

State of the Union – NA Models



M. D. Hanigan and J. R. Knapp

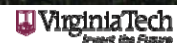


Environmental Impact of Waste N

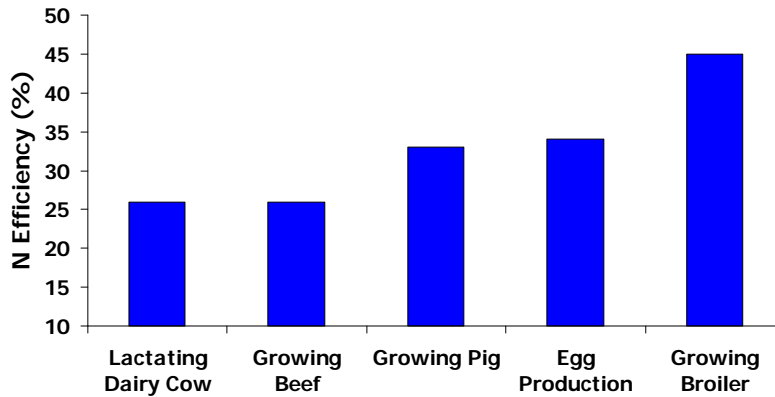
Eutrophication



Air Quality and High N Rain



N Conversion Efficiencies for Different Production Systems

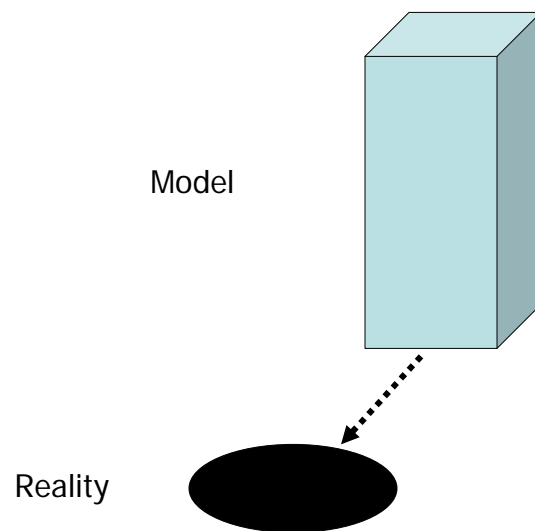


Bequette et al., 2003



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Is Our Bias Preventing Progress?



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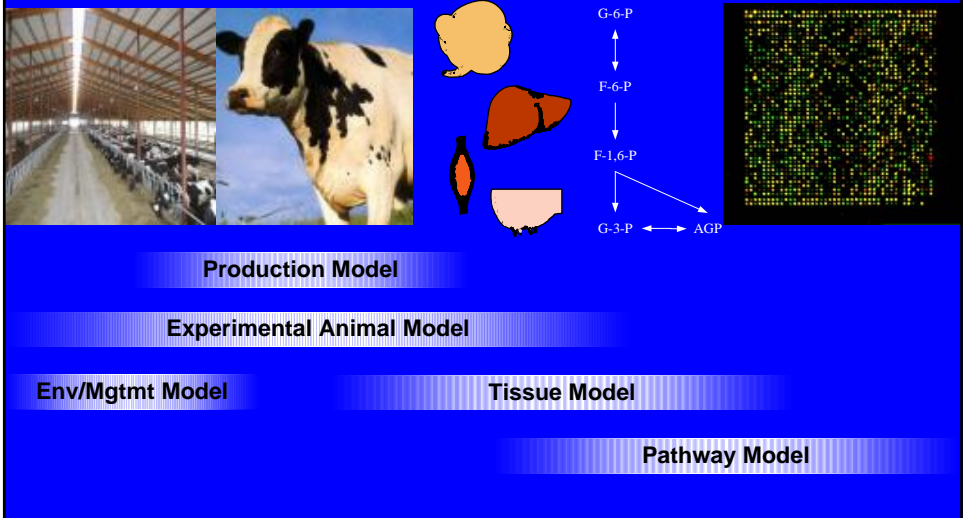
Models “Developed” in North America

- NRC 2001
- Cornell Net CHO & Protein System
 - CNCPS
 - CPM – derived from CNCPS
- Molly – UC-Davis model
- How well does each work?

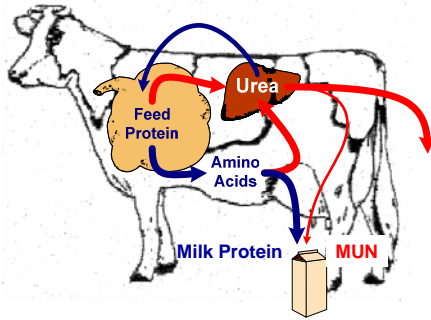
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Knowledge Integration



