

## Verification of a QTL on BTA1 for temperament in German Simmental and German Angus calves (Short Communication)

KRISTINA GLENSKE<sup>1</sup>, HORST BRANDT<sup>1</sup>, EVA-MARIA PRINZENBERG<sup>1</sup>, MATTHIAS GAULY<sup>2</sup>  
and GEORG ERHARDT<sup>1</sup>

<sup>1</sup>Department of Animal Breeding and Genetics, Justus-Liebig-University of Giessen, Giessen, Germany, <sup>2</sup>Department of Animal Science, Georg-August-University of Göttingen, Göttingen, Germany

### Abstract

A QTL on BTA1 near *BMS574* was described for temperament in cattle. Eight German Simmental and six German Angus half sib families with all together 962 calves born in four consecutive years were used to verify the importance of this QTL. *BMS574* and four flanking microsatellites (*INRA117*, *DIK634*, *BMS4020* and *DIK4957*) were used in the study. Microsatellite *INRA117* was monomorphic in both breeds and replaced. The number of alleles varied from two to 16 within breeds. Allele frequencies differed between the breeds and ranged from less than one percent to 99%. All calves have been tested and scored for their behaviour in three different tests (tethering test, weighing test, separation- and restraint test). In addition, in German Simmental the status of polledness, horned or scurs respectively was recorded. A variance analysis separated by breeds was conducted for all microsatellites and the scores. The allele 169 of *BMS1928* showed a significant effect on the score during weighing in German Simmental. Effects of *BMS574* approached *P*-values near the 5%-level in both breeds. So the study confirmed the importance of the proximal region of BTA1 in genetic background of behaviour in suckler cow calves.

**Keywords:** BTA1, microsatellites, temperament, polledness, beef cattle, calves

### Zusammenfassung

#### Bestätigung eines QTL auf BTA1 für Temperament bei Kälbern der Rassen Deutsches Fleckvieh und Deutsche Angus (Kurzmitteilung)

Auf BTA1 bei *BMS574* wurde ein QTL für Temperament bei Rindern beschrieben. Zur Bestätigung dieses QTL wurden acht Deutsches Fleckvieh und sechs Deutsche Angus Halbgeschwisterfamilien mit insgesamt 962 Kälbern, die in vier aufeinanderfolgenden Jahren geboren wurden, untersucht. *BMS574* und vier flankierende Mikrosatelliten (*INRA117*, *DIK634*, *BMS4020* und *DIK4957*) wurden analysiert. *INRA117* stellte sich als monomorph heraus und wurde ersetzt. Die Anzahl der Allele je Mikrosatellit variierte zwischen zwei und 16 zwischen den Rassen und die Allelfrequenzen reichten von weniger 1 % bis 99%. Alle Kälber durchliefen drei verschiedene Verhaltenstests (Anbinde- test, Wiegetest, Separier- und Rückhaltetest) mit entsprechenden Bewertungen in Form von scores. Zusätzlich wurde bei dem Deutschen Fleckvieh noch der Hornstatus mit erfasst und in die Analyse einbezogen. Statistisch wurde eine nach Rassen getrennte Varianzanalyse durchgeführt. Das Allel 169 von *BMS1928* hatte

einen signifikanten Effekt auf den Score während des Wiegens bei Deutschem Fleckvieh. *BMS574* zeigte Effekte nahe der 5%-Signifikanzgrenze in beiden Rassen. Somit bestätigt diese Studie den Einfluss des proximalen Abschnittes von BTA1 auf das Temperament bei Mutterkuhkälbern.

**Schlüsselwörter:** BTA1, Mikrosatelliten, Temperament, Hornstatus, Fleischrind, Kälber

## Introduction

QTL-studies with beef cattle are limited although their importance is increasing. In beef cattle the temperament and behaviour of the animals is very important; for the safety and welfare of the animals and for the safety of the farmer (GRANDIN 1993). The temperament also influences the daily gain of cattle and such with calmer temperament show higher gains than nervous cattle (VOISINET *et al.* 1997). Also the feeding duration and temperament is genetically correlated (NKRUMAH *et al.* 2007).

