Profile of *PRNP* gene in three dairy goat breeds and association with milk production and udder health

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Background

Scrapie

Infectious, neurodegenerative and fatal disease with production and financial losses

Sheep

Selective breeding programs for increased frequency of ARR haplotype in the *PRNP* gene

Goats

Alleles 222K, 146S/D and 211Q: Strong degree of resistance – most suitable candidates for breeding programs

Conditions for selective breeding programmes in **goats**

- ✓ Frequency of resistance-associated alleles in the population
- ✓ Assessment of potentially adverse effects of selection for scrapie resistance on other important traits

Objectives

- Determine the genetic profile of scrapie codons 146, 211 and 222 in three dairy goat breeds in Greece

- Assess the impact on milk production and udder health

Materials and Methods

- 766 dairy goats
- 7 farms
- 3 breeds (2 indigenous, 1 foreign)

Eghoria (264)

Skopelos (287)

Damascus (215)

Materials and Methods

Genotyping

- DNA extraction
  - Blood samples from individual goats
  - GeneJET Whole Blood Genomic DNA Purification Mini Kit (Thermo Scientific)

- Real-Time PCR
  - 4 Custom TaqMan SNP Genotyping Assays
  - Polymorphisms at codons:

- $146_{N \rightarrow S/D}$
- $211_{R \rightarrow Q}$
- $222_{Q \rightarrow K}$

3,064 analyses

Materials and Methods

Phenotypic measurements

- Monthly test-day measurements for 2 milking periods
- 5 measurements/milking period
- Traits

Milk production (Daily – Total)

- *Milk yield*
- *Fat*
- *Protein*
- *Lactose*
- *SNF*

} Content Yield

Udder health

- *SCC*
- *CFU*

Materials and Methods

Genetic analyses

- Genotypic, allelic and haplotypic frequencies calculation
- Genetic distances among the three studied breeds
  - *Fixation index F_{ST}*
  - *Arlequin v3.1 software*
- Genetic comparisons between the three studied breeds and 30 other goat breeds from different countries
  - *Neighbour-Joining tree*
  - *PHYLIP package v3.695*

In all cases
P=0.01

Materials and Methods

Statistical analyses

- R package «lme4»
- Mixed linear models

Fixed effects

- *PRNP*
- *Farm*
- *Period of kidding*
- *Age at kidding*
- *Days from kidding*
- *Milking period length*

