Comparison of left vs right body composition endpoints in beef cattle using carcass ultrasound

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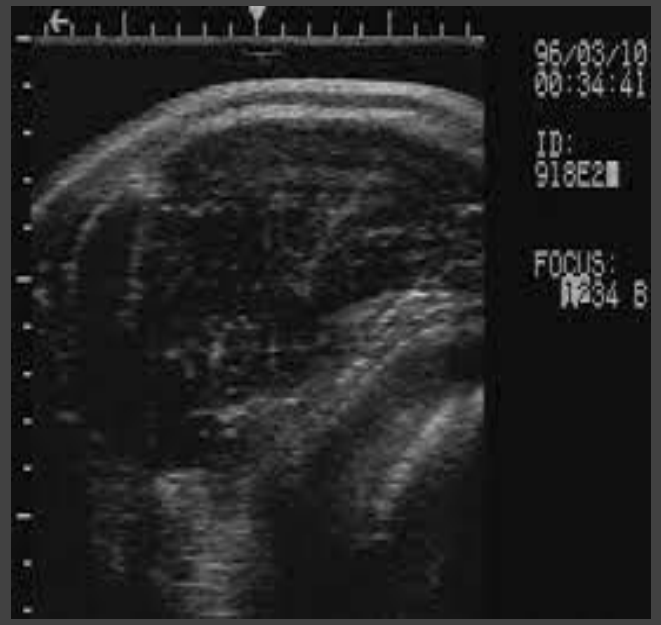
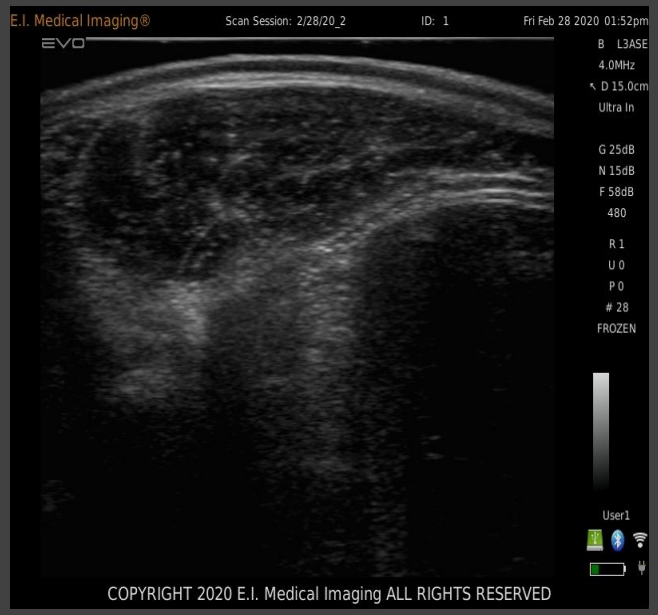
Presented by

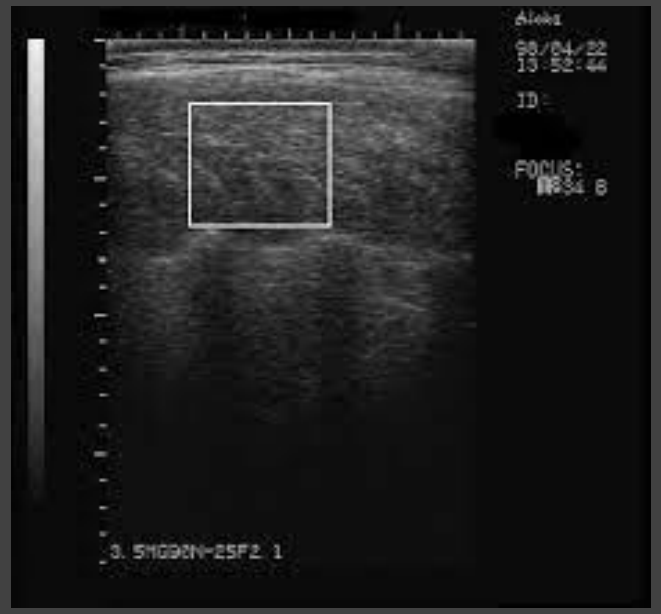
Noah Jesko

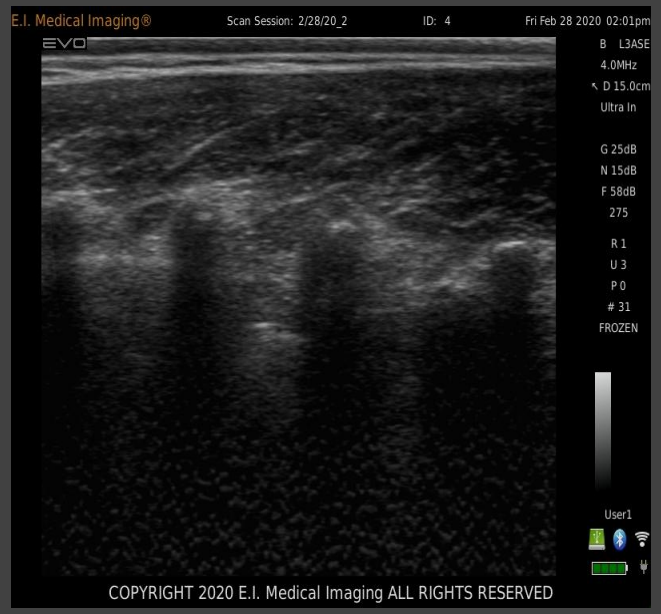
Objective I

- Compare the left and right side of individual animals using both carcass ultrasound and actual carcass data.









Objective II

- Compare the Aloka 500 and the EVO ultrasound units to each other and carcass.

Literature

Ultrasound shown to be accurate in measuring fat thickness in meat animals	Improvement of ultrasound accuracies when predicting carcass ribeye area.	Marbling estimates of beef carcass using ultrasound techniques.
• Davis et al., 1966; Hazel and Kline, 1959; Stouffer et al., 1962	• Davis et al., 1964; Price et al., 1960; Stouffer et al., 1961.	• Brethour, 1990, 1994; Yang et al., 2006.

Literature

Various studies have assessed the accuracy and precision of carcass ultrasound measurements on ribeye area, 12-13th rib fat thickness, and percent intramuscular fat.

- Perkins et al., 1992, 1992a; Robinson et al., 1992; Wallace et al., 1977.

Variation of beef carcass composition and yield of left vs right side has been studied briefly with differences being associated with techniques used in the harvest process.

- Butler et al., 1956; Brungardt and Bray, 1963.

Materials & Methods

- Fifty bovine were ultrasounded during the Ultrasound Guidelines Council (UGC) Carcass Certification live animal exam at West Texas A&M University (Canyon, Texas).
- Cattle consisted of steers, cows, heifers, and bulls with breeds including Angus, Charolais, Corrientes, Holstein, Shorthorn and others.
- On day-0 a UGC certified technician ultrasonically scanned the cattle at the WTAMU Research Feedlot.

Materials & Methods

- Day I
  - Technician I scanned the animals right side using an Aloka 500.
  - Technician II scanned the animals left side using an EVO.
- Day II
  - Technician I scanned the animals left side using an Aloka 500.
- Day III
  - Technician II scanned the animals right side using an EVO

Materials & Methods

- Carcass ultrasound measurements were taken with both an Aloka 500 and an EVO and included:
  - Ribeye area (REAU)
  - 12th rib subcutaneous fat thickness (FTU)
    - All images of REAU and FTU were taken between the 12-13th ribs
  - Intramuscular fat percentage (IMFU)
    - All IMFU images were taken over the *longissimus dorsi* muscle along the 11-12-13th ribs.
  - Rump fat thickness
    - Each RFU image was taken at the junction of the *biceps femoris* and *gluteus medius* muscles.

Materials & Methods

- After final ultrasound on day-3, cattle were harvested at Tyson Foods (Amarillo, Texas).
  - Actual carcass data was collected by the WTAMU Beef Carcass Research Center and included:
    - ribeye area (REAC)
    - 12th rib subcutaneous fat thickness (FTC)
    - Marbling score (MarSco)
      - Both the left and right side of the carcass.
    - Ether extractable fat (IMFC) was obtained from loins collected at the plant and brought back to WTAMU for the right side of the carcass only.
- Data was analyzed using the Proc Correlation and Proc Mixed Procedures of SAS 9.4.

Descriptive Statistics

Table 1. Means and standard deviations for carcass attributes.

Measure	Mean	SD
Marbling number		
Left	46.18	15.14
Right	46.00	15.11
Intramuscular fat, %		
Left	-	-
Right	4.58	2.16
Fat thickness, cm		
Left	0.97	0.46
Right	1.04	0.65
Ribeye area, cm^2		
Left	87.22	13.85
Right	84.94	13.10

*Mean weight of carcasses was 325.00 kg with a SD of 60.40 kg.

Descriptive Statistics

Table 2. Statistics for EVO ultrasound.

Measure	Mean	SEP	SD
Intramuscular fat, %			
Left	5.30	0.95	1.77
Right	4.93	1.01	1.65
Fat thickness, cm			
Left	1.20	0.13	0.52
Right	0.97	0.12	0.42
Ribeye area, cm^2			
Left	91.94	1.12	12.63
Right	85.55	0.79	12.50
Rump fat, cm			
Left	1.34	-	0.62
Right	1.23	-	0.56

Descriptive Statistics

Table 3. Statistics for Aloka 500 ultrasound.

Measure	Mean	SEP	SD
Intramuscular fat, %			
Left	4.89	1.50	1.30
Right	5.02	1.27	1.40
Fat thickness, cm			
Left	1.10	0.12	0.44
Right	1.14	0.12	0.48
Ribeye area, cm^2			
Left	89.10	1.29	14.78
Right	91.10	1.28	12.58
Rump fat, cm			
Left	1.28	-	0.56
Right	1.30	-	0.50

Correlations

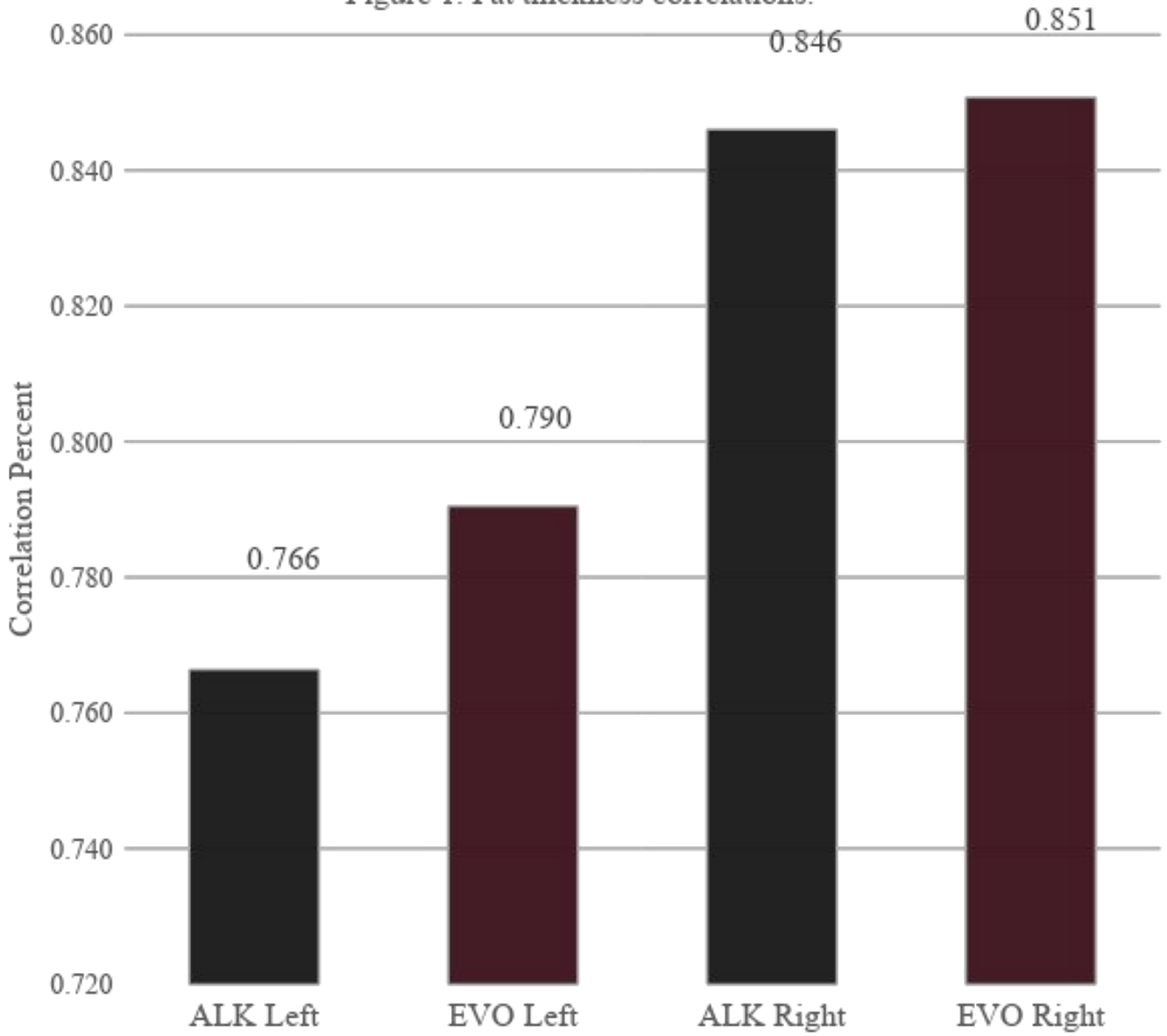
Table 4. Simple correlation coefficients between ultrasound and carcass for fat thickness.

	ALK Left	ALK Right	EVO Left	EVO Right
Carcass Left	0.766	0.758	0.790	0.756
Carcass Right	0.781	0.846	0.870	0.851

All correlations significant at ($P < 0.05$)

Correlations

Figure 1. Fat thickness correlations.



Correlations

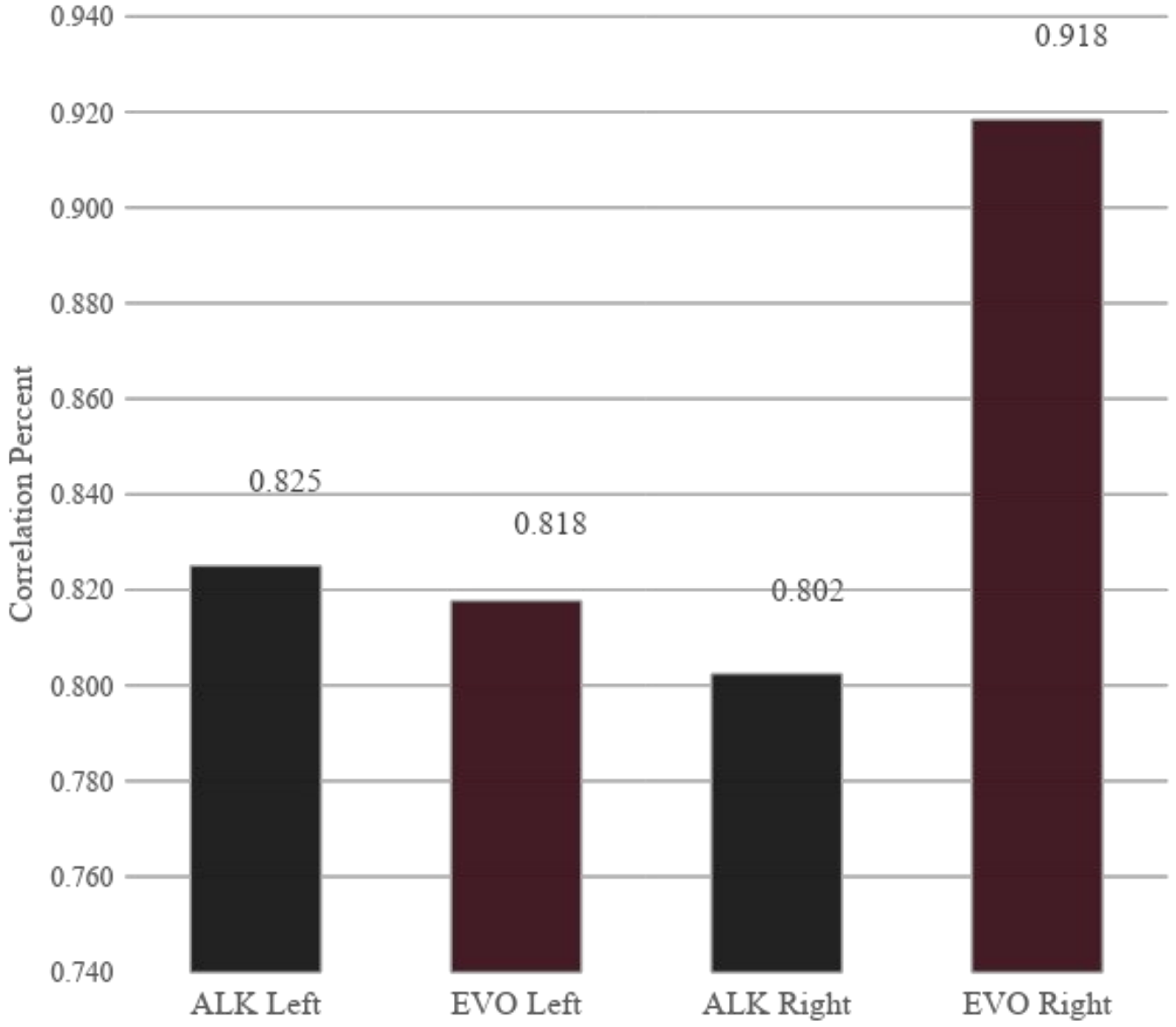
Table 5. Simple correlation coefficients between ultrasound and carcass for ribeye area.

	ALK Left	ALK Right	EVO Left	EVO Right
Carcass Left	0.825	0.798	0.817	0.881
Carcass Right	0.828	0.802	0.819	0.918

All correlations significant at ($P < 0.05$)

Correlations

Figure 2. Ribeye area correlations.



