Heifer Growth, Nutrient Requirements and Nutritional Management

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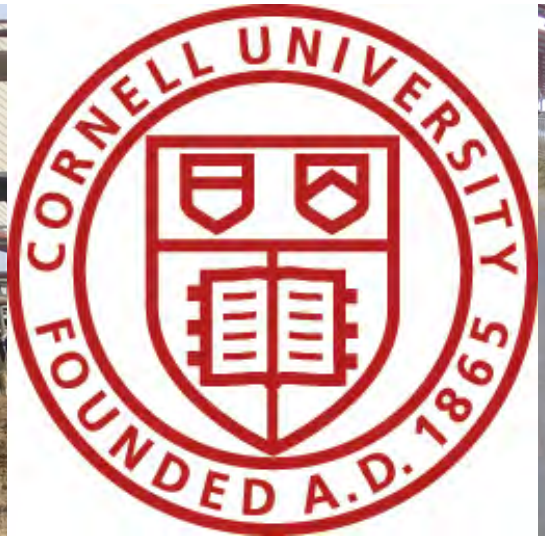


Overview of today's discussion

- Identifying disruptors…. All the best biology in the world will not overcome a lack of monitoring and feedback of the system
- What are the major management disruptors that impact heifer profitability at the farm level and what is their value?
- Benchmarking
- Inventory
- Age at first calving
- Summary

Growth objectives actualized – Rodrigo and his favorite calf

338 lb @ 91 days

Averaged 2.8 lb per day gain from birth

Herd Replacement Objectives

- Optimize profits by obtaining the highest quality heifer at the lowest possible cost usually in the least amount of time
- Focus on return on investment – over their productive life
- Minimize non-completion (animals that are born and either never milk or finish a lactation)
- Optimize the productivity of the animal over their productive life (manage them for their genetic potential starting at birth)

PRO-DAIRY

Snapshot Evaluation of the Potential Quality of The Replacement

- 1st Calf Heifers "Treated" as Calf/Heifer* ≤30%
  24 hrs. → 3 mos. ____, 4 mos. → fresh ____
- DOAs in first calf heifers ≤7%
  Male DOAs. ____, Female DOAs ____
- 1st Calf lactation total yield ~80% of Mature
- 1st Calf Culls ≤ 60 Days in Milk ≤5%
- 1st Calf ME's ≥Mature
- 1st Calf "Treated" in Lactation* ≤15%
- 85% retention (any herd) to 2nd lactation ≥85%
- Lower #1 reason for 1st lact. culls(continuous improvement)

Growth Benchmarks to Optimize First and Subsequent Lactation Milk Yield

Birth to weaning: double body weight at minimum

Breeding and Pregnancy: 55-65% mature BW

Post-calving BW first lactation: 82 to 85% mature BW
Goal is to achieve 82% of mature size to achieve 80% of mature cow milk yield – minimize nutrient use for growth during lactation

Mature weight determined at middle of 3rd and 4th lactation – 80 to 200 days in milk on healthy cows, not cull cows

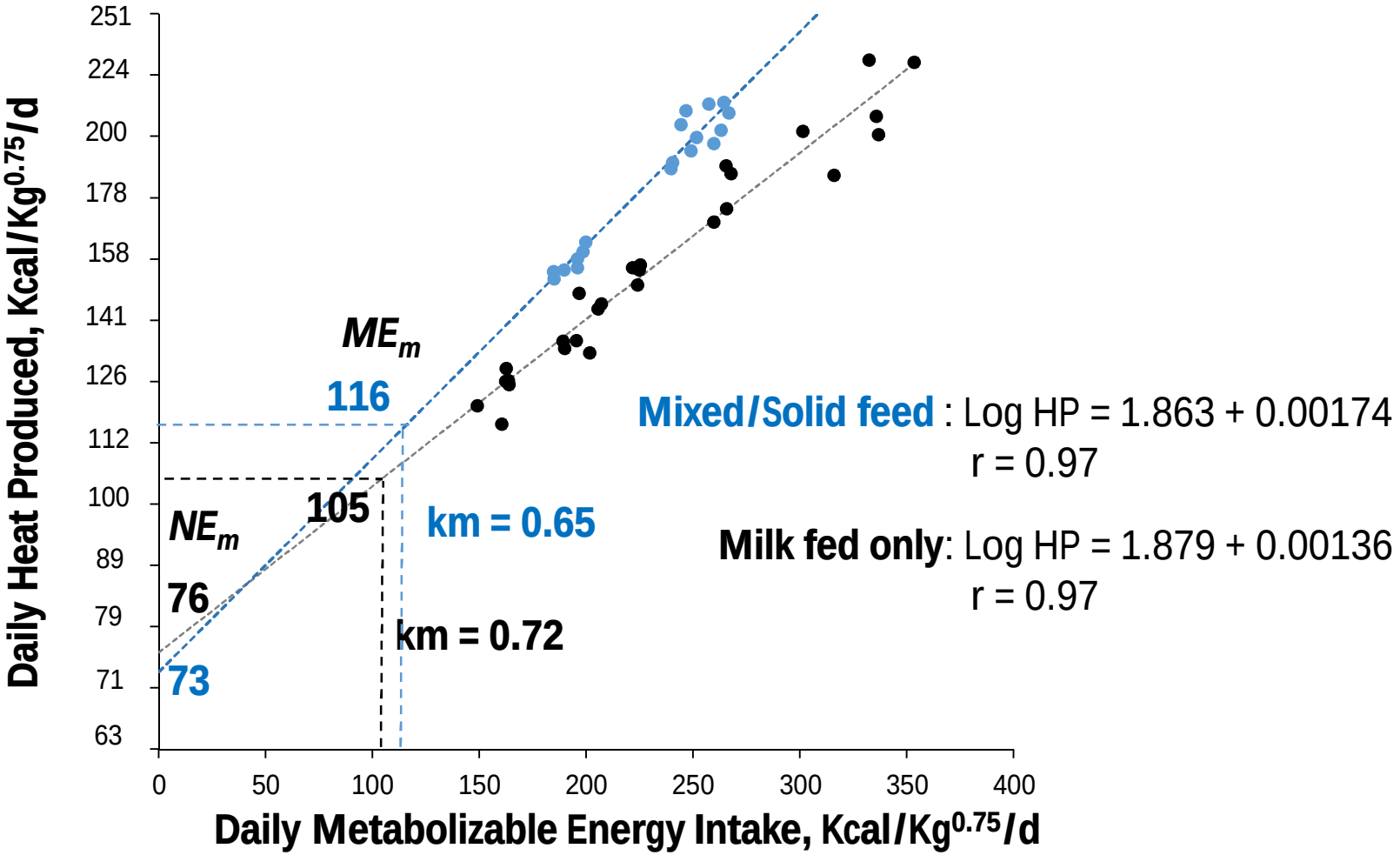
Van Amburgh et al., 1998, 2019; Fox et al., 1999; NRC, 2001

Body Composition Data Sets Available for Use in Evaluation and Model Building

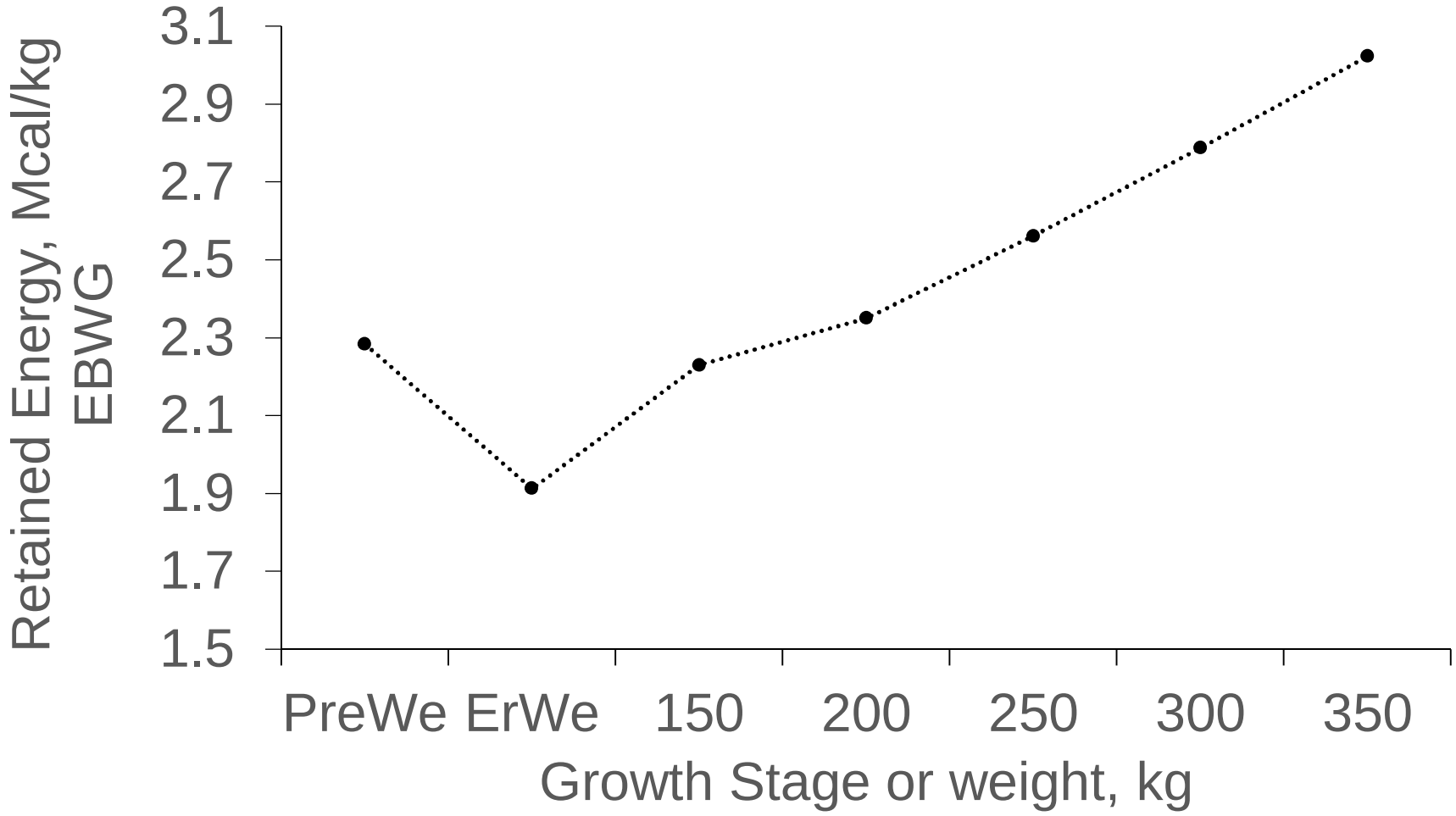
Total of 451 calves and heifers

Study	n	BW range, kg	Titration	Breed
Blome	33	40 - 70	Energy	H
Diaz	60	40 – 105	Energy	H
Tikofsky	30	40 – 85	Fat:Carb	H
Bartlett	48	45 - 60	Energy & Protein	H
Bascom	33	30 - 42	Protein & Fat	J
Mills	36	46 - 88	Fatty acids	H
Stamey	42	40 - 100	Energy & Protein	H (W)
Meyer	78	40 - 350	Energy	H (W)
Smith	27	123 - 320	Fat – CLA vs Sat.	H (W)
Waldo	64	170 - 328	Energy	H (W)

Maintenance Requirements
Holstein EBW basis



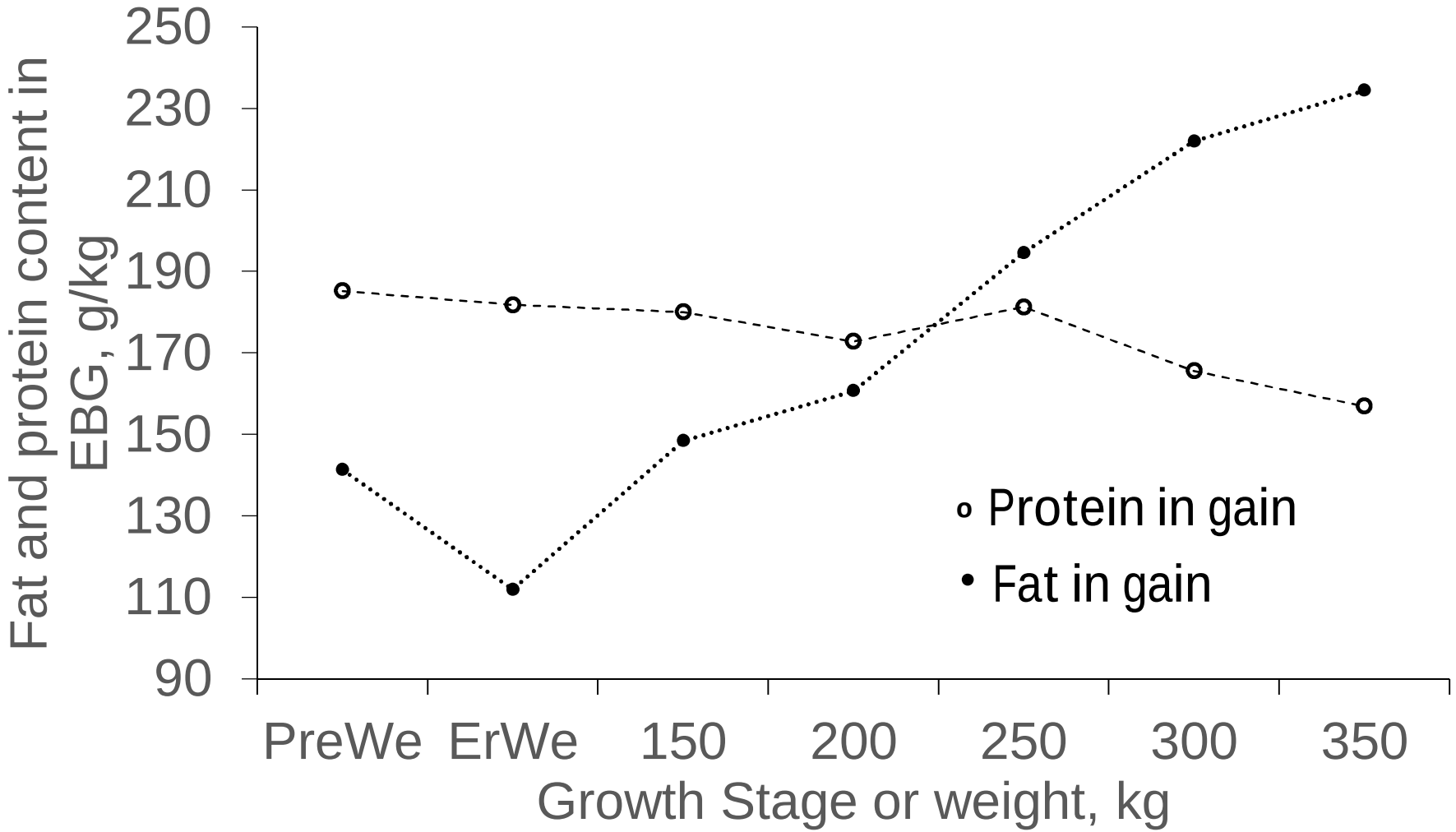
Retained energy in empty body gain during different stages of growth and EBW of dairy heifers.



What does energy and protein requirements look like during development of the GIT?

