

Effect of diets on bovine muscle composition and sensory quality characteristics

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This study is part of the European



project

Is a 5-year integrated project funded by the European Commission.

Its overall aim is to advance **safety** and **quality** in beef production and processing, across **Europe** through research and innovation.

Its overall objectives are to enhance quality, choice and diversity in the beef chain, to **boost consumer trust** and to **invigorate the European beef Industry**.

Study the effect of diet on muscle characteristics and meat qualities

Effects of diets enriched with PUFAs and antioxidants on bovine muscle characteristics and meat sensory qualities of different animal types

Objectives

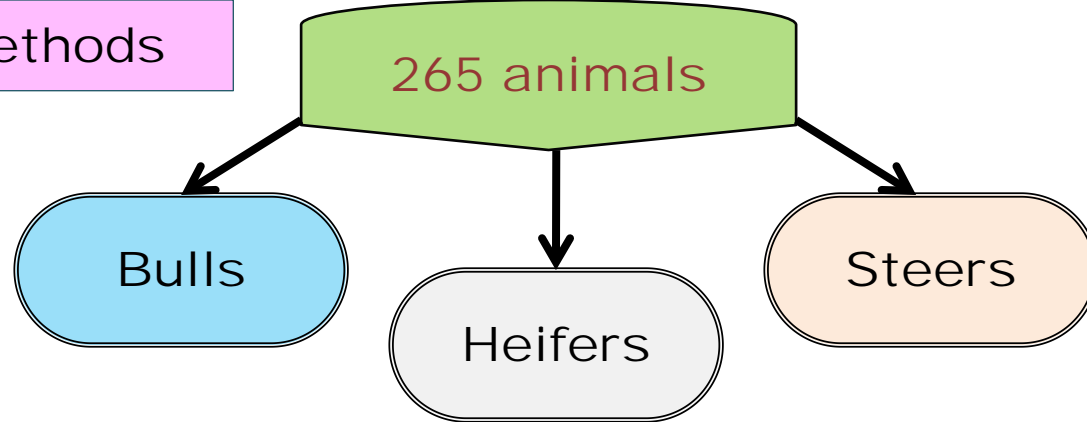
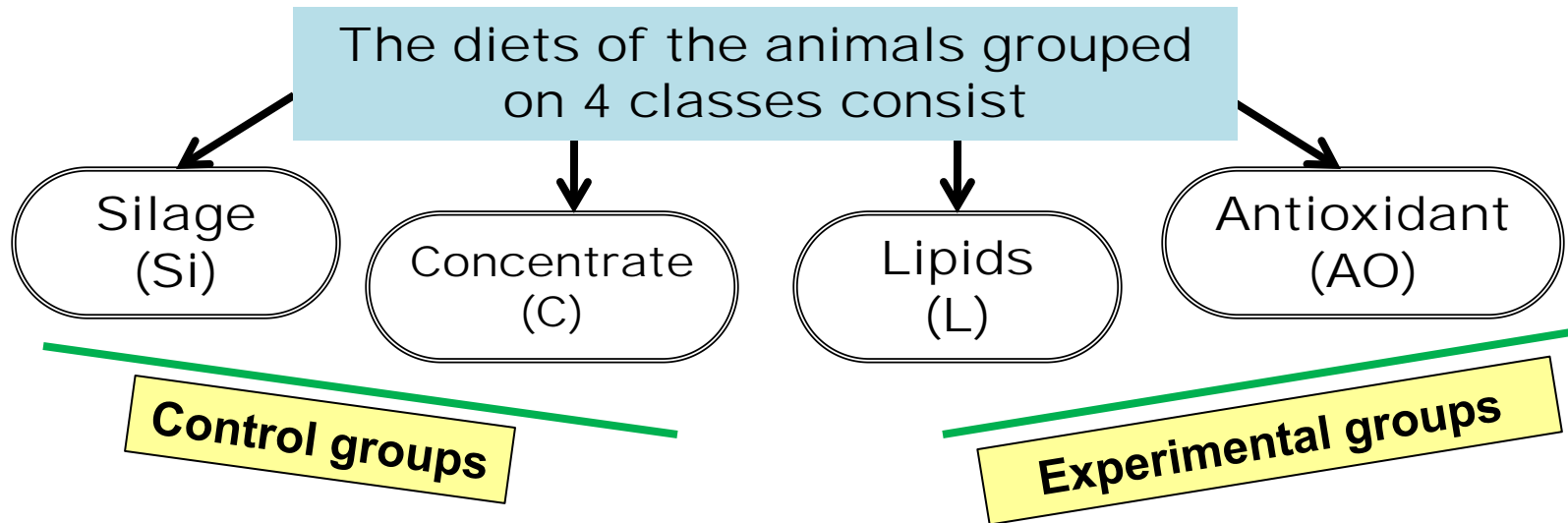


