Protein and Energy Nutrition of the Neonatal Calf

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Part I – WIT-FM?

WIT-FM?
What's in this for me?

What's in this for me?

1) More efficient gain
2) Lower cost of gain
3) Better carcass quality

Part II –
Things We Forgot…
Then,
Recently Re-Discovered:

Milk Replacer Balance Determines Calf Performance

Rate of Gain, Efficiency of Gain, and Composition of Gain Depends on Protein:Energy Ratio.

Effect of Lipid and Protein Level vs Performance of *Litopenaeus vannamei*

Lipid Level, %	3	3	3	11	11	11
Protein Level, %	10	18	25	10	18	25
Survival Rate, %	75.8	82.2	92.5	66.7	74.2	75.8
Weight Gain, mg	64.4	72.4	76.7	58.3	74.1	71.4
Feed:Gain	2.4	1.9	1.6	3.0	2.1	2.1

Source: Velasco *et al*., 2000

Effect of LYS:DE Ratio on Performance of Pigs

Lys:DE Ratio	Low	Medium	High
ADG, lb	1.32[a]	1.47[b]	1.61[c]
Feed:Gain	3.16[a]	2.86[b]	2.67[c]
Empty Body Wt, lb	220.0	220.9	220.7

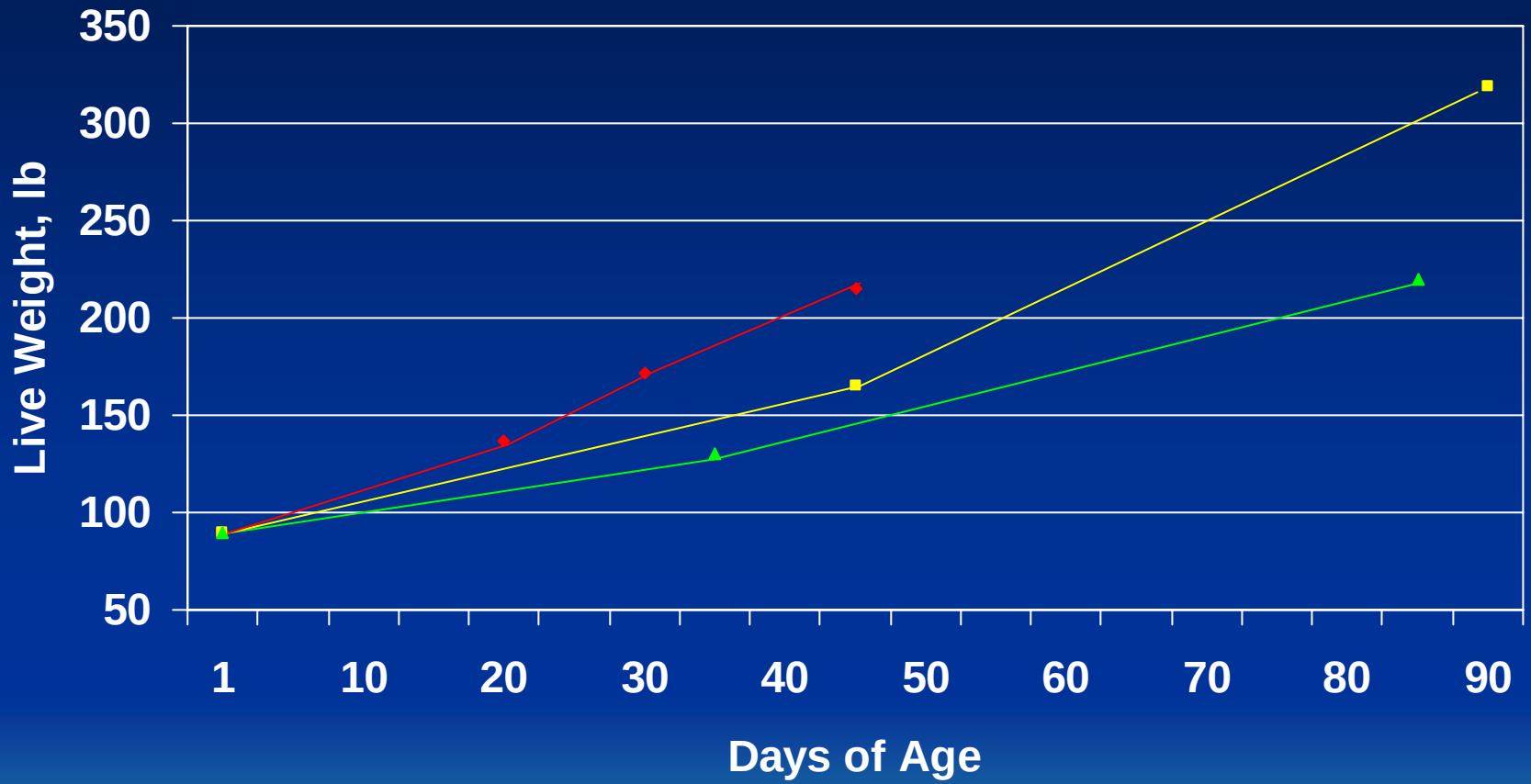
Source: Szabó *et al*., 2001

Effect of LYS:DE Ratio on Carcass Composition

Lys:DE Ratio	Low	Medium	High
Carcass Fat, %	25.9[a]	23.5[b]	20.7[c]
Carcass CP, %	14.1[a]	14.5[ab]	14.8[b]
Carcass DM, %	43.3[a]	41.1[b]	38.8[c]
Carcass Ash, %	2.72[a]	2.80[a]	2.77[a]

