Rethinking Energy for Dry Cows

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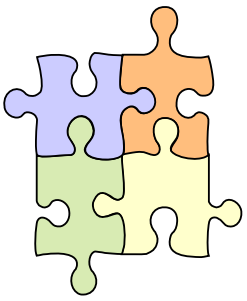
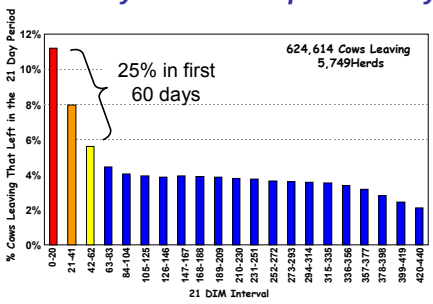
The Transition Cow Puzzle: Outline for today

- What is "controlled energy"?
- What is the scientific basis for the approach?
- How do we put diets together to accomplish the goals?
- What are the common pitfalls of this approach?



What drives my work:
Too many health problems, Too many cows leave prematurely



Stewart, Eicher, et al., Univ. MN

Diet is an important component but not the whole story…

- Cows need low-stress, comfortable, non-crowded environments
- Stressors decrease DMI, increase NEFA, divert nutrients from milk to stress response and immune system

Most transition health problems are related to ***excessive negative nutrient balance*** and ***body fat mobilization*** around calving

Controlling energy intake to meet but not exceed requirements during the dry period may actually ***improve*** postcalving energy balance.

Take-home message 1:

If it ain't broke, PLEASE don't try to fix it!

What are "Controlled Energy Diets"?

- Feed to meet cows' requirements
- Not too much, not too little…***But just right***
  - **The "*Goldilocks Diet"?***
- Goal is *consistent intake* throughout dry period

Controlled energy may mean *less* or *more* energy in diet

May need to *dilute* energy density (e.g., if high corn silage) or *increase* energy density (if only poor quality roughage available

Energy (NE_L) requirements 2 days before versus 2 days after calving

	1550-lb Cow		1250-lb Heifer	
Function	Pre	Post	Pre	Post
Maintenance	11.2	10.1	9.3	8.5
Pregnancy	3.3	---	2.8	---
Growth	---	---	1.9	1.7
Milk production	---	18.7	---	14.9
Total (Mcal)	14.5	28.8	14.0	25.1

Calculated from NRC (2001). Assumes milk production of 55 lb/d for cow and 45 lb/d for heifer, each containing 4% fat.

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Typical intake	**14-17**	**19-21**		

Calculated from NRC (2001). Assumes milk production of 55 lb/d for cow and 45 lb/d for heifer, each containing 4% fat.

Dry cows will easily consume more energy than they require

NE_L (Mcal/lb)	DMI (lb) for 15 Mcal	NE_L (Mcal) at 27 lb DMI
0.60 (high straw)	25.0	16.2
0.64	23.4	17.3
0.68	22.0	18.4
0.72 (typical close-up)	20.8	19.4

Dry cows do not regulate "energy" intake on a short-term basis.

Dry cow? Pre-fresh? Transition? Fresh cow?

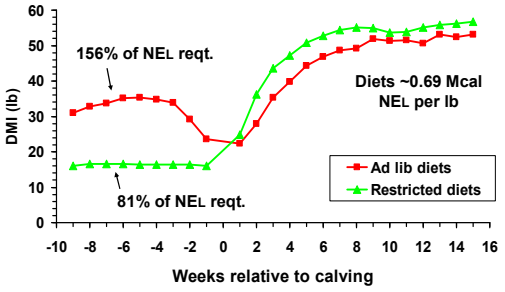
- Take-home message 2:

  High-bulk diets are **NOT** a strategy for pre-fresh/close-up groups only!

  – Dry matter intake will drop until cows adjust; requires 5 to 10 days

- Must be a **dry period strategy**, not a close-up or pre-fresh strategy only.

Cows fed even moderate-energy diets during the dry period easily over-consume energy relative to requirements



Douglas et al., 2006

Strategies to control energy intake by dry cows

- Feed only low energy ingredients
  - Higher risk for inadequate nutrition or variability
- Limit-feed higher quality diets
  - Requires careful bunk management
  - Few data available for once-daily feeding
- Ad lib feeding of high-bulk diets
  - Allow bulk to control total intake

High-bulk dry cow diets: back to the future?