Have two data sets: Stamey et al
Meyer et al.

Protein and fat contained in empty body gain during different stages and EBW of dairy heifers

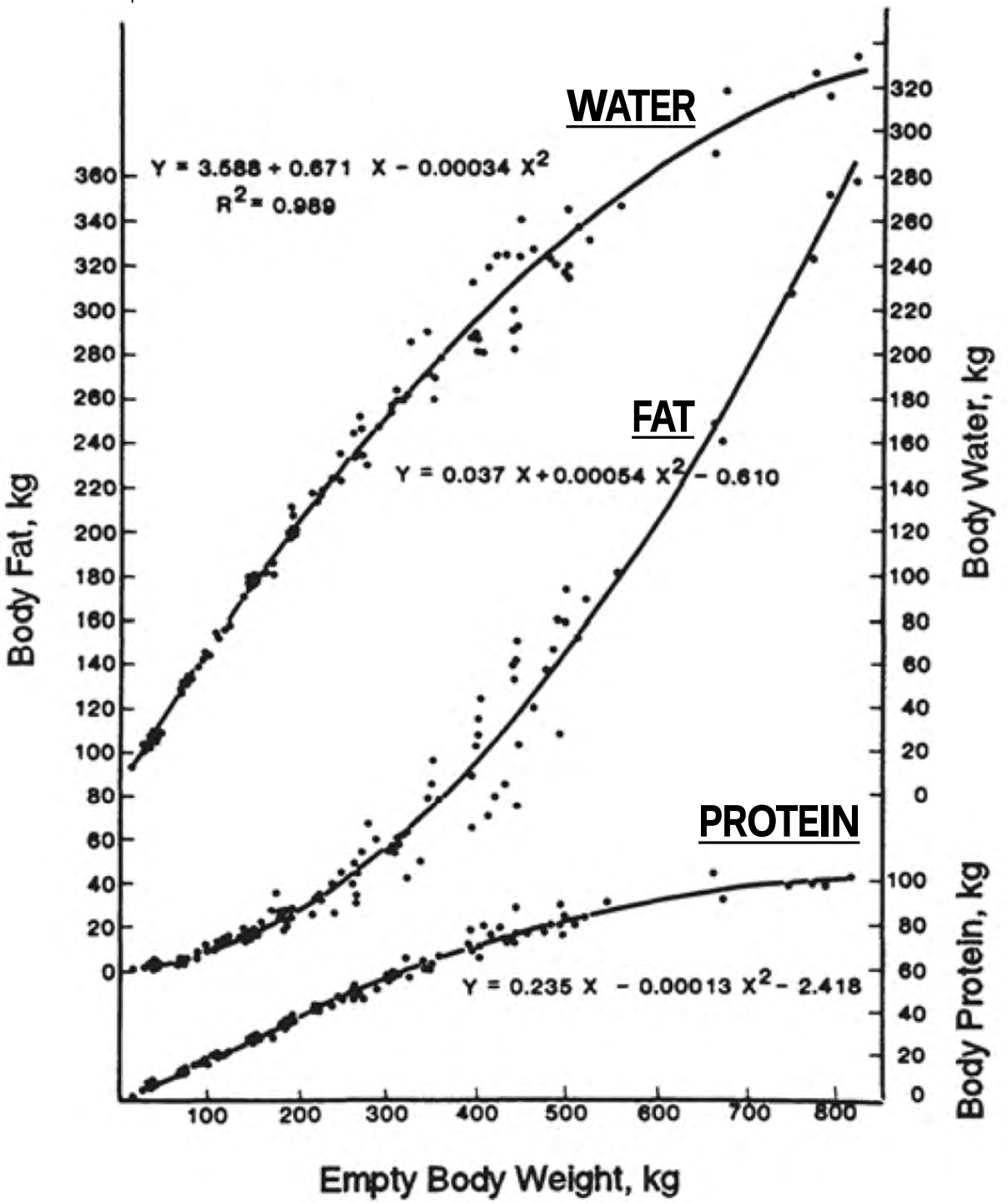


Actual and predicted efficiency of metabolizable energy utilization for growth

Stage of Growth[1]	k_g Observed	k_g Predicted[2]
Pre-weaning	0.55	0.34
Early post-weaning	0.28	0.31
150 kg	0.39	0.35
200 kg	0.40	0.36
250 kg	0.40	0.38
300 kg	0.40	0.40
350 kg	0.41	0.42

[1](Barlett, 2001; Diaz et al., 2001; Tikofsky et al., 2001 and Mills et al., 2010) (Meyer, 2005; Stamey et al., 2012);

[2] $k_g = 0.75/ (1 + 2.75*RE_p/RE)$ where REp is retained energy as protein and RE retained energy. Williams and Jenkins (2003).

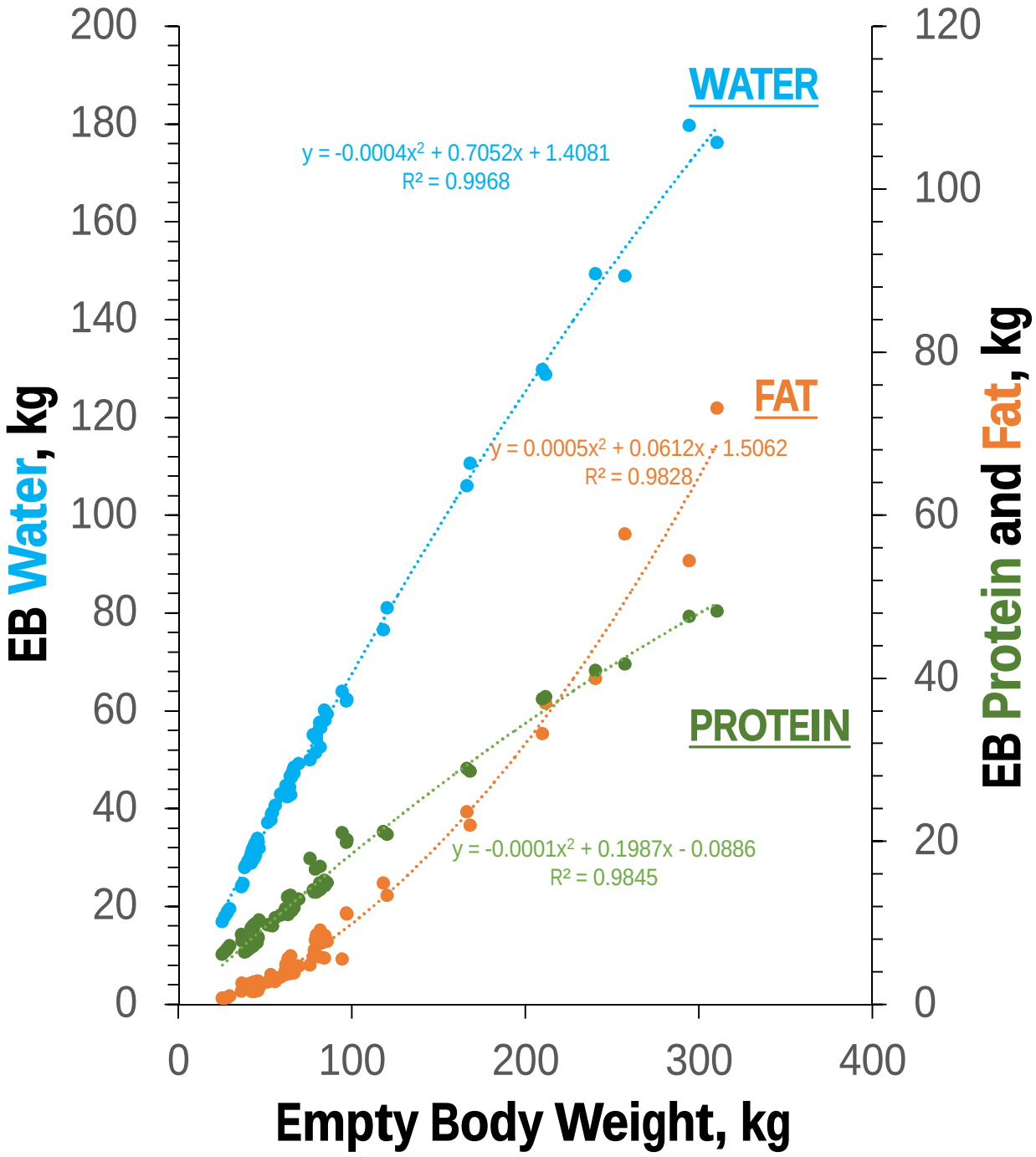


Body Composition

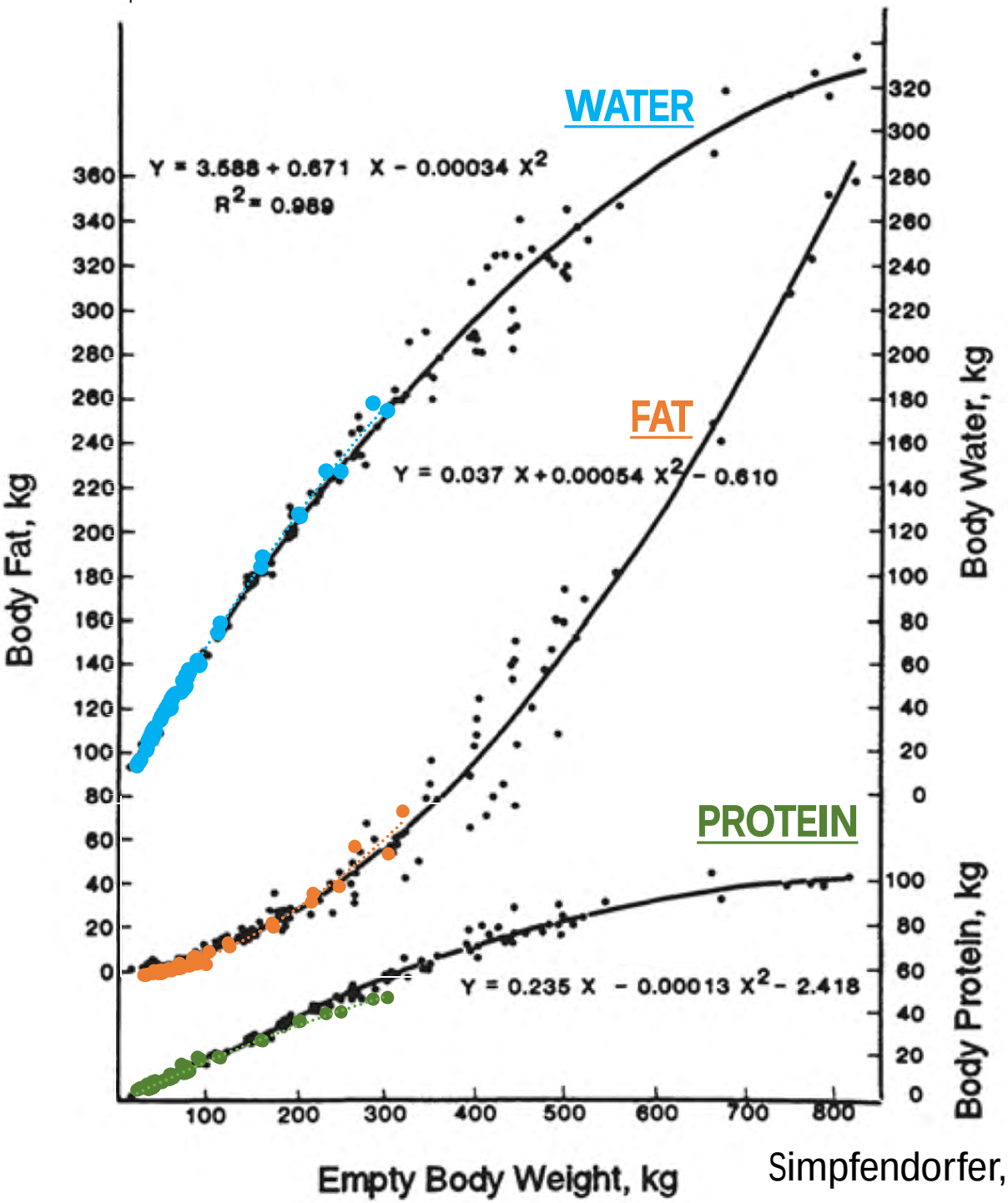
Data from studies conducted from 1910 to 1940

Simpfendorfer, 1974

Body composition of the contemprary calf and heifer data

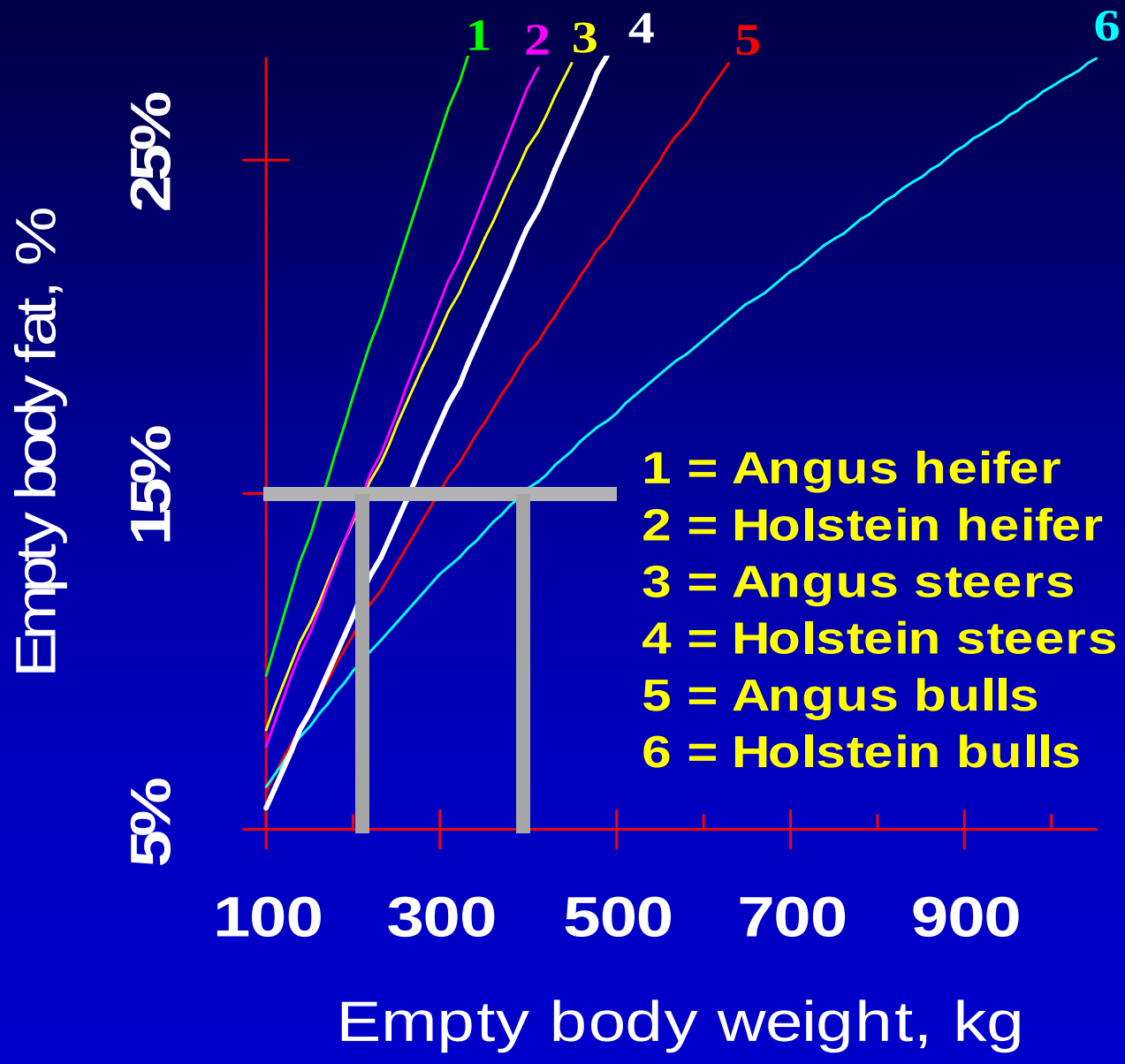


Body Composition



Simpfendorfer, 1974

Non-implanted cattle of Fortin et. al., 1980 (50 heifers, 37 steers and 54 bulls)