Table 1. Details of the animals used in the study

Gender	Breed	n	Rearing country
Bulls	Limousin (LIM)	25	France
	Blond d'Aquitaine (BA)	25	
	Aberdeen Angus (AA)	24	
	Holstein (HO)	25	Germany
Heifers	Belgian-Blue x Friesian (BF)	47	Ireland
	Angus x Friesian (AF)	47	
Steers	Belgian-Blue x Holstein (BH)	40	UK
	Charolais crossbred (CH)	32	



The finishing step period for the **265 animal types** was carried under intensive conditions with *ad libitum* access to feed.



- The animals were slaughtered under standard conditions at the same commercial fat class core ≈ 3 .
- Equal numbers of cattle from each nutritional regimen/animal type combination were processed on each killing day.
- All animals were without feed before slaughter for less than 24 hours and had free access to water.
- The carcasses were not electrically stimulated and they were chilled and stored at 4°C until 24 h *post-mortem*.

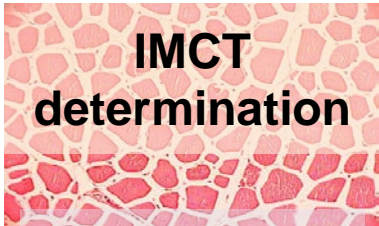


Longissimus thoracis muscle (right side)

1

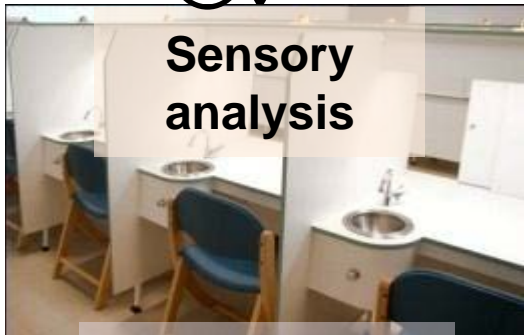
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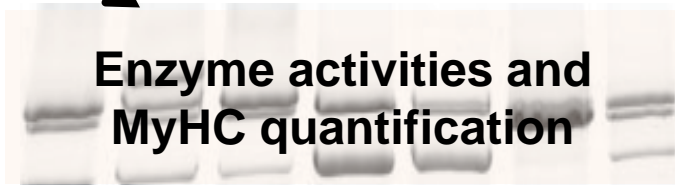
IMCT determination

Total and insoluble collagen content (Listrat et al., 1999)



Sensory analysis

(Gagaoua et al., 2013)



Enzyme activities and MyHC quantification

Glycolytic enzymes (PFK and LDH)
Oxidative enzymes (ICDH, CS and COX)
MyHC isoformes determination by 1D electrophoresis (Picard et al., 2011)

- Muscles cut into steaks, placed in plastic bags under vacuum and aged for 14 days (bulls and heifers) or 10 d (steers from UK) at 2-4°C.
- Steaks heated between two aluminium sheets, until the end-point temperature of 55°C or 74°C.
- The steaks were presented to 12 trained panelists



Sensory analysis on a 0 to 10 unstructured scale was used

Global tenderness (GT),
Juiciness (JUIC),
Beef flavour intensity (BF),
Abnormal flavour intensity (ABF),
Overall liking (OL).

