The effects of polymorphisms in the *calpastatin* and *μ-calpain* genes on beef tenderness are breed-specific

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Context:

There is no routine measure of beef meat quality. A solution to improve meat tenderness could be to develop a marker assisted selection. Calpastatin/μ-calpain protein complex is involved in the process of post-mortem tenderization of meat.

Objectives:

1) Estimation of allelic frequencies of markers in the *calpastatin* (*CAST*) and *μ-calpain* (*CAPN1*) genes
2) Estimation of the effects of the polymorphisms on meat tenderness

Material and Methods:

1114, 1254 and 981 purebred young bulls from respectively 48 Charolais, 36 Limousin and 30 Blonde d'Aquitaine sires.
2 traits: Warner-Bratzler shear force and meat tenderness score by a test panel

7 SNP in the *CAST* and *CAPN1* genes:

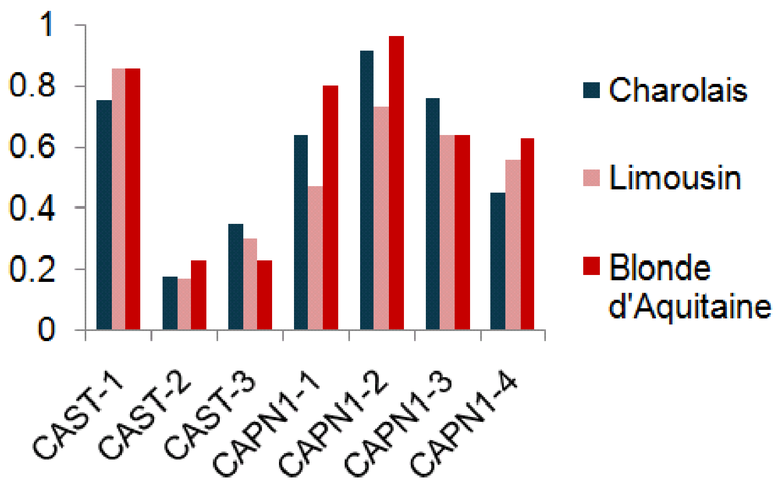
Gene	BTA	SNP name	Location	Position on Btau 4.0	Polymor-phism	Amino acid substitution	Other SNP name
CAST	7	*CAST-1*	Intron 8	97531815	A/G		
		CAST-2	Exon 30	97574679	A/G		
		CAST-3	Exon 30	97576054	A/G		
CAPN1	29	*CAPN1-1*	Exon 6	45219395	A/G		
		CAPN1-2	Exon 9	45221250	C/G	Gly/Ala	CAPN316
		CAPN1-3	Exon 14	45237834	A/G	Ile/Val	CAPN530
		CAPN1-4	Intron 19	45241089	A/G		

longissimus muscle
↓
steaks
↓
14 day ageing at 4°C
↓
cooking to an internal temperature of 55°C
↓
measures

Analyses were conducted by breed. Regressions on each SNP and multiple regressions on haplotypes were performed in a mixed model (random effect of the sire).

Results:

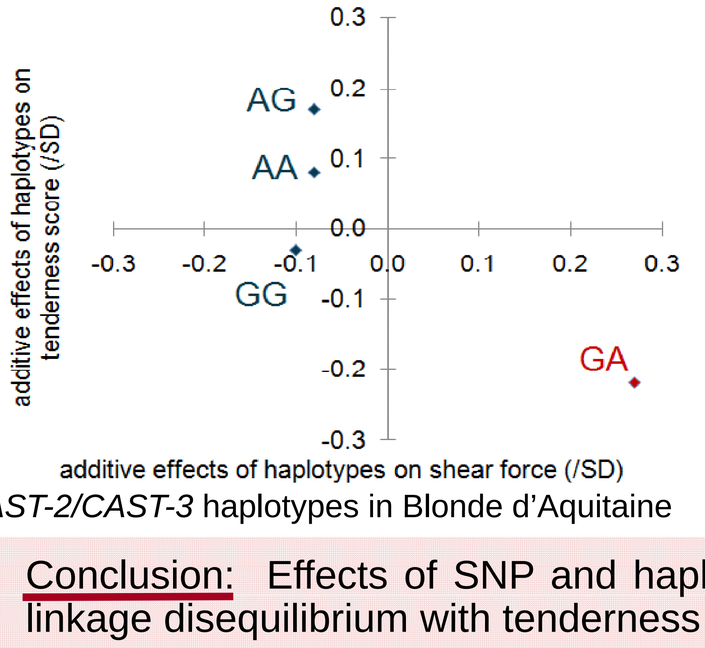
Frequencies of the G allele:



Additive effects of the G allele divided by the phenotypic standard deviation:

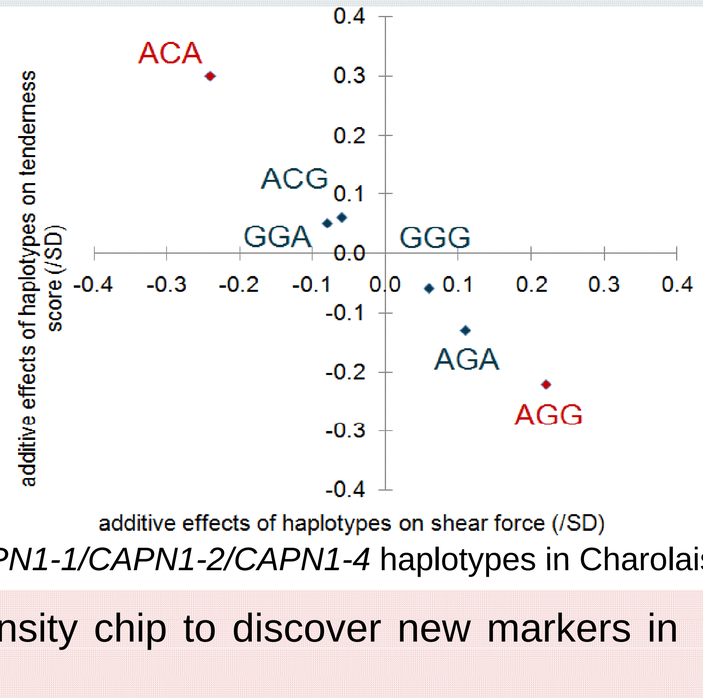
Markers	Charolais		Limousin		Blonde d'Aquitaine	
	Shear force	Tenderness score	Shear force	Tenderness score	Shear force	Tenderness score
CAST-1	-0.08 ns	0.02 ns	0.08 ns	-0.17 **	0.06 ns	-0.10 ns
CAST-2	0.11 ns	0.06 ns	-0.03 ns	-0.04 ns	0.18 **	-0.22 ***
CAST-3	0.12 *	-0.07 ns	-0.004 ns	0.03 ns	-0.06 ns	0.05 ns
CAPN1-1	-0.03 ns	0.04 ns	-0.005 ns	0.05 ns	-0.08 ns	0.12 ns
CAPN1-2	0.22 **	-0.25 **	0.12 *	0.01 ns	-0.05 ns	0.06 ns
CAPN1-3	-0.07 ns	0.02 ns	-0.05 ns	0.05 ns	0.08 ns	-0.003 ns
CAPN1-4	0.11 *	-0.11 *	0.01 ns	0.02 ns	0.03 ns	-0.04 ns

CAPN1-2 and *CAPN1-4* had a signifcant effect on shear force and tenderness score in the Charolais breed.
CAST-2 had a signifcant effect on the two traits in the Blonde d'Aquitaine breed.



CAST-2/CAST-3 haplotypes in Blonde d'Aquitaine

We found a significant effect of the CAST GA haplotype on shear force (+0.27 SD) and tenderness score (-0.22 SD) in Blonde d'Aquitaine.
In the Charolais breed, the CAPN1 ACA haplotype was associated with a low shear force (-0.24 SD) and a high tenderness score (+0.30 SD) and the AGG haplotype with a tough meat (|0.22 SD|).



CAPN1-1/CAPN1-2/CAPN1-4 haplotypes in Charolais

Conclusion: Effects of SNP and haplotypes were breed-specific. The use of a high density chip to discover new markers in linkage disequilibrium with tenderness QTL is very promising.

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