Use of Cloning in Beef Production: The WTAMU PrimeOne Project

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West Texas A&M University

PrimeOne

Introduction

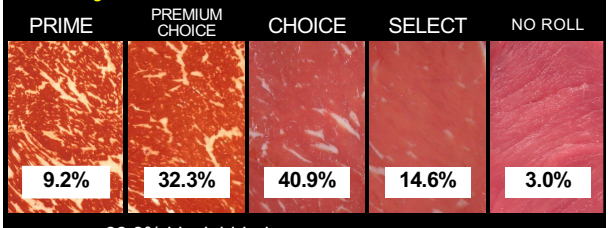
- Background
- Objectives
- Project History
- Progeny data from PrimeOne lines
- Genetic evaluations
- Conclusions/next steps

Background and Justification

- Global focus on feeding the world…..while conserving resources.
- Increased interest in efficient protein production
- Demand for beef that is high quality and lean
- Role of technology in addressing these challenges?

Quality Grading

- **Marbling**
  - **subjective evaluation of the quantity of intramuscular fat in the *longissimus* muscle between the 12th and 13th ribs**

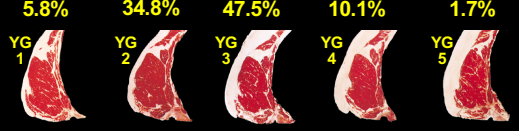


66.3% black hided

USDA NATIONAL STEER & HEIFER ESTIMATED GRADING PERCENT REPORT
http://www.ams.usda.gov/mnreports/nw_ls196.txt

Yield Grading

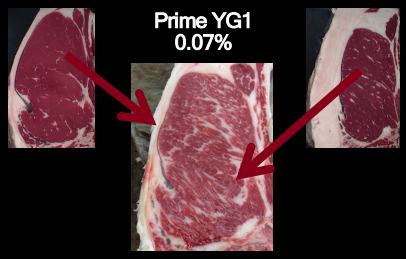
- **Fat Thickness**
  - **Linear measure of backfat**
- **Rib eye Area**
  - **Cross-section area of *longissimus* muscle**
- **Hot Carcass Weight**
  - **Weight of the freshly dressed carcass immediately prior to chilling**
- **Estimated % of Kidney Pelvic and Heart Fat**
  - **Subjective evaluation of weight of internal fat in relation to carcass weight**



http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELDEV3023704

The Problem:
QUALITY
AND
YIELD
ARE
ANTAGONISTS

Antagonistic Relationship



Project Beginning

PrimeOne Project Acknowledgments: A Public/Private Partnership

- WTAMU Beef Carcass Research Center
- Timber Creek Veterinary Clinic - Dr. Greg Veneklausen
- Mendota Ranch - Jason Abraham
- Viagen and TransOva
- Cactus Feeders - Justin Gleghorn, Kelly Jones

Our Goals

- Develop genetic opportunities to improve beef quality and yield
- Produce higher quality beef more efficiently
- Highlight the role of technology in agriculture
- Provide unique learning opportunities for students

Carcass Selection

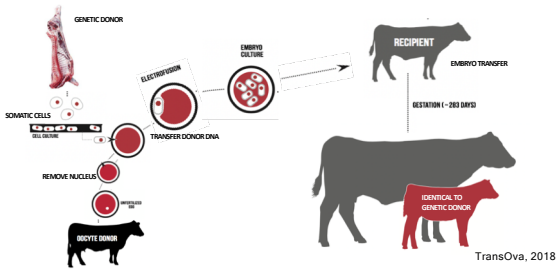
17 Prime YG1 carcasses selected

Further DNA-based selection

- Tissue sample from clone candidates are sent to a lab that processes DNA looking for growth, quality, and palatability traits

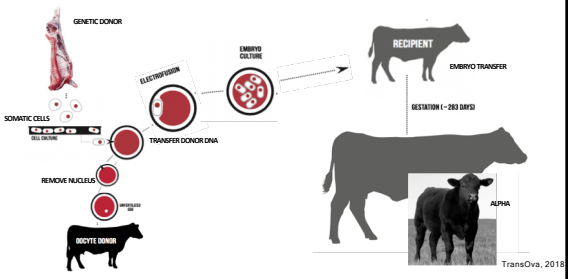
- **Prime and YG 1 occur at rate of 1 per 3,333**
- **We refine that to a rate of 1 per 15,555 for cloning**