Key Components of N Metabolism

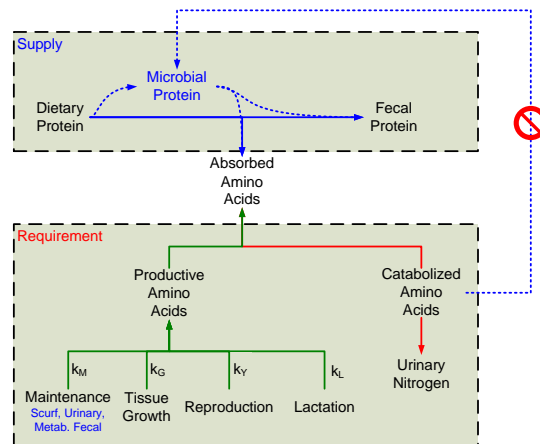


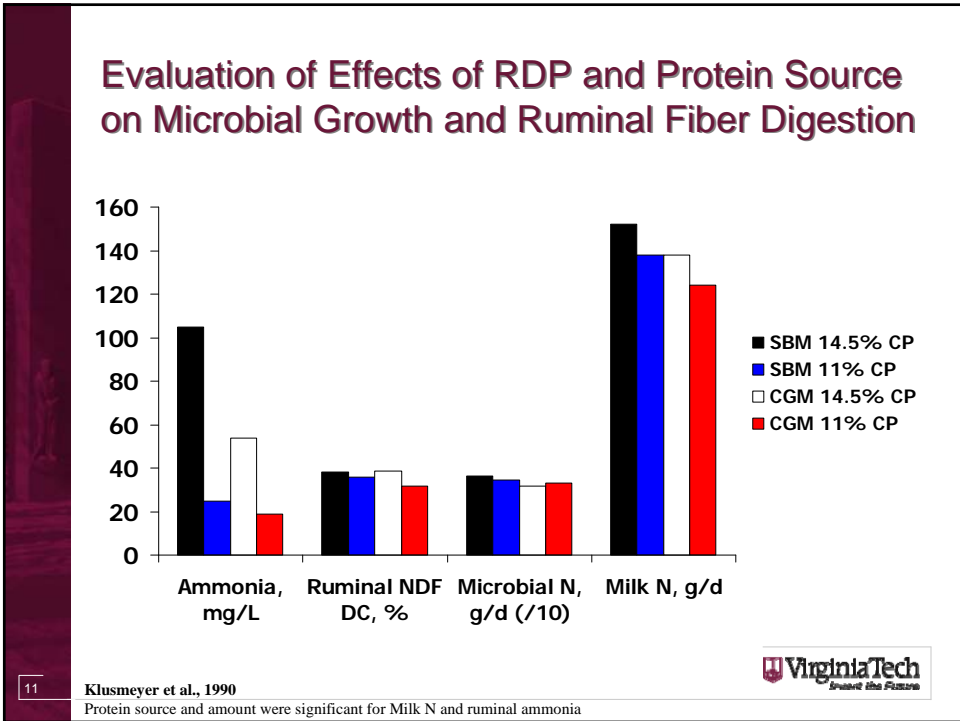
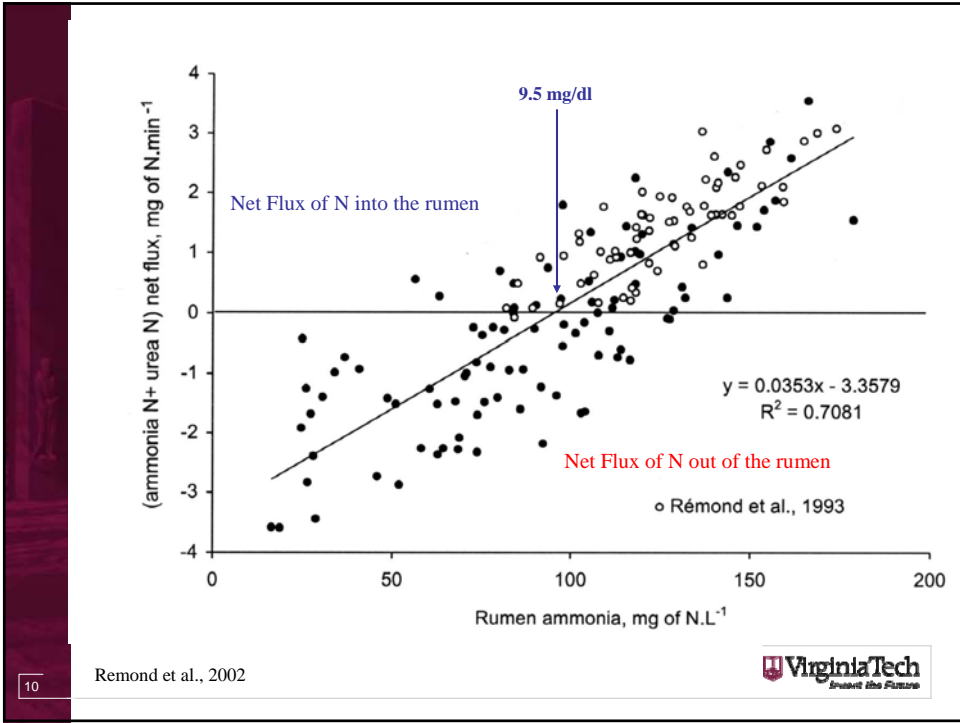
CPM
NRC Molly

- Ruminal Degradation ✓ ✓
- Microbial Growth
 - Dietary RDP ✓ ✓
 - Recycled N ?
- Intestinal Absorption
 - Duodenal N ✓ ✓
 - Endogenous losses ?
- Postabs N partitioning
 - Productive Use ✓ ✓
 - Maintenance Use ✓ ✓
 - Catabolism ? ✓
 - Amino Acids ?

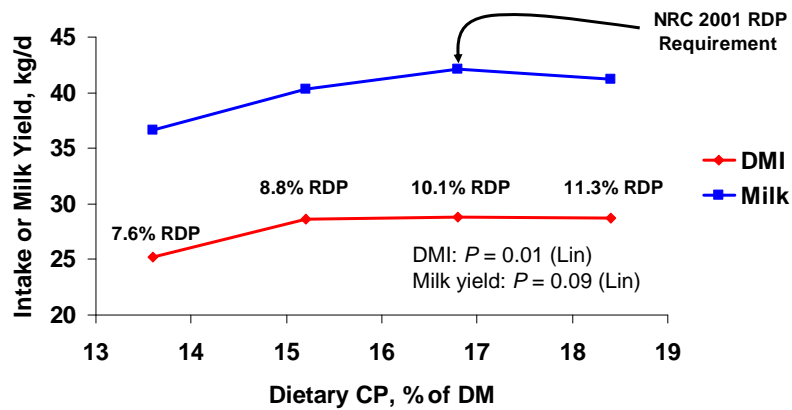
NRC 2001/CNCPS/CPM

Is N Recycling Important?





