The Value of Recording Live Animal and Carcase Scan Traits for the Genetic Selection of Lean Meat Yield in Lamb

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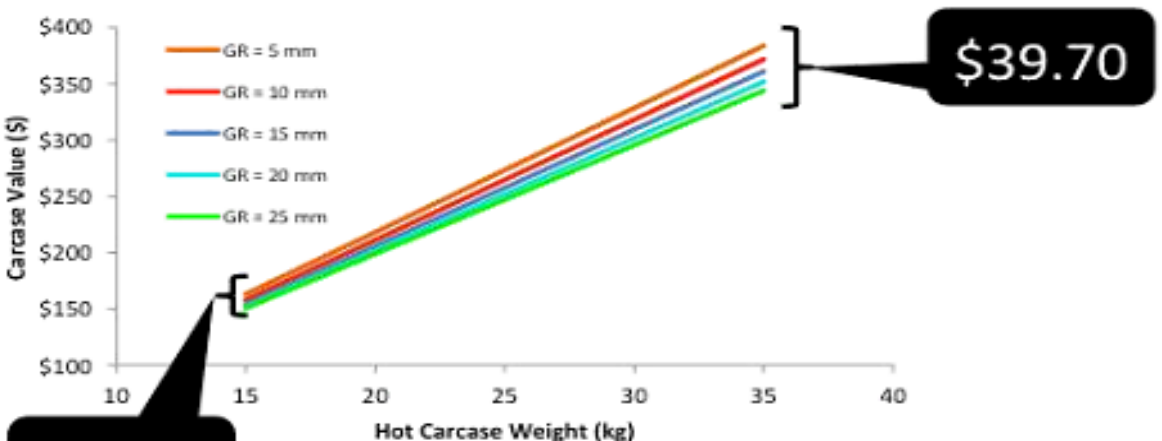
ICAR Meeting 2018

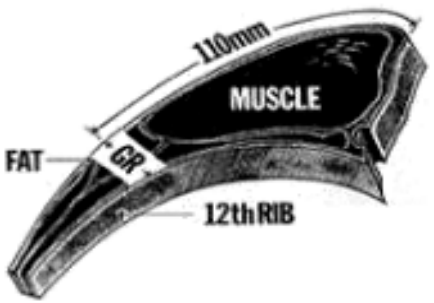
Lean Meat Yield (LMY)

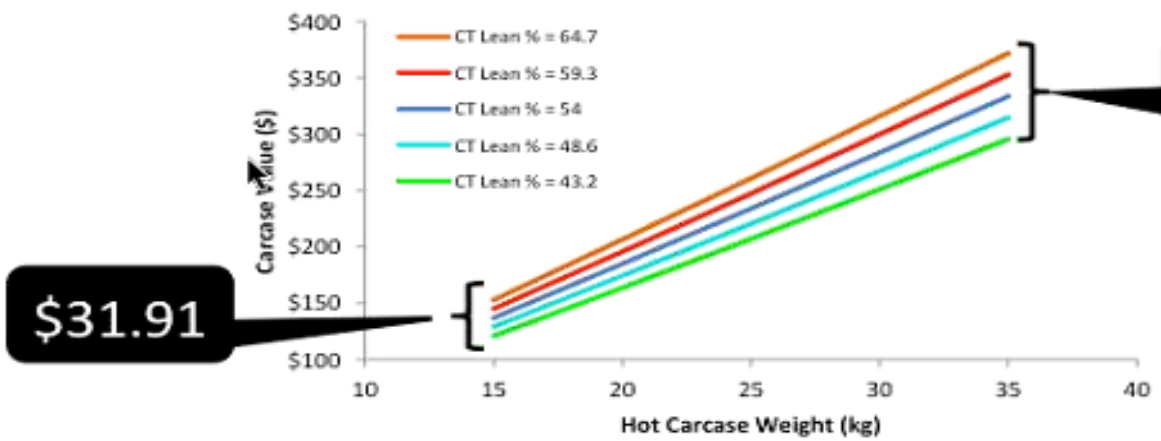
- The proportion of the carcase that is lean meat (muscle), with all visible subcutaneous and intramuscular fat removed
- A key efficiency and profit driver

- Hard to measure
  - Grinding whole carcase
  - Complete dissection / bone out
  - CT considered Gold Standard

