Why Dry or Why Not?

Pros and cons of shortening and omitting the dry period for cows, calves and farmer

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This presentation

- Why reconsidering the **dry period**?
- Consequences of dry period length for **cows** and **calves**
  - Metabolism, Mammary health, Calves, Behaviour and Fertility
- Consequences of dry period length for the **farmer**
- How to manage cows with a short or no dry period?
  - **Customised Dry Period Management**

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Why reconsidering the dry period?

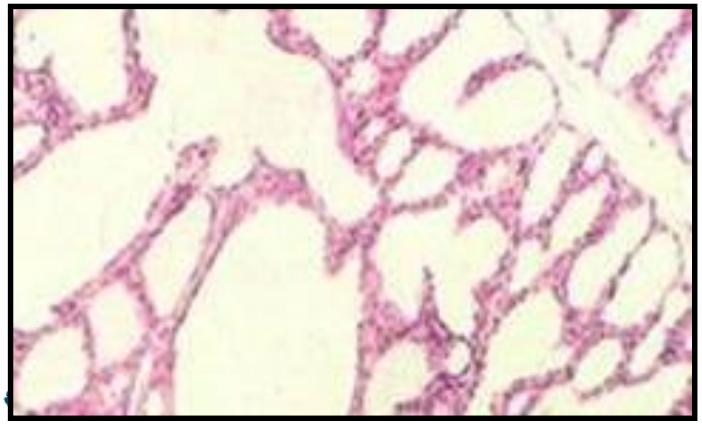
Why a dry period?

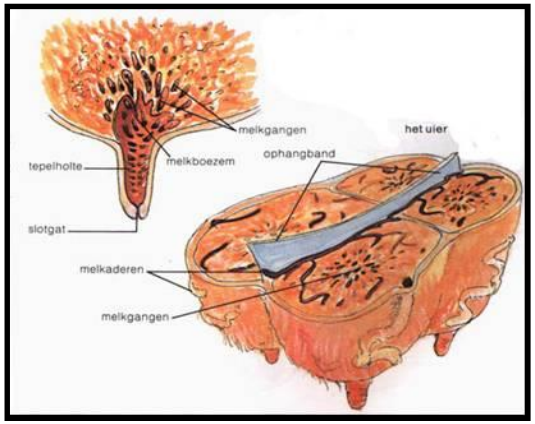
Advice to farmers: dry period of 6 till 8 weeks...

.... to maximize milk yield in the next lactation.

Function of the dry period for dairy cows:

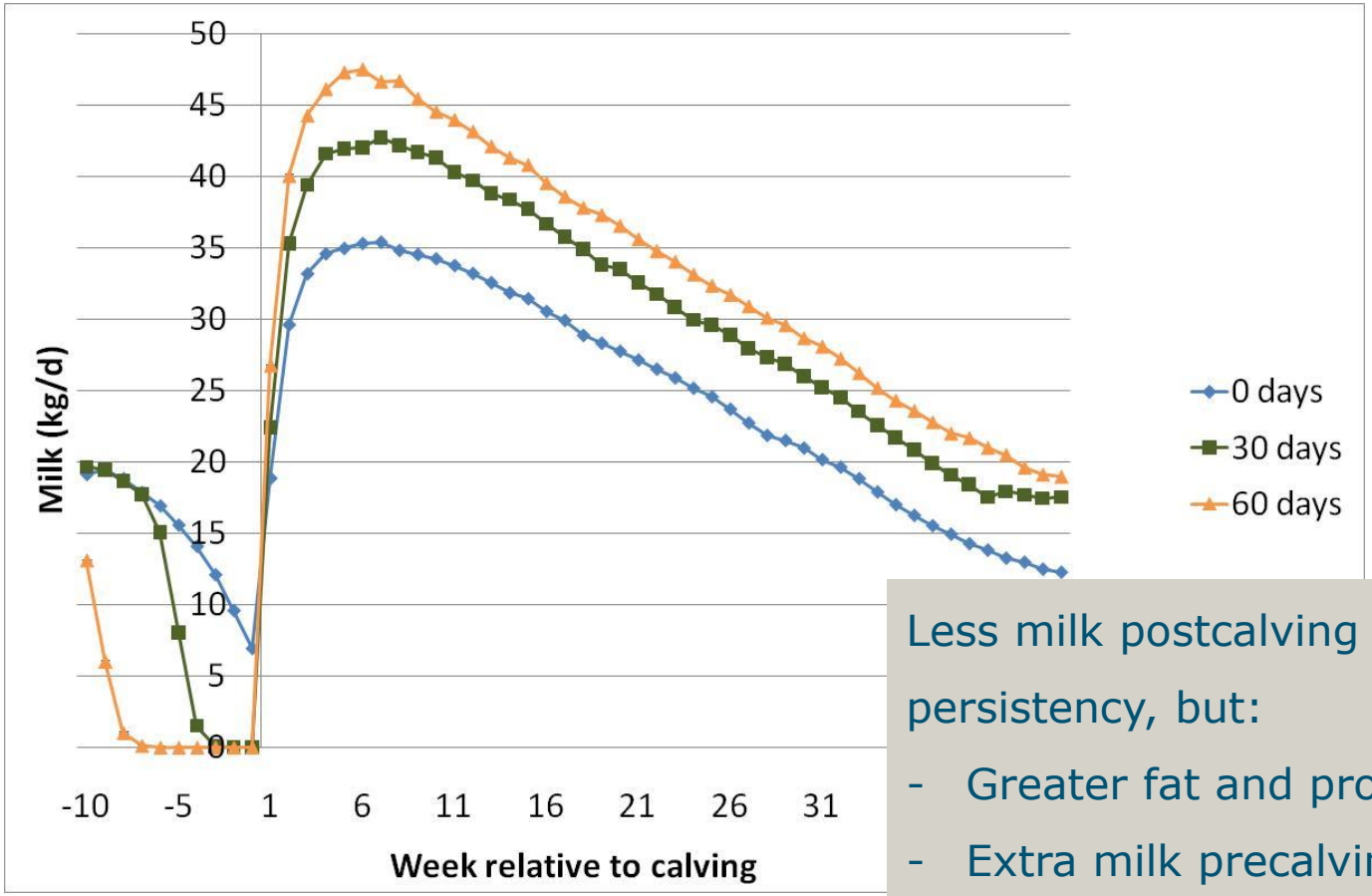
- ❖ renewal of mammary secretory cell population (Capuco et al., 1997)
- ❖ period to treat cows with (preventive) antibiotics (Neave et al., 1966)
- ❖ (previously also: restoring body reserves)