SOMATIC CELL NUCLEAR TRANSFER



TransOva, 2018

SOMATIC CELL NUCLEAR TRANSFER



TransOva, 2018

Dr. Hawkins and Alpha's surrogate Dam

Alpha at Birth July 2012

Alpha

PHENOTYPIC	
Sex:	Steer
HCW:	782
12th rib fat:	0.44
REA:	15.9
REA/HCW:	2.03
YG:	1.98
Marbling:	Slab70
Hide:	51% Blk

86% Angus
14% Zebu

GENOTYPIC - GeneStar	
Color:	EDED (Homozygous black)
Feed efficiency:	MVP = -0.76 (10 percentile)
Marbling:	MVP = +0.15 (30 percentile)
Tenderness:	MVP = -0.59 (6 percentile)
Palatability:	MVP = 429 (8 percentile)

Alpha 2016

Alpha 2016

PrimeOne Timeline

- Alpha - July 2012
- Gammas- November/December 2012
- Delta - September 2014
- Alpha x Gammas born April 2015
- AxG steers harvested May 2016
- Progeny testing 2016 - present

PHENOTYPIC	
Sex:	Heifer
HCW:	708
12th rib fat:	0.16
REA:	15.5
REA/HCW:	2.19
YG:	1.03
Marbling:	Slab10
Hide:	51% Blk

GENOTYPIC - GeneStar	
Color:	E+ED (Black, Wild type carrier)
Feed efficiency:	MVP = -0.18 (30 percentile)
Marbling:	MVP = +0.41 (5 percentile)
Tenderness:	MVP = -0.28 (30 percentile)
Palatability:	MVP = 454 (6 percentile)

Gamma 2

AxG 1 as calf

Progeny Testing

- Genetic evaluation of clones from carcass:
  - No pedigree
  - No contemporary group

LIVE AND CARCASS PRODUCTION TRAITS FOR PROGENY OF PUREBRED SIRES IN COMPARISON WITH THE CLONE OF A USDA PRIME YIELD GRADE ONE CARCASS

Jessica L. Sperber
West Texas A&M University

Objective

- To determine the progeny success of a sire with the rare Prime YG 1 genetics with competitive purebred sires selected for carcass characteristics

Terminal Sire Comparison

Alpha

PHENOTYPIC	
Sex:	Steer
HCW:	782
12th rib fat:	0.44
REA:	15.9
YG:	1.98
Marbling:	Slab70
Hide:	51% Blk

WTAMU "Alpha" clone of USDA P1 Carcass

86% Angus
14% Zebu

GENOTYPIC - GeneStar	
Color:	EDED (Homozygous black)
Feed efficiency:	MVP = -0.76 (10 percentile)
Marbling:	MVP = +0.15 (30 percentile)
Tenderness:	MVP = -0.59 (6 percentile)
Palatability:	MVP = 429 (8 percentile)

Black Angus Sire

	CW	Marb	REA	FAT
	+29	+1.53	+.42	+.062
	.80	.78	.75	.78
29AN1688 RITO REVENUE	65%	1%	50%	95%

ABS Global, 2018

Simmental Sire

	CW	YG	Marb	BF	REA
	+16.6	-.49	+.36	-.109	+.78
	.84	.62	.83	.78	.82
29SM0390 SURE BET	95%	40%	2%	65%	65%

ABS Global, 2018

Charolais Sire

	CW	REA	FAT	MARB
	26	1.01	-0.011	0.07
	0.10	0.10	0.08	0.05
ANJOU PURE POWER 184Y	15	4	25	60

AICA, 2018

Cactus Feeders
Syracuse, KS

Heifer carcass metrics reported for all sires in study.

