MUSCLE PROTEOME OF "BLONDE D'AQUITAINE" YOUNG BULLS AND MEAT EATING QUALITIES

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Introduction

Blonde d'Aquitaine is a bovine French breed renowned for its palatable meat. Sensory properties of meat depend largely on muscle composition in terms of proteins. For example, some proteins and fragments detected 72h *post mortem* correlate well with pork tenderness (Lametsch *et al.*, 2003). The present study was designed to determine whether muscle proteins present early after slaughter predict later eating qualities of aged and cooked meat of Blonde d'Aquitaine, using proteome techniques.

Materials and Methods

Ten 15-month old Blonde d'Aquitaine bulls were slaughtered and *Longissimus thoracis* samples were taken 1-h post-mortem. The *Longissimus thoracis* muscle was then separated from the carcass, aged for 14 days and grilled. Meat sensory properties (initial, overall and residual tenderness, flavour intensity, juiciness) were rated by a trained panel. Muscle samples taken at slaughter were characterised by measuring citrate synthase (CS, oxidative metabolism) activity, total hydroxyproline (OH-Prol, i.e. collagen) content and composition in myosin heavy chain (MyHC) types (I, IIa, IIx). Two-dimensional electrophoresis (2DE) was performed (5-8 pH gradient, 11% polyacrylamide gel, 800µg total protein per gel). Proteins of interest were identified by MALDI-ToF mass spectrometry.
Pearson and Spearman rank correlations were calculated between muscle traits or spot intensities and sensory ratings. Proteins significantly correlated in both correlations to sensory ratings were subjected to a multiple forward stepwise regression analysis. Principal Component Analysis (PCA) was performed for each sensory property using the 9 proteins identified as the most strongly correlated with the sensory trait.

Results and Discussion

OH-Prol was negatively correlated to CS (Table1), an oxidative metabolism marker. Muscle fibre composition, in terms of MyHC types, were not strongly associated with measured meat quality traits. In accordance with previous reports (Renand *et al.*, 2001), the higher the total collagen content, the less tender the meat initially and overall and the tougher (P<0.10) the bolus when swallowed (residual tenderness). This is consistent with the positive link between initial and overall tenderness, themselves negatively linked to residual tenderness.

Table 1: Correlation coefficients between muscle traits and sensory ratings. * p<0.05; ** p<0.01; *** p<0.005.

		CS	OH-Prol	MyHC			tenderness			flavour
				I	IIa	IIx	initial	overall	residual	
OH-Prol		-0.63*								
	I	0.45	-0.38							
MHC	IIa	0.57	-0.15	0.20						
	IIx	-0.37	0.43	-0.47	-0.49					
	initial	0.35	-0.87***	0.22	-0.04	0.51				
tenderness	overall	0.30	-0.87***	0.09	0.00	-0.42	0.97***			
	residual	-0.24	0.59	0.31	0.26	0.26	-0.67*	-0.68*		
flavour		-0.41	-0.16	0.05	-0.72*	0.12	0.31	0.27	-0.46	
juiciness		0.06	-0.59	0.31	-0.50	-0.30	0.59	0.53	-0.57	0.70*

Out of 250 separated by 2DE, more than 40 were linked to texture and juiciness, whereas only 3 spots could predict flavour (Table 2). The finding that only few proteins, within the limits of observed molecular weight and isoelectric point, predict flavour, is coherent with the report that complex mechanisms involving lipid content, *post mortem* oxidation and production of small peptides determine flavour of cooked beef (Spanier *et al.*, 2004).
Regarding texture attributes, only positive correlations were found between spot intensities and initial/overall tenderness, while mostly negative correlations were found between spot intensities and residual tenderness, in accordance with the negative significant correlation between initial/overall and residual tenderness (Table 1). Several spots were good predictors of initial tenderness: spot 5702 alone (identified as succinate dehydrogenase: SDH; Figure 1) explains 67% of variability. Using two spots (0802 and 1301, non identified), 74% of variability can be explained.

Table 2: Number of spots significantly ($p<0.05$) correlated (Pearson and Spearman) with meat sensory ratings.

	initial tenderness	overall tenderness	residual tenderness	flavour	juiciness
Positive correlation	31	27	8	2	18
Negative correlation	0	0	39	1	2

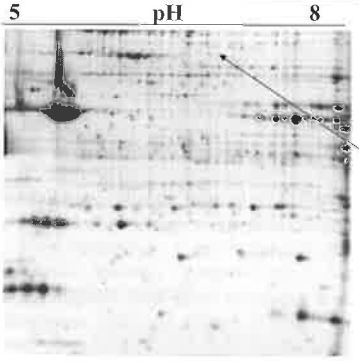
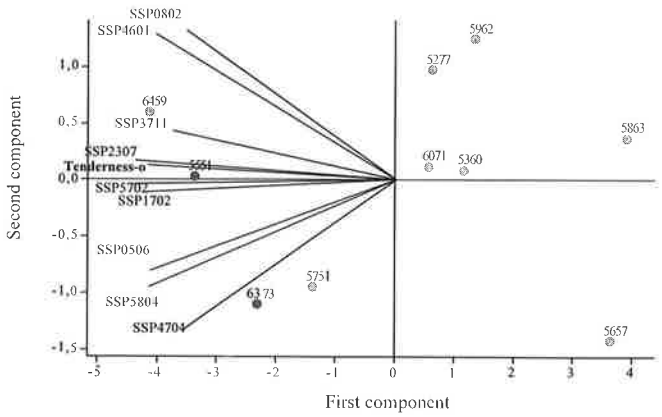


Figure 1: 2DE separation of bovine muscle total proteins and position of spot 5702.

PCA analysis (Figure 2) further illustrates the clear association of overall tenderness with several spots (e.g. 2307 and 5702) on the first axis of PCA (90.2% of variation explained). This axis identifies correctly animals according to tenderness (e.g. animals 6459 and 5863, were rated most and least tender, respectively). The second axis (8.0% of variation explained) was not correlated with any of the phenotypic measurements.

Figure 2: PCA analysis of 10 animals (dots) and the 9 spots (lines) most strongly correlated with initial tenderness.



Conclusions

Presence of many early *post mortem* proteins, including SDH, predict later initial and overall tenderness. Results suggest that in Blonde d'Aquitaine young bulls, characterised by a mostly glycolytic muscle metabolism, animals with the "least glycolytic / most oxidative" muscles provide more tender meat.

References

Lamestch, R., Karlsson, A., Rosenvold, K., Andersen, H.J., Roepstorff, P. and Bendixen, E. (2003). Postmortem proteome changes of porcine muscle related to tenderness. *Journal of Agricultural and Food Chemistry, 51*, 6992-6997.

Renand, G., Picard, B., Touraille, C., Berge, P. and Lepetit, J. (2001). Relationships between muscle characteristics and meat quality traits of young Charolais bulls. *Meat Science, 59*, 49-60.

Spanier, A.M., Flores, M., Toldra, F., Aristoy, M-C., Bett, K.L., Bystricky P. and Bland, J.M. (2004). Meat flavor: contribution of proteins and peptides to the flavor of beef. In: "*Quality of fresh and processed foods*", ed. Shahidi *et al.*, Kluwer academic, p 33-49.