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Effect of linseed supplementation on fatty acid composition and lipid oxidation of Maremmana beef

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65th

Fatty acids composition and human health

The **fatty acid composition** of meat is of interests because of its implications for **human health**.

Nutritionists now recommend:

- **limiting fat intake**
- **Increasing consume of PUFA in substitution of SFA**
- **n-6/n-3 < 4**
- **α-linolenic acid intake in adults at least 2 g/d**

European Food Safety Authority

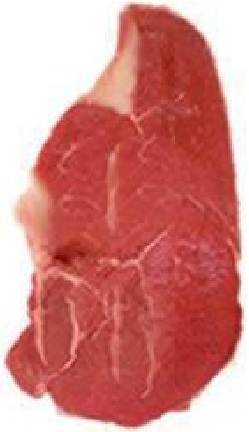
American Heart Association

Learn and Live

Linseed supplementation in the diet of beef cattle has resulted in an increase in **α-linolenic** and **conjugated linoleic acid (CLA)** content in intramuscular fat (Bas et la., 2007; Jeronimo et al., 2009; Berthelot et al., 2010)

Meat oxydation and shelf-life

High level of
PUFA



Reduction of :
stability to oxygen;
resistance to rancidity;
optimal sensory quality;
colour;
shelf life

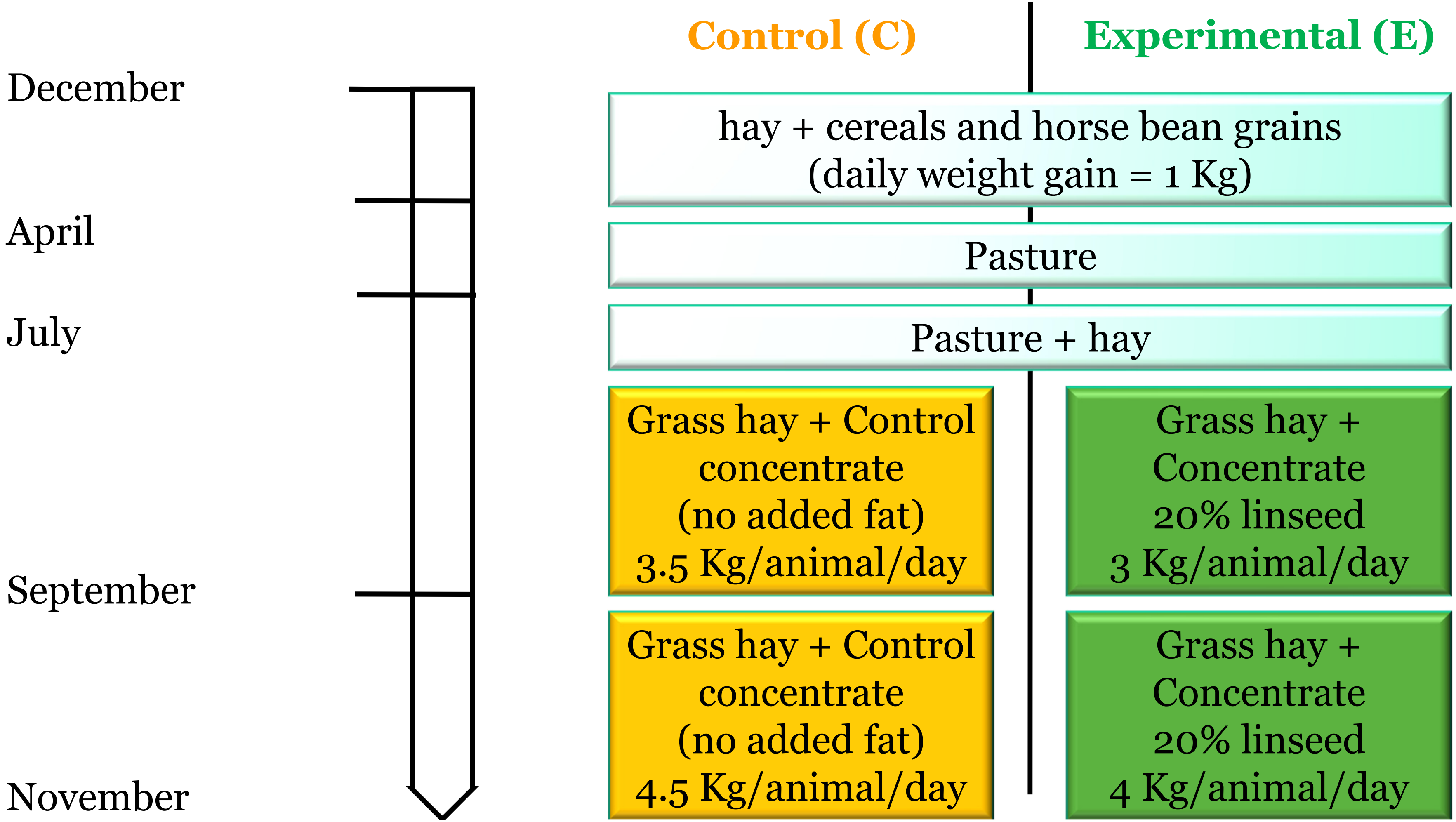
Aim of the work

The aim of this work was to evaluate the oxidative stability of intramuscular fat of beef obtained from Maremmana young bulls fed a diet supplemented with extruded linseed.