(Short and) No dry period costs milk

Fig 1. Milk production for cows with conventional (60d), short (30d) or no dry period (N=167).



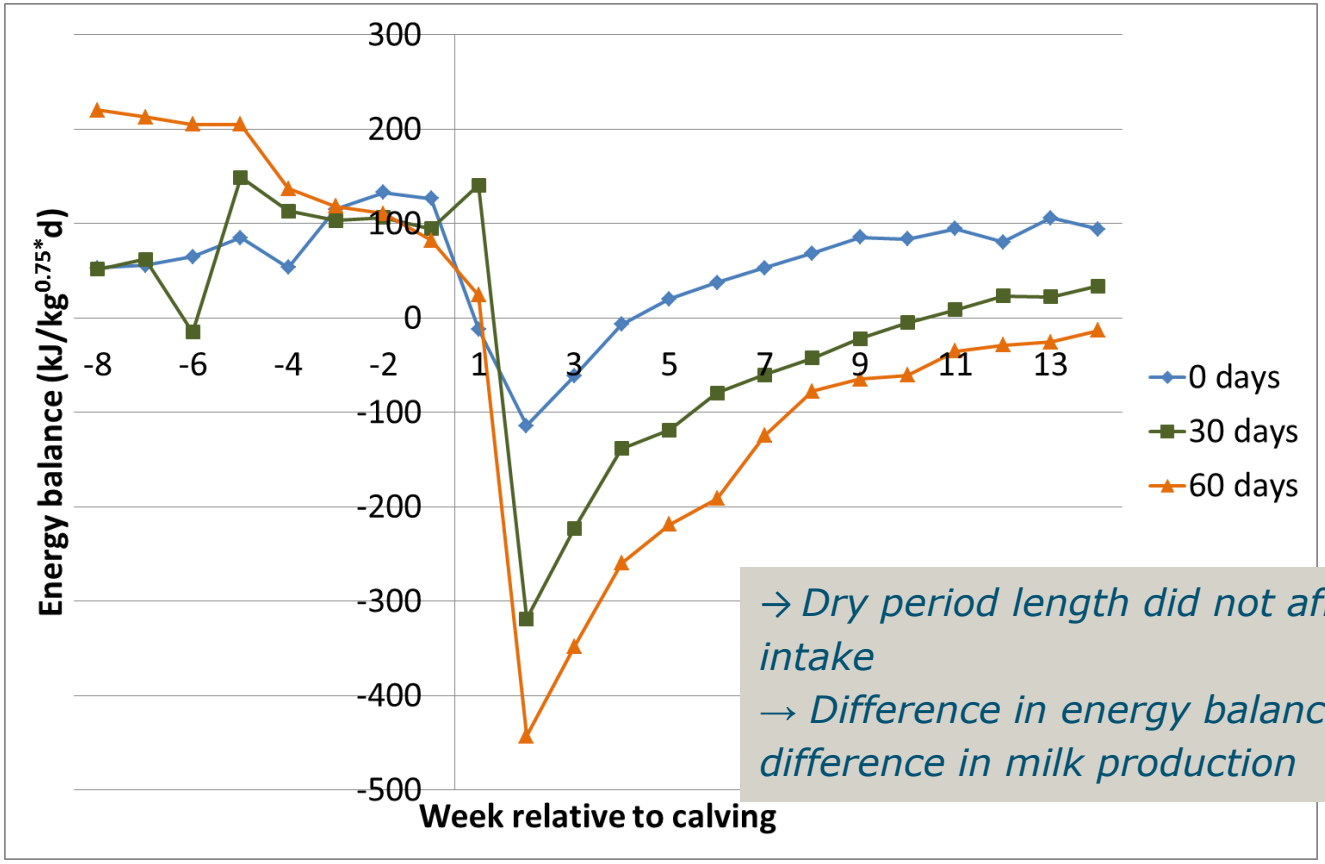
Less milk postcalving and no effect on persistency, but:

- Greater fat and protein %
- Extra milk precalving
- Depended on parity

(Van Knegsel et al., 2014)

Short or no dry period results in better energy balance

Fig 2. Energy balance for cows with conventional (60d), short (30d) or no dry period (N=167)



→ Dry period length did not affect dry matter intake
→ Difference in energy balance due to difference in milk production

Post calving: Dry period: $P<0.01$;
Diet: $P=0.02$ (Van Knegsel et al., 2014)

Reconsidering the dry period...

- No and a short dry period improve the energy balance in the next lactation[1]
- AB use at dry off is not standard practice anymore[2]
- Problems with drying off cows with a high milk yield
  - Consequences for inflammation, udder health and welfare[3,4]
- Management of dry cows is an (underestimated) challenge
  - treat existing intramammary infections
  - prevent new intramammary infections
  - stimulate mineral metabolism
  - maximize feed intake
  - limit energy intake and prevent fattening

([1]Rastani et al., 2005; [2]Scherpenzeel et al., 2016; [3]Zobel et al., 2015; [4] Trevisi et al., 2019)

Consequences for cows and calves

Part I: metabolic effects

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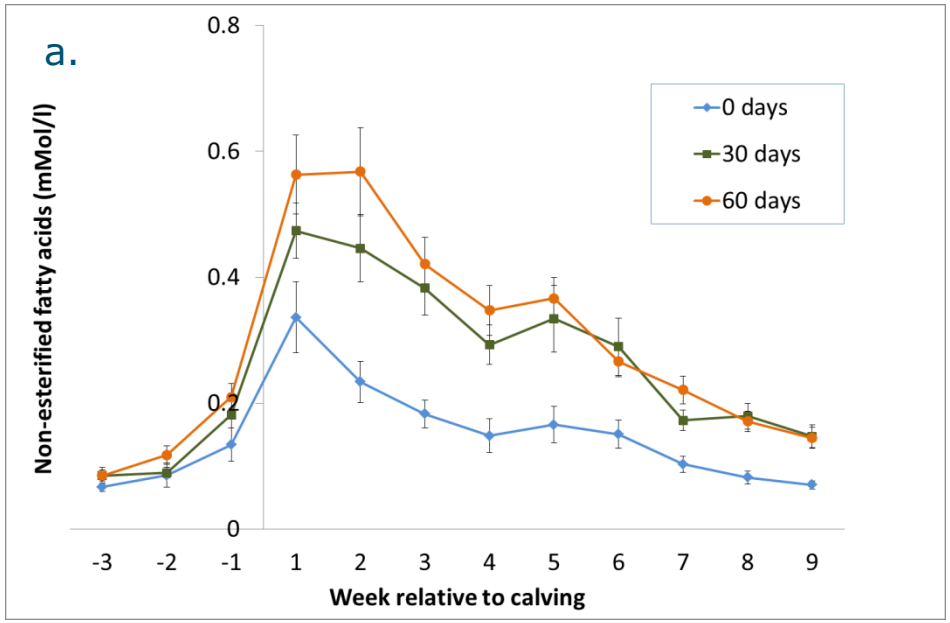
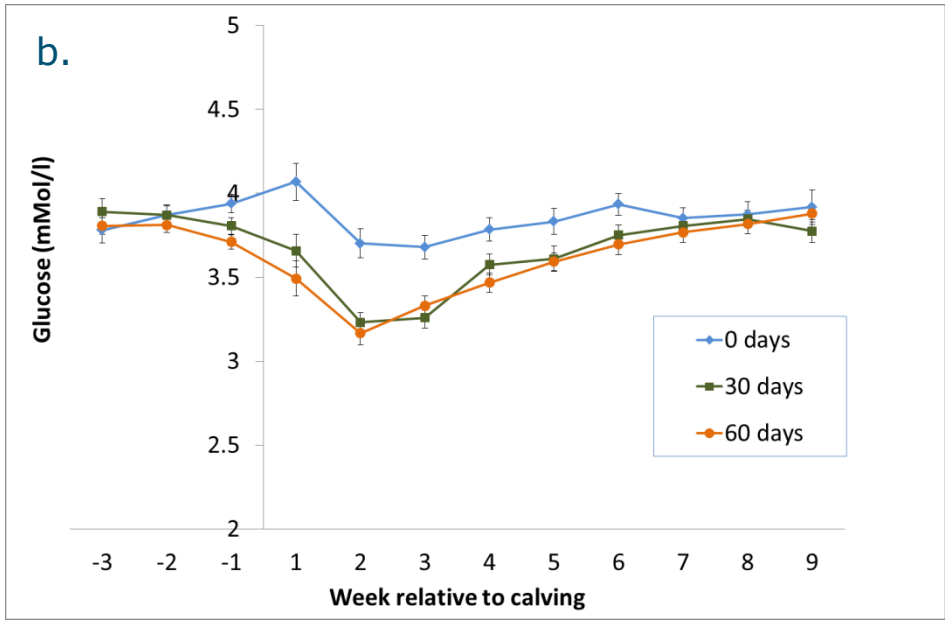
No and short dry period improve metabolic status