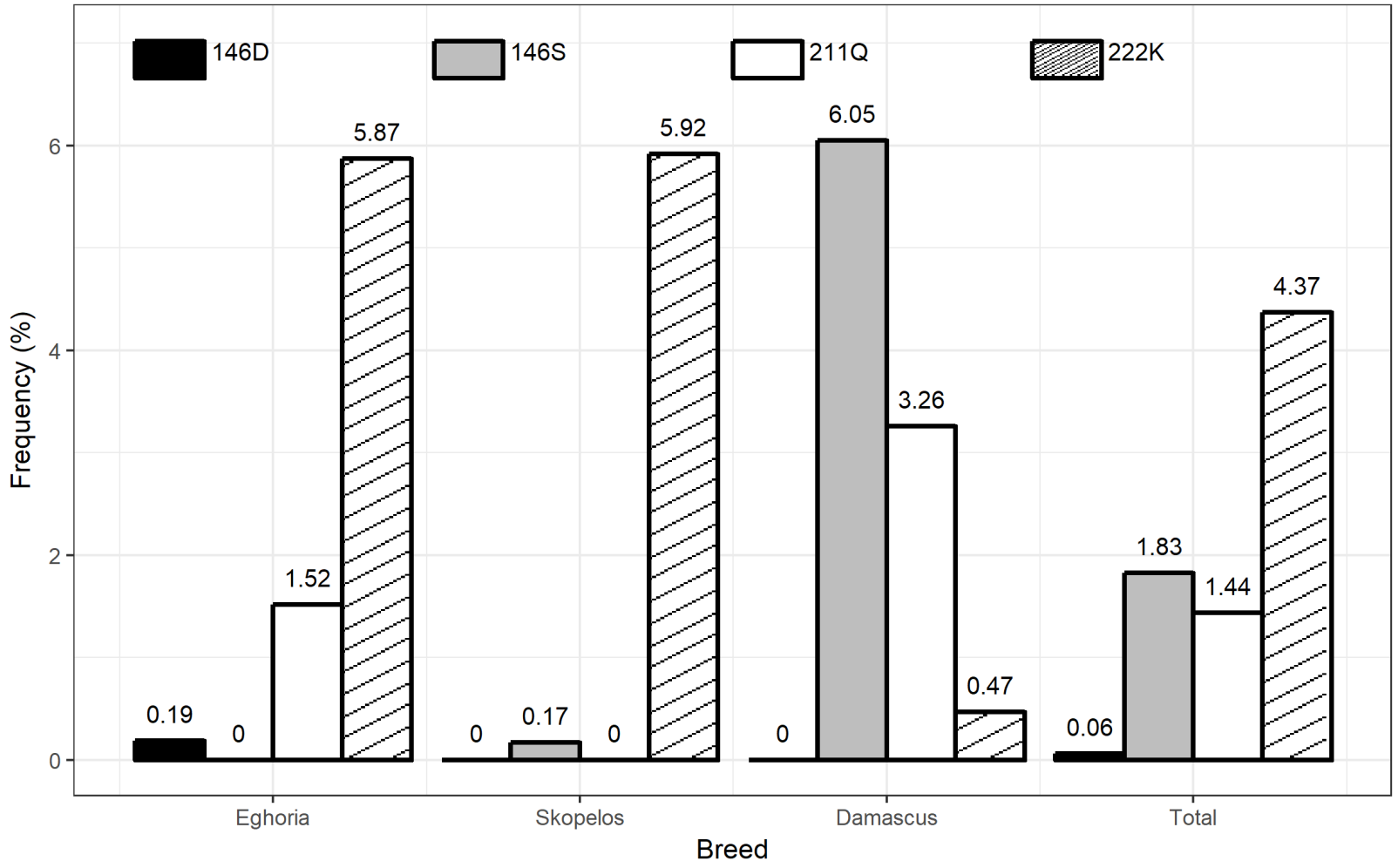
Random effects

- *Animal*
- *Days from kidding×Animal*

- Initially: **P=0.05**
- Bonferroni adjustment: **P=0.0017**

Results

Allelic frequencies



