Sustainable animal production: Productivity aspects related to milk and meat quality

Aspects of meat quality and meat products in relation to sustainable production in sheep and cattle

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Overview

- Meat quality a component of sustainability
- Production system effects
- Flavour
- Post-slaughter handling
- Salt content
- Packaging

What is sustainable?

- Wikipedia: “Sustainable agriculture integrates three main goals: environmental stewardship, farm profitability and prosperous farming communities.”
- Defra: “Development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (originally the Brundtland Commission)

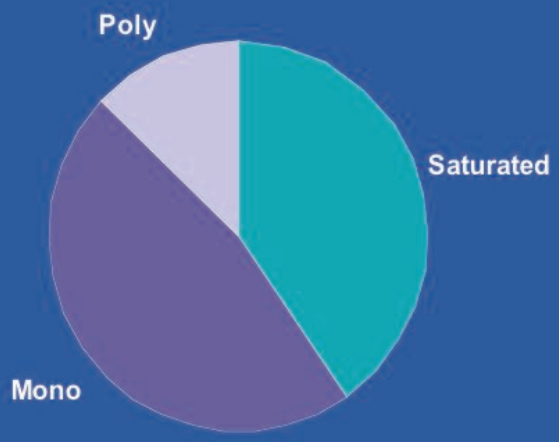
Meat quality and sustainability

- Environmental stewardship: production system effects on meat quality, packaging
- Farm profitability: depends on continued demand for meat

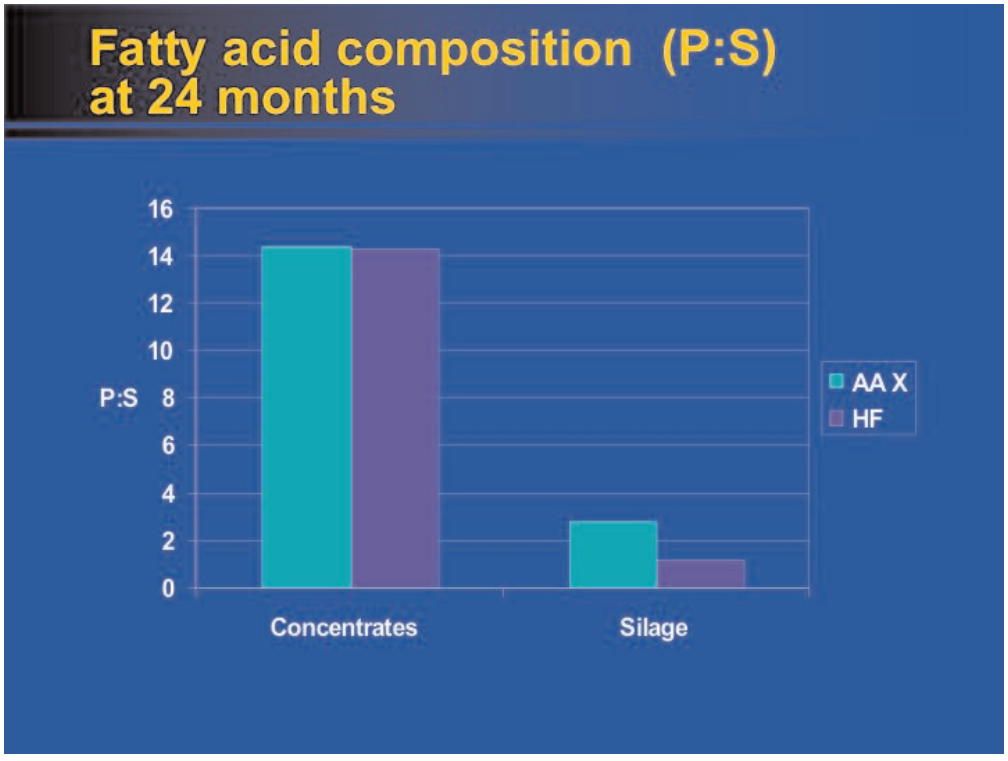
Important aspects of meat quality

- Nutritional quality
  - Fatty acid composition
  - Sodium (salt) content
- Sensory properties
  - Tenderness
  - Flavour

