

SMAGEN AF LAMMEKØD – HVORDAN KAN DEN DIFFERENTIERES GENNEM PRODUKTION?

Margrethe Therkildsen, Institut for fødevarer, Aarhus Universitet

- Hvad er smag
- Betydningen af intramuskulært fedt
- Effekten af fodermidler
- Betydningen af køn



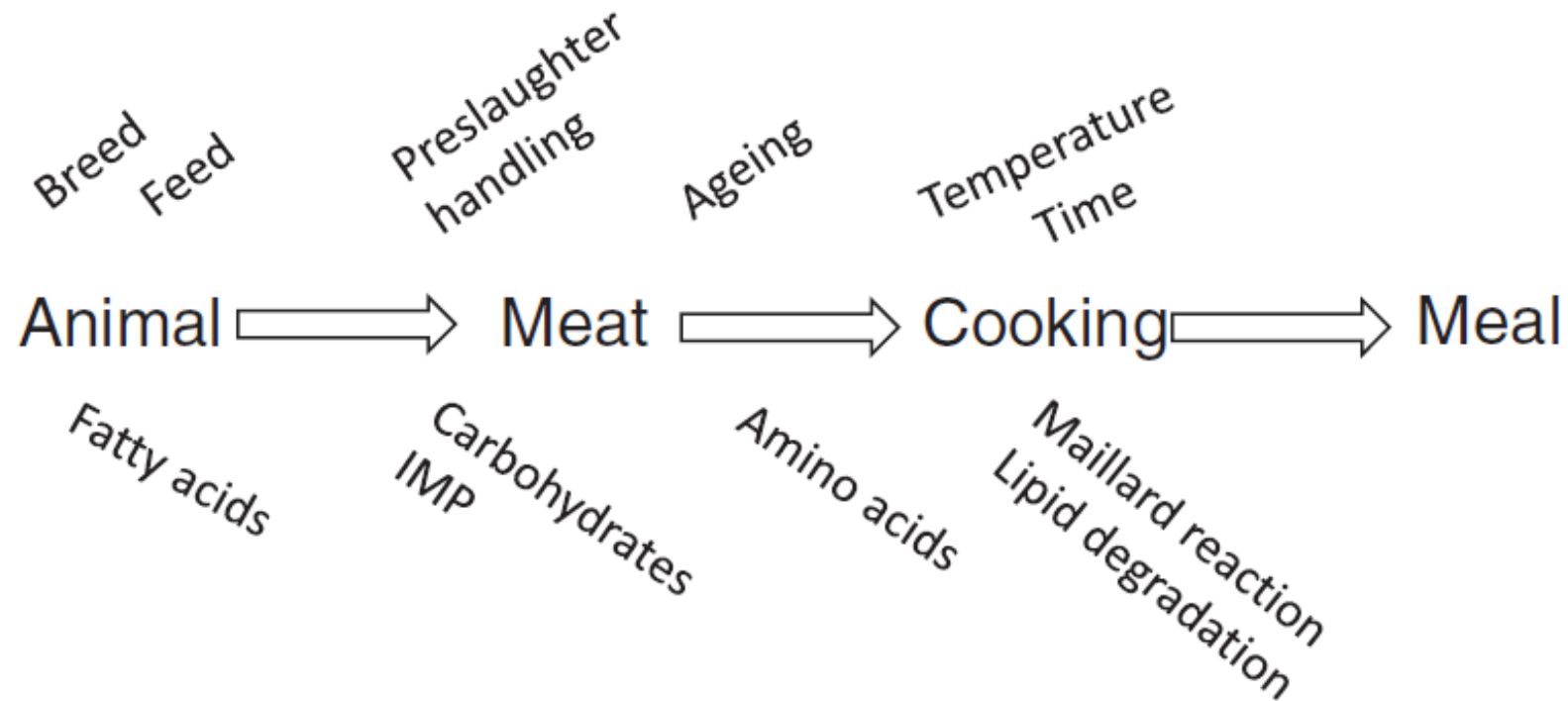


Fig. 1. Factors influencing meat flavour from animal to meal.