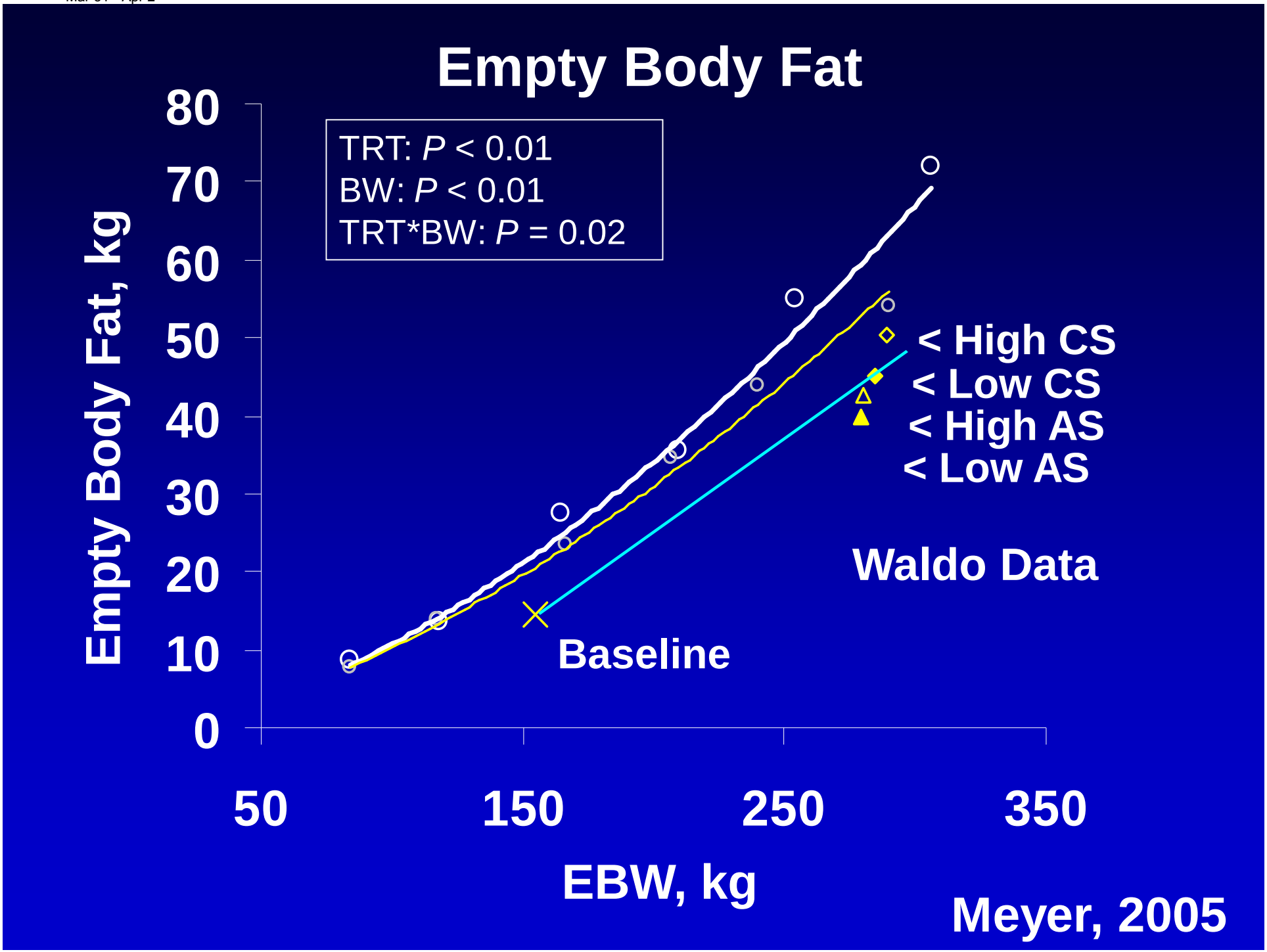
Evaluation of the Net Energy Predictions for Post-weaned Heifers

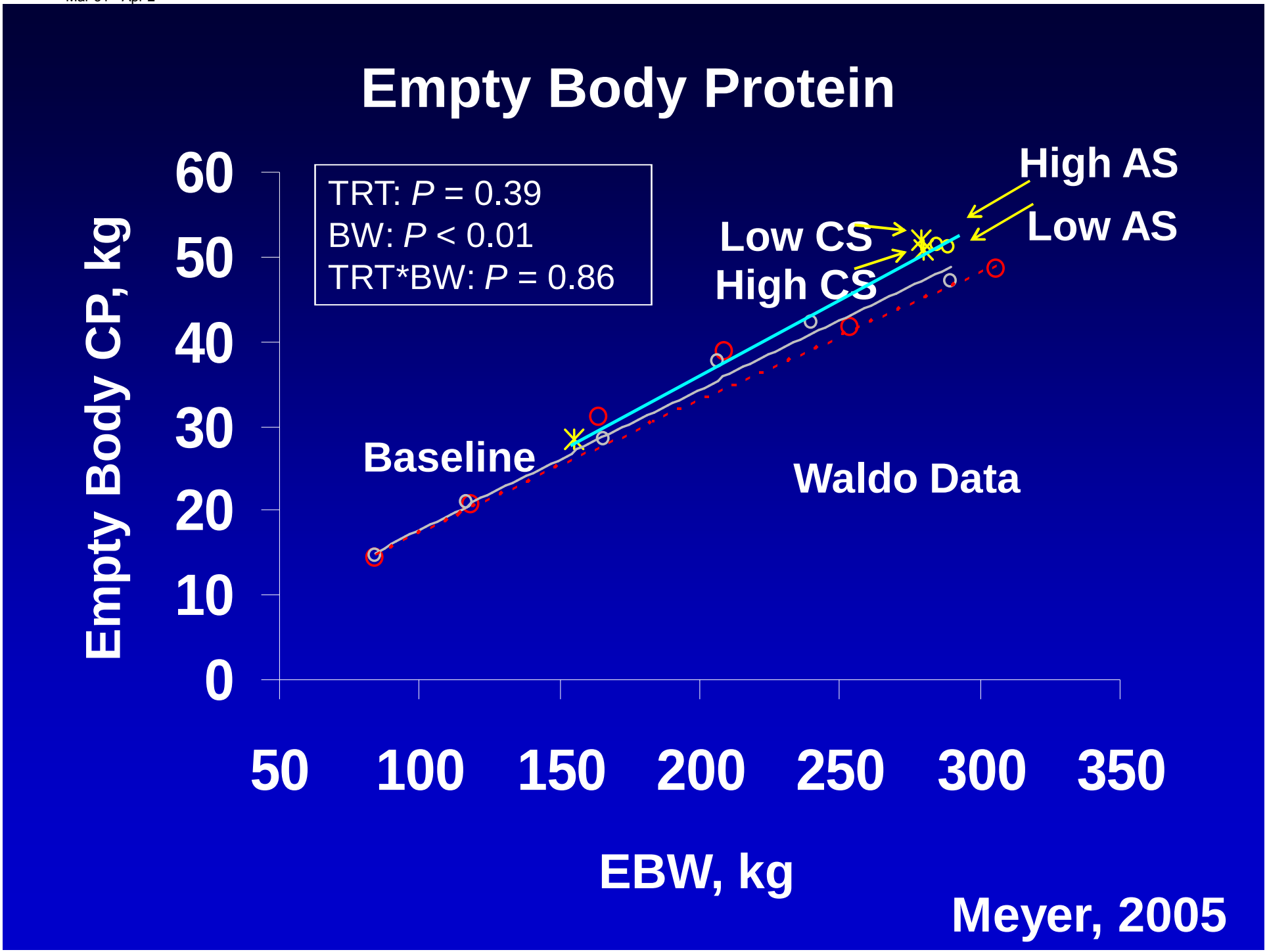
Data of Meyer, 2005:

- Two treatments from birth –
  - 0.65 and 0.95 kg ADG
  - harvested every 50 kg from 50 to 350 kg BW
  - Fed two levels of milk replacer (22:20 and 28:20)

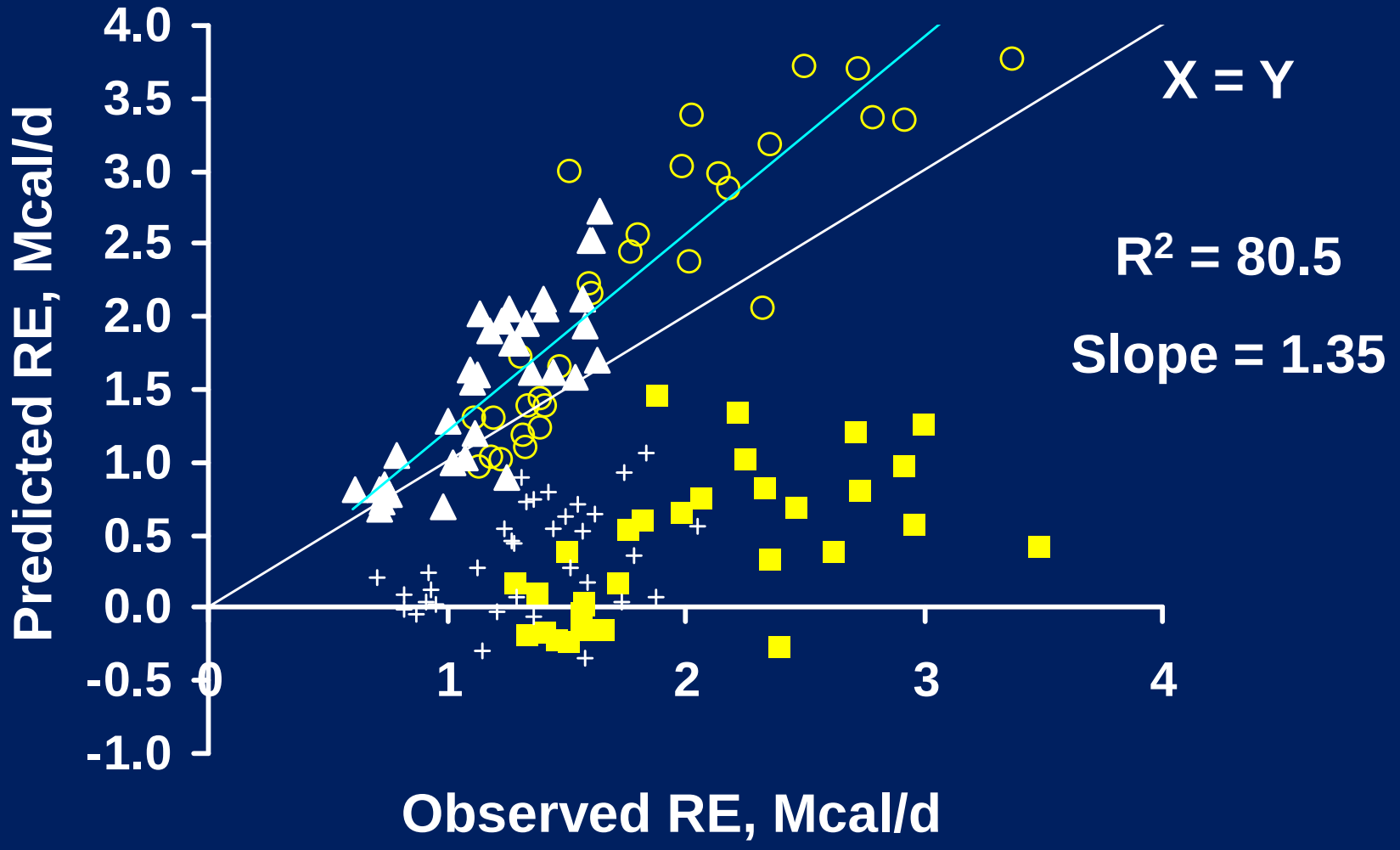
- Calculated energy values for fat and protein

  - Based on calorimetry and regression analysis: 9.51 Mcal/kg fat and 5.82 Mcal/kg protein – nearly identical to the values of Brouwer, 1965





2001 NRC Predicted RE vs. Observed without Adjustment for Mature Size



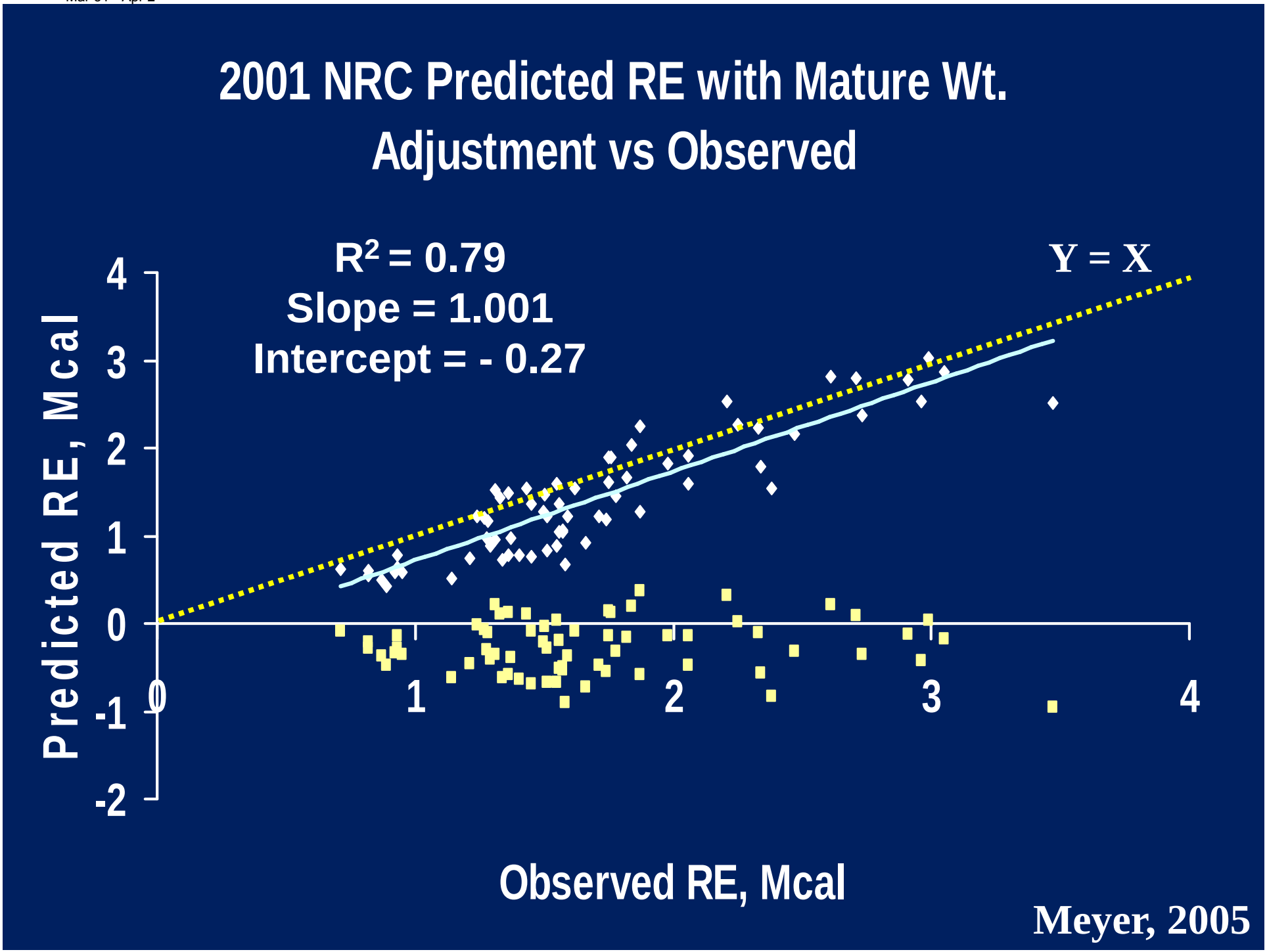
Meyer, 2005

Data of Meyer - Mature Size Adjustment

Mature size used with the standard reference weight to adjust the empty body weight: 657 kg