Effects of Dietary Protein (RDP) on Intake and Milk Yield

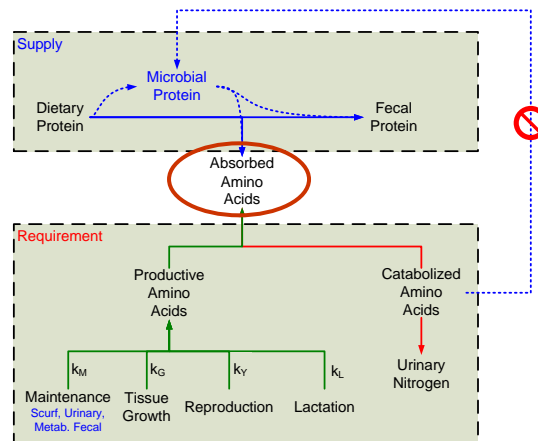


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Cyriac et al., in press, JDS



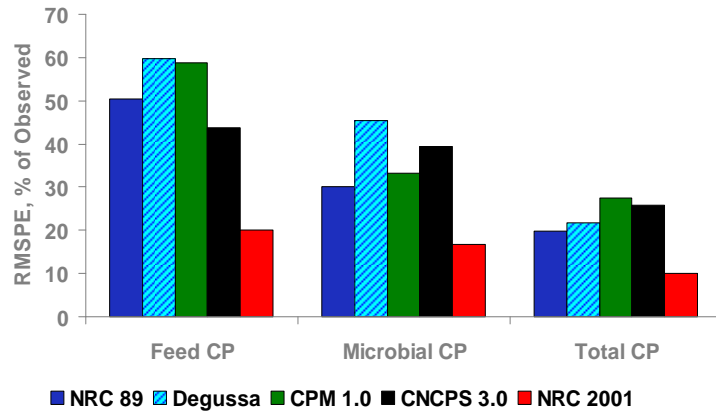
Duodenal Protein Flow Predictions NRC, CPM, & CNCPS



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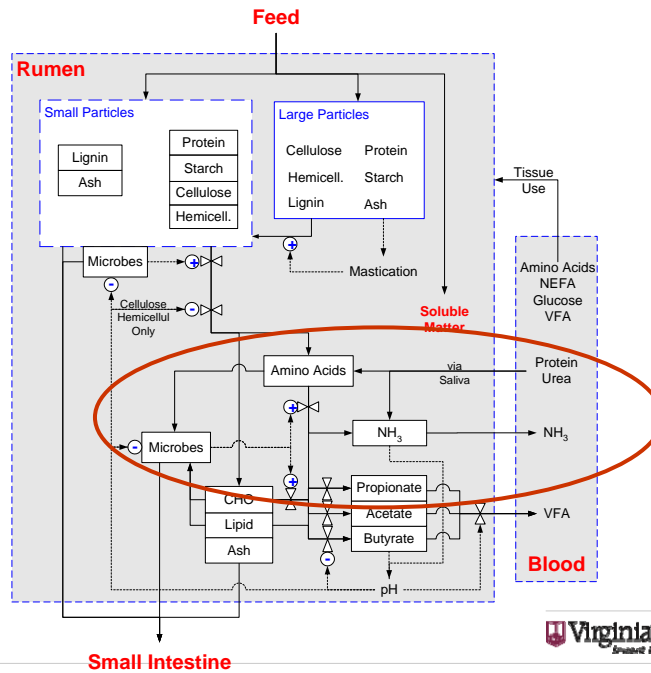
Evaluation of Model Accuracy in Predicting Abomasal Protein Flow



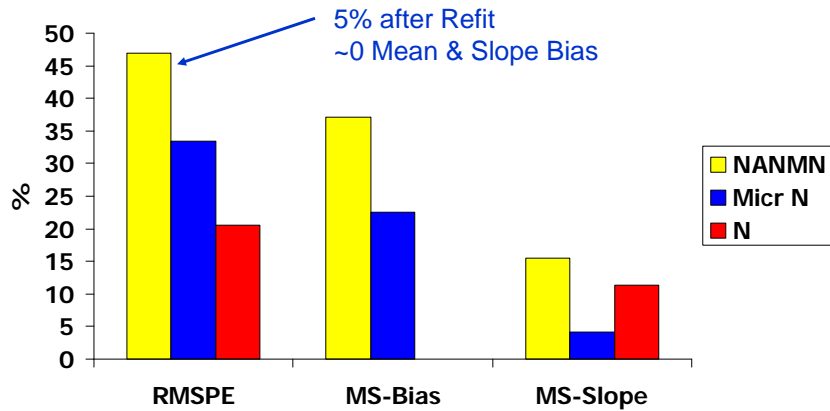
Adapted from Bateman et al.,
JDS 2001 & NRC, 2001



Molly



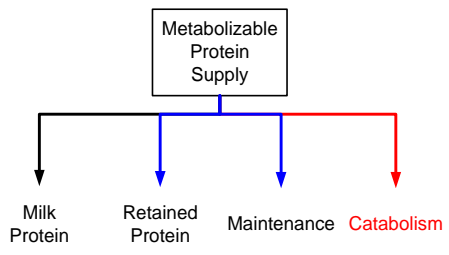
Molly Prediction Errors for Duodenal Flow



