Growth Path Effects on Lean Meat Yield and Eating Quality

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Balancing lean meat yield & eating quality

- Lean meat yield (LMY)
  - muscling & fatness
- New cuts based MSA lamb model
- Intramuscular fat

LMY is especially important in lamb

$42/kg (44% fat trim) → $75/kg (36% bone)

$117/kg for lean !!

- Australian lamb abattoirs now have high quality boning rooms
- However difficult to remove all seam fat in lamb
- Lamb mince NOT a major product (a lot of beef fat is sold at mince/sausage price)
- = A level of carcase leanness crucial for profitability

Carcase Value

Carcase value ($) = Wt retail cuts (kg) X Value of the cuts ($/kg)

LMY

Lean meat yield

MSA 3*4*5*

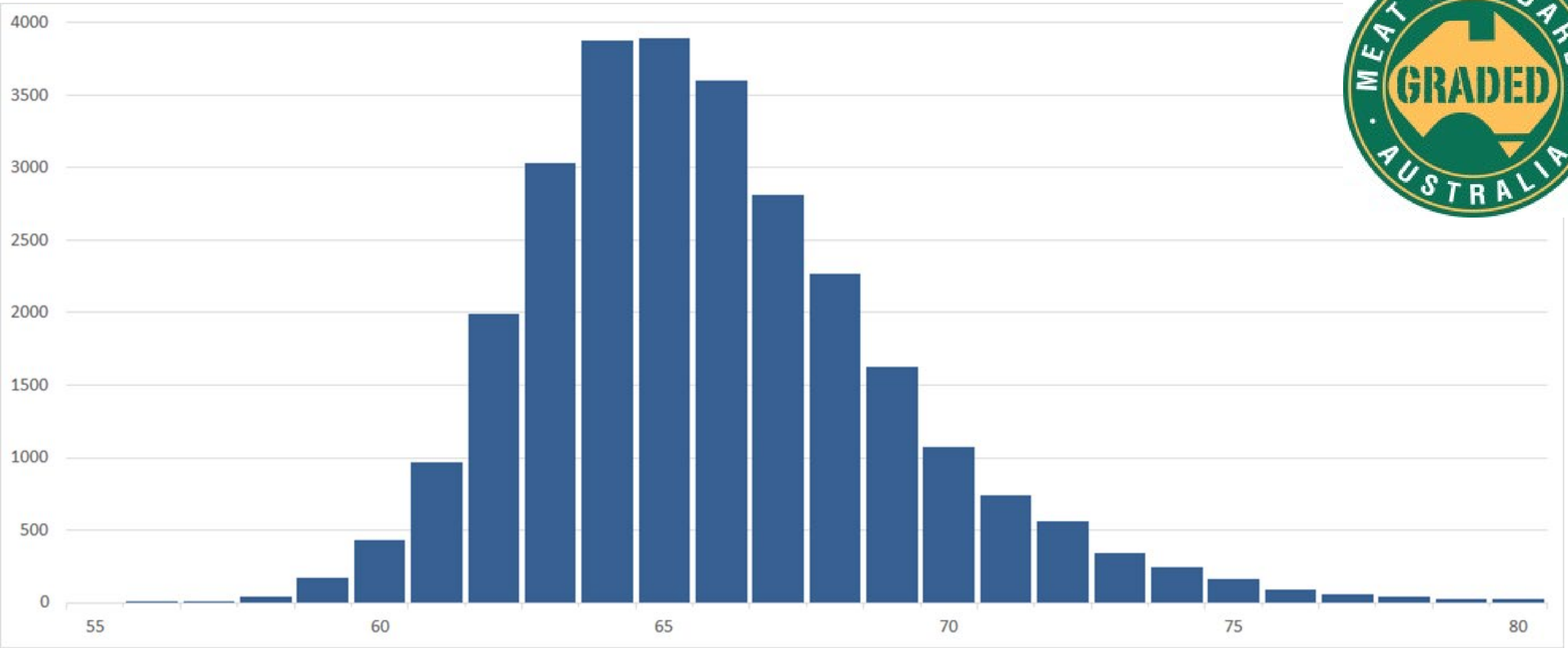
good/better/best

Cuts based MSA model what can you do?

- Lean meat yield (LMY)
- Intramuscular fat (IMF)

- 2 model inputs that you can control ??

Sheep meat Model MQ4 Score Distribution for Loin



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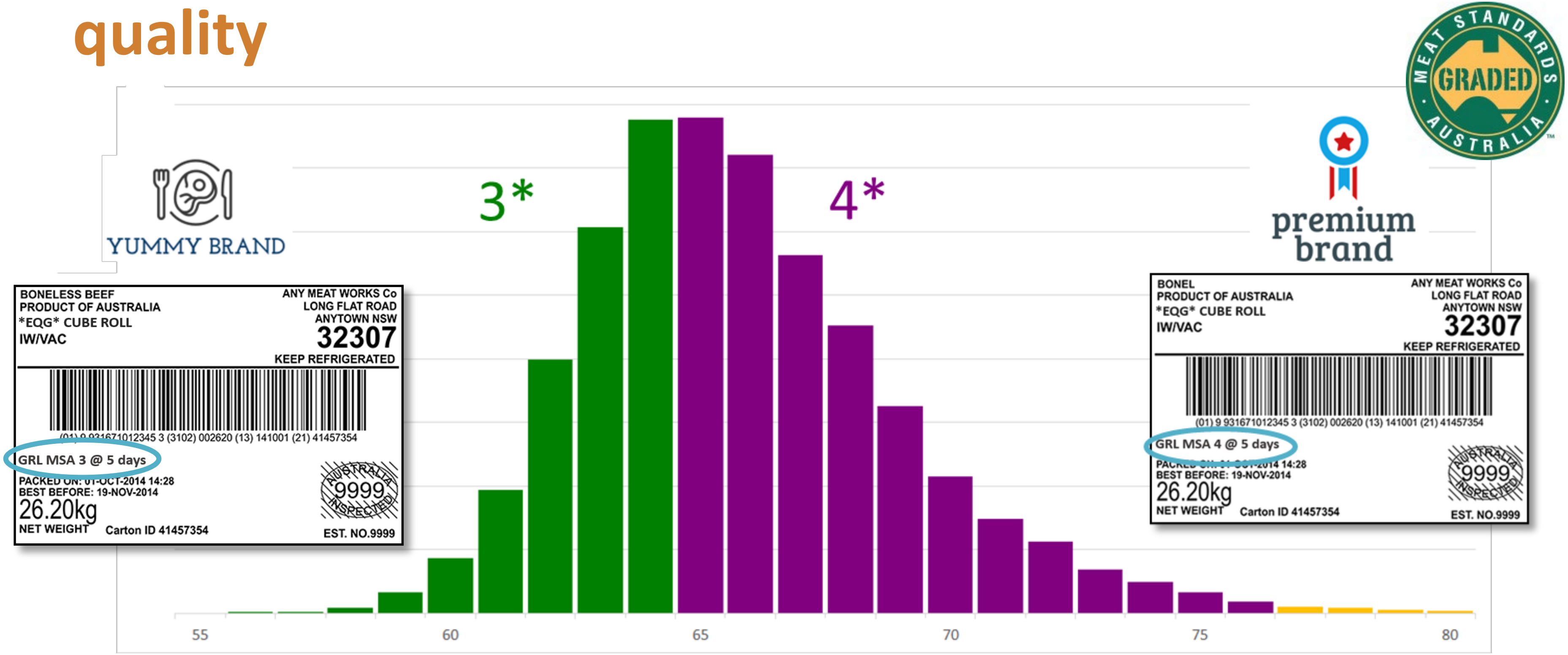
Brand owners will segregate product on MSA eating quality



Lean Meat Yield (LMY) and Intramuscular Fat (IMF)

