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ASSOCIATION OF BETA-LACTOGLOBULIN (LGB) GENOTYPES WITH QUALITY COMPOSITION OF MILK AND COAGULATION PROPERTIES IN BULGARIAN BLACK-AND-WHITE CATTLE

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ABSTRACT

The aim of the present study was to establish the relationship of LGB genotypes with the traits characterizing the qualitative composition of milk and its coagulation ability in cows of the BBW cattle.

Milk proteins' polymorphism was evaluation in 132 tissue samples from cows reared at 4 farms by PCR–RFLP analysis. During the study, the following parameters were studied: daily milk yield (kg), fat and protein contents (%), rennet coagulation time, curd firmness and curd firming time.

The presence of 2 alleles of LGB – A, B, which determine three genotypes – AA, AB, BB.

Homozygous animals carrying the BB genotype of LGB are characterized by the highest average daily milk yield – 31.00 kg.

It was found that animals with genotype AA produce milk with the highest fat content – 3.90%, the fastest rennet coagulation time – 19.82 min and the hardest coagulum – 25.99 mm.

Key words: LGB, genotypes, Bulgarian Black–and–White cattle, coagulation, milk.

Introduction

Beta-lactoglobulin (LGB) is the first milk protein for which polymorphism has been detected (Aschaffenburg and Drewry, 1955). Beta-lactoglobulin accounts for about 50% of the total milk whey protein in ruminants (Walstra et al., 2006). LGB is described by a total of 15 alleles, among which A and B are the most commonly encountered (Matejicek et al., 2007).

Numerous researchers (Zaglool et al., 2016; Botaro et al., 2009; Stipp et al., 2013; Singh et al., 2014) have investigated the relationship between kappa casein (CSN_3), beta-lactoglobulin (LGB) genotypes and milk yield, milk composition and cheese making properties.

The effect of CSN_3 and LGB on milk yield has been studied in 278 Holstein dairy cows during the first two lactations (Tsiaras et al., 2005). LGB genotypes were associated with milk yield (cows with genotype AB had higher milk yield than those with genotype AA), fat content (BB > AA > AB) and protein content of milk (AB > AA).

These results are in line with other reports: Piątkowska et al. (2011); Heidari et al., (2012); Vidovic et al., (2014) that demonstrated highest ilk yields in cows with LGB genotype AA.

Neamt et al. (2017) and Pečiulaitienė et al., (2007) observed highest milk yield and milk fat content in cows with LGB genotype AB, whereas Czerniawska–Piatkowska et al. (2011) affirmed that cows with LGB genotype AA showed the highest milk yield for all lactations, and that cows from the BB genotype produced milk with higher fat content.

The association between polymorphism of κ–casein and beta–lactoglobulin and milk coagulation traits has been subject of a number of studies.

According to Ikonen et al., 1997; 1999; Di Stasio and Mariani, 2000; Wedholm et al., 2006; Hallén et al., 2007, 2008 the presence of allele B of β-CN, κ-CN and β-LG was beneficial for milk coagulation and its further processing into cheese.

Molina et al., (2006b) found out that the milk of cows from LGB genotype AA had substantially firmer curd ($P \leq 0.05$) as compared to the milk of cows from genotype AA.

Jensen et al., (2012) reported that animals with β-LG genotype BB exhibited better milk coagulation properties.

The purpose of the present study was to establish the association of LGB genotypes with milk composition and coagulation traits in Bulgarian Black-and-White cows.

Materials and methods

Data: For evaluation of milk coagulation properties and milk composition, 132 individual milk samples were obtained from 132 Bulgarian Black-and-White cows from 4 farms. Milk samples were collected during the morning milking, without adding any preservative.

Laboratory analysis: The analysis of individual coagulation properties of milk was done in the lab of the Agricultural Institute – Stara Zagora, by means of Computerized Renneting Metter – Polo Trade, Italy. The test of milk coagulation properties took 30 min. Milk samples (10 ml) were preheated (35°C) before addition of 200 µL chymosin. Naturen Plus 215 /0.8L chymosin was used, with milk coagulation activity of 215 IMCU/ml. During the study, the following parameters were studied: daily milk yield (kg), milk fat and protein contents (%), rennet coagulation time (RCT, min), curd firmness (a_{30}, mm) and curd firming time (k_{20}, min).