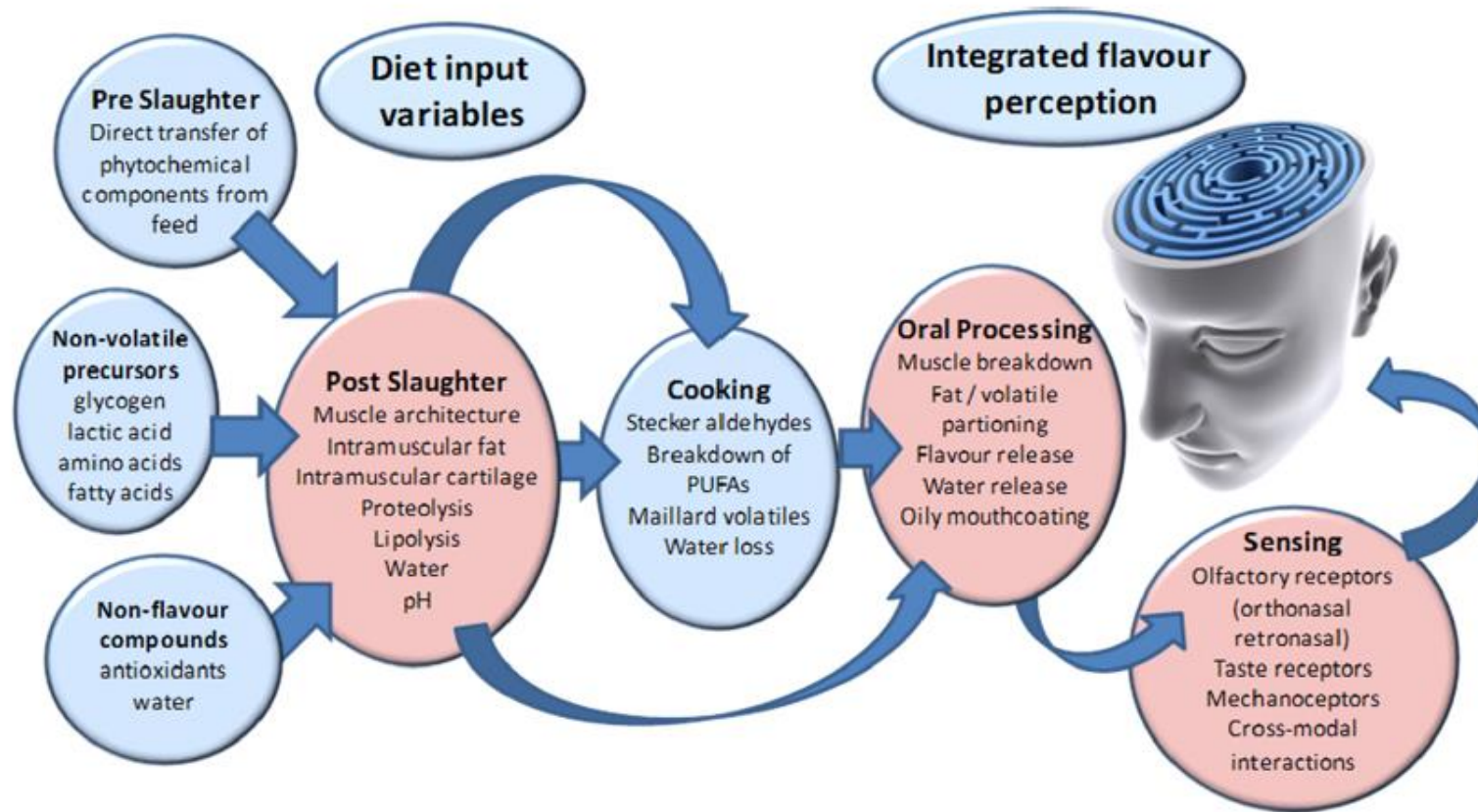


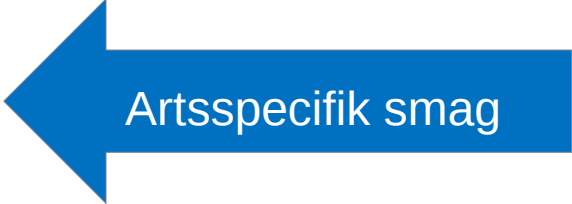
Figure 2. Diagrammatic summary of important variables where the interactions of feed and processing may directly or indirectly affect the final flavor attributes of lamb (meat) and perception.



Smagen – flavour (“taste + odour”)

Kombinationen af

- Smag registreret på tungen – (Salt, surt, sødt, bitter og umami)
- samt flygtige forbindelser som via retronasale pathways registreres af duft epitheliet i næsen
- Kulhydrater – sukkerstoffer
- Proteiner – frie aminosyrer
- Fedtsyrer – oxidation af fedtsyrer



Artsspecifik smag



Forbruger drivers for “liking” – lammekoteletter (loin steaks) – Nord Irland

- ✓ Sød flavour
- ✓ Kød eftersmag
- ✓ Stegt lamme flavour og eftersmag

- Bitter flavour og eftersmag



Sammenhæng mellem flavour og andre spisekvalitetssegenskaber

Table 4

Phenotypic partial correlation coefficients for the different sensory traits within the loin (above diagonal) and within the topside samples (below diagonal).

