Genetic Evaluation of Feed Intake, Efficiency, and Maintenance Energy in the Cow:

What do we need to learn?

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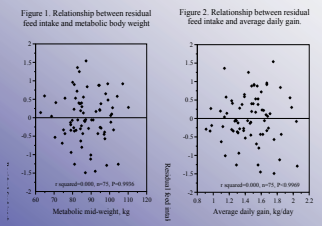
Background

- **The majority of research (and application) addressing feed efficiency has been directed at bulls and feeder calves**
- **Genetic connections to the cow have largely been indirect**
  - Rg of RFI in heifers and later as cows > 0.95 in Australia
  - Efficient cows produce efficient feeder calves (Alberta)
- **This area will emphasize the need for a robust measure**
  - Repeatable across segment and within animal
- **Use in genetic improvement will require other considerations**
  - Opportunity for selection (h^2, Vg, intensity, data)
  - Minimize antagonism
  - Data collection

The RFI methodology

- **As a trait, RFI has desirable properties, but for cow efficiency, we emphasize RFI as a methodology**
- **General definition: RFI = Actual Intake – Expected Intake**
  - Expected intake: body weight, gain, composition, etc. as predictors
- **In young growing cattle, we can only account for about 70% of intake, leaving 30% "unknown" as RFI**
- **Preliminary results indicate cow intake is less predictable**
  - Weight, growth, fat, conceptus weight ~ 35-40% of intake
  - Suggests great potential for improvement

RFI and Production Independence



Figures courtesy J. A. Basarab

Differences in RFI groups

	RFI < 0.00 Efficient	RFI > 0.00 Inefficient	P-value
Intake per d, lb	21.7	25.5	<0.001
Total 84-d intake, lb	2121.9	2511.0	<0.001
Total 84-d gain, lb	264	270	>0.470
Feeding Events per d	5.56	6.22	<0.001
Carcass fat, in	0.28	0.30	<0.110
Lean Yield, %	59.93	59.47	>0.240
Marbling score	Select 80	Select 75	>0.640

Crews et al., 2003

Desirable properties of NCE traits:

How does residual intake stack up?

Property:	RFI:	Comments:
Direct effect on cost/income	Yes	RFI can be thought of as "adjusted" intake
Easily measured	No	Requires individual feed intake
Stable genetic parameters	Yes	Heritability ~ 0.40 across most studies
High data density	No	Reduced by reliance on intake
Little genetic antagonism	Yes, but…	We can force independence, this is a non-issue
Measured earlier in life	Relatively	Yearling or near-yearling ages is most common
EPD are user-friendly	Sort of…	Remember negative is better
Large genetic variance	Yes	≥ 30% of intake variance is "residual"

RFI Genetic Correlations

Trait	Rg(RFI)	Reference
Feed Conversion Ratio	0.70	Herd and Bishop (2000)
Feed Conversion Ratio	0.85	Arthur et al. (2001a,b)
Feed Intake	0.64	
Feed Intake	0.79	
Back Fat	0.17	
Live weight	0.32	Arthur et al. (2001b)
ADG	0.10	
Carcass REA	-0.17	Schenkel et al. (2004)
Carcass marbling score	-0.44	Crews et al. (2003a)

Potential Industry Impact

- Our results show that the more efficient half of steers gained the same amount of weight, produced carcasses with the same yield and quality grades with the same amount of time on feed but consumed 390 pounds less feed than the less efficient half.
- In a region with 2+ million head processed per year, that 780 million pounds of feed costs almost $40 million in the feedlot sector.
- Estimates are that relative savings in supplemental feeding for cows would be similar to that predicted for feeder cattle.

What About Efficiency in Cows?

Two guiding principles to remember:

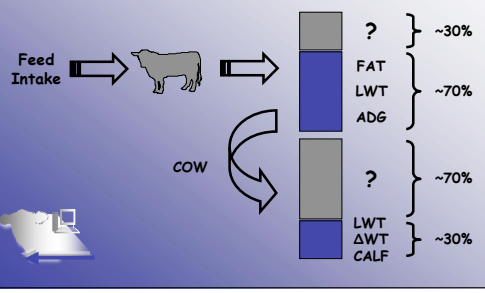
For every complex problem, there is a simple solution…
…that doesn't work

It is quite possible that RFI is not the same trait in cows
…but the conceptual approach remains the same

What Should Cow Efficiency Do?

- Cow efficiency as a trait:
  - Retain the desirable properties of RFI
  - Minimize antagonisms with reproduction, longevity, maintenance
- Cow efficiency as a correlated trait:
  - Selection for efficiency in feeder calves should not be antagonistic
  - Probably modeled as separate but correlated to steer RFI

Conceptual RFI: Steer vs. Cow



What Do We Know?

A Retrospective Study

- Tested steers categorized as LOW, MED, HIGH RFI
- Performance of dams (n ~ 130) of those steers
  - 10 year productivity cycle
  - Some dams also tested for RFI
- What can we say about the dams of (in)efficient progeny?
  - Reproductive differences
  - Condition score
  - Cow intake
  - Calf performance and general productivity

Dams of Efficient Steers:
Reproductive Performance

- **Mothers of steers with low (efficient) RFI:**
  - Higher 10-yr average condition score
  - Lower intake on forage
  - Calved ~5 days later in the calving season
- **Mothers of steers with high (inefficient) RFI:**
  - Twice the death loss, more twins (4 vs. 0%)
- **No differences were observed among RFI groups:**
  - Pregnancy rate, calving rate, weaning rate (per cow exposed)
  - Calf weaning weight

What Don't We Know?
Research Gaps

- **What should be intake predictors in cows**
  - Use the Koch et al. (1963) "energy sink" concept
- **To what extent does efficiency correlate across animal type**
  - Bull, steer, heifer, cow traits may be separate
- **What can we learn from replacement heifers**
  - Reports seem to verify high repeatability with later life measures
- **Defining cow efficiency is only intermediate**
  - Similar to RFI in steers and bulls, efficiency and intake are parts of a larger system of relevant traits

What Don't We Know?
Research Gaps

- **The genetic associations of cow efficiency measures**
  - Reproductive longevity
  - Heifer pregnancy rate
  - Mature maintenance requirement
- **How to reliably measure cow intake**
  - Drylot versus range
  - Diet differences

A Major Limitation Remains

- **The bottleneck which limits most efficiency research will always be the availability of individual feed intake data**
- **Predicted intake:**
  - Eliminates the possibility of an RFI approach
  - Relies completely on indicator traits as predictors
  - Genetic architecture may be dissimilar to actual intake

Thank you.