Can now be accurately measured 'on line' at processing

ALMTECH ADVANCED LIVESTOCK MEASUREMENT TECHNOLOGIES

Rate of growth & lean meat yield

Poll Dorset

x Merino

Muscle	Control	Growth

x

2 levels of

nutrition

40 kg 60 kg

Live weight

8mo slaughter

140 vs 230gm/day

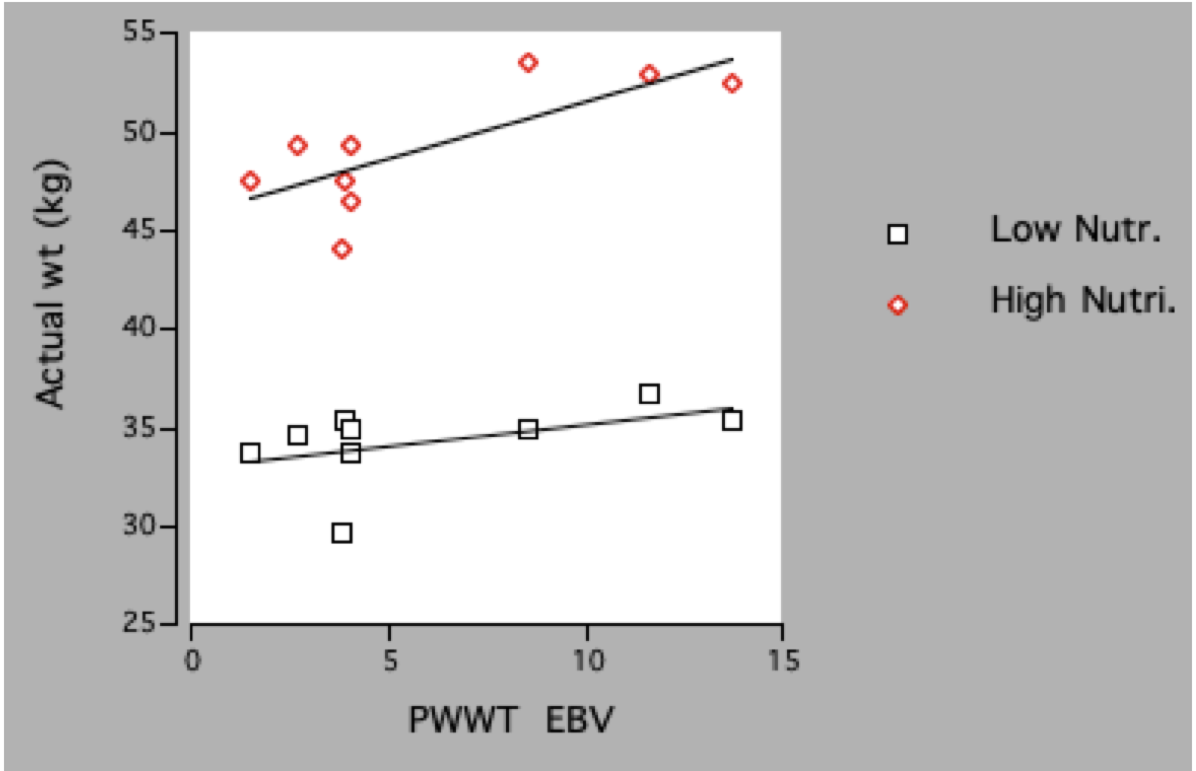
Growth x nutrition

- Nutrition difference ~10kg HCW
- Carcase fatness driven by nutrition ~2 fat scores

	Low	High
HCW (kg)	16.3	26.6
GR (mm)	7	21
% fat	21.5	29.2
At same 21.5kg HCW (low = about 12mo !!)		
GR (mm)	9	19
% fat	24.6	27.1
% LMY	59	55

Growth x genetics

- EBV for PWWT - lose 60% of benefit under low nutrition



Growth retardation and compensatory growth

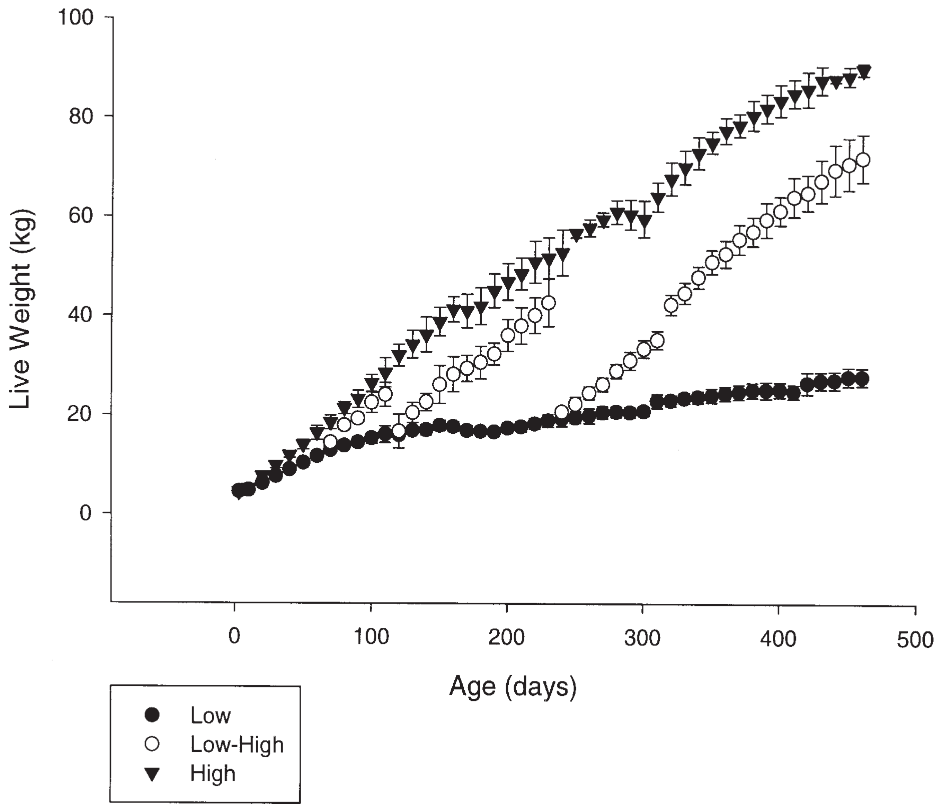
1. New Zealand pen study

   Oldham JM, Kirton AH & Bass JJ (1999) Proc NZ Society for Animal Production 59, 111-113

   http://www.nzsap.org/search/site

1. NZ work

- Indoor expt – 78 ewe lambs from 3 days old
- Lambs raised on milk replacer then balanced pellets (Lucerne, barley) @ 3.74mo
- 2 growth rates = High and Low