Based on knowledge of the herds cattle were acquired from

2001 NRC Predicted RE with Mature Wt. Adjustment vs Observed



Starter formulation

Calf Starters

+ 0.16% DM Metabolizable Met

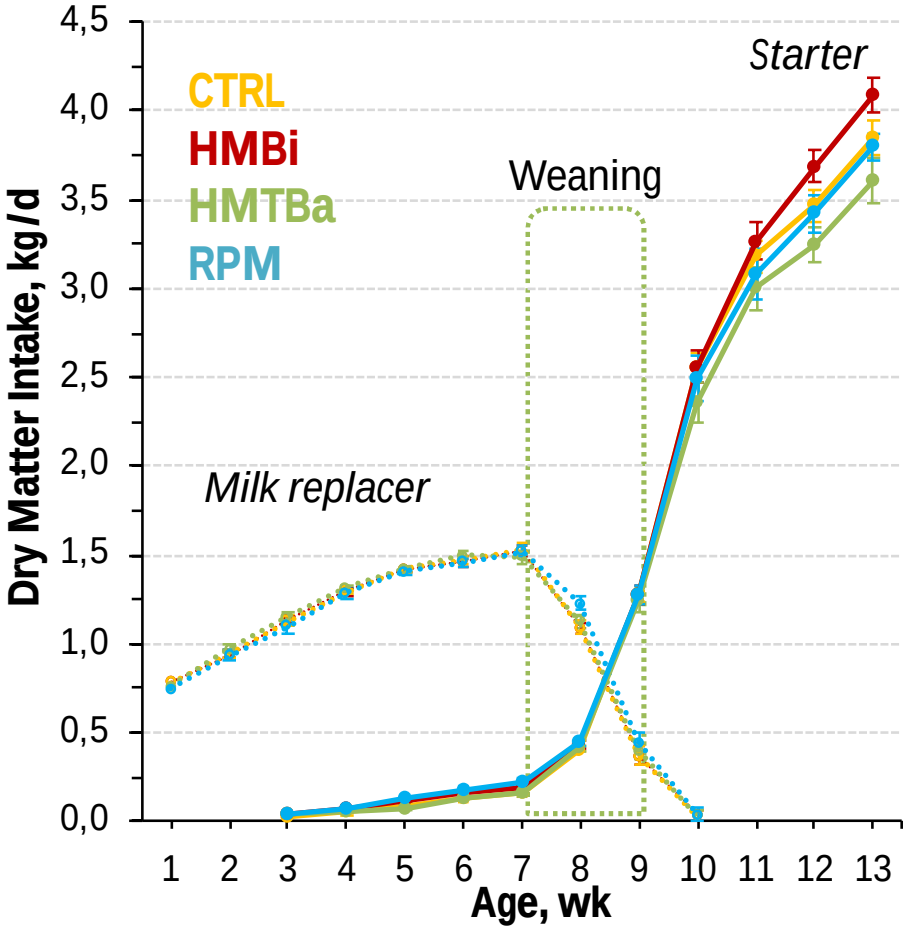
Ingredient inclusion, %DM	Control	HMBi	HMTBa	RPM
Pellet ingredients				
Wheat midds	22.2	22.2	22.2	22.0
Soybean Meal	6.9	6.9	6.9	6.8
AminoMax Pro	13.6	13.6	13.6	13.5
Sugar	3.4	3.4	3.4	3.4
Dried whey	6.2	6.2	6.2	6.2
Blood meal	5.9	5.9	5.9	5.8
MetaSmart (HMBi)	-	**0.7**	-	-
RumenSmart (HMTBa)	-	-	**0.4**	-
Minerals	1.2	1.2	1.2	1.2
Vitamins ADE	0.3	0.3	0.3	0.3
Bovatec	0.3	0.3	0.3	0.3
Flavor/odor enhancer				
Adisseo Vanilla	0.3	0.3	0.3	0.3
Fat	0.7	0.7	0.7	0.7
Celmanax	0.7	0.7	0.7	0.7
Beet pulp shreds	13.8	13.8	13.8	13.7
Flaked corn	21.0	21.0	21.0	20.8
Molasses	3.7	3.0	3.3	3.7
Smartamine (RP Met)	-	-	-	**0.3**

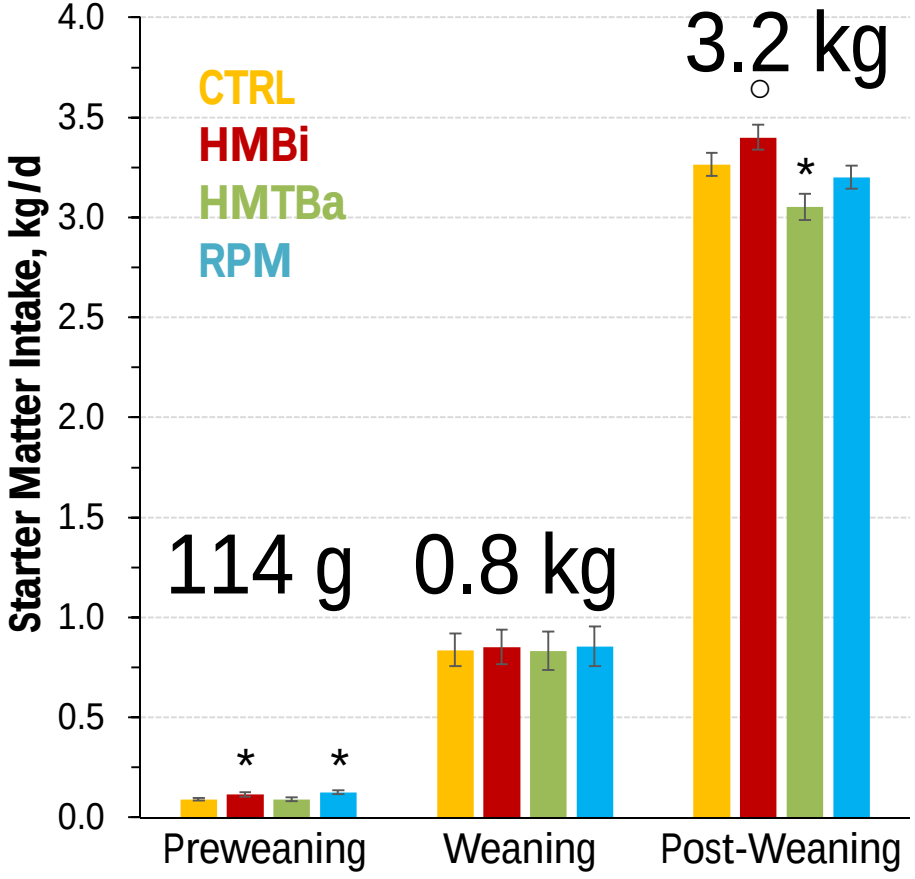
Calf Starters Composition

Chemical Composition, % DM	Control	HMBi	HMTBa	RPM
DM, % AF	88.7	88.6	88.3	88.7
Crude Protein	24.8	25.2	25.0	24.5
Crude Fat	3.3	3.2	4.1	3.4
aNDFom	21.2	20.6	20.9	21.5
Starch	20.6	18.8	18.6	20
Soluble Fiber	7.7	9.3	9.1	8.4
Sugars	14.8	15.0	14.7	14.6
Ash	7.7	7.9	7.7	7.5
ME, Mcal/kg	2.5	2.5	2.5	2.5

Formulated methionine is 14 g metabolizable Met at 3 kg of DMI.