- Statistical analysis: GLM (SAS Stat 9.1 and Xlstat 2009).

Table 2. Effect of diet on muscle characteristics.

Traits	Diet (n)	C 57	L 138	Si 28	AO 42	SEM	P-value
<i>Metabolic enzyme activities ($\mu\text{mol min}^{-1} \cdot \text{g}^{-1}$)</i>							
		Glycolytic		Oxidative			
ICDH		1.20c	1.40b,c	1.88a	1.60b	0.04	***
LDH		1075a	985b	865c	910b,c	12.03	***
PFK		103.6	106.2	118.1	102.6	3.38	ns
COX		15.36b	17.49a,b	20.17a	19.66a	0.37	**
CS		5.94	6.33	5.82	6.55	0.09	ns
<i>Collagen contents ($\mu\text{g OH-prol} / \text{mg DM}$)</i>							
Total collagen		3.45b	3.26b	3.58b	4.25a	0.07	***
Insoluble collagen		2.60b,c	2.46c	2.91a,b	3.09a	0.05	***
<i>Myosin Heavy Chain - MyHC (%)</i>							
MyHC IIa		34.91	36.56	39.48	37.76	0.81	ns
MyHC I		19.45b	23.74b	30.72a	20.83b	0.62	***
MyHC (IIb + IIx)		45.63a	39.69a	29.78b	41.41a	1.07	**
<i>Muscular characteristics</i>							
Ultimate pH		5.54c	5.56a,b	5.62a	5.57a,b	0.007	*
Total lipid (g/100 g wet tissue)		3.56a	3.72a	2.84a,b	2.15b	0.11	***

Generally, the traits which were significantly different were found between C and S diets.