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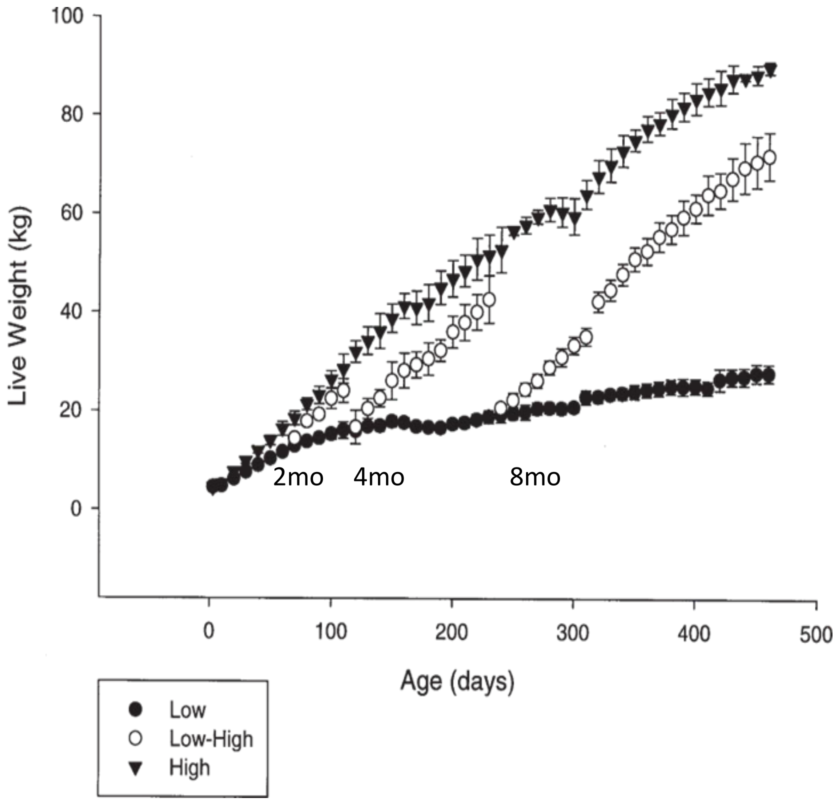
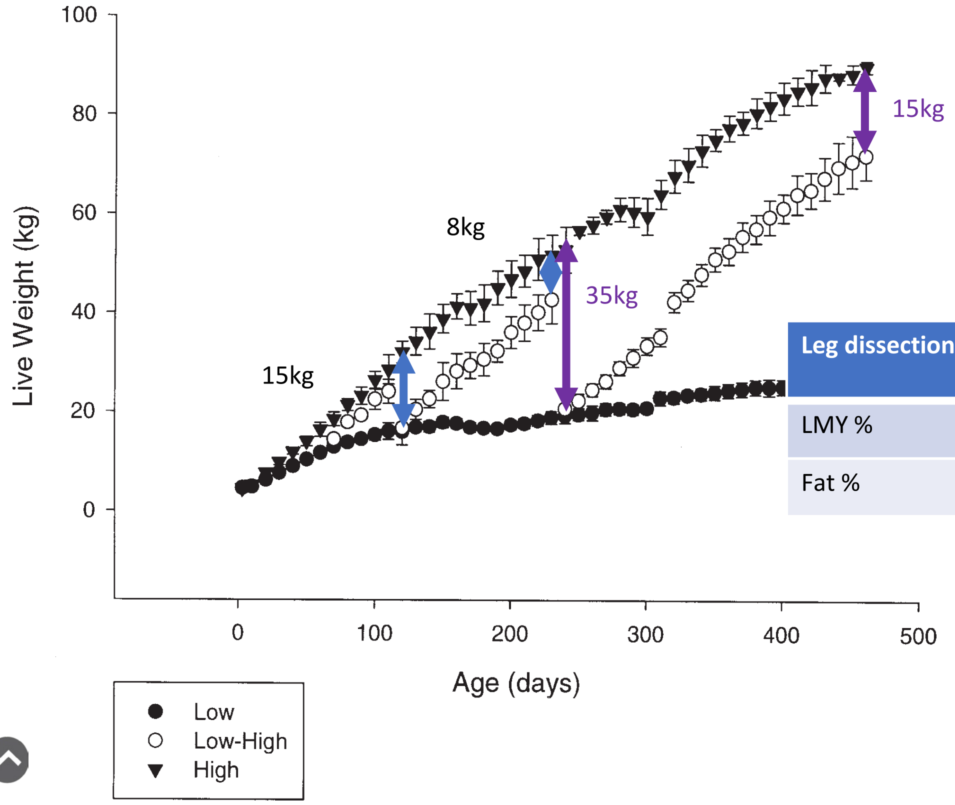
1. NZ work

- Weaning 105 days 3.75mo old)
- Transferred to high diet at 2, 4 and 8mo old



- gm/day
- 2-4mo = 246 vs 242 (ns)
- 4-8mo = 206 vs 234 (sig just)
- 8-15mo = 153 vs 224 (sig)

1. NZ work Carcase composition same



Leg dissection	H	L->H	
LMY %	56.2	57.1	N sig
Fat %	34.0	32.6	N sig

Adjusted to same HCW

2. CRC Growth path x Genetics

- Weaned 20 kg (9 weeks) - unrestricted
- Weaned 30kg (14 weeks) - unrestricted

- Weaned 20 kg (9 weeks) - restricted 56 days - back on feed
- Weaned 30kg (14 weeks) - restricted 56 days - back on feed

Sheep CRC Special edition – Australian Journal of Experimental Agriculture **47**, 1117-1238
14 papers – 2 specifically on this experiment.

2. CRC Growth path x Genetics

- 6 year old Merino ewes (Centre Plus)

- Poll Dorset sires
- Growth
- Muscling
- Muscle & Growth
- Control

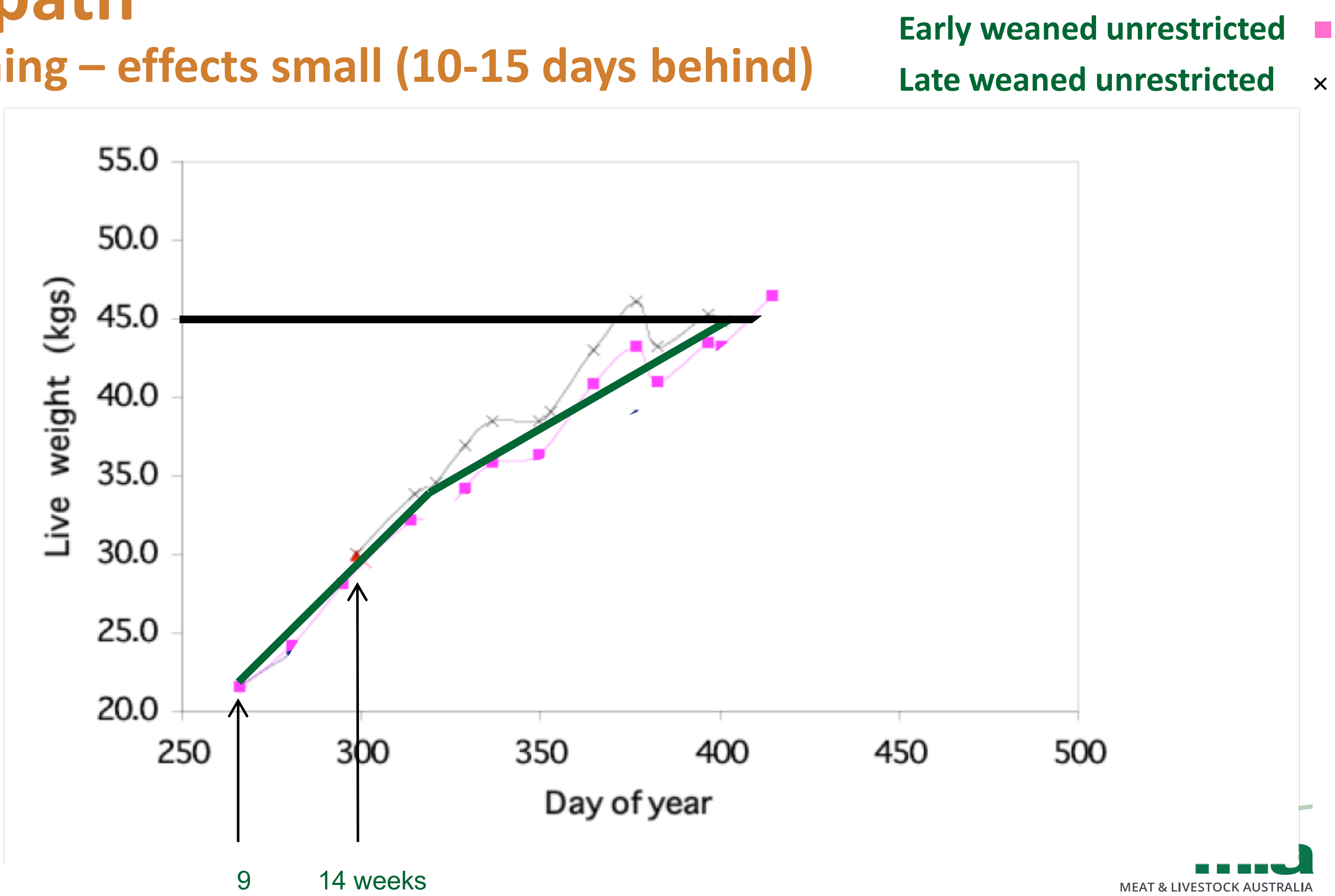
- 627 lambs
- PWWT ASBV varied 3->14kg, PEMD -0.24 –> 3.6

Unrestricted

Restricted = roundup !

