ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS
SBORNÍK MENDELOVY ZEMĚDĚLSKÉ A LESNICKÉ UNIVERZITY V BRNĚ

Ročník LV 6 Číslo 1, 2007

EFFECT OF *C-CSN* AND *B-CSN* GENOTYPES ON MILK PRODUCTION TRAITS IN CZECH FLEKVIEH AND HOLSTEIN BREED

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Received: January 16, 2007

Abstract

GAZDOVÁ, V., HUMPOLÍČEK, P., DÉDUCHOVÁ, V., FILKUKOVÁ, J., DVOŘÁK, J.: *Effect of C-CSN and B-CSN genotypes on milk production traits in Czech Flekvieh and Holstein breed*. Acta univ. agric. et silvic. Mendel. Brun., 2007, LV, No. 1, pp. 55–58

The effect of the χ-casein (*C-CSN*) and β –casein (*B-CSN*) loci on the milk production traits (milk yield, fat, protein and lactose content) was estimated for 807 and 488 Czech Fleckvieh and 402 and 244 Holstein cows, respectively. Genotypes of *C-CNS* and *B-CNS* were determined by the use of PCR–RFLP method. The genotypes were detected by use of electrophoresis on agarose gel. The associations of studied polymorphisms with milk production traits were estimated using the mixed linear model procedure REML in SAS for Windows 9.1.3. Results indicated that protein content is significantly affected ($P \leq 0.01$) by *C-CSN* genotype (genotype *BB* > *AB* > *AA*). Fat and lactose content were not affected by *C-CSN* locus. The *B-CNS* locus had no significant effect on any milk production traits.

χ–casein, β-casein, Czech Fleckvieh, Holstein cows

The composition of bovine milk protein is an important factor for the profitability of the dairy industry. *C-CSN* and *B-CSN* loci are using as gene marker in cattle breeding because of effects on milk production previously found. There are many published studies focused on the effect of *C-CSN* genotypes on milk production traits. Most of previous studies have found a favorable effect of the *BB C-CSN* genotype on the protein yield and content (Tsiaras *et al.*, 2005; Kučerová *et al*., 2004; Chrenek *et al*., 1998). Bobe *et al*. (1999) tested effects of *C-CSN* genotypes on milk protein concentration and composition. They did not find any statistically significant effects on the total milk protein concentration. However *C-CSN B* gene variant additively increased the proportion of *C-CSN* in total milk protein. Generally *C-CSN BB* genotype is associated with protein and fat content. Conversely *C-CSN* genotype *AA* is binded with higher yield of milk, proteins and fat. Recently, milk protein genotypes (*B-CNS* and *C-CNS*) are used as a selection factor in cattle breeding programs to improve milk production (yield, fat and protein % content, ect.) so it is necessary to explore the association of this genotypes and other production traits, mostly reproduction. Tsiaras *et al*. (2005) investigated relation among *C-CSN* genotypes and reproduction parameters (calving interval, age at first and second lactation, ect.). They did not find any negative association of these genotypes on the reproduction parameters.

Results of studies on the effect of *B-CSN* genotypes on milk production traits have been lesser uniform. Mostly there are not distinctive associations at all. Recently, there are a lot of studies about association of *B-CSN* genotypes and human diseases. *B-CSN A1* variation is linked with the occurrence of some diseases (sclerosis, autism, ischemic heart disease (McLachlan, 2001).

Aim of our studies was to determine and compare allele frequencies and genotypes of both gene markers and to investigate association among both gene markers and milk production traits by two most common cattle breed in the Czech Republic.

MATERIALS AND METHOD

Animals:

The study was carried out from May to September 2006 in several commercial farms. The cattle originated from 15 herds of Czech Fleckvieh and 10 herd of Holstein breed.

Genotypes detection:

The genome DNA was isolated from milk using Jetquick blood and cell culture DNA spin kit 250 (Genomed). PCR product of *C-CSN* gene was amplified using the amplification protocol by Pinder *et al*. (1991) and Soria *et al*. (2003). The polymorphism at the *B-CSN* was detected with ACRS-PCR method (McLachlan, 2003). The genotype in *C-CSN* and *B-CSN* were determined in 807 and 488 Czech Fleckvieh and 402 and 244 Holstein cows, respectively.

Traits definition:

The following traits were studied: milk yield (kg), count of somatic cells (thous./ml), percentage of fat, protein and lactose.

Statistical analysis:

Only the cows on the first to sixth lactations were included in analysis. The associations of studied polymorphisms with milk yield, count of somatic cells, percentage of fat, protein and lactose were estimated using the mixed linear model (MLM) procedure REML in SAS for Windows 9.1.3. The genotypes of relevant gene (Gen), order of lactation (Lactation), milk yield at sampling day (Yield), stage of lactation (Stage, the lactations were divided into the 100 days period) were used as fixed effects. The interaction of herd, months and year of milk sampling (HYM) were used as random effect.

$$y_{ijklmn} = \mu + GEN_i + LACTATION_j + HYM_k + YIELD_l + STAGE_m + e_{ijklmn}$$

RESULTS AND DISCUSSION

Frequency distribution of genotypes and alleles for *C-CSN* in the Czech Fleckvieh and Holstein cows are shown in Table I. Observed frequencies are in agreement to studies of different authors (Kučerová *et al.*, 2004; Tsiaras *et al.,* 2005; Bobe *et al*., 1999). Generally dairy breeds as Holstein breed have lower frequency of allele *B*, contrary to breeds with milk-meat performance as Czech Fleckvieh, which have higher frequency of allele *B* in *C-CSN* locus. The frequency distribution of *B-CSN* genotypes and allele for both breeds are shown in Table II. Both breeds demonstrated high values of frequency *A2* allele.