Extra precision gives more accurate (and wider) differentiation of carcase value







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Breeding for yield and eating quality: Sheep Genetics

Animal performance from Resource flocks and ram breeders

Carcass measurements

Actively using LMY, SF and IMF data in ASBVs and Indexes

Consumer eating quality

Genomic testing

LAMBPLAN ASBV

SHEEP GENETICS

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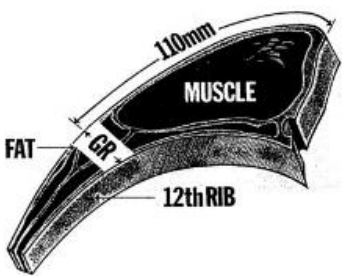
Measurement of Lean Meat Yield

‘Gold standard’

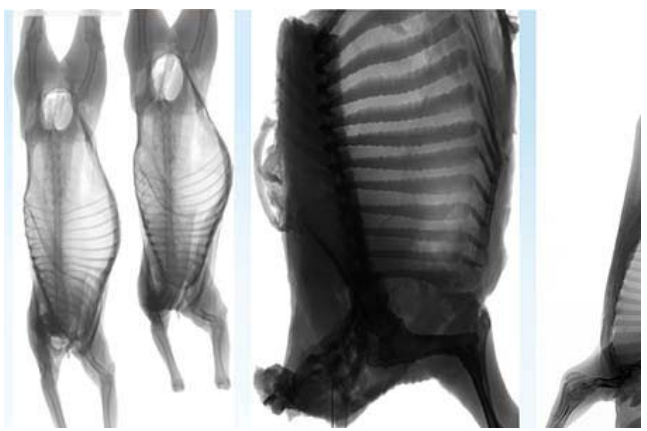
Computed tomography (CT)

Indicator traits using selection indexes based on

Weight and Ultrasound on live animal

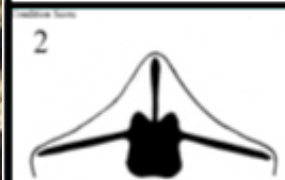
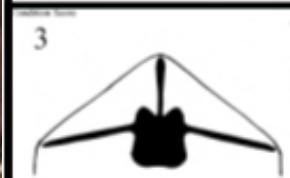
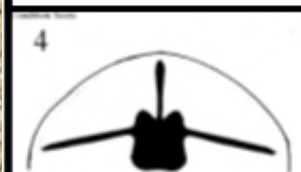


Measures on the carcase



New technologies
e.g. dual-energy x-ray absorptiometry (DEXA) (Brown *et al.*, 2017)

Condition Scoring

1 	**Backbone** The bones form a sharp narrow ridge. Each vertebra can be easily felt as a bone under the skin . There is only a very small eye muscle. The sheep is quite thin (virtually unsaleable)	**Short Ribs** The ends of the short ribs are very obvious. It is easy to feel the squarish shape of the ends. Using fingers spread 1cm apart, it feels like the fingernail under the skin with practically no covering
2 	**Backbone** The bones form a narrow ridge but the points are rounded with muscle. It is easy to press between each bone. There is a reasonable eye muscle. Store condition- ideal for wethers and lean meat.	**Short Ribs** The ends of the short ribs are rounded but it is easy to press between them. Using fingers spread 0.5cms apart, the ends feel rounded like finger ends. They are covered with flesh but it is easy to press under and between them.
3 	**Backbone** The vertebrae are only slightly elevated above a full eye muscle. It is possible to feel each rounded bone but not to press between them. (Forward store condition ideal for most lamb markets now. No excess fat).	**Short Ribs** The ends of short ribs are well rounded and filled in with muscle. Using 4 fingers pressed tightly together, it is possible to feel the rounded ends but not between them. They are well covered and filled in with muscle.
4 	**Backbone** It is possible to feel most vertebrae with pressure. The back bone is a smooth slightly raised ridge above full eye muscles and the skin floats over it.	**Short Ribs** It is only possible to feel or sense one or two short ribs and only possible to press under them with difficulty. It feels like the side of the palm, where maybe one end can just be sensed.
5 	**Backbone** The spine may only be felt (if at all) by pressing down firmly between the fat covered eye muscles. A bustle of fat may appear over the tail (wasteful and uneconomic).	**Short Ribs** It is virtually impossible to feel under the ends as the triangle formed by the long ribs and hip bone is filled with meat and fat. The short rib ends cannot be felt.