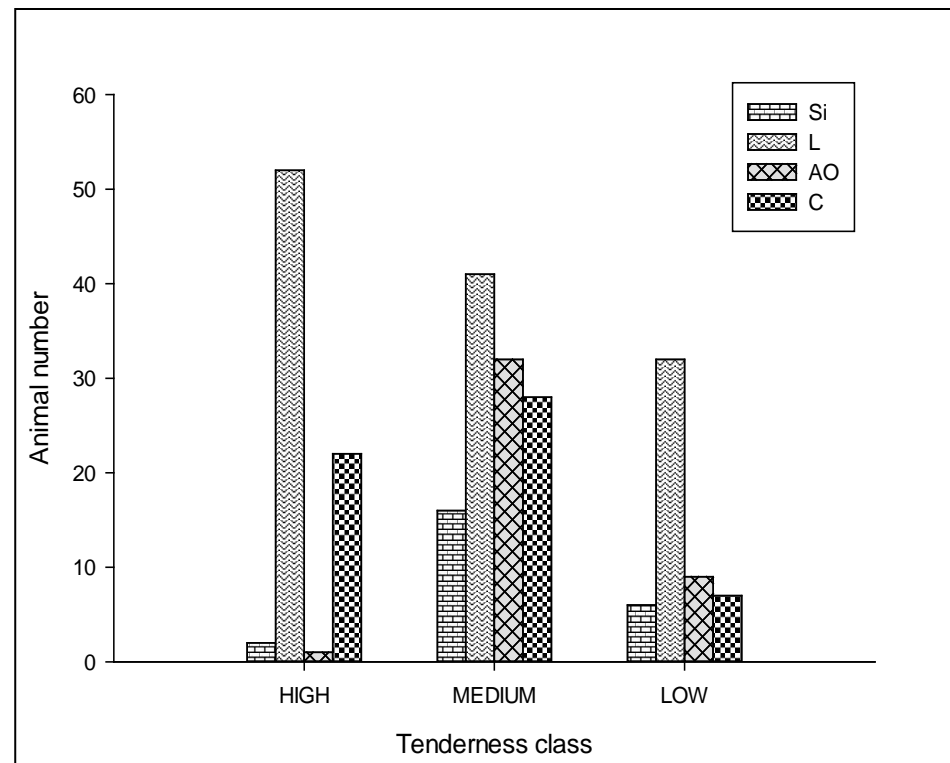
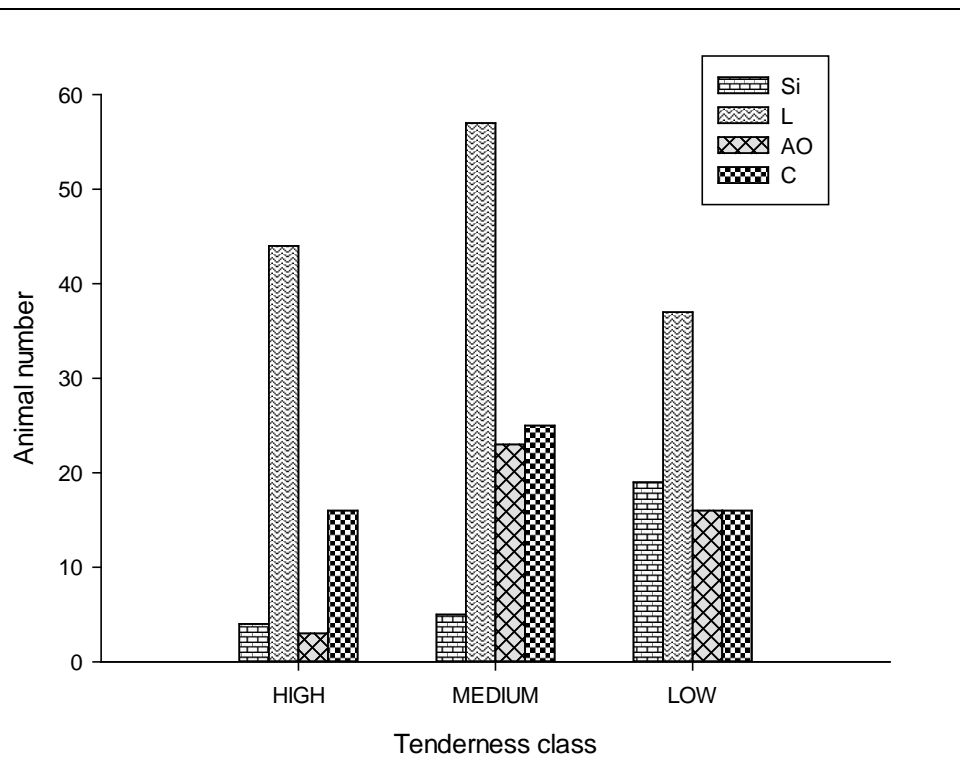
Muscle pHu was higher in silage.

Table 3. Results of the sensory quality attributes of the 14 day aged *M. Longissimus thoracis* of all diets.

Sensory attributes ^a	Diet ¹	C	L	S	AO	SEM	P-value
	(n)	157	138	28	42		
<i>Steak samples grilled at 55°C^b</i>							
Global tenderness		5.75a	5.66a	4.96b	5.11b	0.06	**
Juiciness		6.27a	6.19a	5.31b	5.20b	0.08	***
Beef flavour		4.66a	4.68a	4.32b	4.21b	0.04	***
Abnormal flavour		2.77	2.74	2.71	2.78	0.03	ns
Overall liking		3.88	3.70	4.10	3.80	0.05	ns
<i>Steak samples grilled at 74°C</i>							
Global tenderness		4.94a	5.00a	4.35b	4.54b	0.06	**
Juiciness		5.26a	5.31a	4.46b	4.12b	0.08	***
Beef flavour		4.88a	4.83a	4.60a,b	4.40b	0.04	*
Abnormal flavour		2.77	2.87	2.97	2.79	0.03	ns
Overall liking		3.92	3.89	4.17	3.85	0.08	ns

Beef flavor intensity was different between diets and grilled temperatures



There was a trend for tenderness at both temperatures ($P < 0.01$) in the order:
C ≥ L > AO > S.