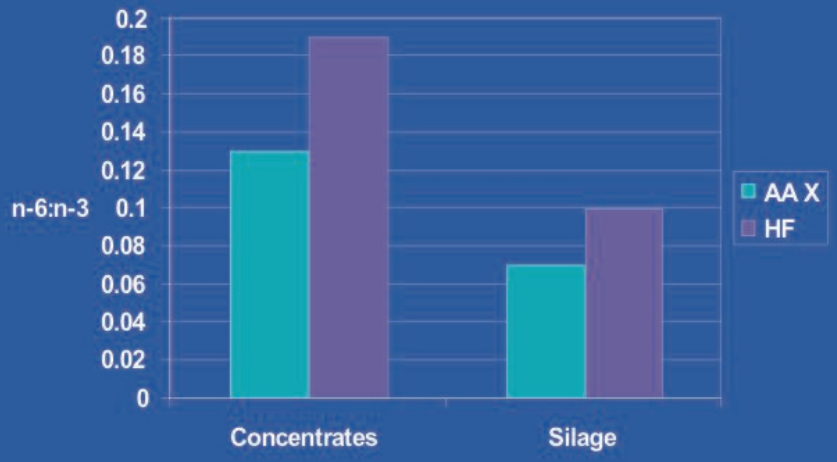
Fatty acid composition of household fat intake from meat and meat products



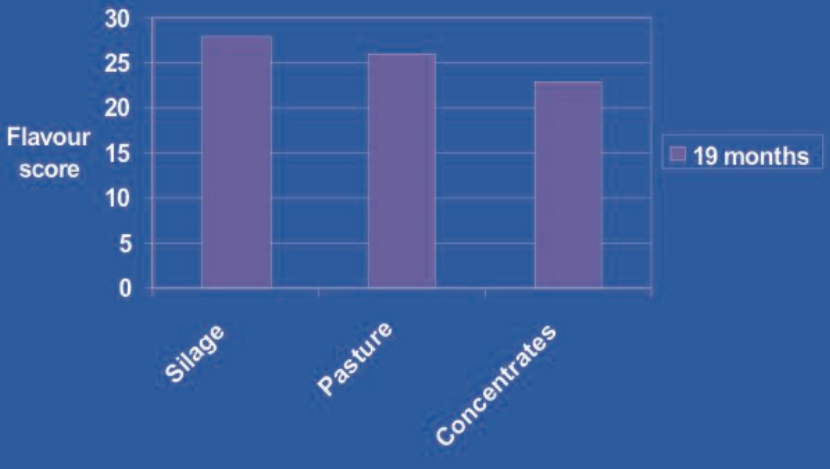
National Food Survey (1999)


Fatty acid composition (P:S)
at 24 months
16
14
12
10
P:S 8
6
4
2
0
Concentrates
Silage
AA X
HF

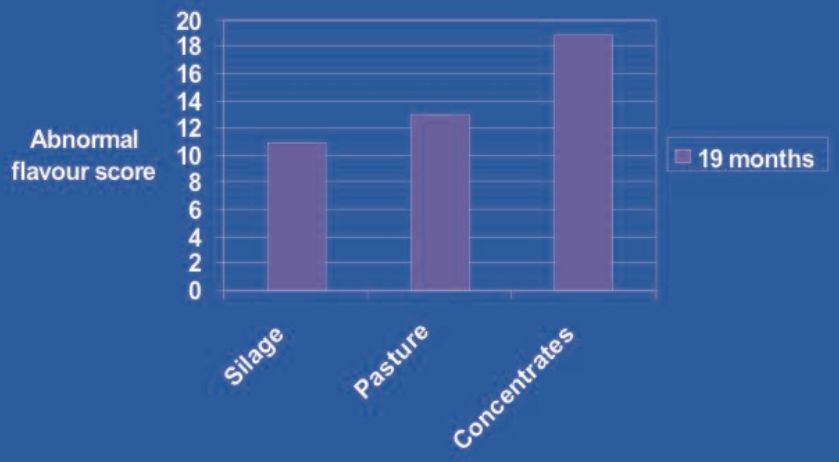
Fatty acid composition (n-6:n-3) at 24 months



