Effect of tumbling and antioxidant marinating on the tenderness and nutritional qualities of intermediate tenderness beef cuts from grass-fed crossbreds

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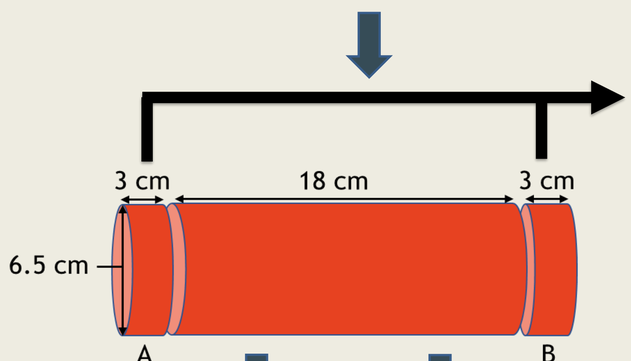
1. Background

Meat tenderness is a very important quality trait that determines consumer acceptance, repeat purchase and willingness to pay higher prices [1]. Several post-mortem tenderization techniques have been developed to improve meat tenderness. Tumbling, a mechanical tenderization technique, involves placing meat pieces in cylindrical drums subjected to rotation. This method is widely used in the manufacture of cooked ham and promotes the diffusion and absorption of marinades within the muscular tissue [2]. Since the beginning of the 21st century, there has been an increasing interest in the use of natural antioxidants to preserve meat products and enhance their nutritional qualities [3]. **This study aimed to investigate the combined effect of tumbling and antioxidant marinating processes on the tenderness and nutritional qualities of beef cuts from young grass-fed cattle.**

2. Materials and Methods

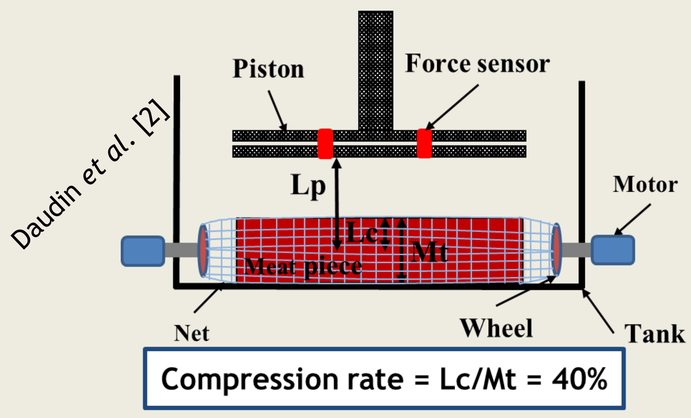
Sixteen *Semitendinosus* (ST) muscles from both sides of 8 young Angus x Salers crossbred cattle aged of 16 ± 1 months, fed on a 65% grass diet, were cut in meat pieces having 24 cm in long and 6.5 cm of diameter

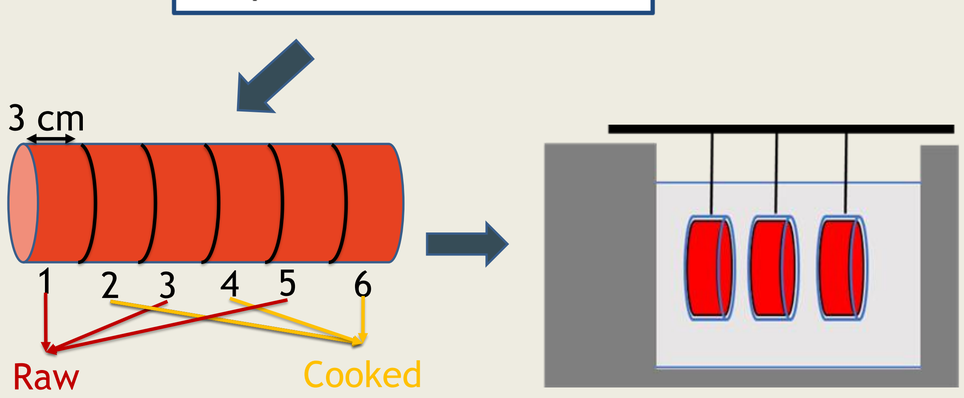


Control meat slices used either raw or cooked

Piece of meat either tumbled (T) or tumbled-marinated (TM) with water and grape seed and olive extract in a v/v 99.6% and w/v 0.4%

Tumbling for 12 hours, corresponding to 9500 consecutive compression cycles at 4 °C





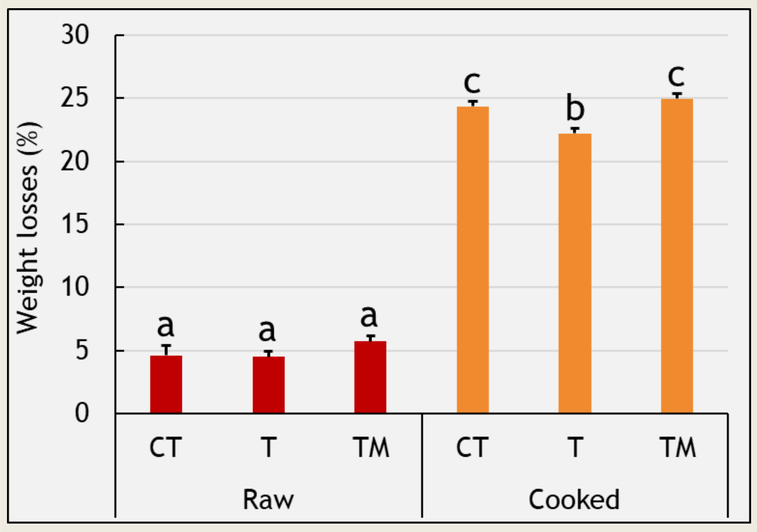
Meat pieces were cut into six 3 cm-thick meat slices

