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Effect of sire breed and genetic merit for carcass weight on the transcriptional regulation of the somatotropic axis in *M. longissimus dorsi* of crossbred steers

S.M. Keady [1, 2], **D.A. Kenny** [1], **M.G. Keane** [3] **and S.M. Waters** [1]

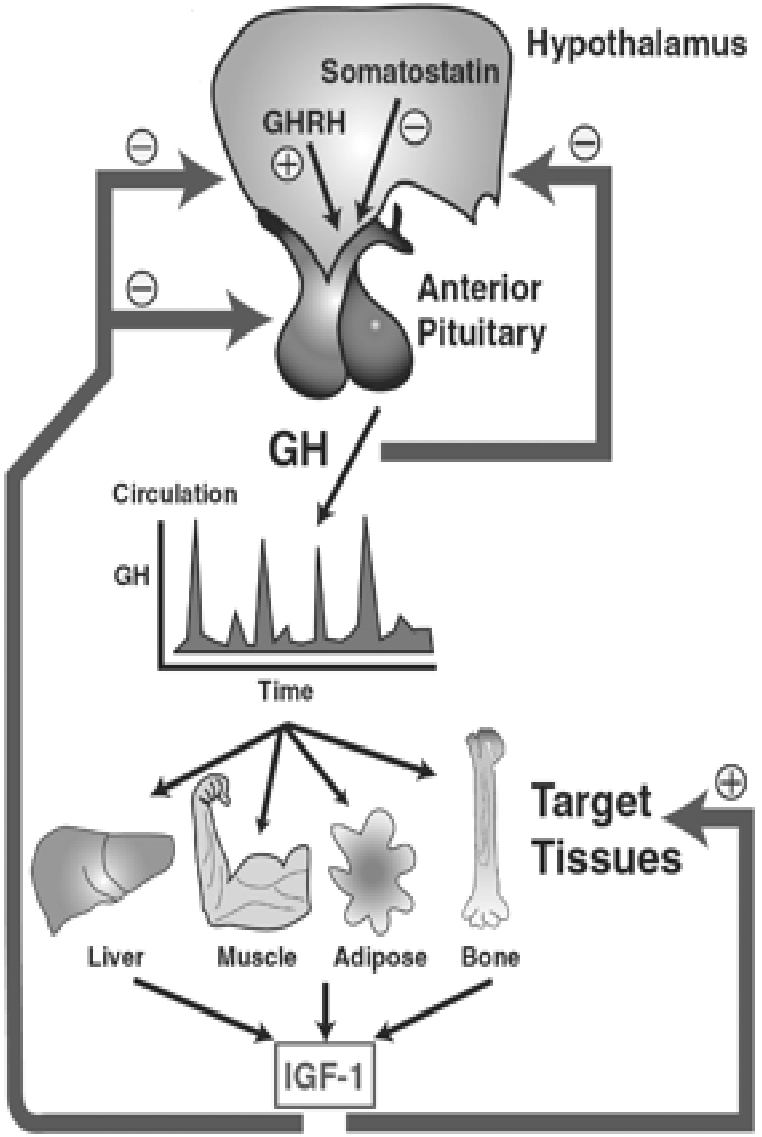
[1]Animal and Bioscience Research Department, Teagasc Grange, Co. Meath, Ireland

