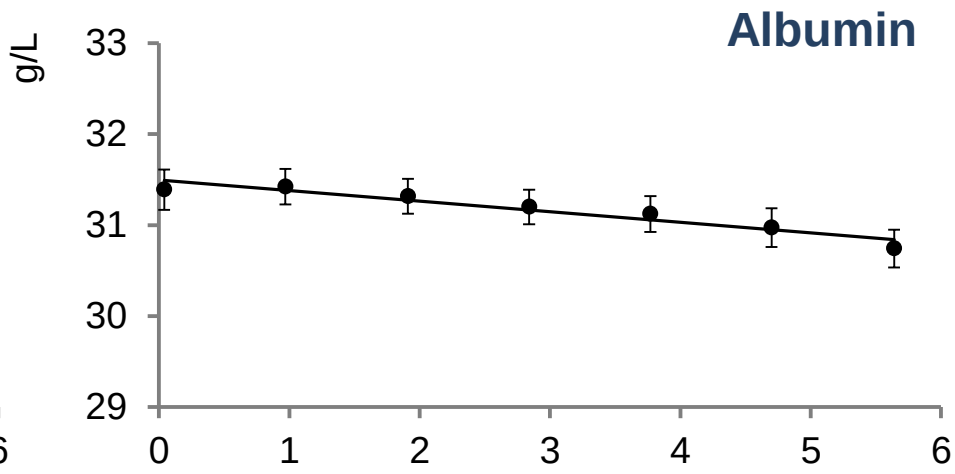


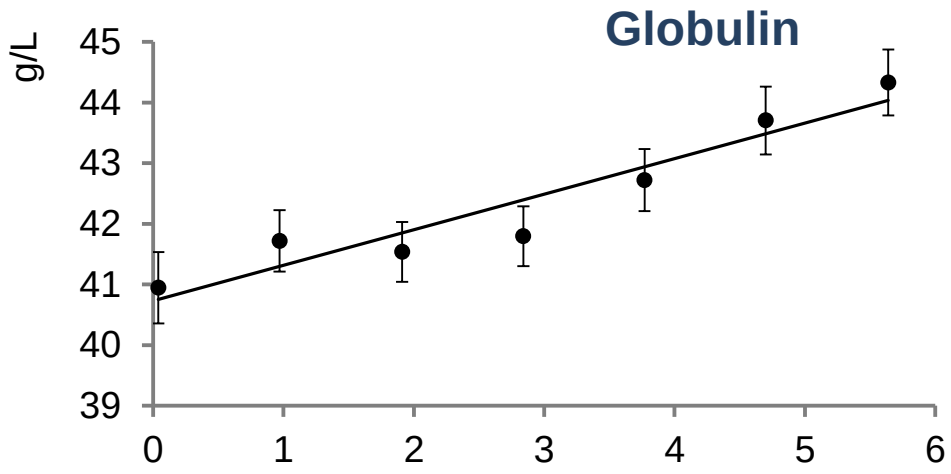


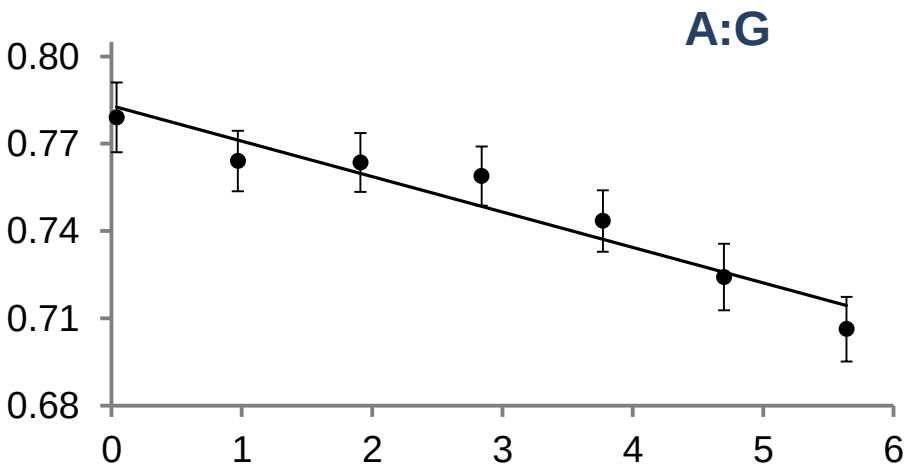
Parity, classes from 1 to ≥ 4

Effect of SCS ($P < 0.01$)









Somatic cell score

Conclusions

- All the effects included in the model were **important sources of variation of the serum protein pattern**

- **Breed differences <u>within herds</u>** in the serum protein content

Jersey

Rendena

Grey Alpine

Holstein Friesian

- **Linear relationship between SCC and serum protein pattern**

SCC

Albumin:Globulin

Perspectives

- Analysis of the **phenotypic relationships** between serum protein pattern and milk composition, detailed protein profile, coagulation properties and cheese yield (with possible inclusion of fertility traits)

- Future perspectives: to estimate the **genetic parameters** of serum proteins and to assess the additive genetic correlations with composition and technological properties of milk




Thanks for your attention

Authors wish to thank Trento Province