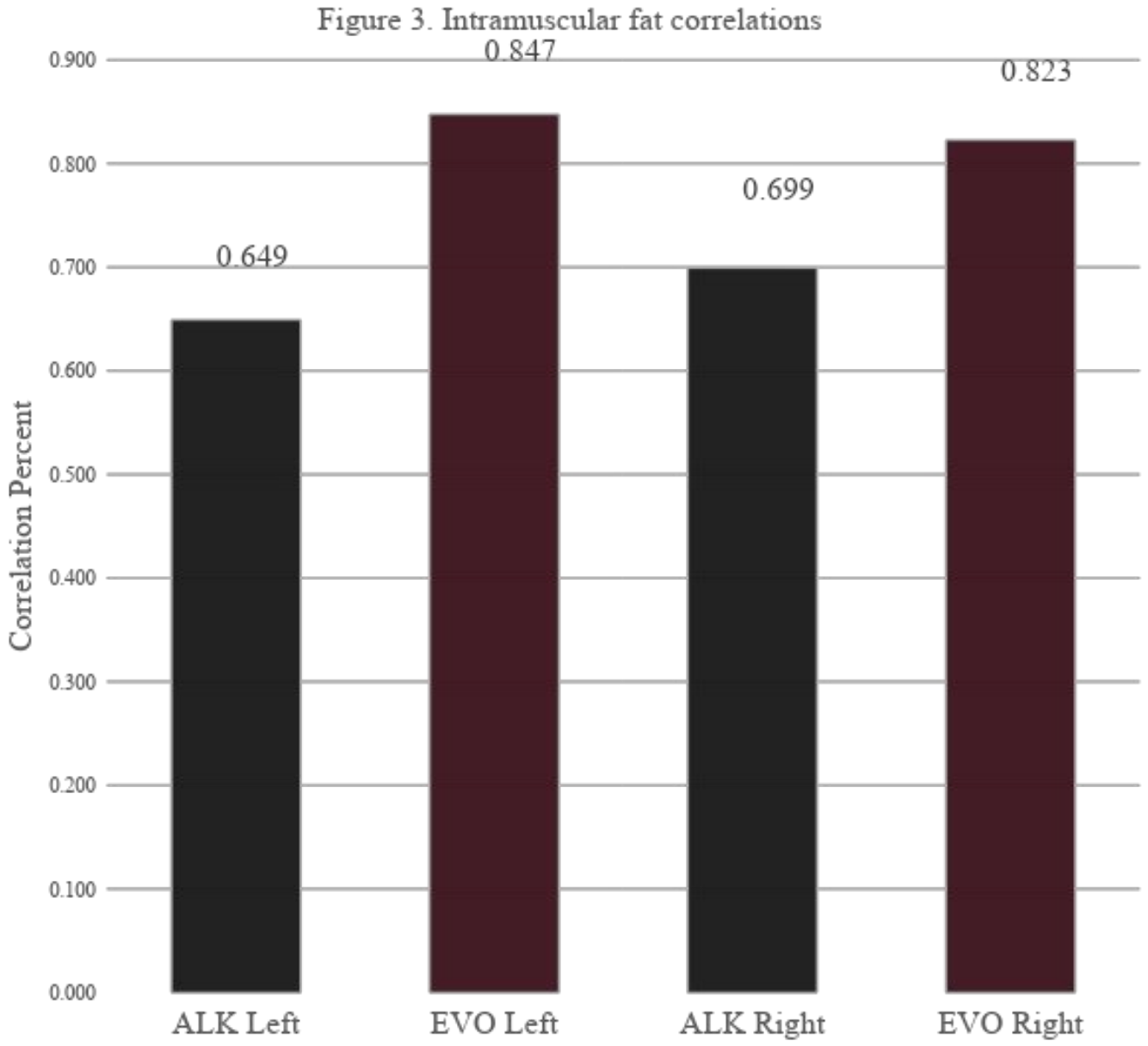
Correlations

Table 6. Simple correlation coefficients between ultrasound and carcass for intramuscular fat.

	ALK Left	ALK Right	EVO Left	EVO Right
Carcass Left	0.649	0.769	0.847	0.834
Carcass Right	0.505	0.699	0.833	0.823

All correlations significant at ($P < 0.05$)

Correlations



Results

Table 7. Comparison of carcass data to Aloka 500.

	Carcass		Ultrasound	
	Left	Right	Left	Right
Ribeye area, cm^2	87.22^{a}	$84.94^{b}{}_{a}$	89.10^{a}	$91.10^{b}{}_{b}$
Intramuscular fat, %	-	4.58_{a}	4.89	5.02_{b}
Backfat thickness, cm	0.97_{a}	1.04	1.10_{b}	1.14
Rump fat thickness, cm	-	-	1.28	1.30

Superscripts denote differences within either carcass or ultrasound, and subscripts denote differences between carcass and ultrasound values for same sides ($P < 0.05$).

Results

Figure 4. Ribeye area, Aloka 500 vs carcass

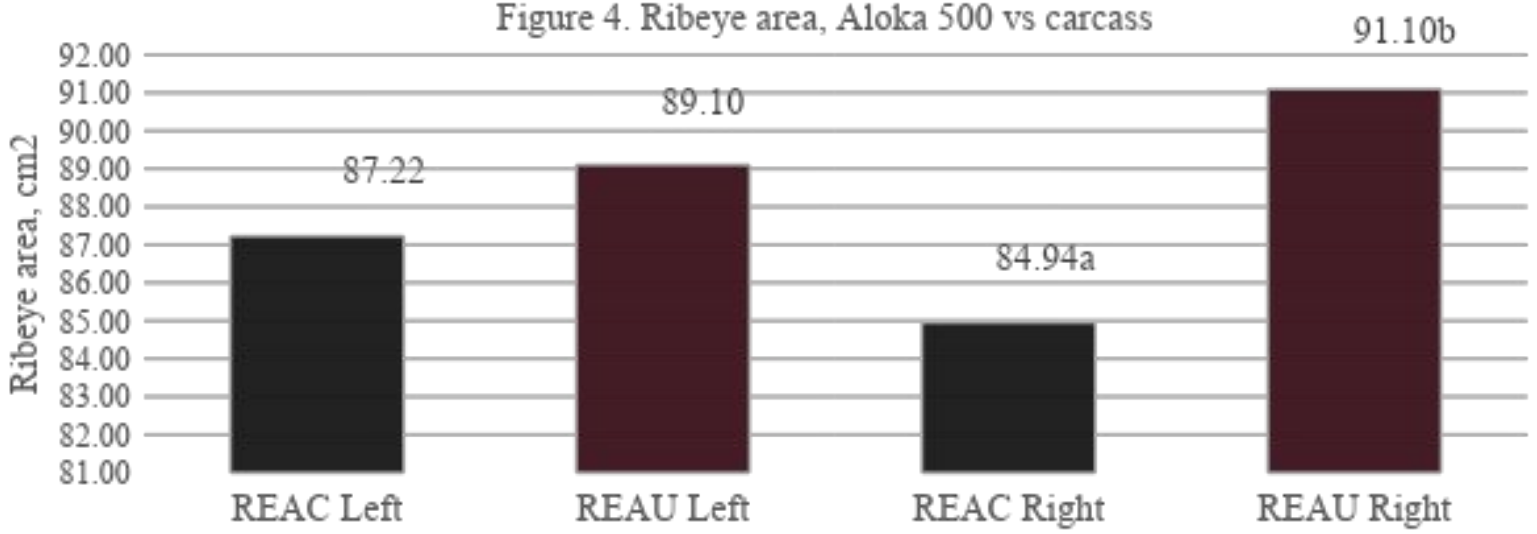
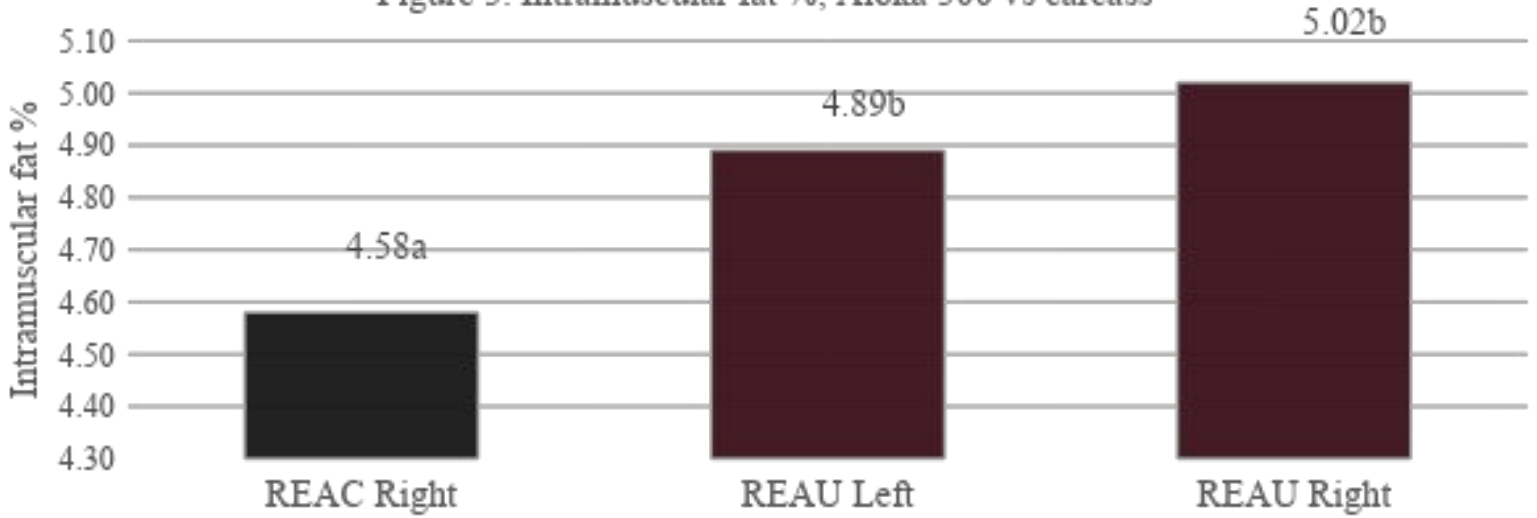


Figure 5. Intramuscular fat %, Aloka 500 vs carcass



Results

Table 8. Comparison of carcass data to EVO.

	Carcass		Ultrasound	
	Left	Right	Left	Right
Ribeye area, cm^2	$87.22^{a}{}_{a}$	84.94^{b}	$91.94^{a}{}_{b}$	85.55^{b}
Intramuscular fat, %	-	4.58_{a}	5.30	4.93_{b}
Backfat thickness, cm	0.97_{a}	1.04	$1.20^{a}{}_{b}$	0.97^{b}
Rump fat thickness, cm	-	-	1.34^{a}	1.23^{b}

Superscripts denote differences within either carcass or ultrasound, and subscripts denote differences between carcass and ultrasound values for same sides ($P < 0.05$).

Results

Figure 6. Ribeye area, EVO vs carcass

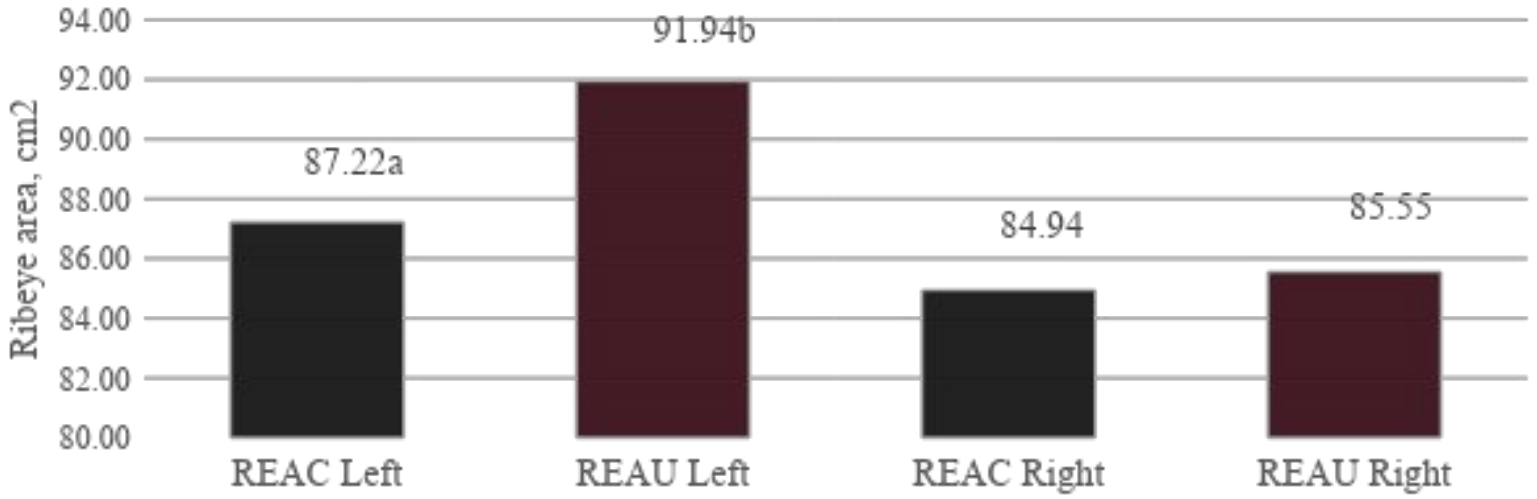
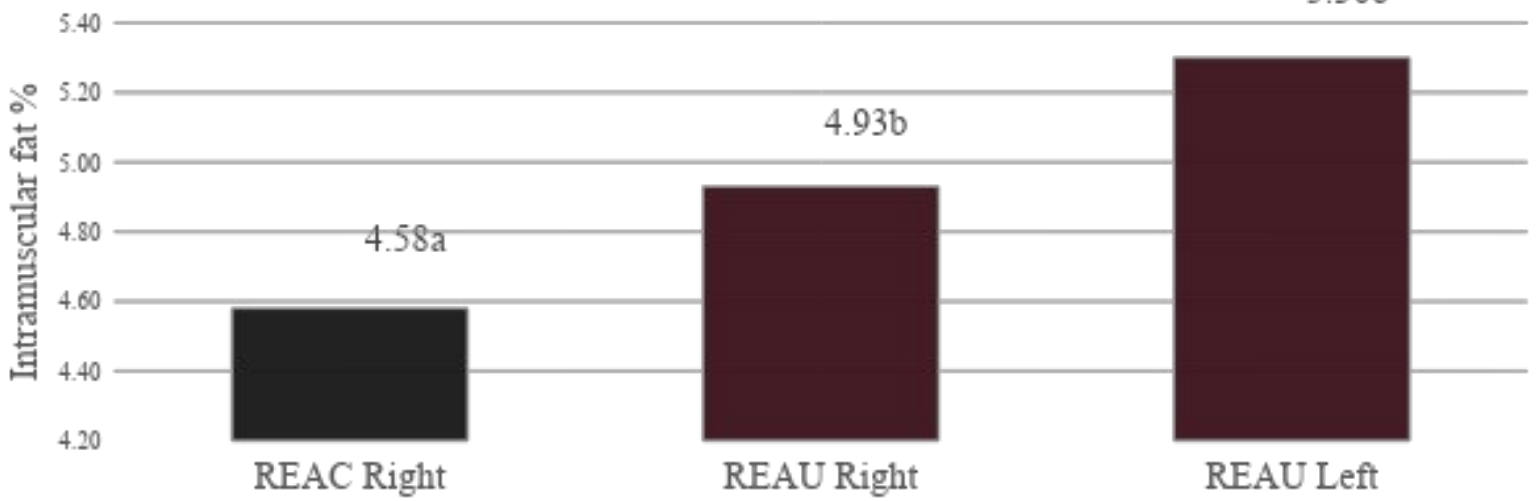


Figure 7. Intramuscular fat %, EVO vs carcass



Results

Table 9. Comparison of Aloka 500 to EVO.

	Aloka 500		EVO	
	Left	Right	Left	Right
Ribeye area, cm^2	89.10^a	91.10^a	91.94^b	85.55^b
Intramuscular fat, %	4.89^a	5.02	5.30^b	4.93
Backfat thickness, cm	1.10^a	1.14	1.20^b	0.97
Rump fat thickness, cm	1.28	1.30	1.34	1.23

Superscripts denote differences between unit ($P < 0.05$).

Results

Figure 8. Ribeye area, Aloka 500 vs EVO

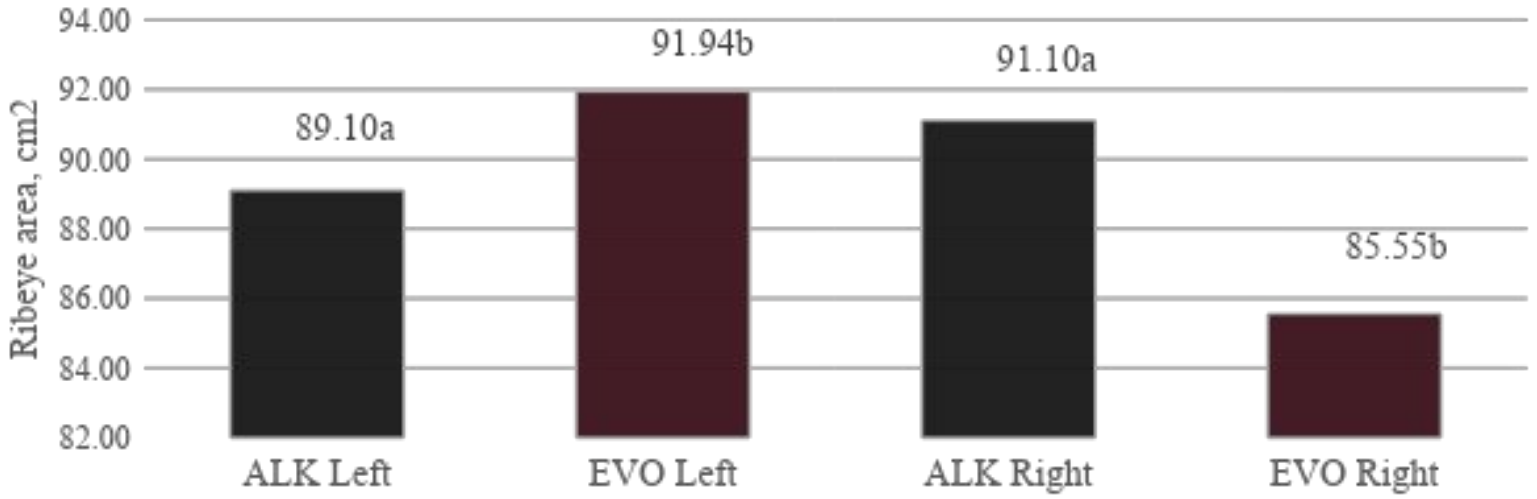
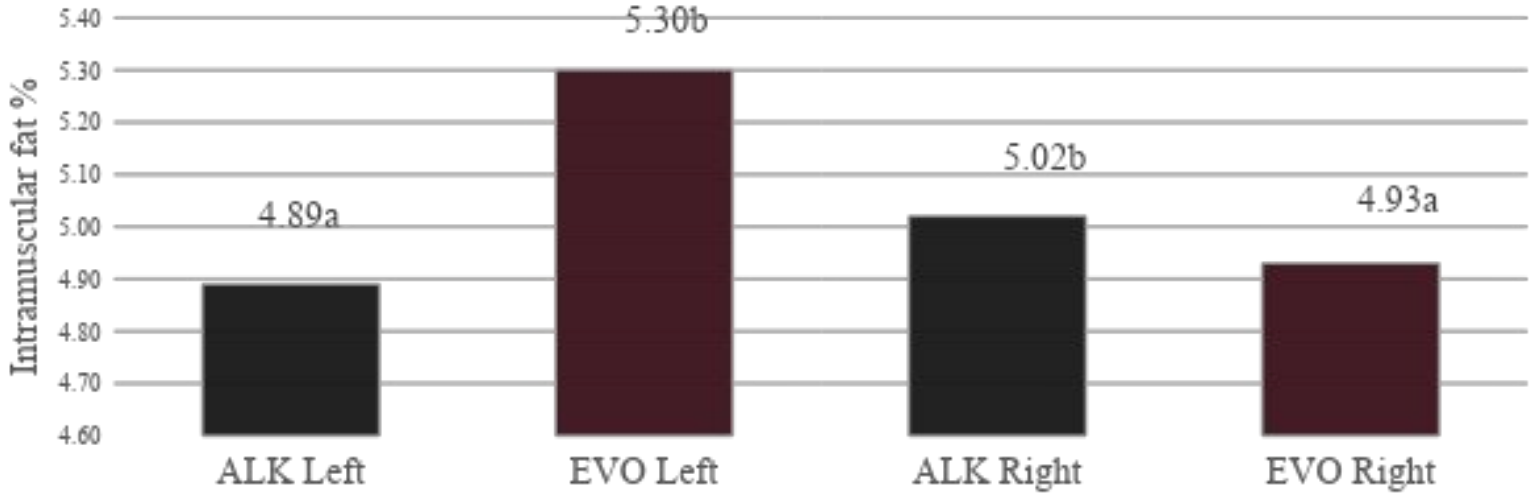


Figure 9. Intramuscular fat %, Aloka 500 vs EVO



Discussion

1. UltraInsights 2020
    1. EVO to Carcass
        1. Fat: 0.78
        2. REA: 0.68
        3. %IMF: 0.80

    2. Aloka to Carcass
        1. Fat: 0.76
        2. REA: 0.72
        3. %IMF: 0.78

2. WTAMU Fall 2020
    1. EVO to Carcass

Discussion

- Aloka 500 vs EVO
  - Split directly down the middle.
    - Aloka consistently higher on the right and EVO consistently higher on the left.
  - Higher variation within EVO, similar variation between units and carcass.
- Carcass
  - Differences within ribeye area indicate technique has effect on outcome.