16 Hanigan et al., 2001
 RMSPE expressed as % of Observed Mean
 Bias, Slope, and Dispersion expressed as % of MSPE



Factorial MP Requirement

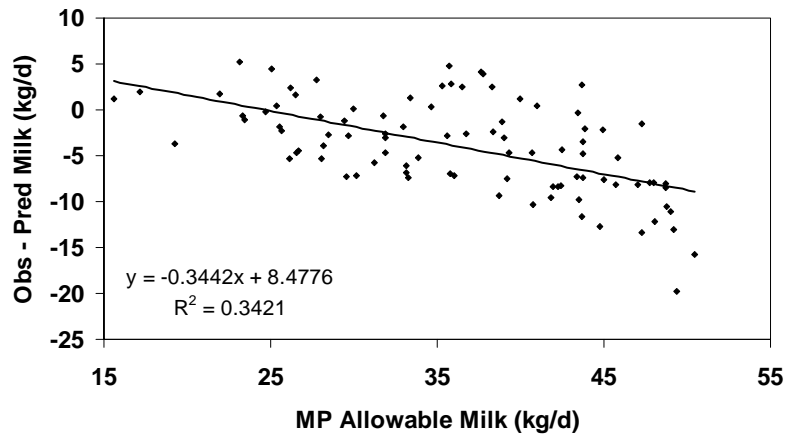


- NRC and all other Dairy Systems
- Eff. Milk CP = 65%
 - Maintenance = fn(BW)

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NRC 2001 Metabolizable Protein Based Predictions

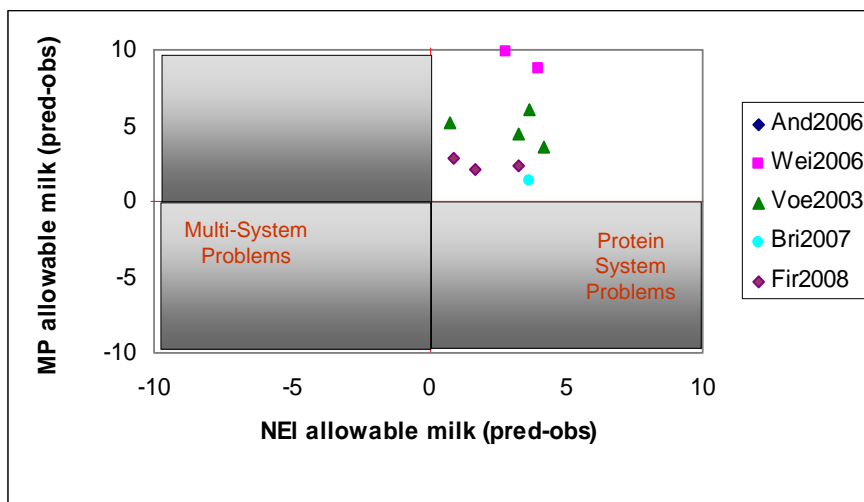


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Fig. 16.3, NRC 2001

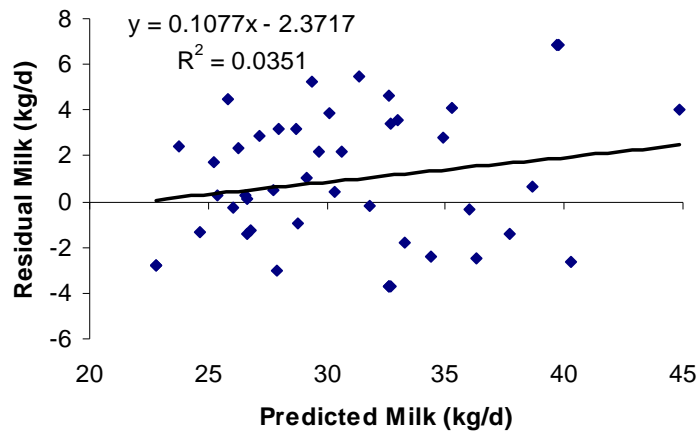


NRC 2001 Evaluations



Knapp, unpublished

CNCPS Predictions



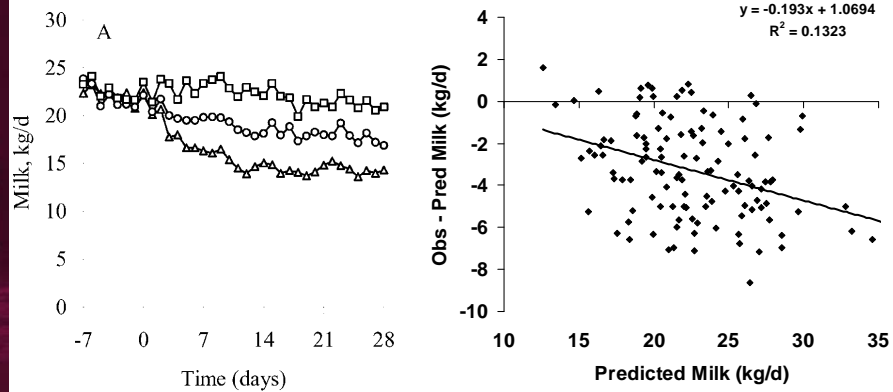
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Ruiz et al., JDS, 2001



CNCPS Prediction Errors

Diets Varied from 9.4 to 14.1% CP (3 Trts)