Milk proteins' polymorphism was evaluation in 132 tissue samples from cows reared at 4 farms. To this end, specialized pliers and marks with a vial containing desiccant were used to obtain and seal the tissue specimen at the time of identification of the animal. The genetic polymorphism of milk proteins was determined by PCR-RFLP analysis in the laboratory of the University of Padova, Italy.

Statistical analysis: The data were processed with statistical software products Systat 13 and graphs were plotted in MS Excel.

Results and discussion

The prevalence of LGB genotypes and allele frequencies in Bulgarian Black-and-White cows are presented on Figure 1. Milk proteins of LBG were characterised by three genotypes – AA, AB and BB. The cows from the AB genotype were the most numerous – 49.25%, followed by cows with genotype BB – 32.84%. Genotype AA was the least frequent –17.91%. The results reported by Soyudal et al., (2019) in a study with Holstein dairy cows in Turkey were very close to ours – highest proportion of heterozygous cows from the AB genotype – 53.44%, followed by those with genotype BB – 28.04% and AA –18.52%.

The frequency of allele B was higher than that of allele A – 0.575 and 0.425%. Comparable results for predominance of allele B were also reported by Ivanković et al., (2011) and Soyudal et al., (2019).

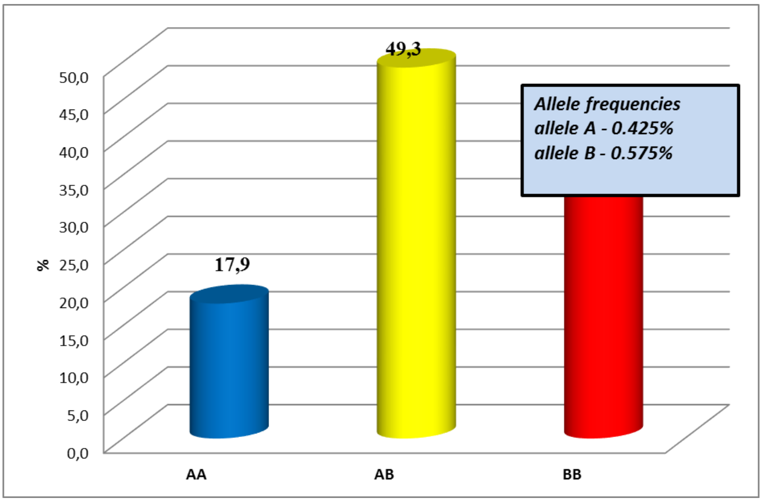

Figure 1: Prevalence of genotypes and allele frequencies of LGB in Bulgarian Black-and-White cows.

Figure 2 presents the average milk yield of cows from different LGB genotypes. Homozygous cows from genotype BB were outlined with highest average milk yield – 30.5 kg, followed by those from genotype AB – 29.0 kg. The lowest milk yield was demonstrated by cows from genotype AA. These data were in line with the results of Čítek et al., (2021), Tsiaras et al., (2005) and Neamt et al. (2017) about higher milk yield in cows with genotype AB.

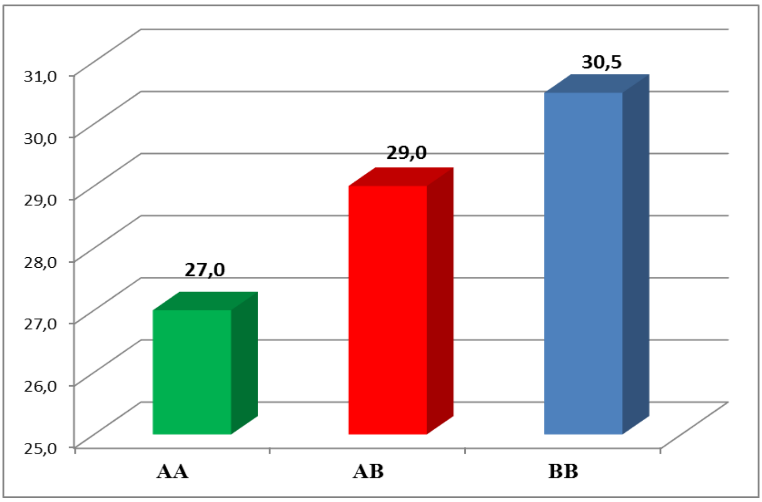

Figure 2: Average milk yield in cows from different LGB genotypes.