A genetic background of temperament is known and the estimated heritabilities of temperament in different tests ranged between 0.0 and 0.33 in German Angus and German Simmental (GAULY *et al.* 2002). In Hereford and Simmental a heritability of 0.03 (HEARNSHAW and MORRIS 1984) and in beef cattle crosses of 0.49 (NKRUMAH *et al.* 2007) are described.

One earlier study with suckler cows measured temperament in Canadian Beef Cattle electronically as movements in isolation of fellows (SCHMUTZ *et al.* 2001). They described among others a QTL on BTA1 near *BMS574* for temperament and habituation.

This study was conducted to verify this QTL and analyse the proximal region of BTA1 for the importance for behaviour in beef cattle calves.

## Material and methods

The temperament of purebred German Angus and German Simmental calves was scored in three different testing situations. The calves were born in four consecutive years and reared at the Experimental Farm Rudlos of the University Giessen. All together, 962 calves descending from six German Angus sires (545 calves) and eight German Simmental sires (417 calves) respectively were evaluated. At three weeks of age the first test, a tethering test (BOISSY and BOUISSOU 1988), was done. The calves were fixated with a headstall and their behaviour after two minutes fixation scored (score TT). The second test was a weighing test (TULLOH 1961) with a commonly used weighing machine at five month of age. The calves were scored while entering the scale (score WT1) and during the weighing process (score WT2). At the age of seven to eight month a separation- and restraint test (LE NEINDRE *et al.* 1995) was done and scored as described in GAULY *et al.* (2001) (score ST). The scores ranged from 1=calm to 5=very excited and nervous. The distribution of the scores is shown in Table 1. In German Simmental 47.86 % of the calves were polled, 34.51 % were horned and 17.63 % had scurs.

Table 1

Distribution of the assigned values (1-5) of the scores of tethering test (TT), weighing test (WT1 and WT2) and separation- and restraint test (ST) in percent for German Angus (GA) and German Simmental (GS) calves  
*Verteilung der Bewertungen (1-5) der Scores für den Anbinde- (TT), Wiegetest (WT1 und WT2) und Separier- und Rückhaltetest (ST) in Prozent bei Deutsche Angus (GA) und Deutsches Fleckvieh (GS) Kälbern*

		1	2	3	4	5
TT	GA	39.46	35.01	12.77	11.80	0.97
	GS	35.25	41.25	11.75	11.23	0.52
WT1	GA	54.67	16.76	11.43	14.86	2.29
	GS	54.08	14.80	11.73	17.09	2.30
WT2	GA	16.22	38.17	34.92	8.97	1.72
	GS	11.03	37.44	35.38	14.10	2.05
ST	GA	18.62	47.41	25.91	7.87	0.19
	GS	15.31	42.60	30.61	8.93	2.55

All calves were genotyped for *BMS574* and in addition two microsatellites proximal (*INRA117*, *DIK634*) and distal (*BMS4020*, *DIK4957*) each on the basis of the MARC USDA cattle genome map. In a first analysis *INRA117* was detected to be monomorphic and replaced by *BMS1928*. One duplex-PCR with *BMS4020* and *DIK4957* and single PCRs for the other microsatellites were established. The microsatellites were analysed at the ALF express (Amersham Bioscience) under standard conditions and alleles were scored with the program AlleleLocator version 1.03. The statistical analysis was done with SAS version 8.01 separated by breeds. In the variance analysis sex and year were included as fixed effects and the sire as random effect. In German Simmental the status horned or polled (with scurs belonging to polled) was used as additional fixed effect. As covariate the age at test was used. For the estimation of allele substitution effects the analysis was done for each microsatellite separately. The allele with the highest frequency per breed was set as standard allele (HOH and OTT 2001) and for all other alleles with a frequency of more than 5% the number of alleles for each animal (0, 1 or 2) was used as covariate in a linear model. The significance threshold of 5% was Bonferroni-corrected.

