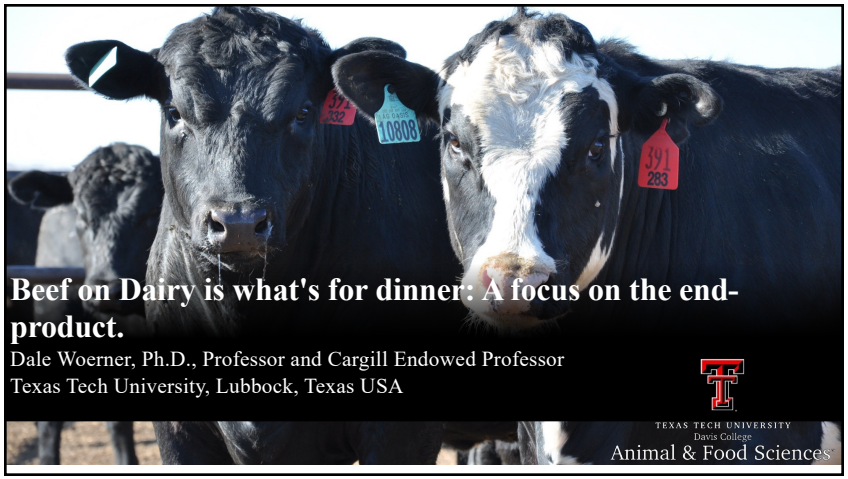
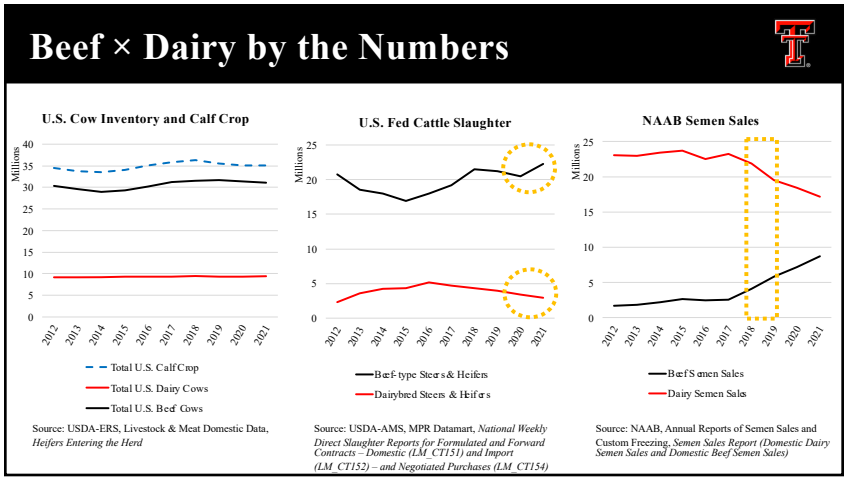

Beef on Dairy is what's for dinner: A focus on the end-product.
Dale Woerner, Ph.D., Professor and Cargill Endowed Professor
Texas Tech University, Lubbock, Texas USA
TEXAS TECH UNIVERSITY
Davis College
Animal & Food Sciences

1


25.4 M
5.1 M
???
USDA NASS Cattle Report (2018); NASS Slaughter Report (2021); USDA ERS (2020)

2


Beef × Dairy by the Numbers
U.S. Cow Inventory and Calf Crop
Millions
Total U.S. Calf Crop
Total U.S. Dairy Cows
Total U.S. Beef Cows
Source: USDA-ERS, Livestock & Meat Domestic Data, Heifers Entering the Herd
U.S. Fed Cattle Slaughter
Millions
Beef-type Steers & Heifers
Dairybred Steers & Heifers
Source: USDA-AMS, MPR Datamart, National Weekly Direct Slaughter Reports for Formulated and Forward Contracts – Domestic (LM_CT151) and Import (LM_CT152) – and Negotiated Purchases (LM_CT154)
NAAB Semen Sales
Millions
Beef Semen Sales
Dairy Semen Sales
Source: NAAB, Annual Reports of Semen Sales and Custom Freezing, Semen Sales Report (Domestic Dairy Semen Sales and Domestic Beef Semen Sales)

3


Beef × Dairy Research at Texas Tech
HDFY
HY-PLAINS FEEDYARD, LLC
Performance Cattle Company, LLC
Max D. Garrison, DVM - President
5909 Pebble Beach Ct., Granbury, Texas 76049 (806)290-1052
ABS
Cargill
BEEF
Funded by the Beef Checkoff