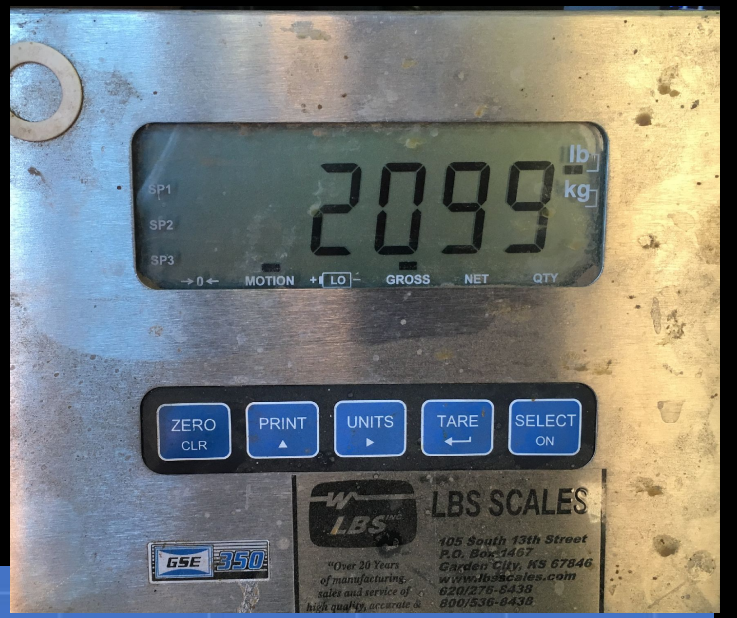
600 lb steers
Angus x Charolais

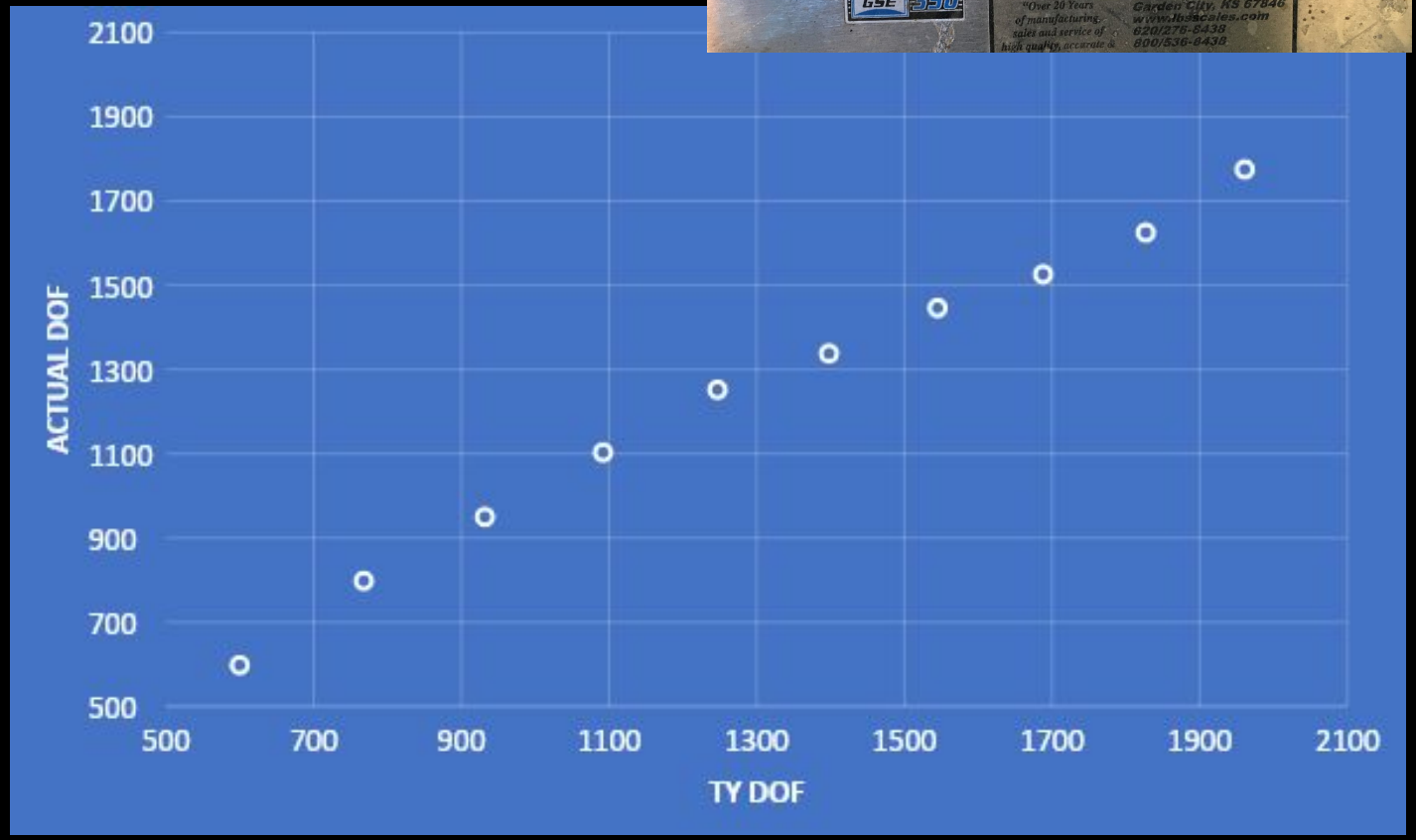
Trts

- Control negative
- XS, XS

M&M

- 4 hd / kill / trt
- 0d, 42d, 84d, 112d, 154d, 196d, 238d
  280d, 322d, ~~364d~~
- 600 - 768 - 932 - 1092 - 1247 - 1398 - 1545
  1688 - 1827 - 1961
- GrowSafe / Kill Yields / Fab Yields → 2 9-10-11, 2 side grind
- Mac system

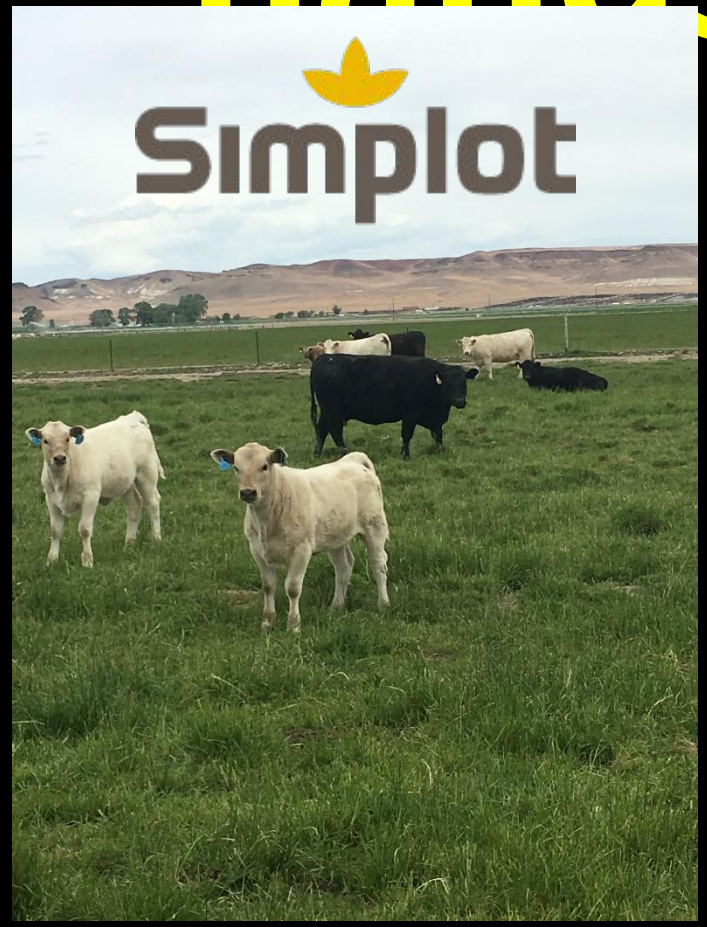




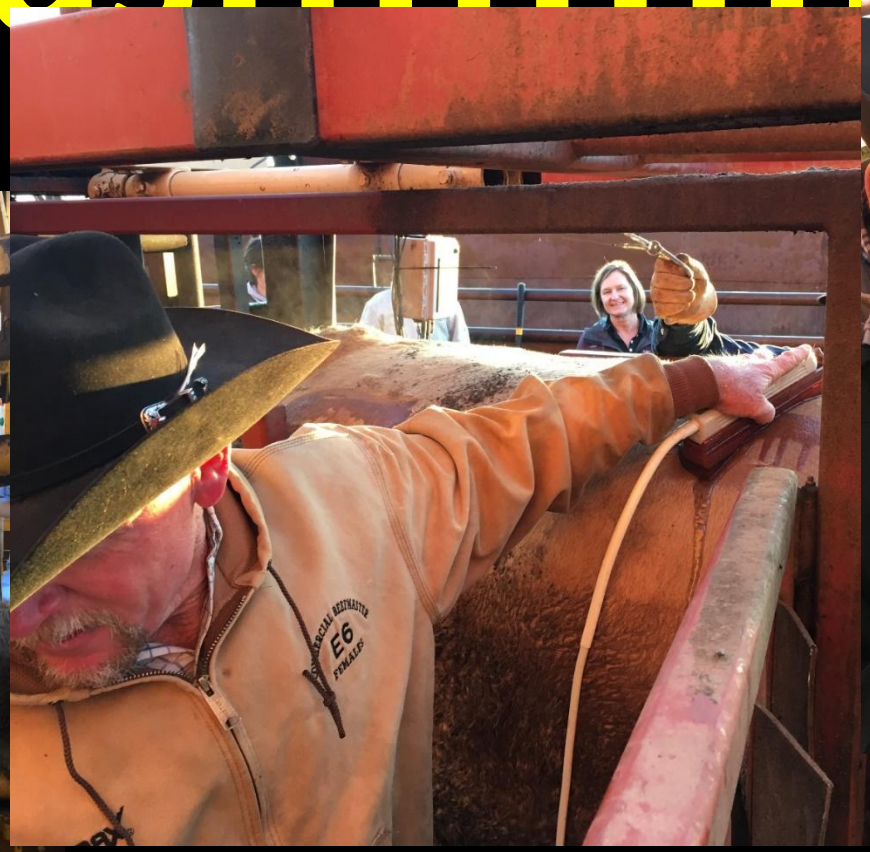
Many hands.....

MERCK
Animal Health

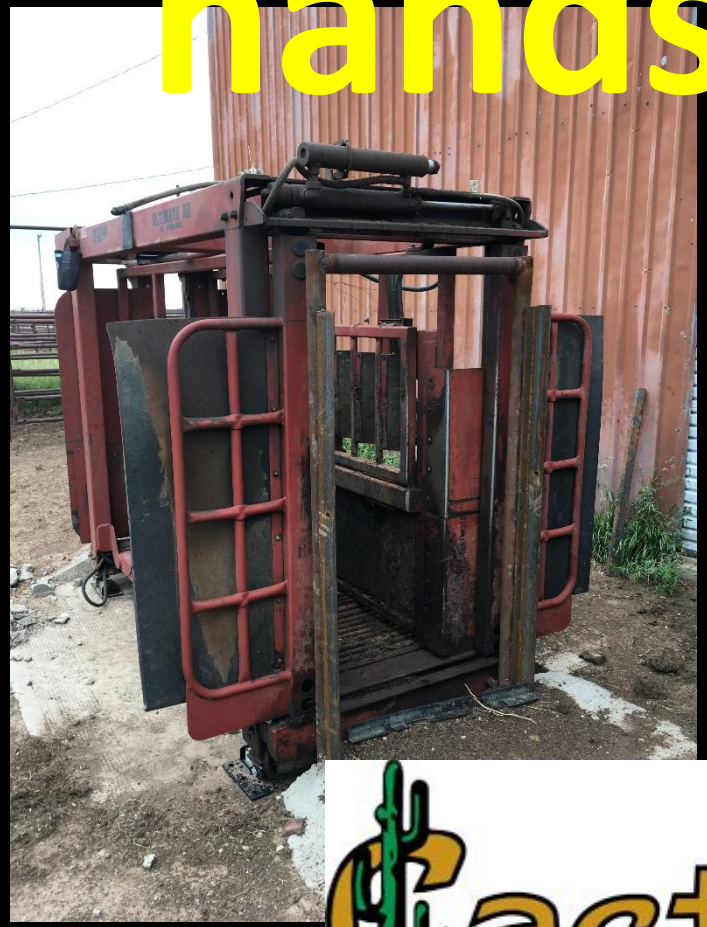
Many hands.....



Many hands.....

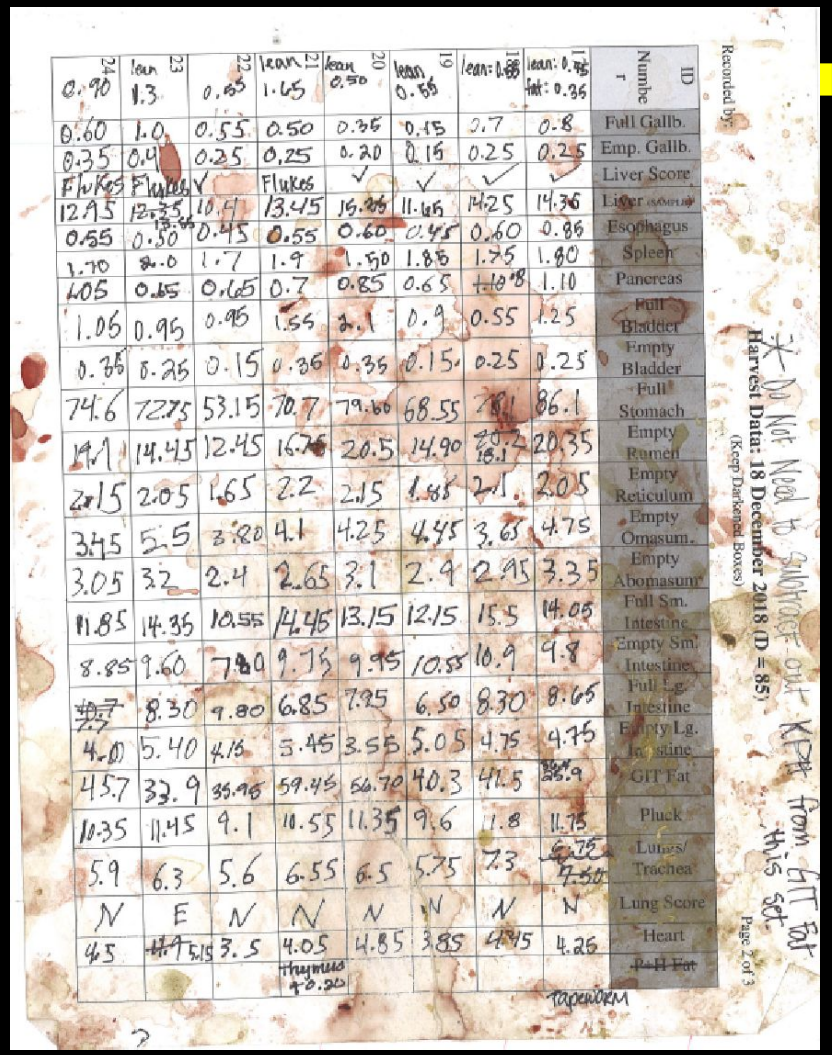


Many hands……



Cactus FEEDERS

Many



ID Number	24	23	22	21	20	19	18	17
	0.90	lean 1.3	0.55	lean 1.65	lean 0.50	lean 0.55	lean: 0.55	lean: 0.45 fat: 0.35
Full Gallb.	0.60	1.0	0.55	0.50	0.35	0.15	0.7	0.8
Emp. Gallb.	0.35	0.4	0.25	0.25	0.20	0.15	0.25	0.25
Liver Score	Flukes	Flukes	✓	Flukes	✓	✓	✓	✓
Liver (SAMPLE)	12.95	~~12.35~~ 13.55	10.4	13.45	15.35	11.65	14.25	14.36
Esophagus	0.55	0.50	0.45	0.55	0.60	0.45	0.60	0.85
Spleen	1.70	2.0	1.7	1.9	1.50	1.85	1.75	1.80
Pancreas	1.05	0.65	0.65	0.7	0.85	0.65	~~1.10~~ 1.8	1.10
Full Bladder	1.05	0.95	0.95	1.55	2.1	0.9	0.55	1.25
Empty Bladder	0.35	0.25	0.15	0.35	0.35	0.15	0.25	0.25
Full Stomach	74.6	72.75	53.15	70.7	79.60	68.55	[illegible]	86.1
Empty Rumen	19.1	14.45	12.45	16.75	20.5	14.90	~~20.2~~ 18.1	20.35
Empty Reticulum	2.15	2.05	1.65	2.2	2.15	1.85	2.1	2.05
Empty Omasum	3.45	5.5	3.80	4.1	4.25	4.45	3.65	4.75
Empty Abomasum	3.05	3.2	2.4	2.65	3.1	2.9	2.95	3.35
Full Sm. Intestine	11.85	14.35	10.55	14.45	13.15	12.15	15.5	14.05
Empty Sm. Intestine	8.85	9.60	7.80	9.75	9.95	10.55	10.9	9.8
Full Lg. Intestine	~~10.7~~ 7.7	8.30	9.80	6.85	7.95	6.50	8.30	8.65
Empty Lg. Intestine	4.0	5.40	4.15	5.45	3.55	5.05	4.75	4.75
GIT Fat	45.7	33.9	35.95	59.45	56.70	40.3	41.5	~~36.4~~ 25.9
Pluck	10.35	11.45	9.1	10.55	11.35	9.6	11.8	11.75
Lungs/ Trachea	5.9	6.3	5.6	6.55	6.5	5.75	7.3	~~6.75~~ 7.50
Lung Score	N	E	N	N	N	N	N	N
Heart	4.5	~~4.9~~ 5.15	3.5	4.05	4.85	3.85	4.45	4.25
~~P+H Fat~~				thymus +0.20				

Recorded by:

Harvest Data: 18 December 2018 (D = 85)

(Keep Darkened Boxes)

* Do Not Need to subtract out KPH from GIT fat this set

Page 2 of 3

Taperform

Many hands.....

