Genetic Relationships Between High-elevation Pulmonary Arterial Pressure and Feedlot Growth, Intake and Carcass Traits

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Pulmonary Hypertension… Regional Concern?

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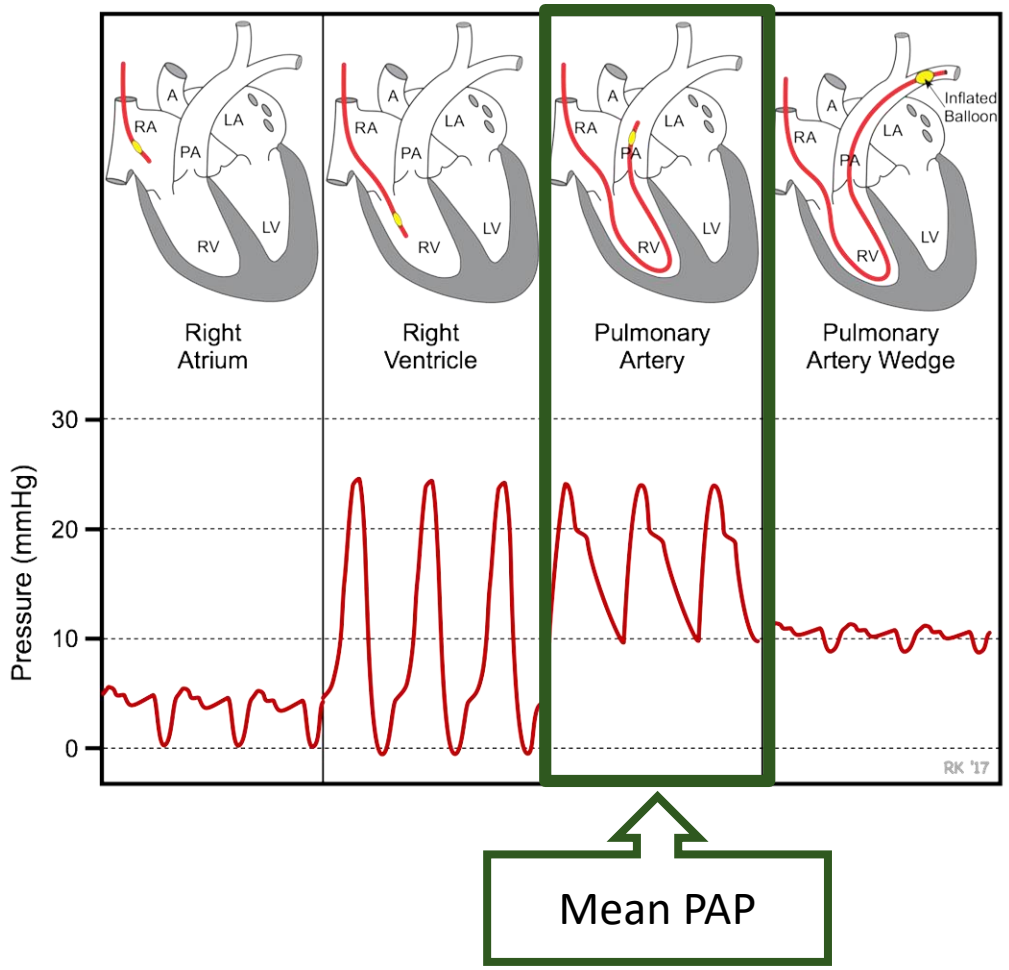
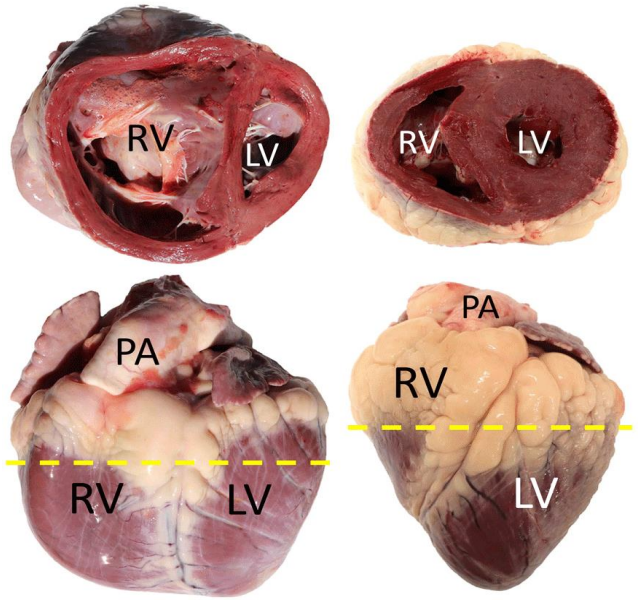
Introduction: Pulmonary Arterial Pressure (PAP)

