14e ÉDITION

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Update on BCS in Dairy Cows: New Views on an Old Topic

James K. Drackley

Professor of Animal Sciences

University of Illinois at Urbana-Champaign, USA

Outline for today:

- What does BCS tell us?
- What should calving BCS be?
- How do we achieve this goal through nutrition and management?
- Summary and conclusions

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Body condition score (BCS)

System to compare relative body fatness by visual and tactile observation, usable on farm.

In North America and Europe, a scale of 1=emaciated to 5=obese is used, with 0.25-point increments.

Scores are dynamic, but we only measure at a few timepoints.

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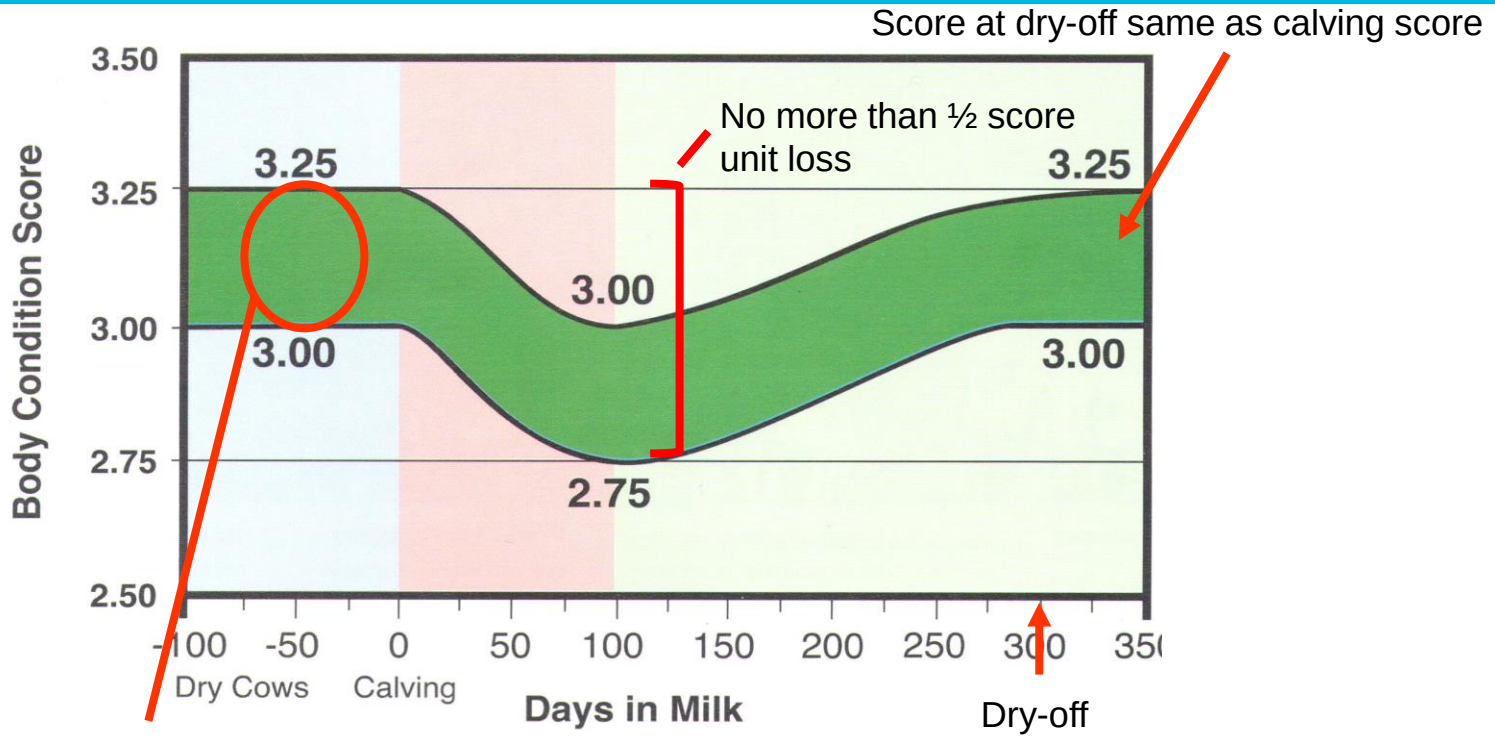
BCS changes over lactation cycle (Hutjens, 2018)



Is this the correct target range for cows at present? (No)

BCS is an important indicator of welfare

Just as in humans!

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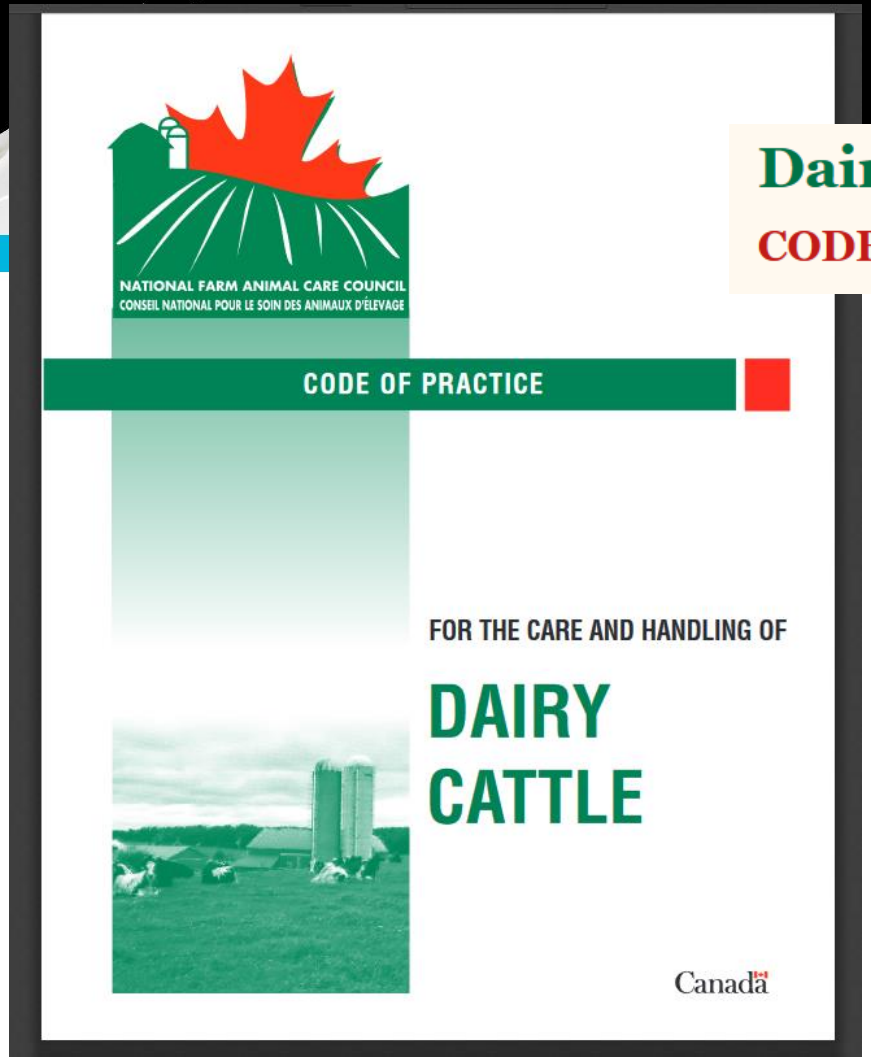
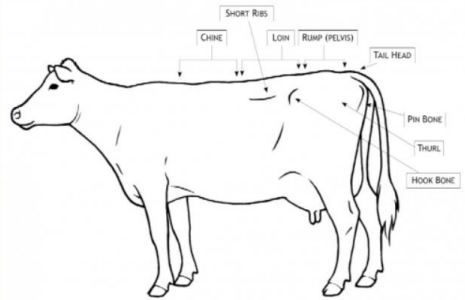


Dairy Cattle

CODE UNDER REVISION

Illustration of a Dairy Cow with a BCS score of 3.