Fig 3. Plasma **NEFA** (a) and **glucose** (b) concentration for cows with conventional (60d), short (30d) or no dry period (N=92).



Post calving: Dry period: $P<0.01$;
Diet: $P=0.48$



Post calving: Dry period: $P<0.01$;
Diet: $P=0.82$

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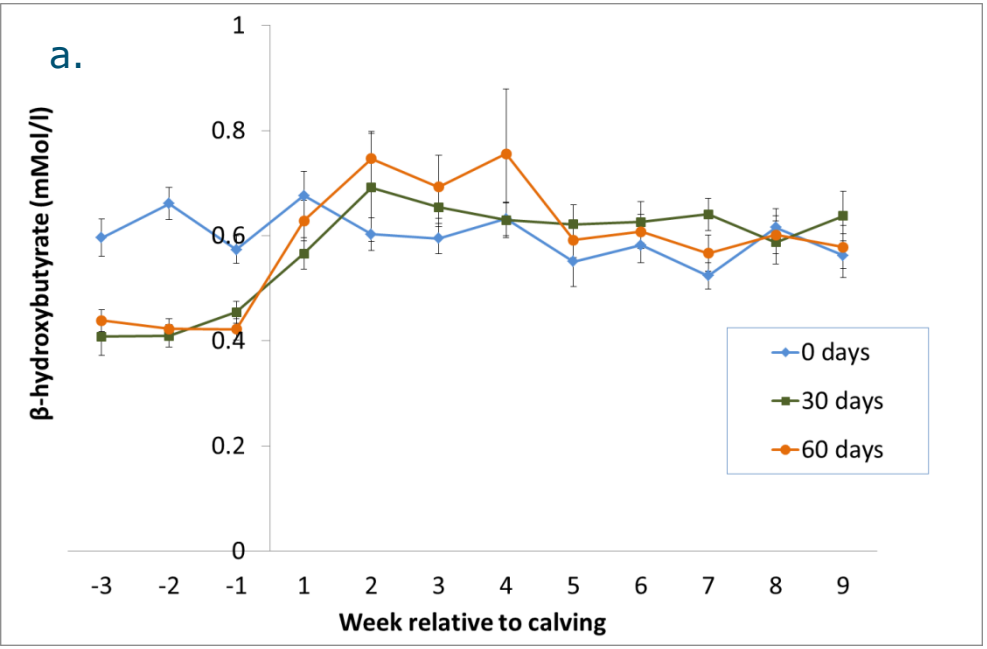
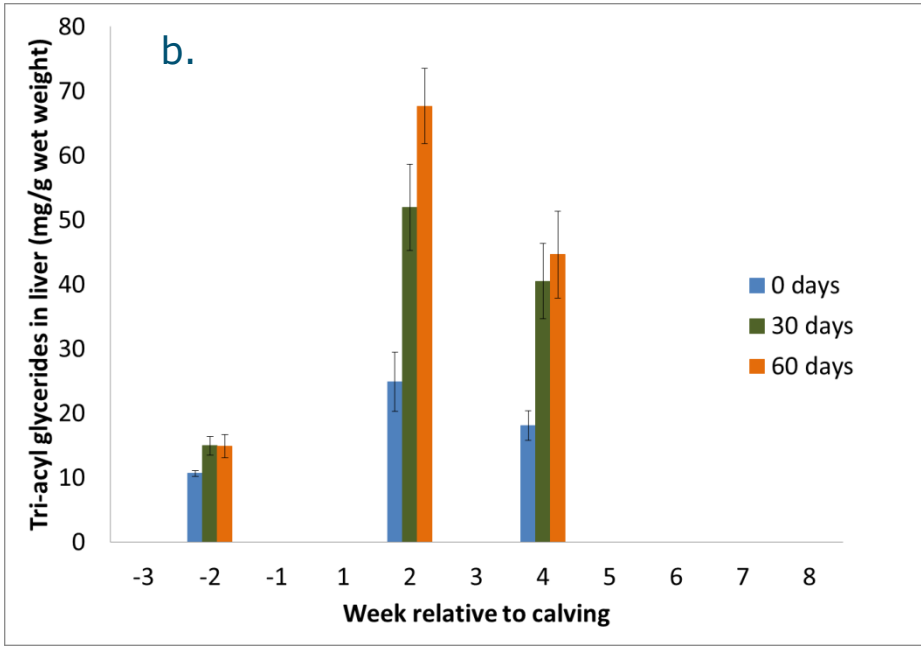
(Chen et al., 2015a)