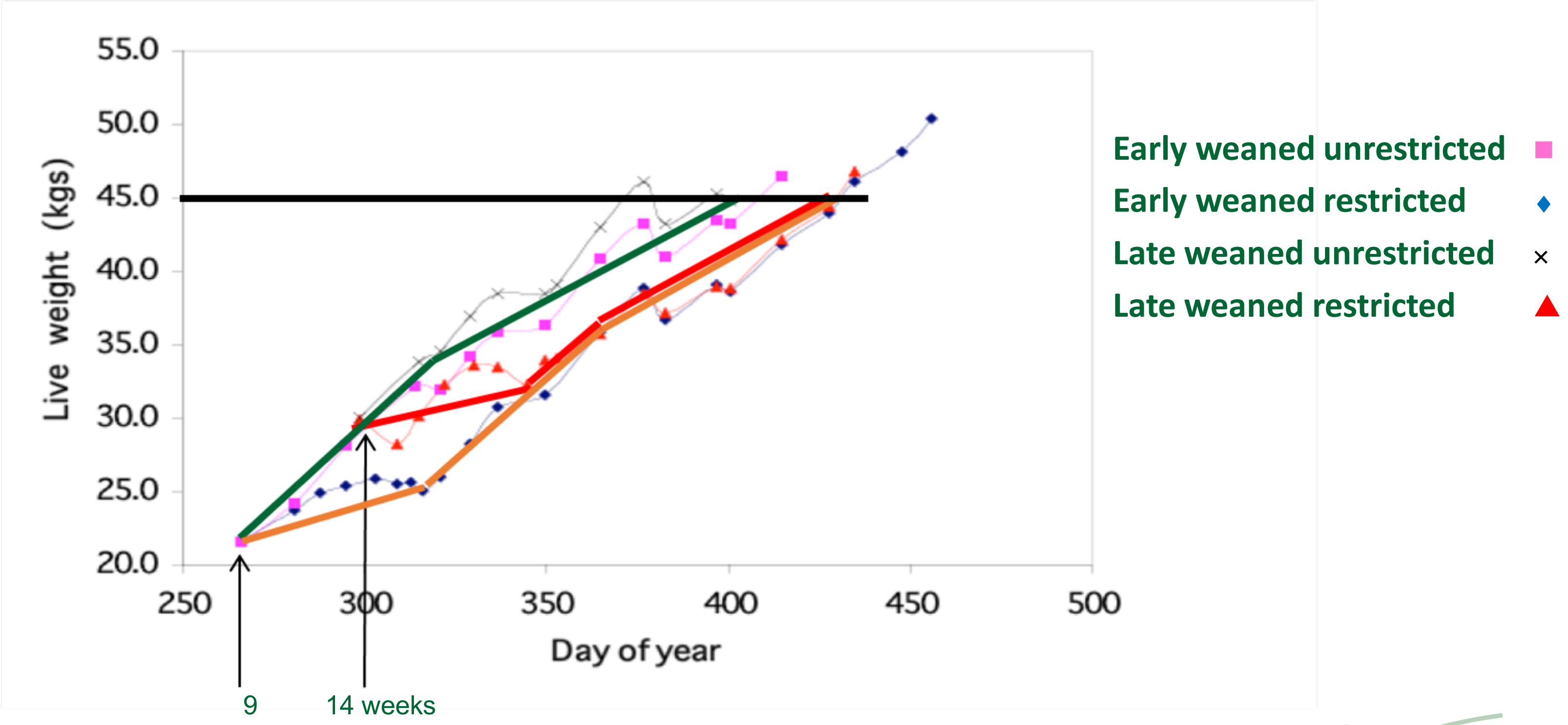
2. Growth path

Early early weaning – effects small (10-15 days behind)



2. Growth path

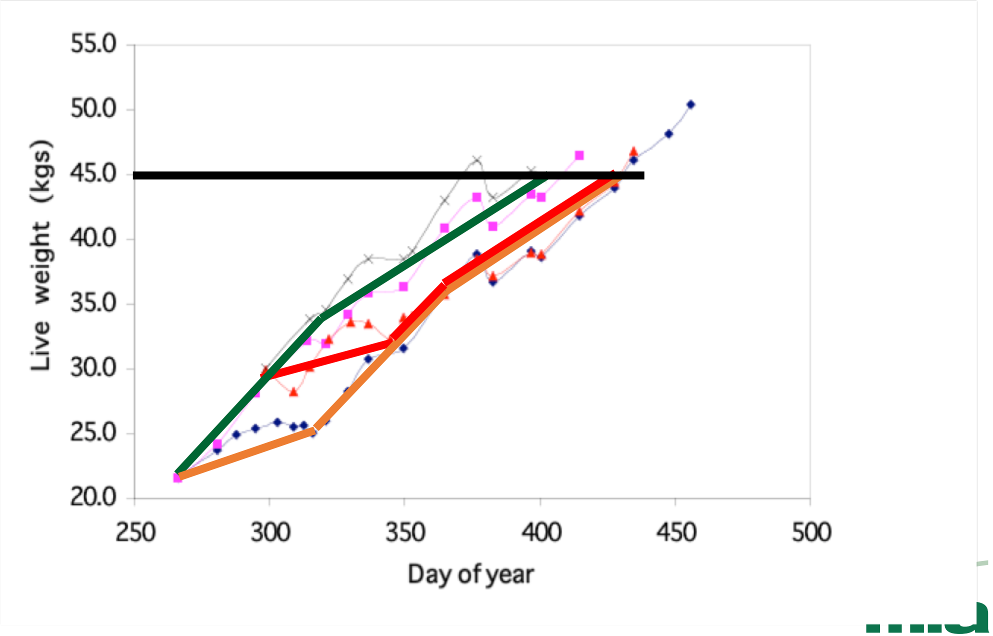
Restricted for 56 days and end up 23 days behind



2. Growth path

- Weaning wt little effect (10-15 days)
- Restricted – made up about half the wt
- Carcase composition same

Early weaned unrestricted
Early weaned restricted
Late weaned unrestricted
Late weaned restricted