[2]National University of Ireland, Maynooth, Ireland

[3]Livestock Systems Research Department, Teagasc Grange, Co. Meath, Ireland

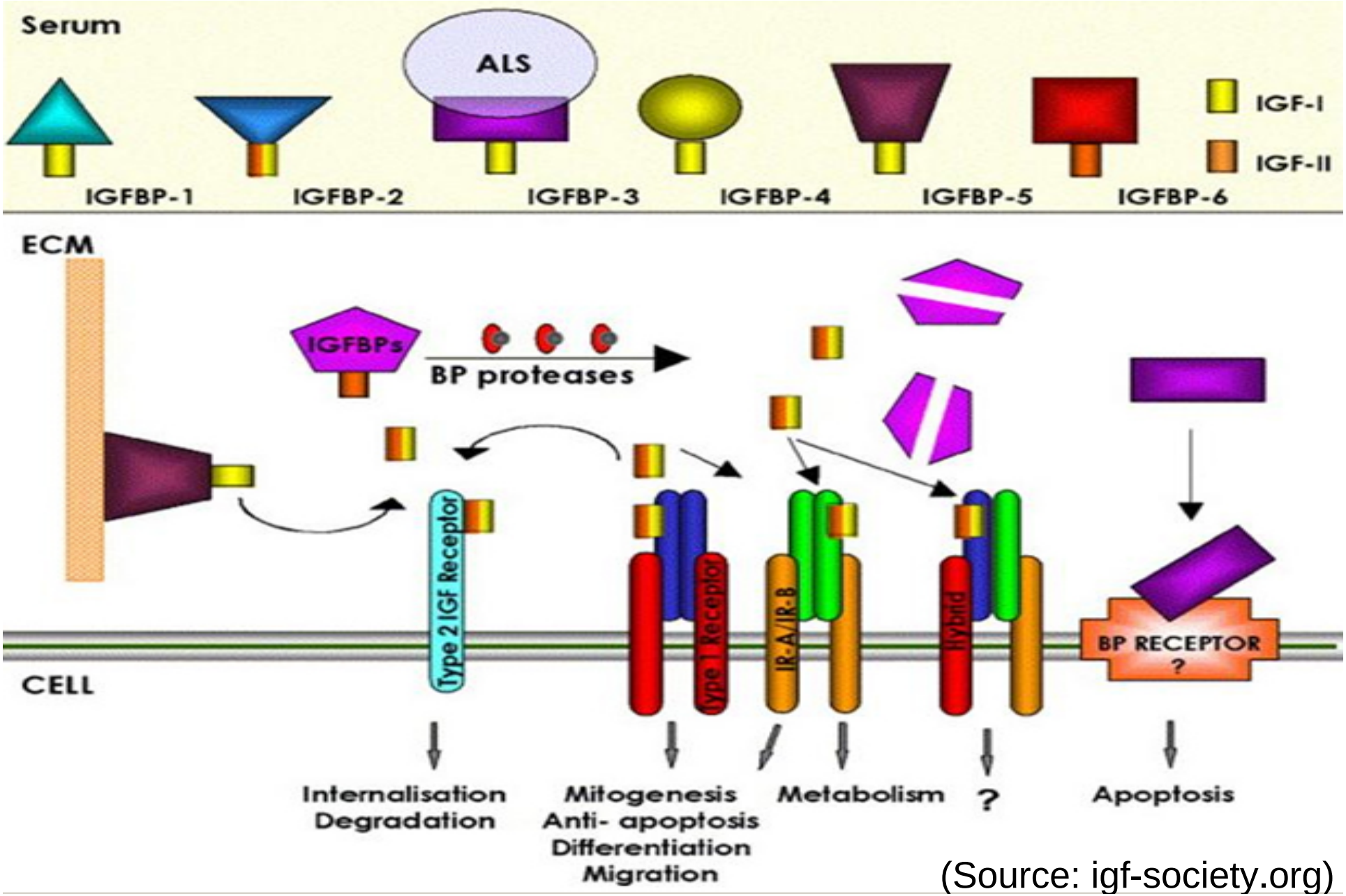
Somatotropic Axis

- Consists of:
  - Growth hormone (GH)
  - GH receptors (GHR)
  - IGF-1 and IGF-2
  - Receptors (IGF-1R, IGF-2R)
  - Carrier proteins (IGFBP)
- Additionally, IGF-1 produced locally by tissues



(Kopchick *et al*., 2002)

IGF-1, IGF-2 and IGFBPs



(Source: igf-society.org)

Objective

- The objective of this study was to determine the effect of:

  (i) sire breed

  (ii) sire EPD_{cwt}

  on the mRNA expression of genes of the somatotropic axis in *M. longissimus dorsi* in Aberdeen Angus (AA) and Belgian Blue (BB) cattle.

Animal model

- 17 Aberdeen Angus x Holstein Friesian (**AA**)
- 16 Belgian Blue x Holstein Friesian (**BB**)
- Sired by bulls with either high (**H**) or low (**L**) expected progeny difference for carcass weight (**EPD$_{cwt}$**)

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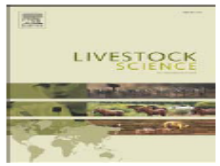


Evaluation of estimated genetic merit for carcass weight in beef cattle: Live weights, feed intake, body measurements, skeletal and muscular scores, and carcass characteristics

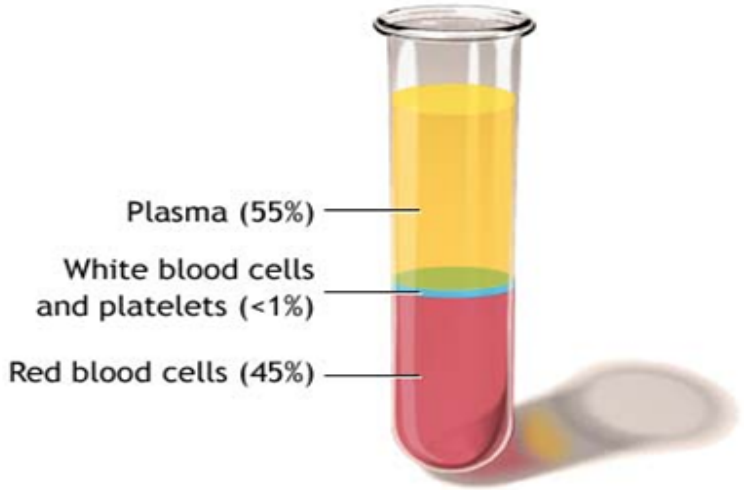
B. Campion [a,b], M.G. Keane [a,*], D.A. Kenny [b], D.P. Berry [c]