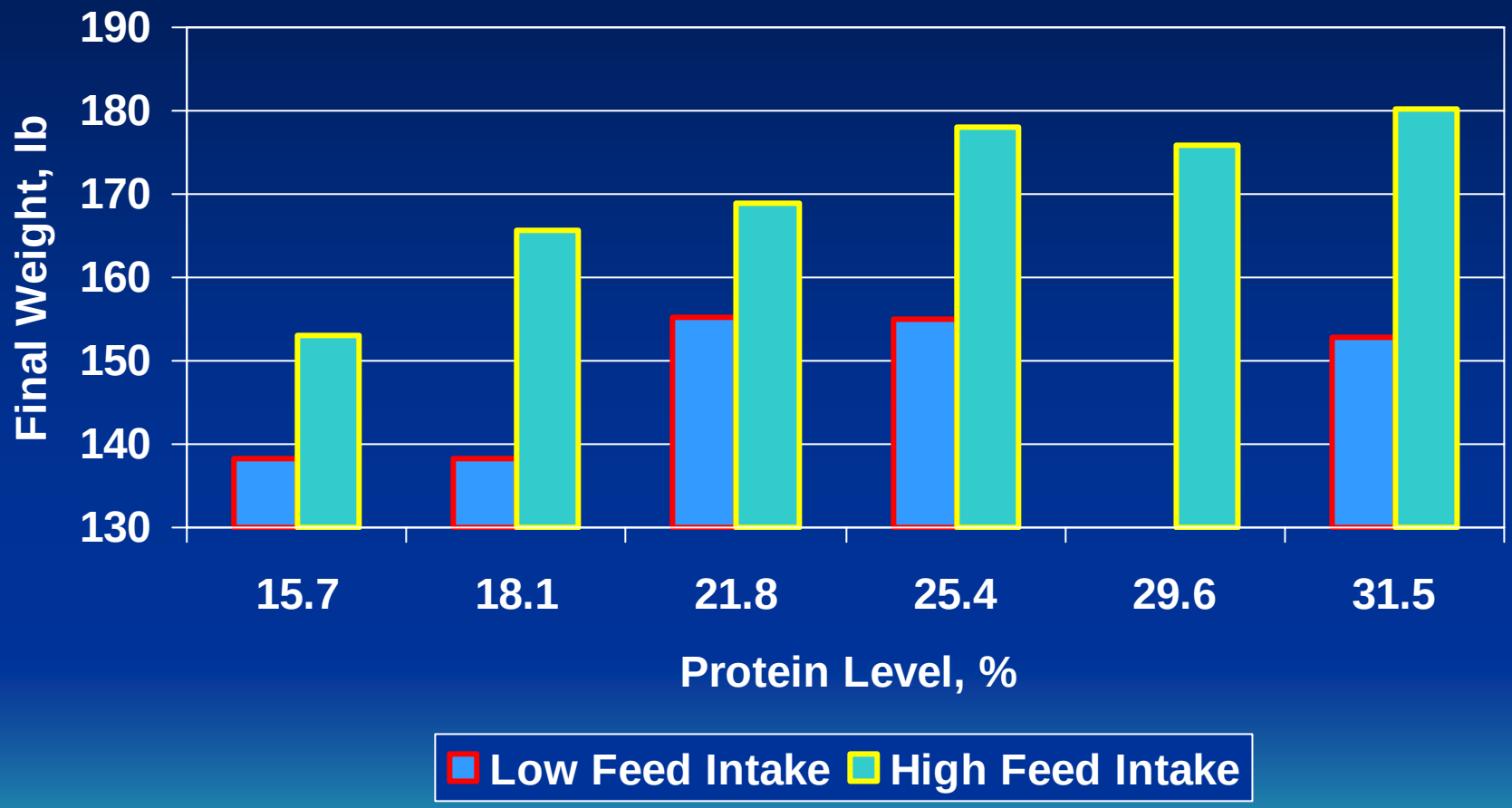
Source: Szabó *et al*., 2001

Live Weight of Calves fed Accelerated, Veal, or Holstein Beef vs Age



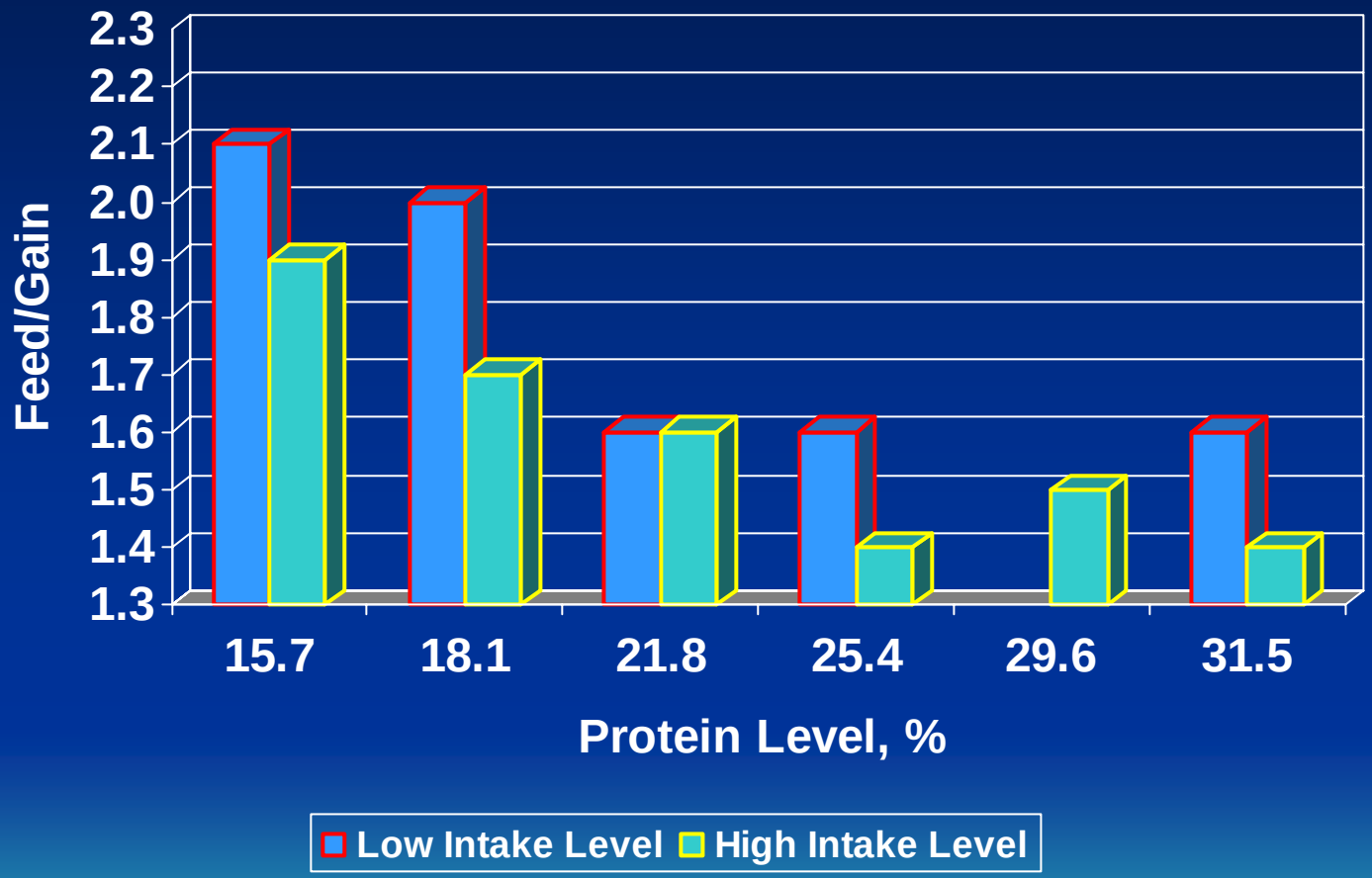
Source: Diaz, 1998; Vermeire, 2002, Vermeire, 1998