Objective

To assess the value of

- Post weaning traits measured on-farm
- Measures on the carcase
- DEXA derived values of lean

for the predicted potential genetic gain of LMY in lamb

Data

- Information Nucleus Flock/MLA Resource Flock:

  100 sires, ~4500 dams, 8 research sites across Australia

Post weaning	Carcase	DEXA	CT
Weight	Hot carcase weight	Predicted lean	Lean
Eye muscle depth	Eye muscle depth		
Fat depth	Fat depth		
Condition score			
2005 to 2016-born		2014-born	2011-born

Data Summary

Trait	Units	Records	Sires	Mean
Post-weaning weight	kg	41,698	1,427	30.53
Post-weaning eye muscle depth	mm	22,411	1,330	25.09
Post-weaning fat depth	mm	22,414	1,330	2.94
Post-weaning condition score	(1-5 score)	14,152	1,106	2.78
Hot carcase weight	kg	24,709	1,409	22.43
Carcase eye muscle depth (C site)	mm	22,879	1,407	29.82
Carcase fat depth (C site)	mm	22,643	1,406	4.11
CT lean	%	2,340	526	57.47
DEXA-derived lean		546	163	83.04

Analysis

Fixed effects
Birth type (1, 2, 3, 4+)
Rearing type (1, 2, 3+)
Age of dam + Age of dam^2
Dam breed
Sire breed
Age of trait measurement
Contemporary group (breed, flock, year of birth, sex, management group, date of measurement, kill group)
(weight for eye muscle depth and fat depth)

Random effects
Sire
(maternal permanent environment for post-weaning traits) No Genetic Group

Expected response to selection

using MTINDEX (van der Wef, 2005)

Expressed as the proportion of genetic gain that could be achieved if all animals had LMY phenotype from CT

Analysis

Two scenarios modelled:

1.Ram breeding

- own record, sire + dam record, 20 half-sibs, 20 progeny for live traits
- 10% progeny and half-sibs with carcase traits

2.Progeny test

- live and carcase records on 30 progeny

Results

Heritability estimates

- CT lean: 0.24 ± 0.03
- Post-weaning traits: 0.20 to 0.36 (± 0.01)
- Carcase traits: 0.24 to 0.29 (± 0.01)
- DEXA-derived lean: 0.59 (± 0.07)

Results: correlations with CT lean

	Phen Corr	Genetic Corr
Post-weaning traits		
Pwt	-0.19 (0.05)	0.10 (0.12)
Pemd	0.11 (0.05)	0.00 (0.11)
Pfat	-0.27 (0.04)	-0.54 (0.11)
PCS	-0.29 (0.08)	0.00 (0.15)
Carcase traits		
Hcwt	-0.36 (0.02)	-0.11 (0.11)
Cemd	0.17 (0.02)	0.35 (0.12)
Ccfat	-0.35 (0.02)	-0.57 (0.09)
DEXA-derived lean		
DEXA lean	0.80 (0.01)	0.75 (0.10)
DEXA fat	-0.80 (0.01)	-0.75 (0.10)