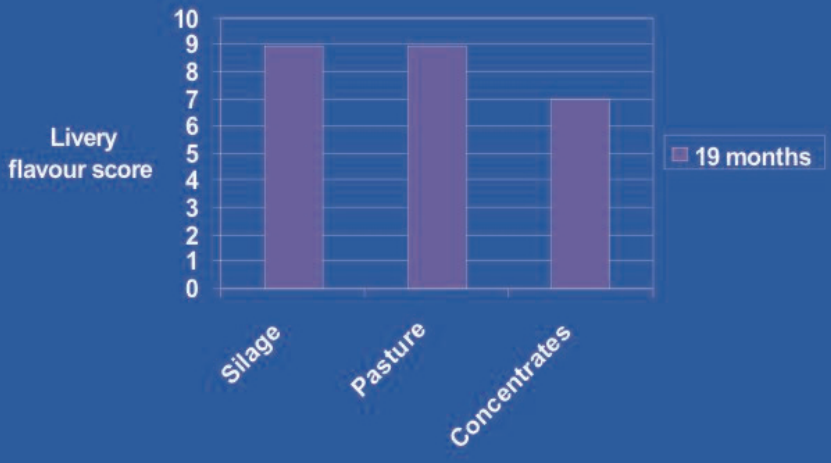
Beef flavour (sensory panel results)



Abnormal flavour (sensory panel results)



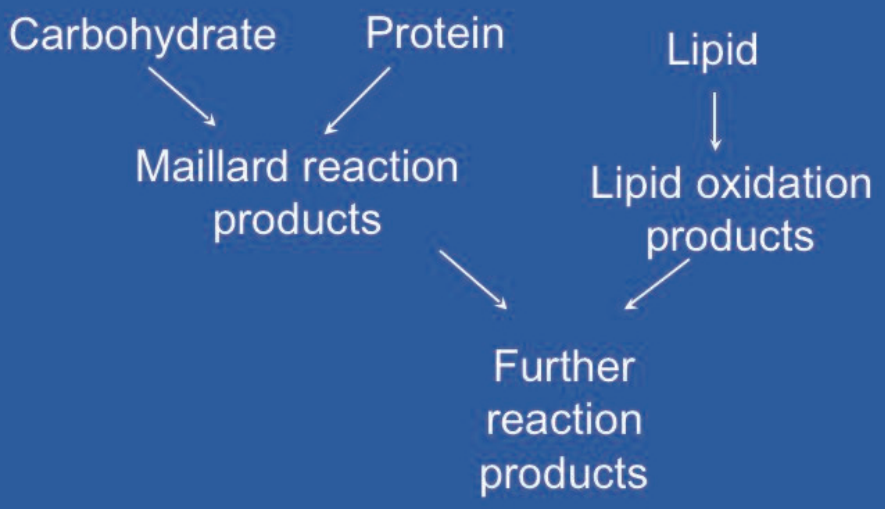
Livery flavour (sensory panel results)



Conclusions

- Silage and grass fed animals had higher beef flavour and lower abnormal flavour scores at 19 months
- Silage resulted in higher livery flavour at 14 and 24 months

Chemical basis of beef flavour



Important flavour precursors

- Reducing sugars
- Amino acids
- Fatty acids

How does grass feeding change flavour?

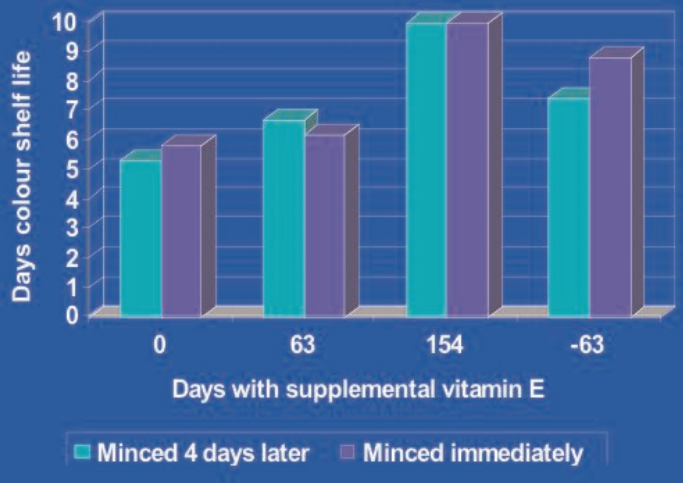
- Aldehydes from unsaturated fatty acids higher on concentrate diet.
- Products of α-linolenic acid and chlorophyll higher on grass diet.
- Skatole higher in grass-fed beef, especially fresh grass.
- Vitamin E higher.
- Lipid oxidation (TBARS) lower.