- Ration energy density closer to NRC National Research Council (NRC, 2001) recommendations **(~0.60 Mcal/lb DM)**, intake of ~15 Mcal/d
- Need a ***balanced diet*** (preferably TMR), lower in energy but adequate in other nutrients, that contains lactation ration ingredients
- *Chopped straw* works ideally to dilute energy of corn silage and other lactation ration ingredients

Capturing the benefits of limit-feeding in practical ad libitum systems for dry cows

Lower-energy ingredients in a TMR

Comparison of ingredient NEL to target diet NEL (0.59 – 0.63 Mcal/lb DM)

Feed	NEL (Mcal/lb DM)
Corn silage	0.74
Mid-mature alfalfa hay	0.64
Mature grass hay	0.60
Wheat hay, headed	0.52
Wheat straw	0.43
Soybean hulls	0.74
Cottonseed hulls	0.26

Values from NRC, 2001

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Corn silage and wheat straw are complementary

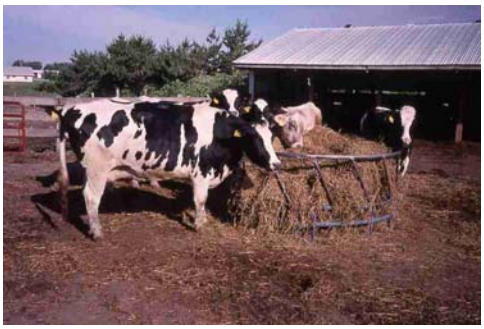
- Equal amounts of DM from corn silage (0.74 Mcal/lb) and wheat straw (0.43 Mcal/lb) results in a mixture of 0.58 Mcal/lb
- Coupled with some alfalfa hay or silage and concentrate = total diet of 0.60 to 0.63 Mcal/lb

What about other low-energy ingredients?

- Diluting energy density and controlling energy intake is the goal
- Other ingredients can be used to decrease energy density (grass hay, mature alfalfa, cottonseed hulls, oat hulls, corn stover, etc) if sorting can be prevented
- May need to feed *more* to get same limit on intake (other roughages), or cows may increase intake of diet with small particle size ingredients (faster digestion and passage)

We want control…

Not **this!**



Why do it? Benefits of high-straw, low-energy diets

- Marked reduction in DA
- Decrease in other metabolic disorders and smoother transitions
  - Would *expect* positive effect on reproduction, body condition, foot health
- May simplify dry cow management and ration formulation, especially for one-group dry cow management

The European experience

- 277 herds (>27,000 cows) in the UK, Ireland, France, Sweden
- Herds above national average for milk yield and incidence of health problems
- Compared data before and after change to high-straw, low-energy TMR during dry period

Source: D. E. Beever, Keenan Co. 2006

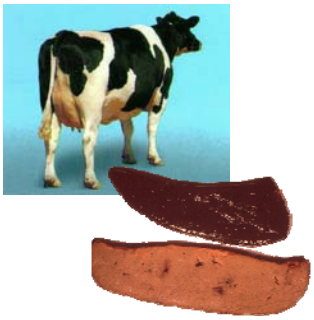
Impacts on health problems

- Assisted calvings ↓ 53%
- Retained placenta ↓ 57%
- Milk fever ↓ 76%
- Displaced abomasum ↓ 85%
- Ketosis ↓ 75%
- Producers reported “greater satisfaction with appetite, body condition, and estrus strength”

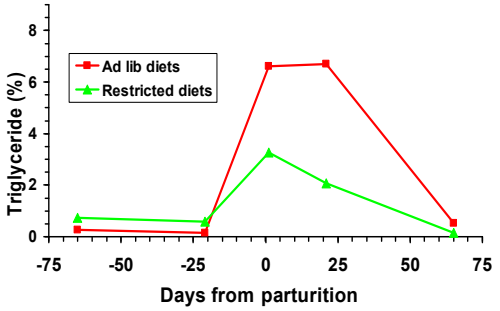
Source: D. E. Beever, Keenan Co. 2006

Why might too much energy in the dry period be bad?