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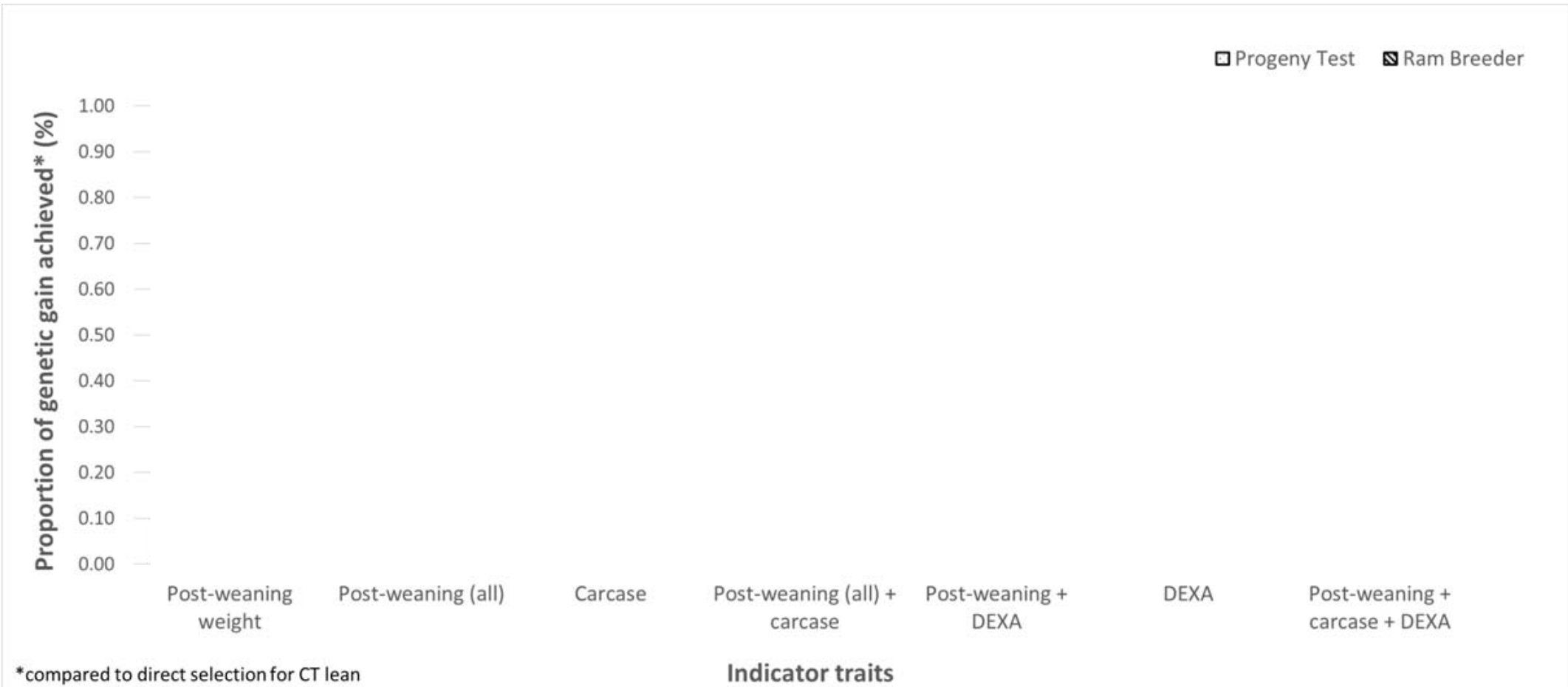
Predicted genetic gains



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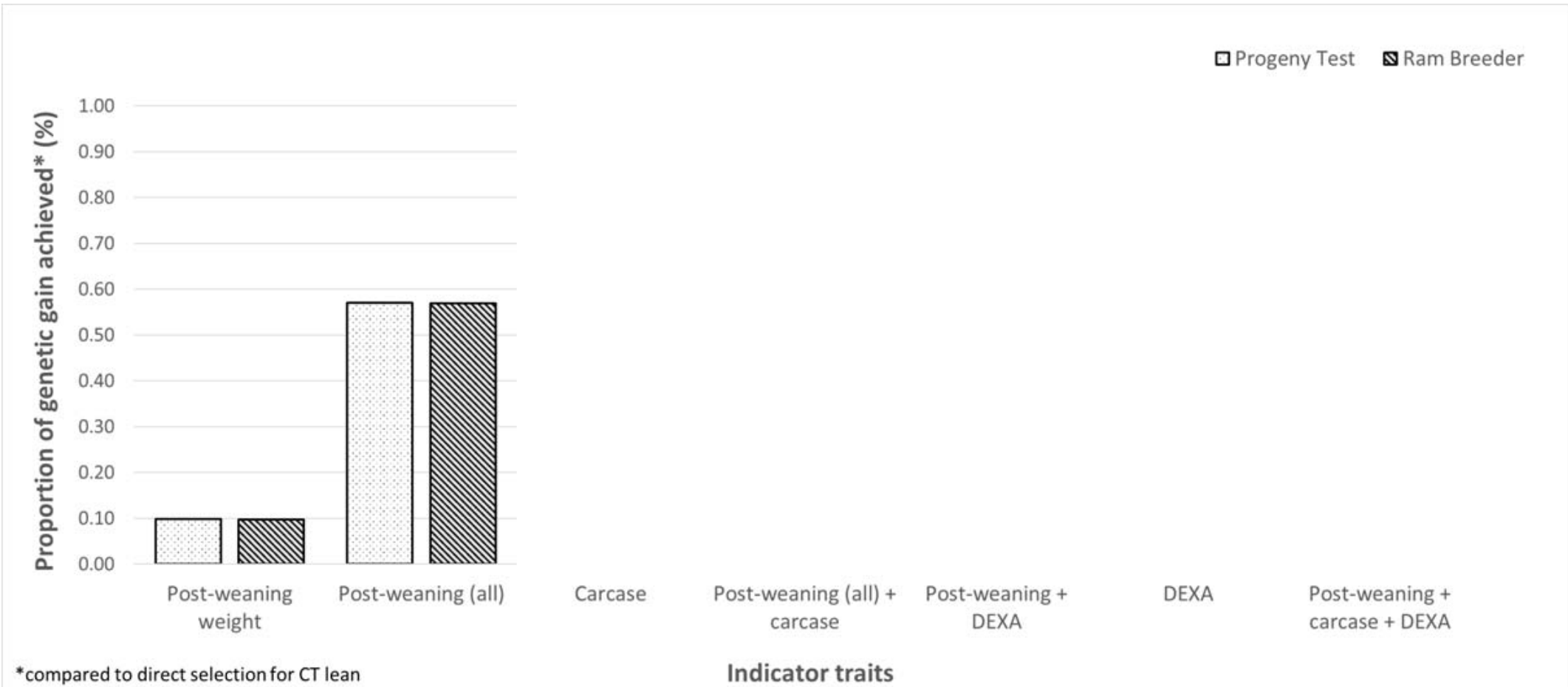