Reducing dry period length reduces liver fattening

Fig 4. Plasma **BHBA** (a) and liver **TAG** (b) concentration for cows with conventional (60d), short (30d) or no dry period (N=92).



Post calving: Dry period: *P*=0.40;
Diet: *P*=0.02



Post calving: Dry period: *P*<0.01;
Diet: *P*=0.58

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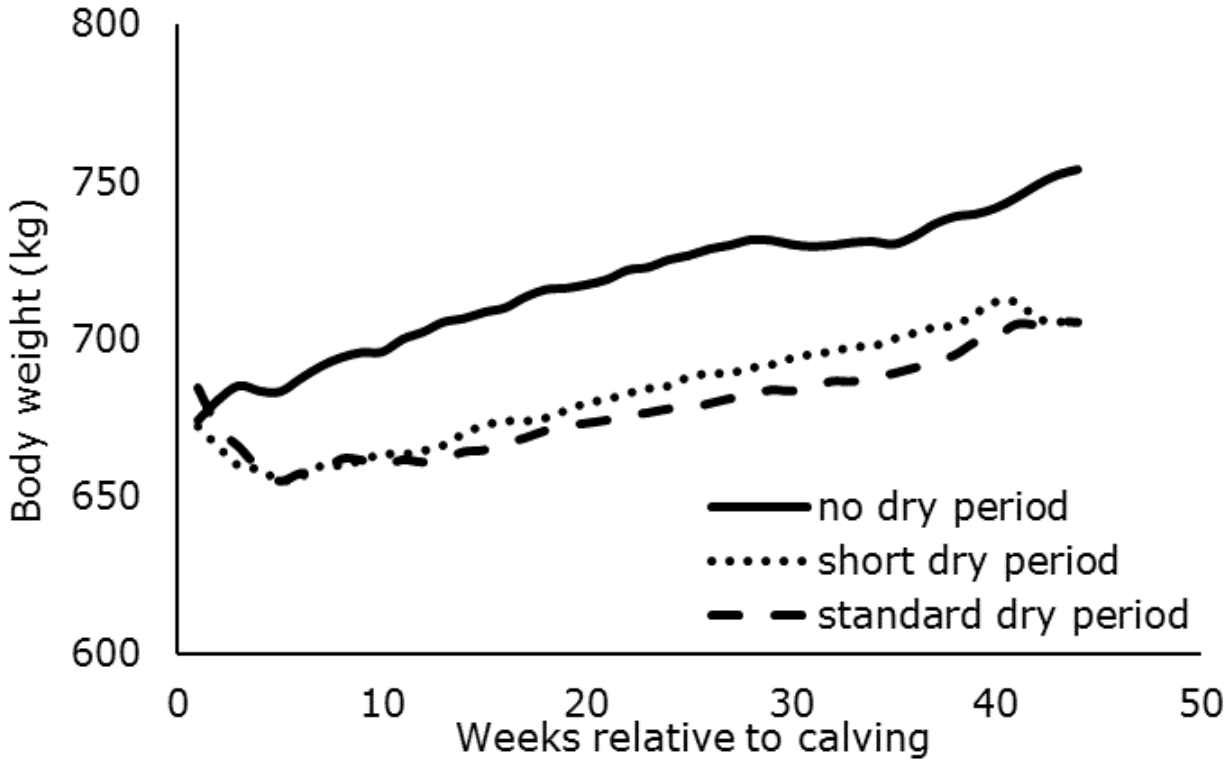
(Chen et al., 2015a)

