The association between *CSN3* genotypes and milk production parameters in Czech Pied cattle

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Abstract

The aim of this study was to detect an association between *CSN3* genotypes and milk production parameters. Data on *CSN3* genotypes in Czech Pied sires and their breeding values for milk yield, protein yield, fat yield, protein content and fat content were available. Four genotypes (AA, AB, BB and BE) of kappa-casein marker (*CSN3*) were observed in the investigated population. Genotypes BB and BE were associated with higher protein content, but lower milk production. In contrast to this, genotypes AA and AB were associated with higher milk production, but lower protein and fat content. Further analyses using granddaughter design population structure will follow this study.

Introduction

Marker polymorphisms related to the performance parameters can be taken into account in selection procedures. Genetic markers explain a part of variance and improve the estimation of breeding value (Přibyl et Hruban, 2000). Marker for kappa-casein (*CSN3*) is one of the relevant markers related to milk production. The objective of this study was to detect an association between *CSN3* genotypes and milk production parameters in Czech Pied cattle.

Material and methods

120 sires were genotyped for marker *CSN3* using a method PCR-RFLP. Breeding values for milk, protein and fat yield and protein and fat content were available. Relation between marker *CSN3* and milk production parameters was analysed in SAS 8.2 by use of GLM:

$$y_{ijklm} = \mu + C_i + bR_j + bP_k + O_l(C_i) + e_{ijklm}$$

where y is the breeding value of sire,
μ is the average of observed breeding value,
C is the effect of *CSN3*,
bR is the regression on year of sire birth,
bP is the regression on share of Czech Pied breed in sires,
O(C) is the effect of grandsire with nested effect of *CSN3*,
e is the set of residual effects.

Results and discussion

Genotype AB was found as the most frequent (49,2 %). Detected frequencies of genotypes AA, BB and BE were 28.3 %, 19.2 % and 3.3 %, respectively. Observed allele frequencies were 0.53 (allele A), 0.45 (allele B) and 0.02 (allele E). Compared to this, Hanuš et al. (2000a) found frequencies of alleles A 0.65 and B 0.35 in observed population of Czech Pied cattle. Neubauerová (2001) reported that allele A tends to prevail especially in milk breeds and improves milk production. Freyer et al. (1999) found prevalent frequency of genotype AA (54 %), frequency of genotype AB 27 %, BB only 2 %, AE 13 %, BE 3 % and EE 1 % in German Holstein cattle. According to studies of Boettcher et al. (2004) and Caroli et al. (2004), allele B increases milk protein content and improves milk protein quality. A negative

effect of allele E on milk production parameters was reported by Ikonen et al. (1997) and Leone et al. (1998).

Sires with *CSN3* genotype AA significantly increased milk, protein and fat yield but decreased protein and fat content compared to the opposite tendency found in sires with genotype BE. Sires with genotype BB increased protein content as well as protein yield but slightly decreased milk and fat yield and fat content. The effects of genotype BB on higher protein content but lower milk yield as well as the effects of genotype AA on higher milk yield but lower protein content were reported by Žitný et al. (1996), Chrenek et al. (1998), Hanuš et al. (2000b) and Kučerová et al. (2004). Contrary to our study, Neubauerová (2001) did not find any significant association between *CSN3* genotypes and breeding values for milk production parameters.

Conclusions

Genotypes BB and BE were associated with higher protein content but lower milk production. In contrast to this, genotypes AA and AB were associated with higher milk production but lower protein and fat content.

Low protein yield was linked with genotype BE compared to genotypes AA, AB and BB.