THESERTATIONS

15,596,690 cells of data 8,940 lines of SAS code

Live Animal Procedures

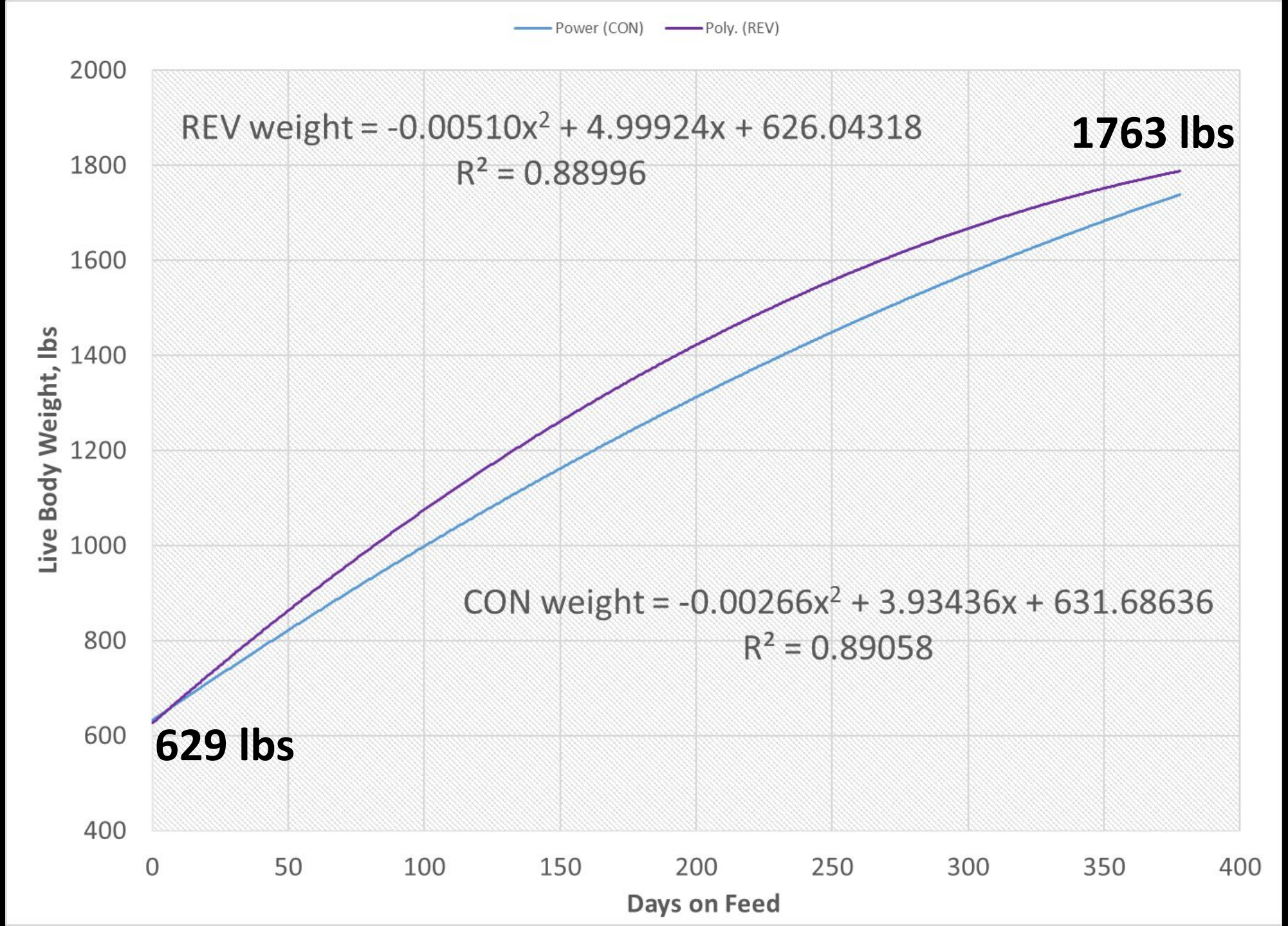
- 120 Charolais x Angus steers
- Weaned on truck (WW = 551 lbs)
- Transported from Grand View, ID to Canyon, TX
- Fed chopped hay, top dressed with starter ration and allowed to acclimate for 24 d to ration and environment

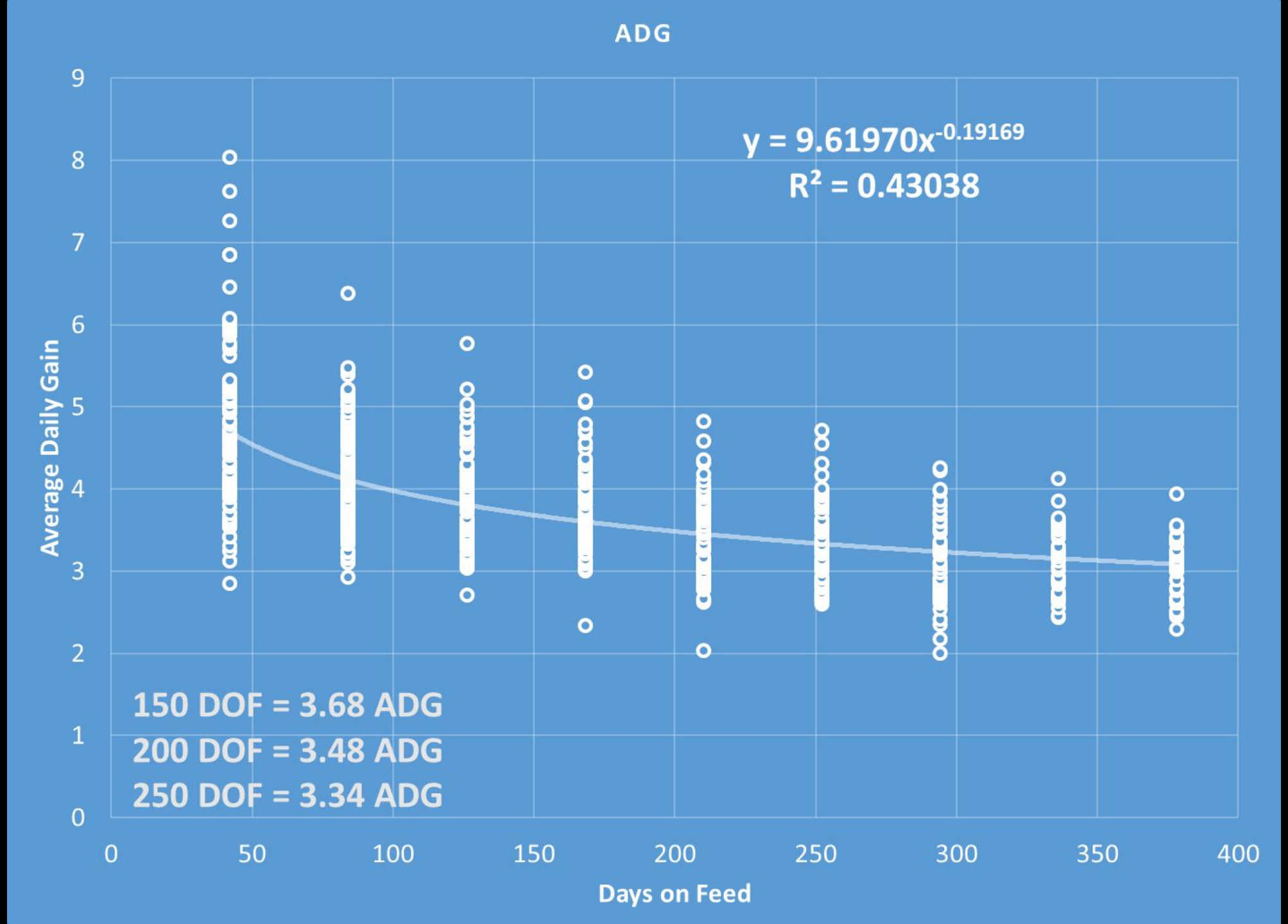
Treatment structure

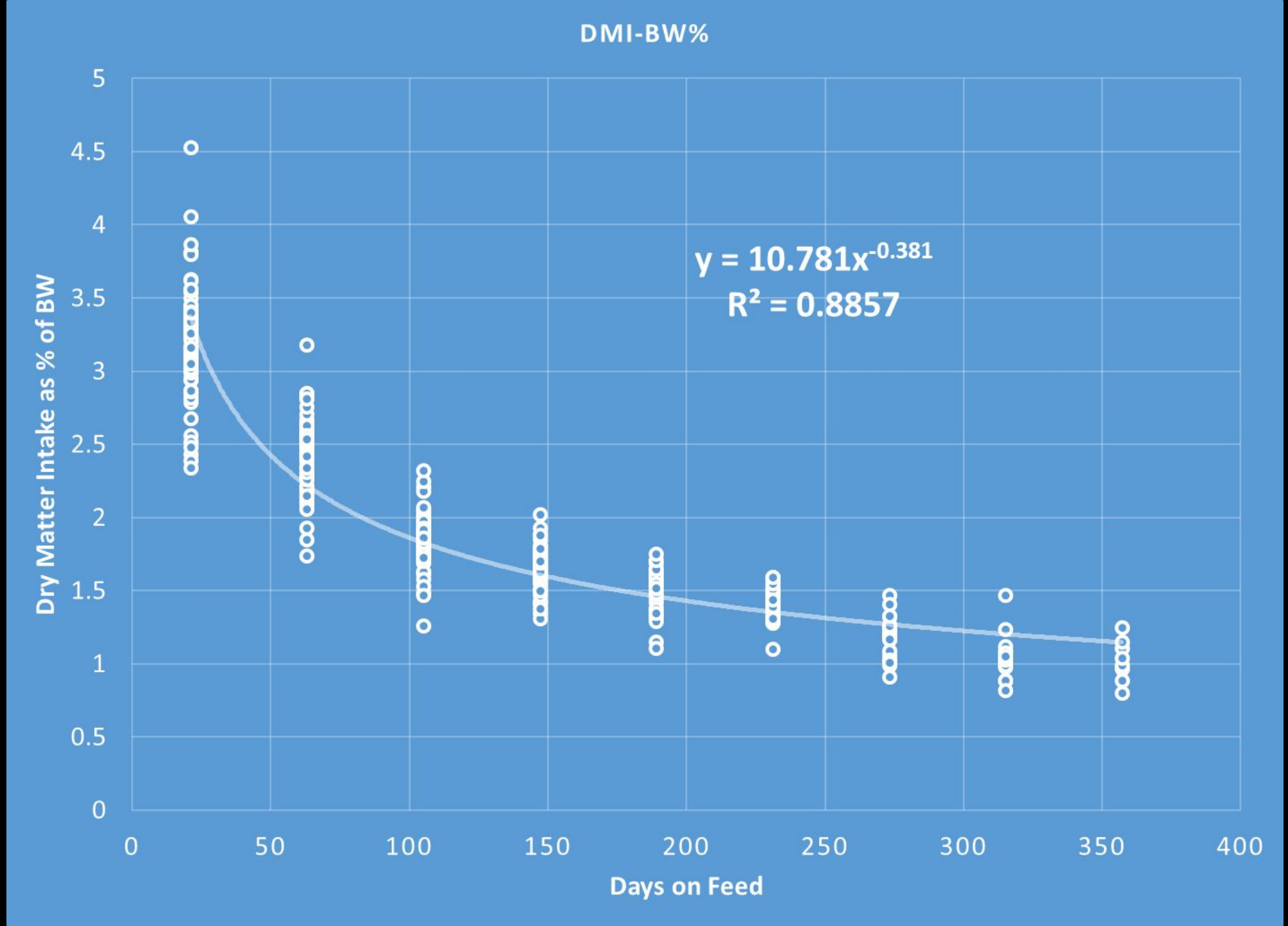
- Steers were paired using phenotype and genotype; within each pair, a steer was randomly allocated to one of two treatments:

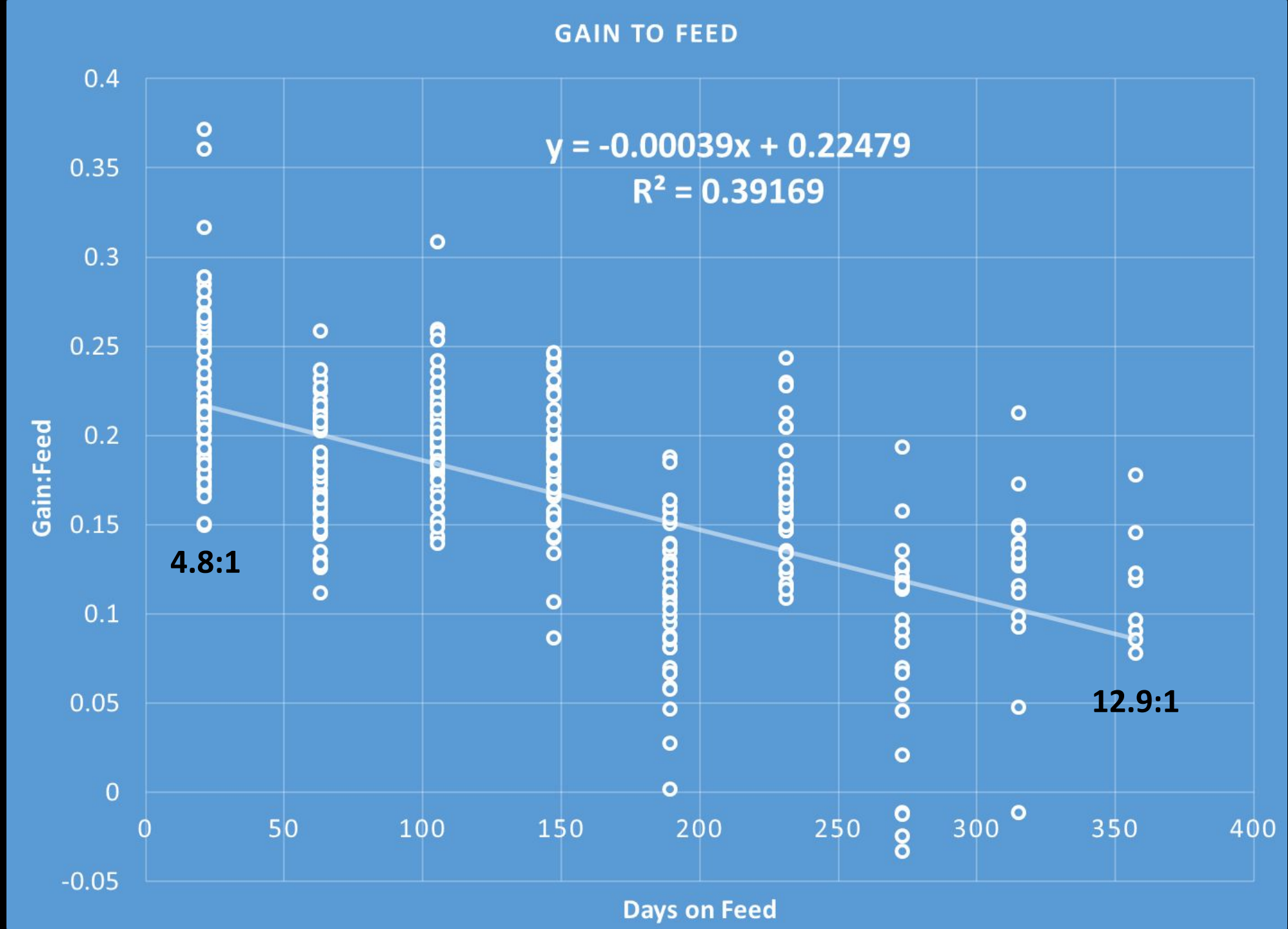
1. **Revalor-XS**
2. **Non-implanted control**

- Eighty steers were utilized for this study (40 CON and 40 REV)
- Remaining 40 steers were used in reserve to compensate for death loss, injury, etc..
- 8 steers comprised of 4 pairs were randomly assigned to 1 of 10 harvest dates
  - d 0 – 42 – 84 – 126 – 168 – 210 – 252 – 294 – 336 – 378 DOF


Power (CON)
Poly. (REV)
REV weight = -0.00510x² + 4.99924x + 626.04318
R² = 0.88996
1763 lbs
CON weight = -0.00266x² + 3.93436x + 631.68636
R² = 0.89058
629 lbs
Live Body Weight, lbs
Days on Feed
2000
1800
1600
1400
1200
1000
800
600
400
0
50
100
150
200
250
300
350
400


ADG
y = 9.61970x^-0.19169
R² = 0.43038
150 DOF = 3.68 ADG
200 DOF = 3.48 ADG
250 DOF = 3.34 ADG
Average Daily Gain
Days on Feed
0
1
2
3
4
5
6
7
8
9
0
50
100
150
200
250
300
350
400


DMI-BW%
Dry Matter Intake as % of BW
Days on Feed
y = 10.781x^-0.381
R² = 0.8857
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
50
100
150
200
250
300
350
400


GAIN TO FEED
y = -0.00039x + 0.22479
R² = 0.39169
Gain:Feed
Days on Feed
4.8:1
12.9:1
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
50
100
150
200
250
300
350
400

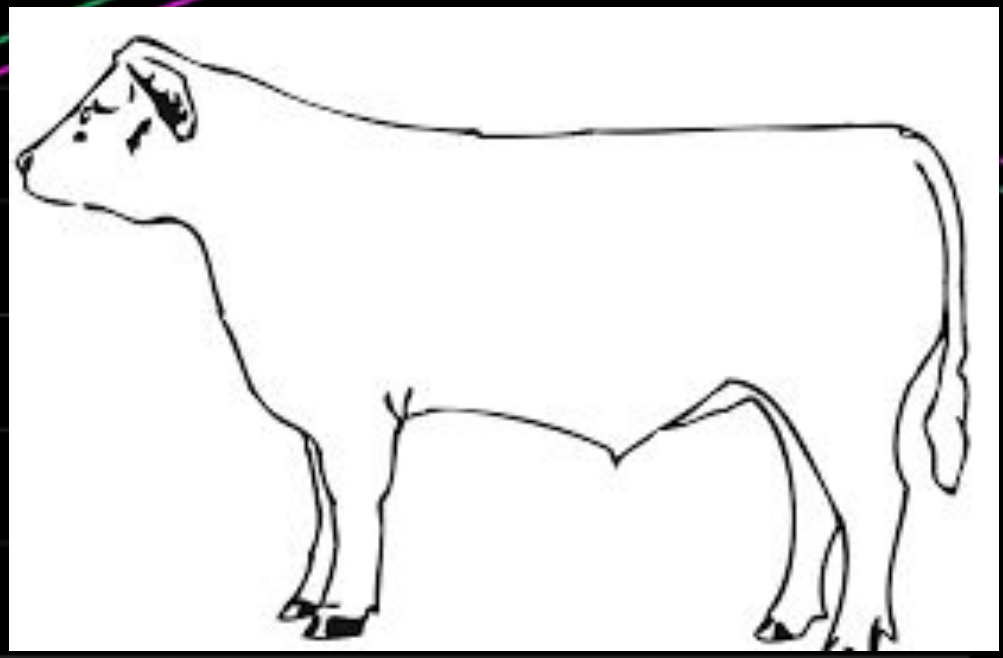
Biometric Measurements

- Collected using a proprietary system from Performance Cattle Company LLC.