Animal distribution for the four diets among the three tenderness classes

(steaks grilled at 74°C).

(steaks grilled at 55°C).

LT muscle of Si animals groups had  proportion of SO fibres and  ICDH activity (P<0.0001)

These are associated with higher pH values

 proportion of FG fibres and  LDH activity (P<0.0001)

Muscles of animals of C and L groups had a higher lipid content than those of Si and AO groups (P<0.0001).

Muscles of animals given C and L diets were more tender and juicy with a higher flavor intensity rating (P<0.0001) than those of S and AO groups.

These results demonstrate that diets enriched with lipids (PUFAs) during the finishing period affect bovine muscle properties and meat sensory qualities.

Thank you
for your attention



Now you can eat your steak

Thanks to AMUVI Team !



Beef contains variable amounts of fat ==> contributes greatly to its palatability.

However, while dietary fat plays an important role in providing energy and essential nutrients to the body, foods high in fat **should be consumed only in moderation.**

The
PROBLEME
?

Consumers have become more aware of food/health issues



Saturated fatty
acids (SFA)

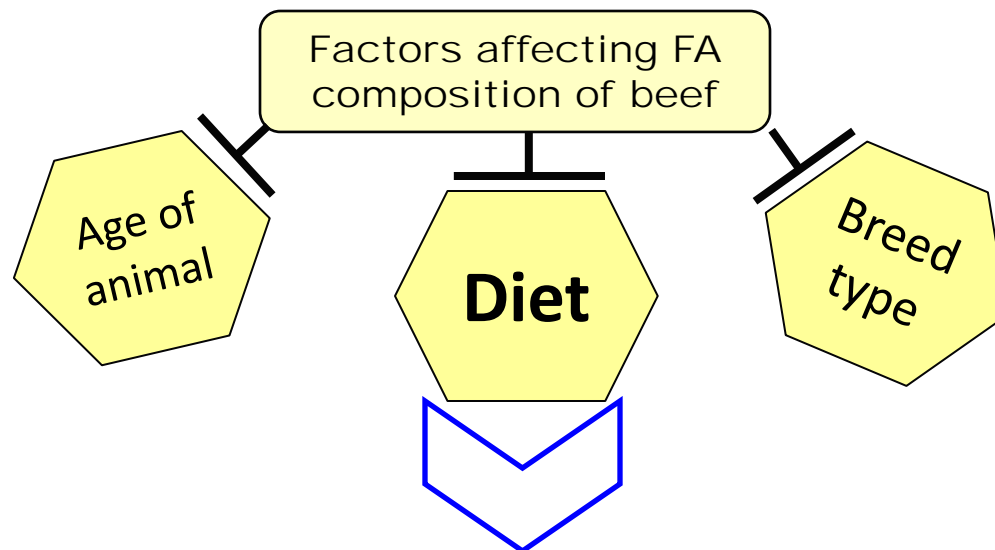
MUFA
&
PUFA

The
SOLUTION
=

They can have beneficial health effect: hypocholesterolemic properties; essential metabolic roles in the eicosanoid production and in the prevention of chronic inflammatory disease.

In addition, several national and international organizations reviewed by EFSA (2005) show that a low PUFA_{n-6}/n-3 ratio aid in the prevention of many chronic diseases.

Scollan et al. (2006) speculated that the increasing of PUFA and reducing SFA contents with the net effect of increasing PUFA/SFA are priorities.



Numerous previous studies reported the effect of different diet regimens (linseed form, concentrate, grass silage, ... etc.) on performance and on FA composition of muscle and adipose tissue in beef cattle.

Smith et al. (2009). *Asian–Australasian J. Anim. Sci.* 22,1225–1233.
Mach et al., 2006; Raes et al., 2004; Scollan et al., 2001

A light blue, multi-pointed starburst shape with a white outline, containing the word 'But' in a bold, black, sans-serif font.

But

Little the studies which studied the effect of diets on bovine muscle characteristics (composition) in relation to meat quality attributes.