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Table 1: Basic statistics of breeding values for milk production parameters observed in sires

Parameter	Breeding values of sires for				
	Milk yield (kg)	Protein content (%)	Protein yield (kg)	Fat content (%)	Fat yield (kg)
$\overline{x}$	127	0,00	13	-0,05	2
s_x	423	0,12	15	0,19	18
Min.	-1162	-0,45	-42	-0,55	-55
Max.	1164	0,28	45	0,50	43

Figure 1: Average breeding values for milk production (kg) according to genotype groups of *CSN3*

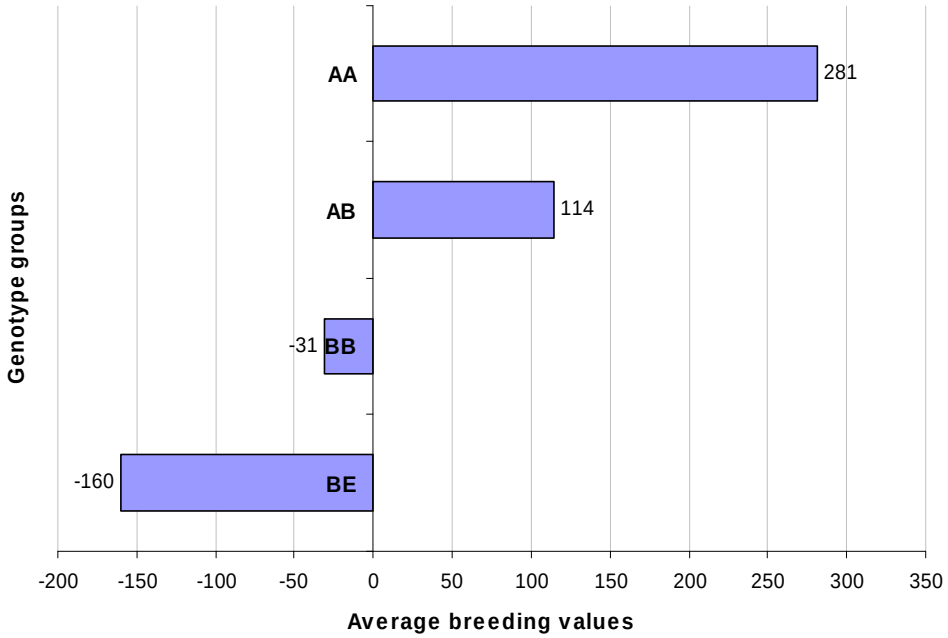

Figure 2: Average breeding values for protein and fat yield according to genotype groups of *CSN3*

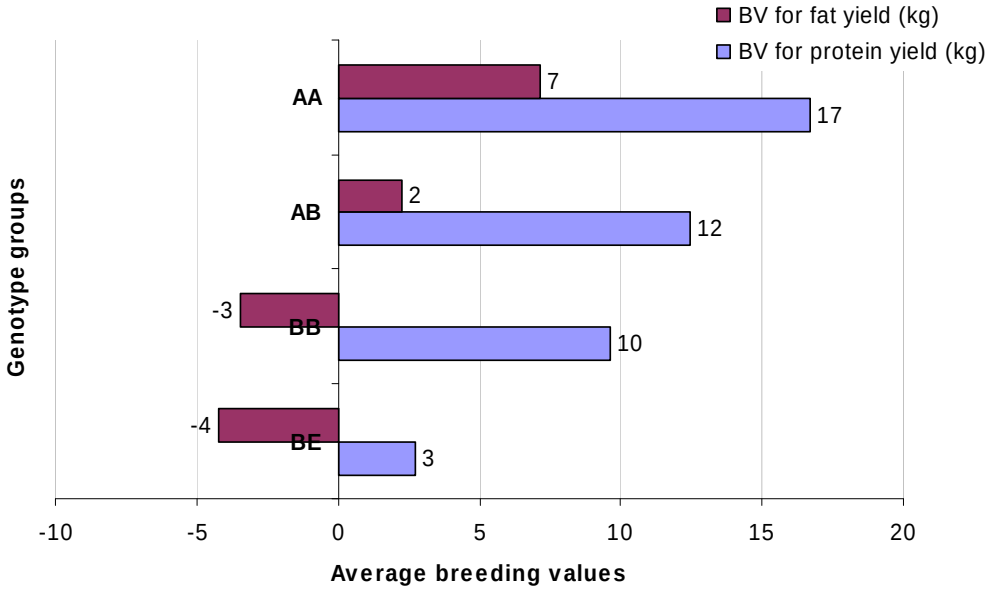

Figure 3: Average breeding values for protein and fat content according to genotype groups of *CSN3*