Navigating a new frontier: Pulmonary Arterial Pressure

ANGUS

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frontiers in Genetics

Genome to Phenome: Improving Animal Health, Production, and Well-Being – A New USDA Blueprint for Animal Genome Research 2018–2027

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Path to a genetic selection tool

2013 PAP score collection began at the Association

2016 Collaboration with Colorado State University

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Answering some tough questions

1. Relationship and value of PAP measurements at elevations
2. PAP and growth traits in Angus cattle
3. PAP and ultrasound carcass traits in Angus cattle

Colorado State University

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Collaboration with Colorado State University

- Combined records from 3 locations
- High elevation vs. Moderate elevation
- High correlation among the two scores

Evaluation of moderate to high-elevation effects on pulmonary arterial pressure measures in Angus cattle

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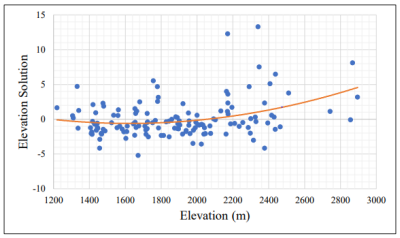
Important take-aways from Pauling

Number of records = 14,665



A logical break in PAP measurements where mean PAP starts to increase due to elevation is 1,620m (5,250 ft)

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Strong correlation between the high and moderate elevation records

	HPAP	MPAP
HPAP	0.34 (0.03)	0.83 (0.15)
MPAP		0.29 (0.09)

No strong correlations between PAP with growth and carcass traits

Trait [1]	PAP	BWT_d	BWT_m	WW_d	WW_m	YW_d	YW_m
PAP	0.22	-0.08	0.56	0.16	-0.15	0.02	-0.06
	(0.04)	(0.13)	(0.14)	(0.15)	(0.13)	(0.13)	(0.17)
BWT_d		0.35	-0.18	0.39	-0.09	0.34	-0.13
		(0.06)	(0.15)	(0.12)	(0.14)	(0.11)	(0.17)
BWT_m			0.15	0.17	0.10	0.01	0.12
			(0.04)	(0.18)	(0.15)	(0.16)	(0.18)
WW_d				0.20	-0.56	0.73	-0.61
				(0.04)	(0.12)	(0.08)	(0.15)
WW_m					0.26	-0.28	0.95
					(0.05)	(0.13)	(0.05)
YW_d						0.36	-0.48
						(0.06)	(0.12)
YW_m							0.13
							(0.04)

[1] PAP = mean pulmonary arterial pressure, BWT = birth weight, WW = weaning weight; YW = yearling weight. Subscript d indicates additive direct. Subscript m indicates additive maternal

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- **Summer 2018** Pauling thesis peer reviewed and published
- **Feb. 2019** Research report release

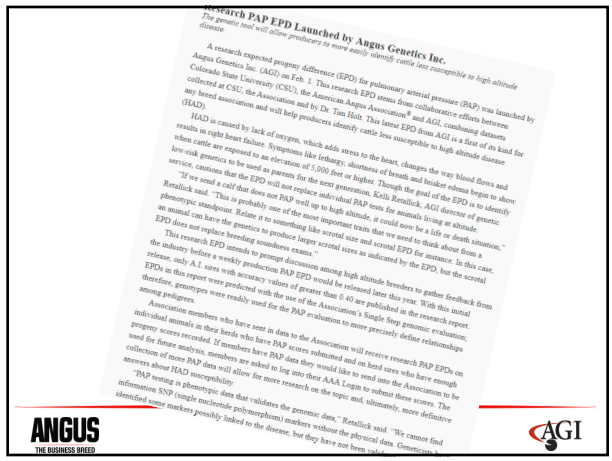
Modelling the new trait: PAP EPD

- Trait being predicted: **High Altitude Yearling PAP**
- **Age** ~ covariate
  - 320 – 720 days of age
- **Elevation** ~ covariate
  - Continuous
- **Contemporary group: herd/sex/test date/elevation** ~ fixed effect
- **Moderate elevation** PAP score ~ correlated trait *(based on work by Pauling et al., 2018)*
- **Genomics** – Single-Step Genetic Evaluation

Elevation breaks for incorporation into national cattle evaluation

- High altitude: 5,500 ft or greater
- Moderate altitude: 4,000 to <5,500 ft

Altitude	No. of Records	Actual Scores	Edited Data	Heritability
High	4,200	28-180	30-80	0.32
Moderate	1,500	25-139	30-80	0.16
				r^2= 0.80



Research PAP EPD Launched by Angus Genetics Inc.

The genetic tool will allow producers to more easily identify cattle less susceptible to high altitude disease.

A research expected progeny difference (EPD) for pulmonary arterial pressure (PAP) was launched by Angus Genetics Inc. (AGI) on Feb. 1. This research EPD stems from collaborative efforts between Colorado State University (CSU), the American Angus Association® and AGI, combining datasets collected at CSU, the Association and by Dr. Tim Holt. This latest EPD from AGI is a first of its kind for any breed association and will help producers identify cattle less susceptible to high altitude disease (HAD).

