Genetic parameters for live animal ultrasound measures, scrotal circumference, carcass and growth traits in Aberdeen Angus

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OBJECTIVES

- Genetic parameters for
  - Live animal ultrasound measures
- Genetic correlations with
  - Carcass traits (SEUROP)
  - Growth traits

DATA

Live animal ultrasound measures

- Collected in 2019, 2020 and 2022
- Accredited ultrasound scanning technician
- Age 250 – 500 days
- 1,949 animals (1,021 bulls)

Carcass traits (SEUROP classification)

- 2006 - 2021
- Commercial abattoirs
- Age 250 – 1080 days
- 7,672 animals

Growth traits

- 2006 - 2022
- Collected by inspectors
- 36,958 animals with weaning weight
- 15,572 animal with yearling weight

DATA

Ultrasound

- Body weight at scanning (SCW)
- Scrotal circumference (SC)
- Rump fat thickness (P8FT)
- Rib fat thickness (RBFT)
- Eye muscle area (EMA)
- Intramuscular fat content (IMF)

Carcass

- Carcass weight (CW)
- Carcass conformation (CC)
- Carcass fatness (CF)

Growth

- Adjusted weaning weight (AWW)
- Adjusted yearling weight (AYW)

MODEL EQUATIONS

	CLASS			REGRESSION		GENETIC
	HYS	**SEX*TWIN**	**AGE OF DAM**	**AGE + AGE^2**	**HETEROSIS**	**ANIMAL**
Body weight at scanning (SCW)	✓	✓	✓	✓		✓
Scrotal circumference (SC)	✓		✓	✓		✓
Rump fat thickness (P8FT)	✓	✓	✓	✓		✓
Rib fat thickness (RBFT)	✓	✓	✓	✓		✓
Eye muscle area (EMA)	✓	✓	✓	✓		✓
Intramuscular fat content (IMF)	✓	✓	✓	✓		✓
Carcass weight (CW)	✓	✓		✓	✓	✓
Carcass conformation (CC)	✓	✓		✓	✓	✓
Carcass fatness (CF)	✓	✓		✓	✓	✓
Adjusted weaning weight (AWW)	✓	✓	✓		✓	✓
Adjusted yearling weight (AYW)	✓	✓	✓		✓	✓

VARIANCE COMPONENT ESTIMATION

- AIREMLF90 (Ignacy Misztal et al.)
- Animal model

$$y_i = X_i\beta_i + Z_i u_i + e_i$$

$$Var(u) = G \times A$$

$$Var(e) = \begin{bmatrix} R_U \times I & 0 & R_{UG} \times I \\ 0 & R_C \times I & R_{CG} \times I \\ R_{UG} \times I & R_{CG} \times I & R_G \times I \end{bmatrix}$$

← ultrasound
← carcass
← growth

VARIANCE COMPONENT ESTIMATION

<table>
<tr><th></th><th colspan="6">LIVE ANIMAL ULTRASOUND MEASURES</th><th colspan="3">CARCASS TRAITS</th><th colspan="2">GROWTH TRAITS</th></tr>
<tr><th></th><th>SCW</th><th>SC</th><th>P8FT</th><th>RBFT</th><th>EMA</th><th>IMF</th><th>CW</th><th>CC</th><th>CF</th><th>AWW</th><th>AYW</th></tr>
<tr><td>SCW
SC
P8FT
RBFT
EMA
IMF</td><td colspan="6">MULTITRAIT MODEL</td><td colspan="3">TWO-TRAIT MODEL</td><td colspan="2">TWO-TRAIT MODEL</td></tr>
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CC
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AYW</td><td colspan="6"></td><td colspan="3"></td><td colspan="2">MULTITRAIT MODEL</td></tr>
</table>

SCW - body weight at scanning, SC - scrotal circumference, P8FT - rump fat thickness, RBFT - rib fat thickness, EMA - eye muscle area, IMF - intramuscular fat content
CW - carcass weight, CC - carcass conformation, CF - carcass fatness
AWW - adjusted weaning weight, AYW - adjusted yearling weight

HERITABILITIES (SD)

	LIVE ANIMAL ULTRASOUND MEASURES						CARCASS TRAITS			GROWTH TRAITS	
	SCW	SC	P8FT	RBFT	EMA	IMF	CW	CC	CF	AWW	AYW
SCW	0.69 (0.05)										
SC		0.77 (0.06)									
P8FT			0.49 (0.08)								
RBFT				0.44 (0.07)							
EMA					0.71 (0.01)						
IMF						0.25 (0.03)					
CW							0.57 (0.10)				
CC								0.37 (0.12)			
CF									0.33 (0.13)		
AWW										0.45 (0.01)	
AYW											0.38 (0.02)