- Cows respond metabolically as if they were too fat, even if they don’t appear to be (insulin resistance)
- Lower dry matter intake (DMI), more body fat loss, fatty liver, ketosis…



Excess dietary energy prepartum leads to greater liver fat after calving



Douglas et al., 2006

Overfeeding during the dry period may increase susceptibility to ketosis postpartum

Dry period diet:	Ad libitum		Limit-fed	
Postpartum diet (from d 5):	Ad lib	Restricted	Ad lib	Restricted
d +14 or clinical ketosis				
Glucose, mg/dL	55	34	54	43
NEFA, μ*M*	834	1761	585	1378
BHBA, mg/dL	7.5	21.3	6.1	14.6
Urine BHBA, mg/dL	2.6	152	2.9	31.9
Liver fat, %	5.4	15.5	5.5	11.6

From Dann et al., 2005 and unpublished

High-energy diets predispose cows to health problems

- May not be a problem in well-managed herds
- But, if intake is interrupted (stressors, disease, poor management, etc.) then overfed cows are more likely to develop subclinical ketosis, fatty liver, and other health problems

The minimal approach:
Controlled energy for far-off dry cows

Controlled Energy in Conventional Two-Group Systems: Experimental Design

Far-off diet
(wk -8 to -3)

High straw
(~NRC NEL)

Extra
(>>NRC NEL)

Limit-fed
(80% NRC NEL)

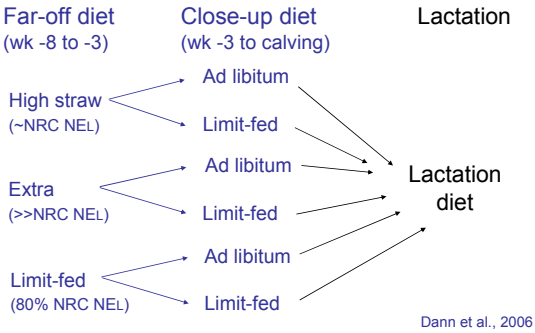
Dann et al., 2006

Controlled Energy in Conventional Two-Group Systems: Experimental Design

Far-off diet (wk -8 to -3)	Close-up diet (wk -3 to calving)
High straw (~NRC NEL)	Ad libitum
	Limit-fed
Extra (>>NRC NEL)	Ad libitum
	Limit-fed
Limit-fed (80% NRC NEL)	Ad libitum
	Limit-fed

Dann et al., 2006

Controlled Energy in Conventional Two-Group Systems: Experimental Design



Dann et al., 2006

Composition (% DM basis) of diets

Ingredient	Straw	Extra	CU	Lact
Corn silage	21.1	25.5	24.5	28.1
Alfalfa silage	41.7	26.2	25.1	20.1
Alfalfa hay	---	14.0	13.4	---
Wheat straw	26.2	---	---	---
Cottonseed	---	4.4	4.2	9.7
Corn grain	7.2	17.2	16.3	25.7
Soy hulls	---	10.2	9.7	1.5
Soybean meal	3.0	---	---	5.2
Expeller SBM	---	1.7	1.6	5.9
Minerals, vitamins	0.8	0.7	5.2	3.8

Dann et al., 2006

Carry-over effects of far-off diets persisted into the close-up period

	Far-off Dry Period Diet			
Variable	Straw	Ad lib	Limit-fed	*P*
Body weight, lb	1571	1626	1555	<0.01
Body condition	3.0	3.3	2.9	<0.01
NEFA, µEq/L	230	323	249	0.04
BHBA, mg/dL	4.6	5.7	5.0	0.04

n = 24

Dann et al., 2006

Far-off diet, but not close-up diet, affected cows during first 10 days in milk

	Far-off Dry Period Diet		
Variable	Straw	Overfed	Limit-fed
DMI, % BW	2.5	2.2	2.5
Energy Balance, % of reqt.	88	80	93
NEFA, µ*M*	787	792	627
BHBA, mg/dL	8.1	9.1	6.6
Milk, lb	65.3	57.2	58.1

n = 24

Dann et al., 2006

Take-Home Message

- In two-group systems, avoiding overfeeding in far-off dry period may be more important to transition success than close-up strategy.
- Far-off nutrition may influence responses to close-up programs.