Experimental design

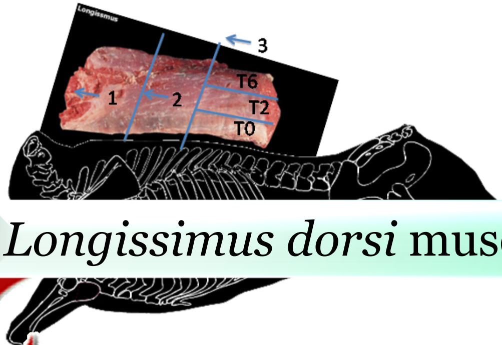
The experiment was carried out on 20 young bulls of the Maremmana breed.

The animals were weaned (6-8 month of age) and randomly assigned to groups of 10 animals each:



Analysis and Statistic

Slaughter weight ~ 550 Kg



Longissimus dorsi muscle

Hamburger thickness = 2 cm

0 — 2 — 6

days

Free Fatty Acid

TBARs

COPs

Colour

Vitamins and Carotenoids

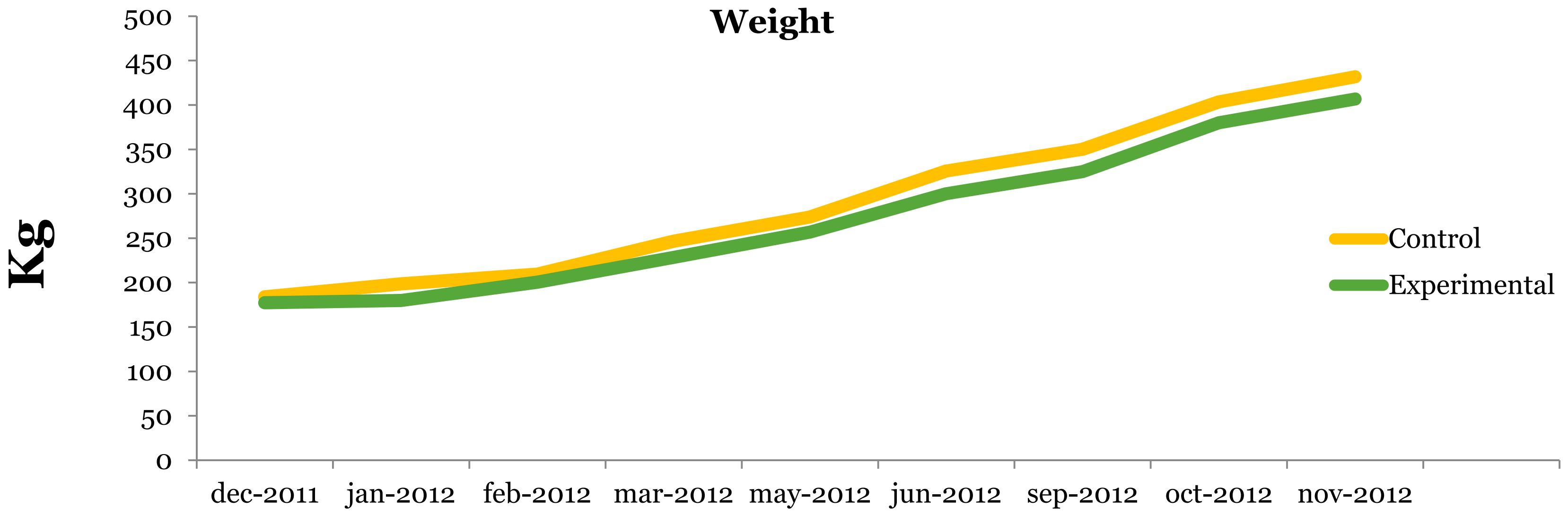
$$y_{ijz} = \mu + T_i + A_j + T_i \times A_j + I_z\,(T) + \varepsilon_{ijz}$$

T = Treatment (C and E)