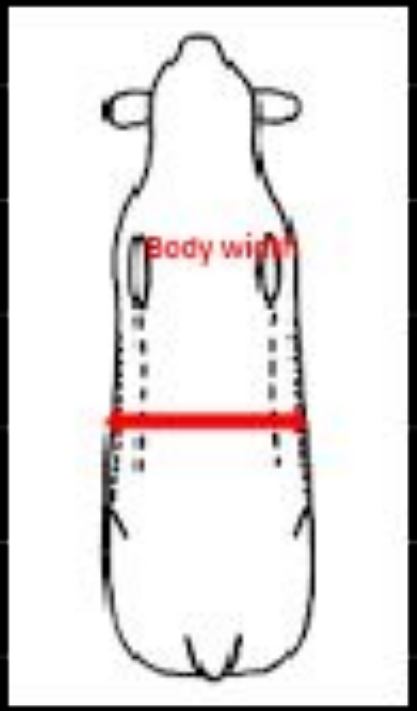
- Attached above working chute with two cable displacement transducers, one in the front area and one in the back area of the chute.
  - Cables linked together with a clevis that serves as the measurement pointer

2/3 Body Length

REV tended to have a 1.25 cm longer ($P = 0.06$) 2/3 BL than CON and increased 1 inch every 23 d



Body Width



REV body width was 0.46 in wider ($P < 0.01$) than CON and increased 1 inch every 74 d

cm

60
58
56
54
52
50
48
46
44
42
40

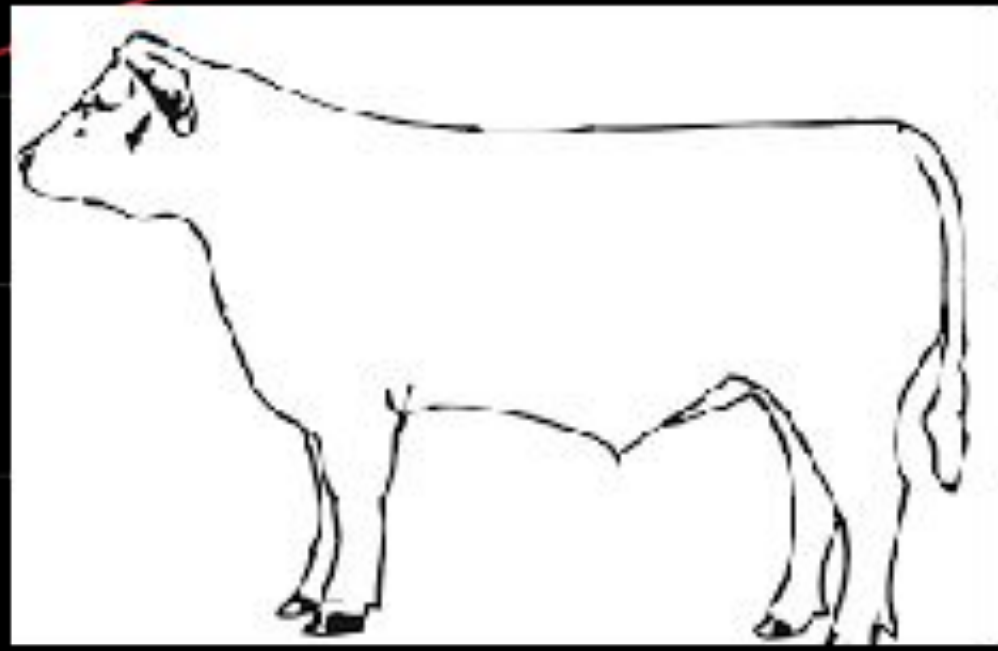
0 42 84 126 168 210 252 294 336 378

DOF

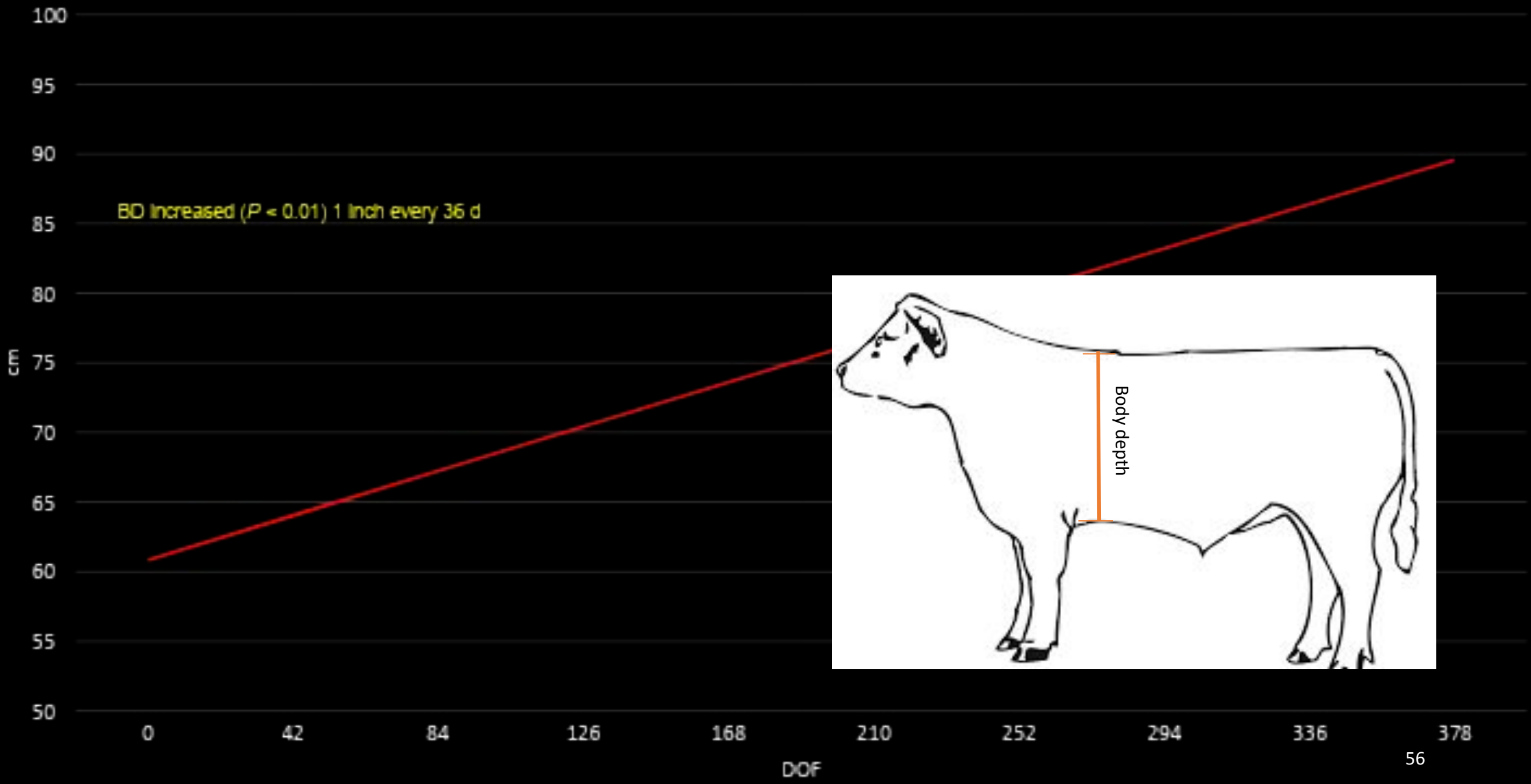
CON
REV
Linear(CON)
Linear(REV)

Hip Height

HH increased ($P < 0.01$) 1 inch every 51 d



Body Depth


100
95
90
85
80
75
70
65
60
55
50
cm
BD increased (P < 0.01) 1 inch every 36 d
0
42
84
126
168
210
252
294
336
378
DOF

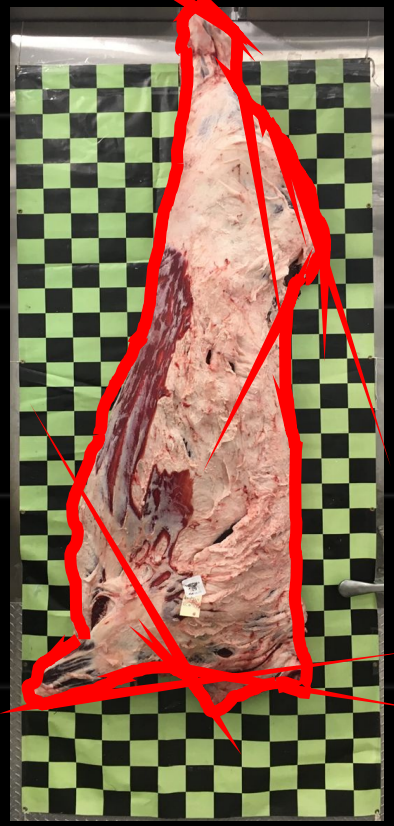
Body depth

Carcass Dimensions

- 48 h after harvest, a digital image was obtained of the lateral aspect of the right side of each carcass
  - Grid containing 390 black and green contrasting squares (100cm^2 each).
  - Maximum length = caudal tip of the hindshank to cranial edge of foreshank.
  - Maximum width = dorsal edge of the crest to ventral edge foreshank

0 42 84 126 168 210 252 294 336 378

Carcass surface area



cm2

18000
16000
14000
12000
10000
8000
6000

0 42 84 126 168 210 252 294 336 378

DOF

CON
REV
Linear(CON)
Linear(REV)

REV carcass area was 4.2% greater (P < 0.01) than CON

Carcass area increased (*P* < 0.01) 3.25 in2/d

Carcass Width

cm

110
105
100
95
90
85
80
75
70
65
60

0 42 84 126 168 210 252 294 336 378

DOF

REV carcass width was 4.5% greater ($P < 0.01$) than CON

Carcass width increased ($P < 0.01$) 1 inch every 36 d

CON
REV
Linear(CON)
Linear(REV)

Carcass Length

Carcass length increased ($P < 0.01$) 1 inch every 15 d

cm

320
300
280
260
240
220
200

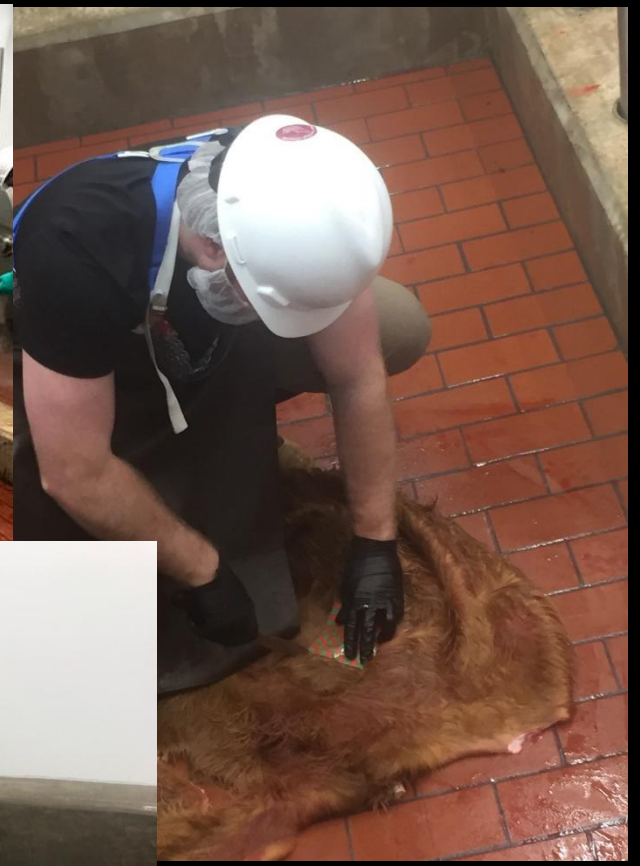
0 42 84 126 168 210 252 294 336 378

DOF

Blood and Hide Sampling

- Immediately during exsanguination, a blood sample was collected for chemical analysis.
  - Animal weight was recorded after a 3 min blood drain to determine blood weight

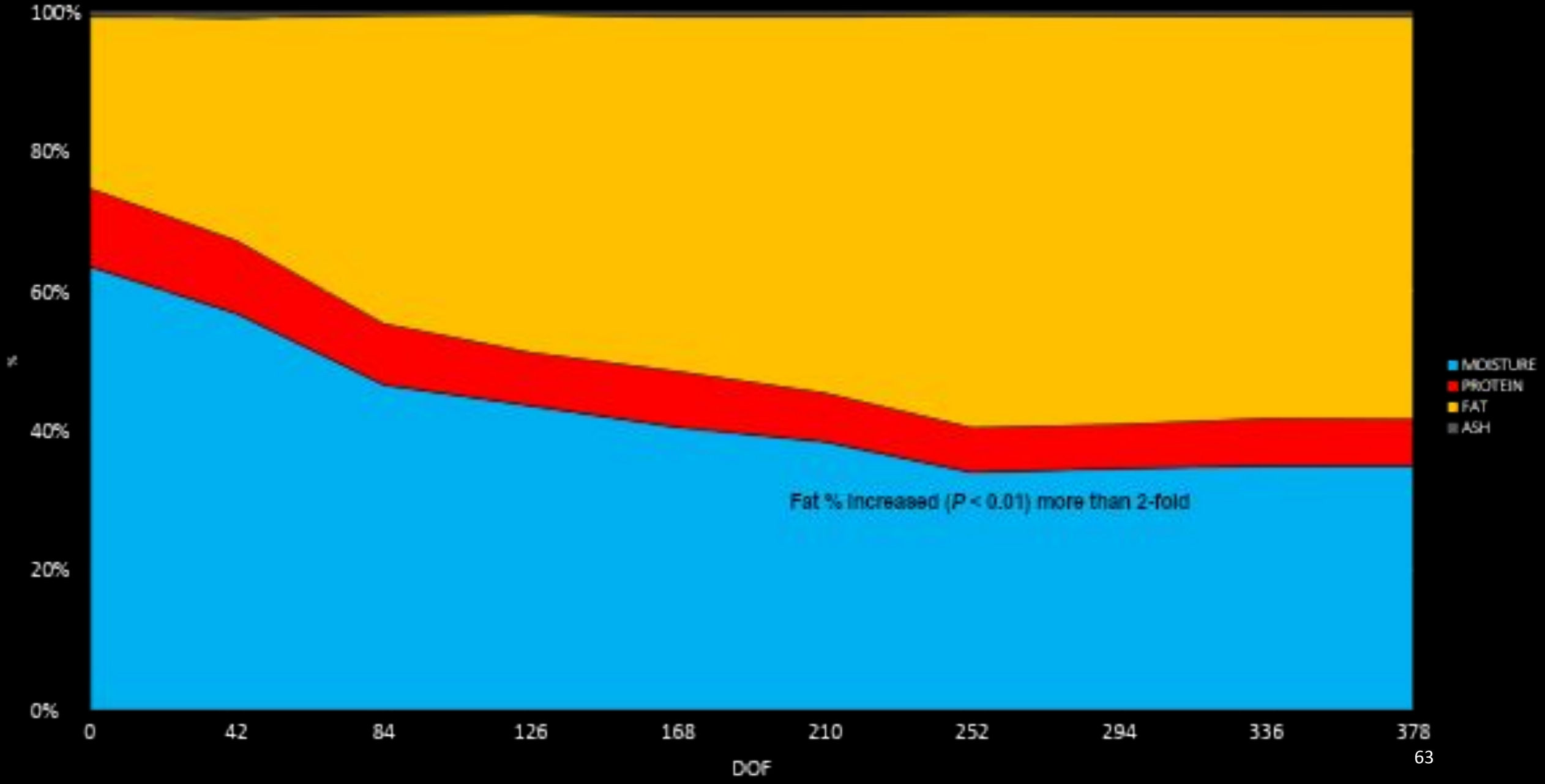
- 100 cm^2 hide sampled 12 cm laterally from the spinal column between the hook and pin.
  - Fat removed from hide and homogenized



Internal Cavity Components Sampling

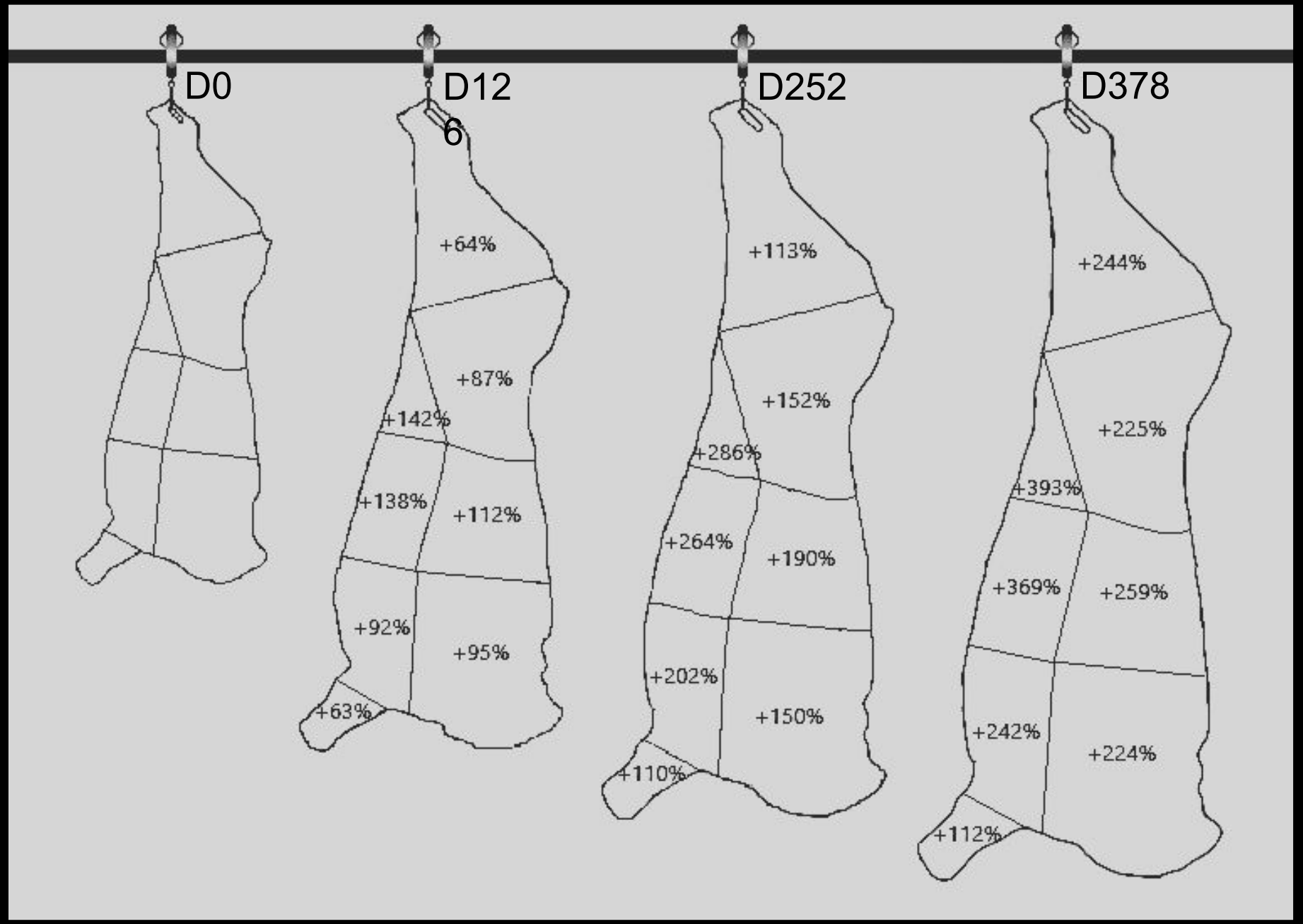
- Internal cavity components (ICC)
  - Kidneys + kidney, pelvic, and heart fat (KPH), and thymus were removed and placed with ICC.
  - ICC separated, weighed full and empty, washed of all contents and digesta, and homogenized.
    - Contents were hand mixed and subsampled in triplicate for each animal