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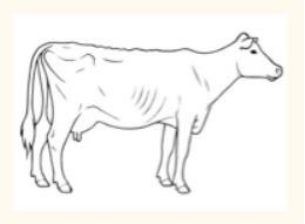
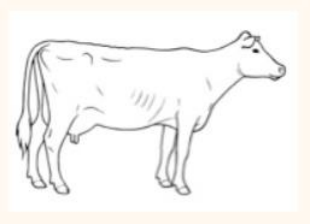
2 Feed and Water

2.1 Body Condition Scoring

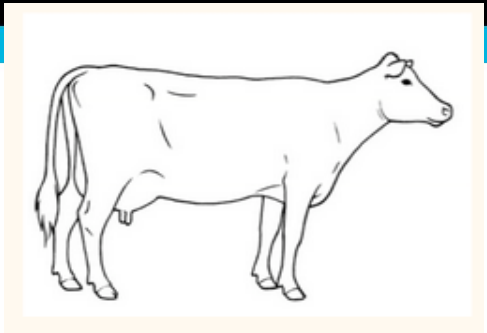
Body condition scoring (BCS) is a tool fc



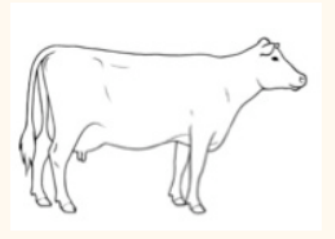
BCS 1



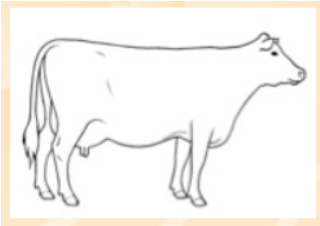
BCS 2



BCS 3



BCS 4



BCS 5

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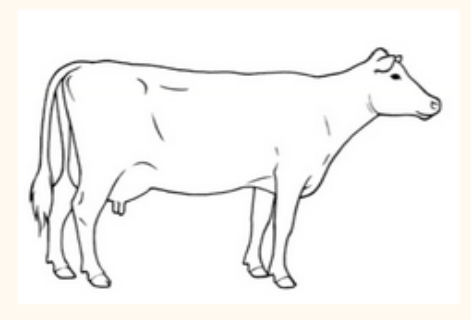
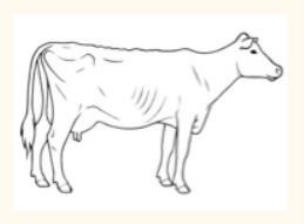
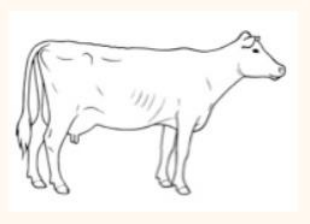


BCS 3



BCS 1



BCS 2

REQUIREMENTS

Producers must take corrective action for animals at a BCS of 2 or lower.

BCS 4

BCS 5

AQINAC

a. use Appendix E - Body Condition Scoring Chart to regularly assess the BCS's of cows

b. aim for the following ideal BCS ranges:

- dry off, 3.25 to 3.75
- calving, 3.25 to 3.75
- early lactation, 2.50 to 3.25
- mid-lactation, 2.75 to 3.25
- late lactation, 3.00 to 3.50
- growing heifers, 2.75 to 3.25
- heifers at calving, 3.25 to 3.75

c. employ corrective measures if more than 15% of the herd is above or below ideal BCS for their stage of lactation (25)

d. keep records - identify animals that are too thin or too fat, ascertain the cause, and fix.

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Welfare, fertility and high milk production: Are they biologically compatible?

Quartile of milk yield	Milk yield (kg/d)	Estrous cyclic by d 65, %	Pregnant at d 30 post-AI, %	Pregnant at d 58 post-AI, %	Pregnancy loss d 30 to 58, %
1	32.1	72.7	37.2	30.3	12.7
2	39.1	77.6	38.9	29.8	11.6
3	43.6	77.6	39.3	33.7	12.8
4	50.0	75.3	37.6	35.3	15.6
P		**0.002**	0.74	**0.008**	0.57

6,396 cows on 4 TMR-fed farms in California (Santos et al., 2009)

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Cows that successfully adapt to lactation without metabolic/physiological imbalance are capable of both high milk yield and successful reproduction, ***if welfare is emphasized***

(Jorritsma et al., 2003; Ingvartsen et al., 2003; Ingvartsen and Moyes, 2013)

If management and nutrition are suboptimal, negative energy balance (NEB) may become more severe

Reproduction is prioritized lower than milk yield in early lactation (Friggens, 2003)

http://1.bp.blogspot.com/_SHx-uyknkwA/TTsArhkFjWI/AAAAAAAAAAY/KXyheGGXtLg/s320/dizzy%2Bcow.gif

Body energy reserves (mostly as fat) may link these different functions

Fat (adipose) tissues are not just "silos" where extra energy is stored passively.

Cows have a target body composition that they actively "defend" over the long term.

Adipose tissues produce a large number of signaling molecules (*adipokines*) to inform the rest of the body of the amount of energy in storage.

- Leptin, adiponectin, resistin, proinflammatory cytokines (TNF-α, IL-1, IL-6), many more

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Designed to find the optimal score and the outliers

Optimal

Too thin

Too fat

Designed to find the optimal score and the outliers

BCS = 3

No cavity around tailhead and fatty tissue easily felt over whole area. Pelvis can be felt with slight pressure. Thick layer of tissue covering top of short ribs which can still be felt with pressure. Slight depression in loin area.

Optimal

BCS = 1

Deep cavity around tailhead. Bones of pelvis and short ribs sharp and easily felt. No fatty tissue in pelvic or loin area. Deep depression in loin.

BCS = 2

Shallow cavity around tailhead with some fatty tissue lining it and covering pin bones. Pelvis easily felt. Ends of short ribs feel rounded and upper surfaces can be felt with slight pressure. Depression visible in loin area.

Too thin

BCS = 4

Folds of fatty tissue are seen around tailhead with patches of fat covering pin bones. Pelvis can be felt with firm pressure. Short ribs can no longer be felt. No depression in loin area.

BCS = 5

Tailhead is buried in thick layer of fatty tissue. Pelvic bones cannot be felt even with firm pressure. Short ribs covered with thick layer of fatty tissue.

AI 7140

Photos by Craig Johnson

Too fat

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Too-thin cows are rare on well-run farms

Only 4.2% of 22,622 cows from 191 herds (average 118 cows per farm) were “thin” (BCS ≤ 2.25).

Adams et al., 2017 from NAHMS 2015 study

- Heat abatement
- Nutritionists creating well-balanced TMR

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Extremely thin cows can be healthy, but:

- **Are more likely to be lame**

- Are more susceptible to infectious diseases
- May not produce as much milk
- May not produce as many milk solids
- May not cycle normally and may have low fertility

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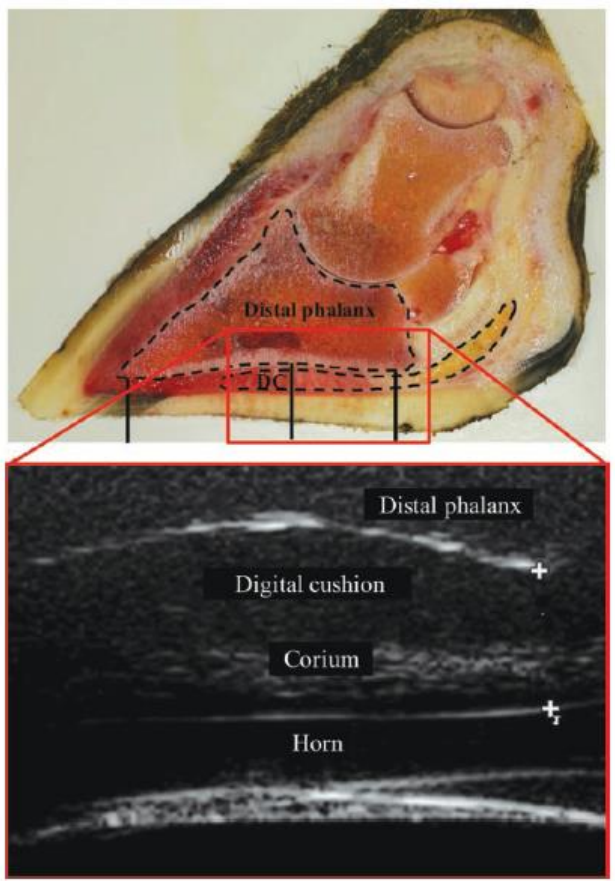
This cow is a welfare problem!

In our dairy systems, most of these cows with BCS <1.5 are lame and/or ill.
This cow is a consumer time-bomb.



Loss of BCS is associated with lameness. Loss of the fatty cushion may be part, but not all, of the story.