Protein Level vs Final Weight of Calves



Source: Donnelly and Hutton, 1976. NZ J Agric Res 19:289-97

Protein Level vs. Feed:Gain of Calves

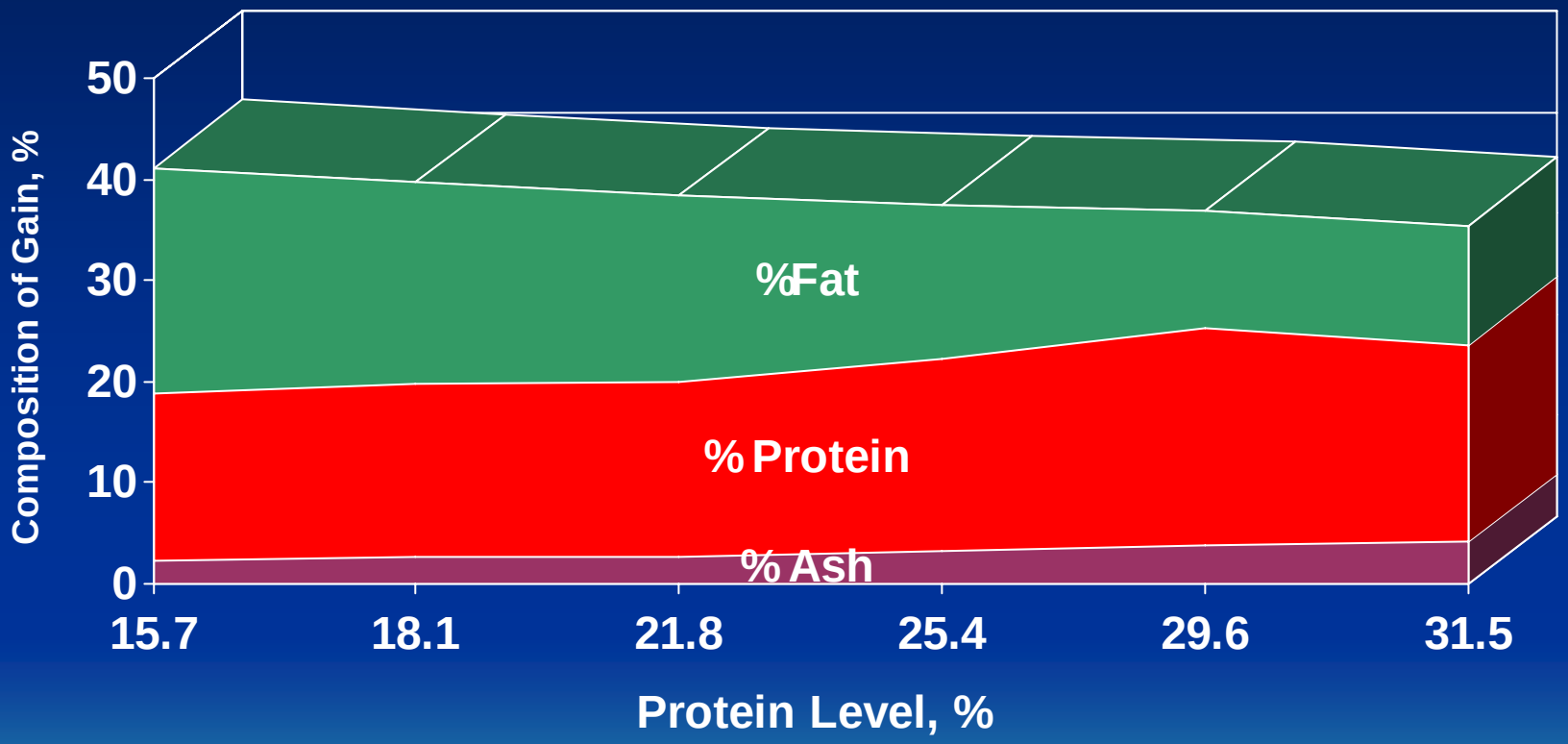


Source: Donnelly and Hutton, 1976. NZ J Agric Res 19:289-97

Live Animal and Carcass Composition Depends on Protein:Energy Ratio

Protein Level vs Composition of Gain

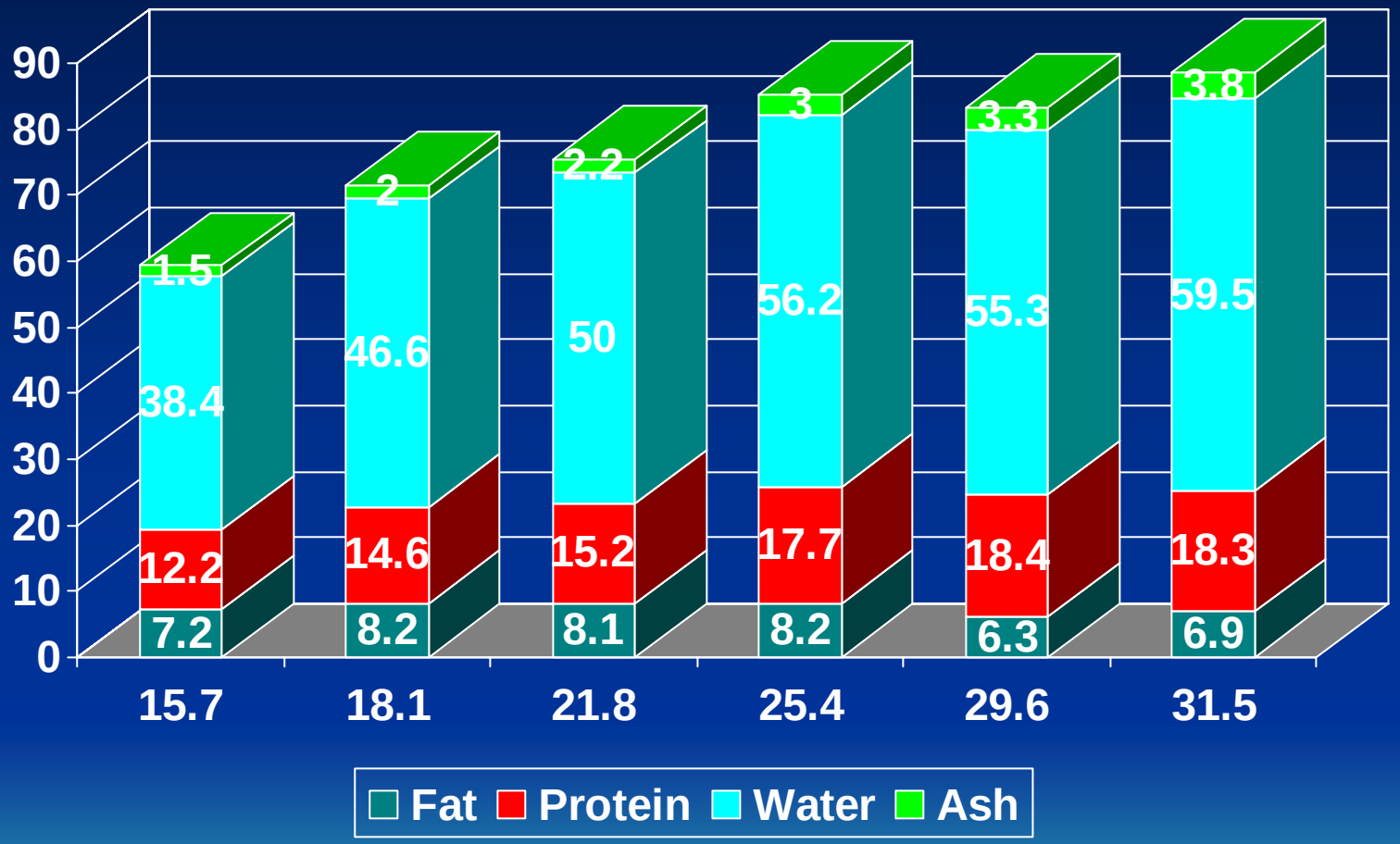
(as a percentage of total gain)



Source: Donnelly and Hutton, 1976. NZ J Agric Res 19:409-414

Protein Level vs. Composition of Gain of Calves

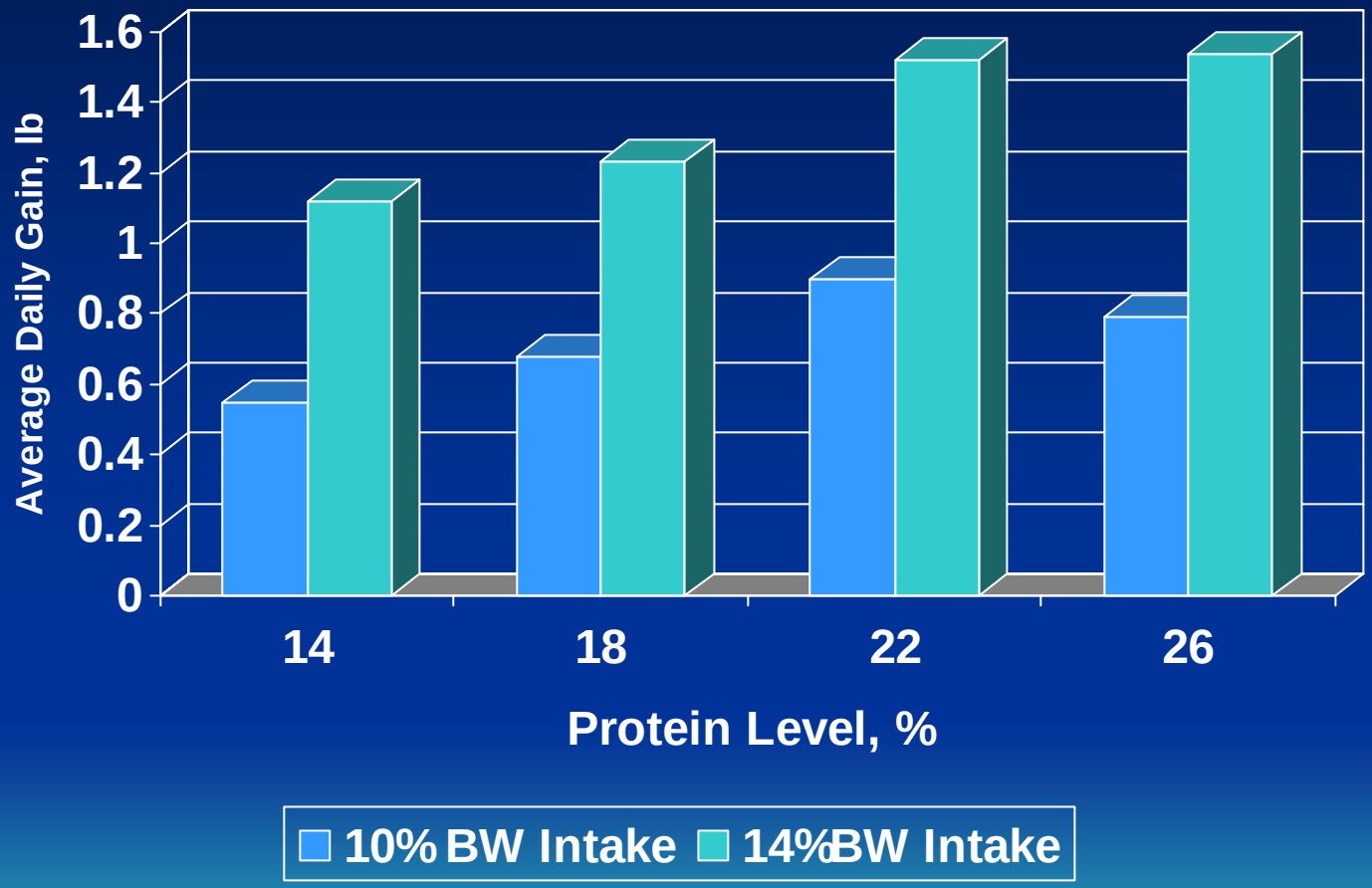
(as total lb gained for each component)



Source: Donnelly and Hutton, 1976. NZ J Agric Res 19:409-414

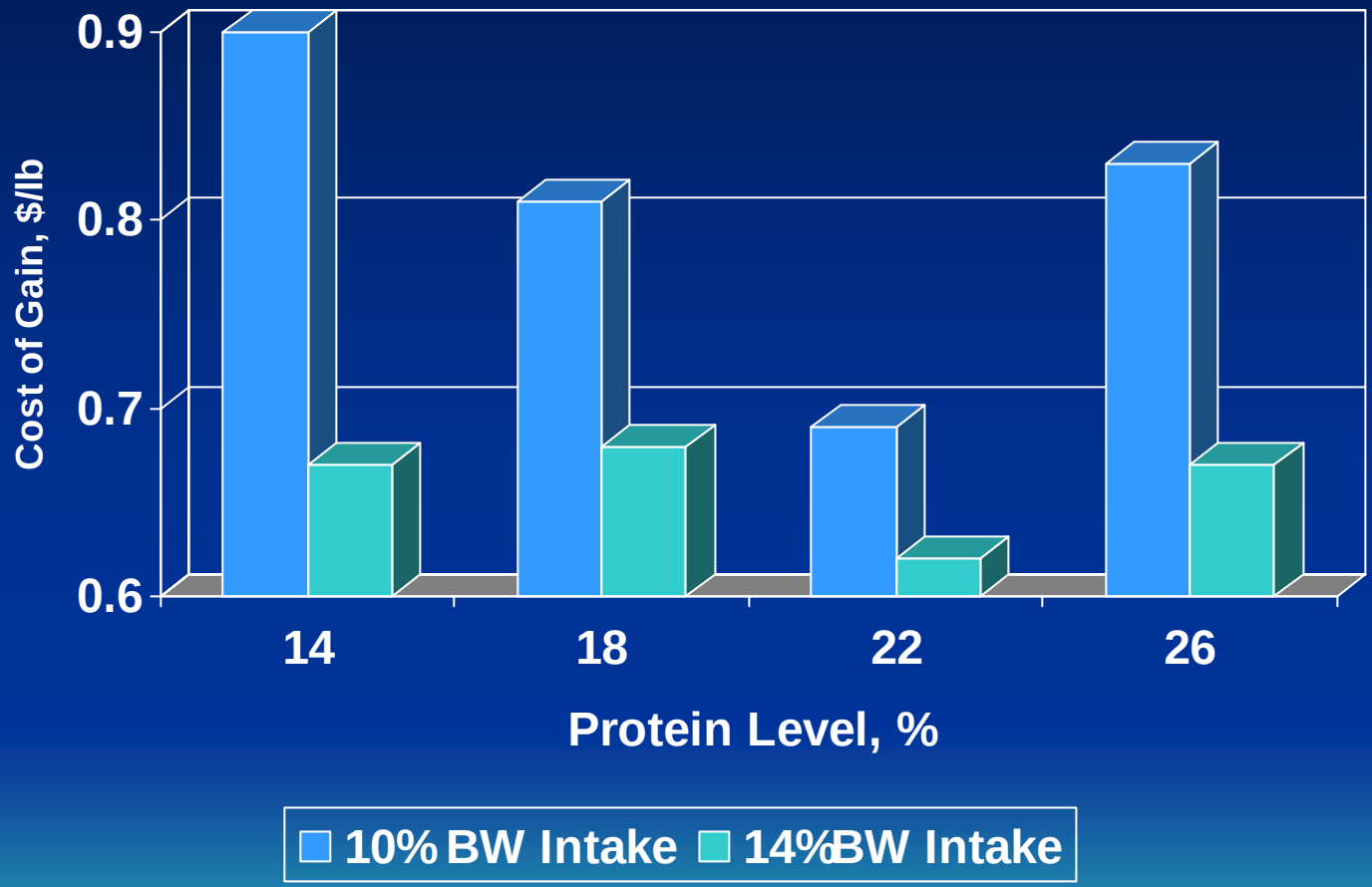
Higher Protein:Energy Ratio Results in Higher Carcass Protein, Water, and Ash with Lower Carcass Fat