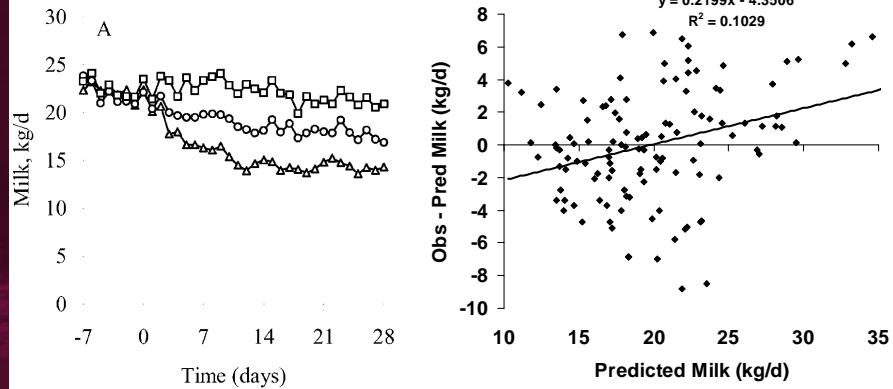


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Ruiz et al., 2002, JDS



CNCPS Prediction Errors after Model Correction Diets Varied from 9.4 to 14.1% CP (3 Trts)



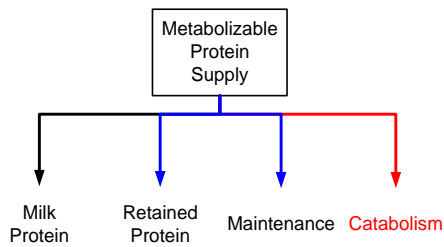
Now Greater Dispersion

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Ruiz et al., 2002, JDS



Factorial MP Requirement



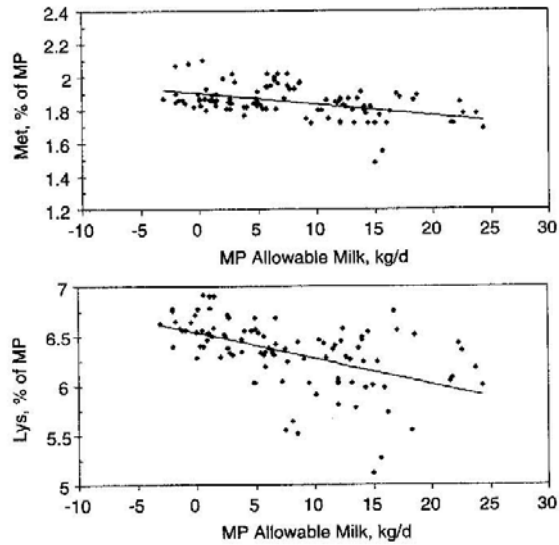
NRC and all other Dairy Systems

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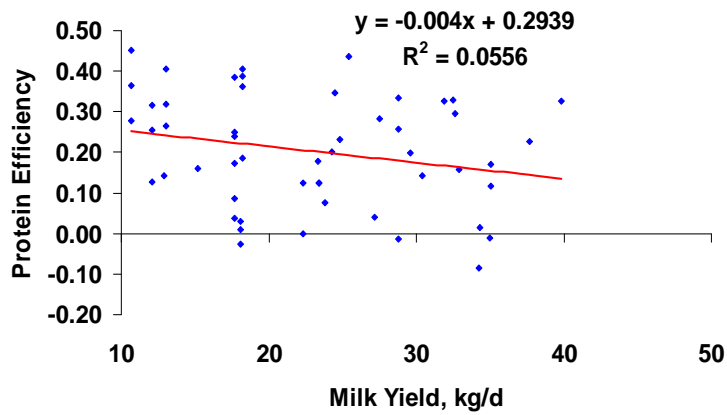