Cooking in a water bath at 60 °C for 1 h

Analysis on raw and cooked meat slices

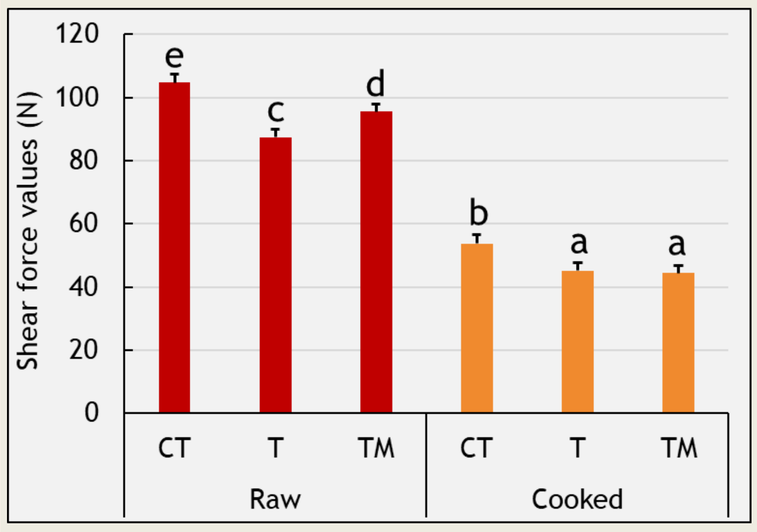
- ❑ **Weight losses**
- ❑ **Shear forces**
- ❑ **Fatty acids (FAs) composition**
- ❑ **Using a Linear mixed model in R for the data analysis**

3. Results



Weight losses (expressed as mean values ± SEM; n = 8 for each raw treatment and n ranges from 16 to 24 for each cooked treatment) of raw and cooked meat pieces from ST muscles of young cattle, tumbled, (T), tumbled-marianated (TM) or not (Control, CT). Different letters (a-c) refer to significant difference between treatments (P < 0.05).

- ➢ The cooked T meat pieces exhibited lower cooking losses compared to CT and TM meat pieces.
- ➢ The disruption of muscle structure in meat pieces would be more pronounced in simple tumbling than in tumbling-marinating.



Shear forces values (expressed as mean values ± SEM; n = 144 for each treatment) of raw and cooked meat pieces from ST muscles of young cattle, tumbled (T), tumbled marianated (TM) or not (Control, CT). Different letters (a-e) refer to significant difference between treatments (P < 0.05).

- ➢ The T and TM meat pieces demonstrated significantly (P < 0.05) lower shear force values than the CT meat pieces.
- ➢ The raw TM meat pieces were tougher than T meat pieces, but this difference was imperceptible when they were cooked.

Table. Mean quantities (n = 8) of the different groups of fatty acids (mg/100g of meat) contained in raw (R) and cooked (C) meat pieces from ST muscles of young cattle, tumbled (T), tumbled-marinated (TM) or not (Control, CT).

	Raw			Cooked			*P-value*		
Treatments	CT	T	TM	CT	T	TM	*SEM*	Cooking	Treatment
Σ SFA	548	537	728	713	865	847	*84.9*	***(C > R)	*0.09*
Σ MUFA	503	481	623	639	752	737	*73.1*	***(C > R)	*0.13*
Σ PUFA	189	163.4	232.8	260.4	248.4	304	*10.7*	***(C > R)	***(TM > T = CT)
Σ PUFA n-6	124	110	146	170	162	191	*6.04*	***(C > R)	***(TM > T = CT)
Σ PUFA n-3	57.6	46.6	76.2	82	74.9	100.7	*4.39*	***(C > R)	***(TM > T = CT)
Σ PUFA n-3 LC	30.1	22.2	41.1	44.3	36.3	55.7	*3.06*	***(C > R)	***(MM > CT > T)

*** refer to P-values < 0.001.

- ➢ The cooking process resulted in an average increase of 36% in fatty acids content, due to the concentration induced by juice losses, as shown by Gruffat *et al* [4].
- ➢ The antioxidant and PUFAs provided by grape seed and olive extracts promote the increase of n-6, n-3 and n-3 LC in TM meat pieces.

4. Conclusions

Tumbling and antioxidant marinating can be combined to better valorize the beef cuts by improving their tenderness and nutritional qualities. However, it would be relevant to conduct sensory studies to evaluate the consumer's interest in these products.

Acknowledgements

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References

1. Warner et al. (2022). *Meat Science 185: 108657.*
2. Daudin et al. (2016). *Journal of Food Engineering 170: 83-91.*
3. Falowo et al. (2014). *Food Research International 64: 171-181.*
4. Gruffat et al. (2021). *Food Chemistry 343: 128476.*