- Used for risk identification of pulmonary hypertension (PH) in cattle
- Animals over 5,000 feet elevation
- Testing animals over 10-12 months of age is most indictive of PH
- Low oxygen levels in high elevation areas
  - Acute hypoxia
    - Vasoconstriction in the pulmonary vasculature



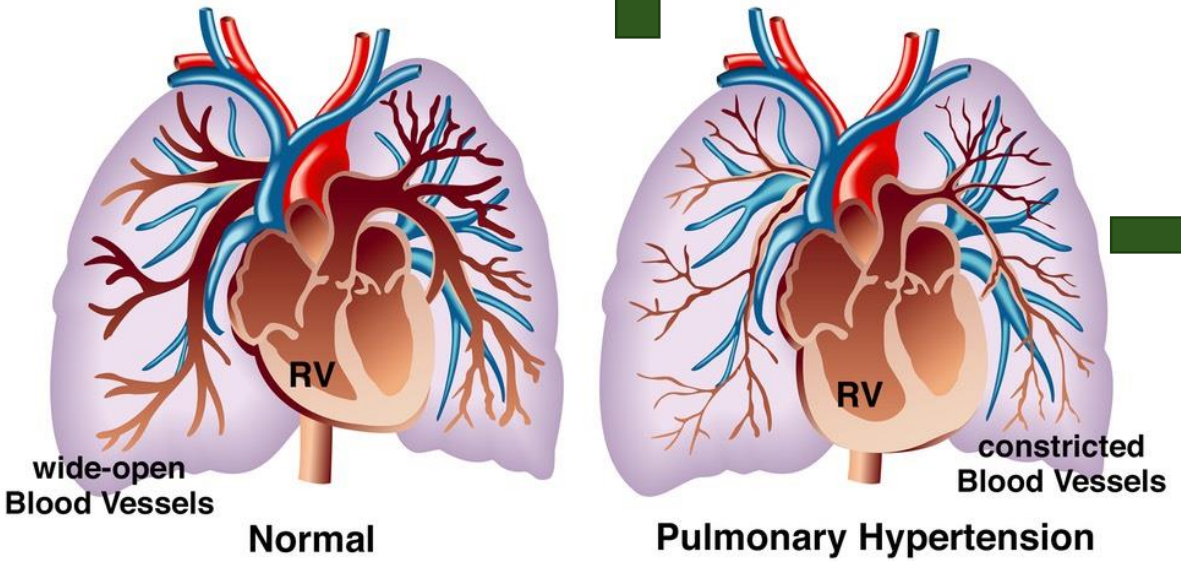
BIF, 2019; Holt et al. 2007

Introduction: Pulmonary Arterial Pressure (PAP)