One-diet dry cow management: use of controlled energy diets

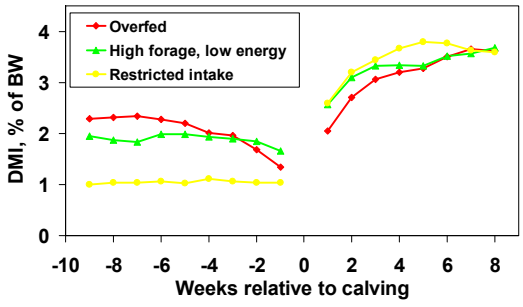
One-diet programs: Ingredient composition of test diets (% DM)

Ingredient	High straw	High energy
Corn silage	35.5	35.8
Alfalfa silage	----	13.3
Alfalfa hay	17.2	9.5
Wheat straw	31.8	----
Whole cottonseed	----	5.1
Concentrate 1	15.5	----
Concentrate 2	----	36.3

(Water @ ~4 lb/cow)

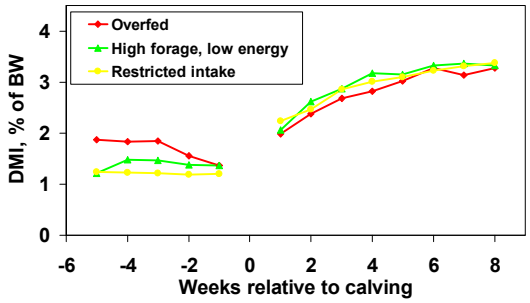
Janovick Guretzky and Drackley, 2006

Weekly dry matter intake for cows fed different amounts of energy during the dry period



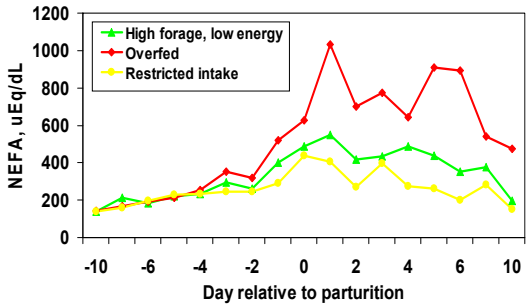
Janovick Guretzky and Drackley, 2006

Weekly DMI for heifers fed different amounts of energy during the dry period



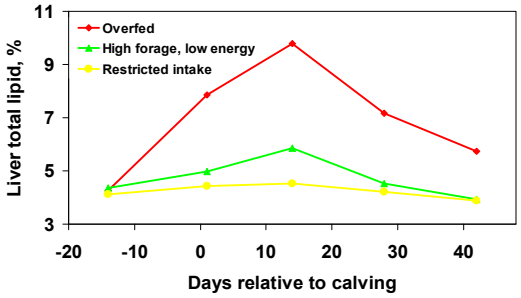
Janovick Guretzky and Drackley, 2006

Controlled energy dry cow diets decreased blood NEFA in peripartal cows



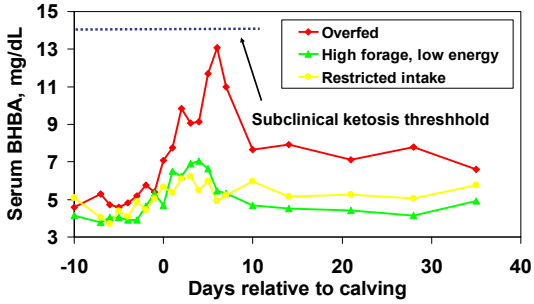
Janovick Guretzky and Drackley, 2006

Controlled energy dry cow diets decreased liver fat accumulation in cows



Janovick Guretzky and Drackley, 2006

Controlled energy dry cow diets decreased serum BHBA in cows



Janovick Guretzky and Drackley, 2006

What about subsequent milk yield?

- Few controlled data yet
- Our data and field experience suggest slightly lower and later peak milk, but greater persistancy
- Therefore, total lactation yields may be essentially the same

Why might these low-energy diets work?