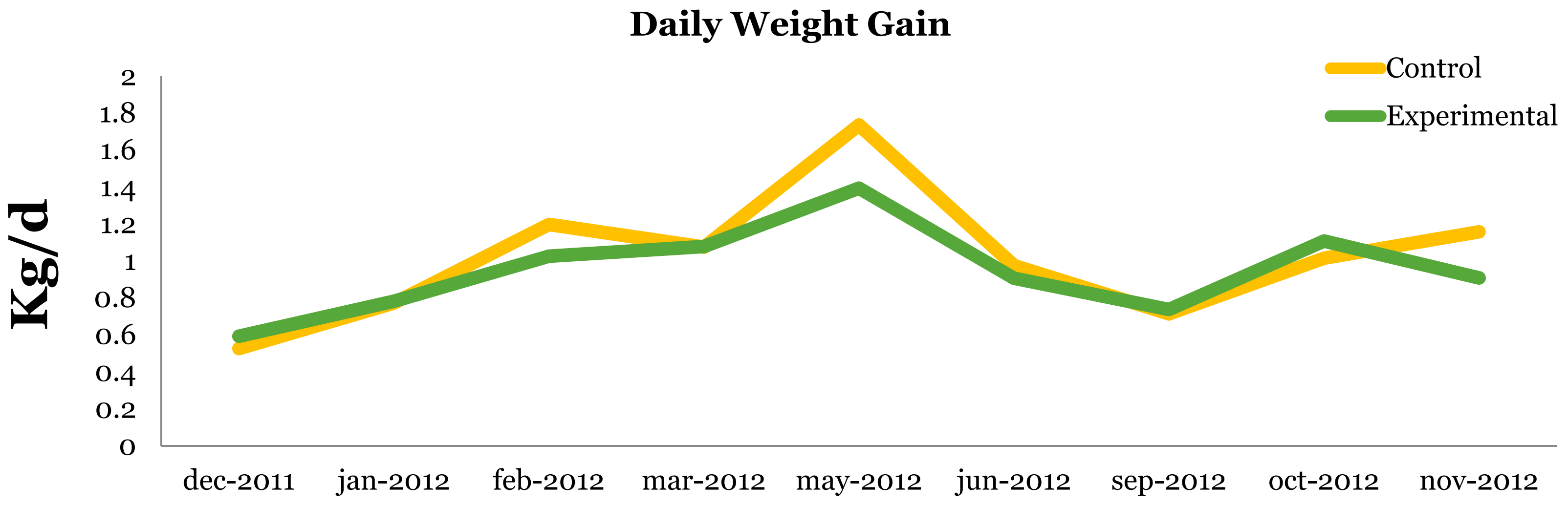
A= Aging (0, 2, 6 days)

I= Animal (1-20) as random factor

Result



Weight
Kg
500
450
400
350
300
250
200
150
100
50
0
dec-2011
jan-2012
feb-2012
mar-2012
may-2012
jun-2012
sep-2012
oct-2012
nov-2012
Control
Experimental



Daily Weight Gain
Kg/d
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
dec-2011
jan-2012
feb-2012
mar-2012
may-2012
jun-2012
sep-2012
oct-2012
nov-2012
Control
Experimental

Results: Meat composition

		C	E	SE	P<F
DM	g/100 g meat	24.34	25.10	0.30	0.10
Protein	g/100 g meat	22.01	21.89	0.32	0.12
Ash	g/100 g meat	1.11	1.10	0.01	0.71
Lipids	g/100 g meat	1.53	1.72	0.14	0.09
Cholesterol	mg/100 g meat	34.02	34.10	0.77	0.77
Iron	mg/100 g meat	1.47	1.50	0.13	0.65
Organic Iron	%	86	86	1.12	0.99

		Bruciapaglia et al. 2013			**Mele et al., 2008**
		Piedmontese	Limousine	Holstein	Chianina
Lipids	g/100 g meat	1.1	1.7	2.3	1.1
Cholesterol	mg/100 g meat	51	50.8	51	30