Sensory traits	Tenderness	Overall liking	Juiciness	Flavour	Odour
Tenderness		0.867	0.808	0.798	0.486
Overall liking	0.888		0.853	0.941	0.587
Juiciness	0.830	0.861		0.805	0.492
Flavour	0.776	0.911	0.814		0.601
Odour	0.402	0.495	0.467	0.568	

Pannier et al. 2014



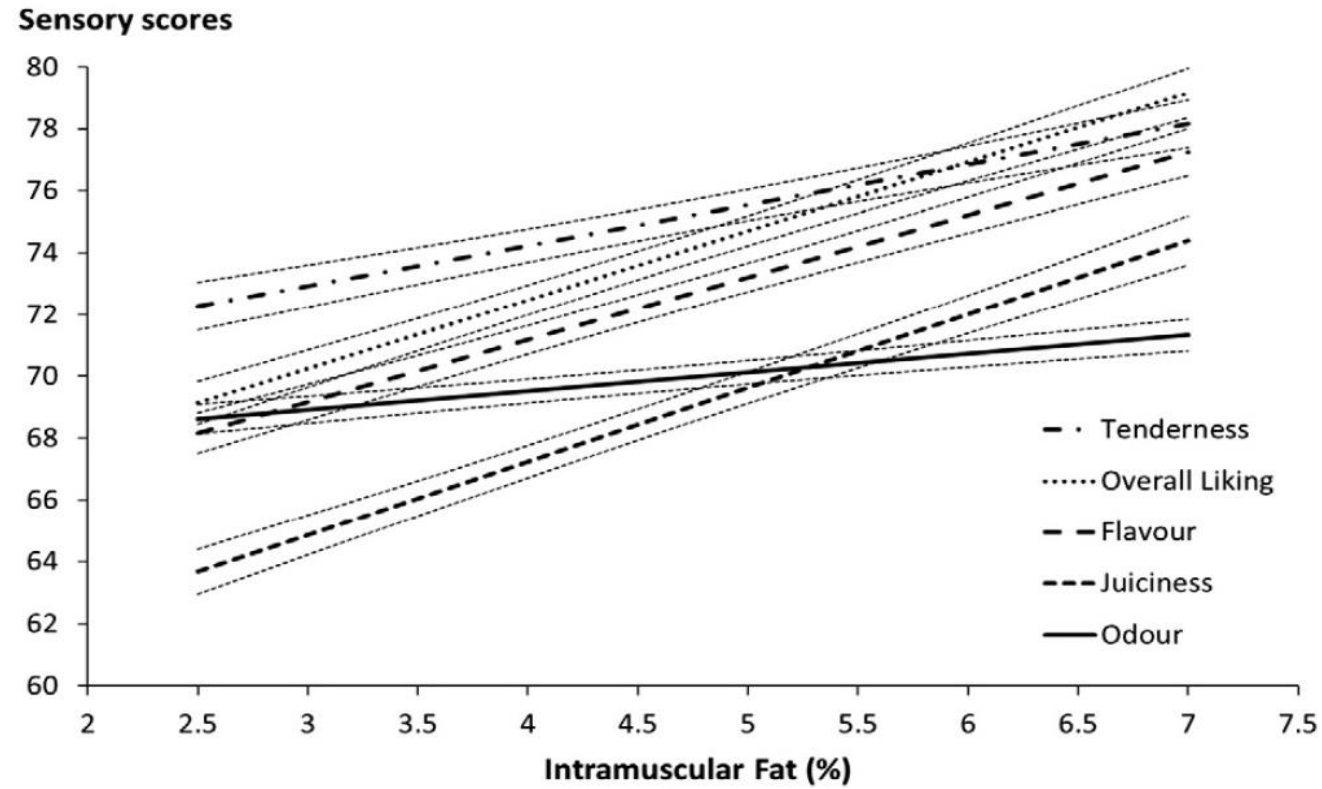


Fig. 2. Relationship between IMF (%) and tenderness, overall liking, juiciness, flavour and odour sensory scores of the loin muscle of lamb. Lines represent least squares means ($\pm$ SE) for the sensory scores across the IMF range from the base model with IMF tested as covariate.