- Improve rumen fill (prevent DA) and fiber mat, and prevent acidosis = "healthy rumen"

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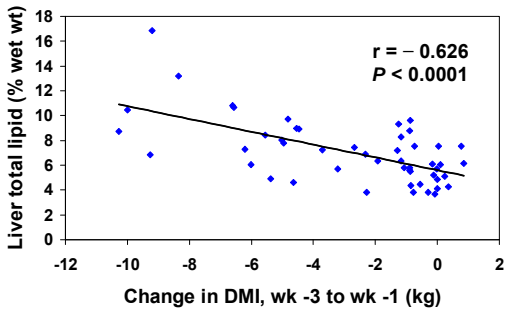
- Stabilize dry matter intake and prevent large drops in DMI before calving

Liver fat content (day 1 postcalving) increases with larger precalving drops in DMI



Drackley, 2003

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- Improve rumen fill (prevent DA) and fiber mat, and prevent acidosis = "healthy rumen"
- Stabilize dry matter intake and prevent large drops in DMI before calving
- Prevent "fat cow"-type responses to excessive energy consumption

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- Prevent "fat cow"-type responses to excessive energy consumption
- Provide adaptation to lactation ration ingredients
- Help maintain low potassium

What should these diets look like?
Drackley's recommendations

- NE_L: ~ 0.59 – 0.60 Mcal/lb DM, to limit intake to ~15 – 16 Mcal/d
- CP: 12 – 15%
- Metabolizable protein (MP): > 1000 g/d
- Starch: 12 – 16%
- NDF from forage: ~0.7 – 0.8% of BW or 10 – 11 lb per head daily
- Minerals and vitamins: according to "standard" guidelines

Drackley's recommendations (cont'd.)

- Mg: >0.4% of DM
- Ca: 0.6% of DM (0.5% to 0.8%)
- P: 0.27% of DM
- K: as low as possible!
- DCAD: If low Ca, may not need to balance; if high Ca decrease to close to 0 mEq/100 g
- Vitamin E: minimum 1,500 IU/day

Common pitfalls:
When things go wrong

- Sorting (improper processing or mixing)
- Inadequate access to feed (overcrowding, no push-up, not enough fed)
- Limited water availability
- Failure to adjust for changing DM% of feeds
- Moldy or poor-quality ingredients

Making these diets work

- For TMR, straw *must* be chopped short enough to prevent sorting.
  - 2" or less (Our study: 1/3, 1/3, 1/3 on Penn State box)
  - Pre-chop (tub grinder or forage harvester)
  - Some reel mixers with knives (e.g., Keenan)
- Free-choice low-energy forage with limit-fed balanced partial mix is a ***poor*** second choice (ensure bunk space and delivery).

Avoid underfeeding too…

- Avoid severe *underfeeding* (<70% of requirements)
  - Too much poor-quality grass or legume hay, insufficient supplementation
  - Overcrowded pens, timid cows, insufficient bunk space, insufficient water…
- If feeding management is limiting, high-straw diets may not be the answer
  - And in fact may be a disaster!

Mixing and delivery are critical

- Uniform mixing (straw chopped but other ingredients not pulverized; concentrates distributed properly)
- Last feed out should be same as first feed out (check particle size or chemical composition at ends of feed line)
- Cows must be able to access feed all day (push-up, adequate bunk space)

Low energy ≠ poor quality!

- Straw (or other low-energy, high-fill forages) must be clean, mold-free, not weather-damaged
- Value in ration is not represented by "relative feed value" or other measures based on CP, ADF, NDF

What about the fresh-cow group?

- Optimal dry period diets dilute lactation diet ingredients with straw (provides rumen adaptation)
- Straw leaves rumen slowly; results in "auto-adaptation" when lactation ration is introduced after calving
- Include small amount (~0.5 to 2 lb) of chopped straw in fresh-cow / lactation groups where effective fiber marginal

Summary and take-home

- Controlled energy diets should greatly decrease transition health problems
- High bulk diets are NOT to be used as only a close-up strategy
- In two-group systems, decreasing energy value in far-off may be more important
- Diets must be mixed and fed properly (no sorting) and feeding management is critical (push-up, adequate bunk space)