Cow may become lame first and then become thin because of pain, discomfort, and decreased DMI.

Newsome et al., 2017

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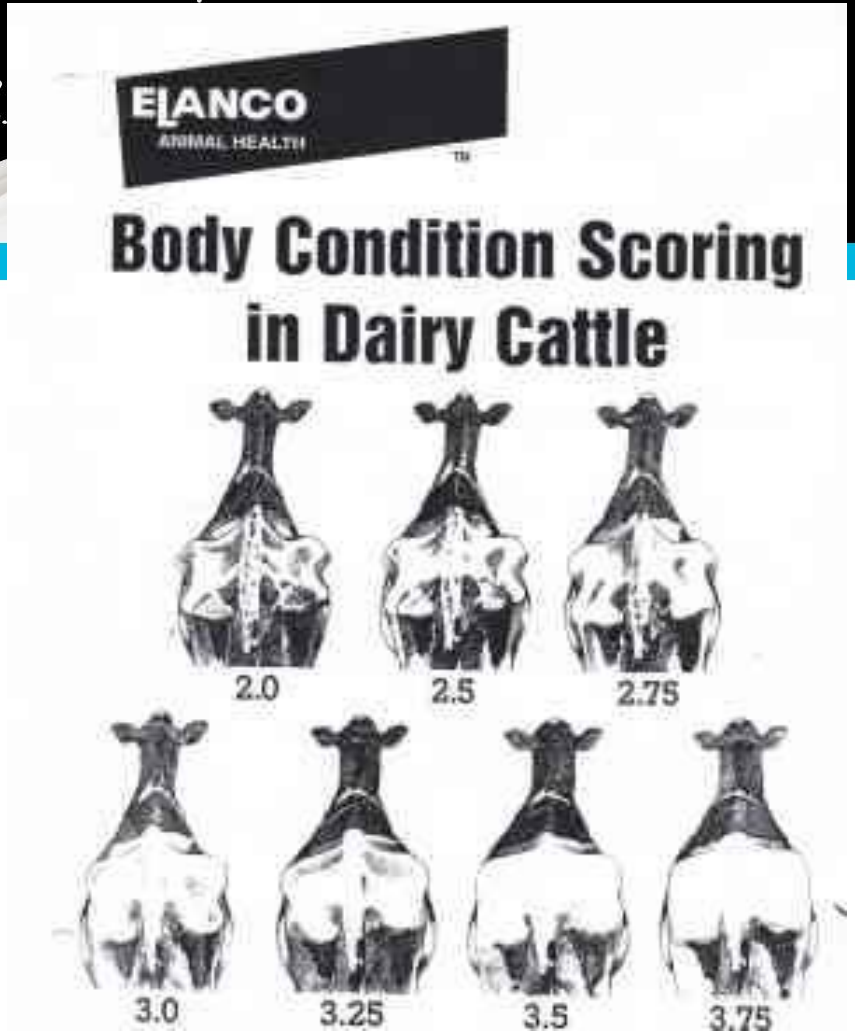

So what should our BCS target score be?

Let's ask the cows….

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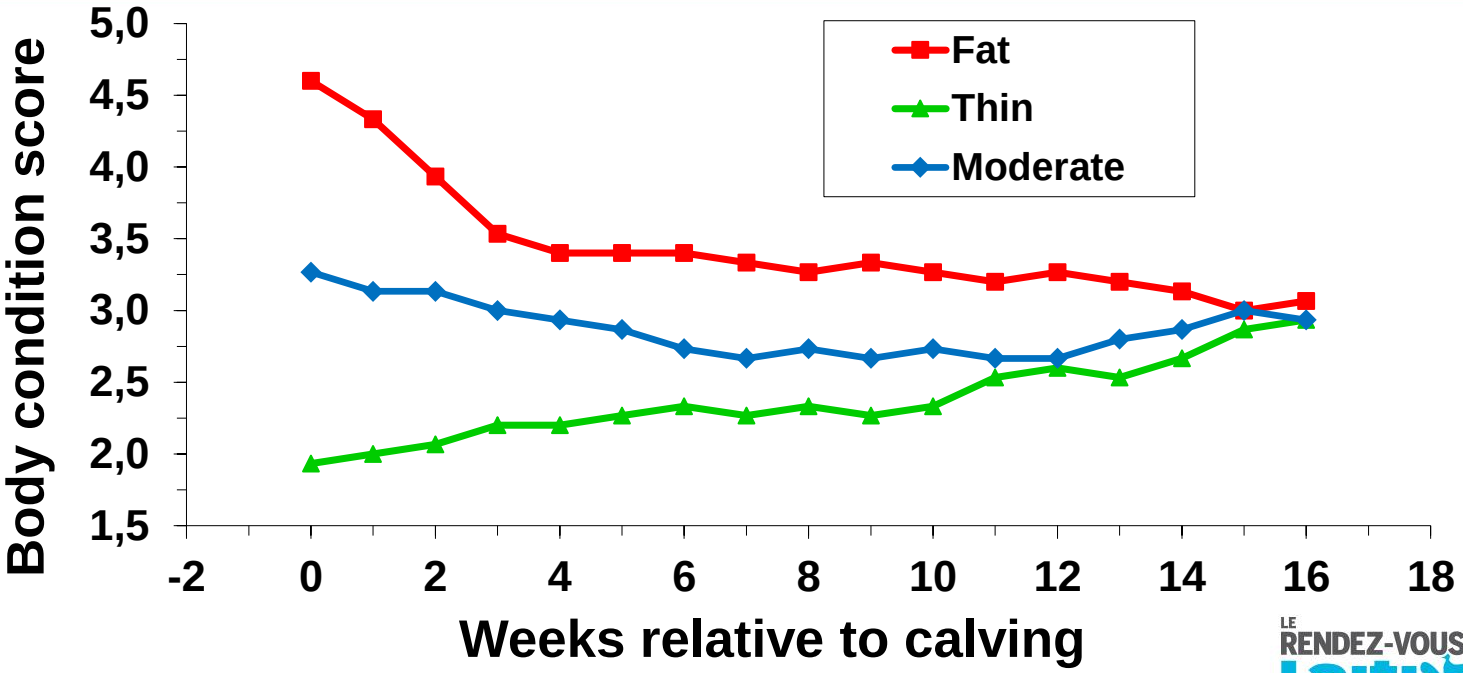
Cows have a “target BCS” during early lactation (at 12-20 wk, energy balance) that likely is as powerful a drive as milk production*



*Thin cows had greatest DMI and milk production. British Holsteins around 1980.

Redrawn from Garnsworthy, 1990 and 2006

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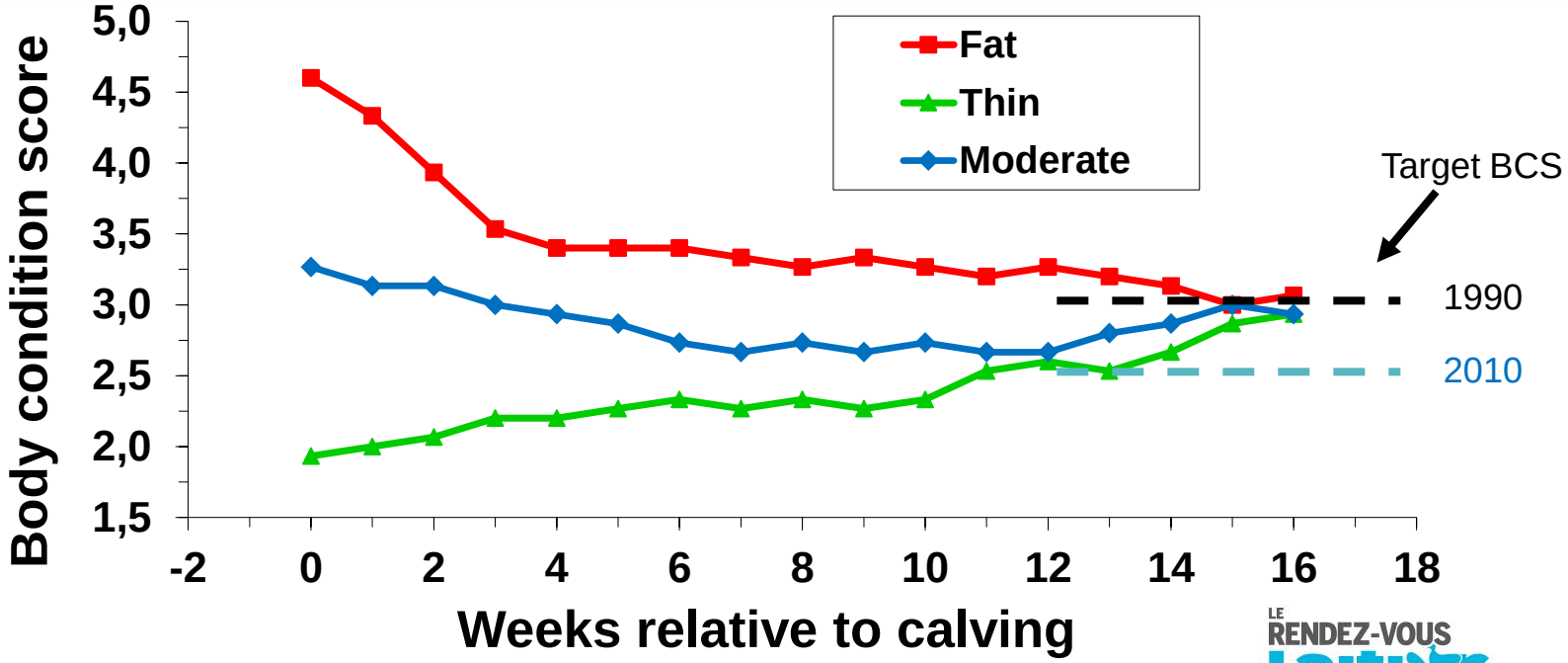

