

Association study of bovine candidate loci to meat quality

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Article Details: Received: 2016-04-25 | Accepted: 2016-06-14 | Available online: 2016-09-01

<http://dx.doi.org/10.15414/afz.2016.19.si.09-10>

The aim of this study was to determine the potential association between candidate loci and indicators of meat quality in Czech Simmentals. For the study, loci for calpain (*CAPN530*) and myostatin (*MSTN*) were chosen. The analysis revealed 258 bulls (locus *CAPN530*) and 228 bulls (locus *MSTN*) of Czech Simmental cattle. Genotyping was carried out by PCR/RFLP method. The association analysis was performed for polymorphisms of both loci and shear force of the raw and grilled meat on the 1st, 14th and 28th day after slaughter. The *CAPN530* locus showed a statistically significant effect on the power cut for raw and grilled meat in the 1st day after the slaughter ($P < 0.05$), and for grilled meat significant changes were stated in the 14th and 28th day post mortem ($P < 0.05$). No significant relationships in locus *MSTN* between genotype and shear force ($P < 0.05$) were found. The *MSTN* genotype affected the ability to bind water. However, the findings should be interpreted with caution to the unequal representation of genotypes for the locus *MSTN* in the study.

Keywords: Czech Simmental, meat quality, *MSTN*, *CAPN530*

1 Introduction

The quality of meat involves many properties. These include also the binding power and fragility, as measured by the power cut. In the final quality, genetic and non-genetic factors play role, when in meat quality also postmortal processes have an important effect. The potential loci related to meat tenderness are described in several studies, genes encoding the group of calpain proteins are considered to be important. The SNP in exon 14 of the *CAPN530* is considered to be in relationship with tenderness. The SNP causes the transition in the 4558th nucleotide with subsequently exchange of the amino acid isoleucine (Ile) for the valine (Val) amino acid in the position 530 (Čítek et al., 2010). Another locus, which may contribute to the resulting meat tenderness, is the locus for myostatin (*MSTN*). Mutations in this locus cause hyperplasia/hypertrophy of muscle fibers. The ultimate result is the visualization of so-called "double-muscling". The group of animals with mentioned type of muscles are characterized by increasing the muscle mass of around 20%. Authors show at potential influence on the power cut (Carcass et al., 2004).

2 Material and methods

The study was carried out on 258 bulls of Czech Simmentals for *CAPN530* locus, and on 228 bulls of the same breed, for the locus *MSTN*. DNA was isolated from the meat samples using commercially available kits. *CAPN530* locus was genotyped according to the study of Ricon and Medrano (2006) and the locus *MSTN* following the study of Zhang et al. (2007). Allele and genotype frequencies were calculated for both loci. The shear force was determined in raw and grilled meat on the 1st, 14th and 28th day after slaughter. Meat was stored at 4 °C, 80 % humidity, during the whole experiment. The grilling was performed at 80 °C for 7 minutes, to ensure the temperature of 75°C inside of the meat. Determination of shear force was carried out using a Warner-Bratzler's shear test on the device TA.XTPlus Texture Analyzer (Stable NiCr Systems Ltd., Godalming, UK). The water binding capacity was determined according to the study of Ingr (1977). Subsequently, the statistical evaluation of the potential association between genotypes and power cut was evaluated. Statistical analysis was performed using Statistica 12.

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3 Results and discussion

The predominated G allele (frequency of 0.622) over the allele A (0.378) was found for the locus CAPN530. The highest frequency (0.523) in the population was stated for heterozygous AG genotype. The homozygous genotype GG was the second most frequent (0.361), the frequency of AA genotype was of 0.116. These results are in slight conflict with other studies (Pinto et al., 2010), where the AA genotype was evaluated as rare with a frequency of 0.01. In contrary, the presence of mentioned genotype is for our group approximately tenfold higher.

The MSTN locus showed significant superiority in the frequency of AA genotype (0.729). Together with the genotype AB (0.258) all individuals represented 98.7 % of genotypes in the group studied. Therefore, there was stated significant predominance of allele A over B (0.858, and 0.142, respectively). In comparison to study of Zhang et al. (2007) on three breeds of Chinese cattle, the frequencies of genotypes AA and AB are in our group significantly lower. Zhang et al. (2007) found the frequency of AA genotype from 0.910 to 0.946, depending on the breed.

ANOVA statistical method revealed the relationship between polymorphisms and power cut. As statistically significant was found the relationship between CAPN530 genotypes and power cut in raw and grilled meat in the 1st day after the slaughter ($P < 0.05$) and between genotypes and power cut in grilled meat on days 14 and 28 post mortem ($P < 0.05$). The highest value of shear force was found always in genotype AA. No statistical differences were found in shear force between alleles. The locus MSTN did not have any significant effect on the shear force ($P < 0.05$). The results' variations of both loci can be explained by their different exposure time in the body – the calpain operates in *postmortem* whilst myostatin in *premortem* period. However, the MSTN locus showed a statistically significant effect of genotype on the water binding capacity ($P < 0.05$). This association was confirmed in the samples measured on the 1st and 14th day after slaughter. Here, it must be mentioned that the frequencies of genotypes in MSTN locus were unbalanced, so the genotype BB was found in 3 individuals only.

4 Conclusions

The CAPN530 locus has been proved as a candidate locus for the beef shear force. The MSTN locus showed a potential relationship to water binding capacity. Anyway, it is necessary to confirm the results by follow-up studies in other breeds, and in groups with balanced genotype frequencies.

Acknowledgments

This research was supported by the project GAJU 002/2016/Z, and the Ministry of Agriculture, project QI91A055.

References

- CASAS E. et al. (2004). Association of myostatin on early calf mortality, growth, and carcass composition traits in crossbred cattle. *Journal of Animal Science*, vol, 82, pp. 2913–2918
- ČÍTEK J. et al. (2010). Genetic markers for qualitative traits in meat and milk. České Budějovice: Jihočeská univerzita v Českých Budějovicích, 154 p. (in Czech).
- INGR I. (1977) Technology of Production and Processing of Animal Products II: Tutorials. Praha: SPN, 100 p. (in Czech).
- PINTO L.F.B. et al. (2010) Association of SNPs on CAPN1 and CAST genes with tenderness in Nellore cattle. *Genetics and Molecular Research*, vol. 9, pp. 1431–1442. doi: <http://dx.doi.org/10.4238/vol9-3gmr881>
- RICON G. and MEDRANO J.F. (2006) Assays for genotyping single nucleotide polymorphisms in the bovine CAPN1 gene. *Animal Genetics*, vol. 37, pp. 293–307. doi: <http://dx.doi.org/10.1111/j.1365-2052.2006.01430.x>
- ZHANG et al. (2007). Association between Polymorphisms of MSTN and MYF5 Genes and Growth Traits in Three Chinese Cattle Breeds. *Asian-Australasian Journal of Animal Sciences*, vol. 20, pp. 1798–1804. doi: <http://dx.doi.org/10.5713/ajas.2007.1798>