Protein Level vs Calf Average Daily Gain



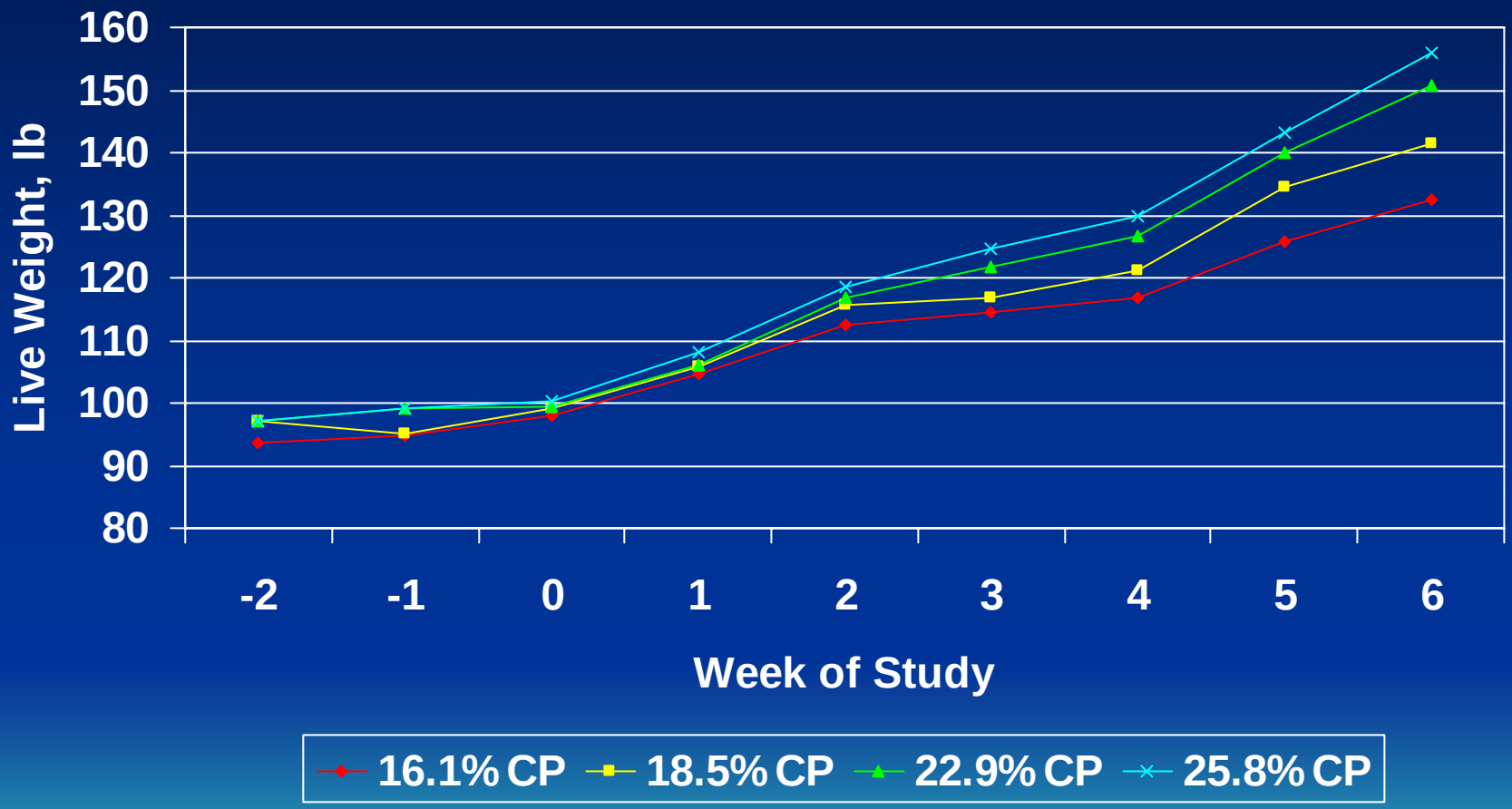
Source: Bartlett, 2001. University of Illinois

Protein Level vs Calf Cost of Gain



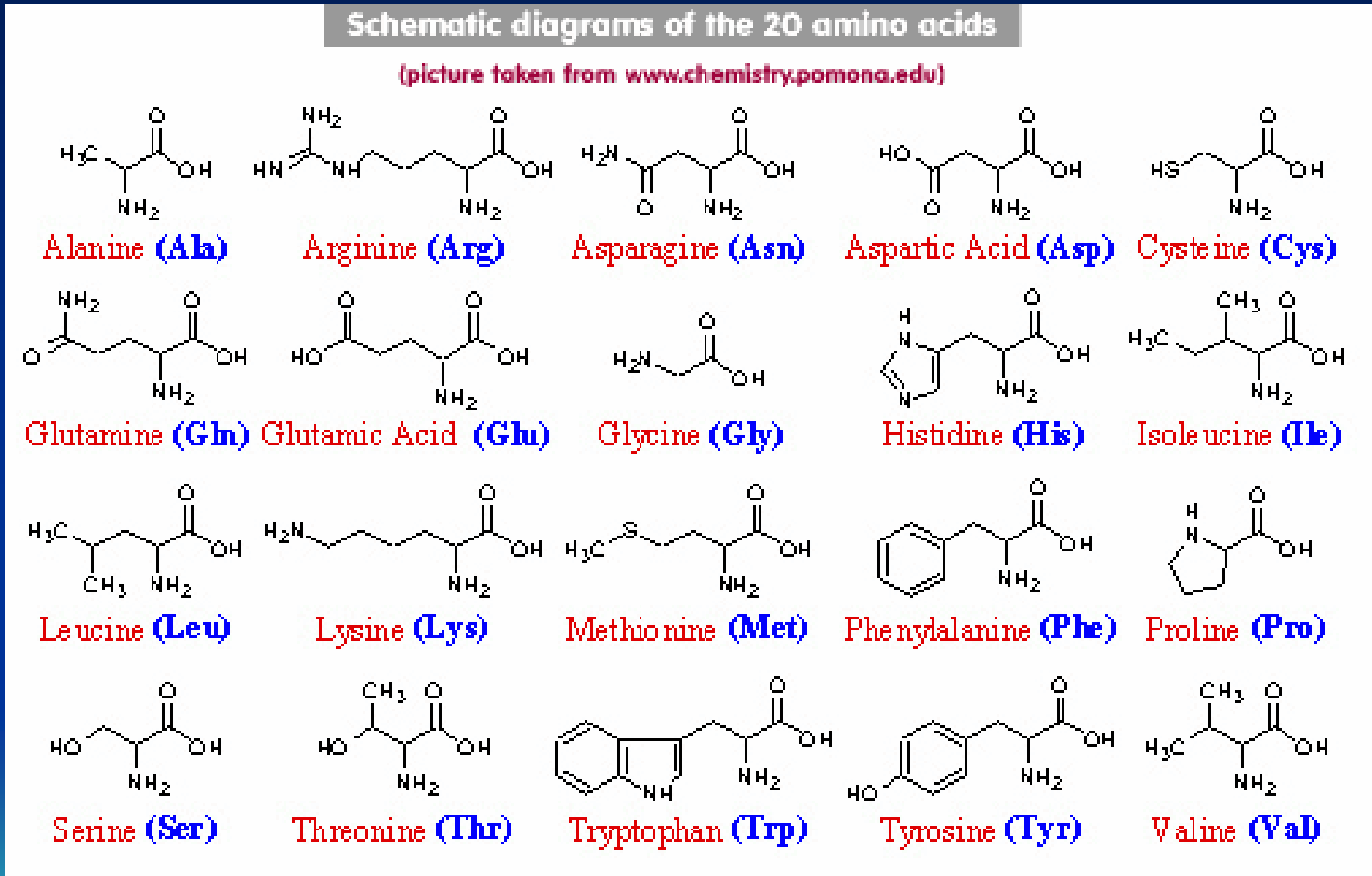
Source: Bartlett, 2001. University of Illinois