Dry Matter Intake, kg/d



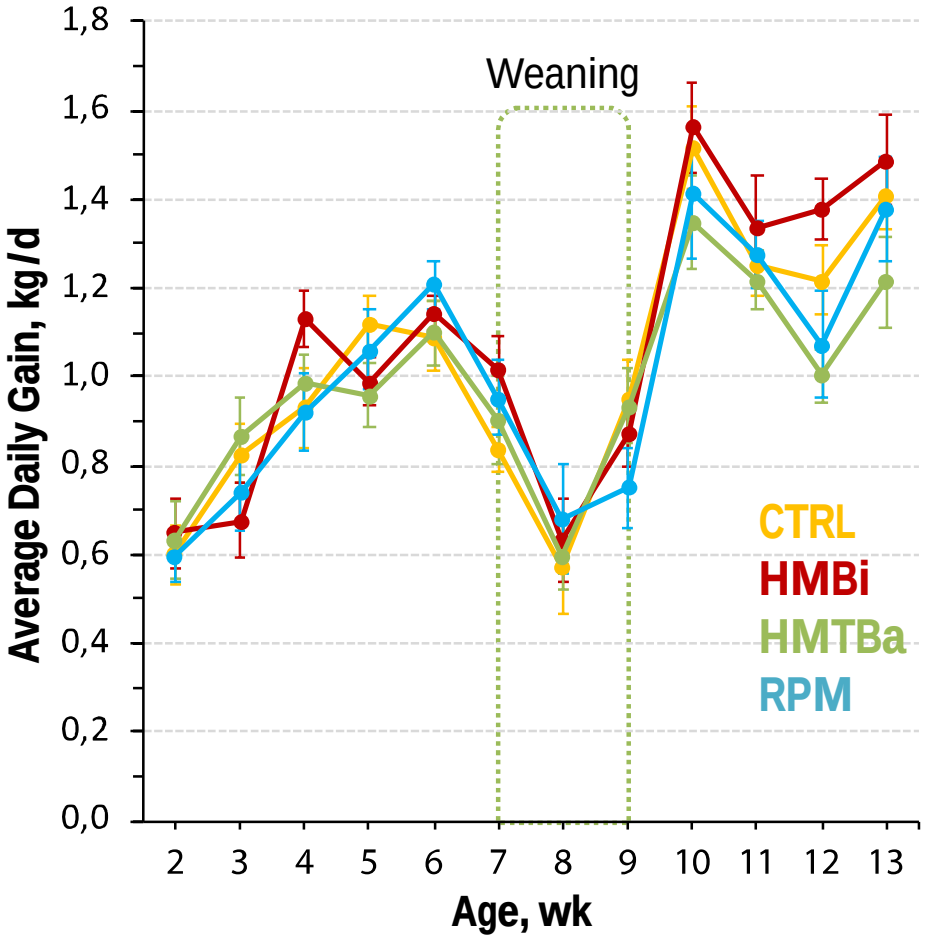


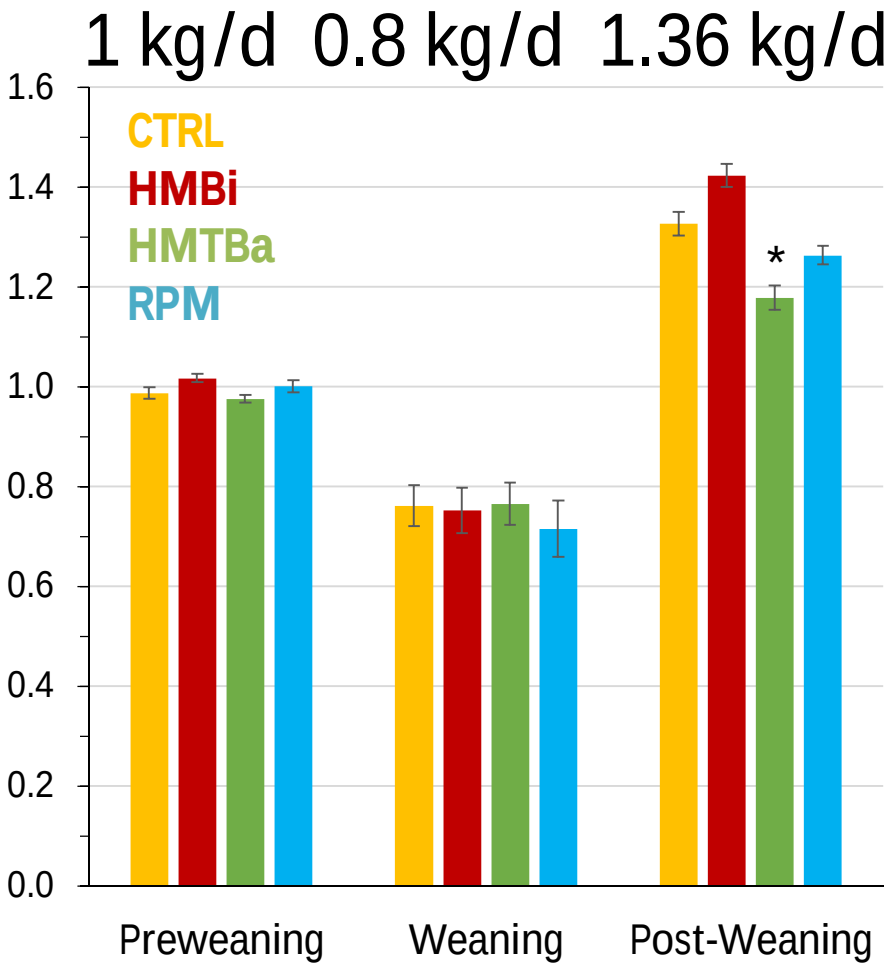
All comparisons against the control

* $P < 0.05$

○ $P < 0.1$

Average Daily Gain, kg/d

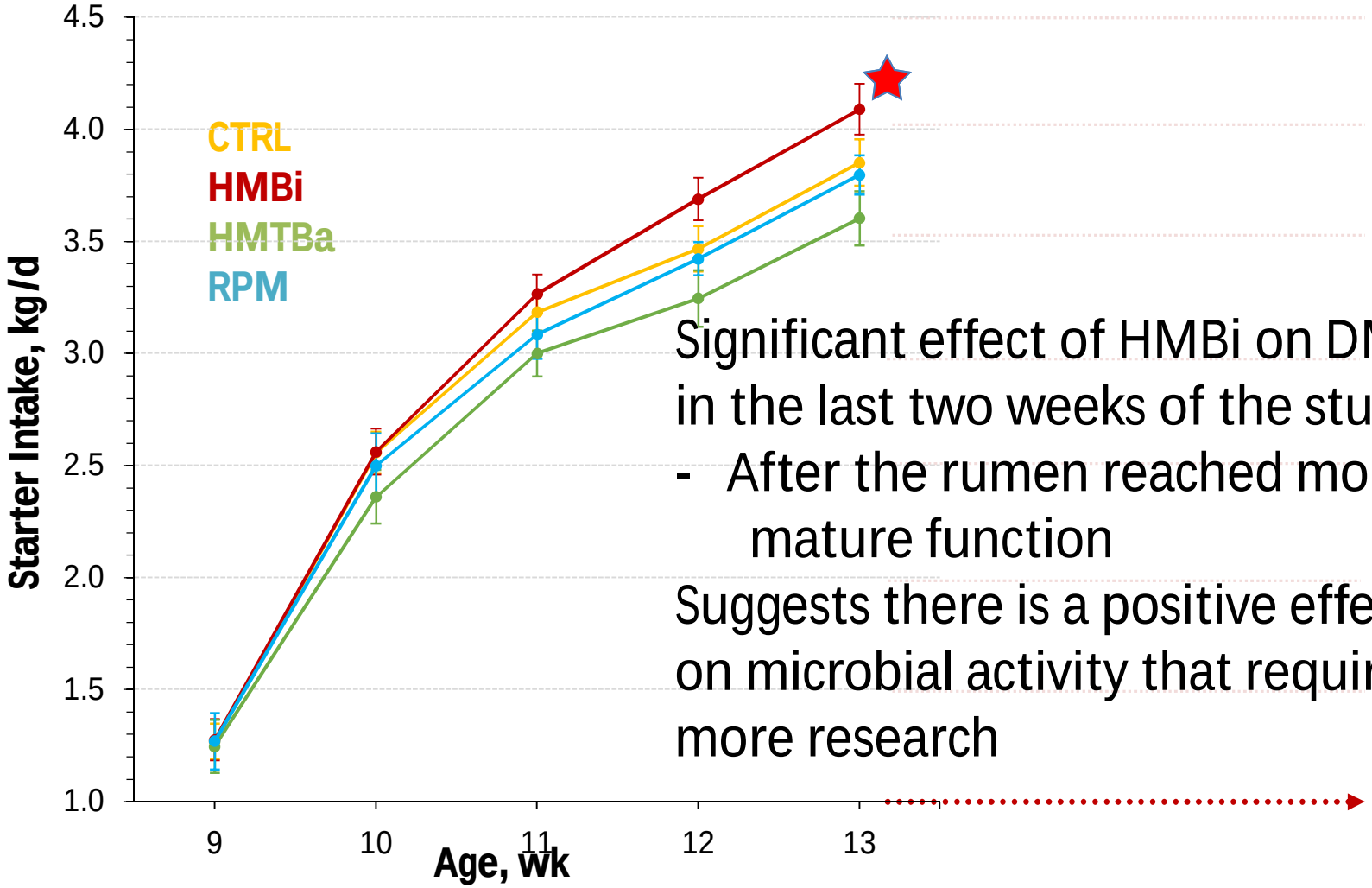




All comparisons against the control

* $P < 0.05$

Future Studies: Post-Weaning



Significant effect of HMBi on DMI in the last two weeks of the study

- After the rumen reached more mature function

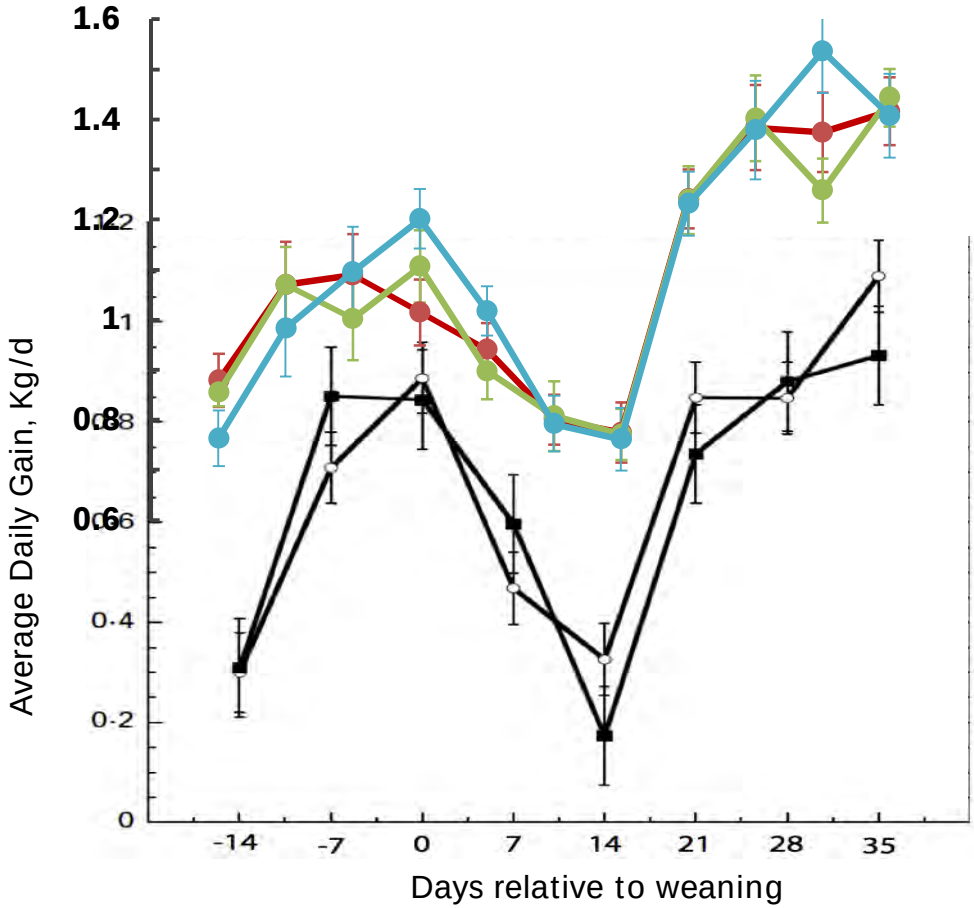
Suggests there is a positive effect on microbial activity that requires more research

Effect of Methionine Supplementation on Starter Intake and Growth

Preweaning	CTRL	RPM	HMTBa	HMBi	SEM
Milk replacer intake, kg/d	1.37	1.35	1.38	1.37	1.37
Starter intake, kg/d	0.09	0.14	0.09	0.13	0.09
BW gain, kg/d	1.00	1.00	0.98	1.02	1.00
BW at d 49, kg	84.7	84.2	85.3	86.0	84.7
Postweaning					
Starter intake, kg/d	3.27	3.20	3.05	3.40	3.27
BW gain, kg/d	1.33	1.26	1.18	1.42	1.33
Final BW at 87 d, kg	133.4	130.2	129.3	137.0	133.4

Results

"Post-weaning Slump" can be Reduced



Adapted from Terré et al, 2006

0.9 kg DM MR/d Max
Weaned Earlier (46 d)
Weaning shorter and less gradua

Summary For: Location 1.heifers 250 to 600
Recipe: heifers 250 to 600 Recipe

Inputted DMI (lbs/day)	9.42
Predicted DMI (lbs/day)	10.87
Inputted / Predicted DMI	86.6
DM (%)	40.6
Cost/head	$ 0.00
Cost/lb Gain	$ 0.00
IOFC	$ 1.45
IOpurFC	$ 1.45
Feed:Gain	4.55

CP (%DM)	15.4
SP (%CP)	35
RDP (%DM)	10.71
Ether Extract (%DM)	3.4
LCFA (%DM)	2.5
Total Unsaturate (g/day)	80.6
NFC (%DM)	38.3
Starch (%DM)	26.9
Sugar (%DM)	3.1
Total Ferm. CHO (%CHO)	69.7
Forage (%DM)	77.5
aNDFom (%DM)	36.26
Forage NDF (%DM)	33.71
Forage NDF (%NDF)	92.98

	ME	MP
Supply	10.9	451
Maintenance	6.3	174
Pregnancy	0.0	0.0
Lactation	0.0	0.0
Growth	4.4	279.0
Reserves	0.0	2
Balance	0.1	-2.1
% Required	101	100
Allowable Gain lbs/day	2.085	2.069
Inputted Gain lbs/day	2.05	

RumenNH3 (%Rqd)	127
peNDF (%DM)	28.1
Rumen_pH	6.46
MP From Bact (%)	63.3
MP From Bact (g)	285.2
Urea Cost	0.00 Mcal

	%Rqd	%MP
Met	154.7	2.47%
Lys	129.8	7.16%
His	122.3	2.63%

Summary For: Location 1.breeding weight heifers
Recipe: breeding weight heifers Recipe

Inputted DMI (lbs/day)	16.11
Predicted DMI (lbs/day)	17.01
Inputted / Predicted DMI	94.7
DM (%)	36.5
Cost/head	$ 0.00
Cost/lb Gain	$ 0.00
IOFC	$ 1.54
IOpurFC	$ 1.54
Feed:Gain	7.33

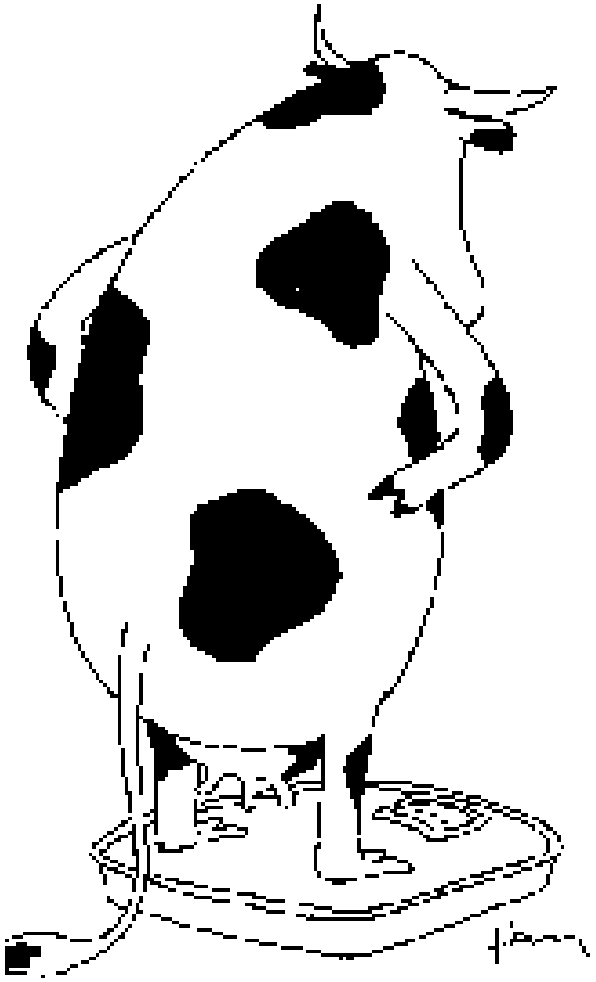
	ME	MP
Supply	18.0	654
Maintenance	10.3	295
Pregnancy	0.0	0.0
Lactation	0.0	0.0
Growth	7.6	295.6
Reserves	0.0	0
Balance	0.1	63.5
% Required	101	111
Allowable Gain lbs/day	2.199	2.671
Inputted Gain lbs/day	2.17	

CP (%DM)	13.0
SP (%CP)	45
RDP (%DM)	9.71
Ether Extract (%DM)	3.3
LCFA (%DM)	2.1
Total Unsaturate (g/day)	115.7
NFC (%DM)	34.3
Starch (%DM)	22.6
Sugar (%DM)	2.8
Total Ferm. CHO (%CHO)	67.4
Forage (%DM)	93.1
aNDFom (%DM)	43.38
Forage NDF (%DM)	42.52
Forage NDF (%NDF)	98.02

RumenNH3 (%Rqd)	120
peNDF (%DM)	35.1
Rumen_pH	6.46
MP From Bact (%)	73.8
MP From Bact (g)	482.3
Urea Cost	0.07 Mcal

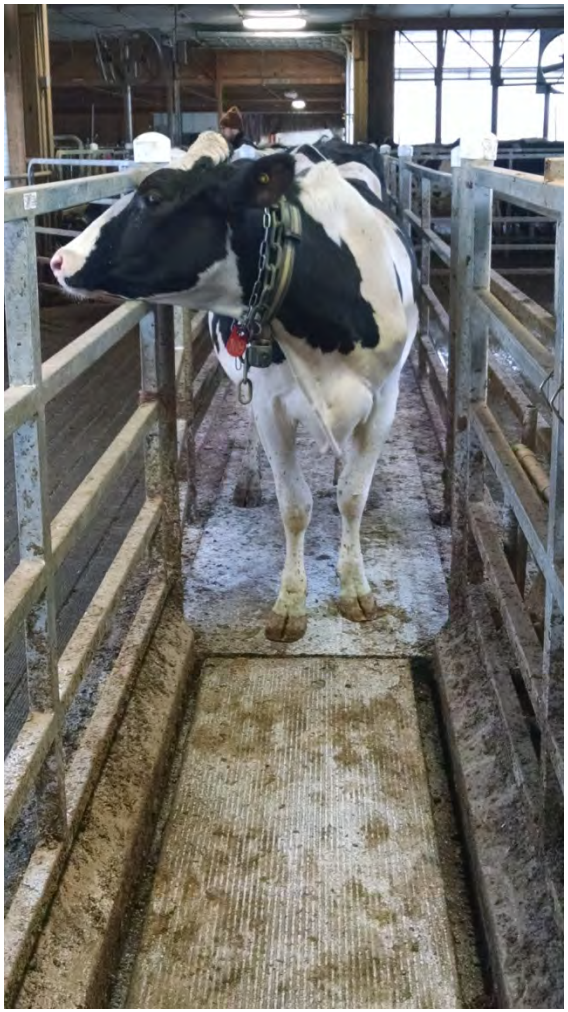
	%Rqd	%MP
Met	171.4	2.35%
Lys	153.2	7.27%
His	139.0	2.57%

The Need and Importance for Monitoring Body Weight



Subpopulation of the Cornell Research Dairy Body weight and BCS of Cattle

Item	Mean	Range
Lactation	2.4	1-6
DIM at trial start	115	50-180
Mature weight, kg	777	613-1000
2+ lactation		
Body weight, kg	761	600-1000
BCS	2.95	2.2-3.6
1st lactation		
Body weight, kg	613	477-716
BCS	3.1	2.87-3.5



Fessenden, 2016

Growth in the First Lactation and Loss of Milk due to Partitioning

- Evaluate the BW relative to maturity across distribution
- 613 kg 1st lact/777 kg mature BW = 0.79 ~ 79% mature size

- 477 kg 1st lact/600 kg MBW = 0.79 ~79%

- 716 kg 1st lact/1000 kg MBW = ~ 0.72 ~ 72%
- In this herd, heifers at the bottom of the distribution curve are close to the benchmark, whereas heifers at the top of the distribution curve are too light