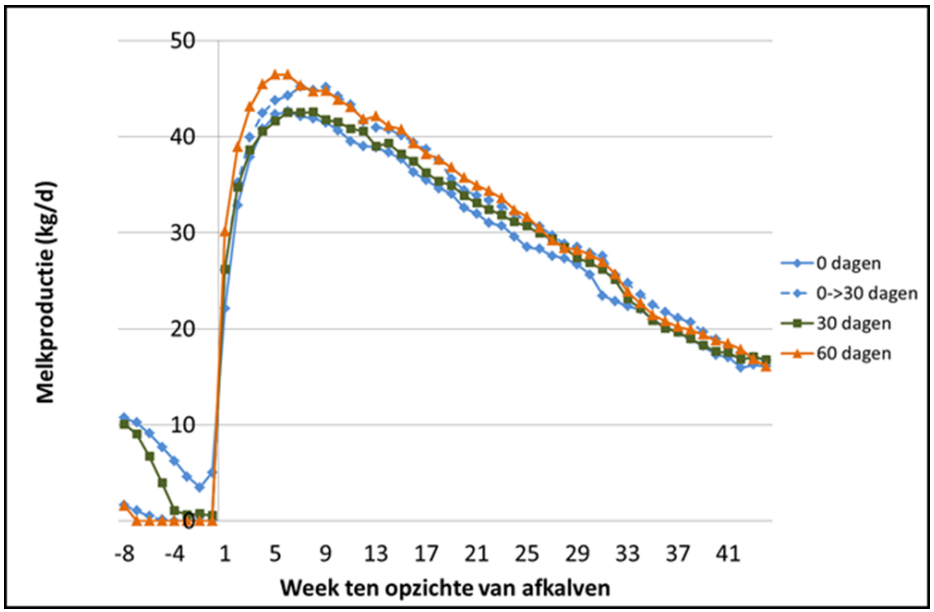
Energy balance is not only improved in early lactation, but in the complete lactation

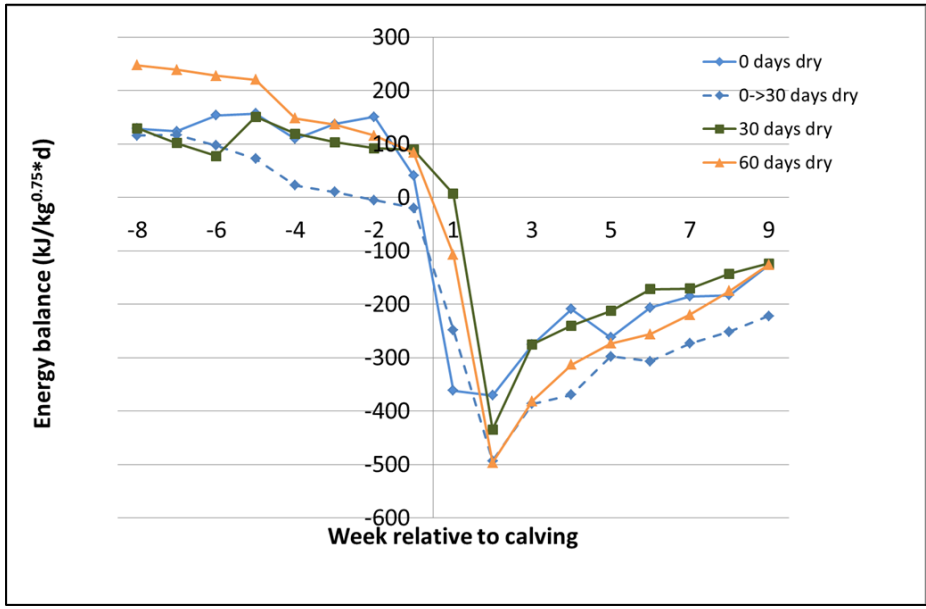


Body weight development during a complete lactation of dairy cows after a 0-d, 30-d or 60-d dry period (based on Chen et al., 2016)

Second lactation: **contrast in milk yield and energy balance reduces**

Milk yield for cows with conventional (60d), short (30d) or no dry period (0d).
(N.B. Cows in the 0->30 days dry group were planned for 0 d dry period, but dried themselves off)





Due to : increase in **parity**, **selection** (19 out of 40 cows dried themselves off), **low milk yield in precalving period** simulates some aspects of the dry period (?)