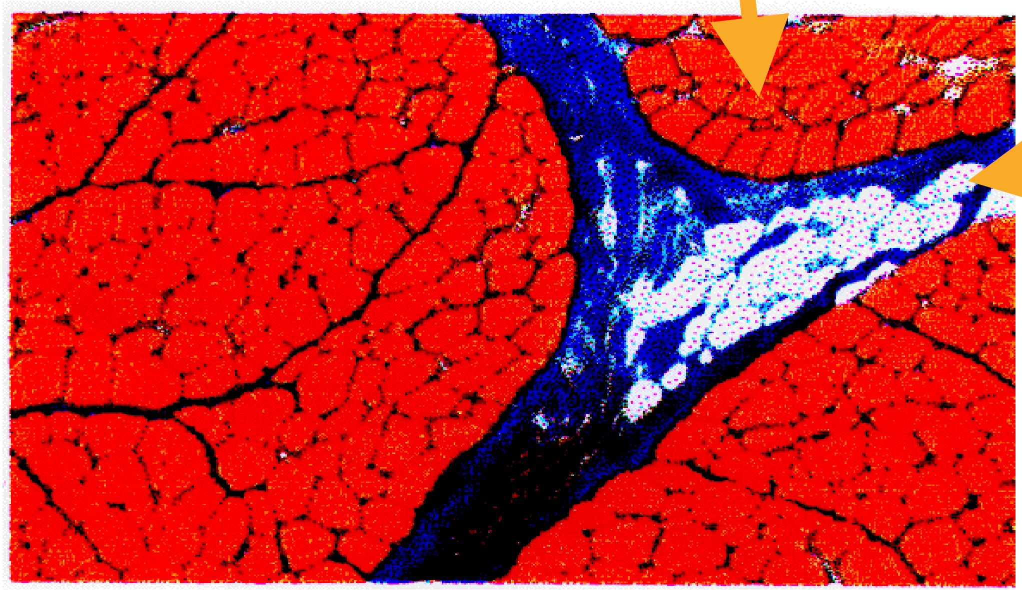
Growth path LMY conclusions

- Faster growth = fatter
- There is compensatory growth after restriction – can make up about 50%
- Live weight gain and carcase composition (LMY) not compromised by periods of restriction <u>at any stage</u> when it is followed by improved nutrition

Intramuscular fat or marbling

Muscle fibres

Fat develops in seams



There are many Fat Depots

- Subcutaneous
- Intermuscular
- Channel & kidney
- Abdominal
- Intramuscular (marbling) = IMF

There are many Fat Depots

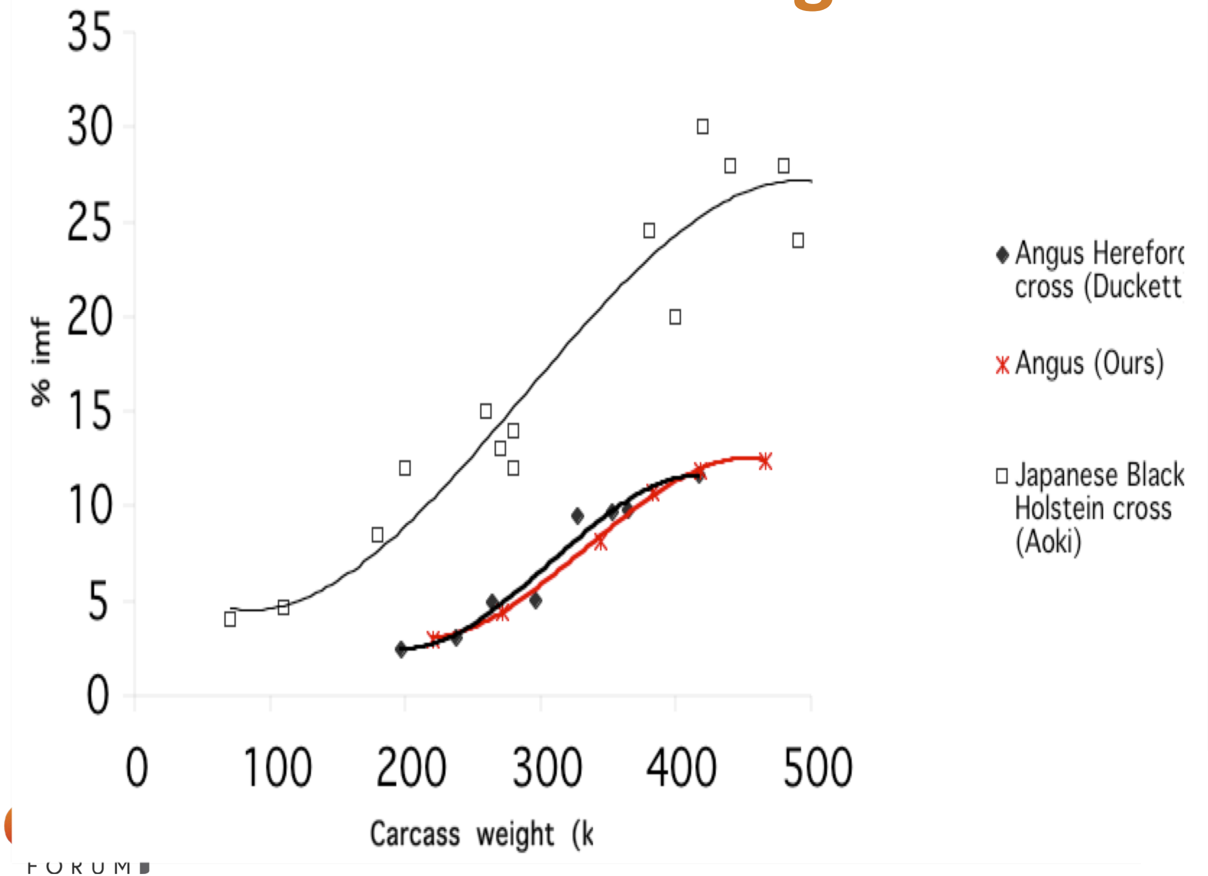
Evidence is they all develop at the same rate

IMF% = muscle and fat

$$\frac{\text{wt muscle fat}}{\text{wt muscle fat} + \text{wt muscle}}$$

So IMF% fat is controlled by both

Beef cattle - 3 serial slaughter studies



Duckett et al. (1993)
Aoki et al. (2001)
Pugh et al. (2005)

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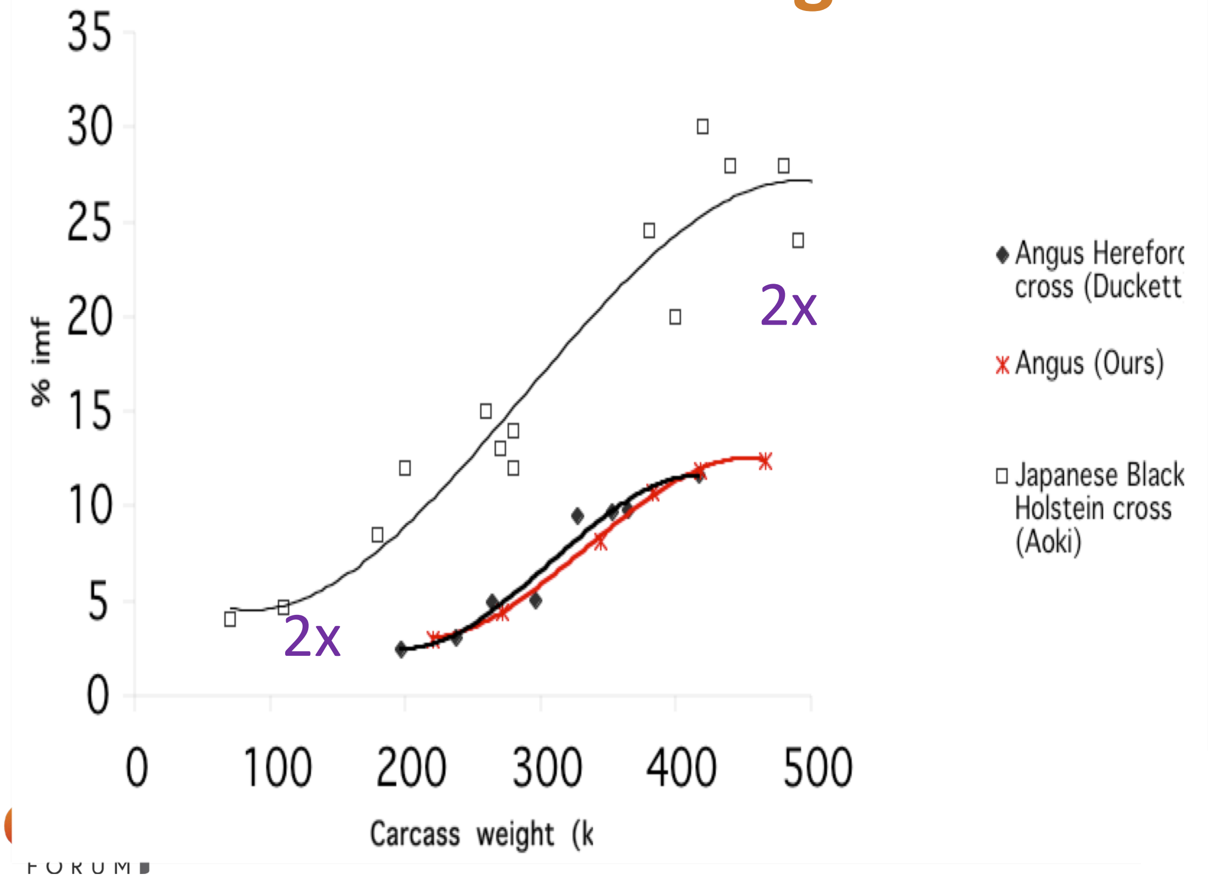