Protein Level vs. Feed:Gain in Calves



Source: Blome *et al.*, 2003. J Anim Sci 81:1641-1655

20 Amino Acids



Amino Acids

- Protein Synthesis – Building Blocks
- Hormone Synthesis and Modulation – Arginine and Growth Hormone
- “Amino Acid Imprinting” Combination of glucogenic and branched chain amino acids in milk replacer for 1st 14 days significantly increased marbling 18 months later

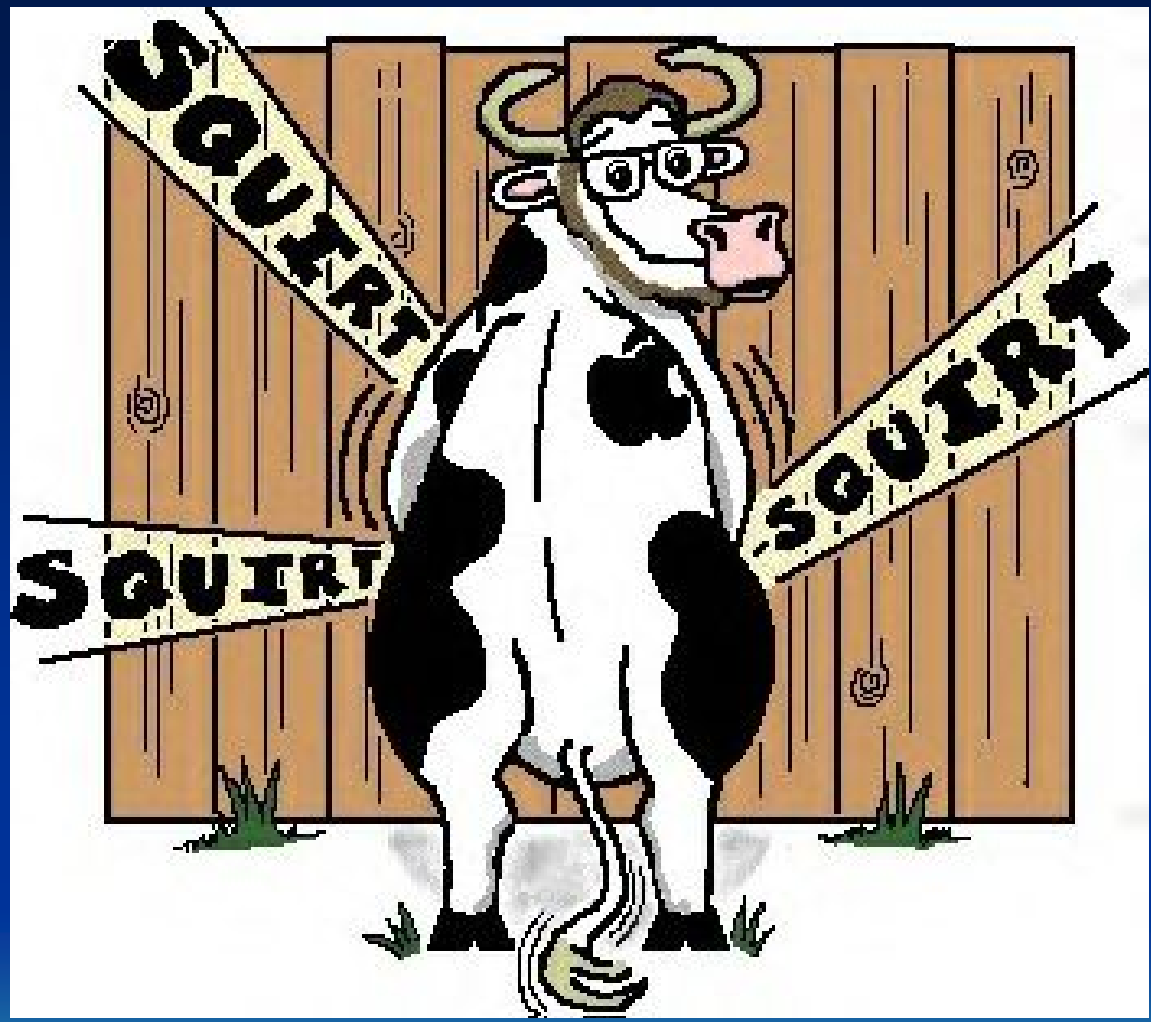
Amino Acids Are Toxic!

Toxicity of Methionine in Neonatal Calves: Methionine Intake vs Performance

g/d DL-MET	0	6	12	18	24
DMI, kg/d	1.55	1.59	1.55	1.24	1.21
ADG, g/d	261	400	243	-229	-129
g gain/kg feed	169	251	157	-185	-107