SCW - body weight at scanning, SC - scrotal circumference, P8FT - rump fat thickness, RBFT - rib fat thickness, EMA - eye muscle area, IMF - intramuscular fat content
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GENETIC CORRELATIONS (SD)

	LIVE ANIMAL ULTRASOUND MEASURES						CARCASS TRAITS			GROWTH TRAITS	
	SCW	SC	P8FT	RBFT	EMA	IMF	CW	CC	CF	AWW	AYW
SCW	**0.69 (0.05)**	**0.38 (0.09)**	**0.54 (0.08)**	**0.61 (0.07)**	**0.90 (0.05)**	**0.70 (0.05)**					
SC		**0.77 (0.06)**	0.19 (0.16)	0.20 (0.15)	**0.42 (0.07)**	**0.60 (0.11)**					
P8FT			**0.49 (0.08)**	**0.99 (0.01)**	**0.35 (0.07)**	**0.87 (0.04)**					
RBFT				**0.44 (0.07)**	**0.43 (0.06)**	**0.88 (0.04)**					
EMA					**0.71 (0.01)**	**0.50 (0.06)**					
IMF						**0.25 (0.03)**					
CW							**0.57 (0.10)**	0.41 (0.15)	**0.92 (0.03)**		
CC								**0.37 (0.12)**	0.19 (0.24)		
CF									**0.33 (0.13)**		
AWW										**0.45 (0.01)**	**0.89 (0.01)**
AYW											**0.38 (0.02)**

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GENETIC CORRELATIONS (SD)

	LIVE ANIMAL ULTRASOUND MEASURES						CARCASS TRAITS			GROWTH TRAITS	
	SCW	SC	P8FT	RBFT	EMA	IMF	CW	CC	CF	AWW	AYW
SCW	**0.69 (0.05)**	**0.38 (0.09)**	**0.54 (0.08)**	**0.61 (0.07)**	**0.90 (0.05)**	**0.70 (0.05)**	**0.99 (0.01)**	0.44 (0.19)	0.24 (0.22)	**0.94 (0.01)**	**0.99 (0.01)**
SC		**0.77 (0.06)**	0.19 (0.16)	0.20 (0.15)	**0.42 (0.07)**	**0.60 (0.11)**	**0.99 (0.01)**	**0.97 (0.01)**	**0.85 (0.08)**	-0.16 (0.14)	0.57 (0.22)
P8FT			**0.49 (0.08)**	**0.99 (0.01)**	**0.35 (0.07)**	**0.87 (0.04)**	**0.61 (0.13)**	0.28 (0.27)	**0.99 (0.01)**	**0.16 (0.06)**	-0.07 (0.11)
RBFT				**0.44 (0.07)**	**0.43 (0.06)**	**0.88 (0.04)**	**0.80 (0.07)**	**0.78 (0.12)**	**0.99 (0.01)**	**0.24 (0.07)**	0.02 (0.12)
EMA					**0.71 (0.01)**	**0.50 (0.06)**	**0.99 (0.01)**	**0.98 (0.01)**	0.03 (0.30)	**0.47 (0.05)**	**0.43 (0.08)**
IMF						**0.25 (0.03)**	**-0.17 (0.01)**	**0.23 (0.02)**	**0.60 (0.06)**	**-0.51 (0.17)**	-0.05 (0.05)
CW							**0.57 (0.10)**	0.41 (0.15)	**0.92 (0.03)**	**0.55 (0.04)**	**0.70 (0.06)**
CC								**0.37 (0.12)**	0.19 (0.24)	**0.20 (0.01)**	**0.09 (0.01)**
CF									**0.33 (0.13)**	**0.27 (0.01)**	**0.15 (0.01)**
AWW										**0.45 (0.01)**	**0.89 (0.01)**
AYW											**0.38 (0.02)**

SCW - body weight at scanning, SC - scrotal circumference, P8FT - rump fat thickness, RBFT - rib fat thickness, EMA - eye muscle area, IMF - intramuscular fat content
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CONCLUSIONS

The results support the potential value of live animal ultrasound measurements in Czech Aberdeen Angus breeding program to generate indicator traits for carcass quality.

Negative genetic correlation between intramuscular fat and adjusted weaning weight indicates that selection on high AWW could lead to lower IMF in the Aberdeen Angus.

- First results obtained on the basis of three years of measurements
- Expectation of improvement with more data
- Next step – incorporation of genomic information

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THANK YOU FOR ATTENTION

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