Elmore *et al* (2004)

Effect of vitamin E on beef colour stability

Courtesy: University of Bristol

Colour shelf life for FQ mince in overwrap



End of shelf life determined by a saturation value of 18

Source of dietary fat affects fatty acid (PL) composition and aroma volatiles

	Megalac	Linseed	Fish oil	Lin/FO	S i g
18:3*n*-3 α-linolenic[1]	2.1[a]	4.3[b]	2.4[a]	3.5[b]	***
20:5*n*-3 EPA	2.3[a]	3.5[b]	4.9[b]	3.6[b]	***
22:6*n*-3 DHA	0.55[a]	0.63[a]	1.08[b]	1.22[b]	***
Heptenal[2]	-	14	8	11	ns
Octenal	3[a]	10[b]	7[ab]	11[b]	*
Nonenal	21[a]	69[a]	44[ab]	78[a]	*
Decenal	41[a]	99[ab]	58[ab]	108[b]	*

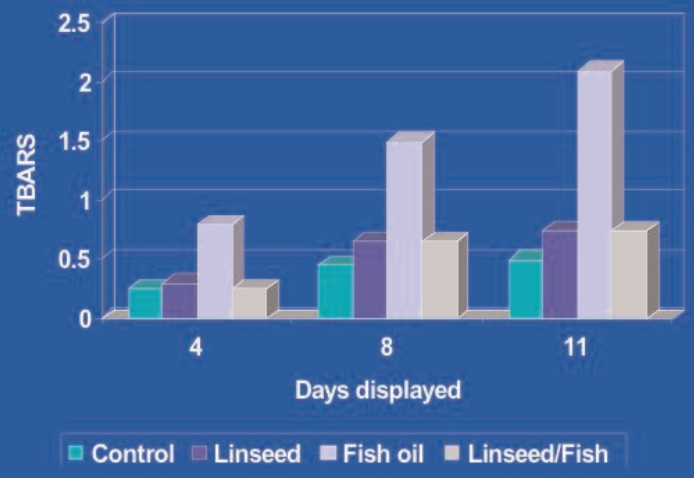
[1]Scollan *et al* (2001) [2]Elmore *et al* (1999)

Source of dietary fat affects flavour

	Megalac	Linseed	Fish oil	Lin/FO	S i g
Beef flavour[3]	3.8	3.8	3.5	3.8	ns
Abnormal flavour	2.8	2.9	3.2	2.9	ns
Flavour liking	4.4	4.5	4.2	4.7	ns
Overall liking	4.4[a]	4.5[a]	3.9[b]	4.6[a]	***
Fatty/greasy	15.7	17.6	19.3	17.9	ns
Bloody	13.2	10.5	13.0	10.0	ns
Livery	14.2	13.1	16.7	15.6	ns
Rancid	1.7[ab]	0.6[a]	2.3[b]	1.1[a]	*
Fishy	5.0[a]	4.4[a]	8.9[b]	4.4[a]	***

[3] Vatansever *et al* (2000)

Source of dietary fat affects lipid oxidation



Vatansever *et al.* (2000)

Dietary effects on lamb flavour

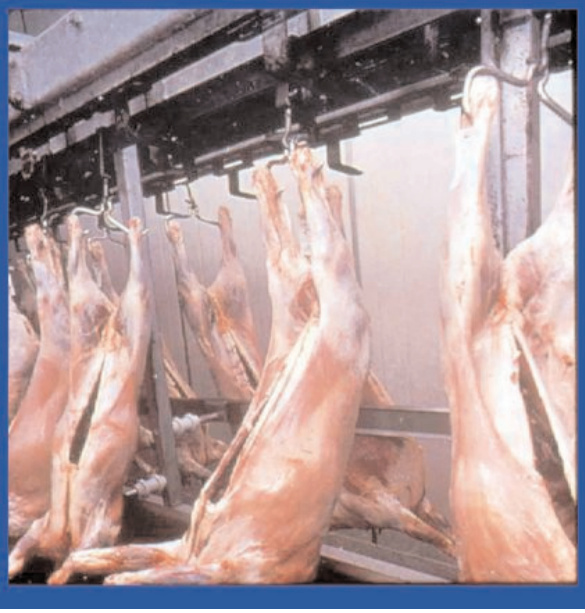
- Fish
- Marine algae
- Protected lipid supplements
- Clover