Pannier et al. 2014



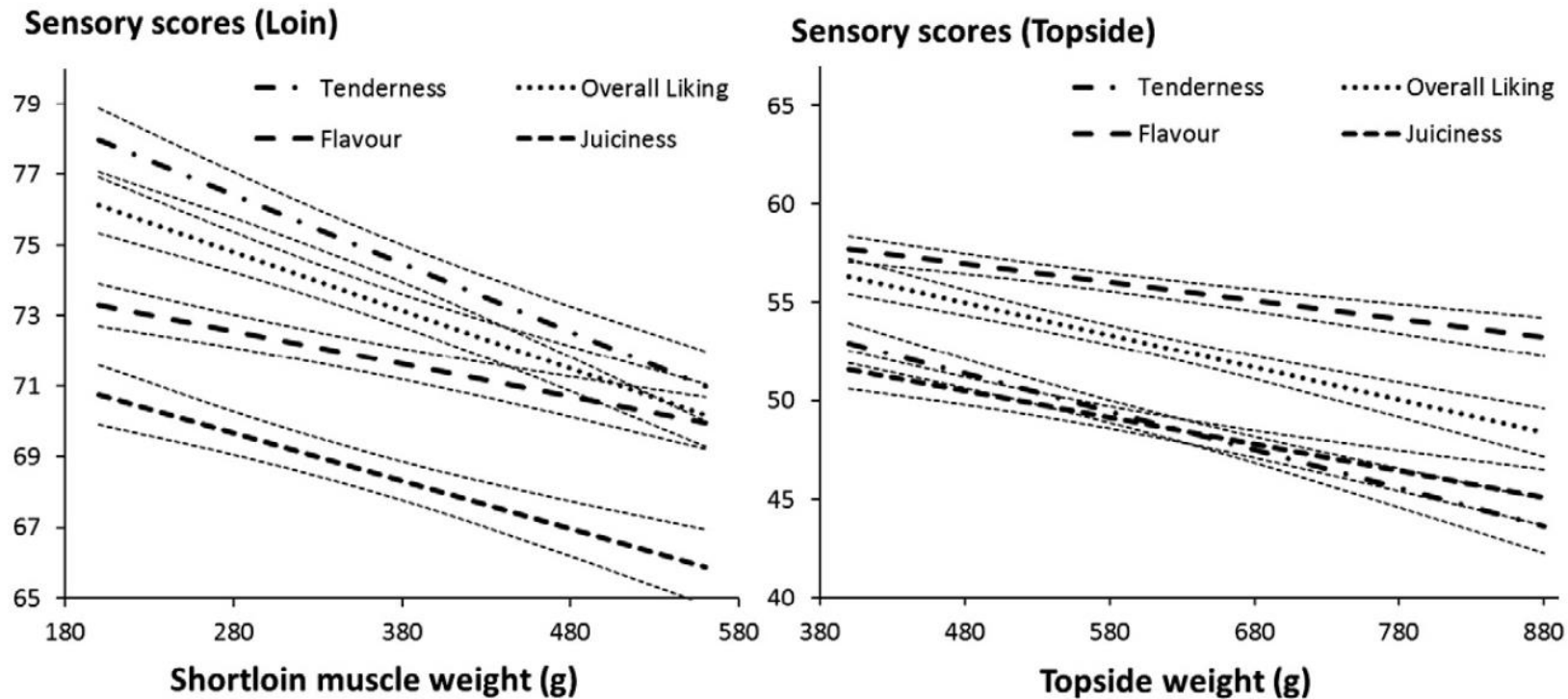
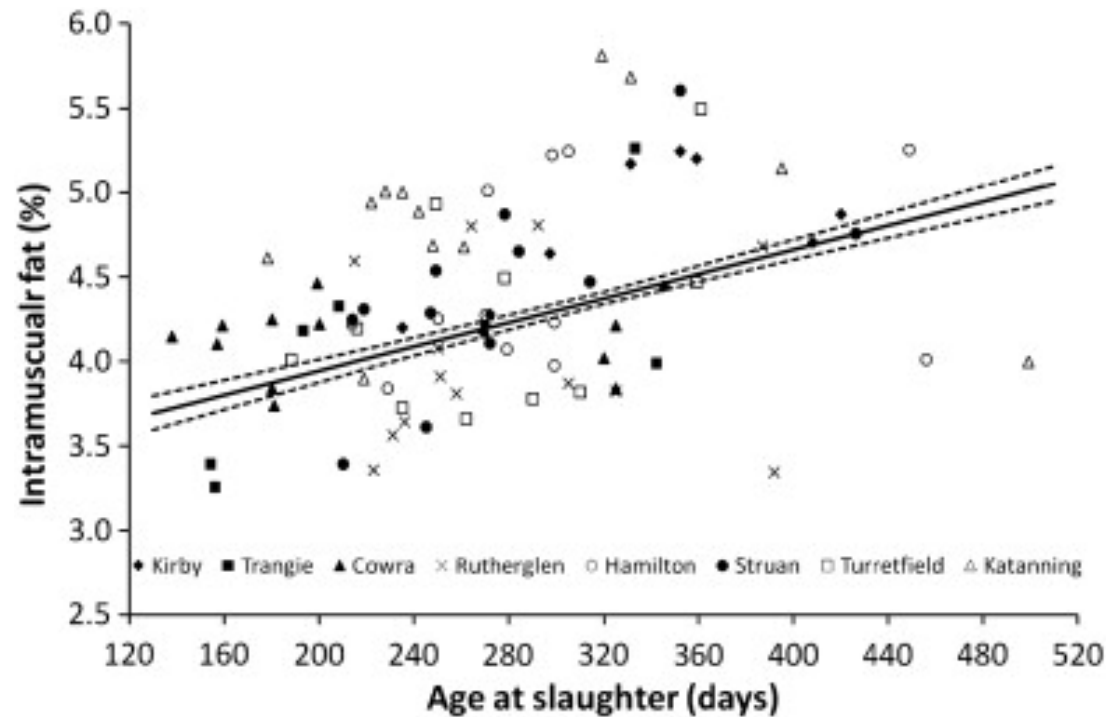


