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

KRISTINA GLENSKE¹, HORST BRANDT¹, EVA-MARIA PRINZENBERG¹, MATTHIAS GAULY² and GEORG ERHARDT¹

¹Department of Animal Breeding and Genetics, Justus-Liebig-University of Giessen, Giessen, Germany, ²Department 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)

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

<table>
<thead>
<tr>
<th>Test</th>
<th>GA</th>
<th>GS</th>
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<tbody>
<tr>
<td>TT</td>
<td>39.46</td>
<td>35.25</td>
</tr>
<tr>
<td>WT1</td>
<td>54.67</td>
<td>54.08</td>
</tr>
<tr>
<td>WT2</td>
<td>16.22</td>
<td>11.03</td>
</tr>
<tr>
<td>ST</td>
<td>18.62</td>
<td>15.31</td>
</tr>
</tbody>
</table>

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).
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.

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Corresponding author:

GEORG ERHARDT
e-mail: georg.erhardt@agrar.uni-giessen.de

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