In the Table III there are presented by Least-squares means and standard errors for selected traits by genotypes of *C-CSN* and *B-CNS* genes. We found statistically significant differences in milk protein content among *C-CSN* genotype (P = 0.01) (genotype *BB* > *AB* > *AA*). Our results correspond to conclusions of previous studies. We did not found out any other significant differences in testing milk production traits according to genotype *C-CSN*. No significant association was detected for *B-CSN* genotypes. We did not found out any significant association in any studying milk performance traits with *B-CSN* genotypes.

High significant differences were detected between fat and protein content of Czech Fleckvieh and Holstein cows. In our study the Czech Fleckvieh have had a significantly higher content of protein and lower of fat, respectively (Table III).

I: *Absolute (n) and relative (r) frequencies of genotypes and relative frequencies of allele at the locus C-CNS*

Breed	n	*AA*		*AB*		*BB*	
		n	r	n	r	n	r
Czech Fleckvieh	807	286	0.35	406	0.50	115	0.14
			A			B	
			0.61			0.39	
		AA		*AB*		*BB*	
		n	r	n	r	n	r
Holstein	488	261	0.53	187	0.38	40	0.08
			A			B	
			0.73			0.27	

II: *Absolute (n) and relative (r) frequencies of genotypes and relative frequencies of allele at the locus B-CNS*

Breed	n	*A1A1*		*A1A2*		*A2A2*	
		n	r	n	r	n	r
Czech Fleckvieh	402	40	0.10	186	0.46	176	0.44
		A1				A2	
		0.33				0.67	
		A1A1		*A1A2*		*A2A2*	
		n	r	n	r	n	r
Holstein	244	37	0.15	126	0.52	81	0.33
		A1				A2	
		0.41				0.59	

III: *Least-squares means and standard errors for selected traits and genotypes of C-CNS and B-CNS genes. Least-squares means and standard errors for differences between Czech Fleckvieh and Holstein breed.*

	C-CNS			Breed	
	AA	*AB*	*BB*	Czech Fleck.	Holstein
Milk protein	3.44 ± 0.03 ^{A}	3.44 ± 0.03 ^{A}	3.54 ± 0.04 ^{B}	3.53 ± 0.04 ^{a}	3.42 ± 0.04 ^{b}
Milk fat	4.23 ± 0.08	4.22 ± 0.08	4.20 ± 0.10	4.04 ± 0.09 ^{A}	4.39 ± 0.10 ^{B}
	B-CNS			Breed	
	A1A1	*A1A2*	*A2A2*	Czech Fleck.	Holstein
Milk protein	3.47 ± 0.07	3.47 ± 0.05	3.47 ± 0.05	3.55 ± 0.06 ^{a}	3.39 ± 0.06 ^{b}
Milk fat	4.04 ± 0.16	4.00 ± 0.11	4.01 ± 0.12	3.91 ± 0.13	4.12 ± 0.13

Note: Values with the different superscripts show significance level within rows: $P \leq 0.05$ (a, b). $P \leq 0.01$ (A, B).

CONCLUSIONS

The results of the present study indicate that *C-CSN* genotypes influence some milk production traits. The *BB C-CSN* genotype had a positive effect on proteins content. We are found out higher frequency of *A2* allele of *B-CSN* loci in the both most common breed in the Czech Republic. Therefore, these genotypes appear to be obvious candidates for selection aiming at improving milk production traits.

SOUHRN

Vliv genotypů *C-CSN* a *B-CSN* na znaky mléčné užitkovosti českého strakatého plemene a holštýnského plemene

Vliv genotypů χ-kaseinu a β-kaseinu na znaky mléčné užitkovosti (obsah tuku, proteinů a laktózy a dojivost) byl stanoven pro 807 a 488 jedinců českého strakatého plemene a pro 402 a 244 jedinců holštýnského plemene. Genotypy byly zjištěny pomocí metody PCR – RFLP, výsledky byly vizualizovány elektroforeticky na 3% agarózovém gelu. Asociační studie mezi zjištěnými polymorfismy a produkčními znaky byla provedena pomocí smíšeného lineárního modelu REML v programu SAS for Windows 9.3.1. Z našich výsledků vyplývá, že obsah proteinu v mléce je významně ovlivněn ($P \leq 0.01$) genotypem v *C-CSN* lokusu (genotyp *BB* > *AB* > *AA*). Nebyl zjištěn vztah mezi lokusem *C-CSN* a obsahem tuku či laktózy. Nebyla detekována žádná asociace mezi genotypem v *B*-CSN lokusu a znaky mléčné užitkovosti.

χ-kasein, β-kasein, české strakaté, holštýnské plemeno

ACKNOWLEDGMENTS

This research was financially supported by the Czech Science Foundation project no. 523/03/H076 and project no. 1G58073 and QF3024

Thanks are offered to LAMGen company for technical assistance and samples providing for this work.

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