Overpredictions May Be Due to AA Supply

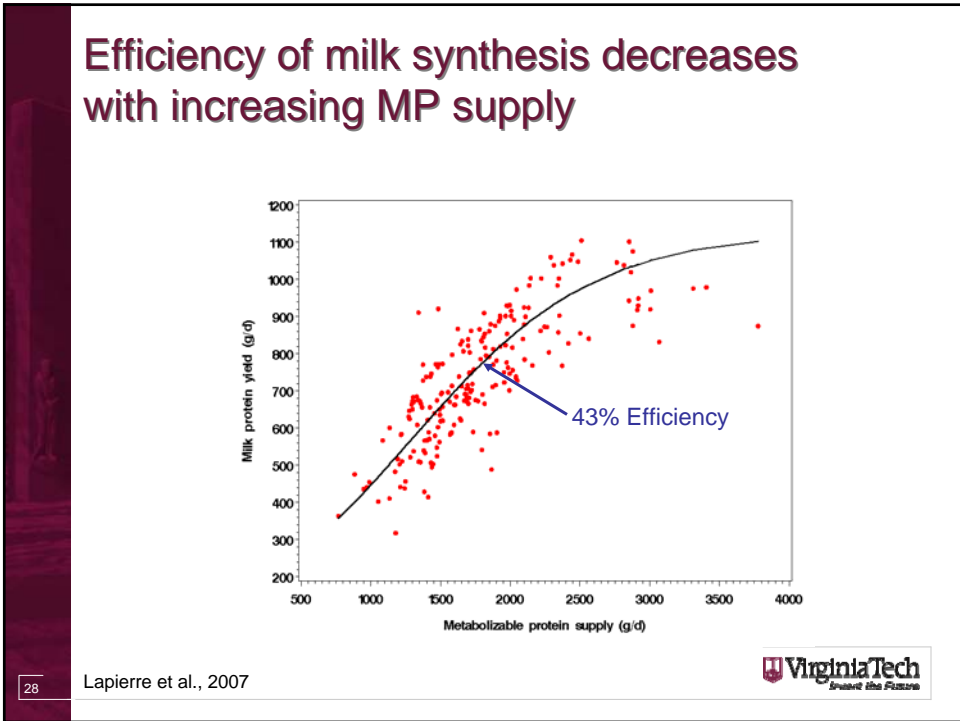
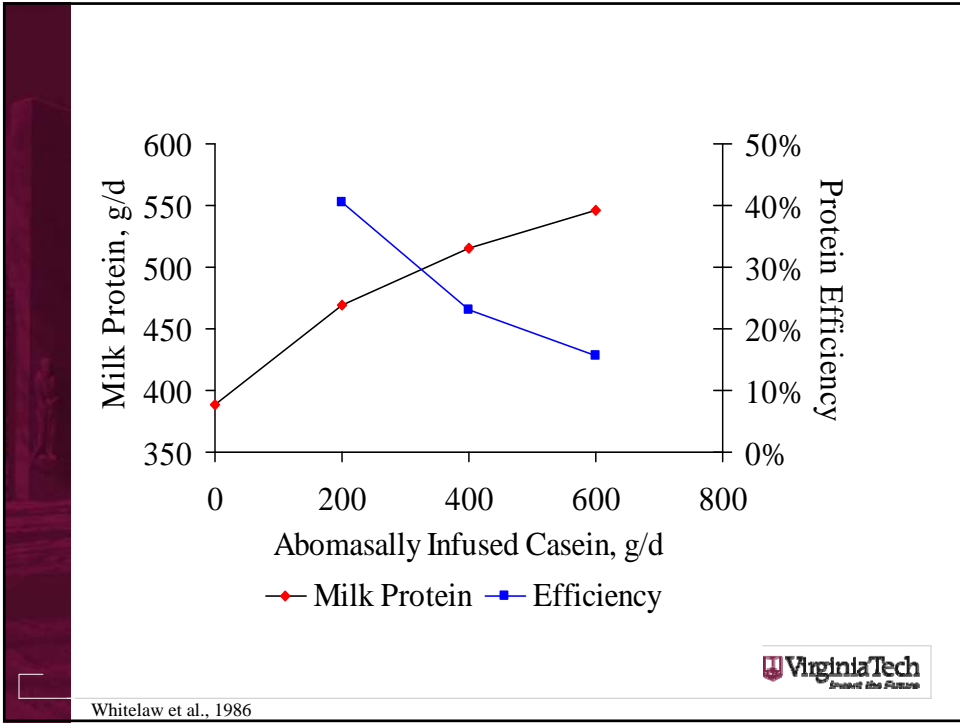


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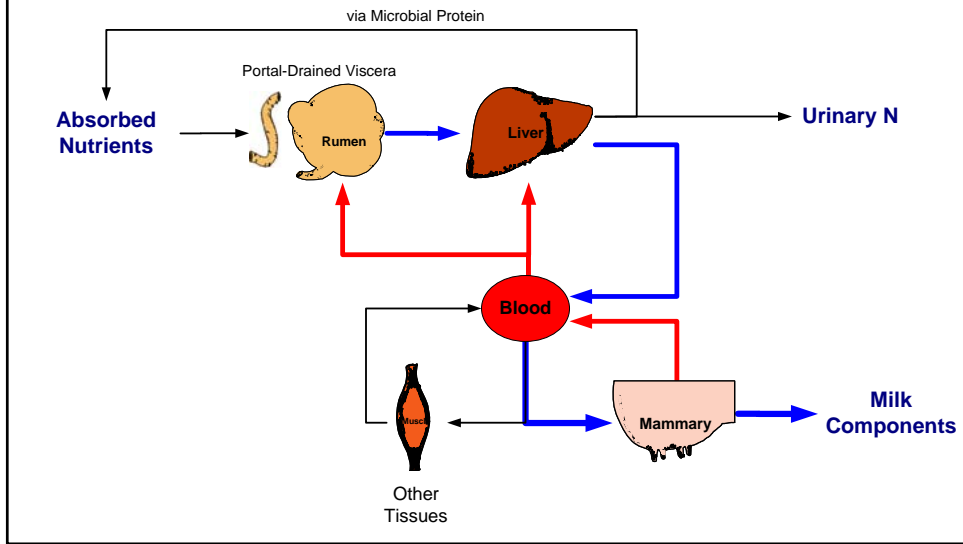
Efficiency of Use of Infused Casein