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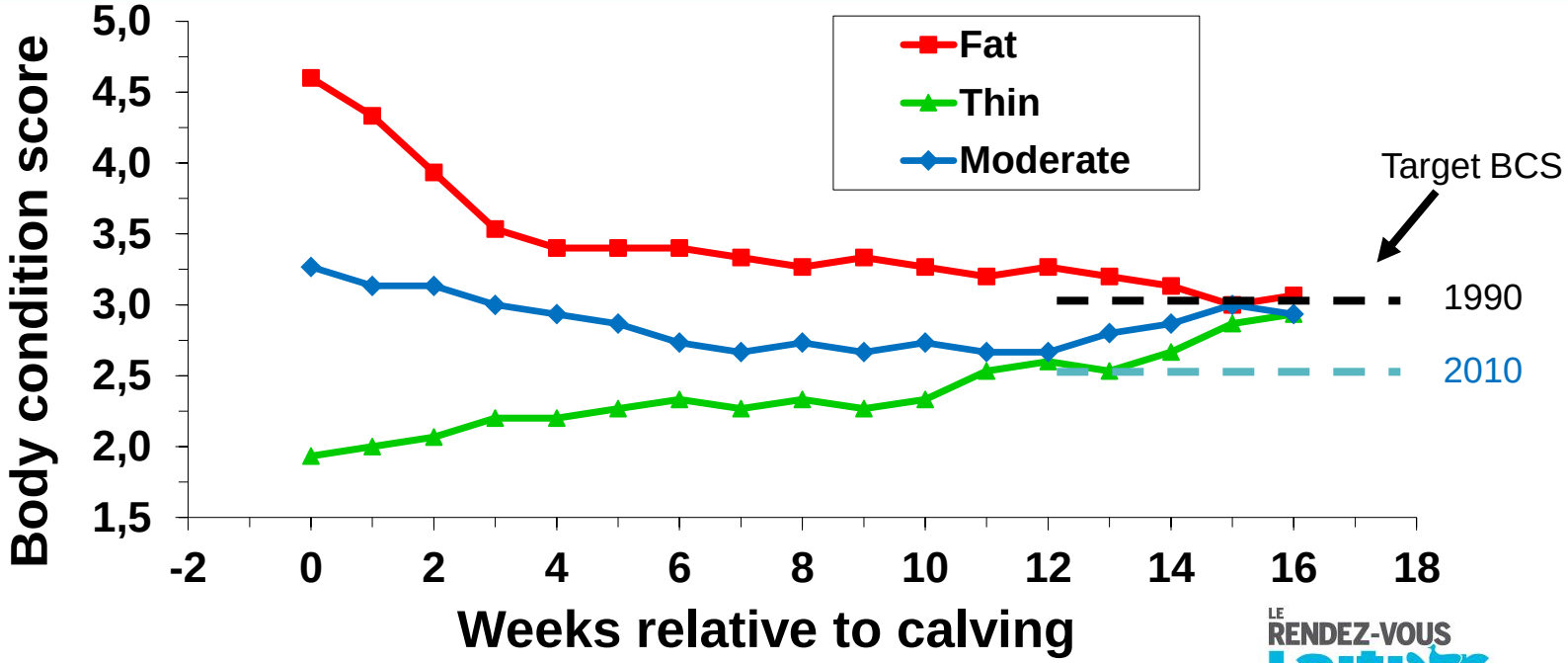
As we breed for milk and milk protein, we are selecting for a genetically thinner cow



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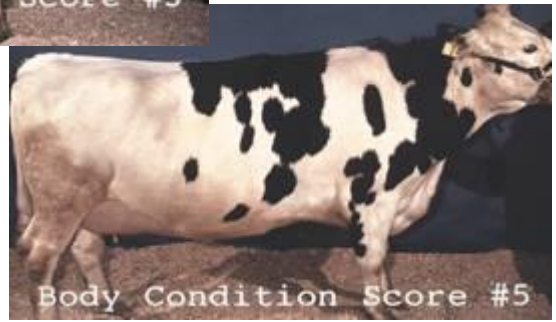
What is over-conditioned?



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http://www.omafra.gov.on.ca/english/livestock/dairy/facts/00-109.htm (2 of 10) [6/19/2010 7:28:35 AM]

What is over-conditioned?

Target 3.0 at calving

Effects of calving BCS on BCS loss after calving

Cows that are above their target will lose BCS

Cows near target will maintain BCS

Cows that are below target will gain BCS

Target BCS in early lactation for modern Holstein cows is likely around 2.25 (high genetic merit) to 2.75 (low genetic merit) (Garnsworthy, 2009)

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Effects of calving BCS on BCS loss after calving

Cows that are above their target will lose BCS

Cows near target will maintain BCS

So, if we allow for a 0.5 to <0.75 BCS unit loss in early lactation, calving BCS should be 2.75 to 3.25 (manage for average of 3.0)

genetic merit) (Garnsworthy, 2009)

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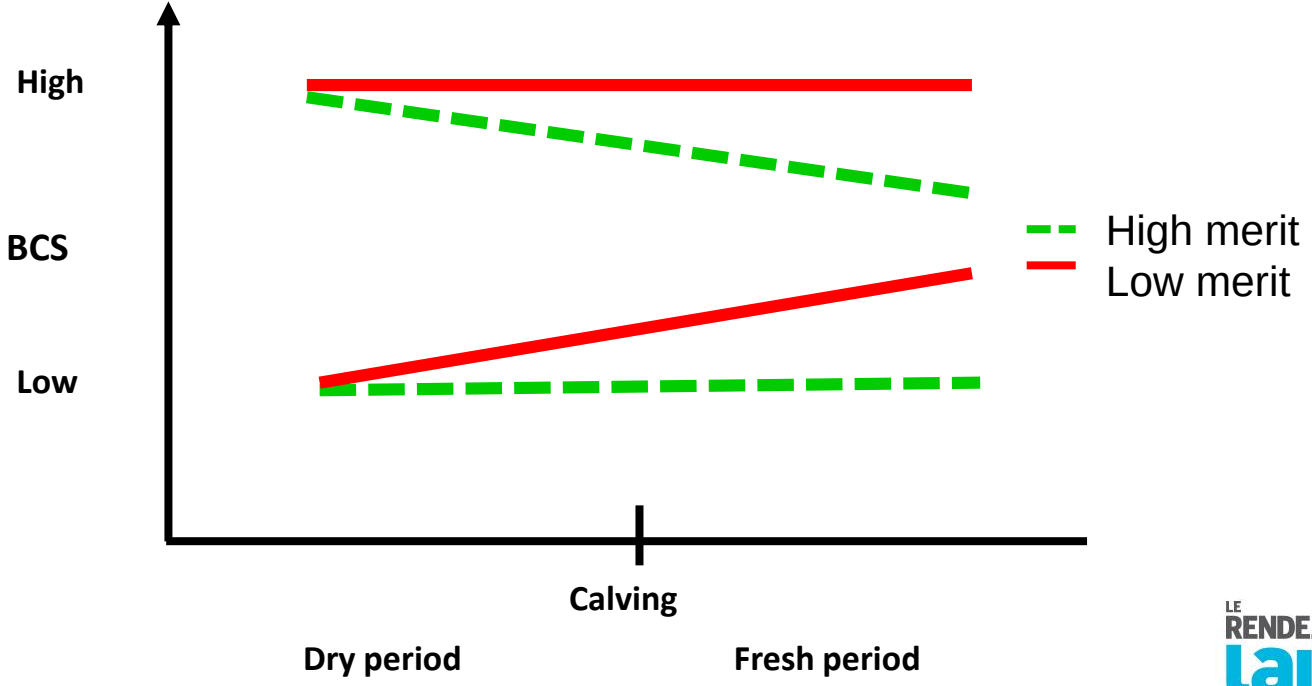
Effects of genetic merit interact with target BCS after calving