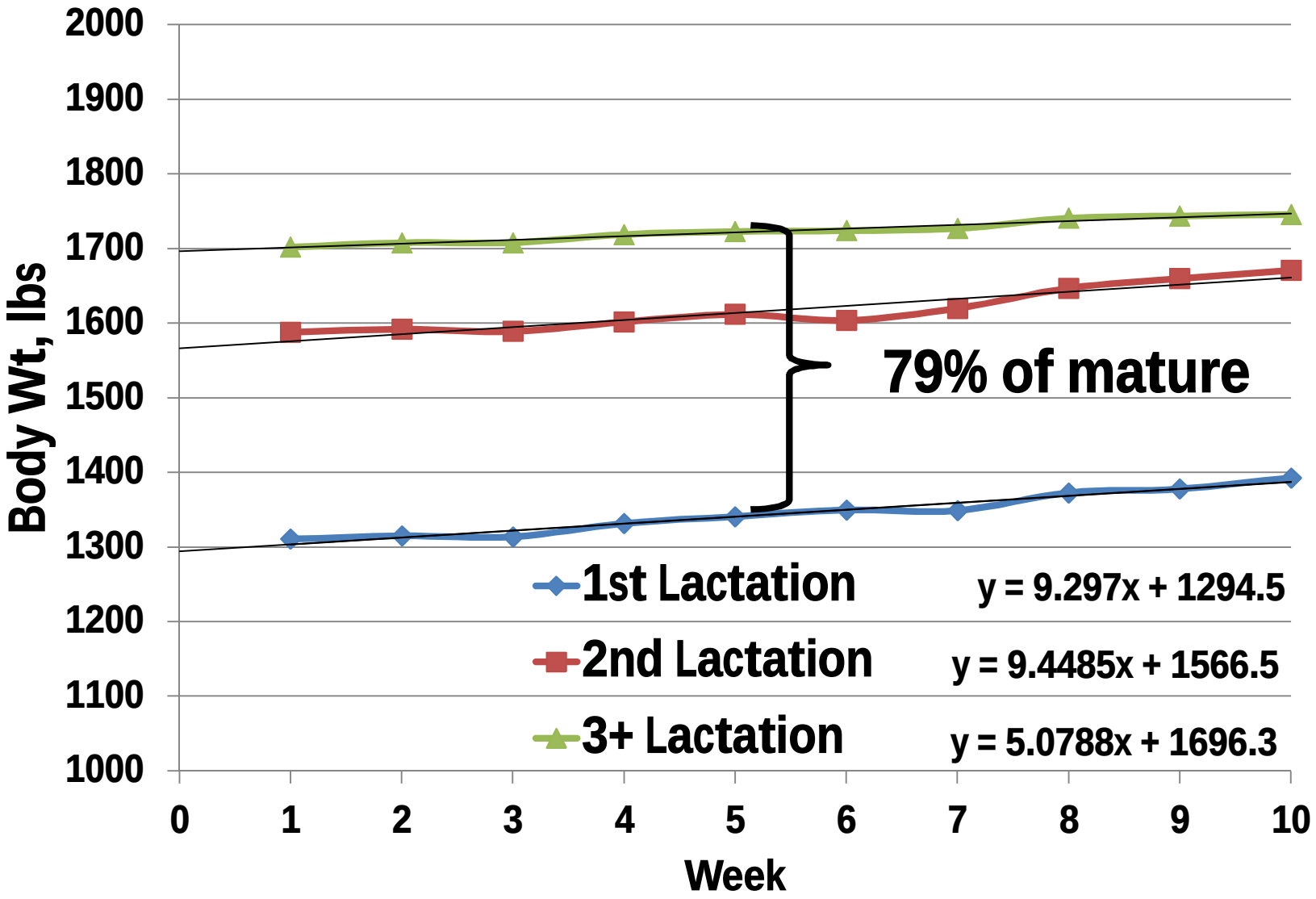
Cattle characterization

Cornell Research Dairy

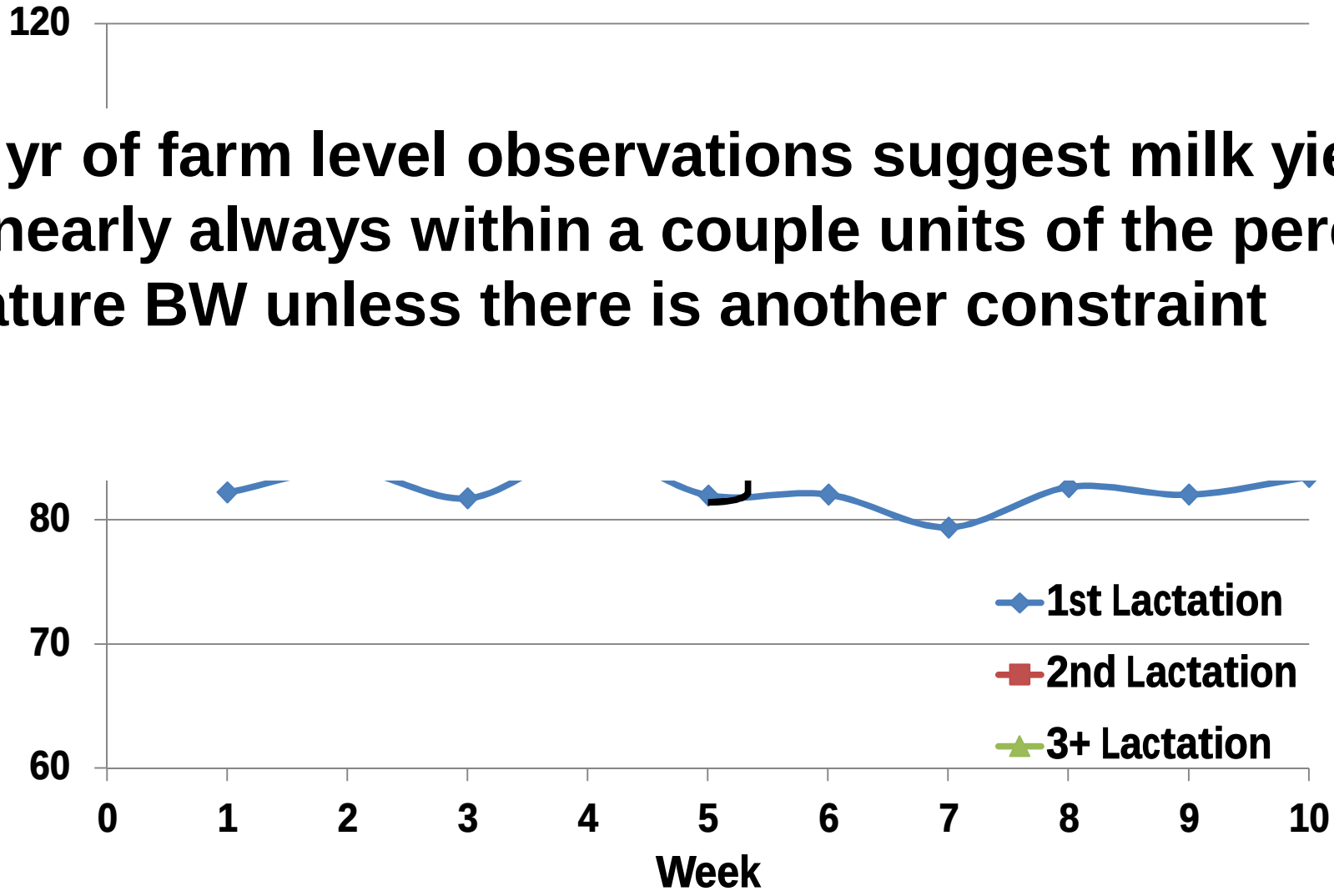
1993 – mature body weight = 1,474 ± 125 lb (668 kg)

2016 – mature body weight = 1,777 ± 160 lb (803 kg)

Body weight by week



Milk production



20 yr of farm level observations suggest milk yield is nearly always within a couple units of the percent mature BW unless there is another constraint

PLOT MILK BY LACT

Overall lactation yield ~ 69% of mature cows

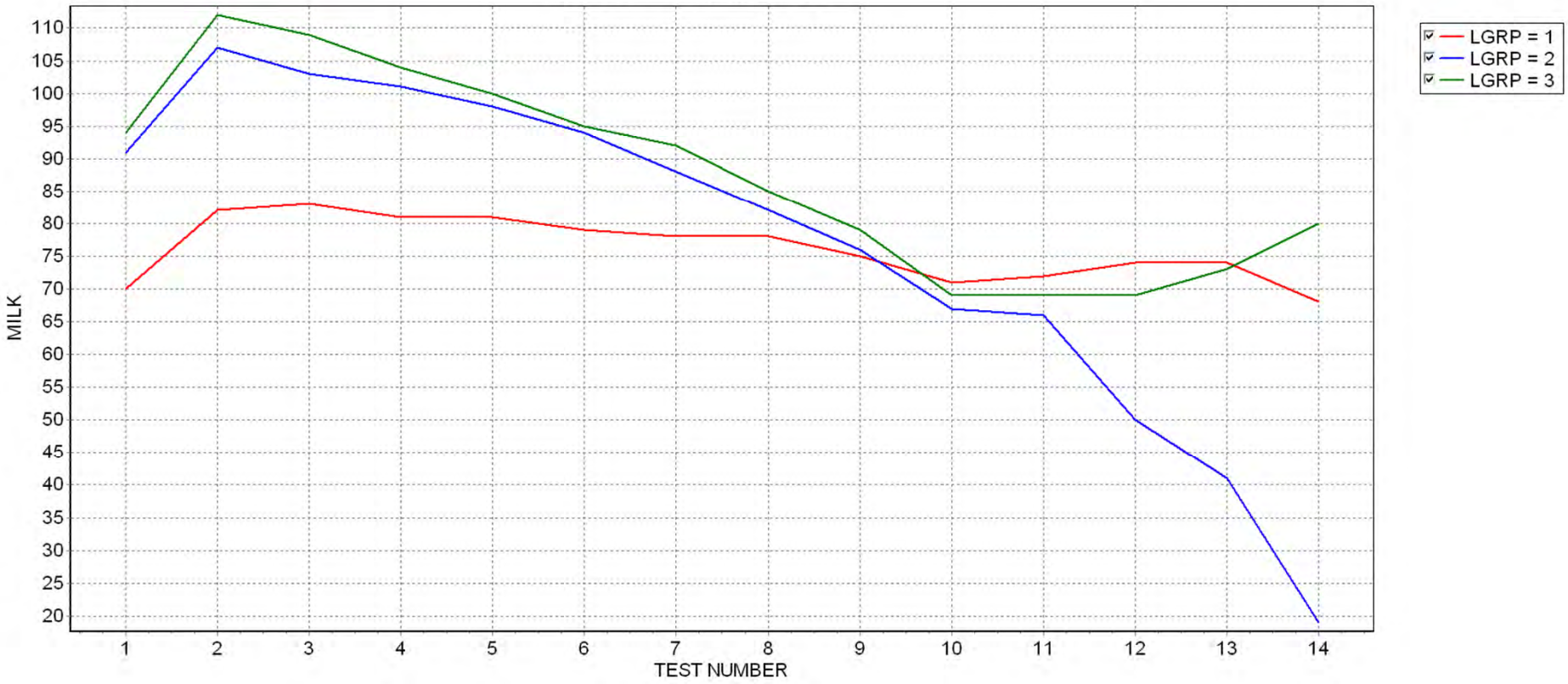
23/25case studies in last 6 yr – same problem

Should be analyzing M305 by lactation in Dairy Comp

Optimum first lactation yield should be 80% of mature cows

If greater than 83% of mature cows, then mature cows are restricted

PLOT MILK BY LACTGRP – Fellows Case Study last spring – heifers producing at 82% of mature cows. 2x herd averaging 40 kg/d



Management scenario for many herds – value of monitoring

2014-2015 – Milk price was high for most of those two years

Cull cow prices were also high for same period

Cull value was almost equal to heifer rearing costs

Many herds now have more than 35% first lactation animals – upwards of 45% 1st lactation in some herds

Little to no monitoring once pregnant – calving in at weights below the benchmark of 82% mature body weight

Current scenario for many herds – value of monitoring for case study herd at 69% of lactation milk

Expected milk if target met: ~ 90 lb (40 kg) at peak

Assume ~225 lb (102 kg) for every pound at peak

11.5 lb (5.2 kg) greater peak * 225 = 2,583 lb (532 kg) unrealized milk due to not meeting the 82% mature size benchmark

Net milk: $16.80/CWT

$8.33 IOFC margin (Net milk – feed cost per CWT)

$8.33 * 25.8 CWT = $215.20 per 1st lactation heifer IOFC

800 cow herd * 40% 1st lactation heifers = 320 heifers * $215.20 IOFC =$68,852 IOFC not realized ($86/lact. cow)

Value of monitoring – $20 milk

Net milk: $20.80/CWT

$8.33 IOFC margin (Net milk – feed cost per CWT)

$12.33 * 25.8 CWT = $318.11 per 1st lactation heifer IOFC

800 cow herd * 40% 1st lactation heifers = 320 heifers *

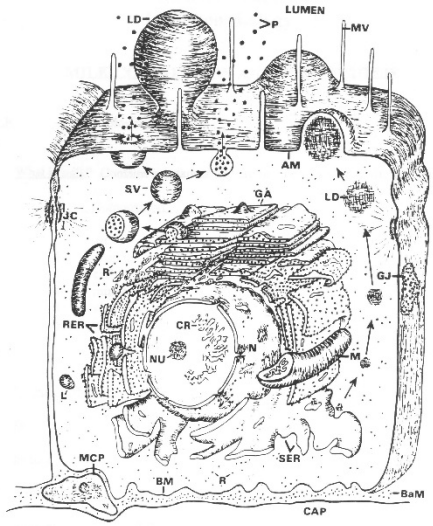
$318.11 IOFC = $101,795.20 IOFC not realized

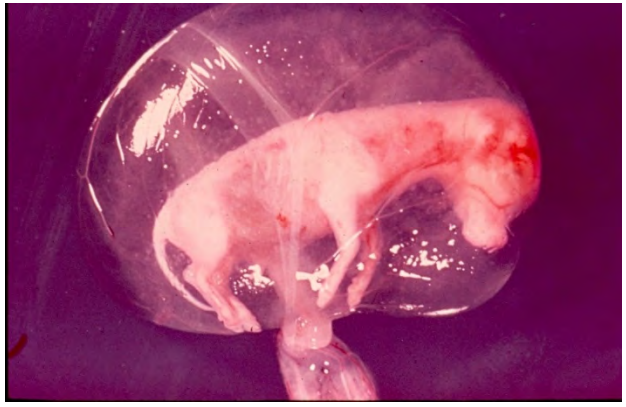
($127/ lact. cow)

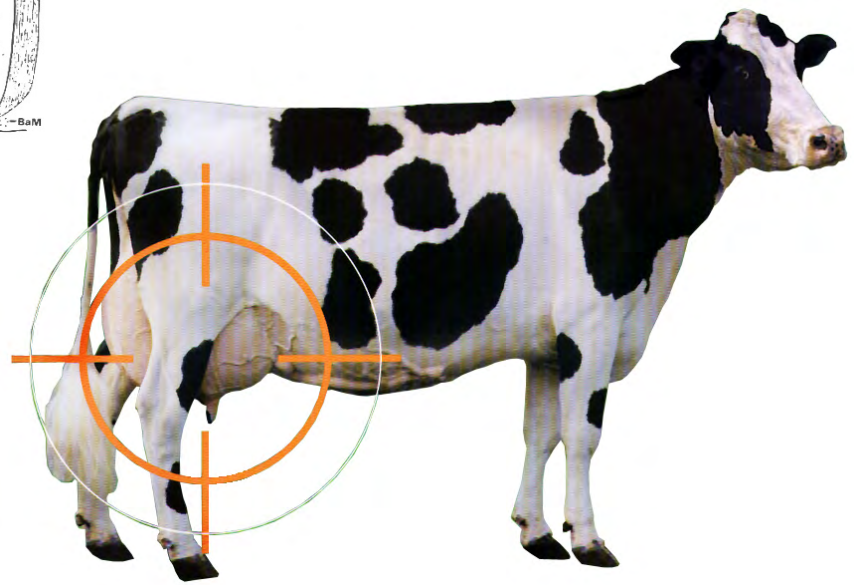
What does a pregnant heifer have to do?