[a] Teagasc, Grange Beef Research Centre, Dunsany, Co. Meath, Ireland
[b] School of Agriculture, Food Science & Veterinary Medicine, University College Dublin, Belfield, Dublin 4, Ireland
[c] Teagasc, Moorepark Dairy Production Research Centre, Fermoy, Co. Cork, Ireland

Methodology

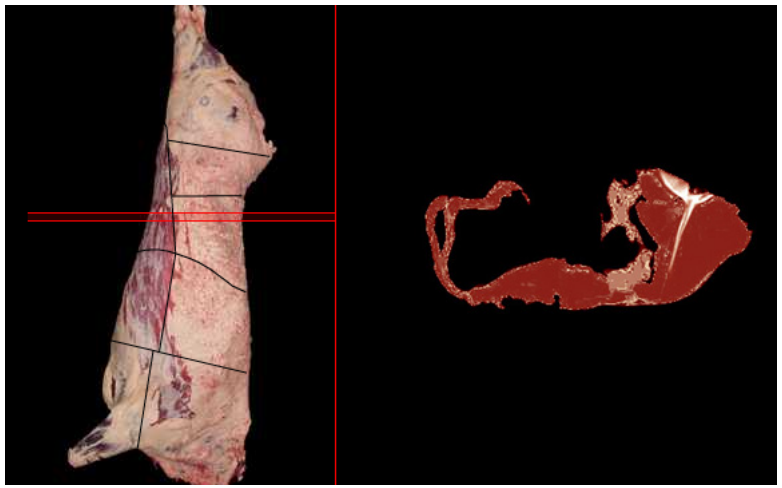
Blood collection

- 7, 14, 18 and 24 months
- IGF-1 and insulin



Tissue collection

- *M. longissimus dorsi*
- Snap frozen in liquid N_2
- Stored at – 80 °C



Data analysis

RT-qPCR

- Total RNA extracted
- cDNA synthesised
- Primers designed
- Reference gene chosen using NormFinder (GAPDH)
- Real time RT-qPCR
- Efficiency calculated

GenEX software v4.2.2

- Efficiency correction
- Normalisation to GAPDH
- Calculation of values relative to the greatest Ct

Statistical analysis

- PROC MIXED, SAS
- Spearman correlation

Results

Table 1: Blood profiles

- No effect of breed or EPD_{cwt} on plasma concentrations IGF-1 and insulin

	Breed			EPD_{cwt}			Time (T)					*P*-Values		
Trait	AA	BB	SED	H	L	SED	7 mo	14 mo	18 mo	24 mo	SEM	B	EPD_{cwt}	T
IGF-1, ng/mL	249.5	275.3	40.54	255.7	268.9	40.61	132.8	271.9	288.2	309.7	28.5	0.579	0.747	<0.001
Insulin, µIU/mL	12.3	14.5	1.54	13.5	13.3	1.55	3.48	5.98	7.52	19.43	1.32	0.175	0.877	<0.001

Table 2: Effect of breed and EPD_{cwt} on the relative expression of genes of the somatotropic axis

	Breed			EPD_{cwt}			*P*-Values		
Gene	AA	BB	SED	H	L	SED	B	EPD_{cwt}	B × EPD_{cw}
IGF-1	6.83	5.12	0.948	7.60	4.36	0.973	0.091	0.004	0.154
IGF-1R	17.2	2.81	2.833	8.41	11.6	2.883	0.0003	0.781	0.496
IGFBP3	57.9	4.61	10.23	41.4	21.2	10.23	<0.0001	0.239	0.025

Table 3: Associations between genes of the somatotropic axis and production traits

Gene	Slaughter weight, kg	Carcass weight, kg	UMD[1], mm	*M. longissimus dorsi* area, cm^2	*M. longissimus dorsi* area, cm^2/kg
IGF-1R				-0.55 ***	-0.41 **
IGFBP3			-0.37 *	-0.63 ***	-0.40 *

[1]Ultrasonically scanned muscle depth

Summary of Results

- Plasma concentrations of IGF-1 and insulin
  - No effect of breed or EPD_{cwt}
- Gene expression
  - IGF-1 up-regulated in H
  - IGF-1R up-regulated in AA
  - AA had greater levels of IGFBP3 in muscle tissue
- Correlations
  - *M. longissimus dorsi* area was negatively associated with expression of IGF-1R and IGFBP3

Conclusions

- Elevated gene expression of IGF-1 promote growth *in vivo* supporting many other research findings (Powell-Braxton et al., 1993; Clemmons, 2009)

- Increase in IGF-1 and reduction IGFBP3 - greater muscle growth

- IGF-1 and IGFBP3 - potential candidates for future investigation of molecular markers for muscle growth

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Co–authors

- Dr. David Kenny
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- Dr. Sinead Waters

Campion et al. (2009)

- Brian Campion

Blood analysis

- Penny Furney UCD

Publication

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Thank you!

Takk