HAD is caused by lack of oxygen, which adds stress to the heart, changes the way blood flows and results in right heart failure. Symptoms like lethargy, shortness of breath and bruised edema begin to show when cattle are exposed to an elevation of 5,000 feet or higher. Though the goal of the EPD is to identify low-risk genetics to be used as parents for the next generation, Kelli Retallick, AGI director of genetic service, cautions that the EPD will not replace individual PAP tests for animals living at altitude.

"If we send a calf that does not PAP well up to high altitude, it could now be a life or death situation," Retallick said. "This is probably one of the most important traits that we need to think about from a phenotypic standpoint. Relative it to something like scrotal size and scrotal EPD for instance. In this case, an animal can have the genetics to produce larger scrotal sizes as indicated by the EPD, but the scrotal EPD does not replace breeding soundness exams."

This research EPD intends to prompt discussion among high altitude breeders to gather feedback from the industry before a weekly production PAP EPD would be released later this year. With this initial release, only A.I. sires with accuracy values of greater than 0.40 are published in the research report. EPDs in this report were predicted with the use of the Association's Single Step genomic evaluation; therefore, genotypes were readily used for the PAP evaluation to more precisely define relationships among pedigrees.

Association members who have sent in data to the Association will receive research PAP EPDs on individual animals in their herds who have PAP scores submitted and on herd sires who have enough progeny scores recorded. If members have PAP data they would like to send into the Association to be used for future analysis, members are asked to log onto their AAA Login to submit those scores. The collection of more PAP data will allow for more research on the topic and, ultimately, more definitive answers about HAD susceptibility.

"PAP testing is phenotypic data that validates the genomic data," Retallick said. "We cannot find information SNP (single nucleotide polymorphism) markers without the physical data. Geneticists have identified some markers possibly linked to the disease, but they have not been validated

Progress with Research EPD

- Additional data captured
  - 2,631 high elevation records
  - 896 moderate elevation records

Current Sires = Registered Progeny within last 2 Years			
Mean EPD	Std. Dev.	Minimum	Maximum
-0.29	0.85	-3.63	5.86

Future work: Incorporation of weaning PAP measurements

Benefits:

- Avoid pre-selection bias into the evaluation
- Include increased number of records with a high correlation
- Number of records
  - ~ 3,000 total
  - ~1,000 with both weaning and yearling PAP at high altitudes

Production PAP EPD to be released Late 2019

Production									Maternal						
CED Acc % Prog	BW Acc % Prog	WW Acc % Prog	YW Acc % Prog	RADG Acc % Prog	DMI Acc % Prog	YH Acc % Prog	SC Acc % Prog	Doc Acc % Prog	HP Acc % Daus	CEM Acc % Daus	Milk Acc %	MkH MkD	MW Acc % Prog	MH Acc % Prog	$EN %
+9 .94 30% 4823	+.6 .98 35% 17340	+64 .98 15% 17619	+124 .96 4% 10450	+.28 .76 15% 147	+.56 .76 85% 147	+.4 .96 50% 4422	+1.18 .96 20% 4680	+11 .94 60% 1978	+9.7 .76 55% 316	+12 .91 15% 2503	+23 .91 55%	722 2994	+54 .85 15% 361	+.5 .86 25% 361	-2.20 50%

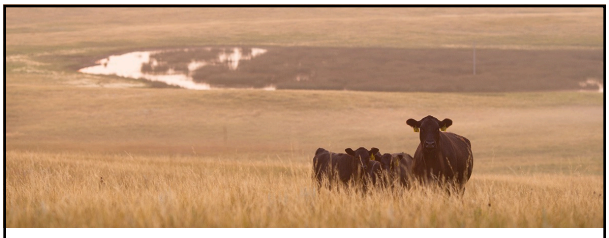
Carcass						$Values					
CW Acc %	Marb Acc %	RE Acc %	Fat Acc %	Carc Grp Prog	Usnd Grp Prog	$W %	$F %	$G %	$QG %	$YG %	$B %
+52 .81 10%	+.96 .79 10%	+.67 .76 15%	-.010 .79 20%	45 91	3521 9477	+70.42 5%	+92.14 5%	+49.12 10%	+43.47 10%	+5.65 35%	+164.85 4%

Path to a genetic selection tool

- **2013** PAP score collection began at the Association
- **2016** Collaboration with Colorado State University
- **Feb. 2019** Research report released
- **Summer 2018** Pauling thesis peer reviewed and published
- **July 2019** Cut-off for data by members
- **Spring 2019** Research to incorporate additional data
- **Late 2019** Production EPD release for yearling PAP

The value of PAP scoring will not diminish: education is key

- A PAP EPD is *not a replacement* to the actual scoring of animals to send to higher elevations
- The value of a PAP EPD, just like any EPD, is to *identify parents* for the next generations
- Inclusion of genomics allows high altitude breeders to identify bulls to utilize in breeding programs with *less risk*.



Questions & Discussion

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Thank you for joining us!