- Grow effectively – she is not a dry cow
- Develop a fetus
- Develop a mammary gland
- Develop colostrum
- Calve successfully without post-partum disorders, dystocia and at an adequate size

Fetal growth and mammogenesis requirements







Mammogenesis – need building blocks for milk synthesis and colostrum components

- Based upon Bell et al. (2000) and VandeHaar and Donkin (1999)
- “Switch” is turned on from 259 days of pregnancy until 21 days of lactation (42 day period: -21 to +21 days)
- Data from Akers and Capuco indicated 65% of secretory capacity of the gland occurs in that period.
- Assumes 80 grams of NP deposition in mammary gland and efficiency of use of 29%
- ME requirements calculated based upon requirements to support 80 g/d of protein deposition
- Result for MP is additional requirement of 277 g/d

Colostrum yield by parity

Factors affecting colostrum quality and yield.

Factor	Size of Effect					
	Fat (%)	Protein (%)	Lactose (%)	Energy (Mcal/kg)	Total Solids (%Brix)	Yield (kg)
Parity	**	*	*	*	*	*
1	7.77 [b]	17.15 [a]	2.24 [b]	1.36 [b]	25.38 [b]	4.95 [a]
2	5.50 [a]	16.93 [a]	2.36 [b]	1.35 [a]	24.40 [a]	6.75 [b]
3	5.32 [a]	17.98 [a]	2.20 [b]	1.32 [a]	25.81 [b]	7.69 [b]
4+	5.92 [a]	18.96 [b]	1.97 [a]	1.36 [b]	26.77 [c]	6.99 [b]

Soufleri et al. 2021

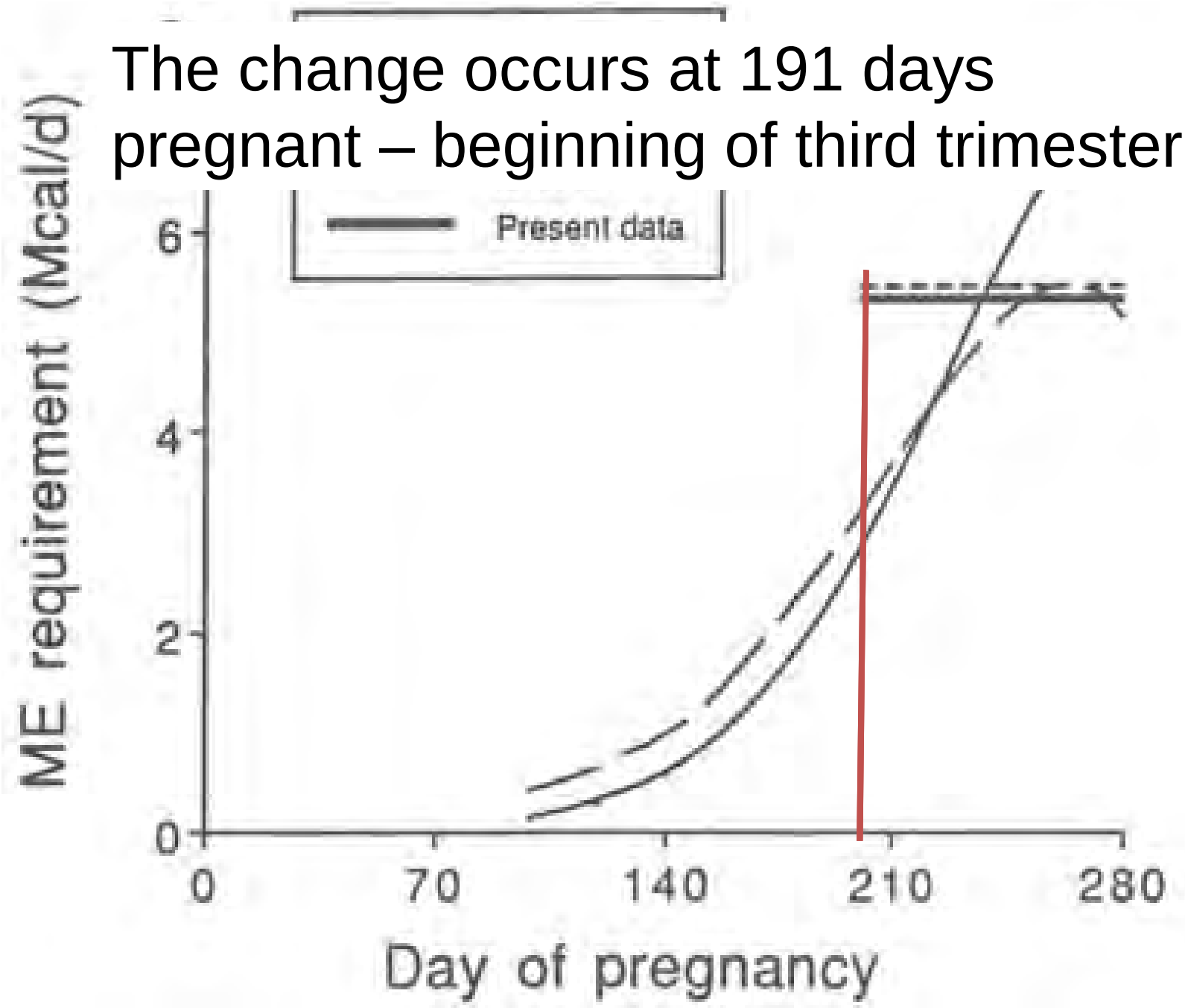
Fetal growth and requirements

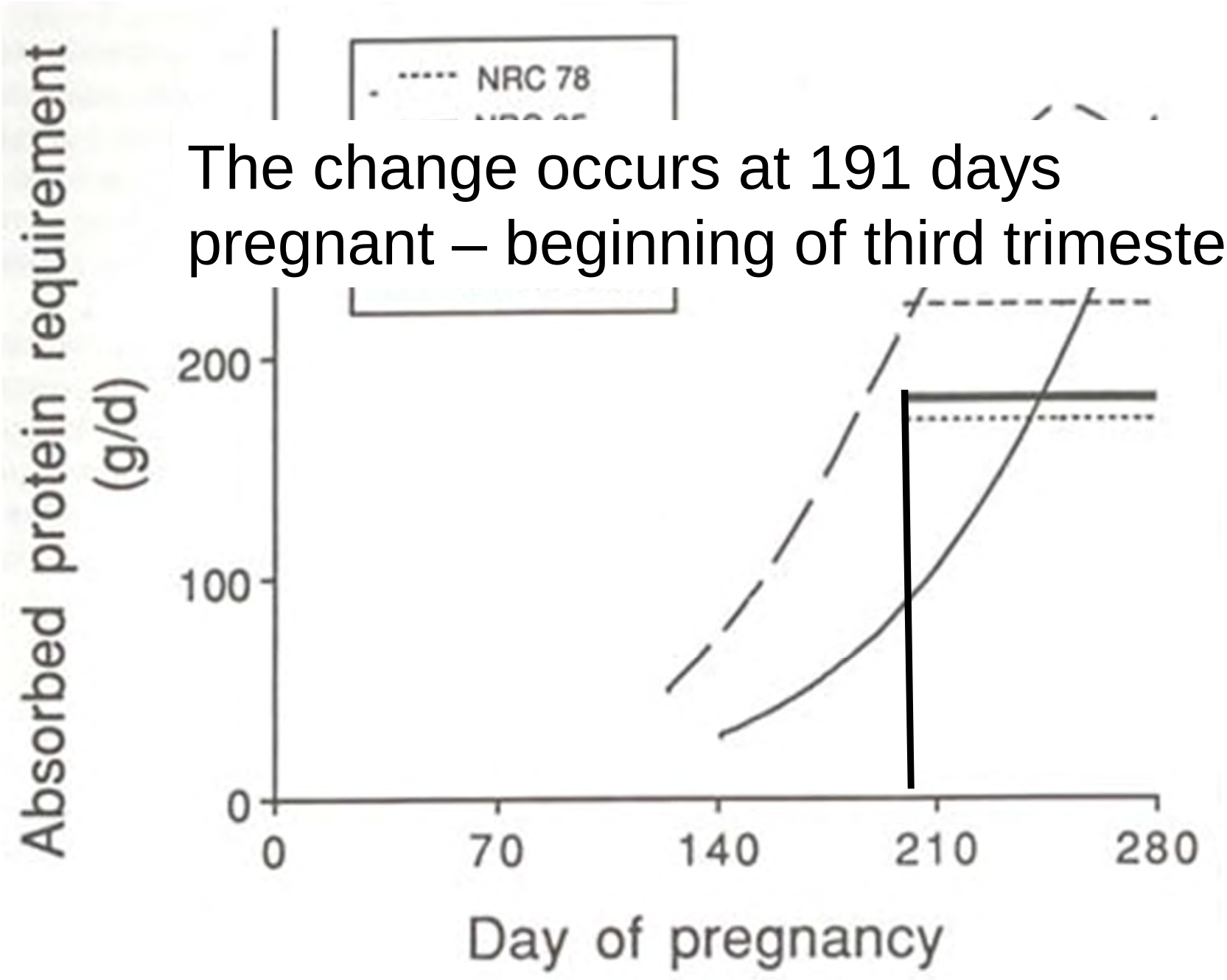
Do you have a pregnant heifer group?

Do you have a late pregnant heifer group?

- Fetal requirements increase
- Mammary development accelerates
- Growth requirements still high
- Liver hypertrophy and colostrum production needs to be considered

The change occurs at 191 days pregnant – beginning of third trimester





The change occurs at 191 days pregnant – beginning of third trimester

Change in metabolizable energy and protein requirements from second to third trimester of pregnancy

ME requirement increases by 5.1 Mcal and MP requirements by 280 g/d (NRC, 2001, CNCPS, 2008).

These changes in requirements can be confused if the MBW and stage of maturity are not considered,

Requirements of ME and MP for pregnancy

- Calculated based upon expected birth weight of calf and day of gestation
- Become meaningful beginning on day 191 of pregnancy
- Efficiency of ME use for pregnancy is 14%
- Efficiency of MP use for pregnancy is 33%

Fetal growth in multiparous Holstein cows (Bell et al., 1995)

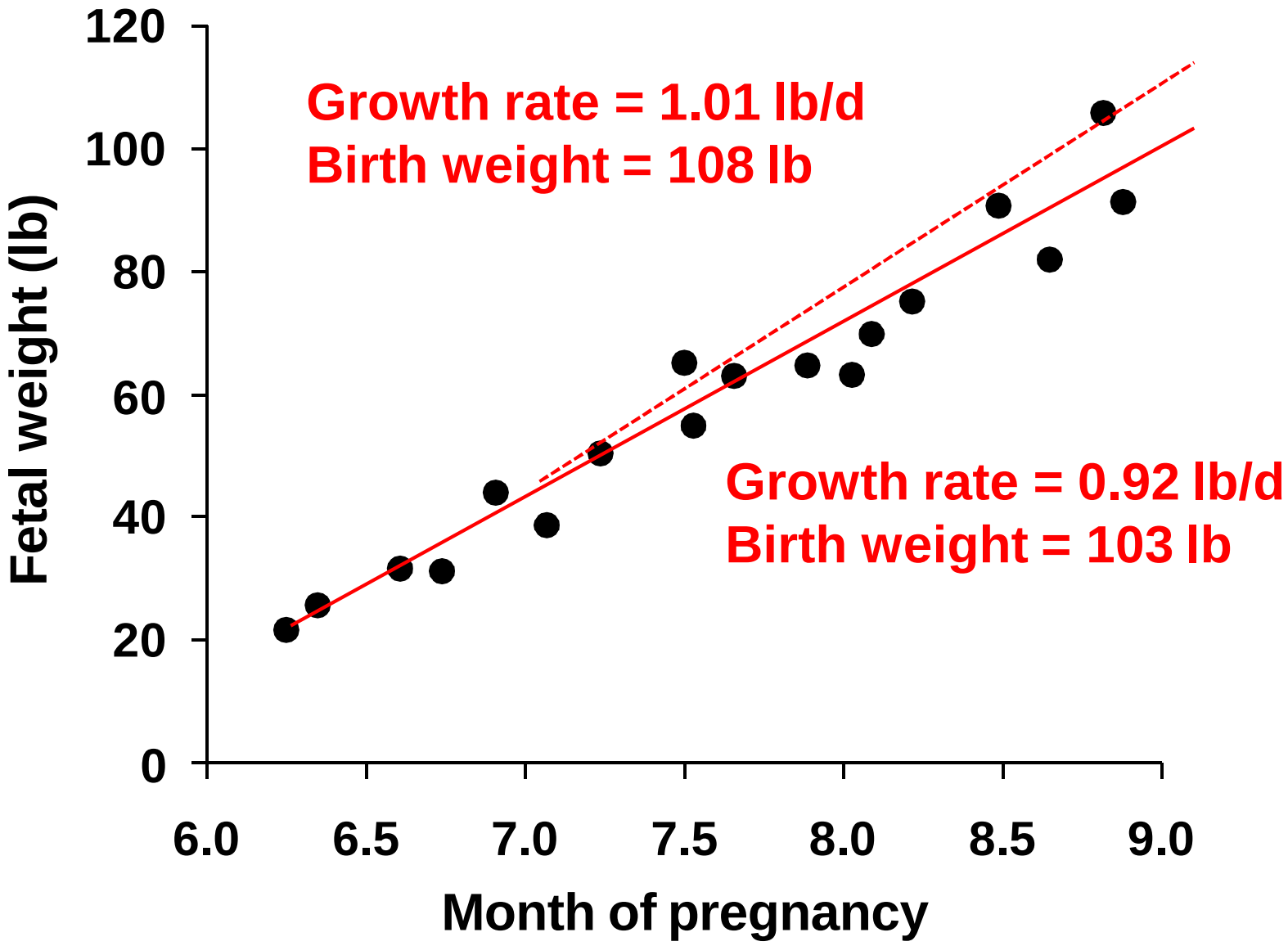


Table 1. Total uterine and fetal rates of wet and dry growth, and accretion of chemical constituents during late pregnancy*

Constituent	Total Uterus	Fetus
Tissue weight (g/d)		
Wet	664	418
Dry	138	121
Energy (kcal/d)	691	605
Crude protein (g/d)	90	74
Fat (g/d)	13	12
Ash (g/d)	23	22
Macrominerals (g/d)		
Ca	5.6	2.2-9.3
P	3.7	1.5-6.3
Mg	0.18	0.15
Na	1.3	0.83
K	1.0	0.83
Trace elements (mg/d)		
Fe	18	17
Zn	12	10
Cu	1.6	1.4
Mn	0.30	0.28

*Estimated from regressions of weight or energy content on day of pregnancy (see text).