Pulmonary vascular remodeling

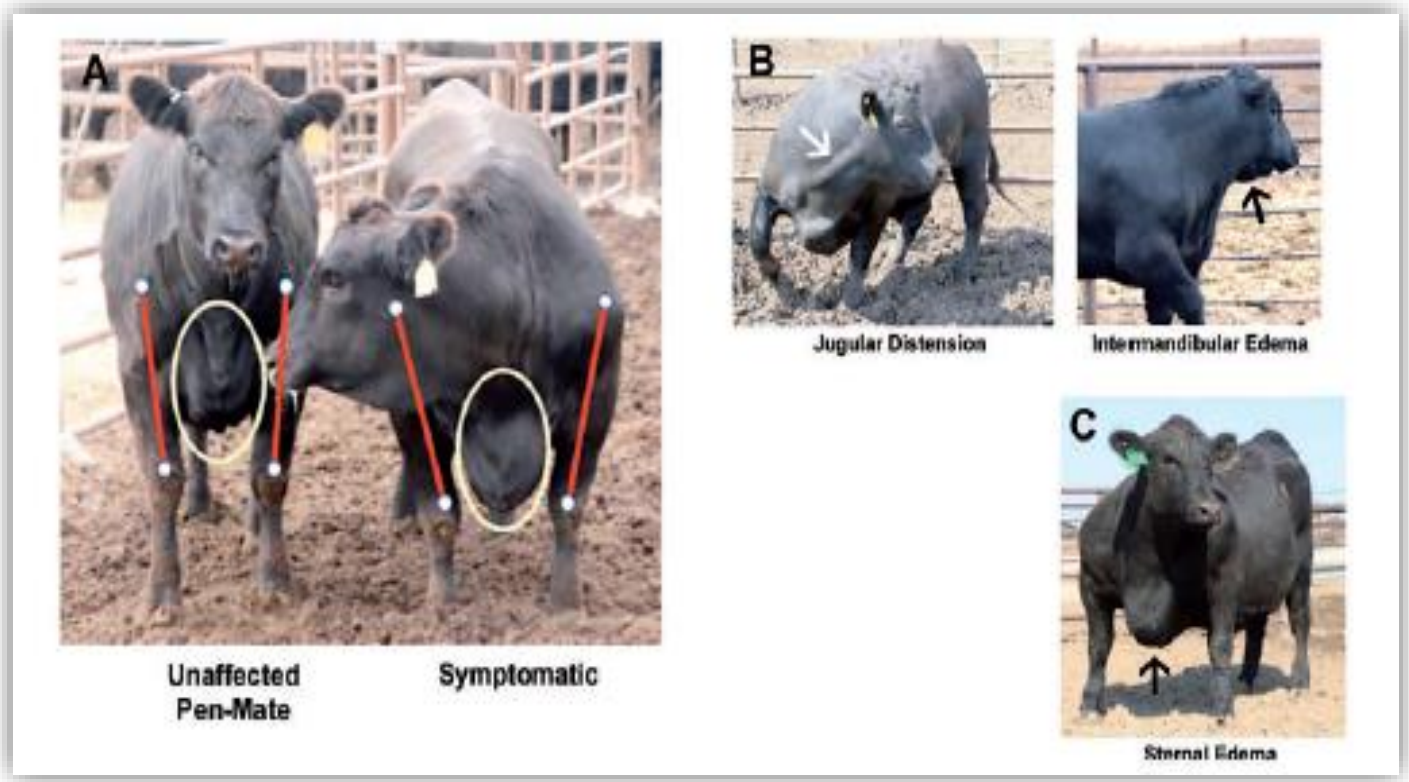
Cardiac functional and structure changes



BIF, 2019; Holt et al. 2007

Introduction: Pulmonary arterial pressure (PAP)

- **Identifying PAP**
  - Brisket edema
    - Hydrostatic pressure due to right ventricle failure and venous hypertension
  - Lethargic
  - Decreased appetite
  - Juglar vein distention



Holt et al. 2007, Krafsur et al., 2018

Introduction: Phenotypic PAP Score Evaluation

PAP test conducted at elevation 5,500-7,000 feet				
PAP Score, mmHg	Use at Low Elev. (< 4,000 ft)	Use at Moderate Elev. (4,000-5,000 ft)	Use at High Elev. (5,500-7500 ft)	Use at Extreme (>7,500 ft)
34-39	Low Risk	Low Risk	Low Risk	Low Risk
40-45	Low Risk	Low Risk	Low/Moderate Risk	Low/Moderate Risk
46-49	Moderate Risk	Moderate Risk	Moderate Risk	High Risk
>=50	Moderate Risk	Moderate Risk	High Risk	High Risk

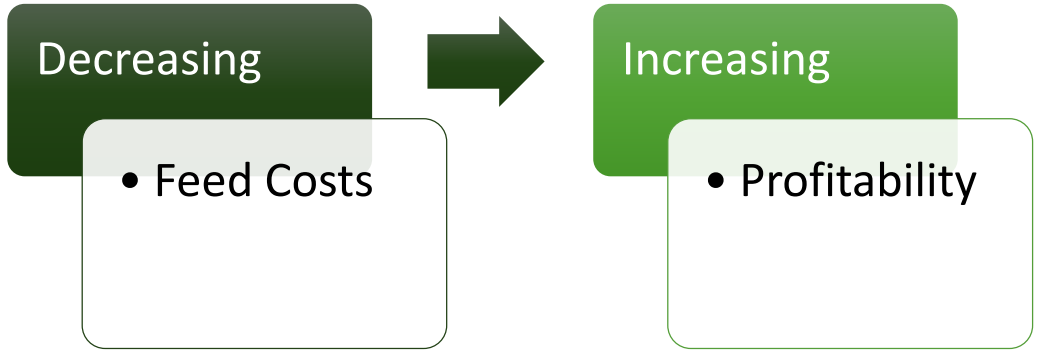
Introduction: Various Genetic Correlations with PAP