Internal Cavity Composition

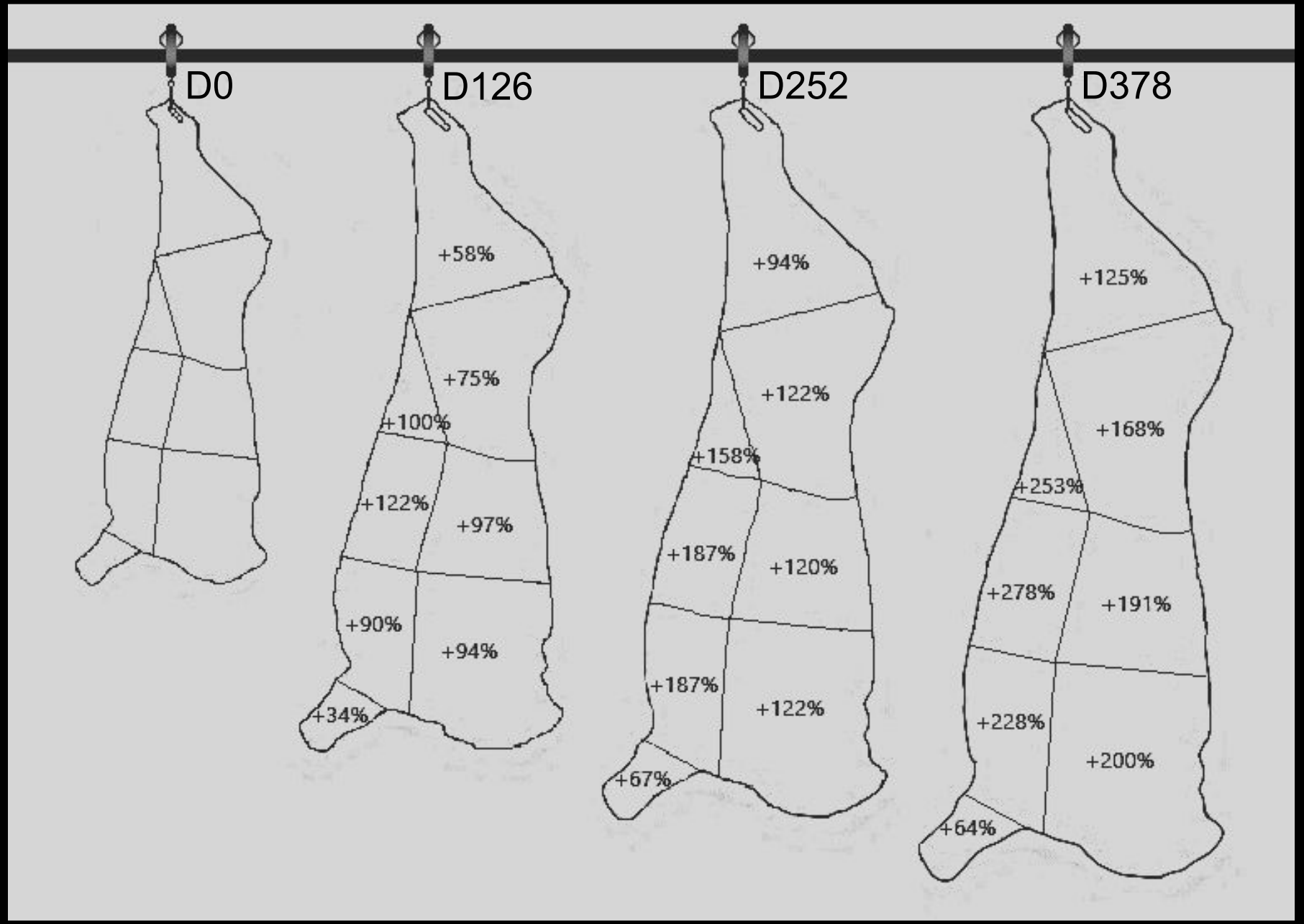


Carcass Soft Tissues Sampling

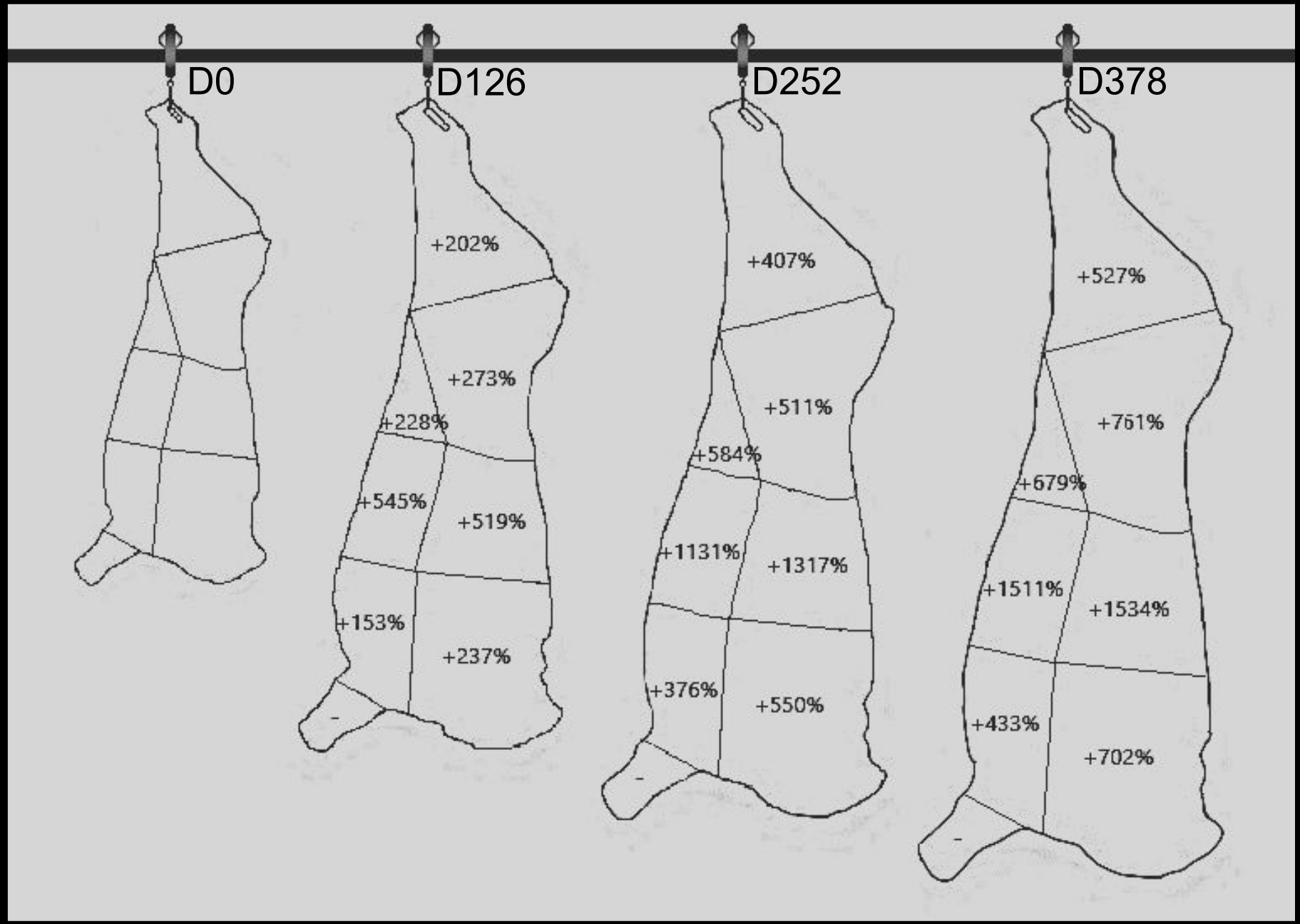
- After 48 hr chill, the right side of each carcass was fabricated
- All carcass soft tissues (CST; lean and fat) were course and fine ground, hand mixed, and subsampled in triplicate for each animal
- Femur and scapula from each side were collected



Percentage change of primal weights from d 0 to d 378



Percentage change of primal lean weights from d 0 to d 378

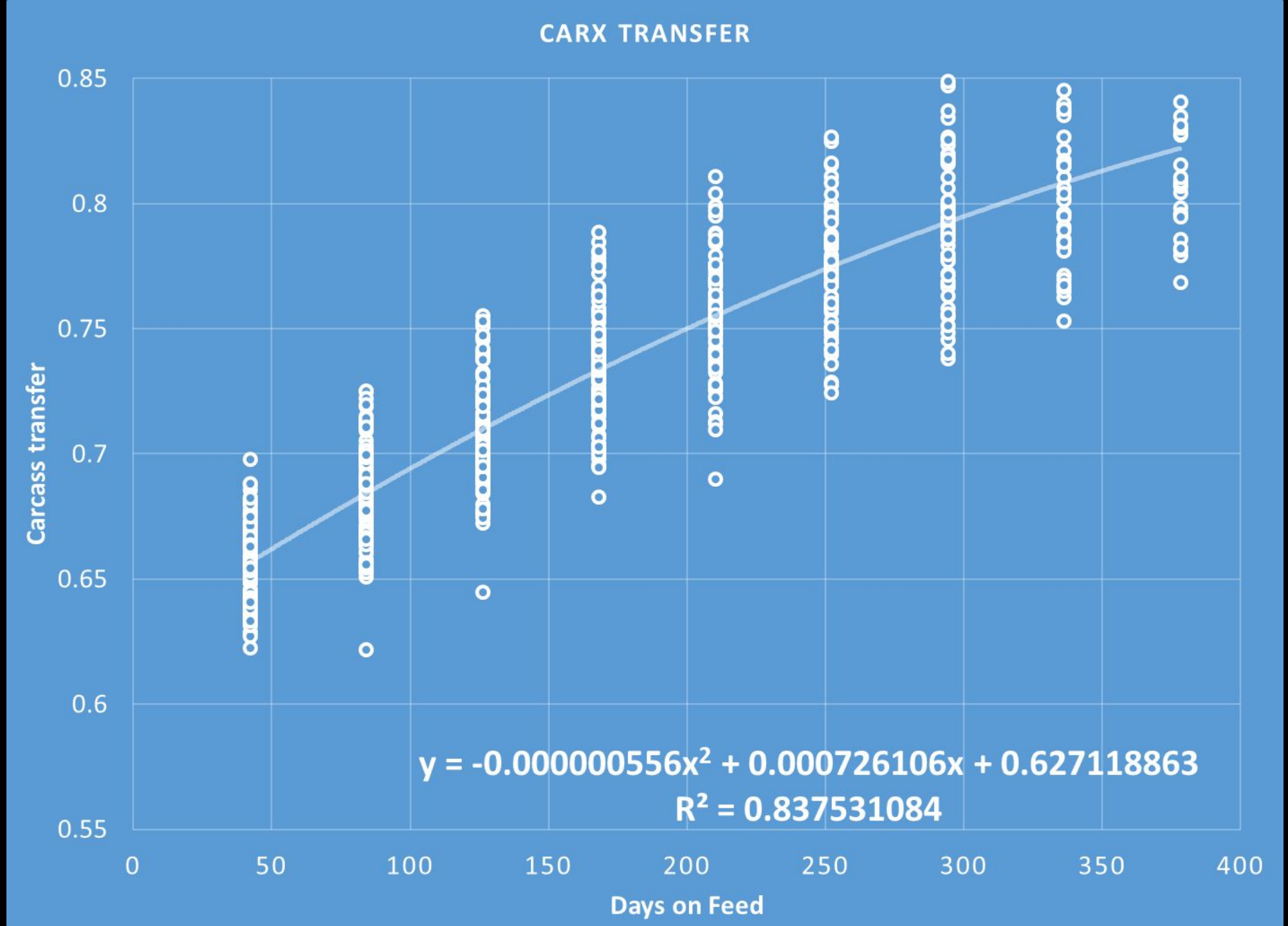


Percentage change of primal fat weights from d 0 to d 378

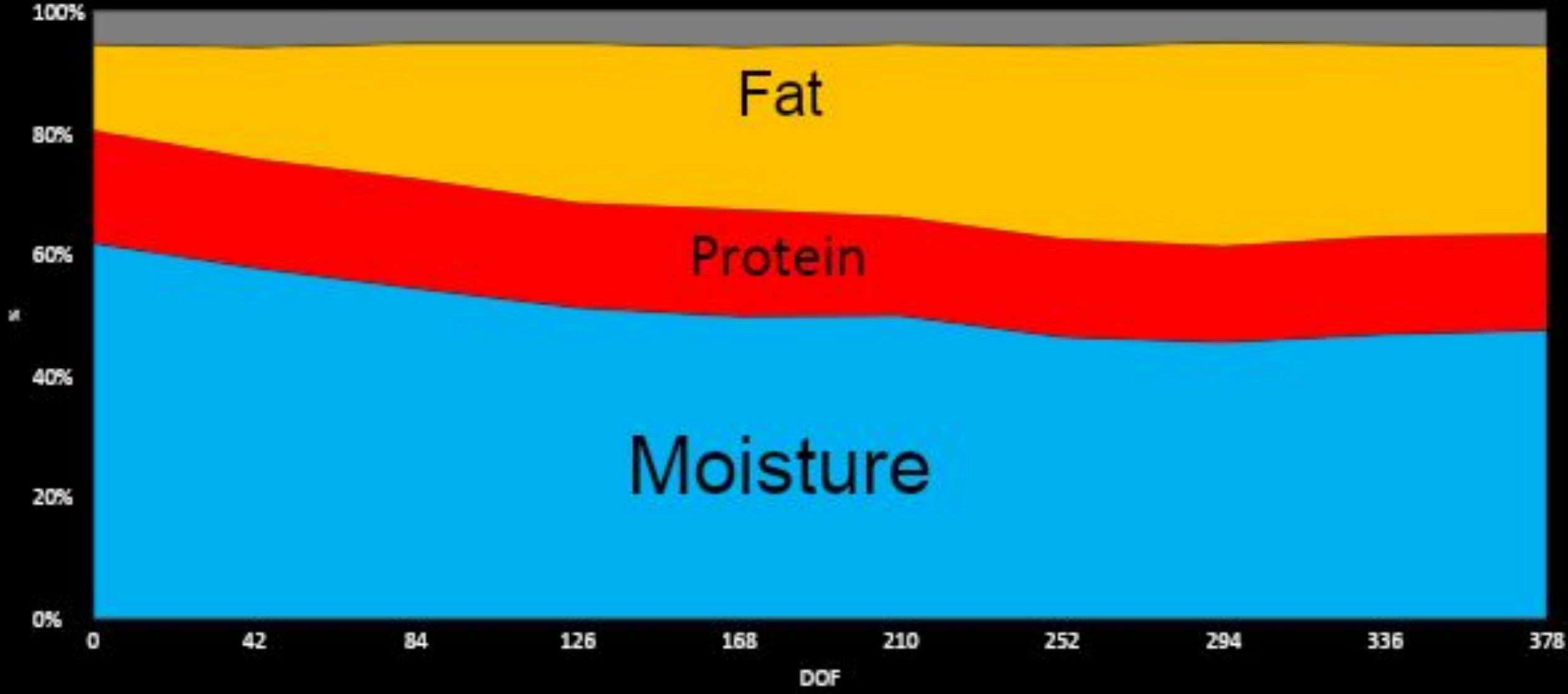
Bone sampling

- Femur and scapula were thawed and cleaned of all lean and fat traces
- Bones were sliced transversely every 1 cm on band saw.
- Entirety of bone “dust” from the blade was collected, handmixed, and sampled for chemical analysis.
- Between each pair of bones, band saw was washed with cold water and dried

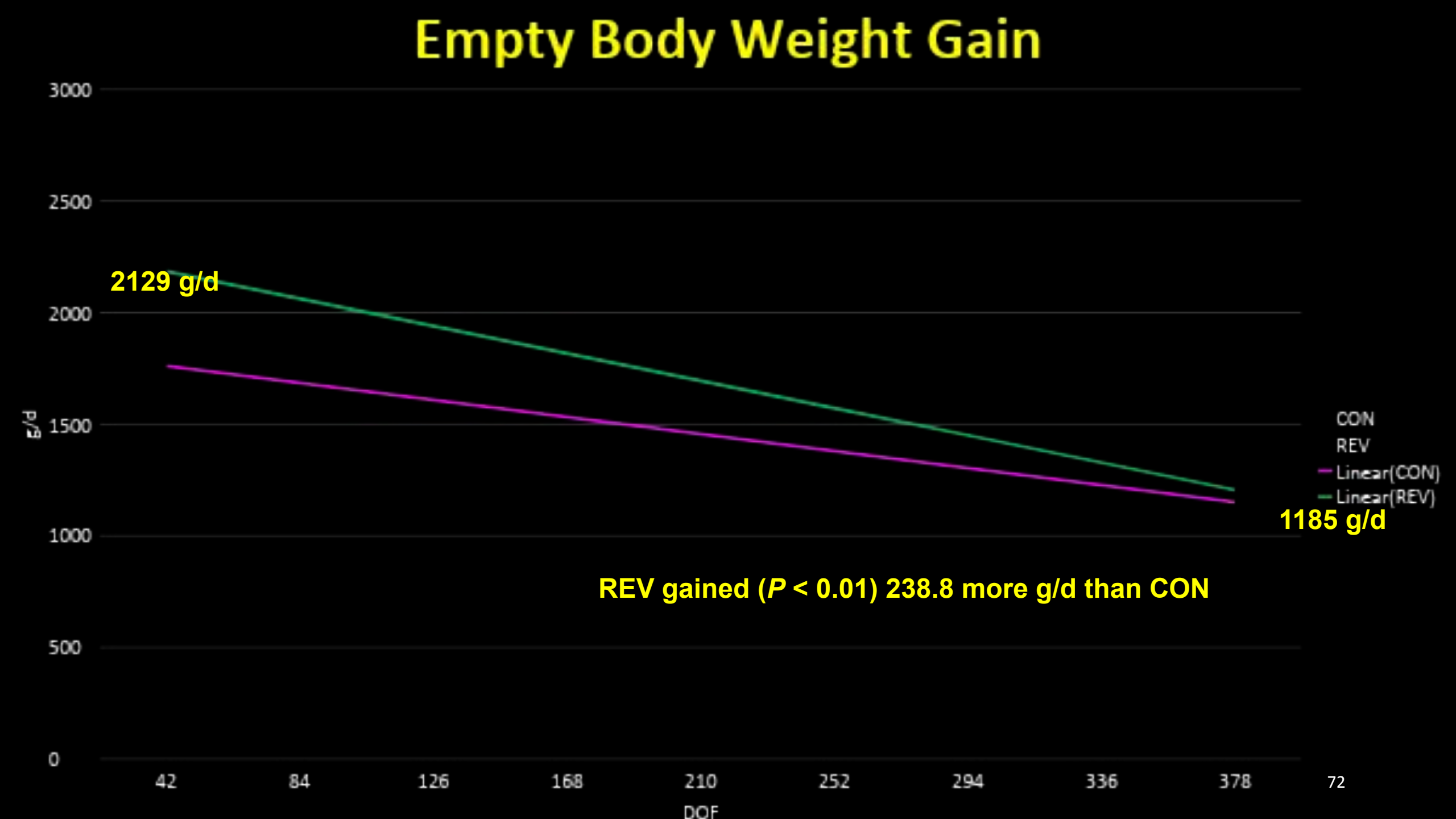
Empty Body Weight
800
700
600
500
400
300
200
100
0
lbs
0
42
84
126
168
210
252
294
336
378
DOF
1608 lbs
533 lbs
REV was 61 lb heavier (P < 0.01) than CON
Adding 2.84 pounds per day
CON
REV
Linear(CON)
Linear(REV)


CARX TRANSFER
Carcass transfer
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0
50
100
150
200
250
300
350
400
Days on Feed
y = -0.000000556x² + 0.000726106x + 0.627118863
R² = 0.837531084