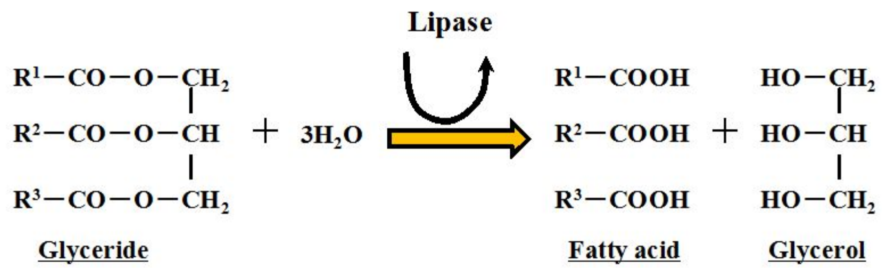
Results: Fatty acid composition

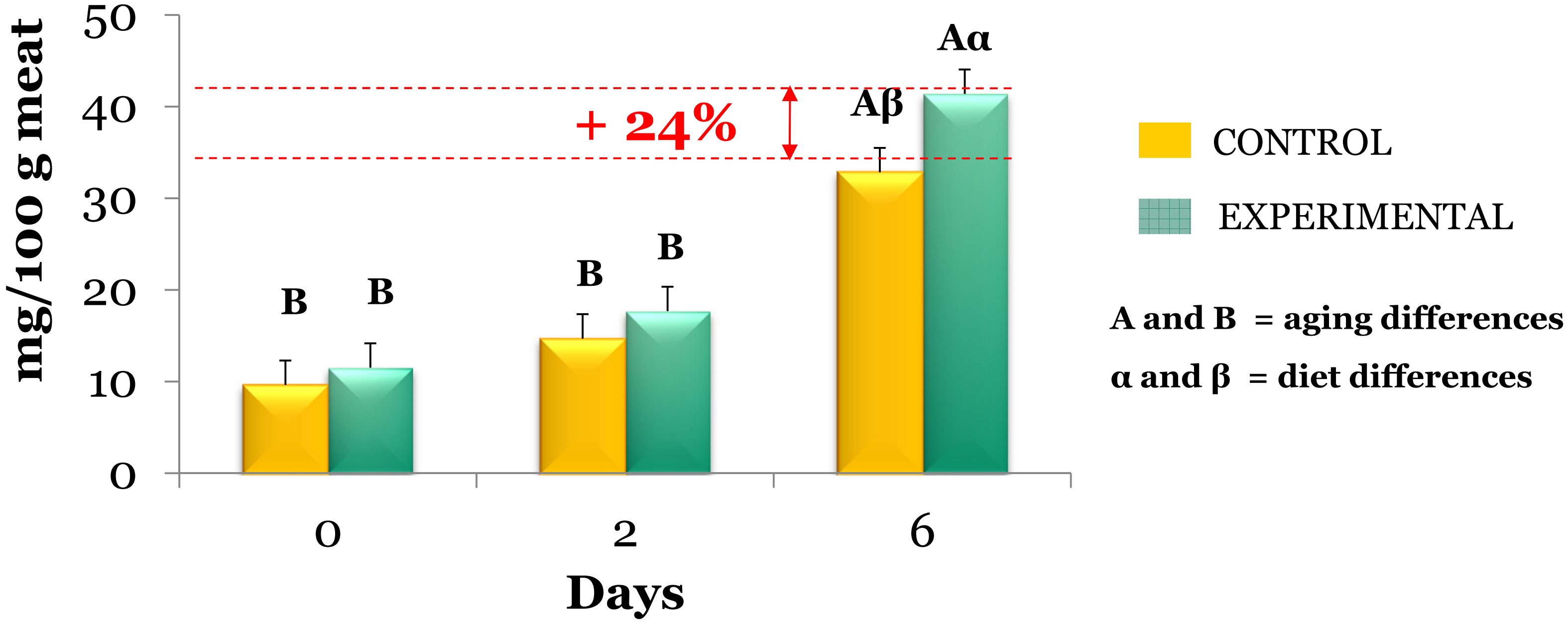
		C	E	SE		
SATURED	g/100 g meat	26.31	24.93	1.07		
MONOUNSATURED	g/100 g meat	24.51	26.27	1.12		
POLYUNSATURED	g/100 g meat	8.76	8.67	0.60		
ω-6	g/100 g meat	7.48	6.64	0.49		
ω-3	g/100 g meat	1.28	2.41	0.10	***	+ 88%
α-linolenic acid	g/100 g meat	0.50	1.06	0.04	***	+ 112%
ω-6/ω-3		5.89	2.76	0.23	***	- 53%
CLA	g/100 g meat	0.31	0.45	0.04	**	+ 45%
TRANS ISOMERS	g/100 g meat	2.33	3.24	0.15	***	+ 39%
Thrombogenic Index		1.21	0.96	0.06	***	- 21%
Atherogenic Index		0.56	0.54	0.03		