## Results and discussion

The number of alleles varied between the breeds from 2 to 16 within breeds (Table 2).

Table 2

Analysed microsatellites with position on BTA1 (MARC USDA database), number of detected alleles and allele sizes in German Angus and German Simmental

*In die Analyse einbezogene Mikrosatelliten mit der Position auf BTA1 (nach der MARC USDA Datenbank), Anzahl der identifizierten Allele und Allelgrößen in den Rassen Deutsche Angus und Deutsches Fleckvieh*

Microsatellite	German Angus			German Simmental		Total number of detected alleles
	Position	Allele size	N of alleles	Allele size	N of alleles	
<i>BMS1928</i>	8.48 cM	143-183	16	151-183	13	19
<i>DIK634</i>	10.01 cM	226-234	4	228-230	2	4
<i>BMS574</i>	15.43 cM	133-155	8	143-153	2	8
<i>BMS4020</i>	18.38 cM	119-121	2	119-121	2	2
<i>DIK4957</i>	20.70 cM	184-190	4	186-190	3	4

The frequencies of alleles ranged from one percent up to 99% with great differences between the breeds. For example the allele *BMS1928* (145) with 15.7% frequency in German Angus which was not shown in German Simmental. On the other hand the allele *BMS1928* (163) is in German Simmental (29.08%) tenfold frequently than in German Angus (2.89%). The standard alleles are the same in both breeds namely *BMS1928* (161), *DIK634* (230), *BMS574* (149), *BMS4020* (121) and *DIK4957* (186).

In German Angus four alleles of *BMS1928* (145, 157, 159 and 183) and in German Simmental three other alleles (163, 167 and 169) were tested. For *DIK634* two alleles in German Angus (228 and 234) and one of these in German Simmental (228) were included in the analysis. For the other three microsatellites the same alleles were tested in both breeds, namely four for *BMS574* (143, 147, 151 and 153) and one for *BMS4020* (119) and *DIK4957* (188) each.

The allele 169 of *BMS1928* had a significant effect on score WT2 in German Simmental with a *P*-value of 0.0078 (5%-threshold  $P=0.016$ ). Close to the 5%-threshold ( $P=0.0125$ ) was the *BMS574* allele 153 with  $P=0.0178$  for score ST in German Simmental. The same allele is also in German Angus close to the 5%-threshold with score WT2 and a *P*-value of 0.0128.

The result is indicating that the important region of BTA1 concerning behaviour of calves is the proximal end above 15 cM. This validated the results of SCHMUTZ *et al.* (2001) although the behaviour tests and breeds analysed were different. In a recently published QTL-study the microsatellite *BM6438* located at 1.781 cM showed a significant influence on habituation in two social separation tests (GUTIÉRREZ-GIL *et al.* 2008). In addition the polled locus, located in proximal region of BTA1 (GEORGES *et al.* 1993, SCHMUTZ *et al.* 1995, DRÖGEMÜLLER *et al.* 2005), is discussed to influence the behaviour of animals. With status of horn included in the model of German Simmental a significant effect of the most proximal microsatellite was proven. Furthermore a difference in allele-frequencies between a polled breed (German Angus) and a breed with polled and horned animals (German Simmental) was shown. So we delivered with this study another point for the importance of the proximal part of BTA1 in cattle behaviour and this region should be kept clearly in mind.

## Acknowledgements

We thank Holger Mathiak, Carina Urban and the staff at the Rudlos Experimental Farm for conducting the behaviour tests. This work was financially supported by the German Research Foundation within SFB299.

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*Received 10 June 2009, accepted 18 January 2010.*

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Corresponding author:

GEORG ERHARDT  
email: georg.erhardt@agr.uni-giessen.de

Department of Animal Breeding and Genetics, Justus-Liebig-University of Giessen, Ludwigstr. 21 B, 35390 Giessen, Germany

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