	Shirley et al. (2008) [1]	Zeng (2013) [2]	Crawford (2016) [2]	Pauling (2017) [2]
Birth Direct	0.49	0.22	0.15	-0.08
Birth Maternal	0.01		0.14	0.56
Weaning Direct	0.51	0.16	0.22	0.16
Weaning Maternal	-0.05	0.10	-0.03	-0.15
Yearling Direct		0.11	0.12	0.02
PWG		0.03	-0.10	-0.06
Ultrasound BF				-0.03
Ultrasound REA				0.24
Ultrasound IMF				-0.04
Ultrasound RUMP				0.10

[1]Weaning PAP
[2]Yearling PAP

Introduction: Why measure feedlot performance?

- Measure of inputs to output
- Extreme economic importance
- Fluctuation of feed costs
- Selecting superior animals
- Population
- Environmental issues
- Decrease in available resources



Introduction: Feedlot and Carcass Traits

Feedlot Performance

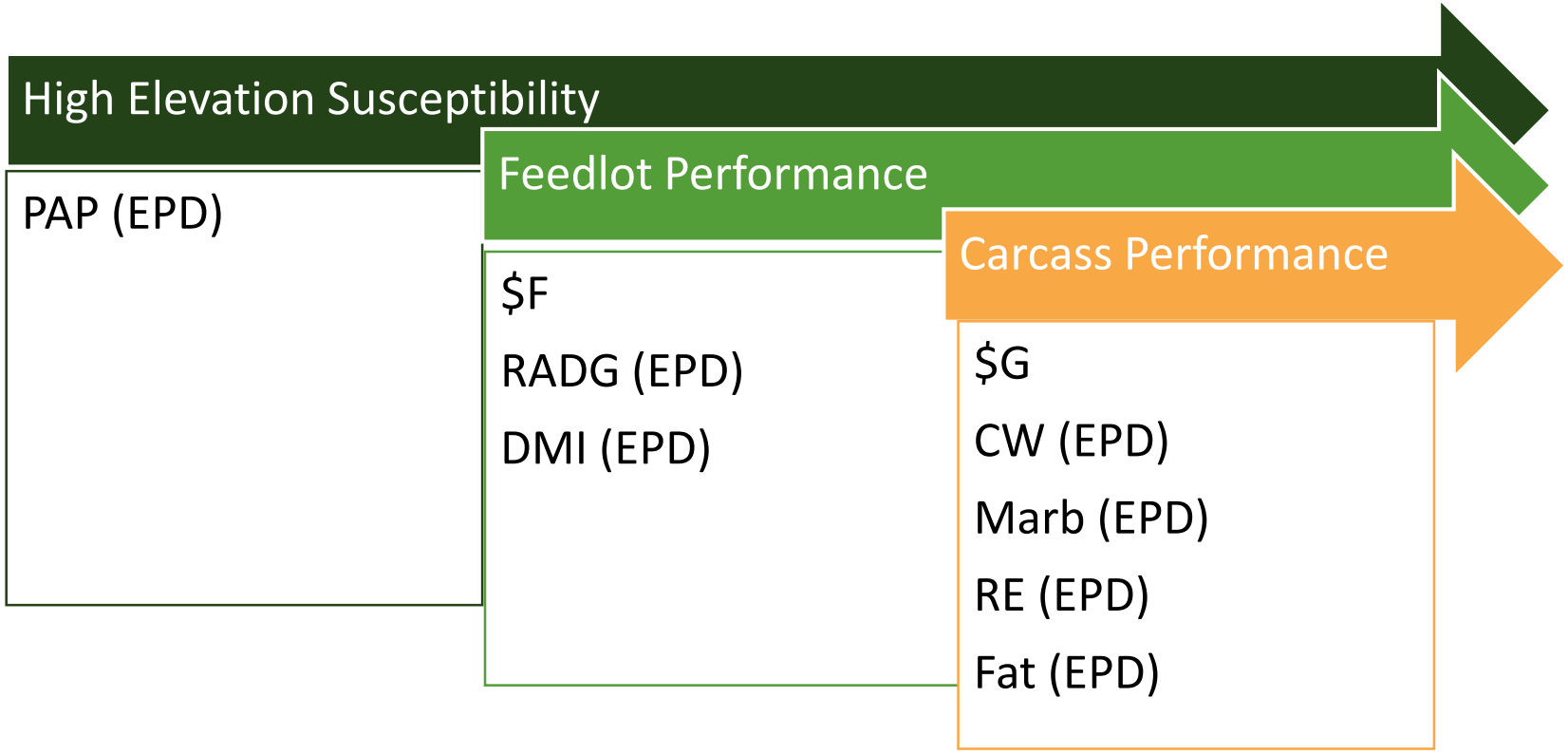
- Feed costs range from 50-70% of costs in production
- 10% improvement in gain will result in a profit increase of 18%