Requirements of ME and MP for pregnancy

- Calculated based upon expected birth weight of calf and day of gestation
- Become meaningful beginning on day 191 of pregnancy
- Efficiency of ME use for pregnancy is 14%
- Efficiency of MP use for pregnancy is 33%

Pregnant heifers – 1,212 lb, 1,770 lb mature BW

180 days pregnant – at the end of the 2nd trimester

Recipe pregnant heifers Recipe

Cattle Location 1.pregnant heifers

Feed-ID	kg/day (DM)
Corn Silage Unprocessed 30 DM 41 NDF Medium-CNCPS-3046	7.6080
Alfalfa Silage 17 CP 46 NDF 20 LNDF-CNCPS-4052	4.3475
Corn Grain Ground Fine-CNCPS-1039	0.5434
MinVit-CNCPS-5053	0.0000
Soy Plus-CNCPS-8030	0.0000
Calcium Carbonate-CNCPS-5007	0.0000
Salt White-CNCPS-5067	0.0272
Vitamin Premix ADE-CNCPS-5085	0.0435
Mineral Mix RAS study-CNCPS-C272059	0.1304
Total	12.7000

Summary Results

Summary For: Location 1.pregnant heifers
Recipe: pregnant heifers Recipe

Inputted DMI (kg/day)	12.700
Predicted DMI (kg/day)	12.692
Inputted/Predicted DMI	100.1
DM (%)	30.9
Cost/head	$ 0.00
Cost/kg Gain	$ 0.00
IOFC	$ 0.00
IOpurFC	$ 0.00
Feed:Gain	8.75

CP (%DM)	13.4
SP (%CP)	60
RDP (%DM)	9.93

	ME	MP
Supply	30.9	1043
Maintenance	14.4	480
Pregnancy	0.0	0.0
Lactation	0.0	0.0
Growth	15.8	420.1
Reserves	0.0	0
Balance	0.7	142.9
% Required	102	116
Allowable Gain kg/day	1.451	1.944
Inputted Gain kg/day	1.40	

Target gain: 3.15 lb/d
ME allowable: 3.2 lb/d
MP allowable: 4.3 lb/d

Pregnant heifers – 1,278 lb; 1,770 lb mature BW

200 days pregnant – into the 3rd trimester

Recipes

Recipe pregnant heifers Recipe

Cattle Location 1.pregnant heifers

Feed-ID	kg/day (DM)
Corn Silage Unprocessed 30 DM 41 NDF Medium-CNCPS-3046	7.6080
Alfalfa Silage 17 CP 46 NDF 20 LNDF-CNCPS-4052	4.3475
Corn Grain Ground Fine-CNCPS-1039	0.5434
MinVit-CNCPS-5053	0.0000
Soy Plus-CNCPS-8030	0.0000
Calcium Carbonate-CNCPS-5007	0.0000
Salt White-CNCPS-5067	0.0272
Vitamin Premix ADE-CNCPS-5085	0.0435
Mineral Mix RAS study-CNCPS-C272059	0.1304
Total	12.7000

Summary Results

Summary For: Location 1.pregnant heifers
Recipe: pregnant heifers Recipe

Inputted DMI (kg/day)	12.700
Predicted DMI (kg/day)	12.693
Inputted/Predicted DMI	100.1
DM (%)	30.9
Cost/head	$ 0.00
Cost/kg Gain	$ 0.00
IOFC	$ 0.00
IOpurFC	$ 0.00
Feed:Gain	13.59

CP (%DM)	13.4
SP (%CP)	60
RDP (%DM)	9.92

	ME	MP
Supply	30.9	1043
Maintenance	13.8	476
Pregnancy	3.9	190.0
Lactation	0.0	0.0
Growth	18.3	485.2
Reserves	5.0	108
Balance	-5.0	-108.3
% Required	86	91
Allowable Gain kg/day	1.203	0.935
Inputted Gain kg/day	1.65	

Target gain: 3.63 lb/d
ME allowable: 2.65 lb/d
MP allowable: 2.06 lb/d

3rd Trimester Heifer Nutrition

- Need to consider a diet that meets their needs
- Might require consideration of another group to overcome feeding higher nutrient density to the entire pregnant heifer group
- Improving the nutrient supply during this period will help overcome poor colostrum production and lower overall milk yields in the first lactation

Summary For: Location 1.Pregnant up to 2nd trimester
Recipe: Pregnant up to 2nd trimester Recipe

Inputted DMI (lbs/day)	23.00
Predicted DMI (lbs/day)	26.13
Inputted / Predicted DMI	88.0
DM (%)	38.6
Cost/head	$ 0.00
Cost/lb Gain	$ 0.00
IOFC	$ 1.57
IOpurFC	$ 1.57
Feed:Gain	10.27

CP (%DM)	12.4
SP (%CP)	42
RDP (%DM)	9.21
Ether Extract (%DM)	3.4
LCFA (%DM)	2.1
Total Unsaturate (g/day)	165.7
NFC (%DM)	31.6
Starch (%DM)	21.6
Sugar (%DM)	2.4
Total Ferm. CHO (%CHO)	65.7
Forage (%DM)	90.9
aNDFom (%DM)	46.01
Forage NDF (%DM)	45.14
Forage NDF (%NDF)	98.09

	ME	MP
Supply	24.7	903
Maintenance	13.9	427
Pregnancy	0.0	0.0
Lactation	0.0	0.0
Growth	10.7	308.9
Reserves	0.0	0
Balance	0.1	167.6
% Required	100	123
Allowable Gain lbs/day	2.240	3.456
Inputted Gain lbs/day	2.23	

RumenNH3 (%Rqd)	124
peNDF (%DM)	37.5
Rumen_pH	6.46
MP From Bact (%)	72.8
MP From Bact (g)	657.6
Urea Cost	0.20 Mcal

	%Rqd	%MP
Met	193.9	2.32%
Lys	174.5	7.23%
His	158.1	2.55%

Summary For: Location 1.Third trimester heifers
Recipe: Copy of Pregnant up to 2nd trimester Recipe

Inputted DMI (lbs/day)	28.34
Predicted DMI (lbs/day)	27.43
Inputted / Predicted DMI	103.3
DM (%)	38.6
Cost/head	$ 0.00
Cost/lb Gain	$ 0.00
IOFC	$ 1.00
IOpurFC	$ 1.00
Feed:Gain	19.85

CP (%DM)	12.4
SP (%CP)	42
RDP (%DM)	9.03
Ether Extract (%DM)	3.4
LCFA (%DM)	2.1
Total Unsaturate (g/day)	204.1
NFC (%DM)	31.6
Starch (%DM)	21.6
Sugar (%DM)	2.4
Total Ferm. CHO (%CHO)	64.5
Forage (%DM)	90.9
aNDFom (%DM)	46.01
Forage NDF (%DM)	45.14
Forage NDF (%NDF)	98.09
Forage NDF (%BW)	1.07

	ME	MP
Supply	30.1	1121
Maintenance	14.6	508
Pregnancy	4.7	266.2
Lactation	0.0	0.0
Growth	20.1	498.3
Reserves	9.4	151
Balance	-9.4	-151.2
% Required	76	88
Allowable Gain lbs/day	2.050	1.428
Inputted Gain lbs/day	3.72	

RumenNH3 (%Rqd)	124
peNDF (%DM)	37.5
Rumen_pH	6.46
MP From Bact (%)	71.0
MP From Bact (g)	796.6
Urea Cost	0.00 Mcal

	%Rqd	%MP
Met	130.1	2.30%
Lys	127.1	7.16%
His	104.5	2.54%

3rd trimester heifers fed pregnant heifer diet

Summary For: Location 1.Third trimester heifers
Recipe: Modified 3rd trimester recipe

Inputted DMI (lbs/day)	28.00
Predicted DMI (lbs/day)	27.68
Inputted / Predicted DMI	101.2
DM (%)	38.7
Cost/head	$ 0.00
Cost/lb Gain	$ 0.00
IOFC	$ 1.84
IOpurFC	$ 1.84
Feed:Gain	10.67

CP (%DM)	13.2
SP (%CP)	40
RDP (%DM)	9.67
Ether Extract (%DM)	3.3
LCFA (%DM)	2.3
Total Unsaturate (g/day)	223.1
NFC (%DM)	40.2
Starch (%DM)	29.4
Sugar (%DM)	2.5
Total Ferm. CHO (%CHO)	69.0
Forage (%DM)	84.2
aNDFom (%DM)	38.13
Forage NDF (%DM)	36.50
Forage NDF (%NDF)	95.73

	ME	MP
Supply	32.6	1233
Maintenance	14.7	439
Pregnancy	4.7	266.2
Lactation	0.0	0.0
Growth	15.4	422.9
Reserves	2.2	0
Balance	-2.2	104.8
% Required	94	109
Allowable Gain lbs/day	2.624	3.274
Inputted Gain lbs/day	3.09	

RumenNH3 (%Rqd)	111
peNDF (%DM)	30.1
Rumen_pH	6.46
MP From Bact (%)	71.5
MP From Bact (g)	881.2
Urea Cost	0.12 Mcal

	%Rqd	%MP
Met	163.3	2.33%
Lys	160.6	7.23%
His	131.5	2.59%

Summary For: Location 1.closeup heifers
Recipe: closeup heifers Recipe

Inputted DMI (lbs/day)	26.06
Predicted DMI (lbs/day)	23.89
Inputted / Predicted DMI	109.1
DM (%)	40.0
Cost/head	$ 0.00
Cost/lb Gain	$ 0.00
IOFC	$ 1.22
IOpurFC	$ 1.22
Feed:Gain	14.89

	ME	MP
Supply	30.6	1293
Maintenance	16.0	410
Pregnancy	5.3	313.8
Lactation	0.0	0.0
Growth	11.8	470.7
Reserves	2.5	0
Balance	-2.5	99.0
% Required	92	108
Allowable Gain lbs/day	1.749	2.117
Inputted Gain lbs/day	1.83	

CP (%DM)	15.5
SP (%CP)	35
RDP (%DM)	10.24
Ether Extract (%DM)	3.4
LCFA (%DM)	2.5
Total Unsaturate (g/day)	223.0
NFC (%DM)	38.1
Starch (%DM)	27.5
Sugar (%DM)	2.8
Total Ferm. CHO (%CHO)	70.8
Forage (%DM)	79.7
aNDFom (%DM)	36.97
Forage NDF (%DM)	34.69
Forage NDF (%NDF)	93.83

RumenNH3 (%Rqd)	116
peNDF (%DM)	28.7
Rumen_pH	6.46
MP From Bact (%)	62.0
MP From Bact (g)	801.6
Urea Cost	0.12 Mcal

	%Rqd	%MP
Met	161.4	2.37%
Lys	159.5	7.29%
His	140.2	2.84%

Mineral and vitamin status of un-supplemented pregnant heifers: 521 kg, 160 days pregnant

Ration Outputs | AA Supp. Tool | CNCPS | Min & Vit | Additives | Amino Acids

Nutrient	Diet Concentration	Diet Intake	Added	Water Intake	Absorbed			%Rqd
					Supplied	Rqd	Balance	
Ca	0.43 %DM	48.6	0	0	20.47	21.67	-1.19 g/day	94%
P	0.44 %DM	49.73	0	-	33.79	17.76	16.03 g/day	190%
Mg	0.25 %DM	27.82	0	-	5.56	2.12	3.44 g/day	262%
K	1.58 %DM	177.7	0	0	159.93	51.03	108.90 g/day	313%
S	0.20 %DM	22.48	0	0	22.48	22.48	0.00 g/day	100%
Na	0.05 %DM	5.68	0	0	5.11	9.56	-4.45 g/day	53%
Cl	0.40 %DM	45.42	0	0	40.88	12.98	27.90 g/day	315%
Fe	175.53 ppm	1973.18	0	0	197.32	42.23	155.09 mg/day	467%
Zn	40.68 ppm	457.27	0	0	91.45	53.28	38.18 mg/day	172%
Cu	7.47 ppm	83.97	0	0	3.36	6.63	-3.27 mg/day	51%
Mn	45.58 ppm	512.39	0	0	5.12	1.91	3.21 mg/day	268%
Se	0.11 ppm	1.21	0	-	1.21	3.37	-2.16 mg/day	36%
Co	0.05 ppm	0.56	0	-	0.56	1.24	-0.68 mg/day	45%
I	0.01 ppm	0.1	0	-	0.09	3.13	-3.04 mg/day	3%
Vit-A	0.00 KIU/lb	0	0	-	0	41.72	-41.72 KIU/day	0%
Vit-D	0.45 KIU/lb	11.24	0	-	11.24	15.65	-4.40 KIU/day	72%
Vit-E	0.00 IU/lb	0	0	-	0	417.23	-417.23 IU/day	0%

Effect of Close-up Dry Period Protein Level on Preparturiental Nitrogen Balance and Lactating Performance of Primigravid and Multiparous Holstein Cows Adachi et al., 2006

- Study evaluated the level of CP in the close up diet and determined under the conditions of their study, 14% CP was adequate to meet the tissue and pregnancy needs of their primiparous heifers and the requirements for mature cows was 12% CP in their study

- However, it is important to note that their primiparous heifers weighed 94% of the mature cattle on the study

- Most of our heifers are approximately 72% to 80% of the mature cows at best, thus those heifers were very close to mature body size by comparison, therefore tissue protein requirements were lower

At 72-78% of mature size and the limitations on DMI, the CP level might need to be as high as 18% to achieve the 1250 g MP supply and this will depend on the amount of forage and type of forages and the level of starch provided

First lactation heifers can be hurt the most in the pre-fresh dry cow feeding scenario

- They still have significant requirements for growth, mammary development, liver hypertrophy, fetal requirements and colostrogenesis
- Low energy, high fill diets are counterintuitive for this group of cattle because of their requirements and intake capacity
- Dry matter intakes are not nearly as high as multiparous cattle, thus with high fill diets, heifers are deficient on nutrients, especially protein

MP and AA recommendations prefresh

- Target 1200 to 1400 g/d MP
- Lysine ≥ 6.8 to 7.2 % of MP (CNCPS 6.5 biology)
- Methionine ≥ 2.6 – 2.8 % of MP (CNCPS 6.5 biology)
- Dr. Patrick French systematic review of literature and regression analysis (2012):
  - Suggests 1,300 g/d MP, 30 g/d Met, and 90 g/d Lys prepartum
- Focus protein supplementation pre-fresh on RUP sources with additional AA supplemented
  - Meet MP requirements more efficiently (feed less supplemental protein)
  - Cow metabolically does not handle excess N well at time of calving

Pre-fresh heifers

MP supply should be at least 1,200 g to 1,300 g depending on size of heifer

- Sounds high, but meets the needs of mammary growth, liver hypertrophy, fetal growth and colostrum production
- Don’t treat a growing, pre-fresh heifer like a multiparous cow. She still has growth requirements and needs a diet more similar to a lactating cow at this point
- Means high quality proteins (blood, RP soy or canola), some methionine and higher digestibility forages

Thank you for your attention