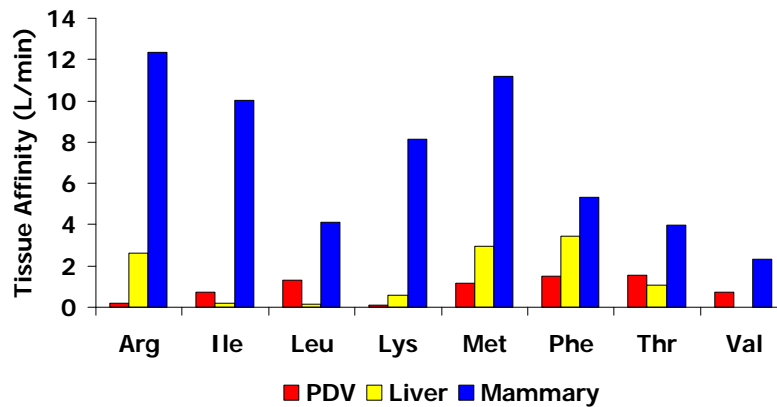
Hanigan et al., 1998



There is a Cost of Delivery of AA that Affects Efficiency

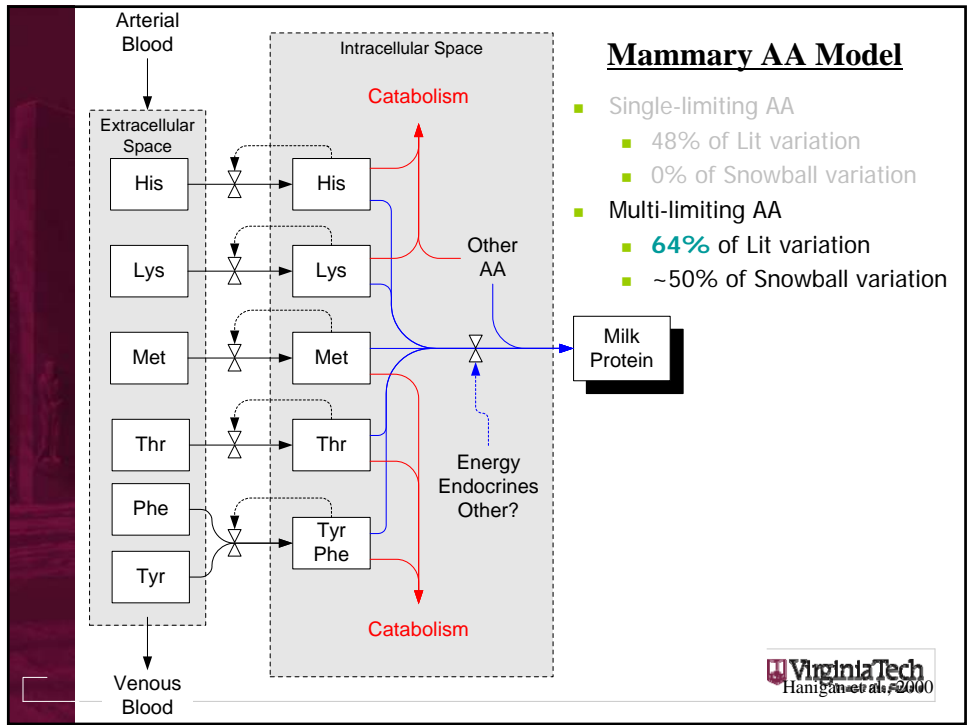
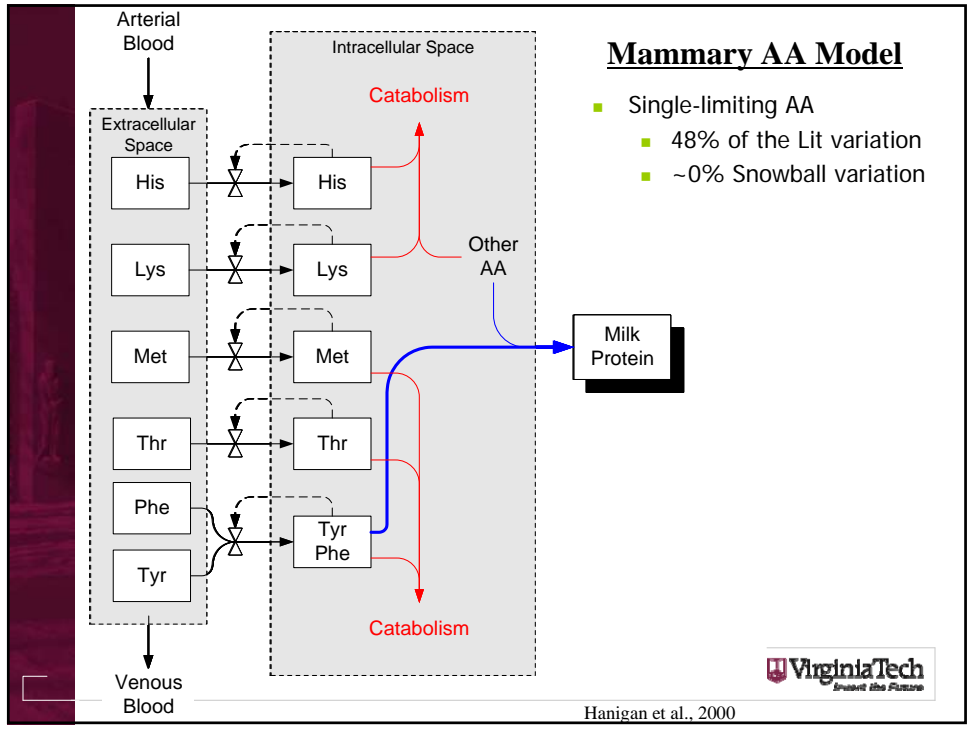