Adapted from data of P. C. Garnsworthy and J. P. McNamara

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High BCS *before* calving increases Negative Energy Balance (NEB) *after* calving

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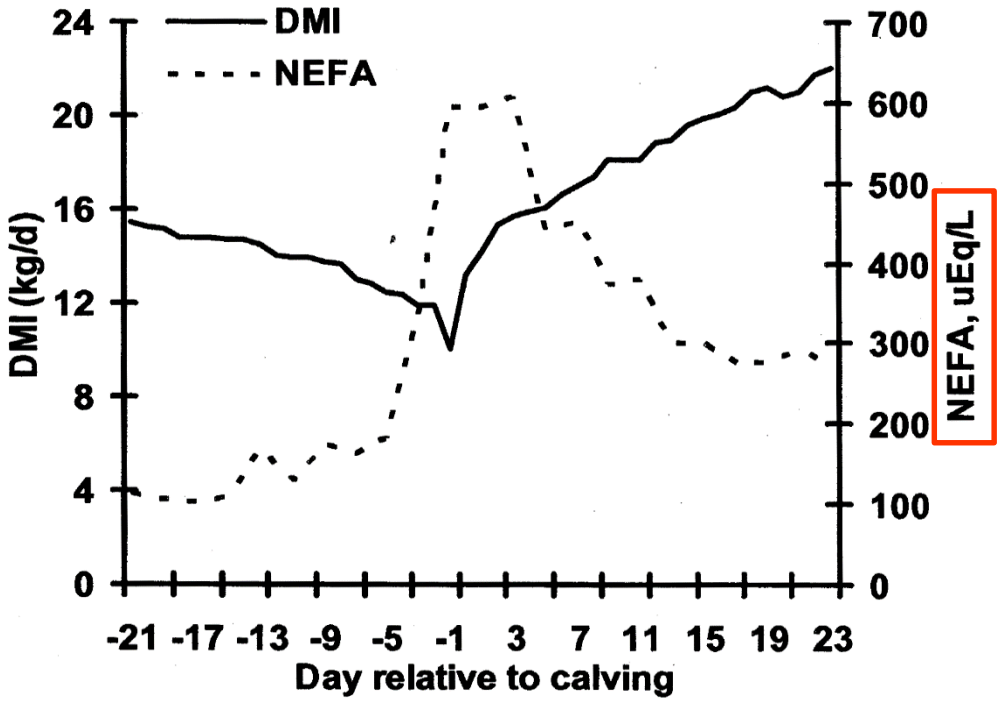
Plasma nonesterified fatty acids (NEFA) concentration reflects fat mobilization (lipolysis)



..., 2004

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Elevated NEFA in blood increases fat accumulation in liver, with peak content at about 10 days post-calving

Impacts of excessive liver fat accumulation:

- Increased ketosis
- Increased displaced abomasum
- Impaired reproduction
- Decreased milk production
- Increased culling
- Increased death loss

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High NEFA in blood lead to increased ketone bodies in blood

Ketone bodies measured in urine or milk

Standard is β-hydroxybutyrate (BHBA) in blood

Cow-side BHB meter

Reports in mmol/L = mg/L [mg/dL]
Uses whole blood
Does not work great if COLD
(keep in jacket pocket)

Outcomes associated with high NEFA and BHBA

Survey of TMR-fed free-stall herds in northeast USA

- **Cows with elevated NEFA (pre- or postpartum) or BHBA postpartum had:**
  - 4.4x greater risk for occurrence of metritis, displaced abomasum, or clinical ketosis
  - 13 – 16% lower risk of pregnancy
  - 393 – 697 kg less ECM

Ospina et al., 2010a,b,c

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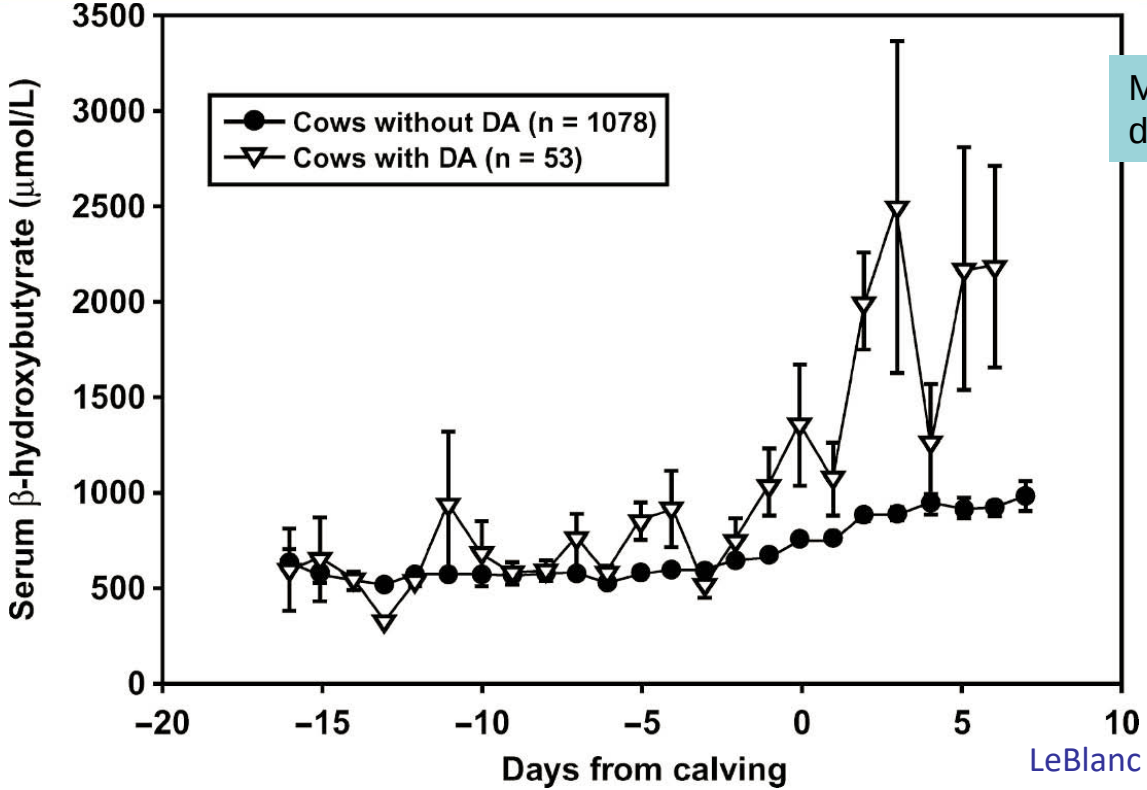
Serum BHBA ≥ 1.2 m*M* increases risk of DA