Empty Body Percentages



Empty Body Weight Gain

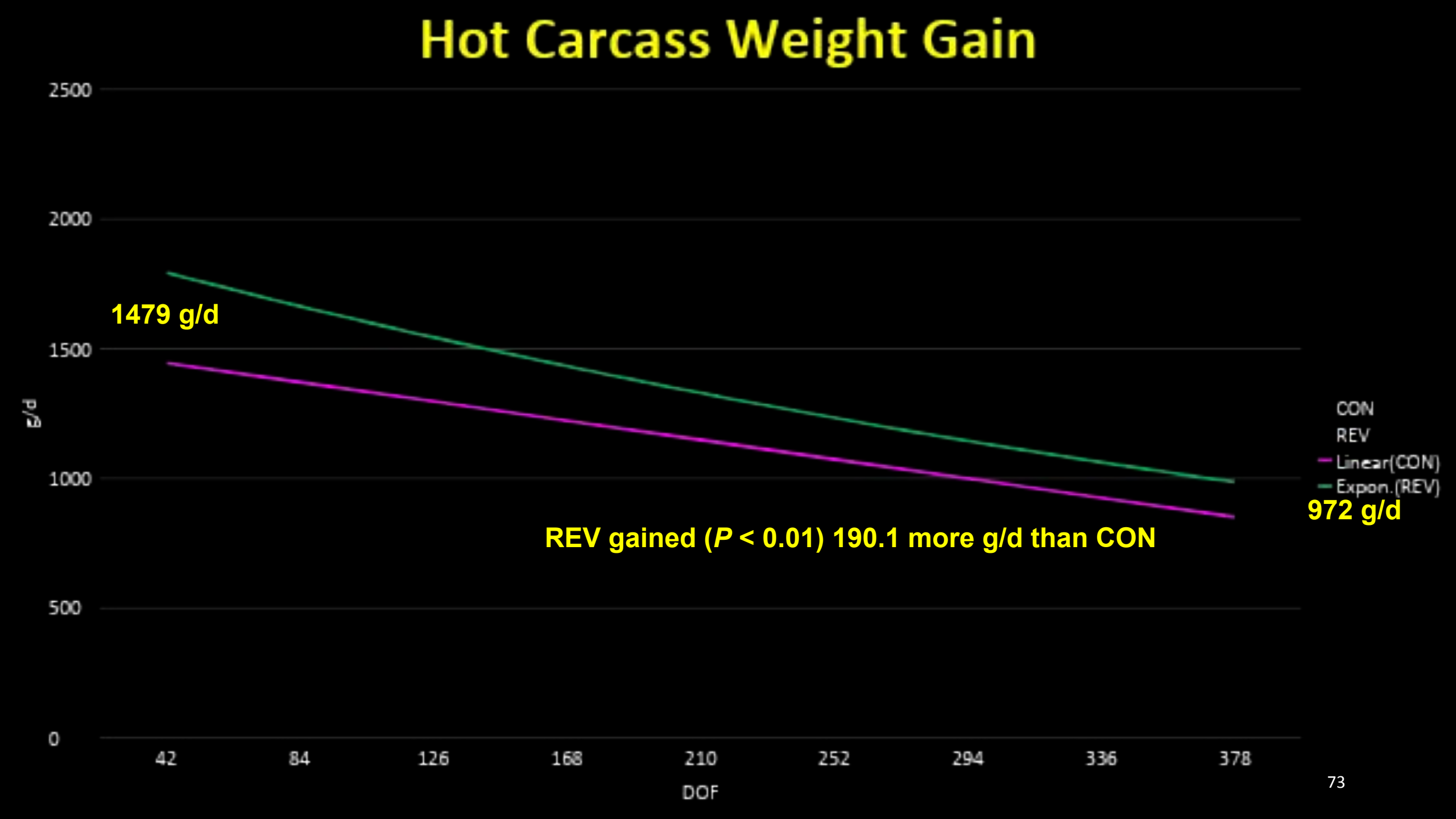


2129 g/d

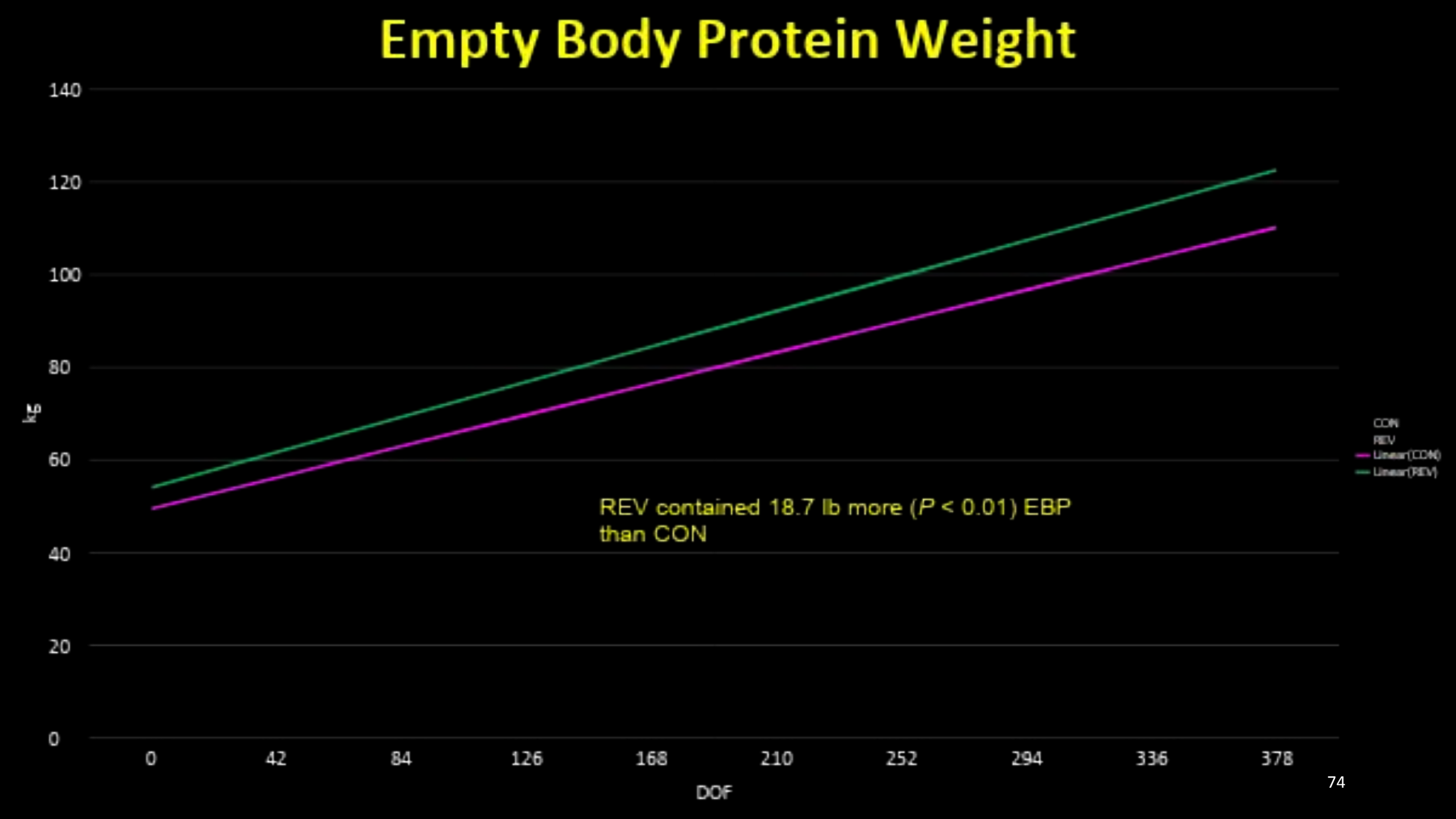
1185 g/d

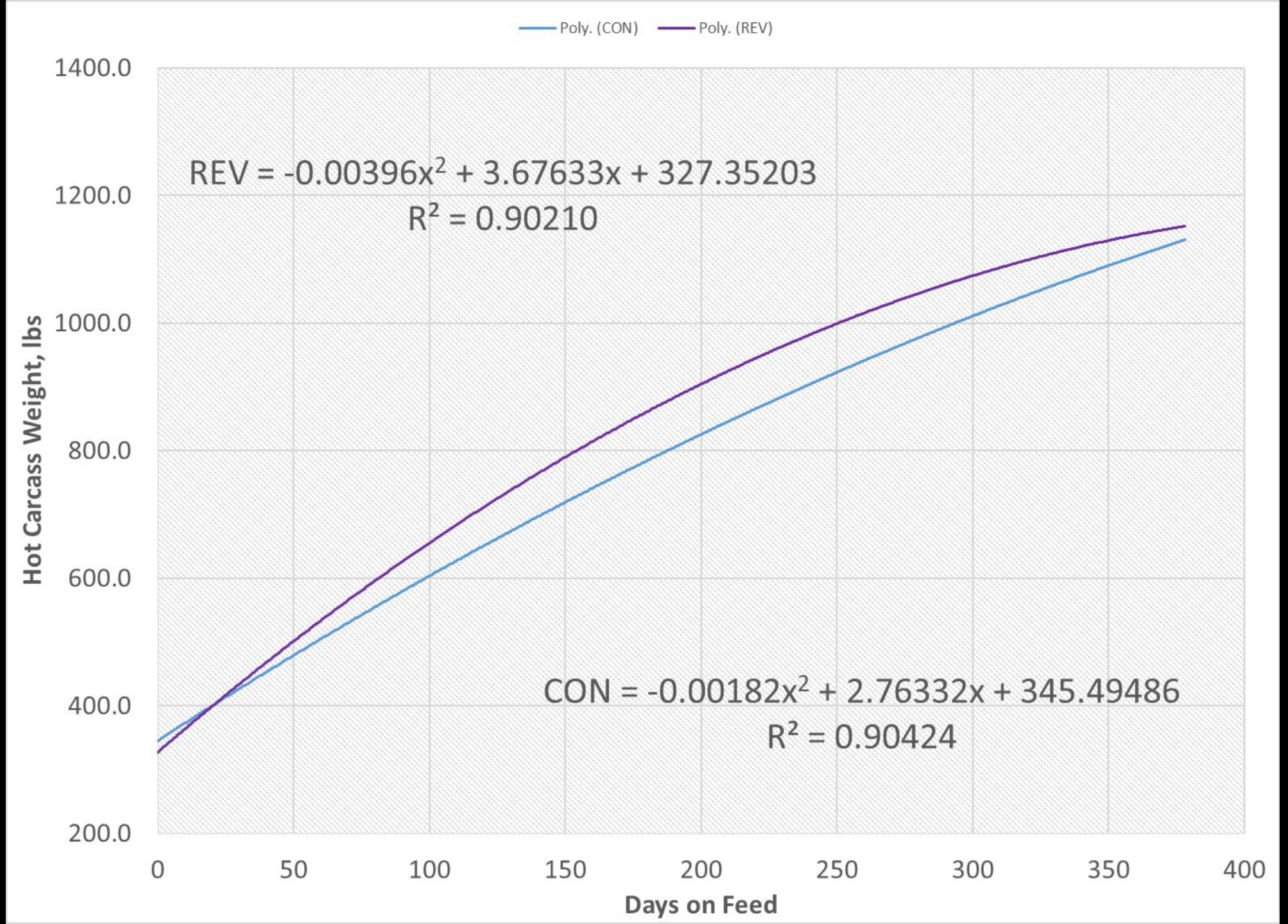
REV gained (*P* < 0.01) 238.8 more g/d than CON