Outcome	Alpha	Angus	Charolais	Simmental	SEM	*P* - Value
n	41	58	74	50	-	-
Feedlot arrival weight, kg	270.8	259.9	269.9	269.0	15.5	0.07
Days on feed	201^{a}	185^{c}	199^{a}	192^{b}	2.1	<0.01
Days of age at harvest	473^{ab}	463^{c}	476^{a}	467^{bc}	2.3	<0.01
Hot carcass weight, kg	368.5	369.0	373.1	370.4	6.9	0.82
Fat, cm	1.5^{b}	1.8^{a}	1.1^{c}	1.5^{b}	0.1	<0.01
Longissimus muscle area, cm^2	95.2^{b}	90.2^{c}	99.9^{a}	93.3^{bc}	1.5	<0.01
Calculated yield grade	2.82^{b}	3.44^{a}	2.22^{c}	2.99^{b}	0.1	<0.01
Marbling score[1]	509^{b}	587^{a}	446^{c}	492^{b}	11.6	<0.01
Empty body fat[2], %	30.4^{b}	33.2^{a}	27.8^{c}	30.7^{b}	0.3	<0.01
Total carcass value	1562.90	1565.71	1583.00	1571.66	29.7	0.81
Carcass value per cwt	192.66	192.55	192.47	192.61	0.1	0.47

[1]Marbling score: 400 = small^{50}, minimum required for U.S. Low Choice; 500 = modest^{50}, minimum required for U.S. Premium Choice.
[2]17.76207 + (4.68142 x 12th rib fat, cm) + (0.01945 x HCW, kg) + (0.81855 X quality grade; 4 = Select, 5 = Choice-, 6 = Choice, 7 = Choice+, 8 = Prime) - (0.06754 x longissimus muscle area, cm^2); Guiroy et al. (2002).
No difference (*P* > 0.05) was detected between sire groups for liver and lung health.

Steer carcass metrics reported for all sires in study.

Outcome	Alpha	Angus	Charolais	Simmental	SEM	*P* - Value
n	42	50	50	59	-	-
Feedlot arrival weight, kg	293.6^{a}	284.3^{b}	296.9^{a}	297.4^{a}	14.6	<0.01
Days on feed	226^{a}	207^{b}	210^{b}	212^{b}	3.0	<0.01
Days of age at harvest	495^{a}	482^{b}	486^{b}	484^{b}	2.9	0.02
Hot carcass weight, kg	413.8^{b}	420.6^{ab}	431.3^{a}	426.2^{a}	7.6	0.05
Fat, cm	1.5^{b}	2.0^{a}	1.1^{c}	1.6^{b}	0.08	<0.01
Longissimus muscle area, cm^2	96.8^{b}	90.7^{c}	102.6^{a}	96.2^{b}	1.1	<0.01
Calculated yield grade	3.16^{b}	4.05^{a}	2.59^{c}	3.40^{b}	0.1	<0.01
Marbling score[1]	504^{b}	586^{a}	420^{c}	489^{b}	14.1	<0.01
Empty body fat[2], %	31.4^{b}	35.0^{a}	28.5^{c}	32.0^{b}	0.5	<0.01
Total carcass value	1757.91^{b}	1787.41^{ab}	1831.42^{a}	1816.22^{a}	31.8	0.04
Carcass value per cwt	192.47^{a}	191.92^{b}	191.82^{b}	192.10^{b}	0.1	<0.01

[1]Marbling score: 400 = small^{50}, minimum required for U.S. Low Choice; 500 = modest^{50}, minimum required for U.S. Premium Choice.
[2]17.76207 + (4.68142 x 12th rib fat, cm) + (0.01945 x HCW, kg) + (0.81855 X quality grade; 4 = Select, 5 = Choice-, 6 = Choice, 7 = Choice+, 8 = Prime) - (0.06754 x longissimus muscle area, cm^2); Guiroy et al. (2002).
No difference (P > 0.05) was detected between sire groups for liver and lung health.

USDA stamped carcass yield grade and quality grade of finishing heifers.