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(Chen et al., *2016a)*

Consequences for cows and calves

Part II: mammary gland, calves, fertility

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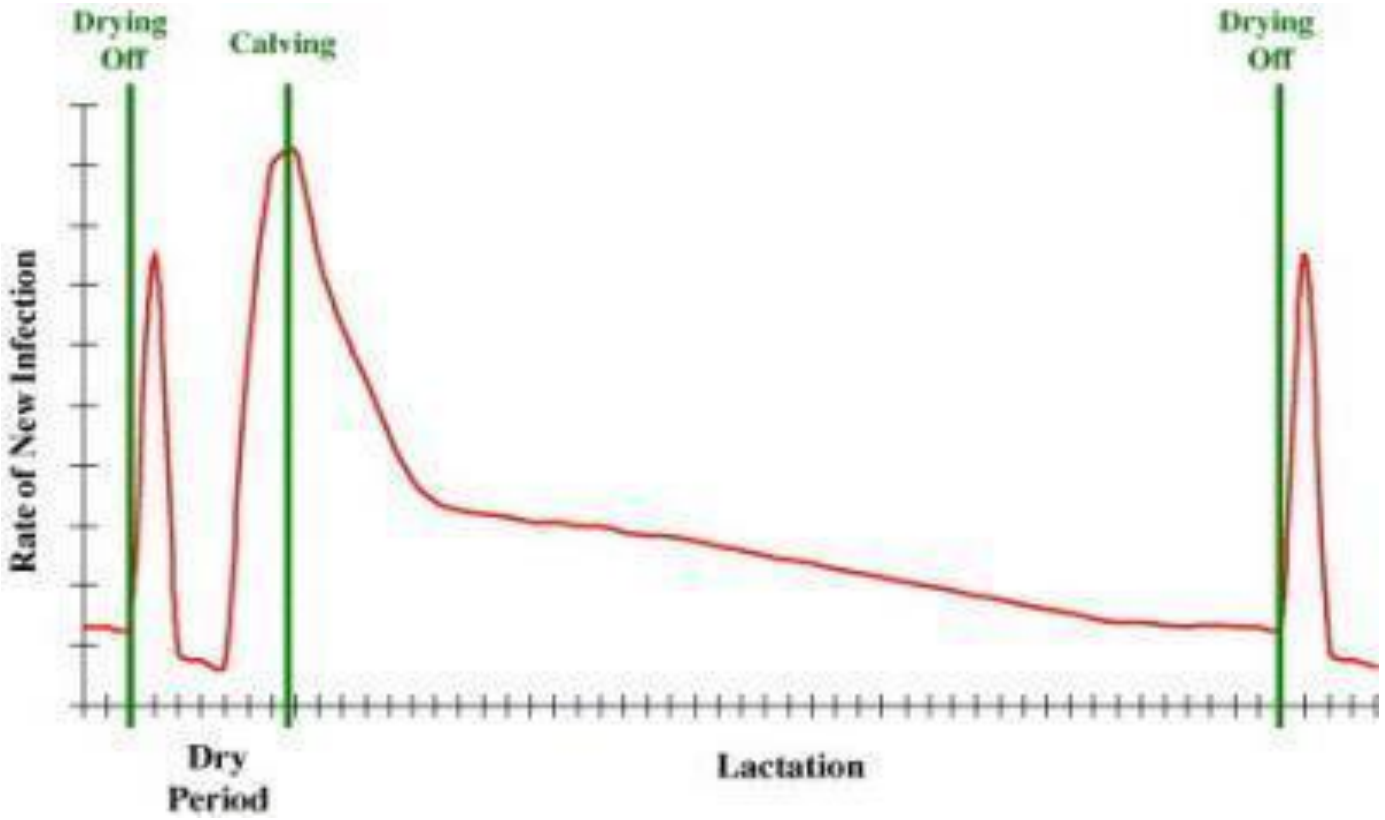
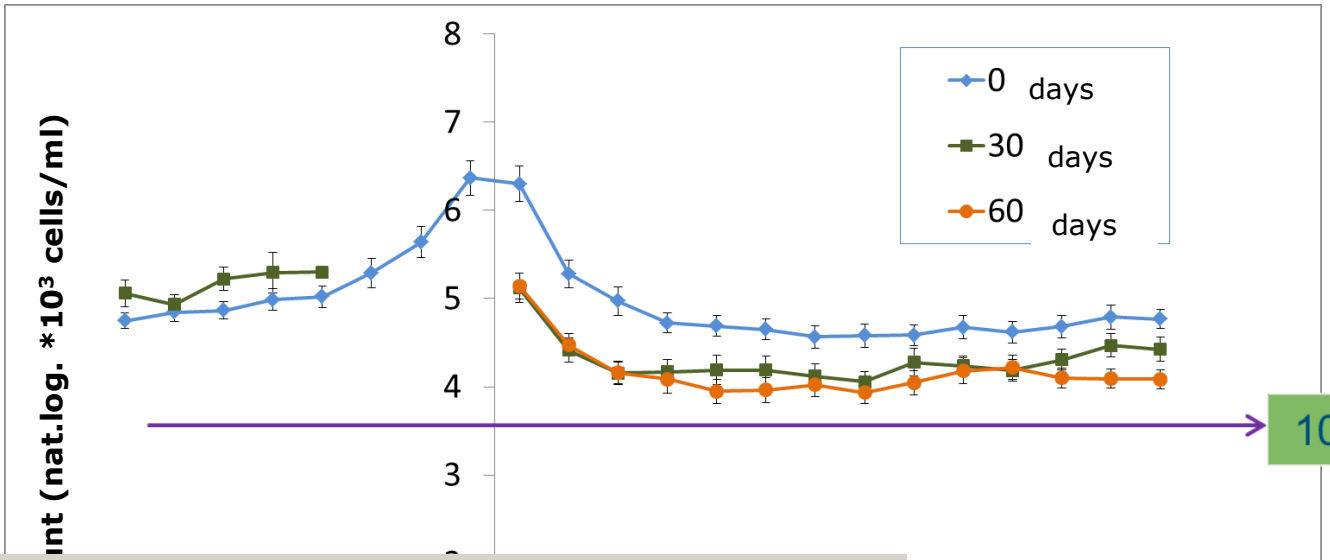
Relation between dry period and mammary health is contradictory ...