4

Cattle Type Comparison

Conventional Beef Cattle

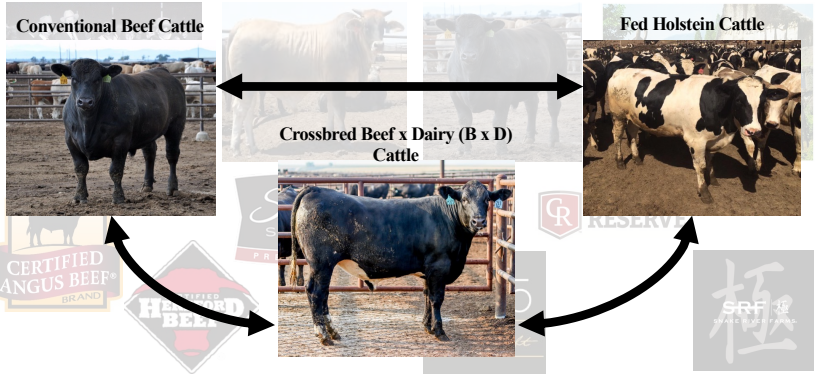
Quicker Growth Rate | Gut Health | Dressing Percent | Muscle to Bone | Steak Shape | Lean Color

Dairy Cattle

Genetic Consistency | Oxidative Fiber Type | Marbling | External Leanness | Tender | Flavorful

5

Where does the B x D crossbred fit?



6

Dairy Cow Performance

DAIRY B

Item	All Dairy LACT I (Dairy)	All Dairy LACT II (Dairy)	All Dairy LACT DIFF	Beef on Dairy LACT I (Dairy)	Beef on Dairy LACT II (Beef)	Beef on Dairy LACT DIFF	LACT I P-Value	LACT II P-Value	LACT DIFF P-Value
Days open (previous lactation)	113	115	2	120	114	-6	0.05	0.56	0.05
Times bred	2.0	1.9	0.0	2.1	1.9	-0.3	0.11	0.35	0.06
Gestation time, d	277	277	1	277	279	2	0.74	<0.01	<0.01
Total milk, lbs	30,294	31,526	1,232	27,390	29,436	2,046	<0.01	<0.01	0.03
Days in milk	337	344	7	336	341	5	0.52	0.17	0.52
Average daily milk, lbs/d	90	92	2	81	85	4	<0.01	<0.01	<0.01
305-d MHE, lbs	28,886	27,874	-1,012	25,850	26,114	264	<0.01	<0.01	<0.01
Peak daily milk, lbs	119	121	2	106	114	8	<0.01	<0.01	<0.01
Days dry before freshening	49	55	5	51	57	6	0.02	<0.01	0.71
Mastitis, %	16	19		13	13		0.30	0.01	

Increased gestation time by breeding to beef semen (1-2 days)

Cows bred to beef semen were inherently less productive

7

Feedlot Growth

Item	Paired Feedlot Closeouts Native	B × D	*P*-value	Phenotype Expression B × D Steers	B × D Heifers
Number of pens	26	26		6	3
Total animal count	1,603	1,492		411	181
Initial BW, lbs	799	805	0.77	788	724
Final BW, lbs	1,329	1,342	0.57	1,432	1,354
Days on feed	157	166	0.16	176	189
ADG, lbs/d	3.5	3.3	0.19	3.7	3.3
Feed:gain	6.6	7.1	0.02		
Dressing percentage	64.1	63.1	<0.01	62.9	62.7
Choice or better, %	78.7	78.7	0.99	82.7	88.9

8

Estimated Carbon Footprint

	Paired Feedlot Closeouts		
Item	Beef	B × D	Holstein
Total CO2e, kg	1386	1489	2255
Total CO2e, kg/kg BW	2.3	2.4	3.6
Total CO2e, kg/kg HCW	3.6	3.9	5.8
Total CO2e, kg/kg BW gain	5.8	6.1	6.3