Median day diagnosis = 11 DIM

LeBlanc et al., 2005

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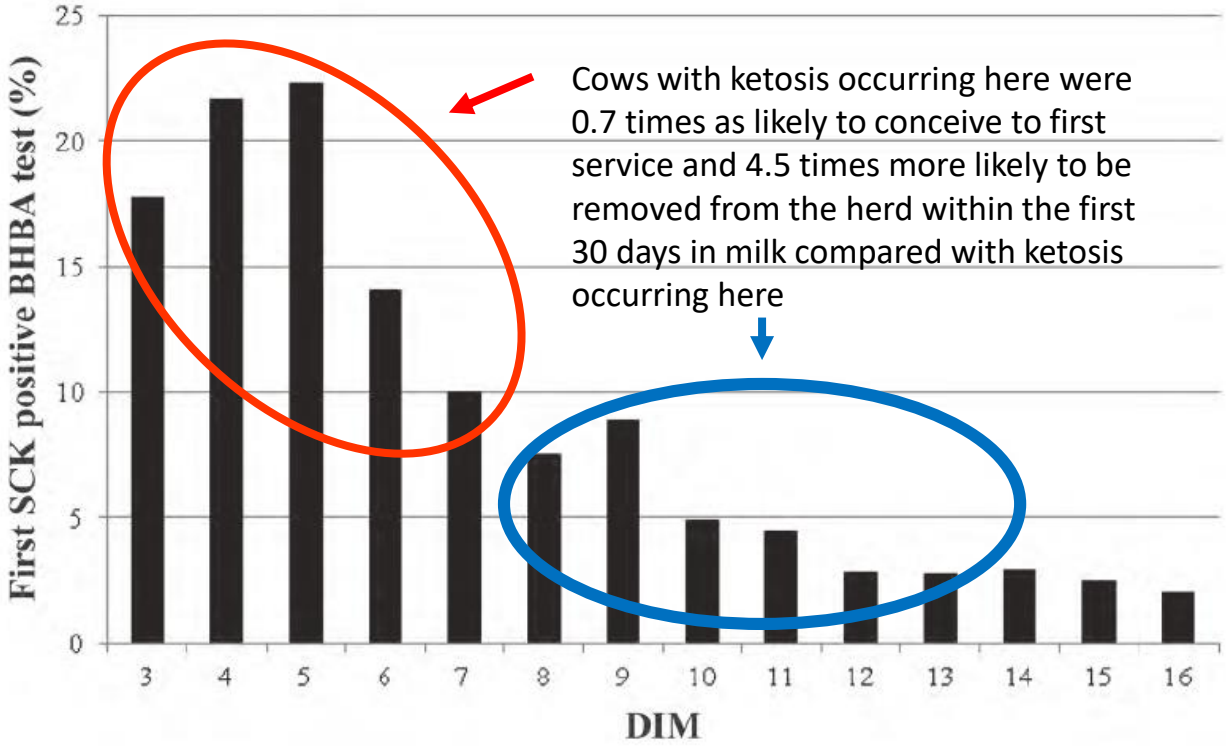
Ketosis appears very early in lactation



McArt et al., 2012

Over 10,000 cows measured; 43.2% of cows had at least one positive subclinical ketosis test (BHBA > 1.2 mmol/L and < 2.9 mmol/L by Precision–Xtra meter)

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Management for minimizing body fat mobilization remains an important management goal

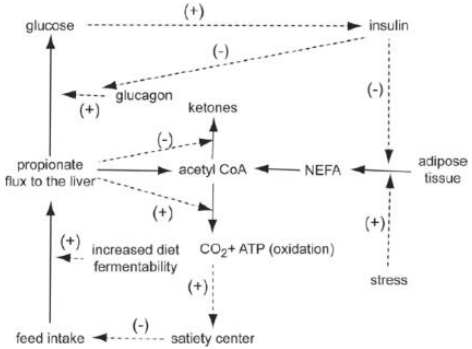
NEFA and BHBA contribute to lower DMI (and thus initiate a downward “doom-loop”), increase oxidative stress, and may compromise immune function

Hepatic oxidation theory (HOT)

The punchline:

Higher NEFA concentrations suppress DMI, at least partly because of greater NEFA oxidation (to CO_2 or ketones) and greater ATP production in liver.

Allen et al., 2009



Our research has shown that overfeeding energy can cause similar changes *even in cows that do not appear to be fat*

-VOUS

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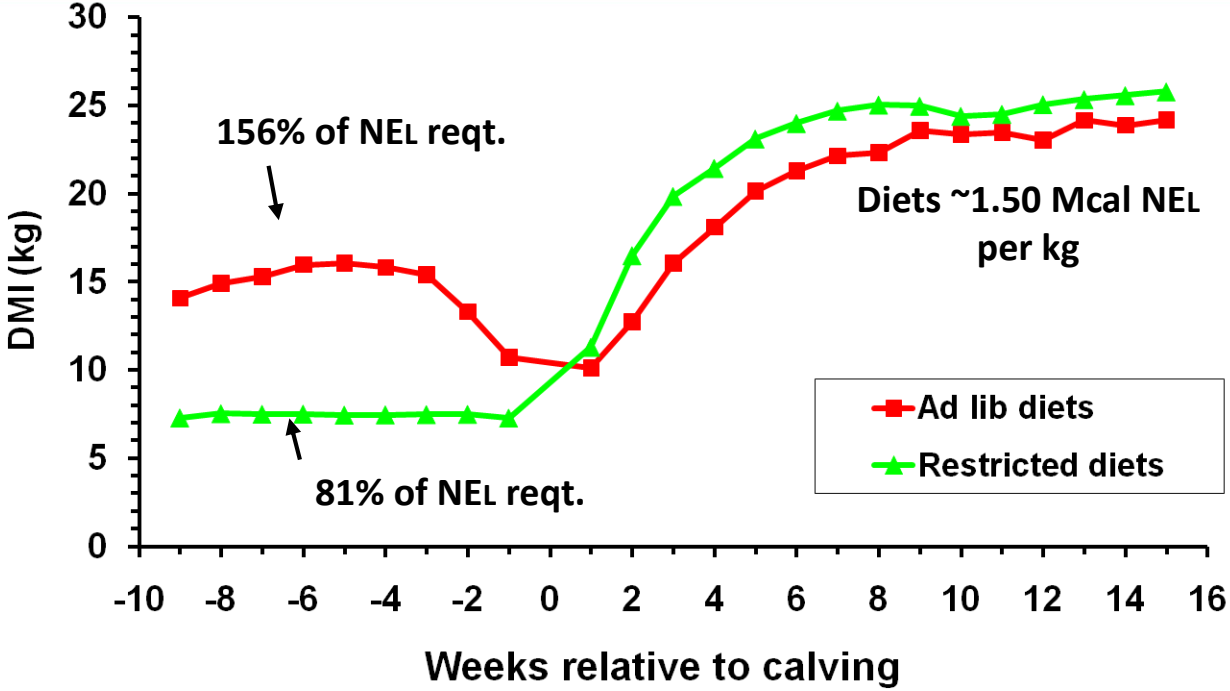
Cows fed even moderate-energy diets during the dry period easily over-consume energy relative to requirements



Douglas et al., 2006

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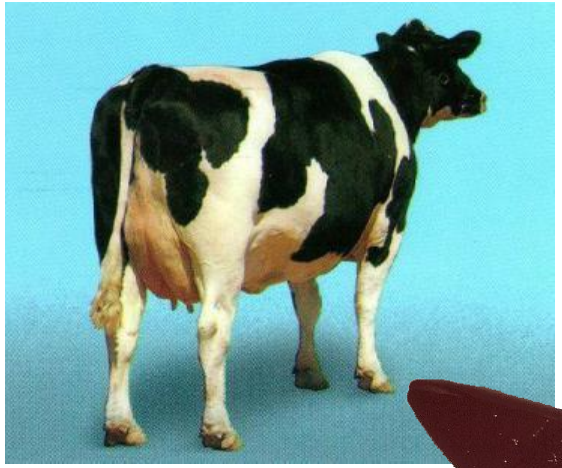
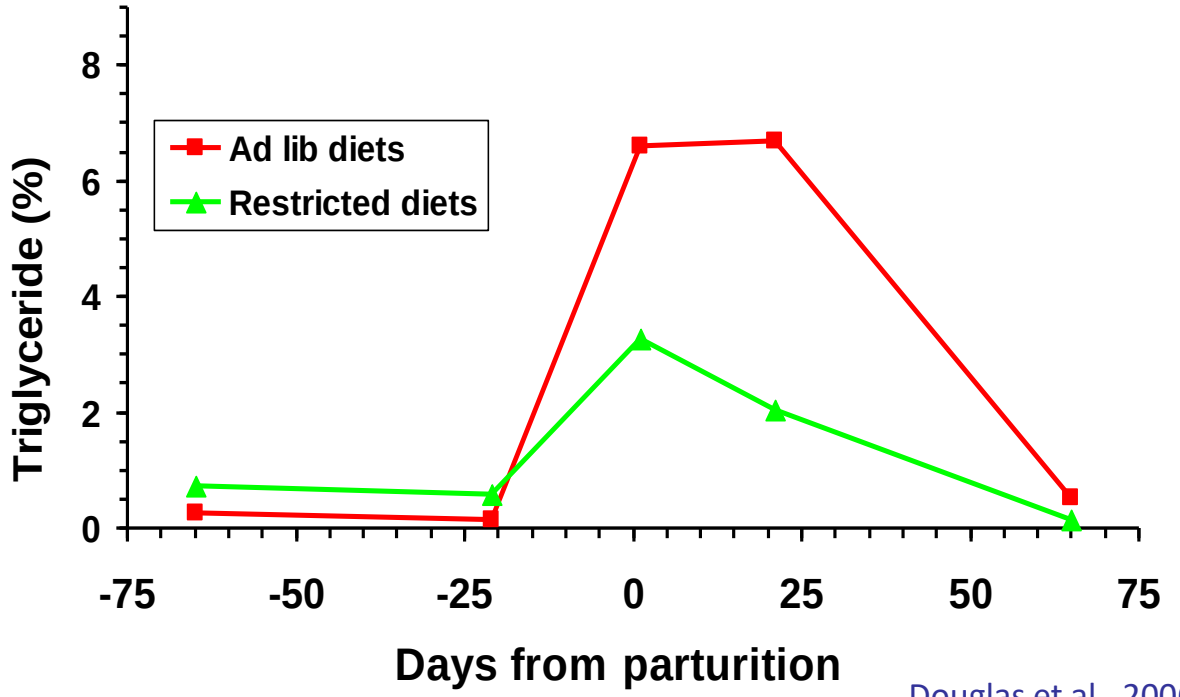
Why might too much energy in the dry period be bad?