Fig. 4. Relationship between shortloin muscle weight (g) and topside weight (g) with tenderness, overall liking, juiciness and flavour sensory scores of the loin and topside muscles, respectively, of lamb. Lines represent least squares means ($\pm$ SE) for the sensory scores across the shortloin muscle weight and topside weight range from the covariate models.

Pannier et al. 2014



Sammenhæng mellem alder og % IMF



Genotyper udvalgt på baggrund af IMF – effect på flavour

Odour characteristic	High IMF	Flavour characteristic	High IMF	Taste characteristics	High IMF
Overall intensity	++	Overall intensity	+	Sweet	Ns
Lamb/mutton	Ns	Lamb/mutton	Ns	Salty	++
Grilled	+	Dairy	Ns	Sour/acidic	Ns
Bloody	Ns	Grassy	Ns	Umami	+
Caramel	Ns	Vegetal	Ns	Aftertaste acidic	-
Barnyard	Ns	Fatty	Ns	Astringent	Ns
Hay/grainy	Ns	Livery	Ns	Oily mouthcoating	+
Livery	Ns	Metallic	ns	Metallic	Ns
Oxidized fat	ns			Lingering	Ns



Fedtsyrer i lammekød

Græs → linolensyre (C18:3- n3) → n3 Poly umættede fedtsyrer (✓✓)

Korn → linolsyre (C18:2 –n6) → n6 Poly umættede fedtsyrer

Hvor meget IMF skal der være? 4-5% (Pannier et al. 2014)



Lammekød præferencer

Europæiske forbrugere foretrækker ofte kød fra dyr der er helt eller delvist fodret med **kraftfoder**

- det er det, de er **vant til**
- de finder, at kød fra græsfodrede dyr kan have **afvigende smag**

Font i Furnols et al. 2009



Table 1. Impact of Various Feeding Regimens on Flavor of Sheepmeat

feeding system	impact on flavor	attribute ^a	ref
Untrained Panel			
chicory vs lucerne	no difference	F	12
rape vs pasture	stronger, less acceptable flavor for rape	F	12
white clover, lucerne, lotus, ryegrass vs corn, corn + fescue	corn finished samples more than forage finished	F + O	41
pasture vs concentrate vs pasture/concentrate	differences based on consumer (country) preference	F	190
saltbush vs barley/lupin/hay	no difference	F	55
mixed pasture vs grain-based or poor quality dry feed	no difference between pasture vs grain	F	46
milk vs milk replacer (rearing system)	no discrimination	F	139
Trained Panel			
white clover vs ryegrass	stronger flavor/odor for white clover	F + O	49
lucerne vs perennial ryegrass	more intense flavor/odor for lucerne	F + O	50
ryegrass, tall fescue, cocksfoot, phalaris, lucerne, chicory, prairie grass	phalaris ("foreign flavor") stronger than others	F + O	123
lucerne vs phalaris	lucerne less acceptable than phalaris	F	186
lucerne	lucerne related flavor increased	F	187
lotus vs ryegrass vs white clover	no influence on meat flavor; (<i>p</i> -cresol negatively correlated with sheepy odor)	F	56
cultivated pasture vs mountain pasture	minor differences in 'metallic' and 'rancid'	F + O	26
<i>Brassica rapus</i> vs pasture	<i>Brassica</i> , strong, unattractive odor/flavor	F	11
rape, vetch, oats vs pasture	low acceptability for rape	F	51
	some differences found for vetch and oats		
tropical legumes vs grass	no significant difference	F	52
grass/clover vs chicory	no appreciable difference	F + O	54
alfalfa vs corn/soybean	flavor more intense for alfalfa	F	39
parthenium weed vs grain	panel could differentiate "taint", differences small	F	40
pasture vs concentrate vs pasture/concentrate	lower acceptance of pasture-fed animals	F	191
cottonseed meal vs corn dried distillers grains	no difference	F + O	192
perennial ryegrass + other grasses vs grain-based	"sheepmeat" higher for pasture than grain	F + O	42
pasture vs grain concentrate	"lamb" flavor higher in concentrate. grass-fed animals; higher in "liver" flavor	F + O	188
pasture vs lucerne or maize concentrate	"sheepmeat" higher for pasture	F + O	44
ryegrass vs concentrate	"off" odors/flavors in pasture-fed meat	F	105
ryegrass vs saltmarsh, heather, moorland	ryegrass less acceptable than others		189

^aFlavor attribute tested: F, taste; O, odor/aroma.