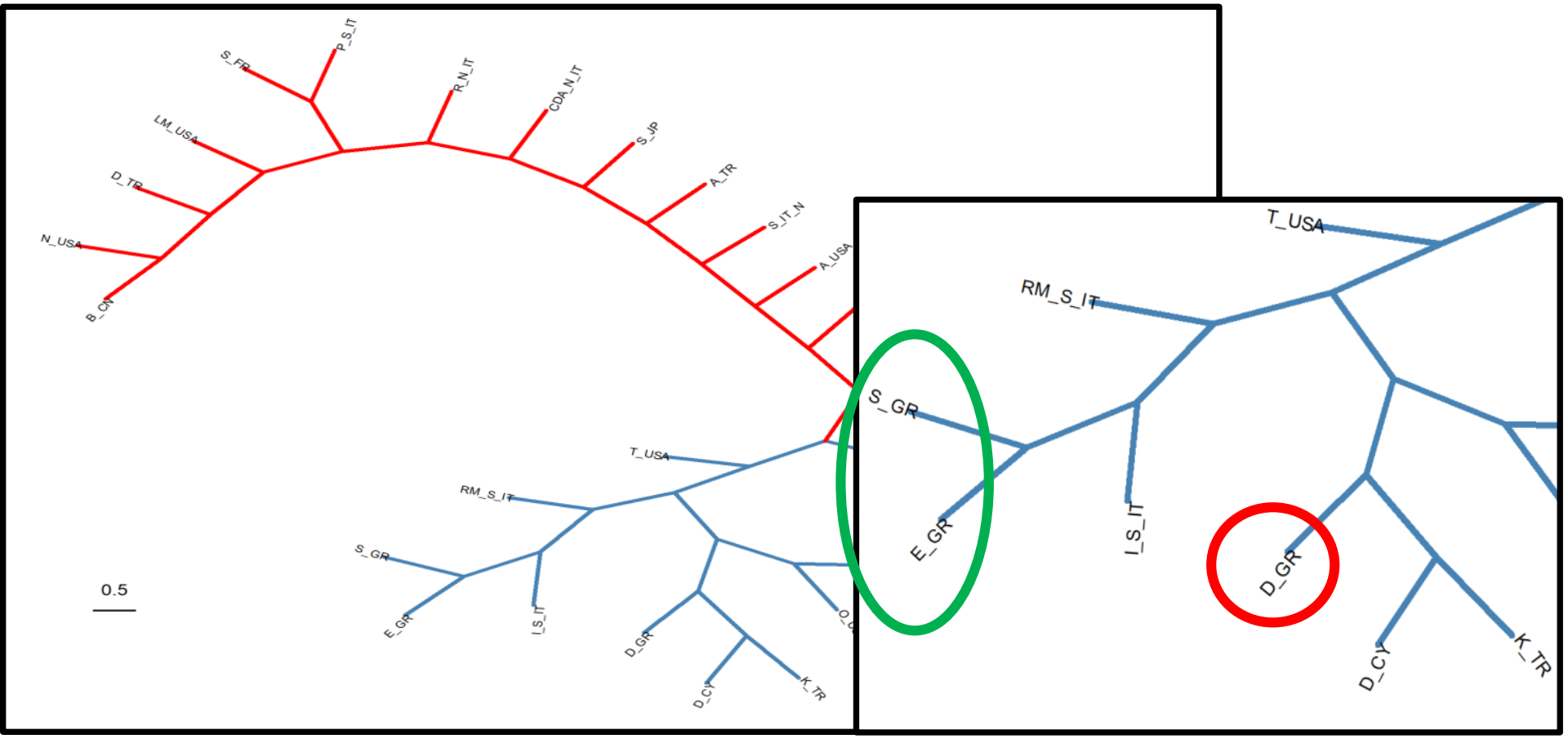
Results

Genetic distances (Fixation index F_{ST})

Breeds	Eghoria	Skopelos	Damascus
Eghoria		0.000	0.020
Skopelos	***P=0.31543***		0.028
Damascus	***P<0.00001***	***P<0.00001***	