Free Fatty Acids

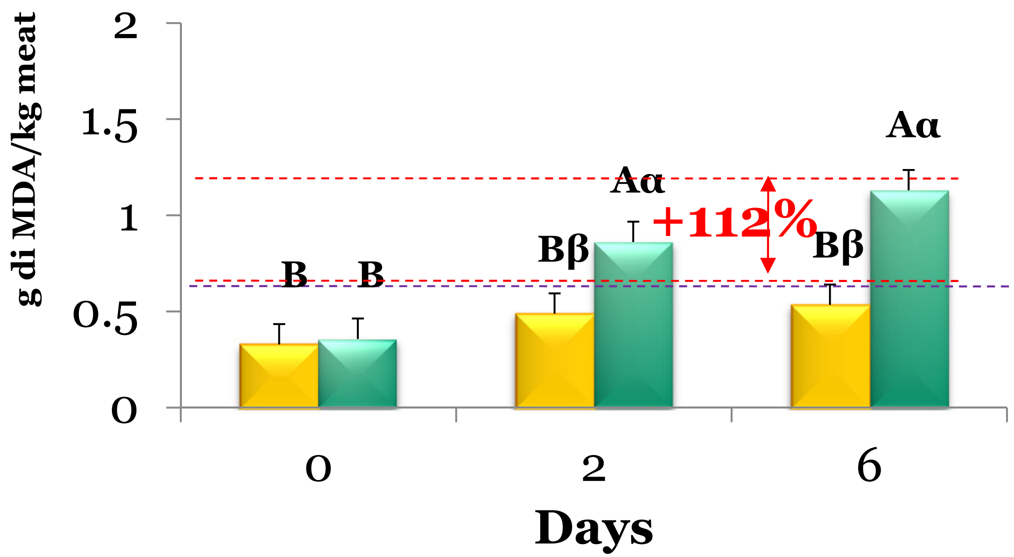
Hydrolysis of triglycerides is the first step of fatty acids oxydation

FFA level increase significantly after 6 days of aging



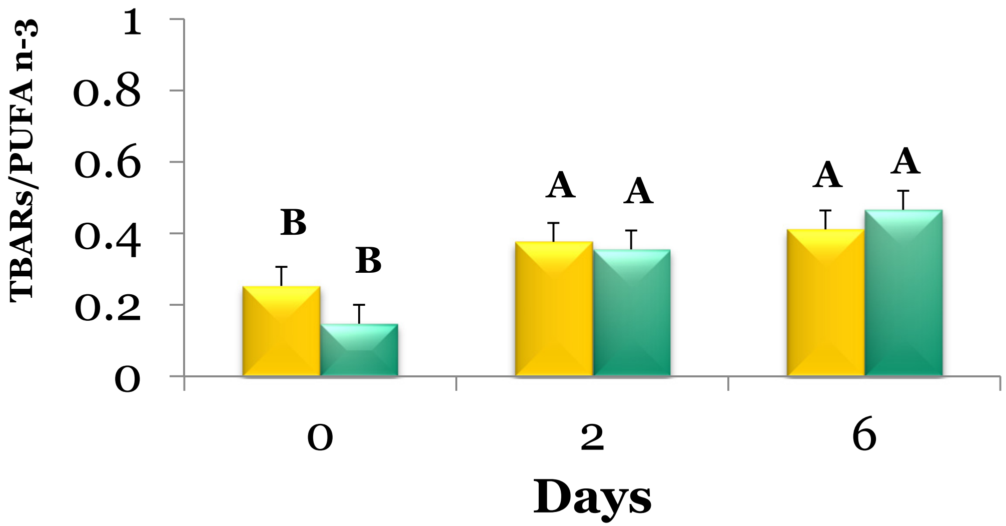


TBARs



TBARs level increase significantly in the experimental group after 2 days of aging, overcoming the rancidity threshold

Rancidity threshold (Lanari et al., 1995)



Relating the level of TBARS to PUFA content, the increase is similar for both groups