9

Carcass Performance

	Eating Quality Study				Phenotype Expression	
Item	Native	B × D	Holstein	*P*-value	B × D Steers	B × D Heifers
Number of carcasses	966	518	935	--	411	181
HCW, lbs	873[a]	867[b]	865[b]	<0.01	901	849
12th rib fat thickness, in	0.51[a]	0.43[b]	0.35[c]	<0.01	0.53	0.56
Ribeye area, in²	14.7[a]	14.3[b]	13.6[c]	<0.01	13.8	14.1
KPH fat, %	3.6[b]	4.5[a]	4.5[a]	<0.01	--	--
USDA Yield Grade	3.1[b]	3.2[ab]	3.3[a]	<0.01	3.3	3.1
Marbling score	447[b]	481[a]	482[a]	<0.01	493	543

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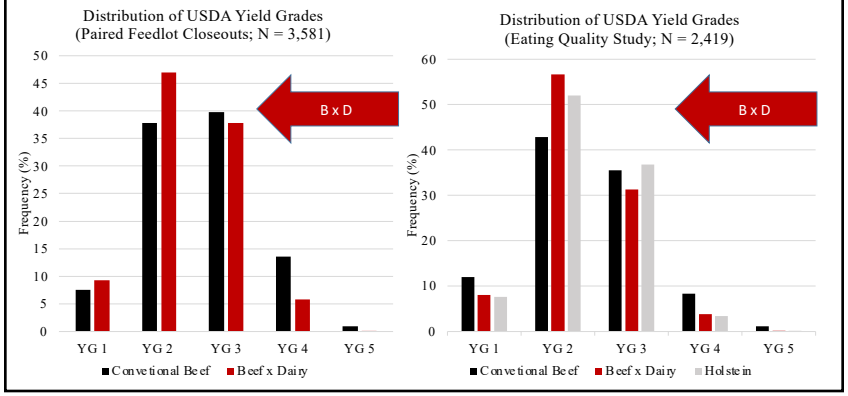
Yield Grades



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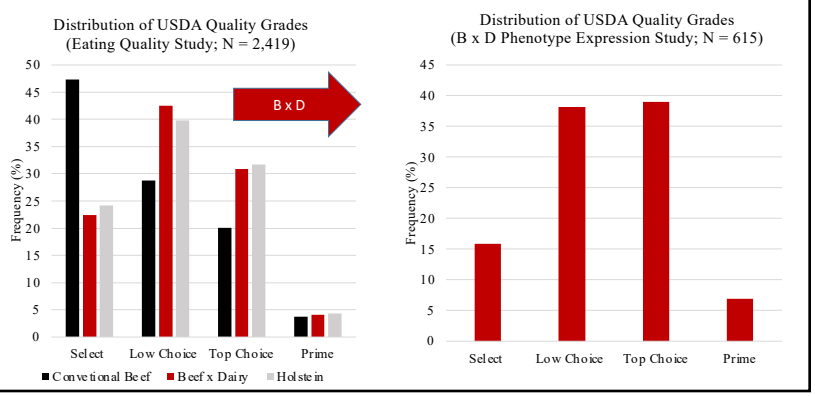
Quality Grades



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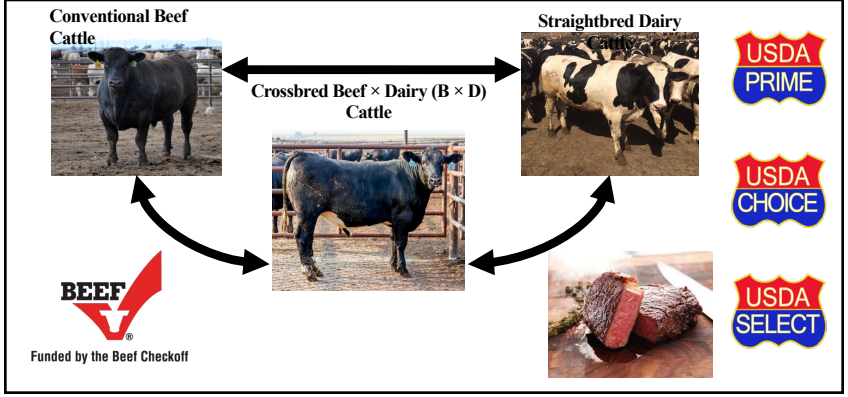
Cattle Types & Eating Quality