Watkins et al. 2013



Smags accept af lam fra Uruguay, fodret med forskellige rationer

Men der er grupper i hvert land der foretrækker

Country of consumers / % weekly consumption	# of lambs	Pasture græs fodret lam	Pasture + 0.6% LW concentrate	Pasture + 1.2% LW concentrate	Concentrate 4% LW + Hay
Spanish / 44.2	200	5.1 ^b	5.6 ^a	5.6 ^a	5.8 ^a
German / 5	200	5.3 ^b	5.8 ^a	6.0 ^a	5.4 ^b
French / 18	179	5.2 ^b	5.6 ^{ab}	5.8 ^a	5.9 ^a
British / 23.2	186	5.0 ^b	5.7 ^a	6.1 ^a	5.2 ^b
Pooled	765	5.2 ^c	5.7 ^{ab}	5.9 ^a	5.6 ^b



Slutfodring med Rajgræs, Lucerne, Plantain og Ryegræs i 76 dage (slagtevægt 19-26 kg)

HCW positivt associeret
med flavour liking

	Lucerne	Plantain	Ryegrass
Aged meat odour	14.29	9.19	12.24
Barnyard odour	11.22	7.33	9.95
Grassy odour	14.78	14.84	12.56
Flavour impact	57.66	58.69	56.75
Liver flavour	44.44	43.20	42.76
Grilled flavour	39.76	41.55	37.88

Frank et al. (2017)



Slutfodring med Rajgræs typer raps i 42 dage (slagte forskellige

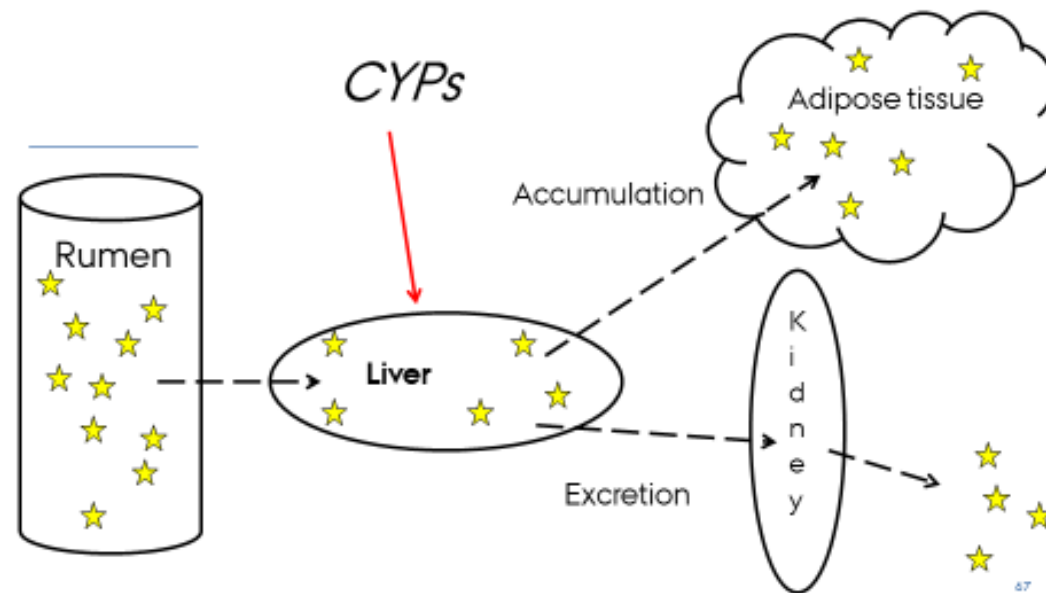
Trænet panel fandt forskelle i
odour, forbrugere fandt forskelle i
flavour – begge grupper til fordel
for foderraps!

	Ryegrass	Lucerne	Titan (Rape – high yield)	Greenland (Rape – late flowering)
Odour intensity	57.9	61.1	59.6	60.1
Odour liking	67.2	65.7	65.8	65.6
Flavour intensity	56.7	63.1	56.2	65.7
Lamb flavour intensity	51.8	57.5	59.4	58.4
Flavour liking	65.7	69.3	65.6	70.6

Frank et al. (2016)



Proteinrigt foder: Aminosyren tryptofan bliver til skatol



Lam fodret med græs eller pelleteret foder

Lugt beskrivelser	Kemisk forbindelser	Afgræsning vædder	Afgræsning - kastrat	Kraftfoder m. lucerne - vædder	Kraftfoder med majs - vædder
Stald lugt/smag		3,22	3,96	2,69	2,47
Fæces	Skatol	74	100	1	1

