

Association of the Ile-442-Met substitution in *NCAPG* with birth weight in German Angus and German Simmental cattle (Brief Report)

Assoziationsanalyse der Ile-442-Met Substitution im *NCAPG*-Gen mit Geburtsgewicht bei Deutsch Angus und Deutsch Fleckvieh (Brief Report)

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Background

The optimal birth weight (BW) of a calf is important and an indicator of the chance to survive and performing later in life (Maltecca *et al.* 2009). The search for the genetic background of BW in cattle on BTA6 is in the focus of many studies. One QTL at 1 cM was described in an Angus × Brahman cross population (Kim *et al.* 2003). Three QTL for BW had been identified at BTA6 at 10 cM, 35-49 cM and 83-86 cM in a commercial line of *Bos taurus* (Kneeland *et al.* 2004). One of these was confirmed in a Jersey × Holstein cross population as a putative QTL at 41 cM (Maltecca *et al.* 2009). In a Holstein × Charolais cross cattle population a highly significant QTL for BW was detected on BTA6 in the same region between BM1329 and DIK1054 (Gutierrez-GIL *et al.* 2009). In another study with Holstein × Charolais the QTL was confirmed and the SNP in this QTL with the strongest effect on BW was in non-SMC condensing I complex, subunit G (*NCAPG* 1326T/G) (Eberlein *et al.* 2009). This SNP induced a Ile-442-Met substitution in the amino acid sequence.

It was the aim of this study to validate this SNP by analysing the effect of the Ile-442-Met substitution in *NCAPG* on birth weight in two important beef cattle breeds in Germany.

Procedures

Animals

507 offspring (German Angus n=322, German Simmental n=185) of six *NCAPG* (Ile-442-Met) heterozygous sires (German Angus n=3, German Simmental n=3) kept at Rudlos Experimental Farm, Hesse, Germany were included in this study. The birth weight (BW) was normally distributed in both breeds. In German Angus calves the mean of the BW with 38.29 kg ± 5.45 kg is less than in German Simmental with 42.28 ± 5.95 kg.

Genotyping the single nucleotide polymorphism

The nonsynonymous SNP in *NCAPG*, 1326T>G with the amino acid substitution Ile-442-Met, was genotyped by PCR-RFLP with *TasI* as described in Eberlein *et al.* (2009).

Statistical analyses

Association analyses between genotype and birth weight was done using a variance analysis including sire nested within breed, sex and genotype as fixed effects and dam and residual as random effects. The interaction of genotype and breed was also tested.

Results and discussion

The allele frequencies are significantly ($P < 0.0001$) different between the two breeds. In German Angus (GA) *NCAPG*, 1326T with 60.1 % is the main allele while in German Simmental (GS) *NCAPG*, 1326G shows a high frequency with 67.0 %.

The effect of the interaction genotype*breed on BW was not significant, so the effect of the genotypes is the same in both breeds.

The genotype of *NCAPG* (Ile-442-Met) influenced the BW highly significant ($P < 0.0001$). The LSMMeans for the genotypes are shown in Table 1.

Table 1
LSMeans and standard errors of the birth weight for the three *NCAPG* (Ile-442-Met)-genotypes

genotype	LSMean of BW	standard error
GG	41.7 ^a	0.49
GT	40.7 ^a	0.36
TT	38.7 ^b	0.51

^{a,b}LSMeans with different letters differed significantly ($P = 0.001$)

NCAPG G benefits the BW. Animals with the allele G (homozygous or heterozygous) showed a significant higher BW (Table 1). These results confirmed the study of Eberlein *et al.* (2009) with likewise higher BW in crossbreeds in combination with allele G. They estimated the effect of the QTL-allele (Q/q) with 3.78 kg increase of BW with Q (associated with allele G of *NCAPG* Ile-442-Met). This is nearly the same effect like in our study. The LSMMeans of both homozygous genotypes differed about 3 kg (Table 1). In GS allele G is the main allele and the BW in GS is about 4 kg higher than in GA.

Although the physiological role of *NCAPG* is still unknown, it is supposed, that the gene is involved in the arginine metabolism and therefore the muscle metabolism (Weikard *et al.* 2010). We could confirm the significant role of the *NCAPG*, 1326T>G SNP on birth weight in the two phenotypic different beef cattle breeds German Angus and German Simmental. Before implementation of this SNP in marker assisted selection further investigations for the optimal birth weight should be done. A higher BW can cause more difficult births or cesarean sections while a lower BW can be associated with reduced survival rate and daily gain during suckling period and therefore economical losses. With the further knowledge of the optimal BW and the frequency of the SNP in different breeds a decision for its use in breeding programmes is possible.

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