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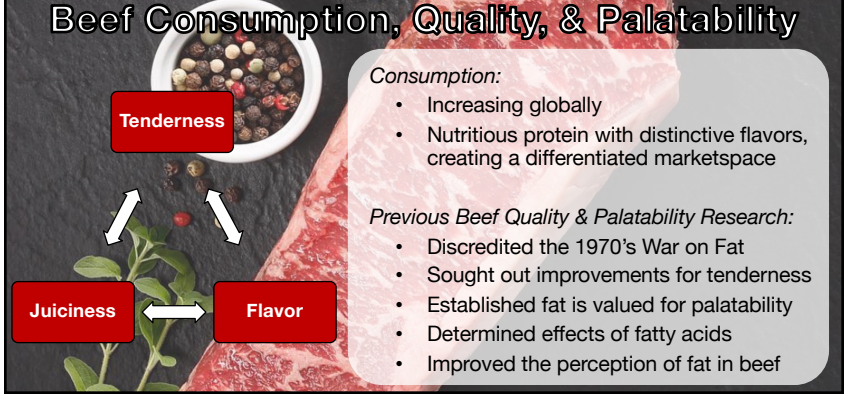
Beef Consumption, Quality, & Palatability



Consumption:

- Increasing globally
- Nutritious protein with distinctive flavors, creating a differentiated marketspace

Previous Beef Quality & Palatability Research:

- Discredited the 1970's War on Fat
- Sought out improvements for tenderness
- Established fat is valued for palatability
- Determined effects of fatty acids
- Improved the perception of fat in beef

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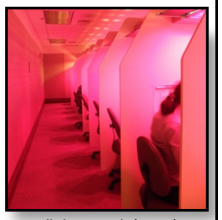
Trained Sensory Evaluation

Panelists were trained twice daily (1 h each session) over 10 d on the following:

- Overall Tenderness
- Overall Juiciness
- Beef Flavor Identity
- Browned
- Buttery
- Fat-Like
- Liver-Like
- Metallic
- Oxidized
- Roasted
- Umami

N = 120



Adhikari et al. (2011)

Attributes were scored using a continuous 100 point scale

0
Tenderness: very tough
Juiciness: very dry
Flavor Note: not present

100
Tenderness: very tender
Juiciness: very juicy
Flavor Note: very intense

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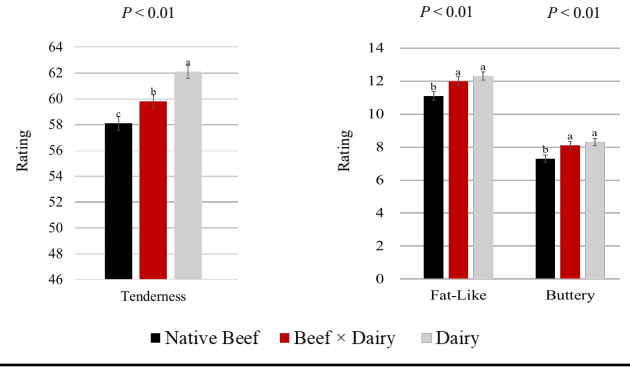
Trained Sensory Evaluation



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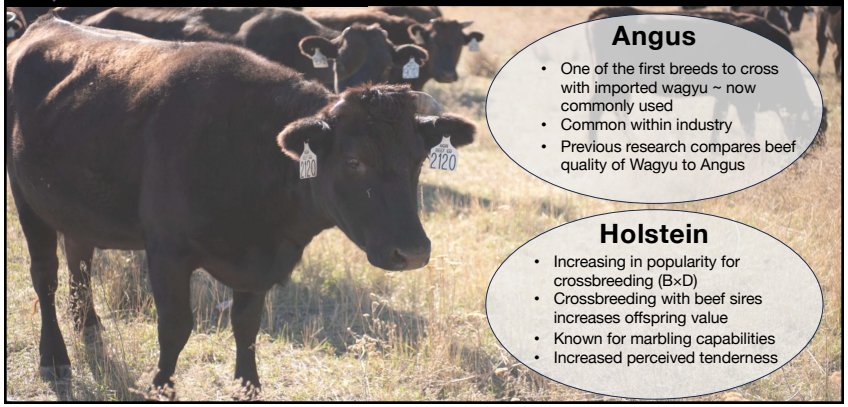

Angus

- One of the first breeds to cross with imported wagyu ~ now commonly used
- Common within industry
- Previous research compares beef quality of Wagyu to Angus