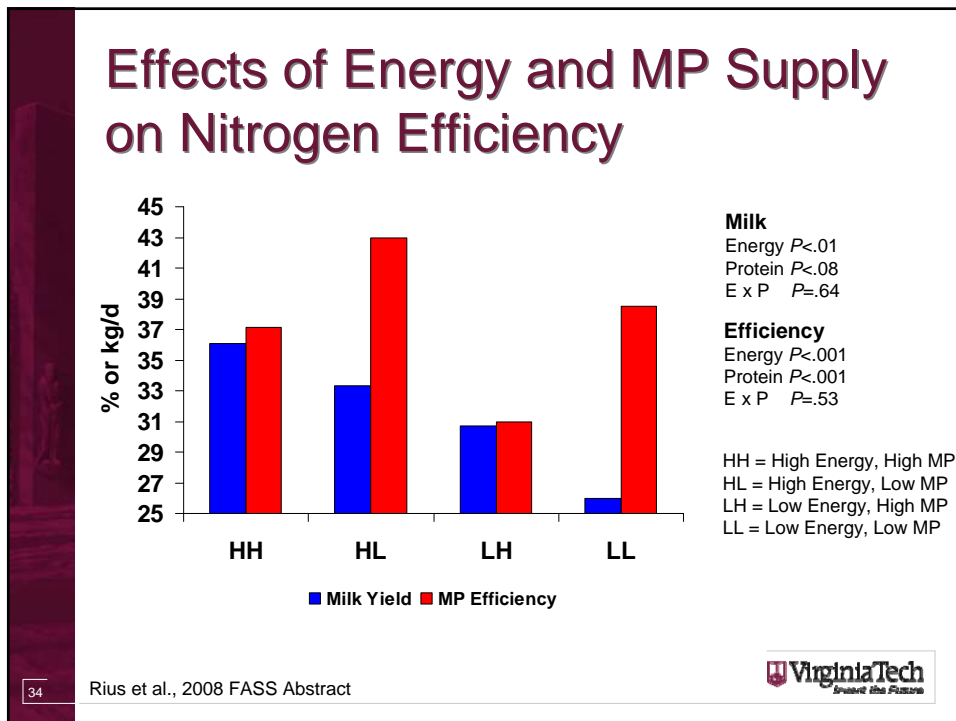
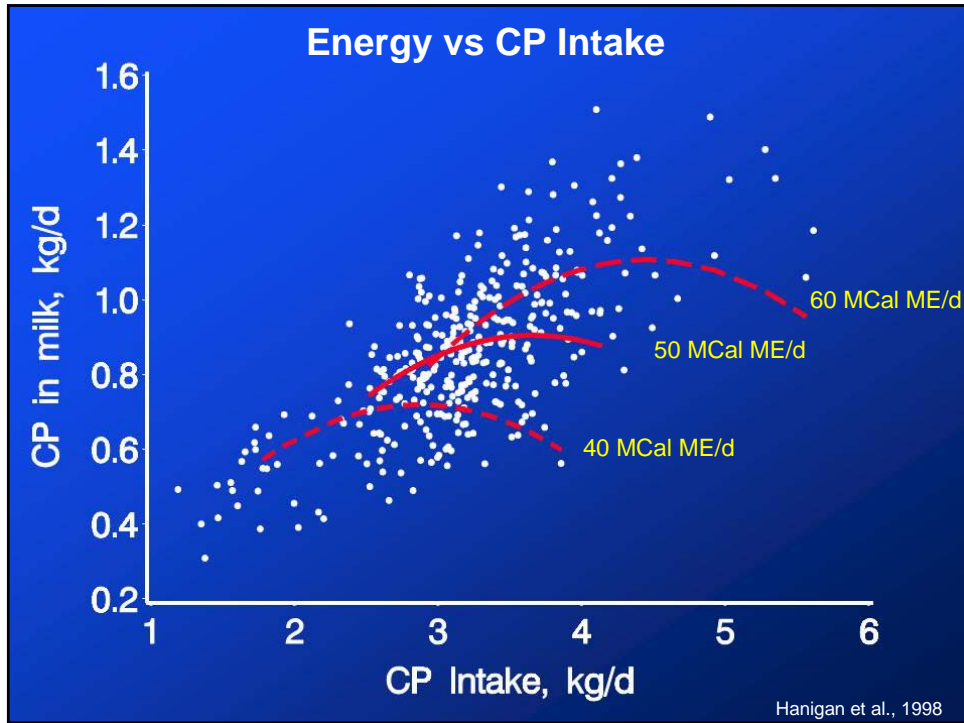
Tissue Affinities for Essential Amino Acids



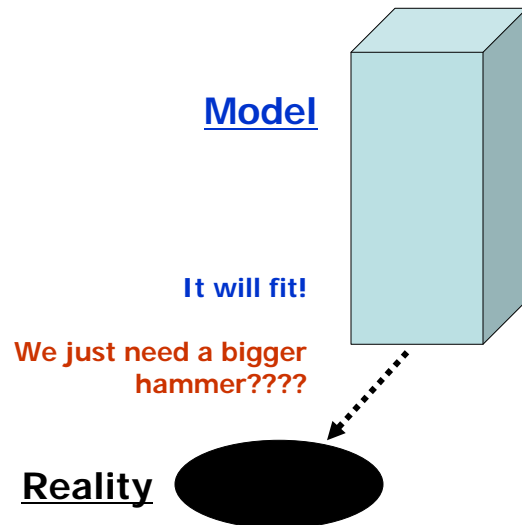
Hanigan et al., 2005







“But this is the way it has always been done!”



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Conclusions

- Must represent N recycling to the GI
 - Probably largest potential gains in N efficiency
- UC-Davis model appears to predict N supply with greater accuracy
 - Use this model to “fix” the empirical models
 - Integration of organ level data
- Linear representation of MP conversion to Milk is problematic
 - Fractional conversion is **NOT** 65%
 - Variable conversion efficiencies
 - Nonlinear response surface
 - Independent energy effects
 - Wrong representation of individual nutrient effects
- Postabsorptive AA models
 - Must consider splanchnic recycling
 - Variable extraction by mammary is problematic

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Lots of Good Integrative Work Already Completed

- Rumen model
 - [Baldwin et al. 1987](#)
 - [Dijkstra et al.](#)
- Mammary model
 - [Hanigan et al., 1998, 2000, 2001, 2002](#)
 - [France et al., 1995, 1997](#)
- Liver model
 - [Hanigan et al., 1998, 2004](#)
 - [France et al., 1999](#)
- Rudimentary PDV model
 - [Hanigan et al., 2004](#)

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