EFFECT OF BREED AND CASTRATION ON MUSCLE FIBRE TYPE, CROSS-SECTIONAL AREA AND MEAT TENDERNESS IN THE BEEF CATTLE

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Background
It is generally accepted that meat quality is affected by the metabolic and contractile characteristics of the muscle. The castration could be a tool to affect the muscle properties and meat quality.

Objectives
The present study aimed at estimating the effects of castration, age at castration and breed on fibre type composition of m. *Semimembranosus* and on tenderness of m. *L. thoracis*.

Methods
First trial – The study involved eighteen calves of Salers breed. At the beginning of the trial half of them were castrated. The animals of the two experimental groups were slaughtered after 190 days from the castration. After slaughter a portion of m. *Semimembranosus* was sampled and stored at -80°C. The histochemical analyses considered the fibre type composition (αW, αR and βR; Ashmore and Doerr, 1971) and the mean fibre cross-sectional area of each fibre type. Serial cross-sections were stained with azorubine (reference staining), processed for myofibrillar ATPase (Brooke and Kaiser, 1970) and stained for succino-dehydrogenase (SDH) activity (Pearse, 1969). Data were processed using a computerised image analysis system (Buche, 1990). Nine days *post mortem* a joint sample of m. *L. thoracis* was dissected from each carcass and Warner-Bratzler (WB) Shear Force test, sensory tenderness (AMSA, 1978) and Myofibrillar Fragments Length measurement (MFL; Olsson and Tornberg, 1992) were performed. *Second trial* – Forty eight calves of two genotypes (G) (24 Simmental – SIM - and 24 Salers - SAL) were used. Half of each genotype was castrated at a liveweight of 350 kg (CW350), the remaining were castrated at liveweight of 420 kg (CW420). In order to slaughter animals with adequate carcass fatness, the fattening period was different for each experimental group: 198 and 191 days for SIM CW420 and CW350, respectively, and 237 and 184 days for SAL CW420 and CW350, respectively. Histochemical and morphometrical analyses, instrumental and sensorial tenderness evaluations were performed as reported above using the same muscles. MFL was determined at 1, 4 and 9 days *post mortem*. Adipocytes presence was detected by colouring the serial cross-sections with Oil Red and then with Crystal Violet. Analysis of variance was performed using the GLM procedure (SAS Institute, 1990), by including castration as fixed effect in the first trial. Genotype, weight of castration and genotype x weight of castration were considered in the statistical analysis of the second trial.

Results and discussion
First trial – Castration treatment did not significantly influence the fibre type composition of m. *Semimembranosus* (Table 1). Steers showed smaller cross-sectional area of the three fibre types ($P<0.05$) than young bulls, likely due to the reduced androgen levels which are partially responsible of the muscle growth. *Second trial* – SIM showed an higher proportion of pure oxidative fibres (βR) than SAL ($P<0.01$) but the fibre cross-sectional area was not significantly different between breeds (Table 2). An interaction G x CW was observed on αW fibre cross-sectional area. Fibre dimensions of SAL CW420 were significantly greater than SAL CW350 (2822 *vs* 2499 μm^2), while the opposite trend was observed on SIM (2351 *vs* 3181 μm^2). This interaction could be explained by the number of days elapsed from castration to slaughter. In the SIM group the interval between the time of castration and slaughter was longer (148 *vs* 191days, for CW420 and CW350, respectively) than that observed for SAL (187 *vs* 184 days). The shorter castration to slaughter interval of SIM CW420, due to their more precocious carcass finishing, did not permit to achieve an adequate muscle hypertrophy. The meat of SAL was more tender than that of SIM ($P<0.05$), because of its typical higher marbling. The shear force was increased by delaying CW ($P<0.05$; Tab. 3). At the 9th day *post mortem* the MFL of m. L. *thoracis*, of SAL CW350 was shorter than that of SIM CW350 ($P<0.01$; Figure 1), indicating an improvement of meat tenderness. The meat of the late castrated SAL showed a longer MFL when compared with the earlier castrated animals and the difference was significant already at the 4th day *post mortem* ($P<0.01$; Figure 2).