Holstein

- Increasing in popularity for crossbreeding (B×D)
- Crossbreeding with beef sires increases offspring value
- Known for marbling capabilities
- Increased perceived tenderness

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Estimated marginal means of instrumental tenderness measurements for striploin steaks (N = 120; n = 40), representing Wagyu × Holstein, Wagyu × Angus, and conventional USDA Prime

	Wagyu × Holstein	Wagyu × Angus	Prime	SEM[1]	*P*-Value[2]
Slice Shear Force, kg	8.09[b]	9.88[b]	10.25[a]	0.23	< 0.01
Warner-Bratzler Shear Force, kg	1.70[b]	2.05[b]	2.13[a]	0.04	< 0.01

[a-c] Estimated marginal means in the same row without a common superscript differ (P < 0.05)
[1] Standard error (largest) of the estimated marginal means
[2] Observed significance levels for main effect of groups

*** WBSF values under 3.9 kg qualify for Certified Very Tender (ASTM, 2011)

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Estimated marginal means of descriptive sensory attributes for striploin steaks (N = 120; n = 40), representing Wagyu × Holstein, Wagyu × Angus, and conventional USDA Prime

Attribute	Wagyu × Holstein	Wagyu × Angus	Prime	SEM[1]	*P*-Value[2]
Overall Tenderness	67.8[a]	63.8[b]	60.7[c]	0.70	< 0.01
Overall Juiciness	62.1[a]	58.9[b]	57.9[b]	0.58	< 0.01**
Beef Flavor ID	56.8	56.3	55.4	0.39	0.05
Browned	54.9[a]	54.1[ab]	53.0[b]	0.42	< 0.01
Fat-Like	21.9[a]	20.0[b]	18.7[b]	0.53	< 0.01*
Buttery	5.83[a]	4.44[a]	2.38[b]	0.55	< 0.01*
Roasted	56.1	55.3	55.2	0.40	0.24
Umami	21.9[a]	20.9[a]	19.4[b]	0.33	< 0.01
Liver-Like	0.20[b]	0.74[a]	1.57[a]	0.28	< 0.01
Metallic	0.99[b]	2.06[a]	2.48[a]	0.28	0.01**
Oxidized	0.13	0.03	0.10	0.08	0.49

[a-c] Estimated marginal means in the same row without a common superscript differ (P < 0.05)
[1] Standard error (largest) of the estimated marginal means
[2] Observed significance levels for main effect of groups
*** Crude Fat as a covariate value (α < 0.05)**
**** Recorded off-temperature as a covariate value (α < 0.05)**

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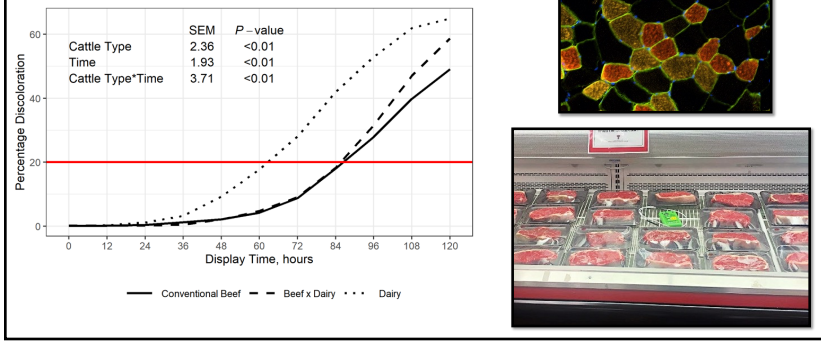
Color Display at Retail



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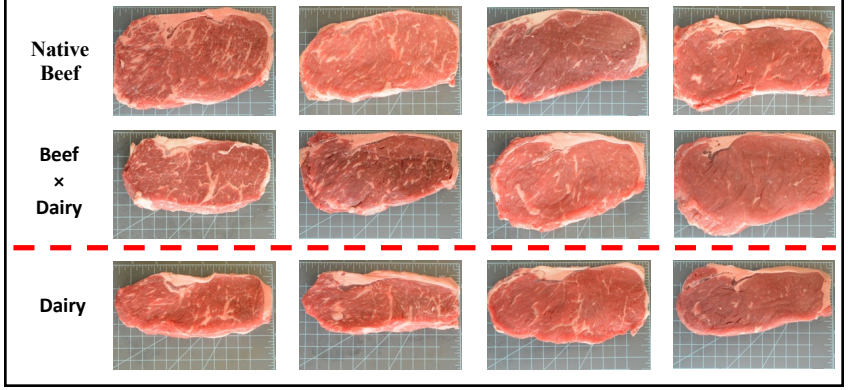
Steak Size & Shape