Source: Abe *et al*. (2000) J Anim Sci 78:2722-2730

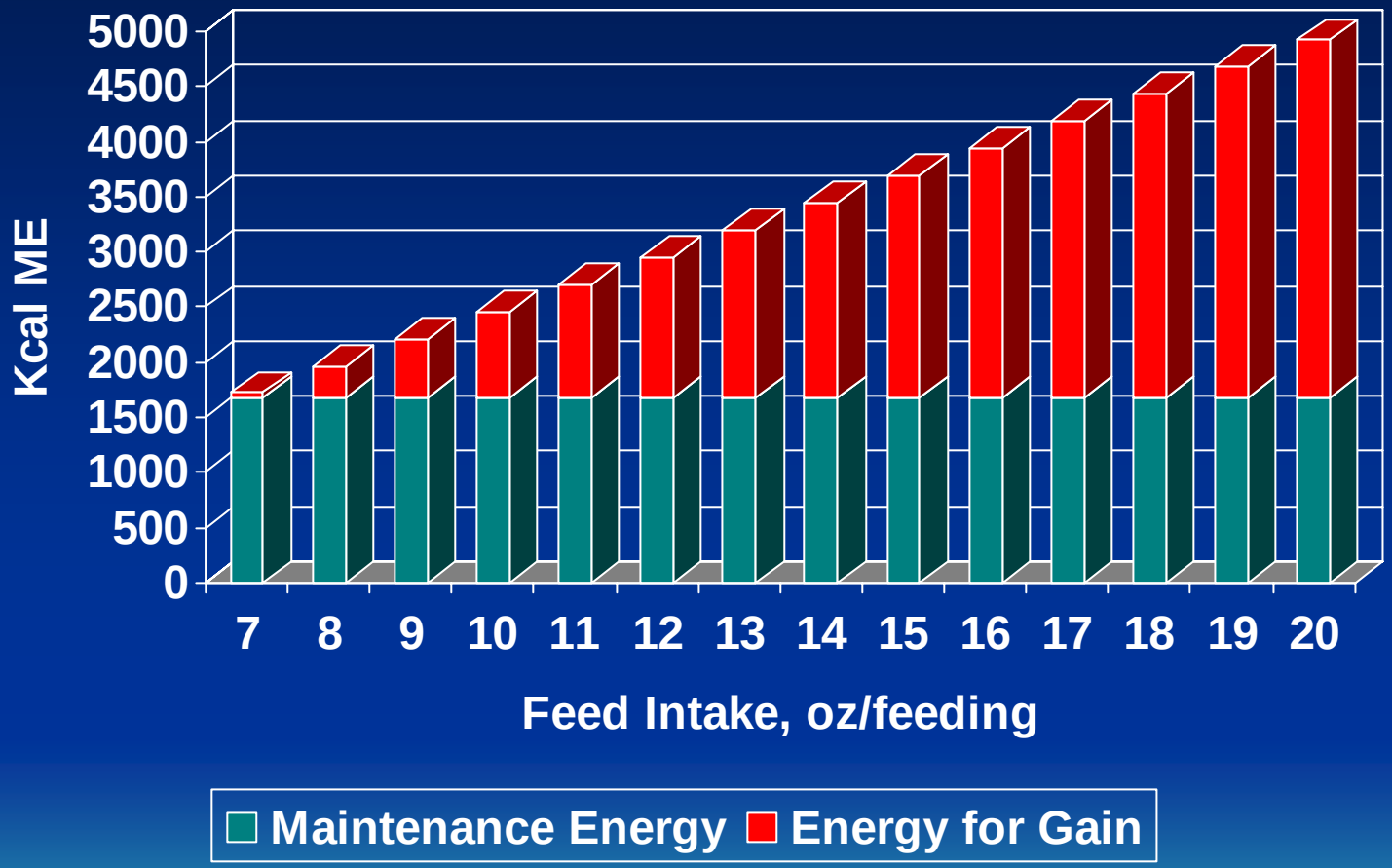
Protein and Energy Needs



Protein and Energy Needs

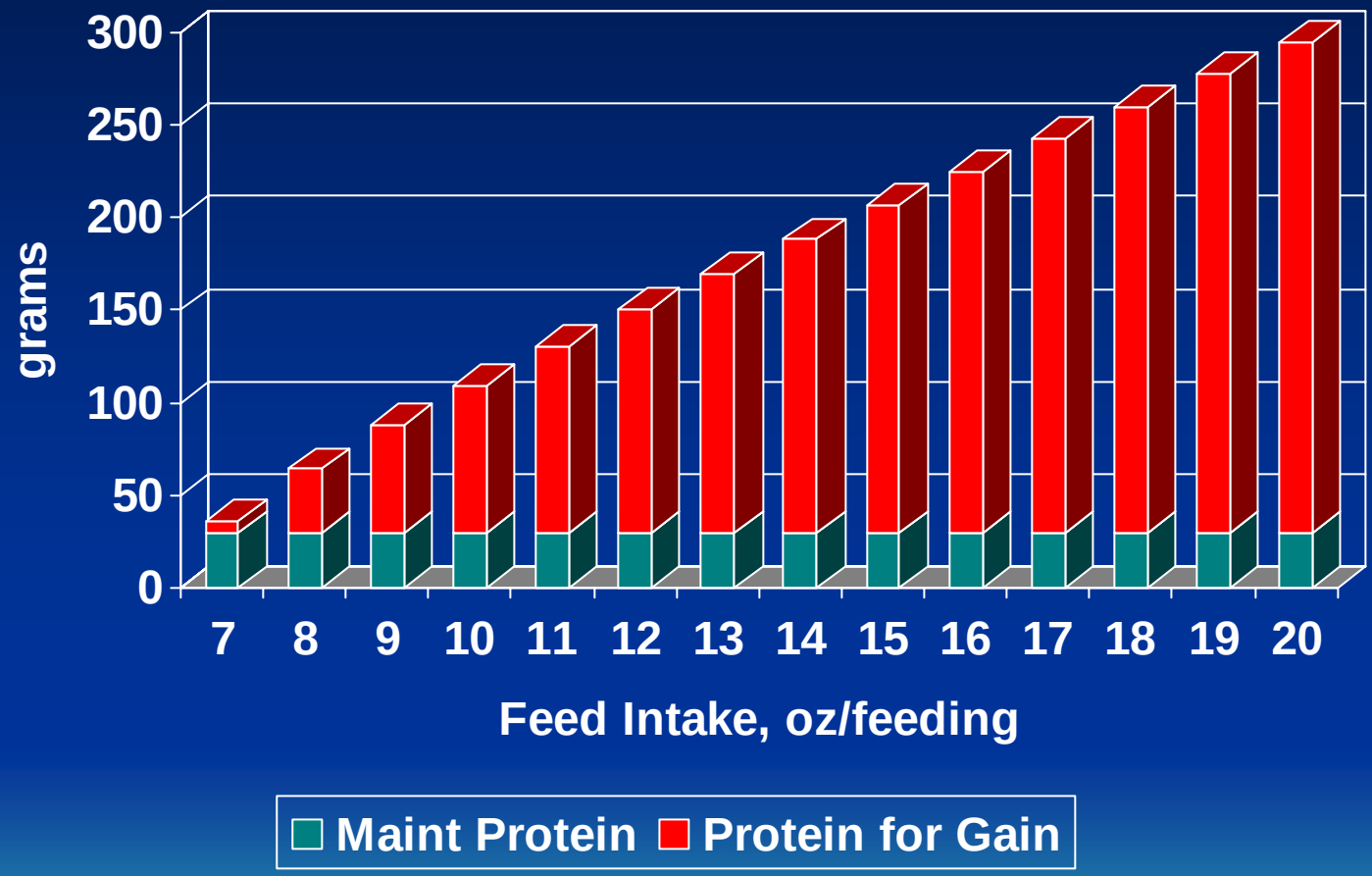
- $ME=0.1\ LW^{0.75} + 0.84(LW^{0.355})(LWG^{1.2})$
- ADP (g/d) =6.25[1/BV*(E+G+M*D)-M*D]
- LW=Live Weight in Kg
- LWG=Live Weight Gain in Kg
- BV = Biological Value = 0.73
- E = Endogenous urinary N = $0.2*LW^{0.75}$
- G = N stored in Gain = 30*LWG
- M = Metabolic fecal N = 2.2*D
- D = DMI in kg