Outcome	Alpha	Angus	Charolais	Simmental	*P* - Value
n	41	58	74	50	-
Quality grade, %					
Prime	2.4	19.0	0	0	0.25
CAB[1]	42.9^{a}	43.1^{a}	1.4^{b}	48.1^{a}	<0.01
Choice	47.6^{b}	31.0^{b}	79.7^{a}	50.0^{b}	<0.01
Select	7.1	6.9	18.9	1.9	0.06
Yield grade, %					
1	2.4^{b}	1.7^{b}	47.3^{a}	7.7^{b}	<0.01
2	71.4^{a}	31.0^{c}	47.3^{bc}	57.7^{ab}	<0.01
3	26.2^{ab}	46.6^{a}	5.4^{c}	23.1^{b}	<0.01
4	0	20.7	0	0	0.66
5	0	0	0	0	1.0

[1]CAB: Certified Angus Beef; brand in which subprimals and retail cuts are marketed; carcasses meeting 10 quality standards.

USDA stamped carcass yield grade and quality grade of finishing steers.

Outcome	Alpha	Angus	Charolais	Simmental	*P* - Value
n	42	50	50	59	-
Quality grade, %					
Prime	2.4	22.5	0	0	0.19
CAB[1]	35.7	42.9	0	35.1	0.85
Choice	59.5^{a}	32.7^{b}	70.0^{a}	54.4^{a}	0.02
Select	2.4^{b}	2.0^{b}	28.0^{a}	10.5^{b}	0.01
Yield grade, %					
1	2.4	0	20.0	3.5	0.06
2	35.7^{ab}	2.0^{c}	56.0^{a}	29.8^{b}	<0.01
3	57.1^{a}	44.9^{a}	22.0^{b}	54.4^{a}	0.02
4	4.8^{b}	46.9^{a}	0^{b}	12.3^{b}	<0.01
5	0	6.1	0	0	1.00

[1]CAB: Certified Angus Beef; brand in which subprimals and retail cuts are marketed; carcasses meeting 10 quality standards.

Summary

- Alpha-sired heifers tended to be the heaviest at Ulysses Feedyard arrival
- Alpha-sired heifers & steers had the largest *longissimus* muscle area & lowest USDA Yield Grade next to the Charolais sire
- Alpha-sired steers worth the greatest value/cwt
- Alpha-sired heifers numerically worth the greatest value/cwt
- Alpha progeny performed comparably to high performing reference sires for terminal sire production traits

Genetic Evaluation - EPDs

Sire	CW	YG	Mrb	BF	REA
Surebet	16.2	-0.47	0.29	-0.105	0.75
Rito Revenue	30.2	0.33	1.32	0.118	0.17
PurePower	19.9	-1.02	-0.38	-0.256	1.32
ALPHA	**16.2**	**-0.3**	**0.56**	**-0.031**	**0.78**

AG1 May 2019

ASAS July 10, 2019
Austin, TX

Live and carcass production traits for progeny of an F1 USDA Prime-yield grade1 carcass clone sire in comparison with progeny of popular reference sires.

-Forest Francis et al

Current Research – Preliminary Results

Carcass characteristics for selected sires.

Outcome	Alpha	AxG1	Rampage	Surebet	Protege
n	79	105	72	91	45
HCW, lbs	846.41	858.31	904.17	875.67	886.78
Quality grade, %					
Prime	1.39	22.86	4.16	2.19	4.44
CAB[1]	54.43	54.29	43.05	53.85	35.55
Choice	34.18	21.90	45.83	42.86	51.11
Select	0.0	0.95	6.94	1.09	8.88
Yield grade, %					
1	1.27	6.67	2.77	4.39	6.67
2	41.77	35.24	31.94	35.16	13.33
3	41.77	51.43	45.83	48.35	55.55
4	13.92	6.67	19.44	12.09	24.44
5	1.27	0	0	0	0

[1]CAB: Certified Angus Beef; brand in which subprimals and retail cuts are marketed; carcasses meeting 10 quality standards.

Conclusions

- Cloning may be used as a tool to preserve rare terminal sire genetics
- Cloned lines in this project produce progeny that perfom comparably to reference sires for carcass traits

Cloning as a Tool

- Available and feasible
- Valuable option for preserving rare genetics
- Potential for producing new lines
- Limitations with cloning

For More Information

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