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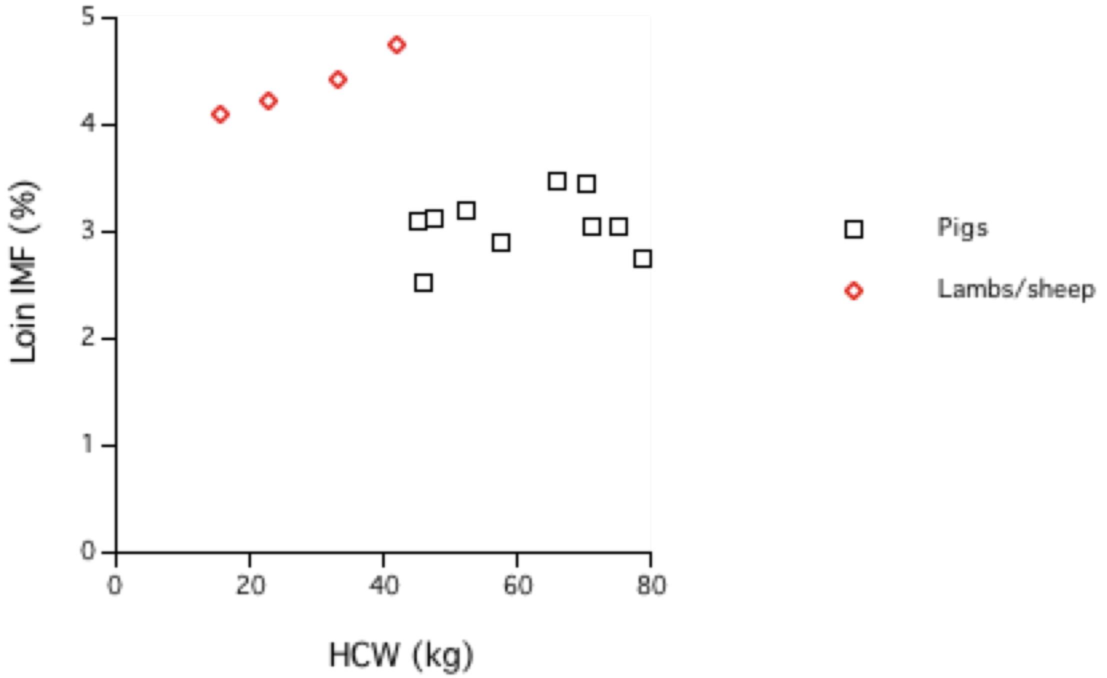
Serial slaughter studies - pigs & lamb/sheep



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D'Souza et al. 2004
Pethick et al. 2007

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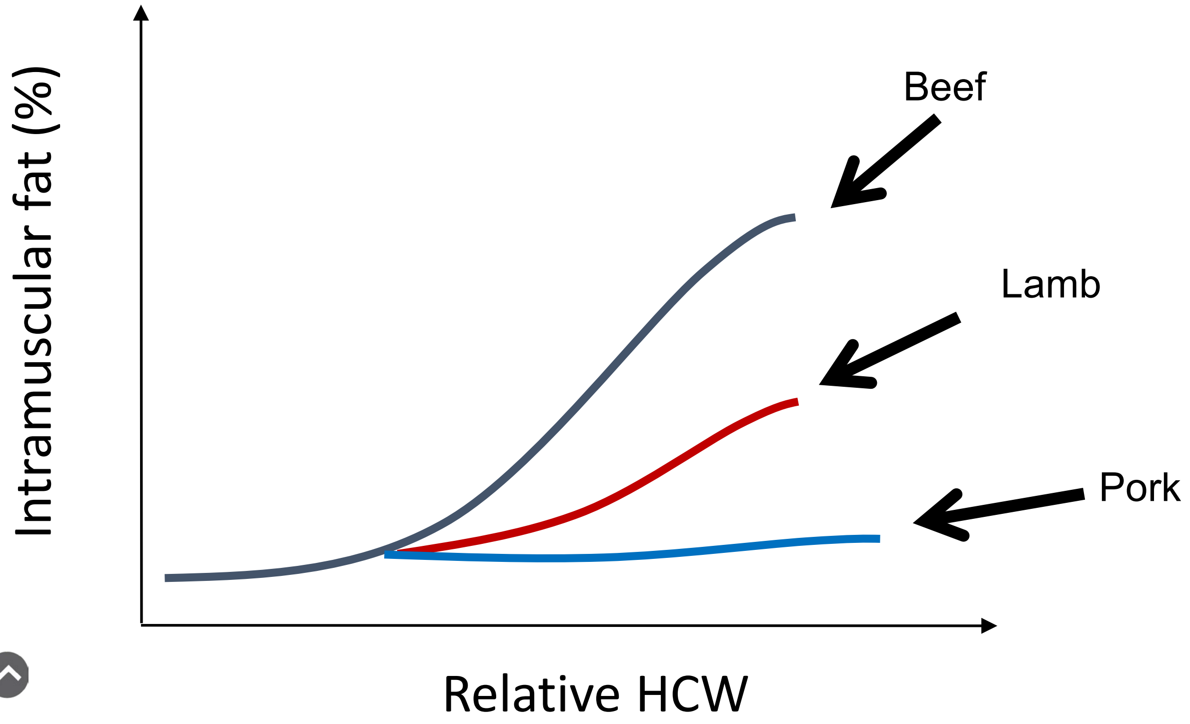
2. IMF development in lamb - slower than beef ?