Cows respond metabolically as if they were too fat, even if they don't appear to be

- Lower dry matter intake (DMI)
- Increased NEFA
- Increased liver fat
- Increased ketones



Excess dietary energy prepartum leads to greater liver fat after calving



Douglas et al., 2006

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Controlled Energy or “Goldilocks” Diets

Feed to meet cows’ requirements

Not too much, not too little…*But just right*

Promote *consistent intake* throughout dry period…

…to promote high DMI post-calving

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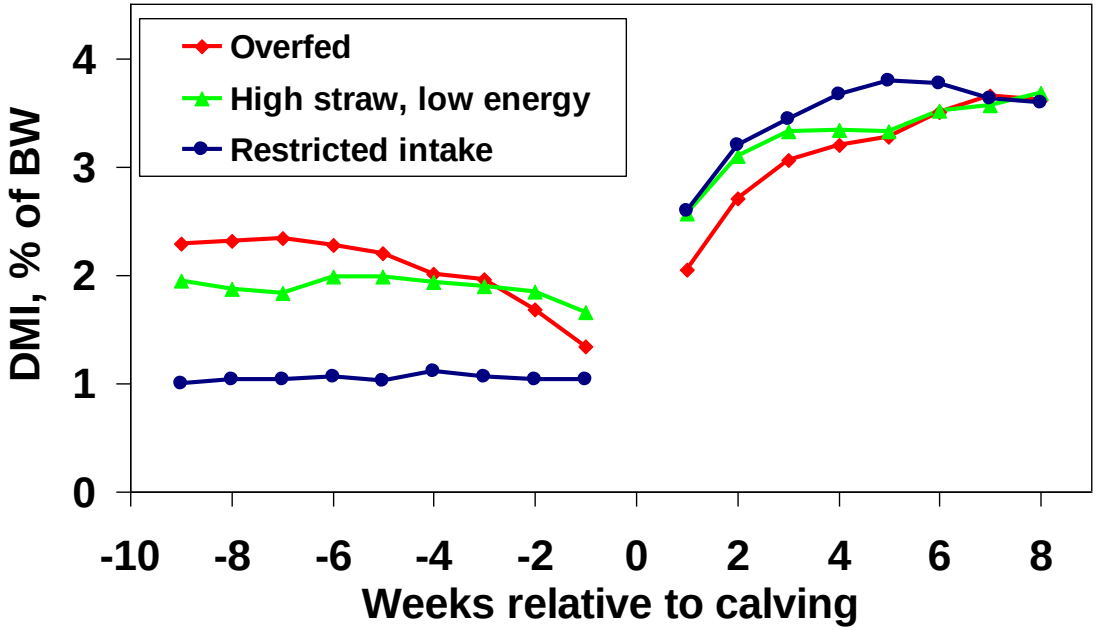
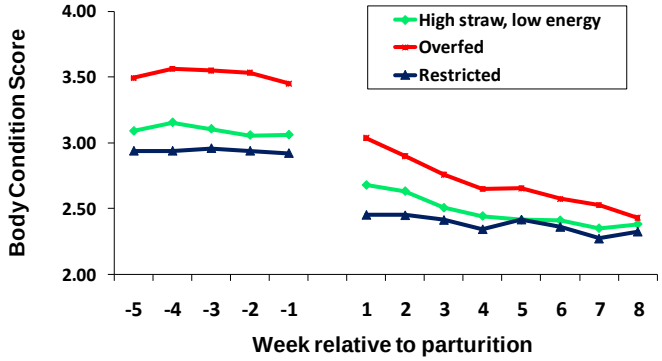
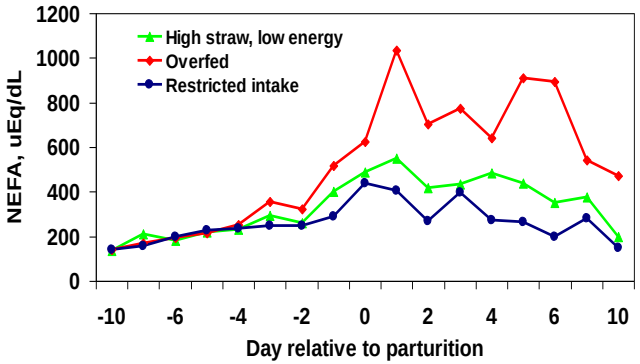
Weekly dry matter intake for cows fed different amounts of energy during the dry period

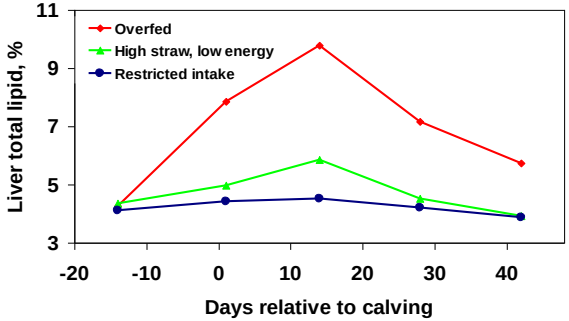


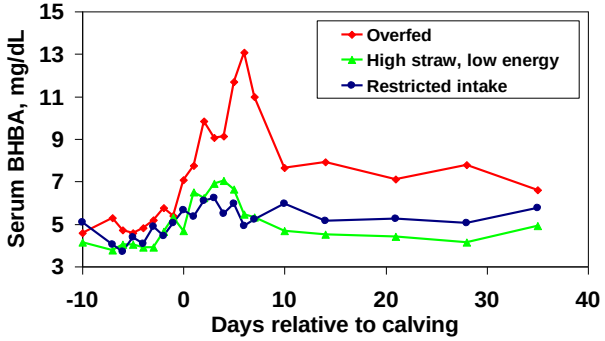
Janovick and Drackley, 2010

Controlled energy diets prepartum resulted in more favorable metabolic status postpartum









Janovick and Drackley, 2010; Janovick et al., 2011

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Overfeeding increases internal fat mass in non-lactating non-pregnant cows after 57 d on diets

Variable	LE	HE	SEM
Initial BCS	3.00	3.08	0.2
Final BCS	3.47	3.52	0.1
BW, kg	751	806	17
Adipose tissue site			
Omental, kg	15.2	26.8**	1.6
Mesenteric, kg	11.2	21.5**	1.9
Perirenal, kg	5.4	8.9*	0.9

n = 9 per diet

** $P < 0.01$

* $P < 0.05$

Drackley et al., 2014

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Overfeeding increases internal fat mass in non-lactating non-pregnant cows after 57 d on diets

Variable LF HF SEM

Modest overfeeding during a normal dry period could lead to a **>75% increase** in visceral adipose tissues that drain directly to liver (the “bad fat” deposits in humans), with *no detectable change in BCS*