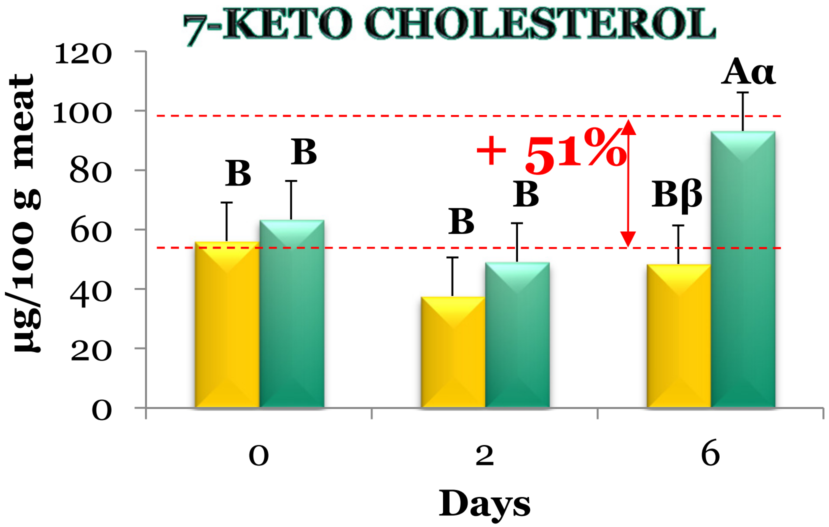
A and B = aging differences

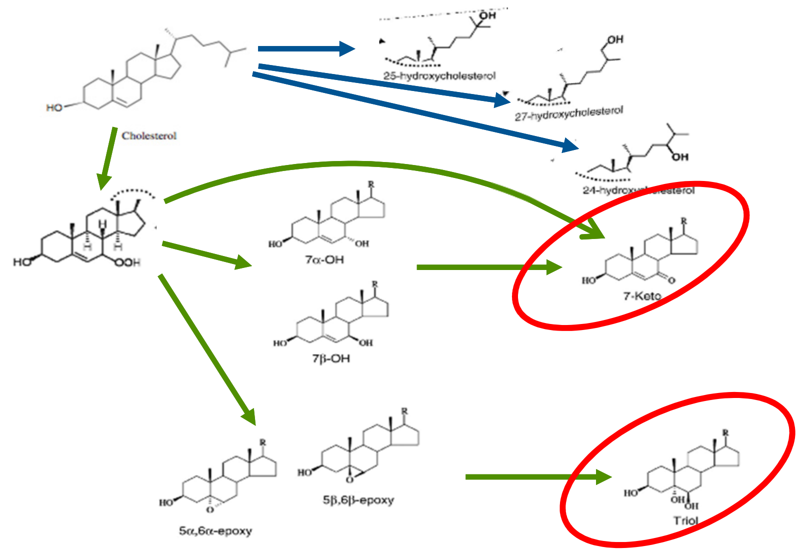
α and β = diet differences

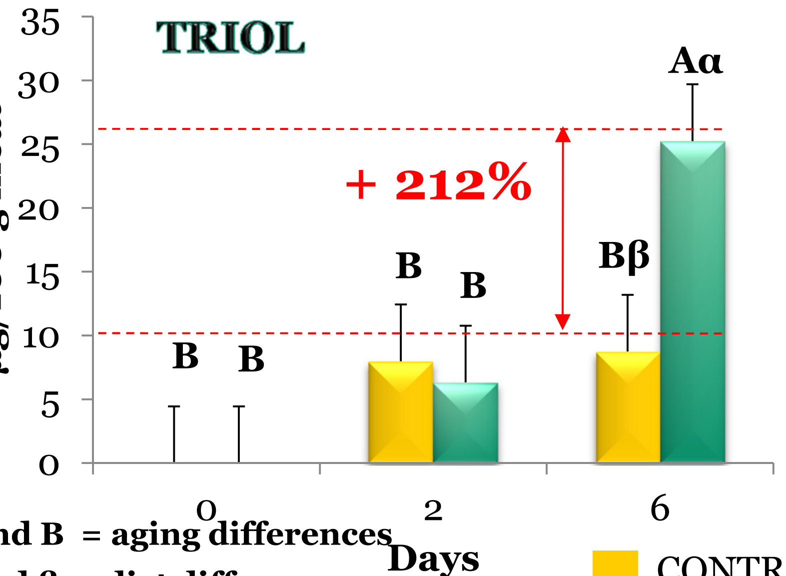
CONTROL

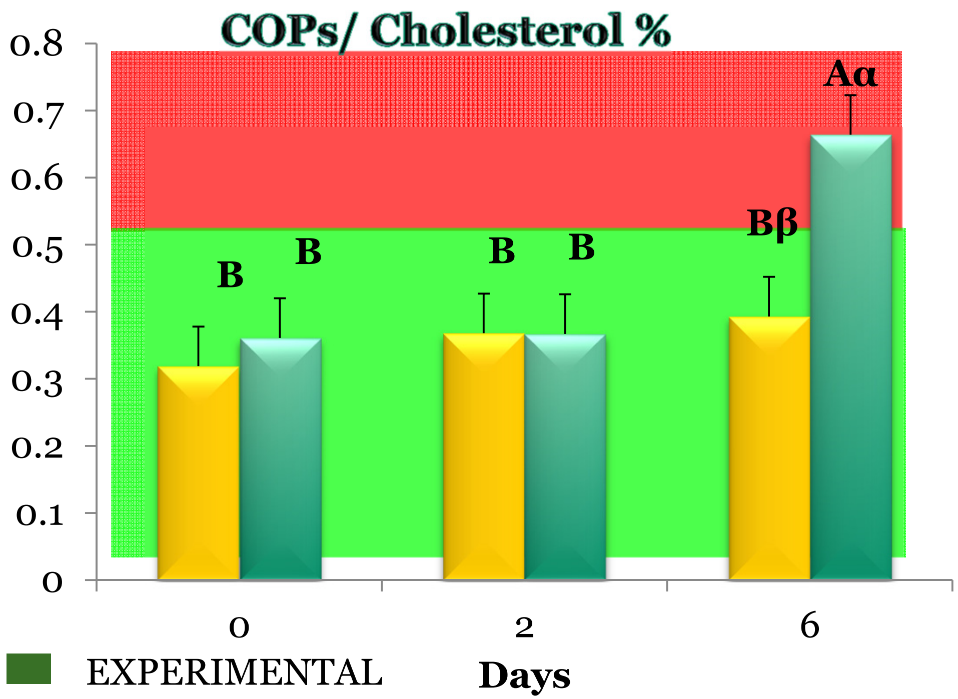
EXPERIMENTAL

COPs







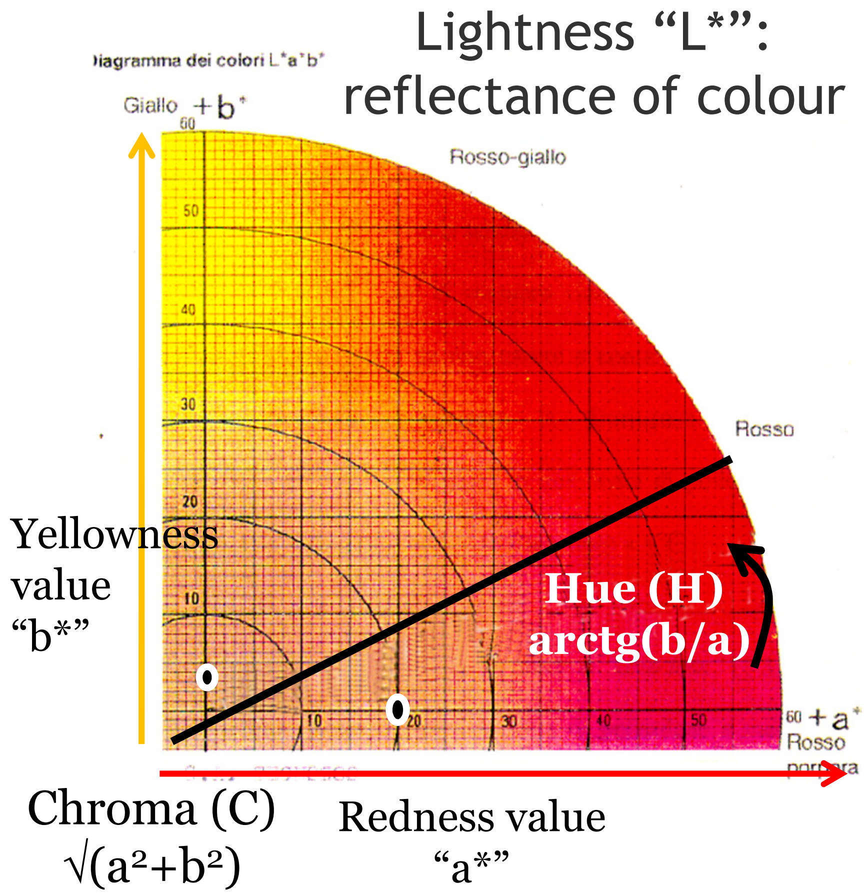


A and B = aging differences

α and β = diet differences

CONTROL EXPERIMENTAL

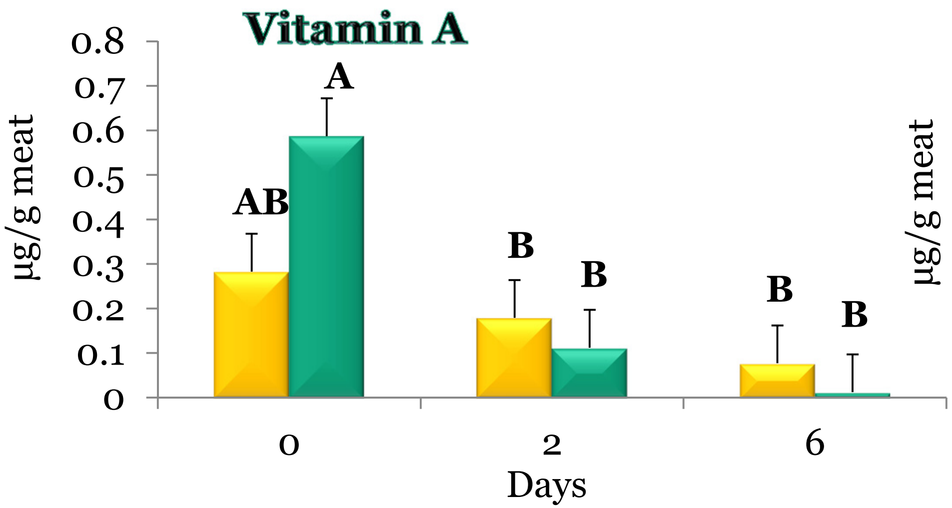
Meat Colour

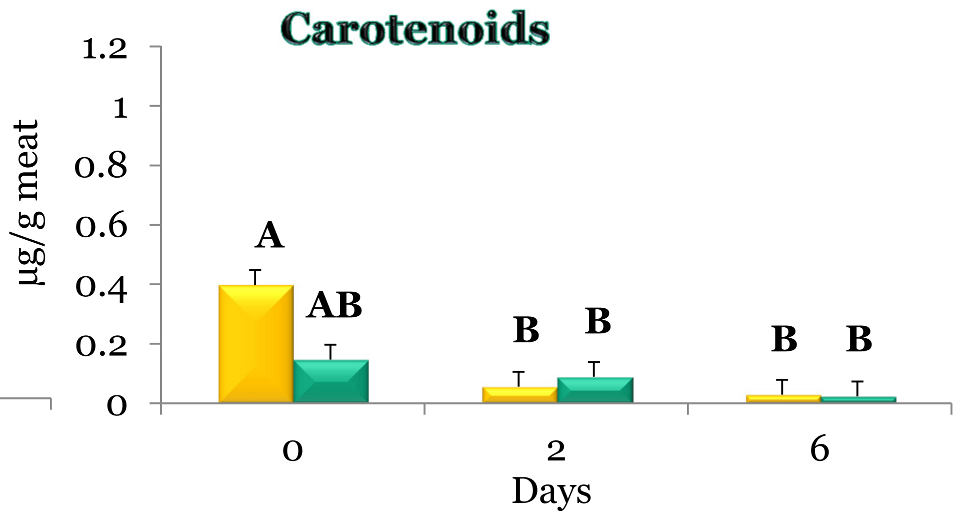


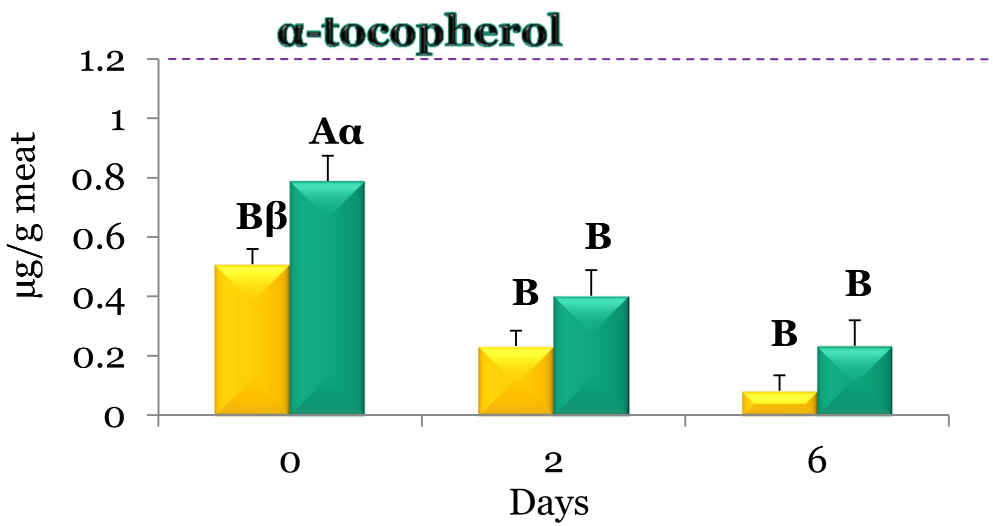
	Control			Experimental			SE	A
	0	2	6	0	2	6		