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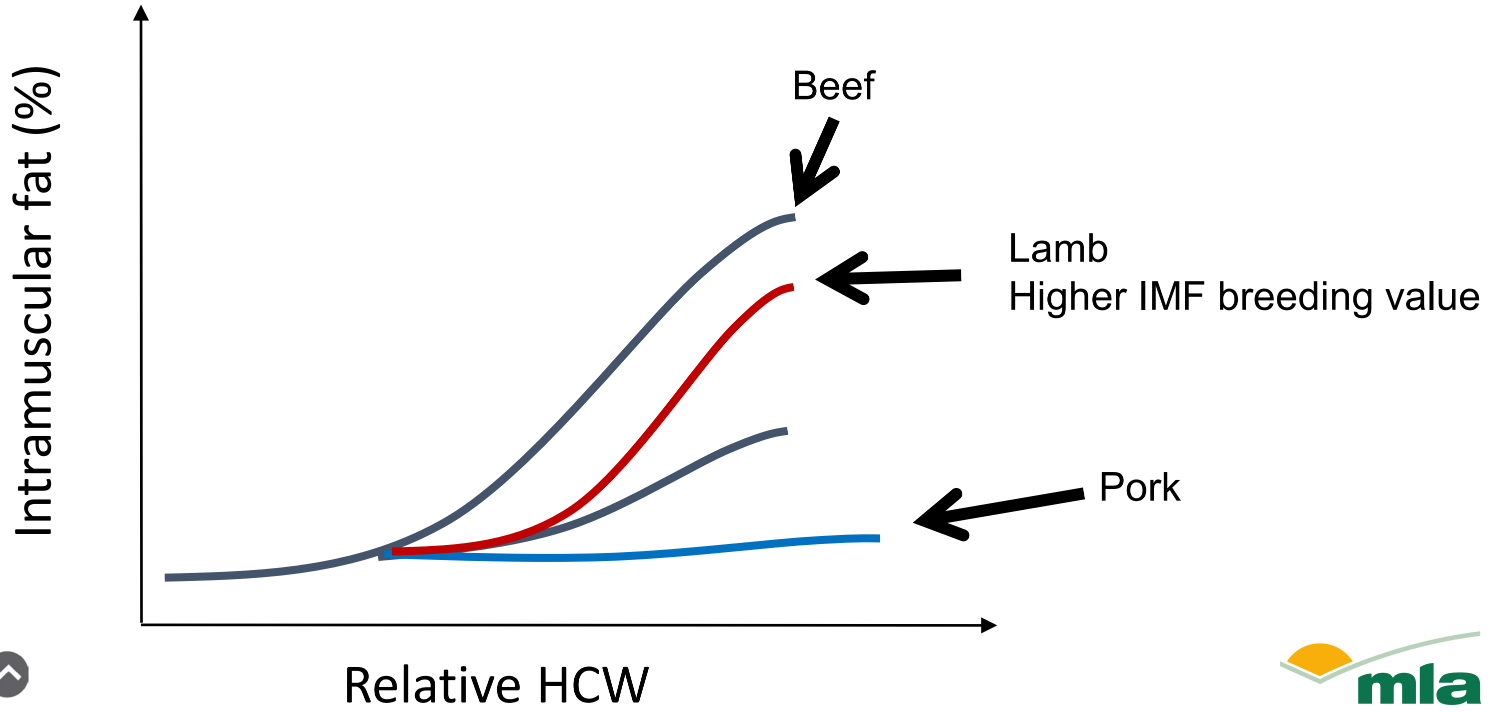

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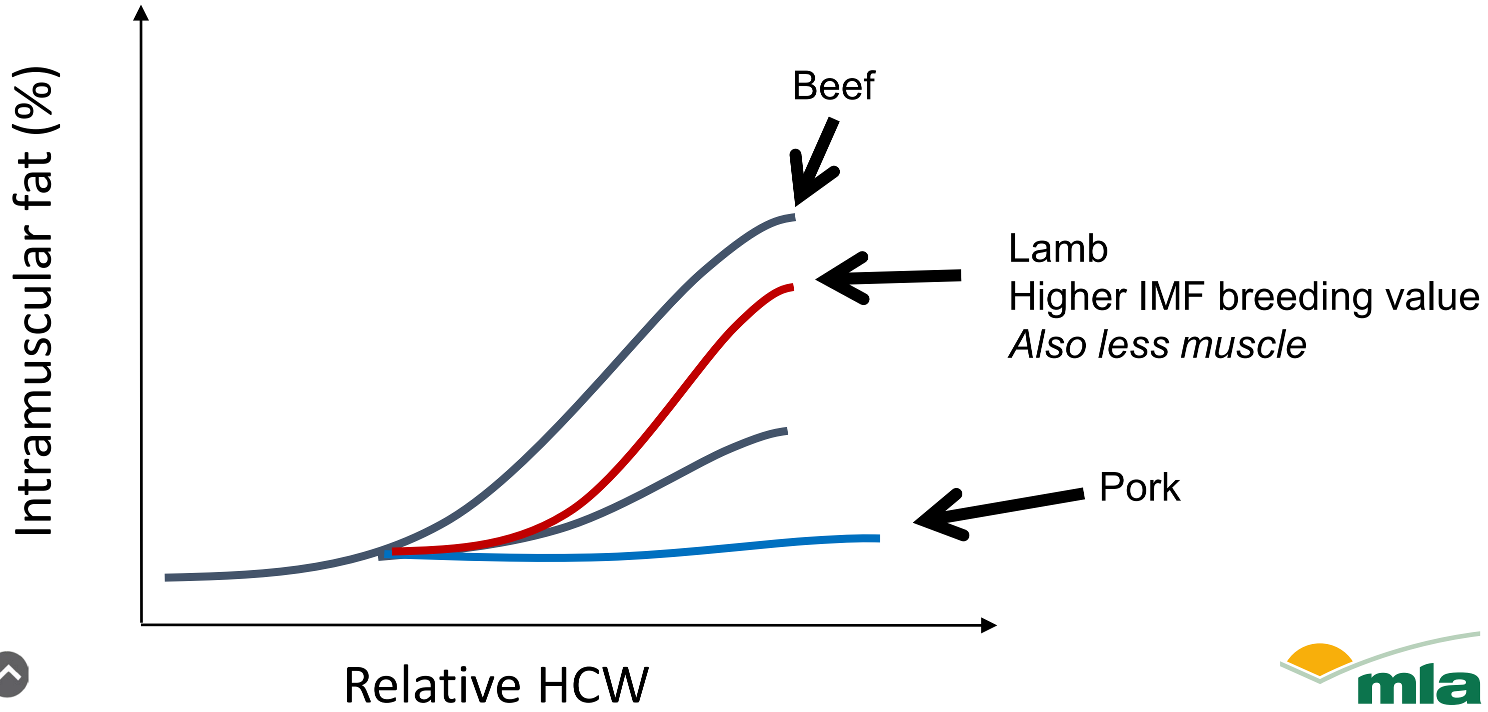

IMF development in lamb

- IMF = % fat in muscle

$$\frac{\text{wt muscle fat}}{\text{wt muscle fat + muscle}} \text{ X } 100 = \%\text{fat} = \text{IMF}$$

- So as muscle grows so does fat – lamb is young so muscle and fat grows together
- = % IMF changes only a little unless have genetics

Some Intramuscular fat metrics for lamb

- 2 weeks of wt loss can reduce IMF by '1%' units
- 1 fat score gives about '0.2%' units of IMF
- 1kg HCW gives about '0.02-0.06%' units of IMF
- beef cattle 10kg HCW gives 0.2-0.3
- Growth rate to 3mo most influence on IMF

- **Overall fatness and weight important (nutrition)**
- **still need genetics**

Grain vs grass finishing

- Approx 8 months old
- Born and raised on grass (SE Sth Australia)
- 3mo before slaughter split into grass vs grain groups

  - PASTURE – irrigated sub clover and rye grass
  - GRAIN – 50:50 barley/lupins and ad lib straw

Carcase data

	Grass	Grain
HCW (kg)	28.4 ± 2.3	30.1 ± 2.9
GR (mm)	14.2 ± 3.3	18.5 ± 4.8
IMF (%)	3.9 ± 0.9	4.3 ± 1.0 **(0.4)**

- Grain feeding did promote more fat including IMF
- In this case the grass was high in energy !!

Dietary effects on sensory/flavor ??