Conclusions
Castration reduced the fibre cross-sectional area of each fibre type. Castration represents an adequate tool to improve meat quality, when CW and breed are considered. As regards the CW, meat resulted more tender on CW350 steers. Thus, postponing castration treatment up to 420 kg of liveweight does not appears to be profitable. The too short period elapsed from castration to slaughter did not allow SIM steers to achieve their own best performance.

Pertinent literature
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Tables

Table 1. Fibre type composition and fibre cross-sectional area of m. *Semimembranosus*

		BULL	STEERS	RSD
Animals	N.	9	9	
Fibre type composition:				
– αW	%	57.1	61.9	9.4
– αR	"	24.1	19.9	8.0
– βR	"	18.8	18.2	6.1
Fibre cross-sectional area:				
– αW	μm^2	4888[b]	3821[a]	996
– αR	"	3120[b]	2317[a]	709
– βR	"	3124[b]	2391[a]	678

RSD: residual standard deviation; *: P<0.05.

able 2. Fibre type composition, fibre cross-sectional area and adipocyte percentage of m. *Semimembranosus*

		SIMMENTAL		SALERS		Significance			RSD
		CW420	CW350	CW420	CW350	G[(1)]	CW[(2)]	G x CW	
Animals	N.	12	11	12	12				
Fattening period	d	198	191	237	184				
Castration to slaughter	"	148	191	187	184				
Fibre type composition:									
– αW	%	48.9	47.5	48.8	50.4				5.9
– αR	"	29.4	32.9	34.6	34.2				6.2
– βR	"	21.6	19.6	16.6	15.4	**			4.9
Fibre cross-sectional area:									
– αW	μm^2	2351	3181	2822	2499			*	546
– αR	"	1400	1844	1877	1540				448
– βR	"	1199	1611	1532	1427				309
Adipocytes	%	1.54	1.24	1.07	1.03				1.1

RSD: residual standard deviation; *: P<0.05; **: P<0.01; [(1)]G: genotype; [(2)]CW: castration weight

Table 3. Warner-Bratzler shear force (WB) and sensory tenderness of m *L. thoracis*

		SIMMENTAL		SALERS		Significance		RSD
		CW420	CW350	CW420	CW350	G[(1)]	CW[(2)]	
Animals	N.	12	12	12	11			
WB	Kg/cm^2	3.76	3.01	3.10	3.08		*	0.62
Tenderness	Score 1 to 5	2.99	3.13	3.23	3.35	*		0.35

RSD: residual standard deviation; *: P<0.05; [(1)]G: genotype; [(2)]CW: castration weight

Figure 1. Miofibrillar Fragments Length (MFL) of m. *L. thoracis* in Salers (SAL) and Simmental (SIM) steers castrated at 350 kg of liveweight

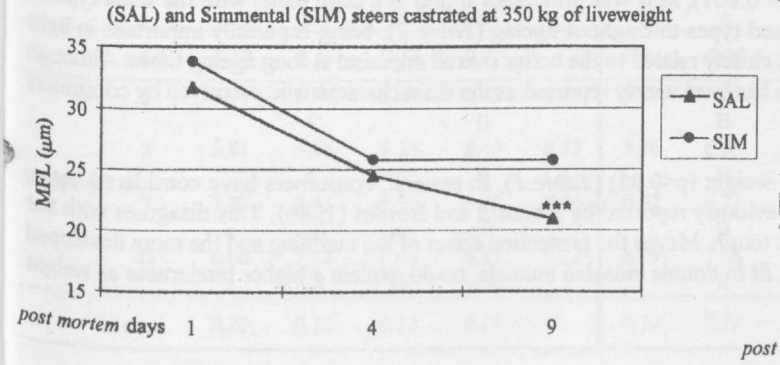

Figure 2. Miofibrillar Fragments Lenght (MFL) of m. *L. thoracis* in Salers steers castrated at 350 and 420 kg liveweight