Sensory attributes of lamb from different production systems

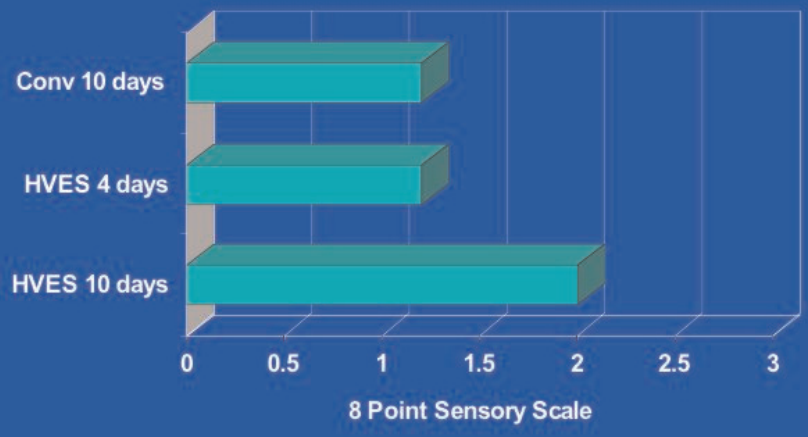
	Suffolk Control	Suffolk Saltmarsh	Scot BF Heather	Scot BF Moorland	Sig
Abn. fat odour	20.0^{b}	12.3^{a}	12.2^{a}	12.8^{a}	***
Lamb flavour	40.4^{a}	45.1^{ab}	43.0^{a}	49.2^{b}	*
Abnormal flavour	22.9^{b}	19.2^{ab}	17.0^{a}	15.4^{a}	*
Rancid	14.7^{b}	11.2^{ab}	7.4^{a}	10.0^{a}	**

Wood *et al* (2006)

HVES Lamb

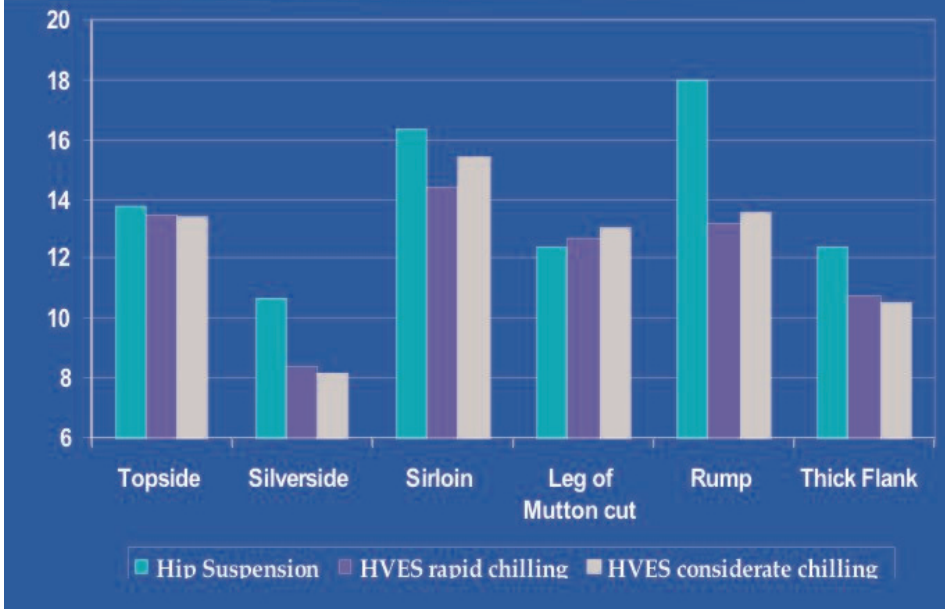


Options for Improving Loin Tenderness



MLC (1994)

Effect of various carcase treatments on sensory tenderness of 6 muscles from steers and heifers, butchered at 48 hours and aged for a further 5 days