Fig. 3 depicts average milk fat and milk protein percentages in Bulgarian Black-and-White cows from the different LGB genotypes. Homozygous AA cows produced milk with the highest milk fat content yet lowest milk protein content – 3.90% and 3.30%, respectively (Figure 3). For the other two genotypes (AB and BB), milk fat and protein percentages were similar. Our results corresponded with those of Vidovic et al., (2014) as the latter researchers reported slightly higher milk fat content in cows with genotype AA and BB vs those from genotype AB. Milk protein percentage was higher in cows from genotypes BB and AB. Opposite data were found out by Zaglool et al.,

(2016) in Holstein cows from the genotype AA, which demonstrated higher milk yield and produced milk with higher protein content and milk solids-non-fat.

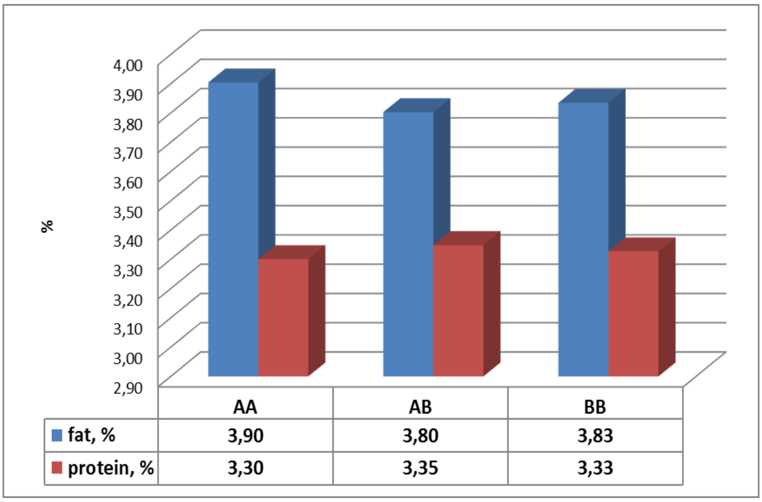

Figure 3: Average milk fat and protein percentage in Bulgarian Black-and-White cows from different LGB genotypes.

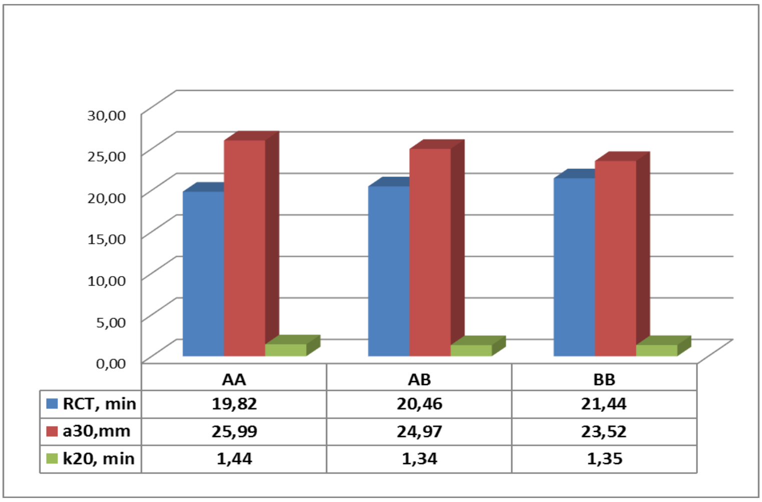

Figure 4: Milk coagulation traits in cows from different LGB genotypes.

Figure 4 shows that the shortest rennet coagulation time of 19.82 min. was observed in cows from genotype AA along with highest curd firmness – 25.99 mm. The longest RCT was found out in homozygous animals from genotype BB – 20.46 min. Heterozygous AB cows showed the shortest curd firming time – 1,34 min. Similar results – better coagulation properties of milk from cows carrying allele A of kappa casein and beta-lactoglobulin, were reported by Ketto et al., (2019). The authors established shorter rennet coagulation time (RCT) in cows from the genotype AB vs those from genotype BB.

Conclusion

1. Two LGB alleles have been detected – A, B as well as three genotypes – AA, AB, BB.
2. Homozygous cows from LGB genotype BB were outlined with the highest average milk yield – 31.00 kg.
3. It was found out that cows with genotype AA produced milk with the highest fat content – *3.90%, shortest rennet coagulation time* – 19.82 min and firmest curd – 25.99 mm.

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