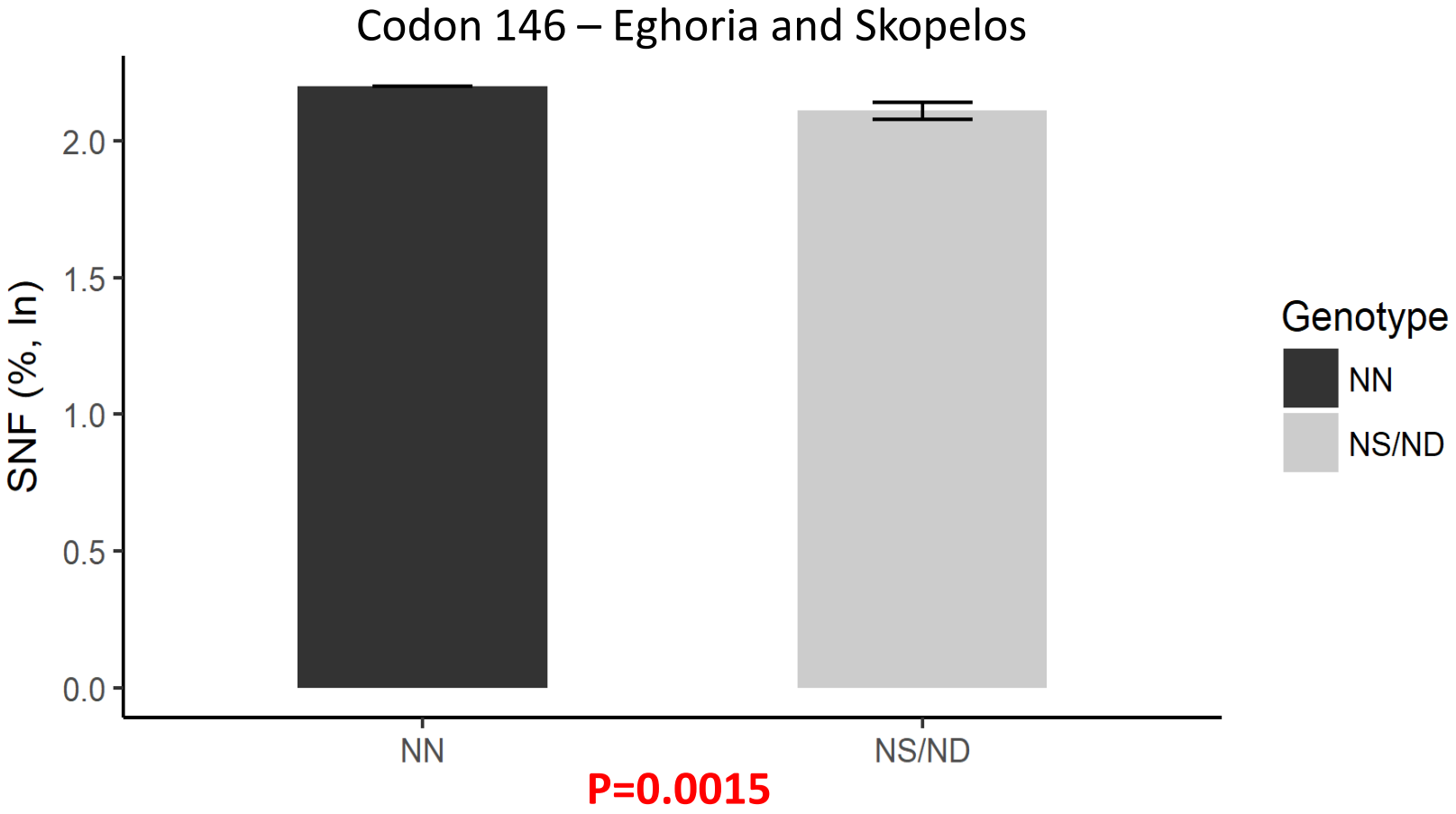
Results

Genetic distances (Fixation index F_{ST})



Results

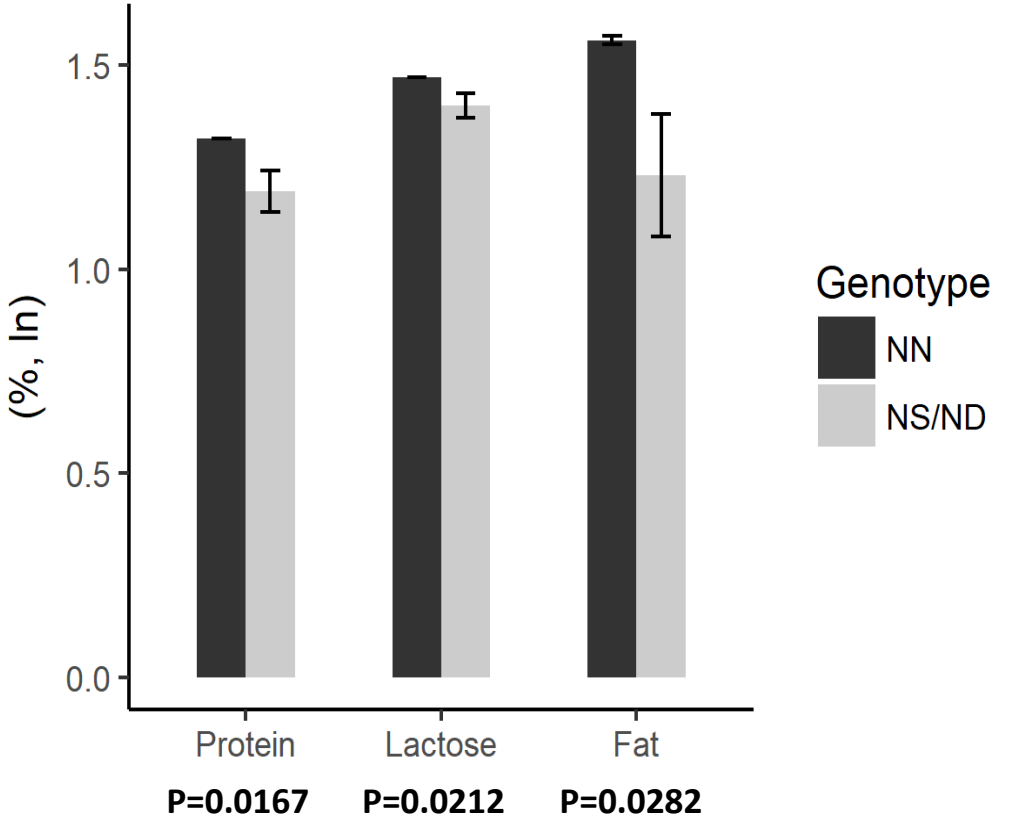
Significant effects after Bonferroni correction