* $P < 0.05$

Some key effects of overfeeding in dry period

- Increased loss of BCS ($P < 0.05$)
- Increased risk of displaced abomasum by 5.0 times ($P < 0.01$)
- Increased risk of ketosis by 2.1 times ($P < 0.05$)
- Increased median days to pregnancy by 10 d (167 vs. 157; $P < 0.05$)
- Did not affect milk yield or composition ($P > 0.10$)

Cardoso et al., 2013

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Reproduction and BCS in the real world

Holstein cows (n = 1,887) in two commercial herds in Wisconsin that lost, maintained or gained BCS from calving to 3 wk postpartum

	BCS change category			
Item	Lost	Maintained	Gained	*P*
% of cows	41.8	**35.8**	**22.4**	
Pregnant to AI at 40 d (%)	25.1	38.2	83.5	< 0.01
Pregnant to AI at 70 d (%)	22.8	36.0	78.3	< 0.01
Pregnancy loss (%)	9.1	5.8	6.2	0.34
BCS at calving	2.93	2.89	2.85	< 0.01
BCS at 21 DIM	2.64	2.89	3.10	< 0.01
Energy-corrected milk[a] (kg/d)	30.9	31.5	28.7	0.30

[a] Mean from calving to d 21 postcalving

From Carvalho et al., 2014

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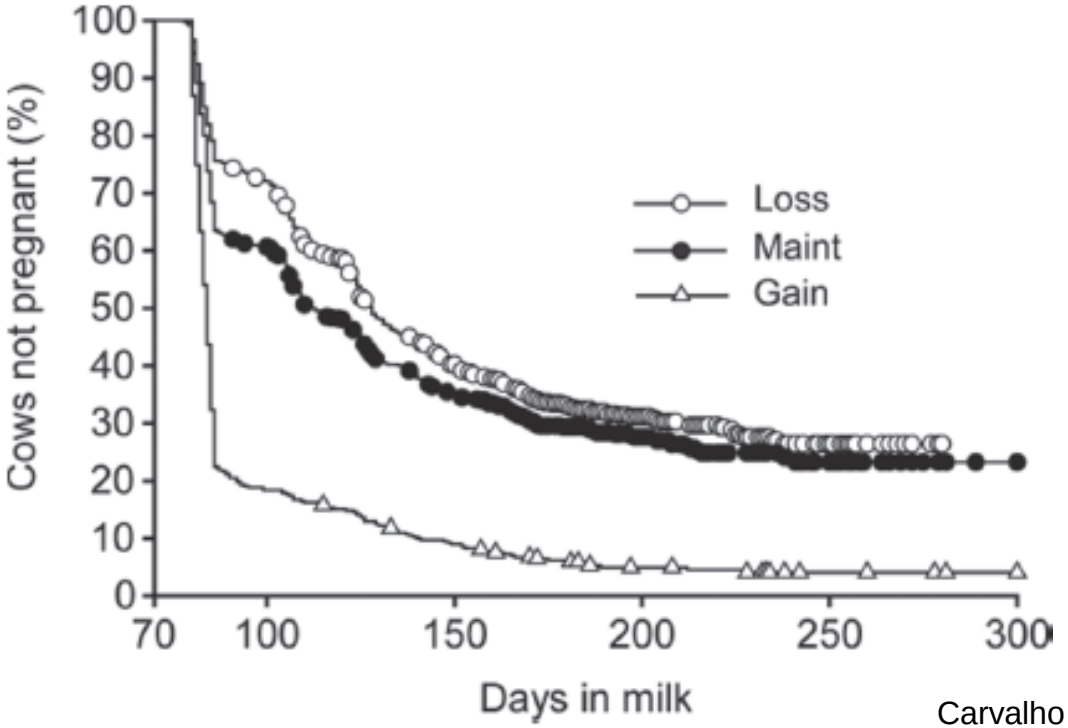
Calving-to-pregnancy interval for cows that gained, maintained, or lost BCS between calving and 21 d postpartum



Carvalho et al., 2014

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Implications

- Higher BCS at calving (>3.25) might allow greater use of stored energy for fat-corrected milk production

- BUT, increases risks of excessive mobilization that is linked to disease and poor reproductive efficiency

OK, Professor, but what do we DO about this?

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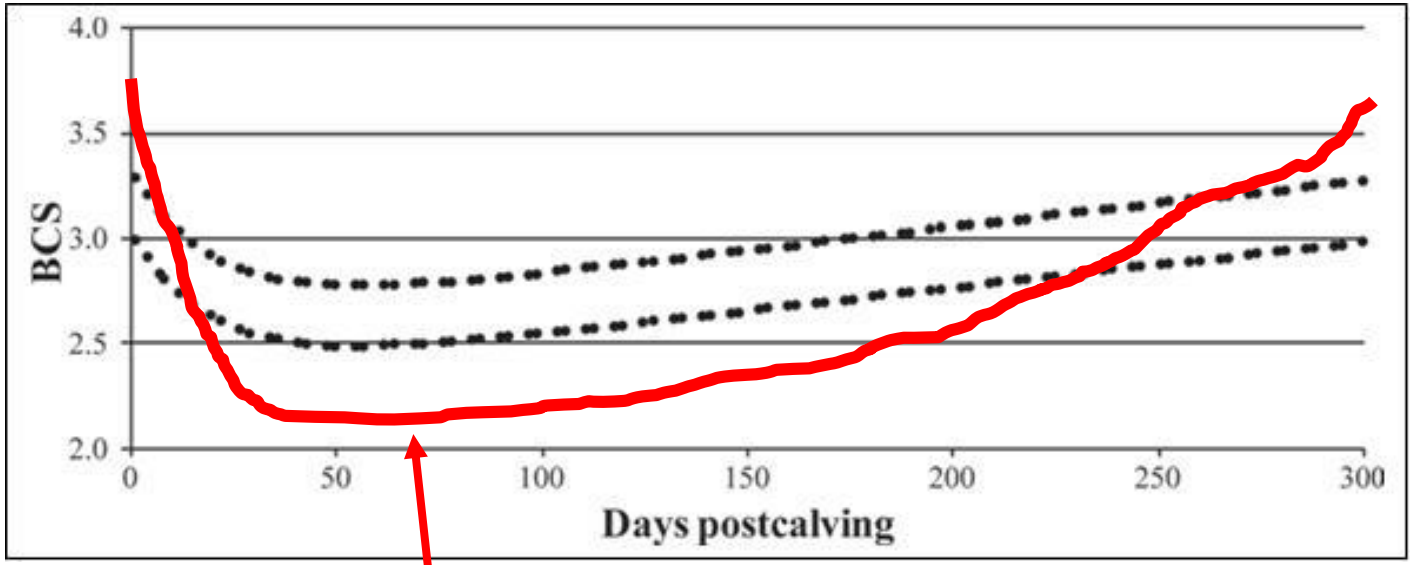
As flat a BCS curve as possible (without decreasing peaks)



These become self-supporting vicious cycles!

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Body condition scoring simplified - 1

PENNSTATE

Angle Between Hooks and Pins

- Angle is a V
- Will be a 3 or less BCS

We want these cows!

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Body condition scoring simplified - 1

PENNSTATE

Angle Between Hooks and Pins

- Angle is a U
- BCS will be more than 3

These cows are too heavy

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Adjusting BCS over time

- Use controlled energy program in dry/transition period
- Improve fresh cow management (don’t be afraid of energy, maximize metabolizable Lys and <3:1 Lys:Met)
- Increase reproductive success
- Cull long-dry cows and cows with chronic repro problems
- Measures to decrease lameness

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Prevent excessive gain of BCS in mid- to late lactation

- Changing to low-energy group may not help; cows drop milk when changed
- Maintain dietary metabolizable protein (Lys, Met) during mid- to late lactation, while decreasing energy
- Decrease supplemental fats and high-fat byproducts
- Substitute high-fiber byproducts for some starch (reduces insulin secretion)

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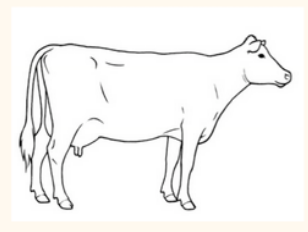
Summary and Take-Home

- BCS remains a valuable tool.
- Current Canadian Code-of-Practice recommendations need revision (IMHO).
- Genetic selection for high milk yield and high protein yield creates a thinner cow.
- We may be evaluating 2020 cows with turn-of-the-century eyes.
- 2020 management target should be 3.0 (+/- 0.25) at calving.



BCS 3

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Thank you

drackley@illinois.edu

http://Illinois.edu/about/landmarks.html

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