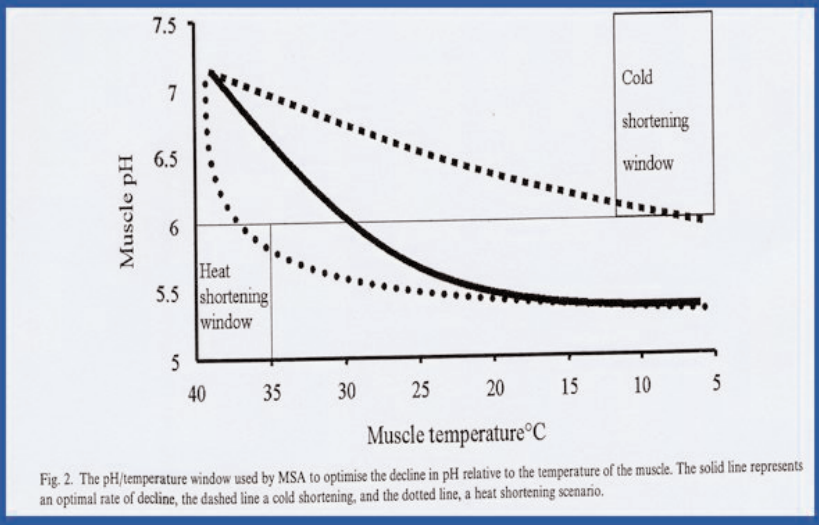
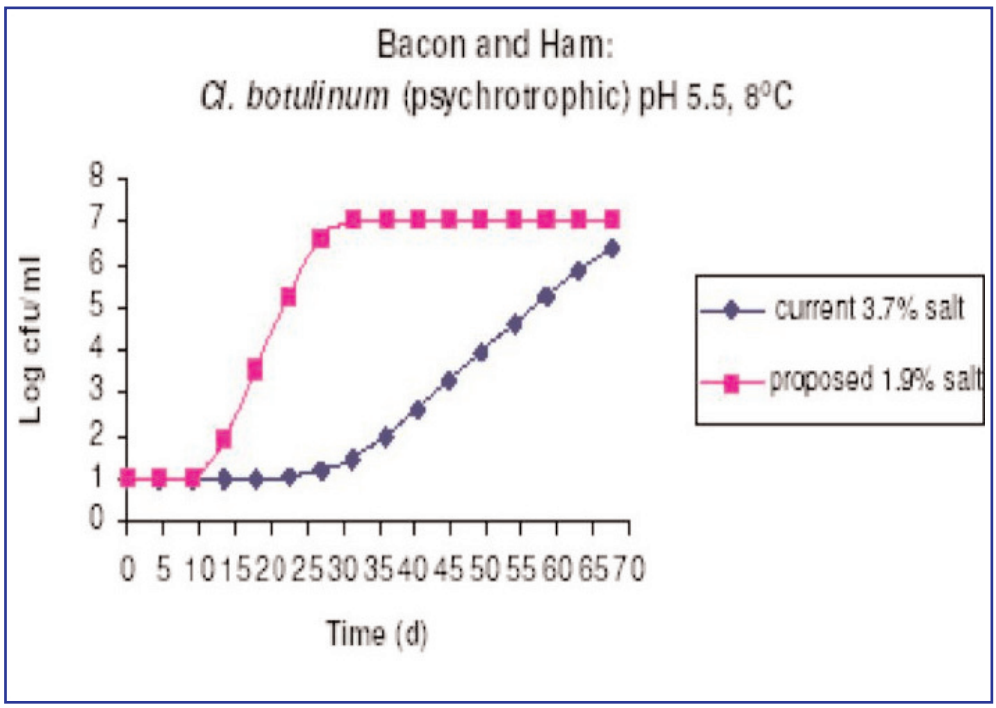


Fig. 2. The pH/temperature window used by MSA to optimise the decline in pH relative to the temperature of the muscle. The solid line represents an optimal rate of decline, the dashed line a cold shortening, and the dotted line, a heat shortening scenario.