L*	49.5^{A}	45.0^{B}	43.6^{B}	50.0^{A}	46.9^{B}	44.6^{B}	1.4	***
a*	13.0^{A}	7.4^{B}	7.4^{B}	12.2^{A}	6.8^{B}	6.3^{B}	1.1	***
b*	12.9^{A}	10.1^{B}	12.8^{A}	12.1^{A}	8.6^{B}	11.2^{AB}	1.2	***
H	44.1^{C}	53.2^{B}	61.1^{A}	44.8^{C}	51.8^{B}	61.1^{A}	1.9	***
C	18.4^{A}	12.6^{B}	14.8^{B}	17.3^{A}	11.0^{B}	13.1^{B}	1.4	***

Meat colour exhibited the expected pattern for satisfactory appearance and demonstrated that including 20% linseed in concentrate did not significantly alter meat colour.

Vitamins







Minimum threshold to increase the shelf life (Liu et al., 1995)

Although tocopherol level is higher in the experimental group, no more antioxidant effect was observed.

CONTROL EXPERIMENTAL

A and B = aging differences

α and β = diet differences

Conclusion

- Linseed supplementation improve meat quality by increasing PUFAω-3 content

- The results confirmed the strictly relationship between the high level of PUFAω-3 and lipid oxidation of meat

- Finally, higher levels of antioxidants than those normally present in the intramuscular fat are needed in order to control the oxidation during the storage and increase shelf life of meat

Thank you for your attention