Feed Intake vs Energy Needs Maint & Growth



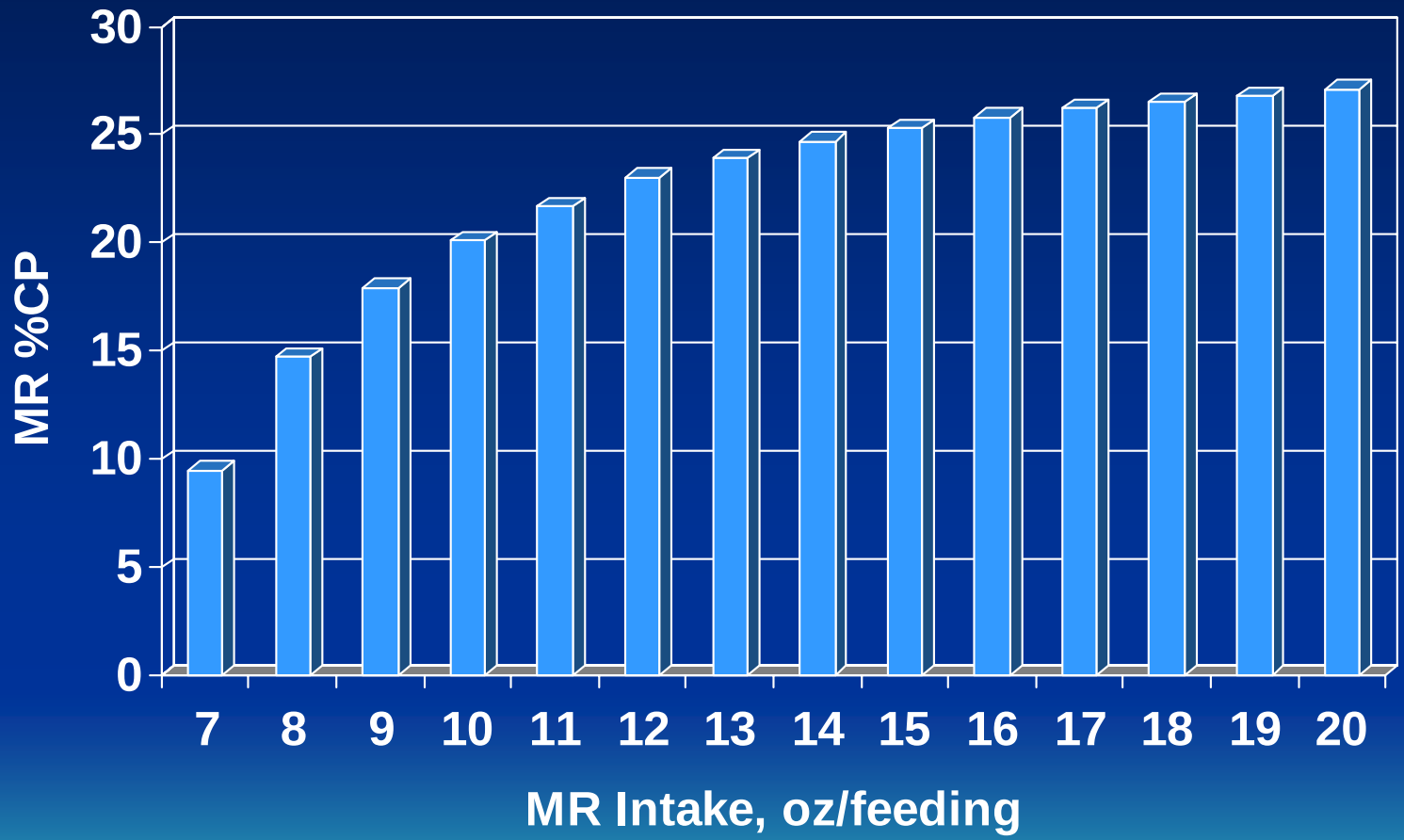
Source: Vermeire, 2005

Feed Intake vs Protein Needs Maint & Growth



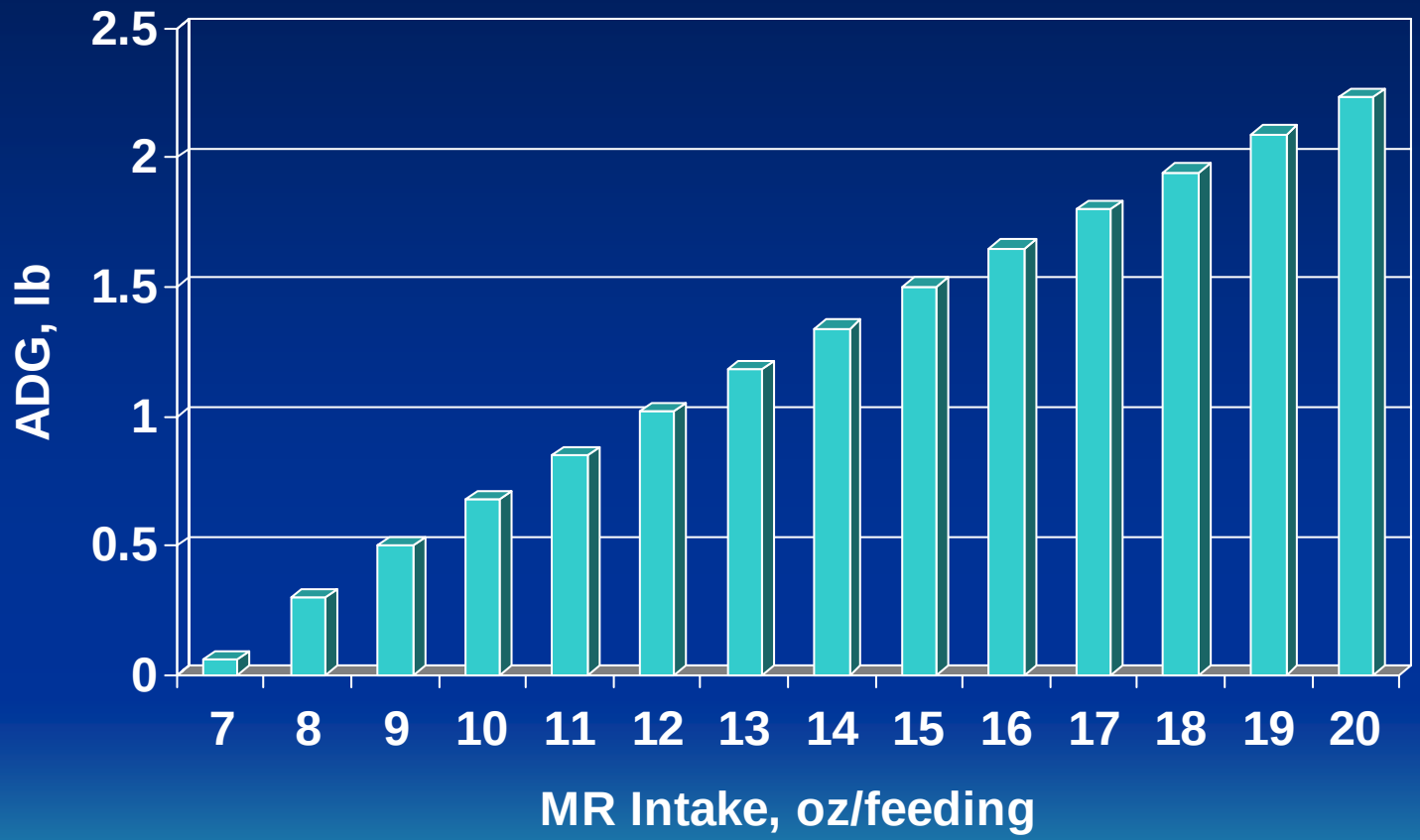
Source: Vermeire, 2005

MR Intake vs Protein Requirement



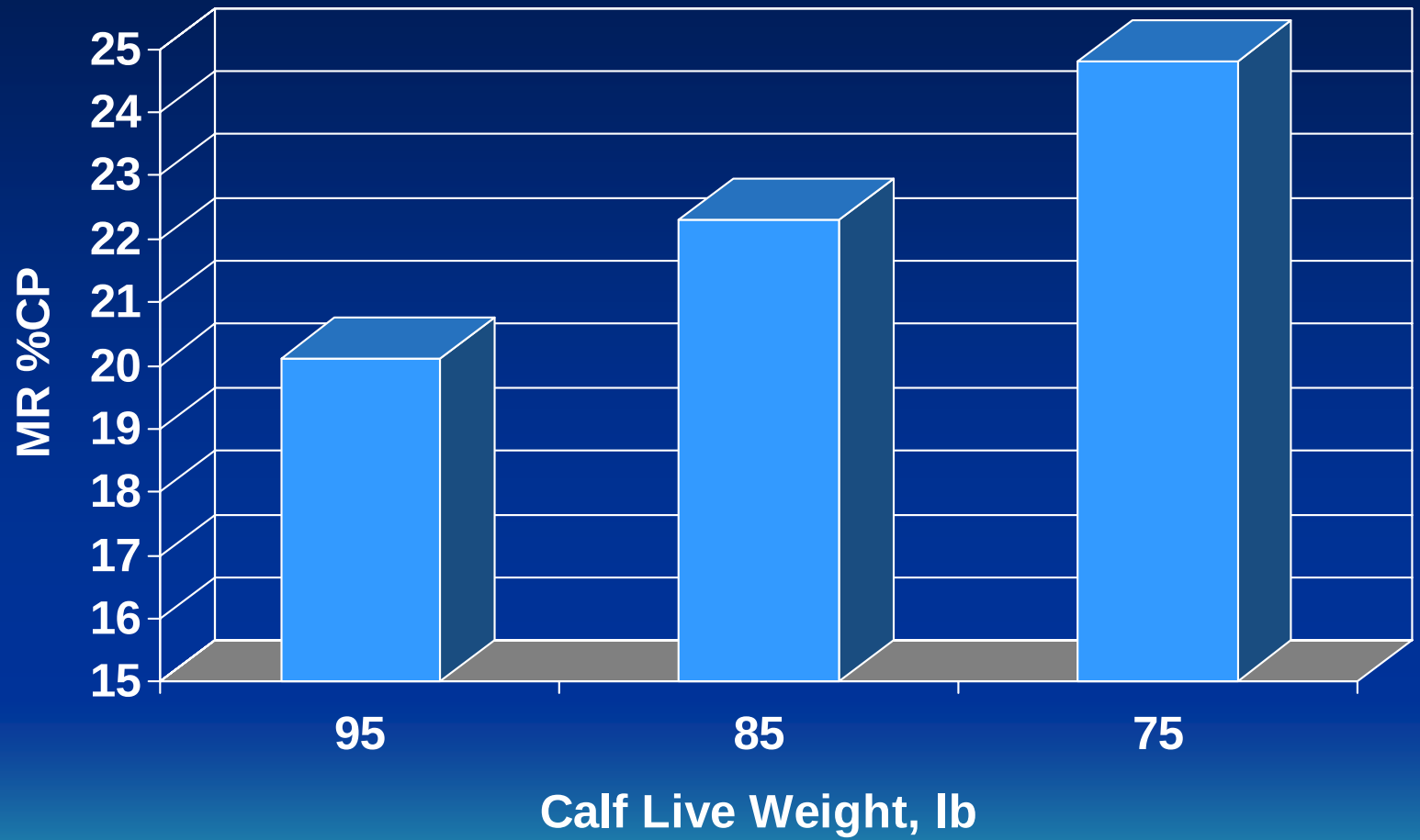
Source: Vermeire 2005

MR Intake vs Avg Daily Gain



Source: Vermeire 2005

Calf Live Weight vs MR Protein Need



Source: Vermeire 2005

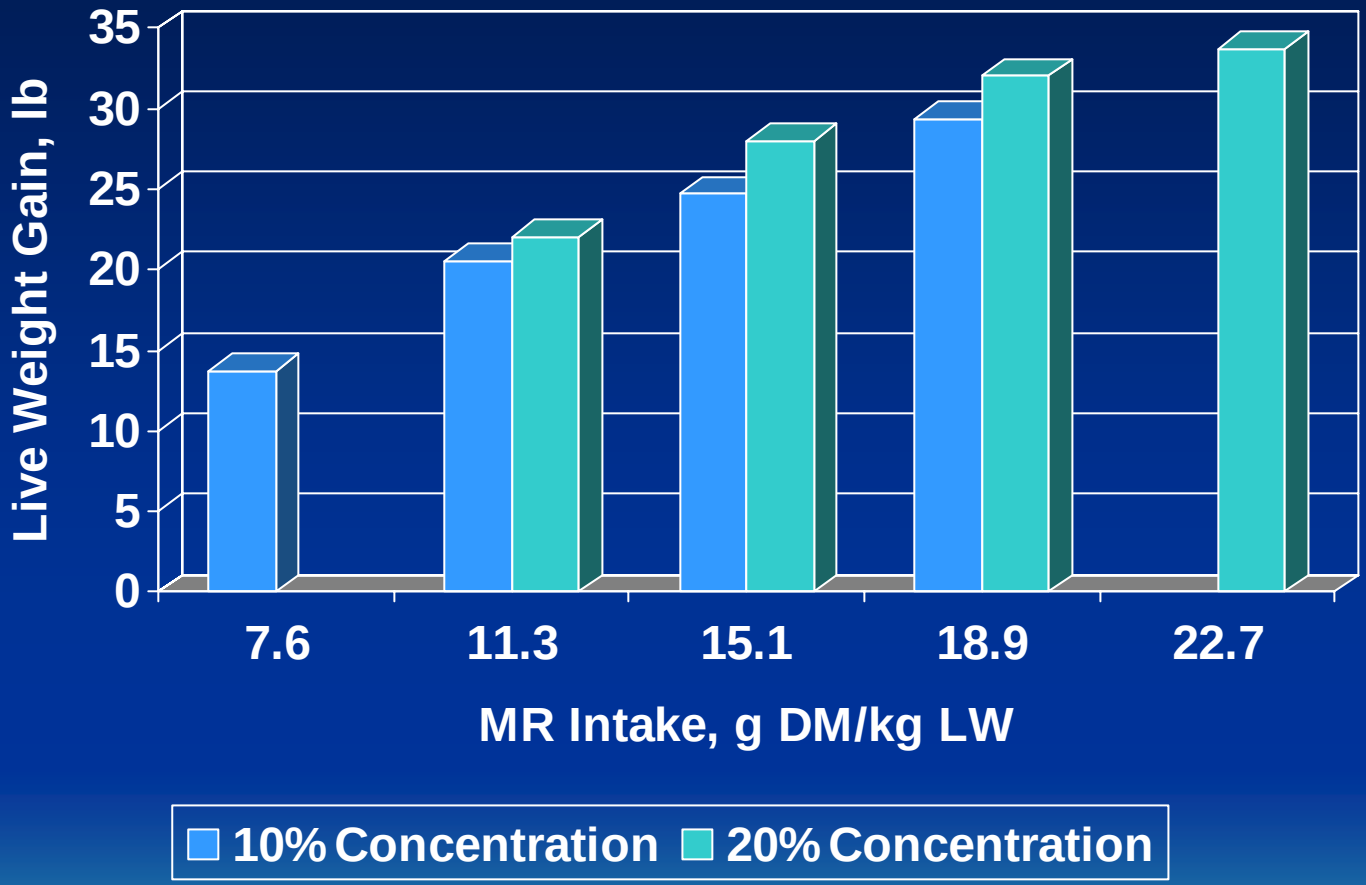
Milk vs Grain

All Milk, No Grain?