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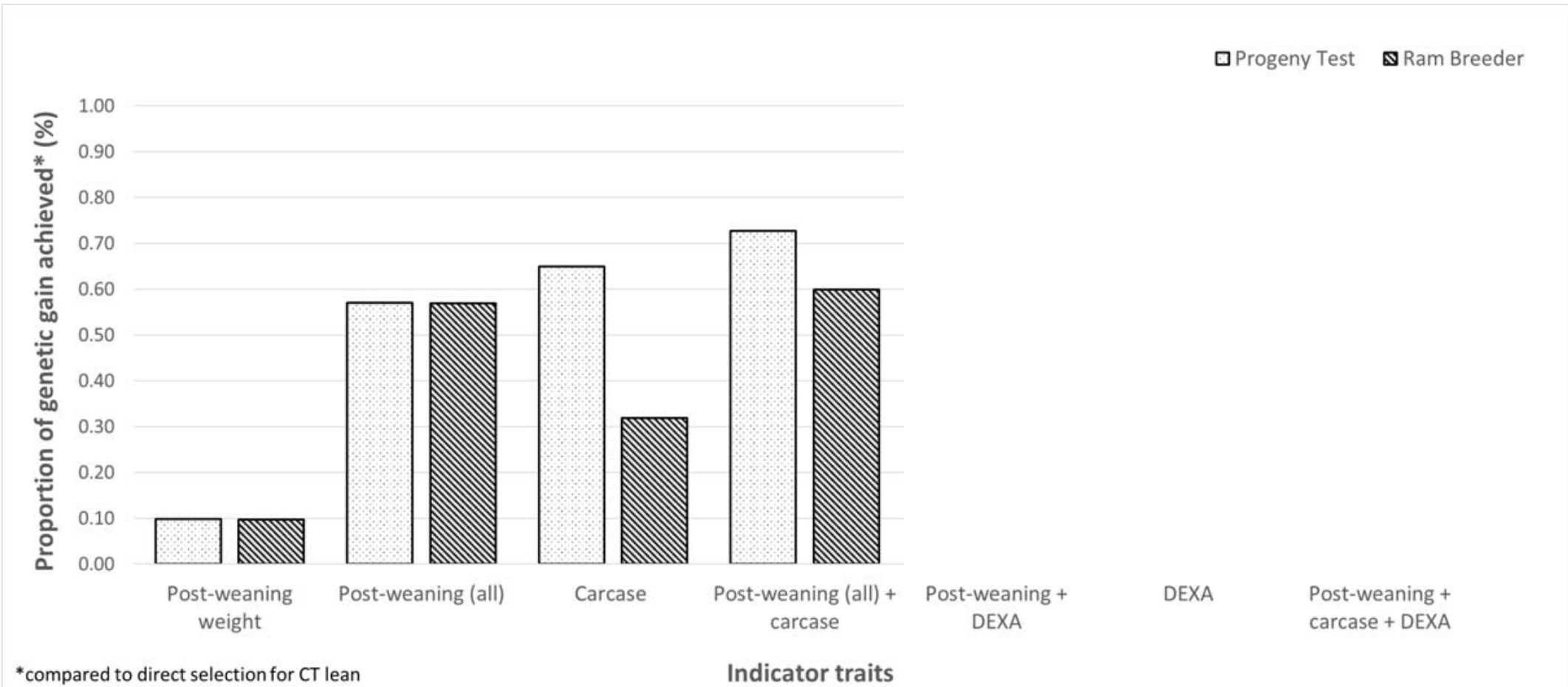