*Letfordøjeligt protein -> øget skatol

Young et al. 2003



Bælgplanter
esparsette (*Onobrychis viciifolia*) og kællingetand (*Lotus
cornicalatus*) indeholder kondenserede tanniner (CT)
CT hæmmer dannelsen af skatol i vommen



Indhold af skatol afhængig af fodring og køn

Foder	Kløvergræs		Rajgræs		Signifikan s
	Gimmer	Vædder	Gimmer	Vædder	
Skatol µg/g	0,059	0,100	0,075	0,050	*

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Konsistens og fedtindhold i filet hos gimmer og vædderlam fodret med enten kløvergræs eller rajgræs

	Gimmer	Vædder	Signifikans
Optøningssvind, %	3,3	2,3	*
Kogesvind, %	13,5	12,5	NS
Konsistens, kg	3,5	4,2	*
Intramuskulært fedt, %	1,30	1,00	NS

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Table II. Mean scores for sensory qualities of meat from lambs slaughtered in October/November 2003 (Experiment 3) by sex type evaluated on a 1–9 scale.

Sensory qualities	Sex type		Significance
	Ram lambs	Ewe lambs	
Texture			
Hardness	3.7 ± 0.1	3.7 ± 0.2	NS
Tenderness	6.1 ± 0.1	6.7 ± 0.2	**
Greasiness	3.7 ± 0.1	3.5 ± 0.1	†
Juiciness	4.8 ± 0.1	5.0 ± 0.1	*
Odour			
Intensity	6.3 ± 0.1	6.2 ± 0.1	NS
Sweet	3.4 ± 0.0	3.3 ± 0.1	NS
Sour	3.2 ± 0.1	3.3 ± 0.1	NS
Metallic	3.4 ± 0.0	3.4 ± 0.0	NS
Ram	2.3 ± 0.1	1.7 ± 0.1	**
Rancid	1.3 ± 0.1	1.4 ± 0.1	†
Taste			
Intensity	5.8 ± 0.1	6.2 ± 0.1	†
Sweet	3.4 ± 0.1	3.1 ± 0.1	*
Sour	3.5 ± 0.1	3.8 ± 0.2	†
Bitter	3.8 ± 0.0	3.8 ± 0.1	NS
Metallic	4.3 ± 0.0	4.4 ± 0.1	NS
Cloying	2.4 ± 0.1	2.0 ± 0.1	*
Gamey	2.1 ± 0.1	2.0 ± 0.1	NS
Ram	2.2 ± 0.1	1.6 ± 0.1	***
Rancid	1.2 ± 0.1	1.3 ± 0.1	NS

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. † $P < 0.1$. NS = Not significant. All values are stronger and more pronounced with increasing figure values.

Table III. Mean scores for sensory qualities of meat from lambs slaughtered in March/April 2002 (Experiment 2) by sex types evaluated on a 1–9 scale.

Sensory qualities	Sex type		Significance
	Ram lambs	Ewe lambs	
Odour			
Intensity	6.3 ± 0.1	6.1 ± 0.2	NS
Sour	3.6 ± 0.1	4.3 ± 0.2	*
Ram	4.0 ± 0.2	3.4 ± 0.5	*
Barn	2.5 ± 0.2	2.1 ± 0.4	†
Rancid	1.2 ± 0.0	1.2 ± 0.1	NS
Taste			
Intensity	6.4 ± 0.1	6.2 ± 0.2	NS
Sour	3.7 ± 0.1	4.4 ± 0.2	**
Bitter	3.9 ± 0.1	3.8 ± 0.1	NS
Metallic	4.3 ± 0.0	4.0 ± 0.1	*
Ram	4.4 ± 0.2	3.2 ± 0.5	*
Barn	2.3 ± 0.1	2.1 ± 0.3	†
Rancid	1.3 ± 0.0	1.4 ± 0.1	NS

* $P < 0.05$, ** $P < 0.01$. † $P < 0.1$. NS = Not significant. All values are stronger and more pronounced with increasing figure values.



Table I. Mean scores for sensory qualities of meat from lambs slaughtered in September 2001 (Experiment 1) by sex type evaluated on a 1–9 scale.

Sensory qualities	Sex type		Significance
	Ram lambs	Ewe lambs	
Texture			
Hardness	4.0 ± 0.1	4.2 ± 0.2	NS
Tenderness	6.0 ± 0.1	5.8 ± 0.3	NS
Greasiness	3.8 ± 0.0	4.0 ± 0.1	*
Juiciness	5.0 ± 0.1	5.3 ± 0.1	**
Odour			
Sweet	4.5 ± 0.1	4.7 ± 0.1	NS
Sour	4.0 ± 0.1	4.2 ± 0.2	NS
Metallic	3.5 ± 0.0	3.5 ± 0.1	NS
Rancid	1.5 ± 0.1	1.5 ± 0.1	NS
Taste			
Sweet	4.3 ± 0.0	4.3 ± 0.1	NS
Sour	4.3 ± 0.1	4.8 ± 0.2	*
Bitter	4.0 ± 0.0	4.0 ± 0.1	NS
Metallic	4.4 ± 0.0	4.4 ± 0.1	NS
Ram	2.4 ± 0.1	2.3 ± 0.1	NS
Gamey	2.6 ± 0.1	2.7 ± 0.1	NS
Rancid	1.3 ± 0.0	1.4 ± 0.1	NS

All values are stronger and more pronounced with increasing figure values. NS = Not significant; * $P < 0.05$, ** $P < 0.01$.