"Each Suckled Calf consumed 16.9 kg milk/day; the Suckled Calves did not consume concentrates or hay, *although feed was freely available*."

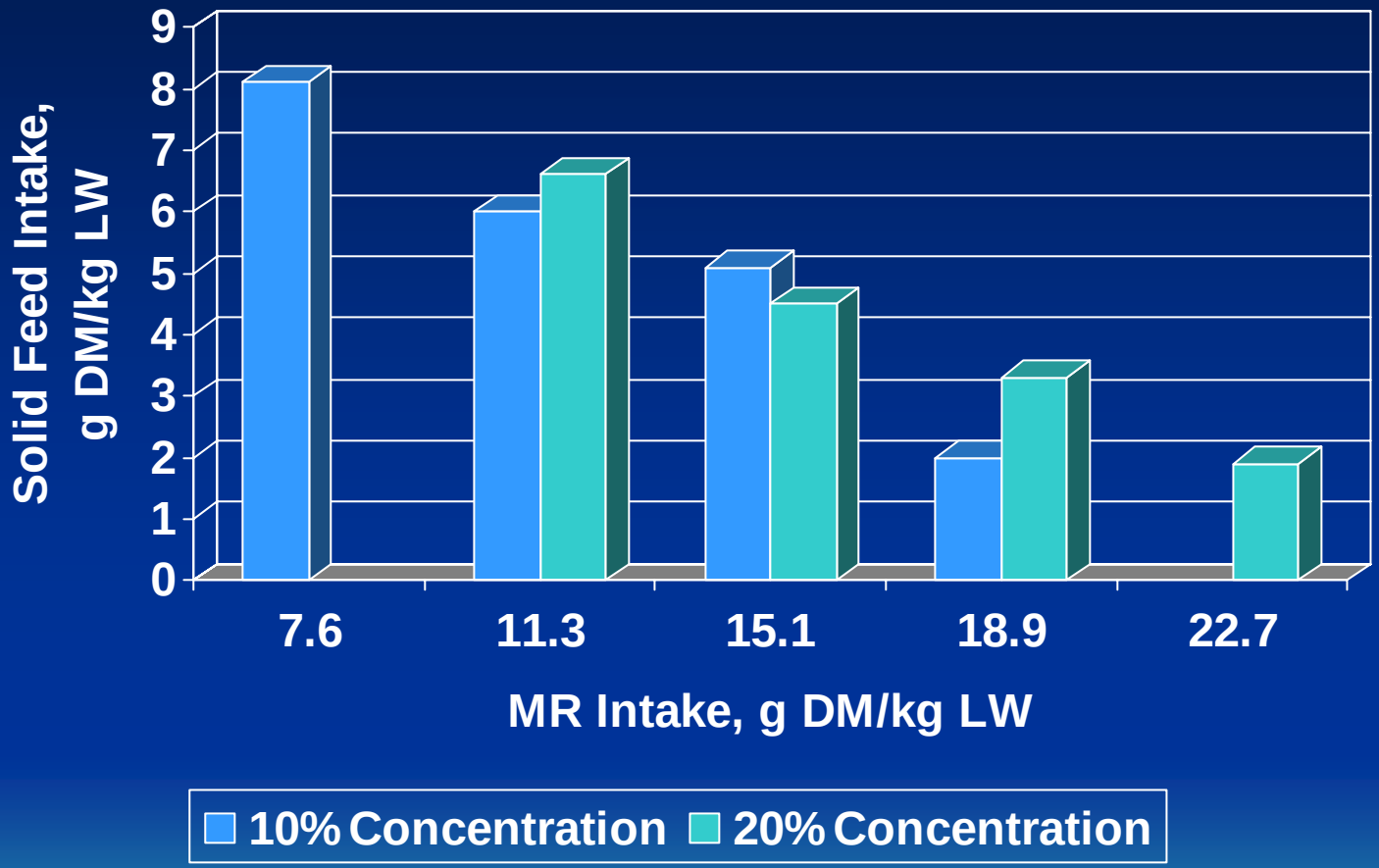
Source: Bar-Peled, *et al.*, 1997. J Dairy Sci 80:2523-2528

MR Intake vs Pre-Weaning Gain



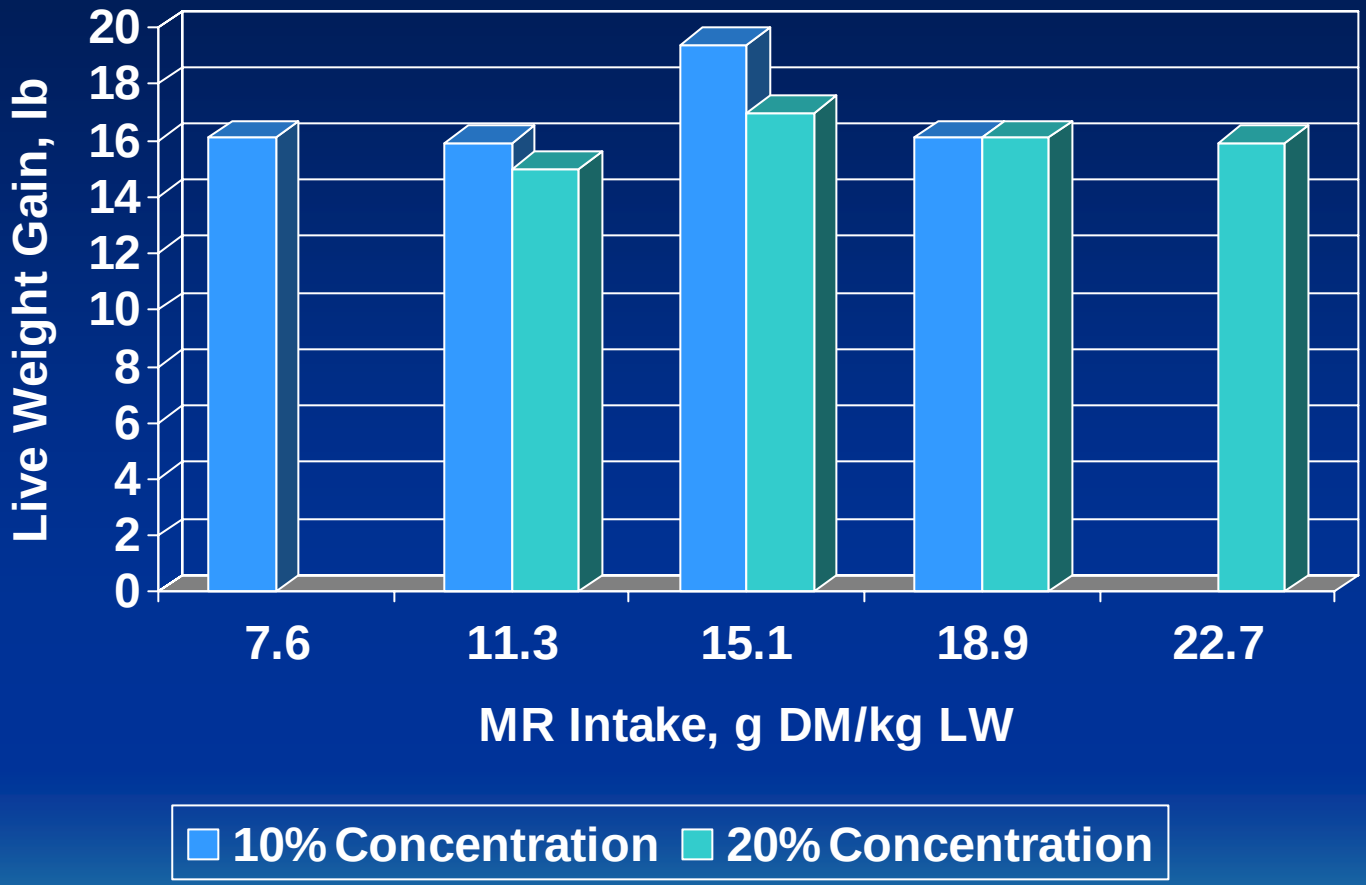
Source: J. Hodgson. 1971. Anim Prod 13:593-597

MR Intake vs Solid Feed Intake



Source: J. Hodgson. 1971. Anim Prod 13:593-597

MR Intake vs Post-Weaning Gain



Source: J. Hodgson. 1971. Anim Prod 13:593-597

Putting It to Use

K.I.S.S. System

Milk Replacer Feeding

- Must plan for MR intake, calf weight, and MR protein concentration
- Must be practical – 2 quart bottle
- I recommend 12-14 oz/feeding in 2 quarts
- Requires 24% CP/16% Fat
- Near-minimum cost of gain
- Maximize starter feed intake

Weaning

- Energy limits performance – not protein
- Solid feed intake prior to/during weaning may influence intake post-weaning
- Step-down may be superior to abrupt weaning for management of calves and post-weaning feed intake

Weaning Criteria

- Calves minimum 3 weeks old
- Calves consume starter feed at rate of 1% of initial Body Weight for 3 consecutive days
- Total dry starter feed intake is ≥9% of initial Body Weight
- Body weight gain is ≥12% of initial Body Weight

Source: Greenwood *et al.*, 1997

Thank You!