Carcass Performance

- Premiums for higher carcass quality
- Branded Beef Programs

Shike, (2013)

Introduction: Genetic Selection



- **Selection pressure on breeding objectives**
- **Potential antagonisms**

Genetic Selection: Trait Evaluation

Heritability

- **Measures strength of the relationship of phenotypic and genotypic values of a trait**

$$h^2 = \frac{\sigma^2_G}{\sigma^2_P}$$

Genetic Correlation

- **Relationship between the breeding vales of a particular trait and the breeding values of another trait**

Bourdon, 2000

Genetic Selection: Trait Evaluation

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Genetic Correlation

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Analysis

- Series of 5 Trait Models

Bourdon, 2000

Data Collection

- Chute Side Procedure
- Elevation 2,115 m
  - CSU-BIC
- 6869 observations
  - Average test age 327 days
  - Age range 166 days to 412 days

High Elevation Susceptibility

PAP

Data Collection

Feedlot Performance

- **ADG**
- **ADMI**

- 558 steers
- Individual intakes measured using the Growsafe Monitoring Systems®
- 21-day warmup period
- 70-day performance test
- CSU- Feed Intake Unit (FIU): Elevation of 1,557 m
- Cattle weighed every 14 days

Data Collection

- Cattle finished at an elevation of 1420 m
  - CSU-ECRC
- 1,627 carcass records
- Average kill age
  - 578 (87) days

Carcass Traits

- **REA**
- **MARB**
- **BF**
- **HCW**
- **CYG**

Results: Summary Statistics

	n	Mean	SD	Min	Max
PAP, mmHg	6898	42.3	9.6	21	139
WW, kg	9026	214.08	30.90	97.98	368.32
ADG, kg/d	558	1.66	0.28	0.30	2.44
ADMI, kg/d	558	11.5	2.3	4.3	19.2
REA, cm^2	1627	80.9	9.3	35.5	119.9
MARB	1627	585	116	90	970
BF, mm	1627	14.4	3.8	2.5	43.7
HCW, kg	1627	383	47	171	519
CYG	1499	3.55	0.56	1.50	5.00

Results: Feedlot Performance

	PAP	ADG	ADMI
PAP	0.20[1] (0.03)	0.03[1] (0.17)	0.32[1] (0.20)
ADG	-	0.42[1] (0.10)	0.52[1] (0.20)
ADMI	-	-	0.29[1] (0.11)

[1] Reported as the average estimate and largest SE of all 5-trait multivariate analyses

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Results: Carcass Traits

	PAP	REA	MARB	BF	HCW	CYG
PAP	0.20[1] (0.03)	-0.30 (0.12)	0.01 (0.13)	-0.07 (0.13)	0.15 (0.10)	0.29 (0.01)
REA	-	0.28 (0.05)	-	-	-	-
MARB	-	-	0.27 (0.06)	-	-	-
BF	-	-	-	0.27 (0.06)	-	-
HCW	-	-	-	-	0.43 (0.06)	-
CYG	-	-	-	-	-	0.28 (0.06)

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Conclusions:

	PAP	ADG	DMI	REA	MARB	BF	HCW	CYG	WWTD	WWTM
PAP	0.20[1] (0.03)	0.03[1] (0.17)	0.32[1] (0.20)	-0.30 (0.12)	0.01 (0.13)	-0.07 (0.13)	0.15 (0.10)	0.29 (0.01)	0.18[1] (0.10)	0.10[1] (0.10)

- **High elevation cattle – Moderate elevation feedlot**
  - **<u>High PAP</u>**
    - **Decrease in feed efficiency**
    - **Poor carcass quality**
  - **<u>Low PAP</u>**
    - **Lower intake values**
    - **Heavy muscled carcasses**

High PAP cattle

Excess energy towards cardiopulmonary system

- **Less efficient**
- **Marginal carcass quality**

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Implications:

- Selection pressure against high PAP animals
  - May not negatively impact feedlot and carcass performance

- Cattle culled from herds for high PAP scores
  - Potential reduction in feed efficiency

Thank you