Græs ensilage + 0,4 kg el. Ad. Lib (1-1,2 kg) kraftfoder

Table II. Effects of concentrate levels and sex of animal on sensory qualities of lamb meat as judged by trained panellists. Results of Experiment I.

Meat variables	Restricted		<i>Ad libitum</i> access		Feeding (<i>F</i>)	Sex (<i>S</i>)	<i>S</i> × <i>F</i>
	Ram lambs	Ewe lambs	Ram lambs	Ewe lambs			
Odour							
Intensity	6.0 ± 0.1	6.1 ± 0.1	6.3 ± 0.1	6.1 ± 0.1	NS	NS	NS
Sweet	3.2 ± 0.1	3.2 ± 0.1	3.3 ± 0.1	3.4 ± 0.1	†	NS	NS
Sour	3.1 ± 0.2	3.4 ± 0.2	3.0 ± 0.2	3.3 ± 0.2	NS	NS	NS
Metallic	3.4 ± 0.1	3.4 ± 0.1	3.5 ± 0.1	3.4 ± 0.1	NS	NS	NS
Male	2.1 ± 0.2 ^{ab}	1.6 ± 0.2 ^c	2.5 ± 0.2 ^a	1.7 ± 0.2 ^{bc}	†	***	NS
Rancid	1.1 ± 0.1	1.3 ± 0.1	1.3 ± 0.1	1.3 ± 0.1	NS	NS	NS
Taste							
Intensity	5.8 ± 0.1 ^b	6.0 ± 0.1 ^{ab}	6.2 ± 0.1 ^a	6.1 ± 0.1 ^a	**	NS	*
Sweet	3.1 ± 0.1 ^c	3.1 ± 0.1 ^{bc}	3.3 ± 0.1 ^a	3.2 ± 0.1 ^{ab}	**	NS	NS
Sour	3.3 ± 0.2 ^b	3.7 ± 0.2 ^a	3.4 ± 0.2 ^{ab}	3.8 ± 0.2 ^a	NS	*	NS
Bitter	3.9 ± 0.1	3.8 ± 0.1	3.9 ± 0.1	3.9 ± 0.1	NS	NS	NS
Metallic	4.4 ± 0.1	4.4 ± 0.1	4.4 ± 0.1	4.4 ± 0.1	NS	NS	NS
Cloying	2.6 ± 0.1 ^a	2.2 ± 0.1 ^b	2.2 ± 0.1 ^b	2.0 ± 0.1 ^b	**	*	†
Gamy	1.9 ± 0.1	1.9 ± 0.1	2.0 ± 0.1	2.0 ± 0.1	NS	NS	NS
Male	1.9 ± 0.1 ^b	1.4 ± 0.1 ^c	2.4 ± 0.1 ^a	1.6 ± 0.1 ^{bc}	*	***	NS
Rancid	1.1 ± 0.1	1.2 ± 0.1	1.1 ± 0.1	1.2 ± 0.1	NS	NS	NS



Køn og slutfodring

	Rye 24		Rye 44	
	Male	Female	Male	Female
Sweet odour	3.29	3.45	3.16	3.48
Sour odour	2.96	3.49	2.97	2.61
Ryegrass odour	2.66	2.17	2.61	2.17
Rancid odour	1.74	1.46	1.67	1.31
Sour taste	2.70	3.57	2.85	3.54
Bitter taste	4.45	4.04	4.37	4.06
Cloying taste	3.40	2.65	3.25	2.73
Rancid taste	2.34	1.63	2.04	1.53

Lind et al. 2011



Opsummering

- Smag (flavour) hænger stærkt sammen med “overall liking”
 - Intramuskulært fedt (IMF) er en væsentlig faktor for smag
 - Avl for muskelvækst kan have negative konsekvenser for IMF
 - Avl for IMF - positiv effekt på smag
 - Græs kontra kraftfoder påvirker smagen – spørgsmål om præference
 - Meget proteinrigt foder øger mængden af skatol – karakteriseret ved stald/fæces lugt
 - Udviklingen af skatol kan hæmmes med specifikke bælgeplanter
 - Vædderlam udvikler oftere/tidligere off-flavour – slagtes tidligt
-
- Hvad er skandinaviske forbrugers præferencer for lammekød?



Tak for opmærksomheden