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Expression of Phenotype & Red Meat Yield

22

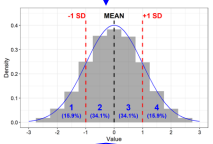
Study Design

Study 1: *Beef- versus dairy-type*

6 pens of steers
3 pens of heifers

Sire: Angus or SimAngus
Dam: Holstein

Processing Time	Days on Feed	BW, lbs
Arrival	0	777
Re-Implant	104	1,234
Harvest	180	1,417



Muscling: 1 (dairy) to 9 (beef)
Frame size: 1 (dairy) to 9 (beef)
Phenotype score = muscling + frame size

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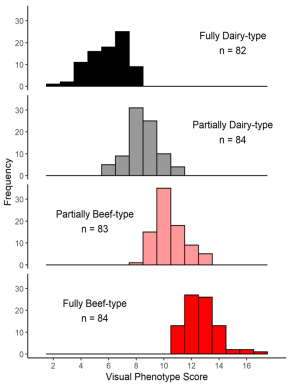
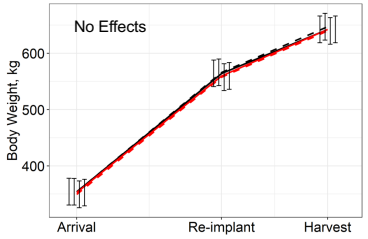
Phenotype Groups

Study 1: *Beef- versus dairy-type*





No difference ($P = 0.81$) in marbling score between phenotype groups (means ranged from 480 to 493).

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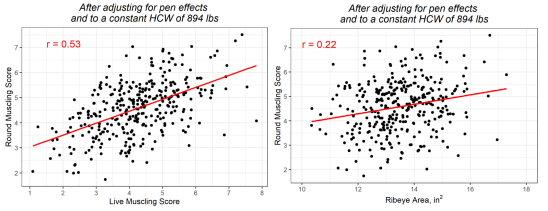
Muscling Considerations

Trait	Fully Dairy-type	Partially Dairy-type	Partially Beef-type	Fully Beef-type	*P*-value
Live muscling score	2.8[d]	4.0[c]	4.5[b]	5.6[a]	<0.01
Ribeye area, in^2	13.2	13.5	13.6	13.5	0.30
Round muscling score	3.8[c]	4.5[bc]	4.8[ab]	5.3[a]	<0.01



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Cattle Type on Carcass Yield and Value

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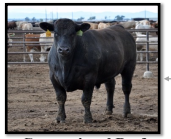
Study Design

Study 2: *Carcass yields and subprimal cutout value*



Conventional Beef
n = 26 steers

HCW and FT criteria

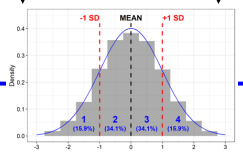
Beef × Dairy
106 steers
8 Harvest Lots with ≥ 10 Head

HCW and FT criteria

Holstein
n = 21 steers

Beef × Dairy, Low Yielding (LY)
n = 28 steers

1 & 2



3 & 4

Beef × Dairy, High Yielding (HY)
n = 28 steers

Average Crossbred = Arithmetic Mean of HY and LY Groups

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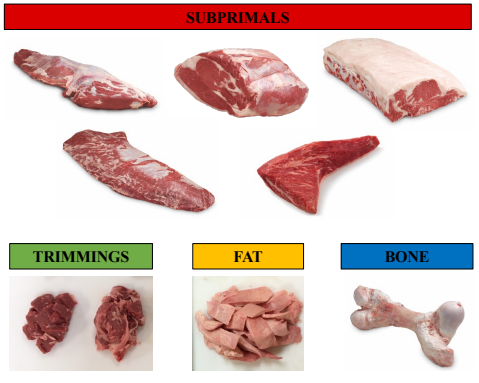
Fabrication Techniques

