Effect of α_{S1}-casein genotypes on yield and chemical composition of milk from Skopelos goats

G. Arsenos, A.I. Gelasakis, M.S. Kalamaki

Veterinary Faculty, Aristotle University of Thessaloniki, Greece

Background

a_{S1} casein (CN) polymorphism

- **Extensive polymorphisms of the caprine gene (*CSN1S1*), which encodes the a_{S1} -CN fraction, have been reported in different goat breeds to be associated with milk yield and composition.**

- **Different alleles have been identified and are classified in 4 groups:**
  - **strong** alleles (A, B1, B2, B3, B4, B', C, H, L, M) are associated with increased a_{S1}-CN in milk (3.6 of g/L),
  - **intermediate** alleles (E, I) at 1.6 g/L,
  - **weak** alleles (F, G) with 0.6 g/L,
  - **null** alleles (01, 02, N) which are characterized by absence of a_{S1}-CN in milk.

Objective

To assess the effect of α_{s1}-casein genotypes on milk yield (MY) and milk composition (MC) of Skopelos Greek dairy goats

Materials and Methods

Animals: 235 randomly selected from two herds in Skopelos and Alonnisos islands in Greece

Sampling:

- Individual milk samples over two successive milking periods (5 months)
- Blood samples
- Milk was analyzed for protein (PRO), fat (FAT), lactose (LAC), solid non-fat (SNF) concentration and total viable count (TVC).

Materials and Methods:

Genotyping of the *CSN1S1* locus

- **DNA was extracted from 200μL of blood using the GeneJET Whole Blood Genomic DNA Purification Mini Kit (**Thermo Scientific Inc.**).**
- **Identification of *CSN1S1* alleles was done:**
  1. by PCR-RFLP (Ramunno et al., 2000, 2005)
     - A* (including A, G, I, H),
     - B* (including B1, B2, B3, B4 and C),
     - F and N alleles
  2. by AS_PCR (Torres-Vázquez et al., 2008 and Cosenza et al., 2003)
     - E and 01 alleles.

Statistical analysis

Univariate Analysis of Covariance (ANCOVA)

$X_{gijk} = m_{gijk} + A_g + H_i + M_j + Y_k + a_1 \cdot milk + a_2 \cdot log\ TVC$

where,

X_{gijk} = variable in question (protein, fat, lactose, SNF)

m_{gijk}= intercept,

A_g= fixed effect of genotype (g= 9 levels),

H_i= fixed effect of herd (i= 2 levels),

M_j= fixed effect of stage of milking period (j= 5 levels),

Y_k= fixed effect of year of sampling (k= 2 levels),

$a_1 - a_2$ = linear regression coefficients of standardized values of:

- milk yield
- log transformed value of TVC

Results

A total of 9 genotypes were identified in the studied population. Genotype A*B* was the most common (23.8%) followed by genotypes B*B* and A*A* (21.7% and 21.3%, respectively). The less frequent genotype was FB* (1.3%).

Table 1. Effects genotypes and other factors used in the general linear model on milk yield (gr) and milk quality traits (protein, fat, lactose and solid not-fat concentration (%).

Effects		Protein (%)	Fat (%)	Lactose (%)	SNF† (%)	12-hours milk yield (gr)
Genotype	AA	0.25***	0.36**	0.09	0.34*	-37.2
	AB	0.15	0.24	-0.06	0.05	-0.8
	BB	0.20**	0.27*	0.08	0.28	1.9
	FA	-0.04	-0.19	-0.03	-0.08	171.1***
	FB	0.18	0.59*	-0.04	0.12	131.6*
	FF	0.16	0.80**	0.07	0.23	-70.6
	NA	-0.02	0.11	0.02	0.01	85.2**
	NB	0.03	0.02	0.00	0.02	52.0
	NN	*Reference category*				
Farm	Farm 1	-0.27***	-0.16	-0.08	-0.38***	-410.6***
	Farm 2	Reference category				
Month after weaning	1st	0.54***	0.68***	0.57***	1.15***	352.7***
	2nd	0.36***	0.27**	0.39***	0.79***	317.4***
	3rd	0.03	0.17	-0.06	-0.03	209.4***
	4th	-0.20***	0.04	0.13*	-0.06	64.6**
	5th	*Reference category*				
Year	1st	0.08*	0.12	0.23***	0.31***	-52.2***
	2nd	*Reference category*				
ZMilk yield‡	Continuous	-0.19***	-0.39***	-0.02	-0.21***	NA
ZTVC‡§	Continuous	0.16***	0.11***	-0.07***	0.10*	-57.8***

†SNF: Solid Not-Fat, ‡Z: Standardized value, §TVC: Total Viable Count; *P<0.05, **P<0.01, ***P<0.001

Conclusions

- **The high frequency of the strong genotypes A* and B* in Skopelos goats is associated with the production of milk with high fat and protein content and with optimal technological properties; caseins are important for cheese making.**

- **The results could be used in genetic improvement programs:**
  - select animals carrying the strong alleles
  - select animals that carry the null (N) allele and produce milk for specialized applications (i.e. milk with low allergenic potential).

Thank you
for your attention

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