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*Short Report*

# β-lactoglobulin genetic variants in Serbian Holstein-Friesian dairy cattle and their association with yield and quality of milk

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**In 765 Holstein-Friesian cows, the following ratios of β-lactoglobulin genotypes were found: 0.23 AA, 0.58 AB and 0.19 BB. The cows of AA genotype yielded more milk and milk fat than cows of genotype AB and BB. Cows with β-lactoglobulin AA and AB genotypes yielded respectively 224 and 190 kg more milk per lactation when compared to cows of BB genotype but the differences were not significant. There were significant (P<0.01) differences in the yield of milk protein produced by cows of the AB, BB and AA genotypes. Milk from cows of genotype AA and BB contained a slightly higher percentage of milk fat when compared to milk of cows with lactoglobulin genotype AB. Percentage of milk protein was higher in the milk of cows of genotype BB and AB.**
**β-lactoglobulin genotype had a significant impact on the yield of milk protein (P<0.01) , but had no influence on the other observed properties of milk.**

**KEY WORDS: β-Lactoglobulin / milk fat / milk protein / milk yield**

Embedding of connection between and among the genes which control the protein polymorphic polygenic traits related to the productive traits of livestock is of great economic importance for animal breeding and can increase whole productivity in this

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production sector [Nemeš *et al.* 2012, Lukač *et al.* 2013]. Usage of genetic molecular markers of polymorphic genes is a promising surrogate to the current methods of selection once these genes are proven to be associated with traits of interest in animals. Some researchers reported that milk protein polymorphism and its relationship with economic traits was not important for milk production traits [Ulutas and Yildirim 2009]. In contrast, some authors reported that this relationship was important for milk production traits [Strzalkowska *et al.* 2009] and recommended that genetic variant of milk protein could be criteria of selection for the improvement of dairy cattle production. Overall, it seems that genetic variation of milk protein to improve milk yield and/or quality could be used as a suitable supplement to conventional breeding procedures [Lukač *et al.* 2013]. As one of the important genes that may affect economically important traits in cattle, the β-lactoglobulin (β-LG) *locus* has been previously studied. Polymorphism of β-LG gene was discovered six decades ago and a total of 15 alleles are known, of which, five common variants; A, B, C, D, and E are well identified. However alleles A and B are the most frequent [Elmaci *et al.* 2006, Matejicek *et al.* 2007]. In experiments aiming at investigating the effect of β-LG genotypes on milk production and quality was found that the AA genotype of β-LG had a favourable effect on protein yield, and the association of significantly higher fat content, protein, casein, true protein, and total solids with BB variant has also been reported [Matejicek *et al.* 2007].

The aim of this study was to identify alleles (A and B) and genotypes (AA, AB and BB) of β-lactoglobulin in a population of Holstein-Friesian cows, evaluate their frequency in this population and to study the effect of the β-lactoglobulin genotypes on milk yield and quality.

## Material and methods

The study included 765 Holstein-Friesian cows, daughters of 18 sires (6 of each genotype group: AA, AB and BB). Isolation of DNA was performed after Sambrook *et al.* [1989], PCR reactions were performed by Popovski [1999] and primers for PCR by Braunschweig and Leeb [2006].

One-way analysis of variance (ANOVA) was applied to determine the effects of β-LG genetic variants (AA, AB and BB) on the fat and protein content, and yield of milk from Holstein-Friesian dairy cows.

## Results and discussion

Out of 765 studied cows, genotypic frequencies and gene frequencies of β-lactoglobulin phenotypes were: 172 cows of the β-LG AA genotype, 448 of genotype AB, and 145 of BB genotype. The frequencies of genotypes AA, AB and BB were 0.23, 0.58 and 0.19, respectively.

Table 1 shows the effect of the β-LG gene on the milk production traits in the cows studied. The cows of AA genotype yielded more milk and milk fat, and less milk protein than cows of genotype AB and BB. The AA cows produced milk with lower protein content (2.72%) and lower protein yield than that of the AB and BB β-LG genotypes. Cows with β-LG AA and AB genotypes produced respectively 224 and 190 kg milk more per lactation compared to cows of BB genotype, but these differences were not significant (P>0.05).

**Table 1**. Yield and quality of milk per lactation of cows with different β-lactoglobulin genotypes

| Parameter of milk | Genotype AA | Genotype AB | Genotype BB |
|---|---|---|---|
| | mean±SD | mean±SD | mean±SD |
| Yield (kg) | 8649±1496 | 8615±1482 | 8425±1419 |
| Fat | | | |
| (kg) | 281.1±39.5 | 277.1±43.8 | 274.6±46.3 |
| (%) | 3.25±0.18 | 3.21±0.16 | 3.26±0.20 |
| Protein | | | |
| (kg) | 235.3±36.7$^{A}$ | 264.4±35.3$^{B}$ | 270.4±29.8$^{B}$ |
| (%) | 2.72±0.42 | 3.07±0.12 | 3.21±0.05 |

$^{AB}$Within rows means bearing different superscripts differ significantly at P<0.01.

**Table 2**. Influence of different genotypes on fat and protein content and yield of milk

| Source of variation | Degree of freedom | Sum of squares | Middle of the squares | F-value | Probability |
|---|---|---|---|---|---|
| Milk yield (kg) | 2 | 3330123 | 1665061 | 0.8 | 0.5 |
| Fat | | | | | |
| (kg) | 2 | 1502 | 751 | 0.4 | 0.7 |
| (%) | 2 | 0.12 | 0.06 | 1.80 | 0.15 |
| Protein | | | | | |
| (kg) | 2 | 16083 | 8042 | 6.8 | 0.00* |
| (%) | 2 | 0.13 | 0.06 | 1.32 | 0.29 |

*P<0.01.

In this study, there were no statistically significant differences in yield of milk fat, percentage of milk fat and percentage of milk protein between the cows of different β-LG genotypes, but in contrast, there were statistically significant (P<0.01) differences in the yield of milk protein. In Table 2 it can be seen the influence of different genotypes on milk yield and composition.

Milk producers have only recently started to pay attention to the manufacturing (technological) properties of milk, as some dairies and industrial companies are beginning to qualify milk according to its composition in terms of fat and protein percentage as well as cheese making properties. Estimated frequency of alleles A

and B can give preliminary information on the presence of different genotypes of β-LG in the population, and later cows milk production. The wide variation found for β-lactoglobulin gene in the Serbian native cattle probably reflects the overall existing variation in milk constituents in these breeds. Attention should be paid also to environmental factors in milk production as well. A genetic screening program for breeding dairy cattle should be set up in Serbia to increase possibilities for profit and to show new options for milk processing industry.

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