Study 2: *Carcass yields and subprimal cutout value*



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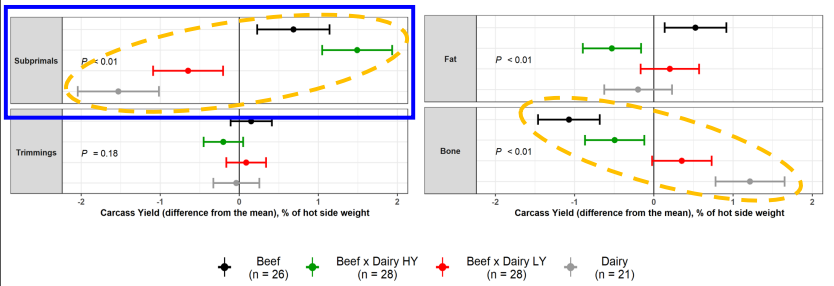
Carcass Yields

Study 2: *Carcass yields and subprimal cutout value*



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Subprimal Cutout Value

Study 2: *Carcass yields and subprimal cutout value*

Subprimal Cutout Value, $ per cwt				Average B×D
Beef	B×D HY	B×D LY	Dairy	
2.97[b]	7.59[a]	-2.12[c]	-8.45[d]	2.74

[a-d] Means with different superscripts differ ($P \leq 0.05$).

!! IMPORTANT !!

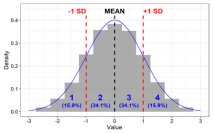
NOT ALL Beef × Dairy Crossbreds Have a Greater Subprimal Cutout Value than Beef Cattle

		Beef × Dairy		
Carcass traits	Beef	HY	LY	Dairy
HCW, lbs	900	904	917	865
12th rib fat, in	0.54	0.40	0.44	0.33

Subprimal Cutout Value Differences

does not include value of trimmings, fat, or bone

Beef vs. Dairy	+ $11.42 per cwt
B×D HY vs. B×D LY	+ $ 9.71 per cwt
Average B×D vs. Dairy	+ $11.19 per cwt



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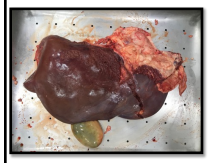
Liver Abscess Concerns

Study 1: *Beef- versus dairy-type*

	No Liver Abscess		Liver Abscess	
Trait	No Skirt Damage	Skirt Damage	No Skirt Damage	Skirt Damage
Number of cattle (%)	208 (38%)	44 (8%)	136 (25%)	162 (29%)
Dressing percentage	63.2	62.9	63.0	62.2
Marbling score[1]	493	490	492	477

[1] Marbling scores: 400 to 499 = Small (Low Choice), 500 to 599 = Modest (Average Choice)



USDA National Weekly Boxed Beef Cutout And Boxed Beef Cuts - Negotiated Sales
Agricultural Marketing Service
Livestock, Poultry, and Grain Market News

Outside Skirt Cutout Value: $1,188.00/cwt

Outside Skirt Damage:
5 lbs. per carcass × $1,188.00/cwt = *$59.40 per animal*

Survey of B × D Crossbred Gut Health (N = 1,161)	
Trait	Prevalence, %
Liver scores	
0	69
A	28
A+	3
Gut pile condemnation	20
Outside skirt damage	14

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Maximizing Value

ENVIRONMENTAL SUSTAINABILITY

CARCASS YIELD & MARBLING

HIGH-QUALITY PRODUCT

CONSISTENCY

TRACEABILITY

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Beef × Dairy in the Literature

ACCEPTED MANUSCRIPT

Invited review: A carcass and meat perspective of crossbred beef × dairy cattle

B A Foraker, J L Frink, D R Woerner

Translational Animal Science, txac027, https://doi.org/10.1093/tas/txac027
Published: 22 February 2022 **Article history**

ACCEPTED MANUSCRIPT

Crossbreeding beef sires with dairy cows: cow, feedlot, and carcass performance

B A Foraker, M A Ballou, D R Woerner

Translational Animal Science, txac059, https://doi.org/10.1093/tas/txac059
Published: 09 May 2022 **Article history**

Meat and Muscle Biology™

Expression of beef- versus dairy-type in crossbred beef and dairy cattle does not impact shape, eating quality, or color of strip loin steaks.

Blake A. Foraker, Bradley J. Johnson, Ryan J. Rathmann, Jerrad F. Legako, J. Chance Brooks, Markus F. Miller, and Dale R. Woerner

DOI: https://doi.org/10.22175/mmb.13926

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