Thompson (2002)

The role of salt in meat products

- Physical
- Sensory
- Preservative



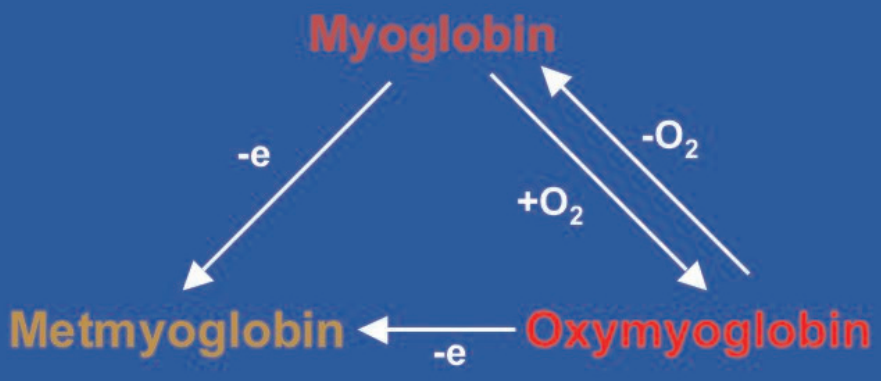
Contribution to sodium in the diet per person per day

- 0.54g from meat and meat products
- 0.01g from beef
- 0.01g from pork
- 0.03g from poultry
- ? from lamb
- 0.2g from bacon and ham
- 0.09g from sausages
- leaves 0.19g from the rest

Meat industry action on sodium levels

- Joint sodium working party
- Self imposed targets
- Dialogue with FSA

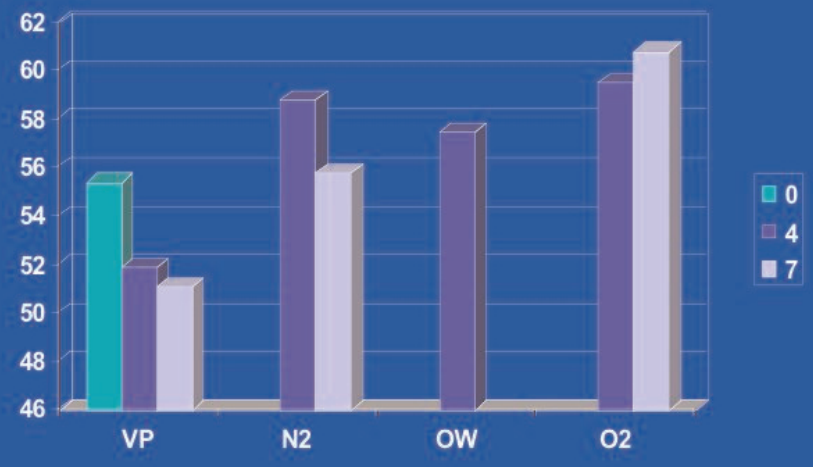
Meat colour



Packaging options

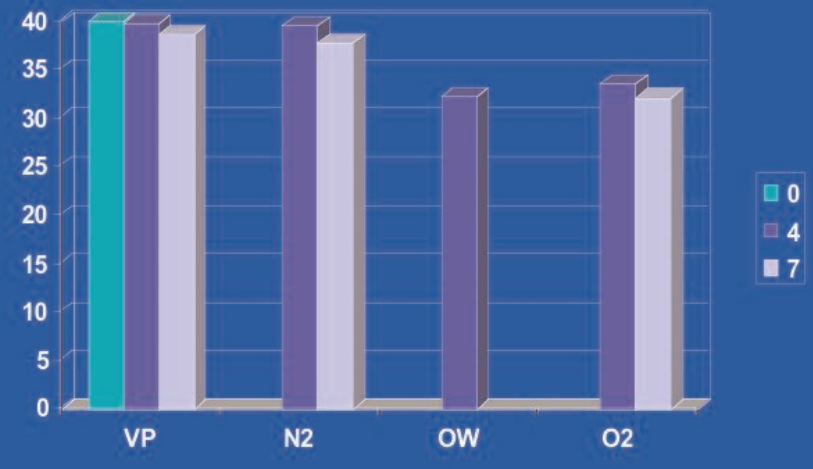
- Air (overwrap)
- Low oxygen (vacuum or MAP)
- High oxygen (MAP)

Chewiness of Beef following various retail packaging treatments



MLC (2006)

Beef flavour following various retail packaging treatments



MLC (2006)

Summary

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- Production system effects
- Flavour
- Post-slaughter handling
- Salt content
- Packaging