Results

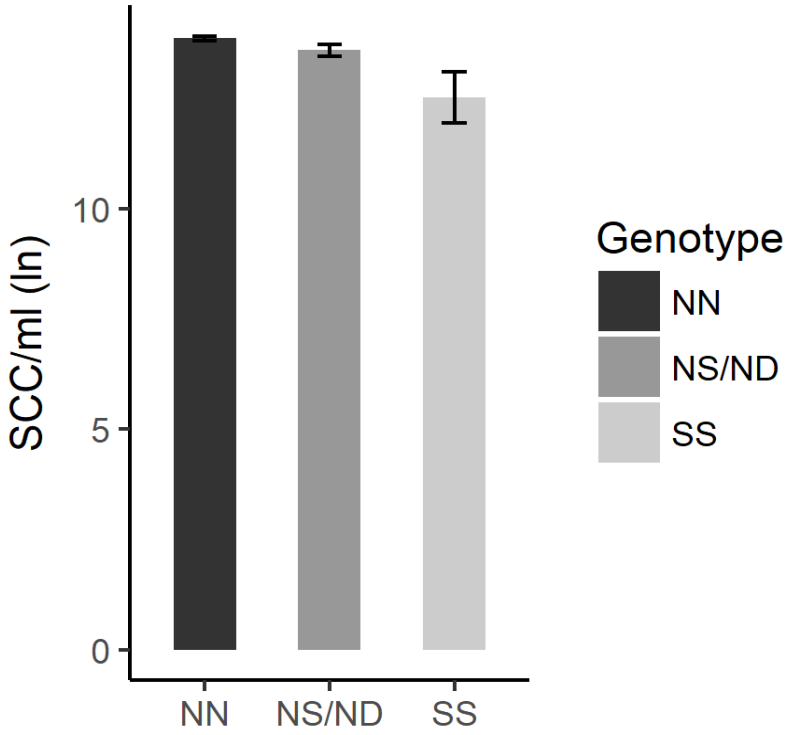
Non-significant effects after Bonferroni correction