- Untrained consumer panels cannot consistently pick up grass/grain differences

- Australian consumers NO difference
- Some evidence for USA consumers BUT not after extended aging
- Backed up by Irish/UK research using trained taste panelists

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Pethick et al. (2005) Aust J Expt Agric 45, 517
Corlett et al (2020) In press
Gkarane et al (2019) Food Research International 115, 54

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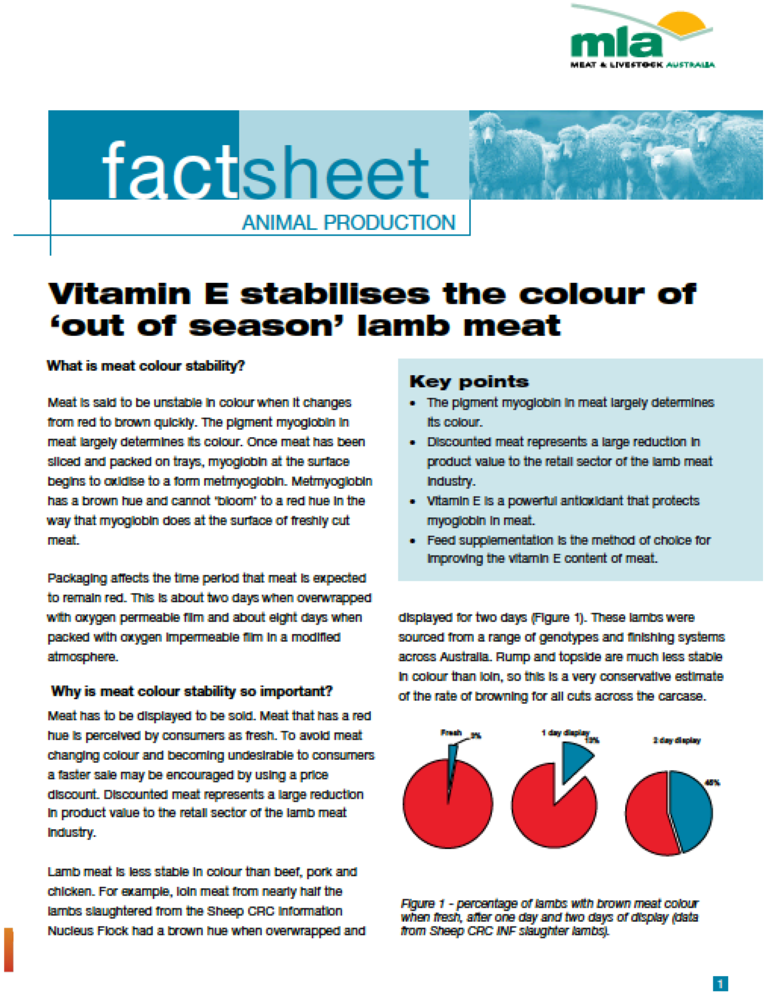
Carcase shrink is huge in lamb

Carcase shrink due to fasting in lamb is very significant

- O.1%/hr carcase weight loss after about 12 hours
- Beef more like 0.03%/hour
- So 36 hrs fasting = -0.6kg for a 25kg lamb carcase



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factsheet

ANIMAL PRODUCTION

Vitamin E stabilises the colour of 'out of season' lamb meat

What is meat colour stability?

Meat is said to be unstable in colour when it changes from red to brown quickly. The pigment myoglobin in meat largely determines its colour. Once meat has been sliced and packed on trays, myoglobin at the surface begins to oxidise to a form metmyoglobin. Metmyoglobin has a brown hue and cannot 'bloom' to a red hue in the way that myoglobin does at the surface of freshly cut meat.

Packaging affects the time period that meat is expected to remain red. This is about two days when overwrapped with oxygen permeable film and about eight days when packed with oxygen impermeable film in a modified atmosphere.

Why is meat colour stability so important?

Meat has to be displayed to be sold. Meat that has a red hue is perceived by consumers as fresh. To avoid meat changing colour and becoming undesirable to consumers a faster sale may be encouraged by using a price discount. Discounted meat represents a large reduction in product value to the retail sector of the lamb meat industry.

Lamb meat is less stable in colour than beef, pork and chicken. For example, loin meat from nearly half the lambs slaughtered from the Sheep CRC Information Nucleus Flock had a brown hue when overwrapped and displayed for two days (Figure 1). These lambs were sourced from a range of genotypes and finishing systems across Australia. Rump and topside are much less stable in colour than loin, so this is a very conservative estimate of the rate of browning for all cuts across the carcase.

Key points

- The pigment myoglobin in meat largely determines its colour.
- Discounted meat represents a large reduction in product value to the retail sector of the lamb meat industry.
- Vitamin E is a powerful antioxidant that protects myoglobin in meat.
- Feed supplementation is the method of choice for improving the vitamin E content of meat.

Figure 1 - percentage of lambs with brown meat colour when fresh, after one day and two days of display (data from Sheep CRC INF slaughter lambs).

Vit E and meat colour

- 250ppm in diet 2-4 weeks prior to slaughter if grain/hay finishing
- Depends on packing systems

- There other anti oxidants
- (e.g. lycopene)

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Take home messages

- Lambs show good compensatory growth after nutrition restricted to around maintenance
- Cannot wreck muscle growth in lambs with nutrition restricted to around maintenance?
- 20 or 30kg weaning is no problems in prime lambs
- IMF – a little different to cattle:
- lamb is v young and so still getting muscle growth ?
- IMF breeding values relatively new BUT will make a big difference
- Grass vs grain – consumers cannot find a difference
- Don’t fast them for long before slaughter (no more than 24hrs)
- Vit E for meat colour
- Glycogen bucket – especially chilled export

Tools and resources

Profitable Grazing Systems
your pathway to success

Meat the Market – Lamb compliance

MEAT STANDARDS AUSTRALIA GRADED

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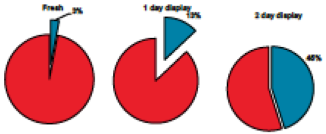

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Bucket of muscle glycogen

- 250ppm in diet 2-4 weeks prior to slaughter if grain/hay finishing
- Depends on packing systems
- There other anti oxidants
- (e.g. lycopene)

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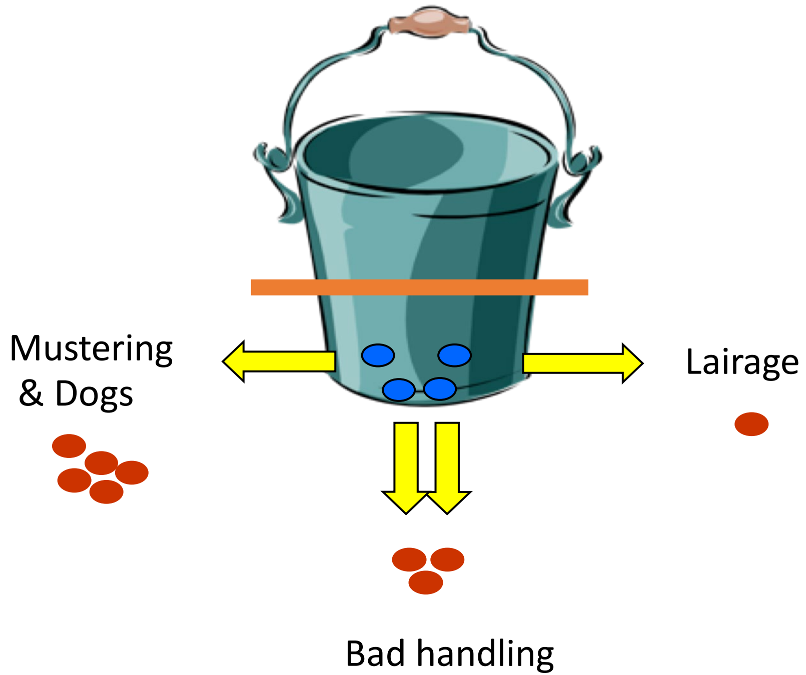
Bucket of muscle glycogen

Nutrition

Holds 2% when full

Stress can empty the bucket needs to be at least half full at slaughter



Nutritional value – pasture vs grain

Highest/lowest

Fatty acid	Dry pasture mg/100gm	Growing pasture mg/100gm
EPA+DHA	15 ↓	37 ↑
EPA+DHA+DPA	25 ↓	65 ↑
n-6:n-3	5.9 ↑	1.0 ↓

Source @ 135gm serve = 22mg/100gm
Good source = 55mg/100gm

Ponnampalam et al (2014) Meat Science 96, 1095

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