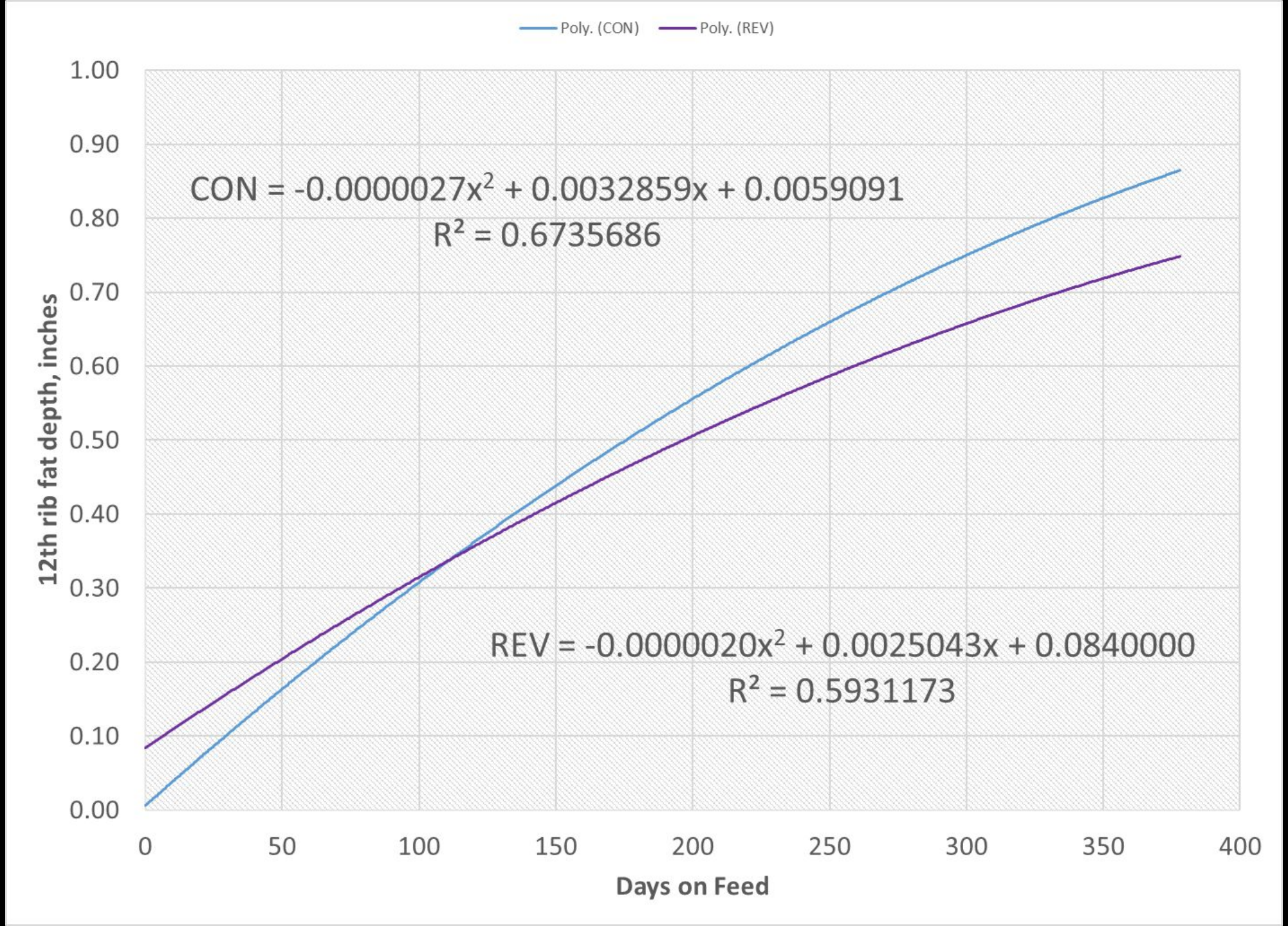
Hot Carcass Weight Gain

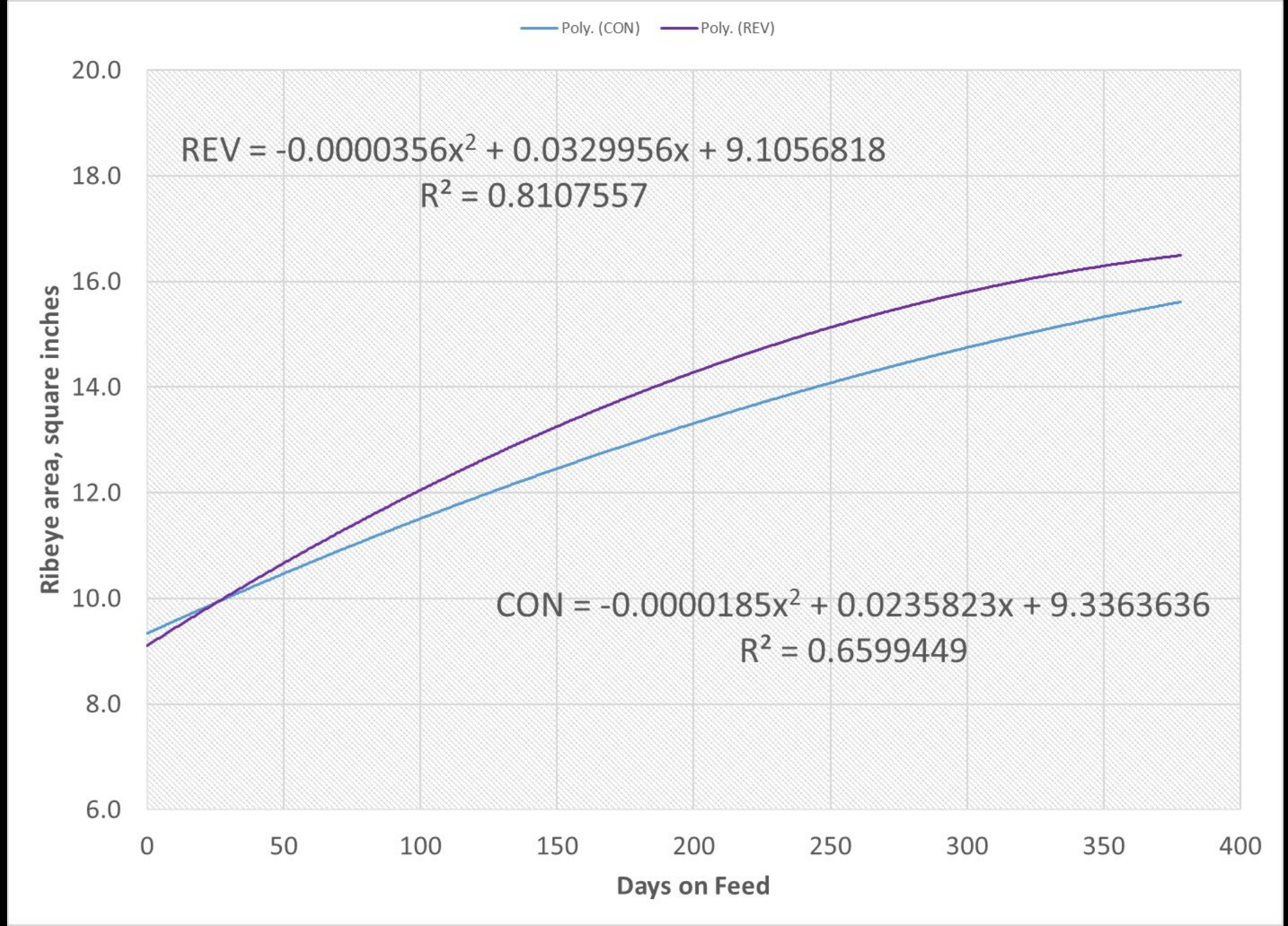


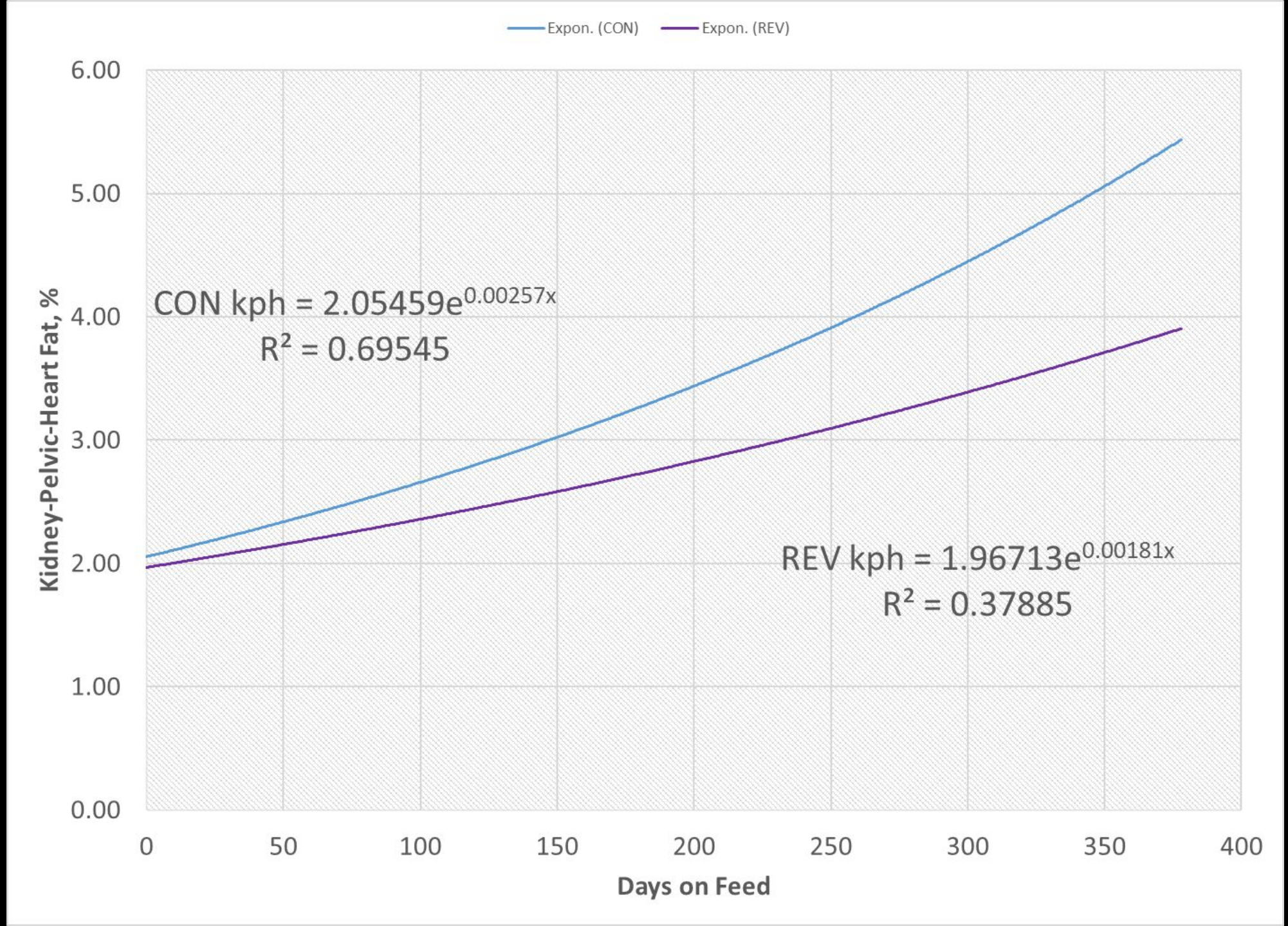
Empty Body Protein Weight

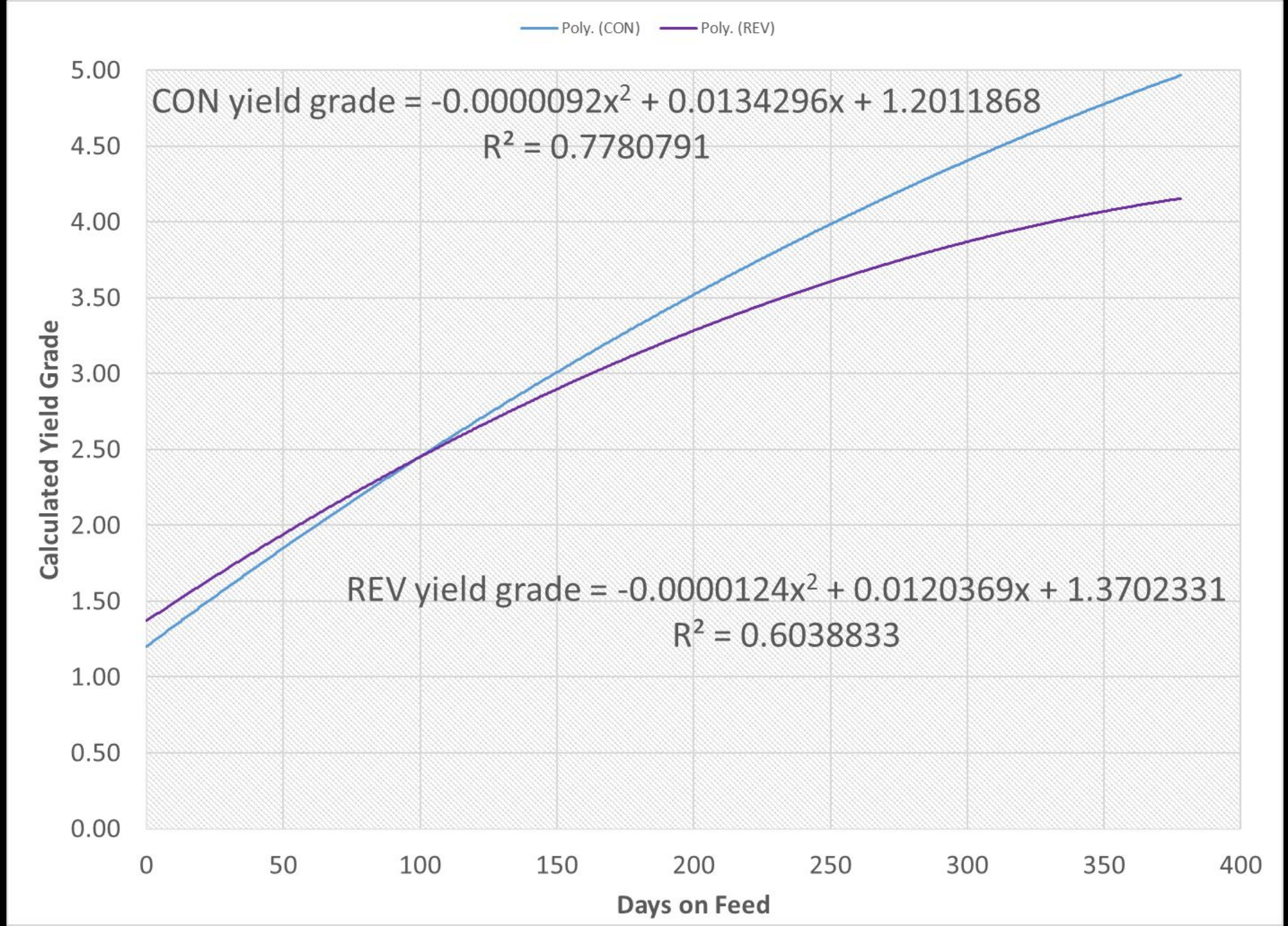


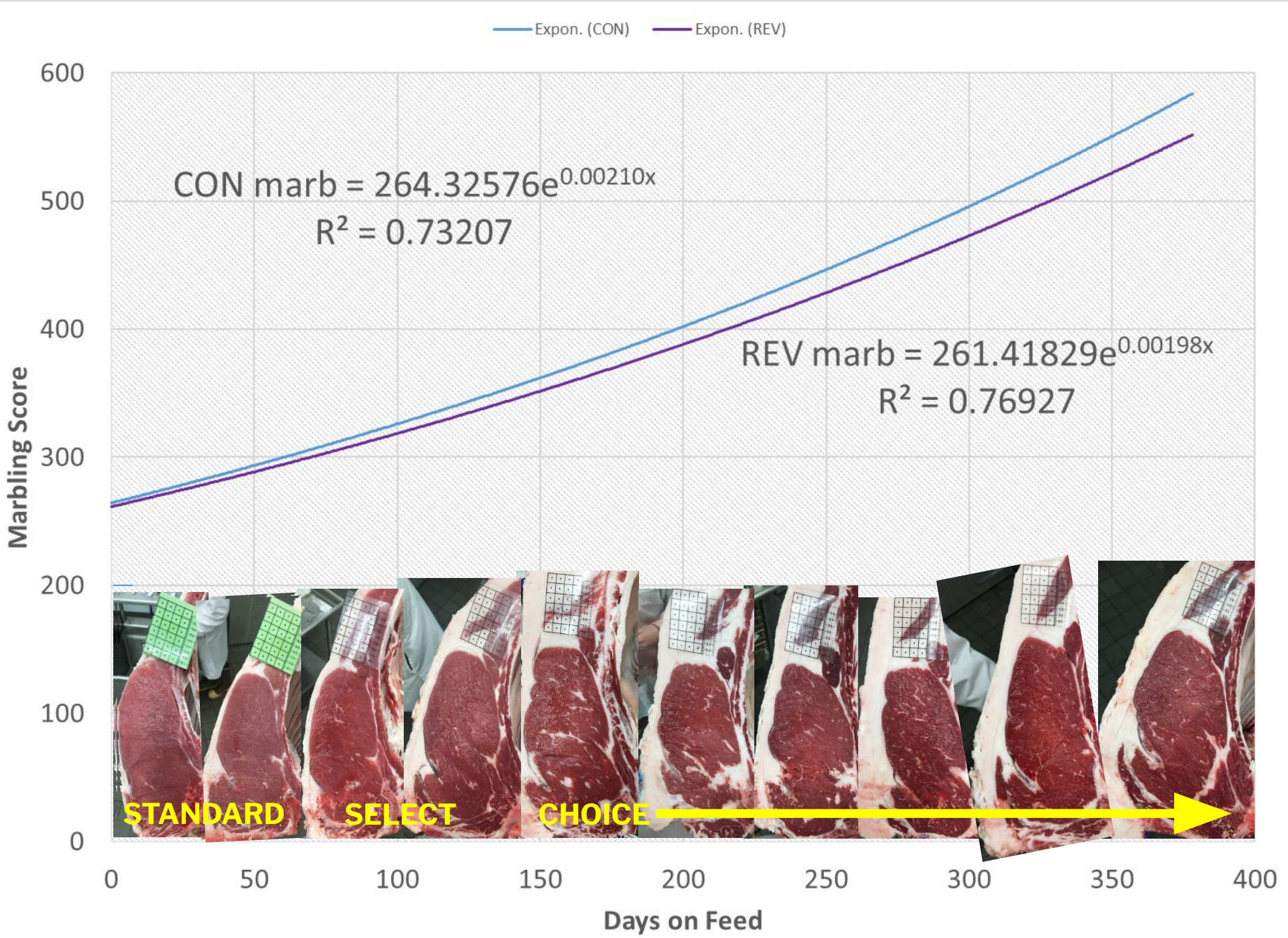

Poly. (CON)
Poly. (REV)
REV = -0.00396x² + 3.67633x + 327.35203
R² = 0.90210
CON = -0.00182x² + 2.76332x + 345.49486
R² = 0.90424
Hot Carcass Weight, lbs
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0
50
100
150
200
250
300
350
400
Days on Feed

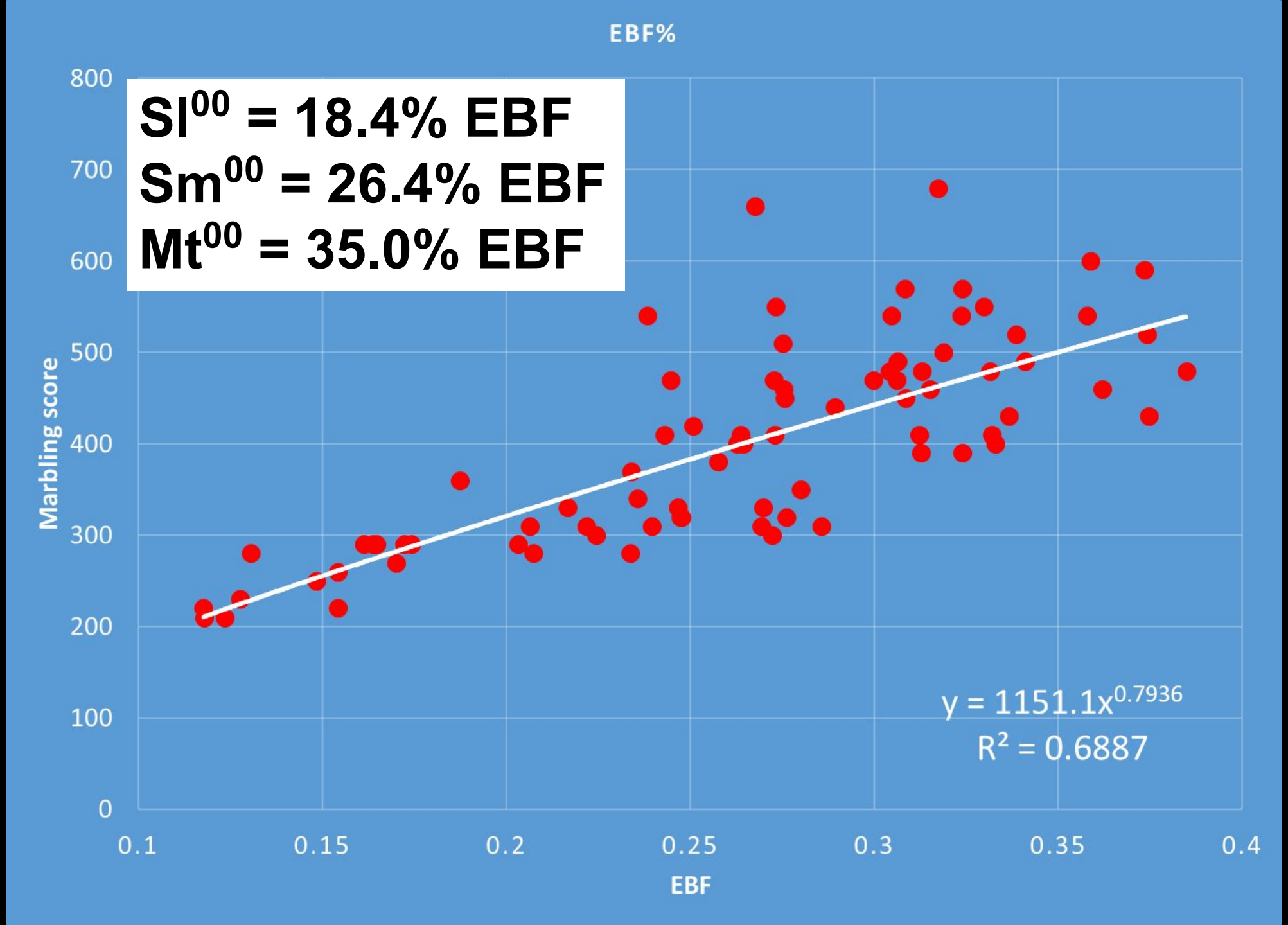

Poly. (CON)
Poly. (REV)
CON = -0.0000027x² + 0.0032859x + 0.0059091
R² = 0.6735686
REV = -0.0000020x² + 0.0025043x + 0.0840000
R² = 0.5931173
12th rib fat depth, inches
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
50
100
150
200
250
300
350
400
Days on Feed

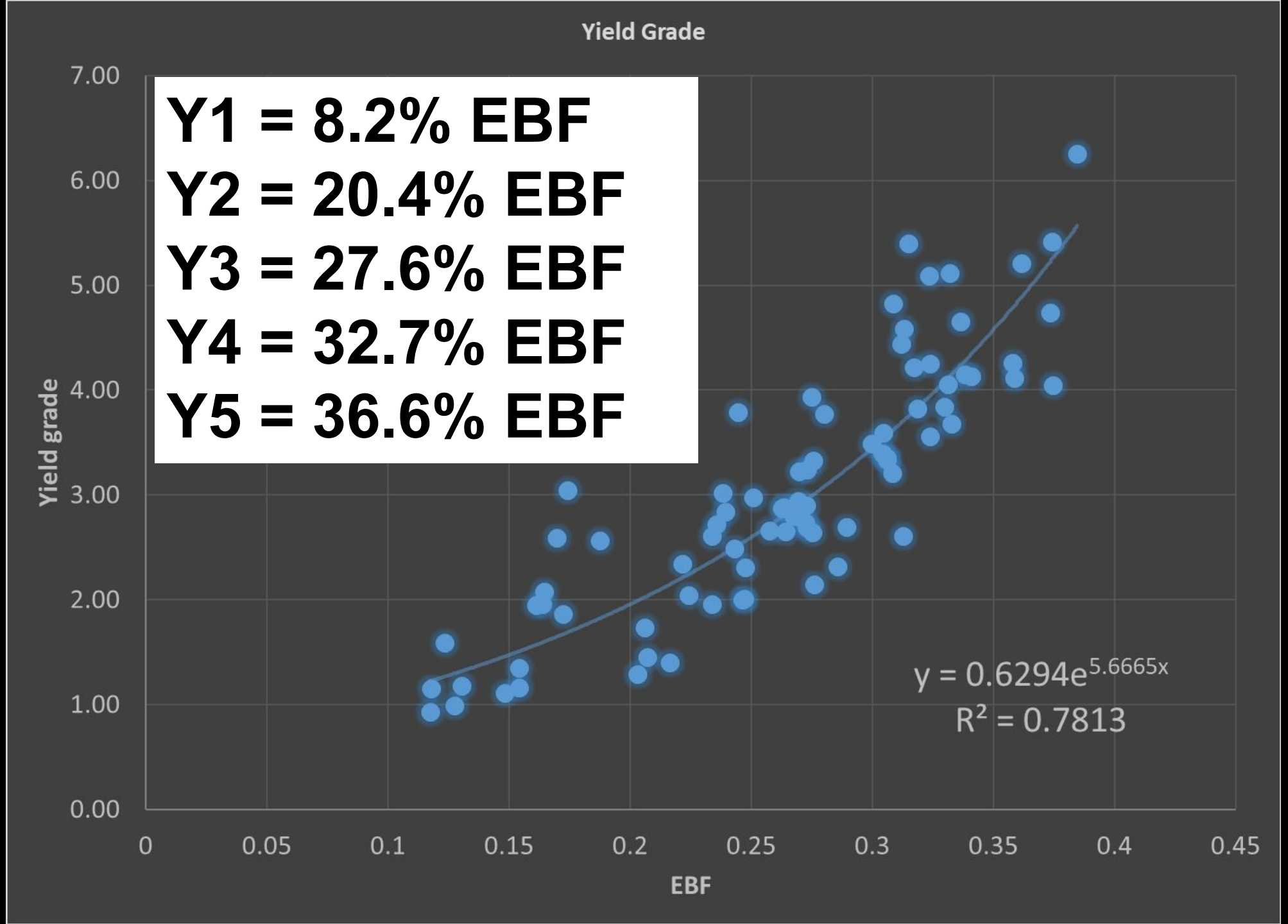

Poly. (CON)
Poly. (REV)
REV = -0.0000356x² + 0.0329956x + 9.1056818
R² = 0.8107557
CON = -0.0000185x² + 0.0235823x + 9.3363636
R² = 0.6599449
Ribeye area, square inches
Days on Feed
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
0
50
100
150
200
250
300
350
400


Expon. (CON)
Expon. (REV)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Kidney-Pelvic-Heart Fat, %
CON kph = 2.05459e0.00257x
R² = 0.69545
REV kph = 1.96713e0.00181x
R² = 0.37885
0
50
100
150
200
250
300
350
400
Days on Feed


Poly. (CON)
Poly. (REV)
CON yield grade = -0.0000092x² + 0.0134296x + 1.2011868
R² = 0.7780791
REV yield grade = -0.0000124x² + 0.0120369x + 1.3702331
R² = 0.6038833
Calculated Yield Grade
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
50
100
150
200
250
300
350
400
Days on Feed


Expon. (CON)
Expon. (REV)
600
500
400
300
200
100
0
Marbling Score
CON marb = 264.32576e^0.00210x
R² = 0.73207
REV marb = 261.41829e^0.00198x
R² = 0.76927
STANDARD
SELECT
CHOICE
0
50
100
150
200
250
300
350
400
Days on Feed


EBF%
800
700
600
500
400
300
200
100
0
Marbling score
0.1
0.15
0.2
0.25
0.3
0.35
0.4
EBF
Sl^{00} = 18.4% EBF
Sm^{00} = 26.4% EBF
Mt^{00} = 35.0% EBF
y = 1151.1x^0.7936
R² = 0.6887


Yield Grade
Y1 = 8.2% EBF
Y2 = 20.4% EBF
Y3 = 27.6% EBF
Y4 = 32.7% EBF
Y5 = 36.6% EBF
Yield grade
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
EBF
y = 0.6294e5.6665x
R² = 0.7813

Questions

For More Information

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