Codon 146 – Eghoria and Skopelos



P=0.0167 **P=0.0212** **P=0.0282**

Codon 146 – Damascus

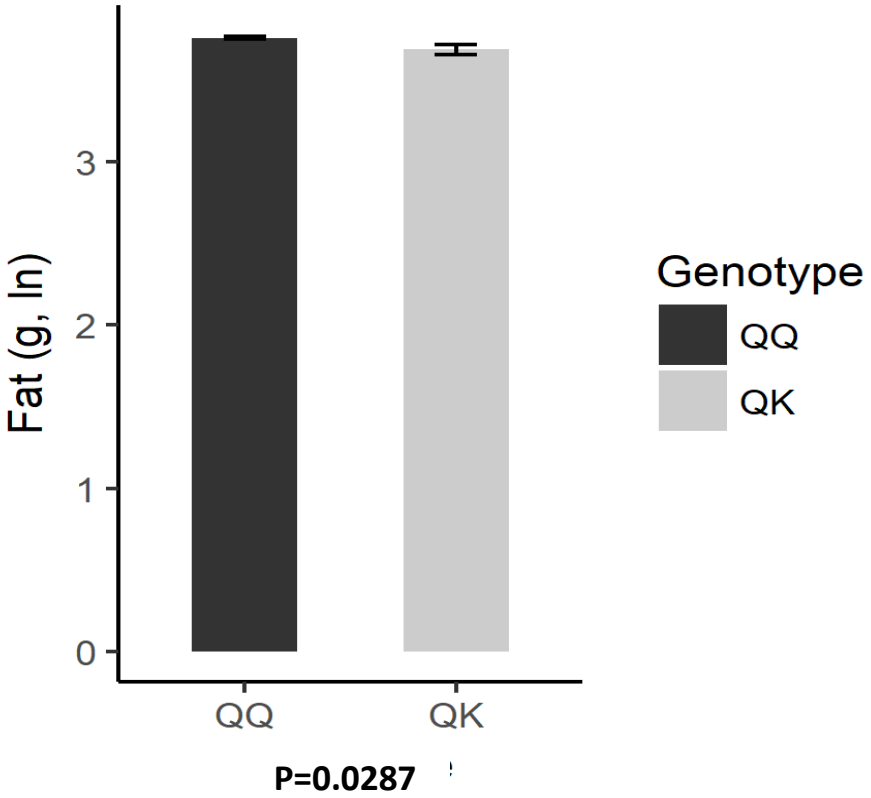


P=0.0217

Results

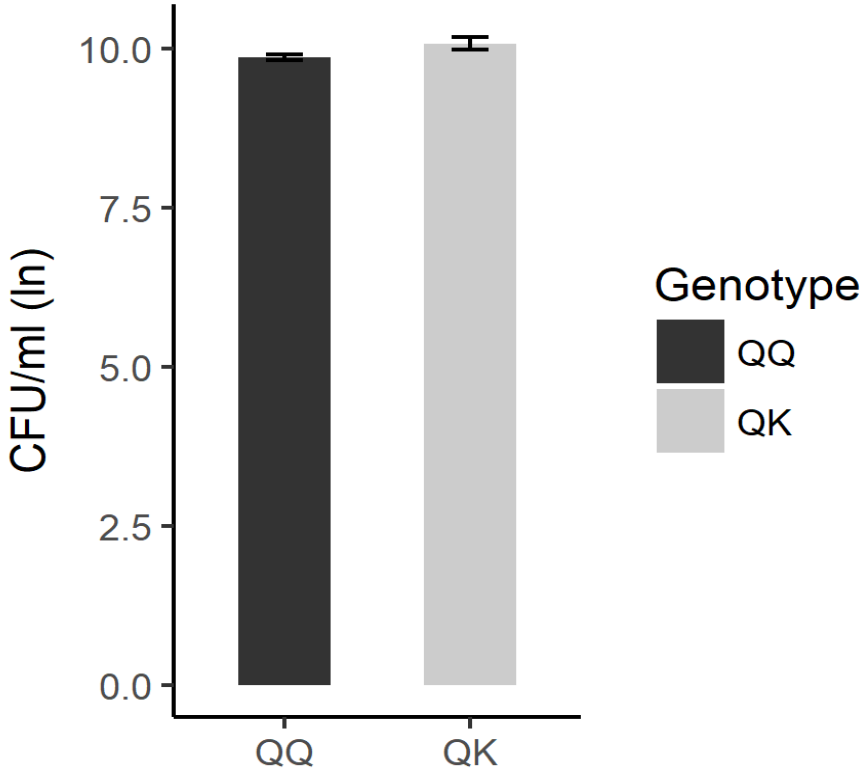
Non-significant effects after Bonferroni correction

Codon 222 – Eghoria and Skopelos



P=0.0287

Codon 222 – Eghoria and Skopelos



P=0.0378

Conclusions

- *PRNP* gene in selective breeding programmes of dairy goats in Greece
- Different breeding programmes for indigenous and Damascus breeds
- Minor effect of codon 146 on milk SNF content in indigenous goats – Selection with caution

In all other cases
Breeding for scrapie resistance
will not affect animal productivity and udder health
of the indigenous and Damascus goat populations of Greece

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ONASSIS FOUNDATION

Animals and Farmers

SOLID | Sustainable Organic and Low Input Dairying