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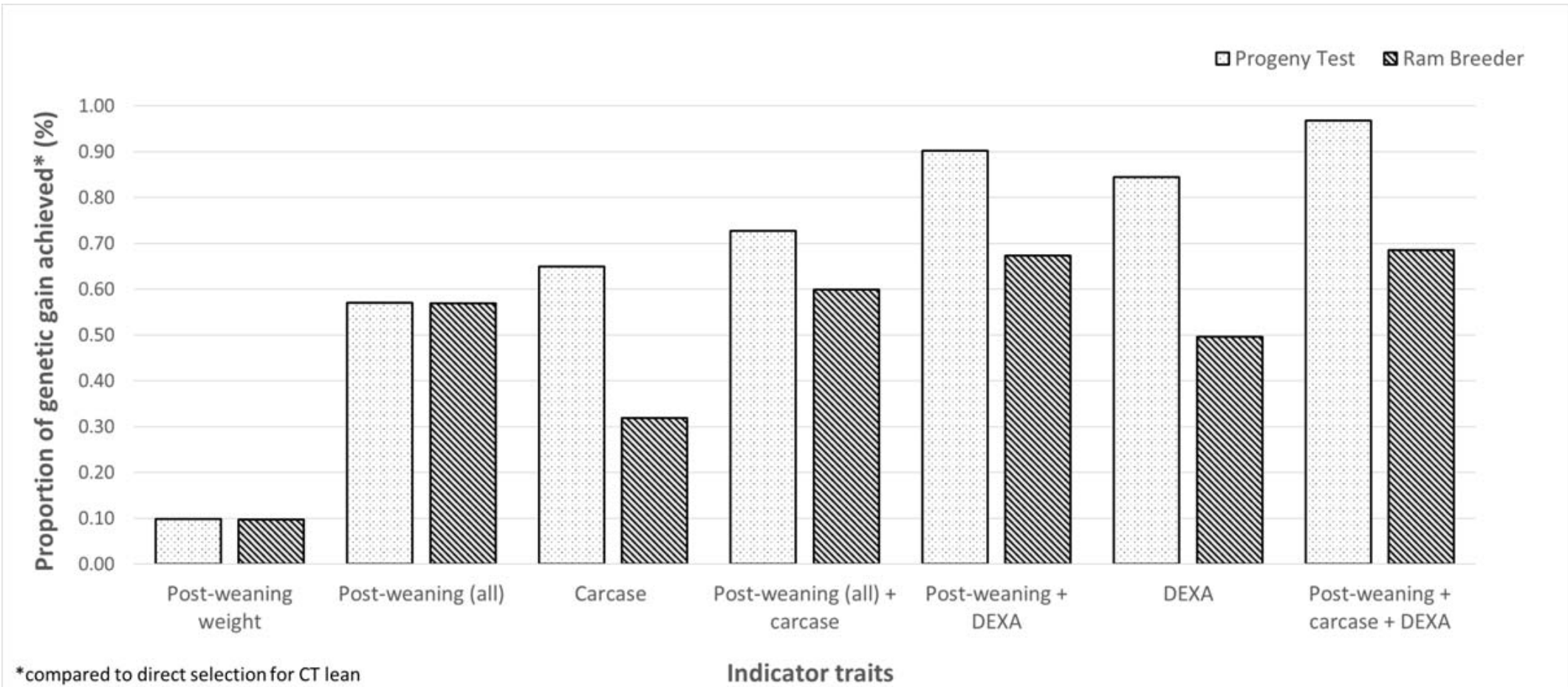
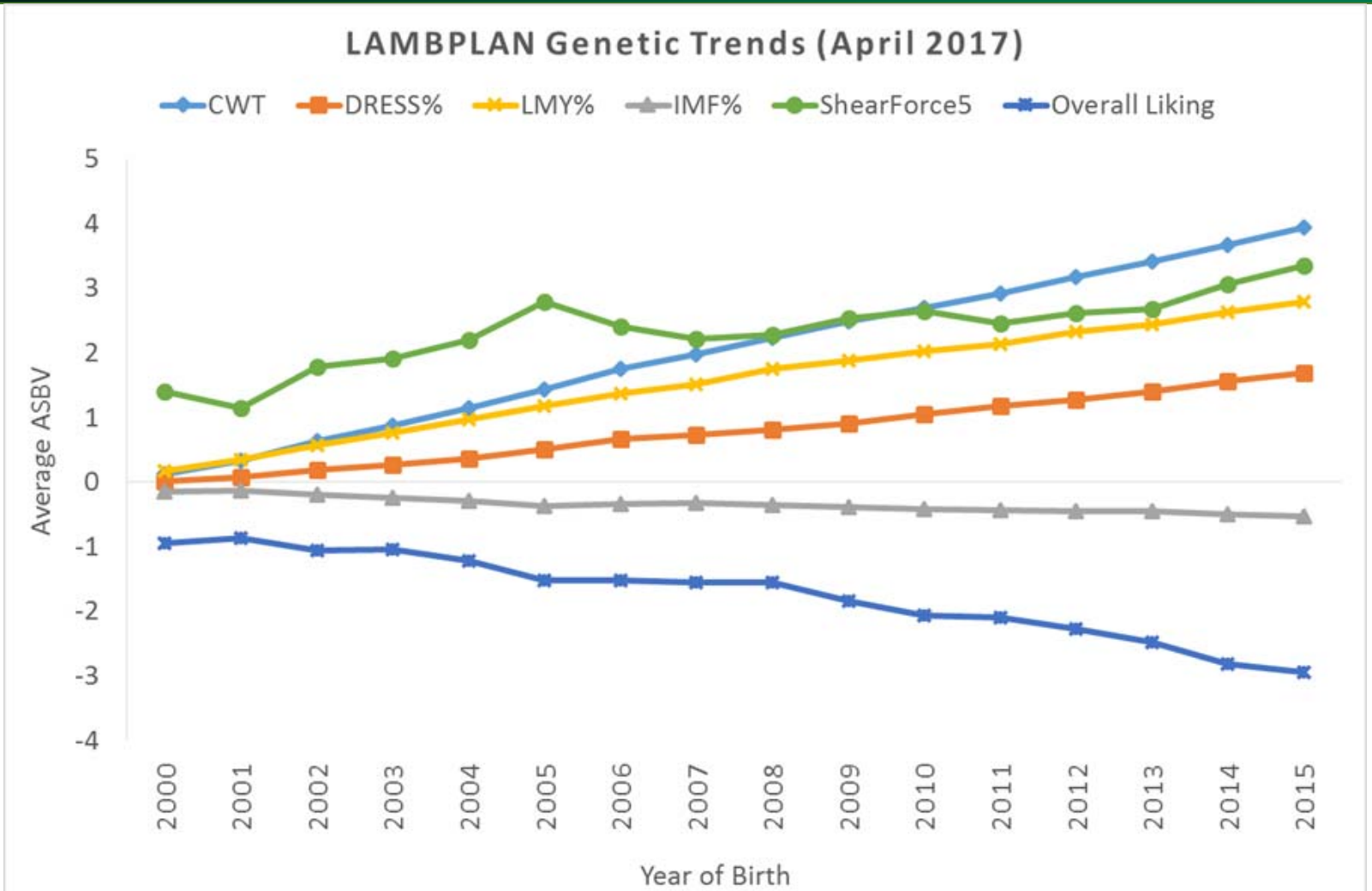


Conclusions

- DEXA is a suitable replacement for CT
  - Need to assess cost-benefit
- DEXA only measured on slaughtered animals:
  - Rely on correlated traits measured on live animals
  - Rely on INF/RF and progeny test flocks
- Eating quality also important

The Genetics Business Case



Future R&D

- Utilisation of commercial data / genomics
- Improve data to more accurately estimate these key relationships
- Measures for eating quality traits

Supporting partners