Rate of new intramammary infections during the lactation cycle (Bradley and Green, 2004).

No dry period increases somatic cell count

Fig 6. Somatic cell count in milk of cows with conventional (60 d), short (30 d) or no dry period (N=167).



→ Increase in SCC only for cows with an elevation in SCC in the previous lactation (Van Hoeij et al., 2016)

→ What is the cause for increase in SCC: omitting the dry period or omitting the antibiotics?
→ Is increase in SCC related with reduced mammary health, less milk or altered regeneration profile in the mammary cells?

Mastitis incidence, week 0-14:

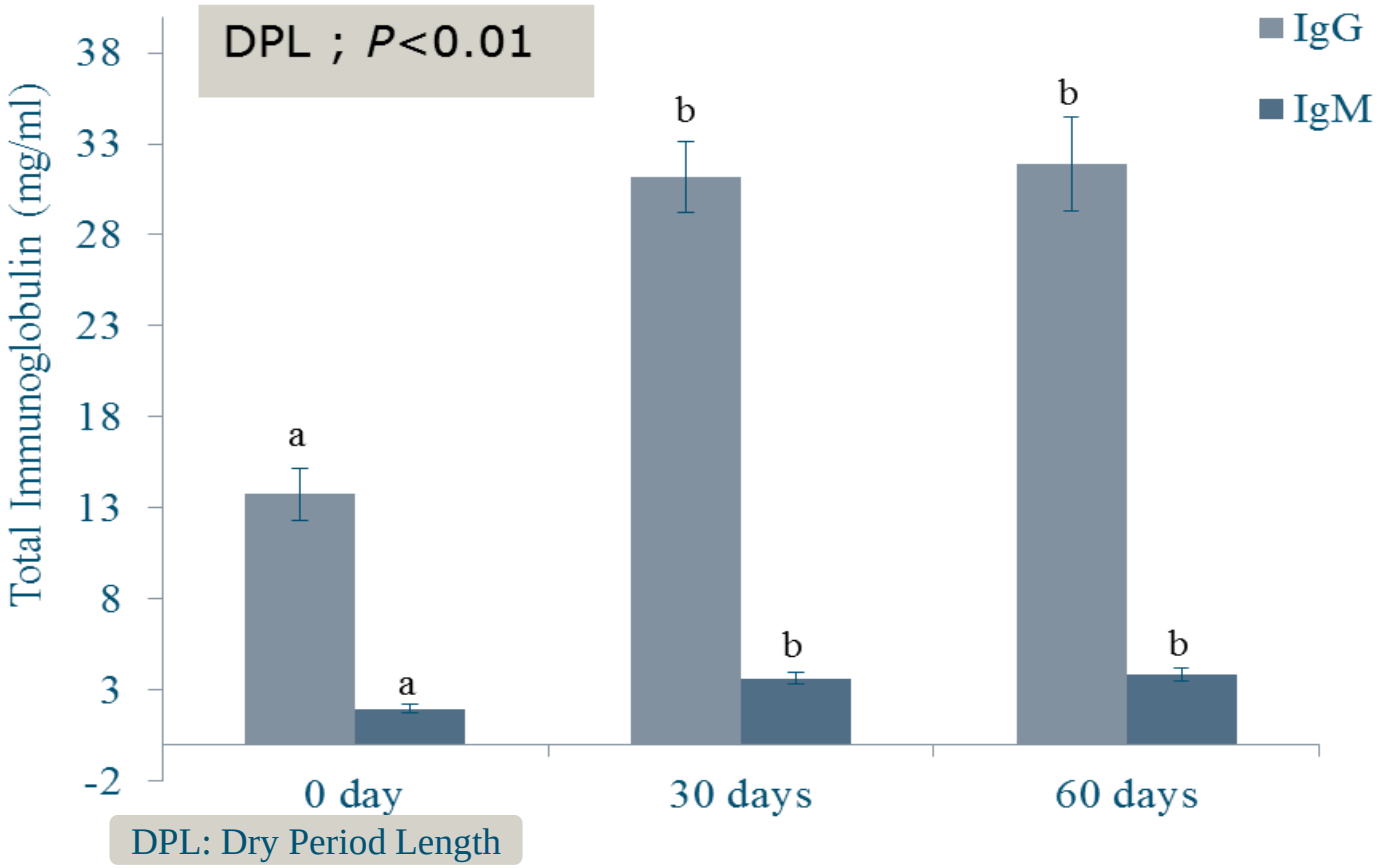
0 days: 12 (10/56 cows);

30 days: 8 (8/55 cows);

60 days: 10 (9/56 cows)

Post calving: Dry period length: $P<0.01$;
Ration: $P=0.95$

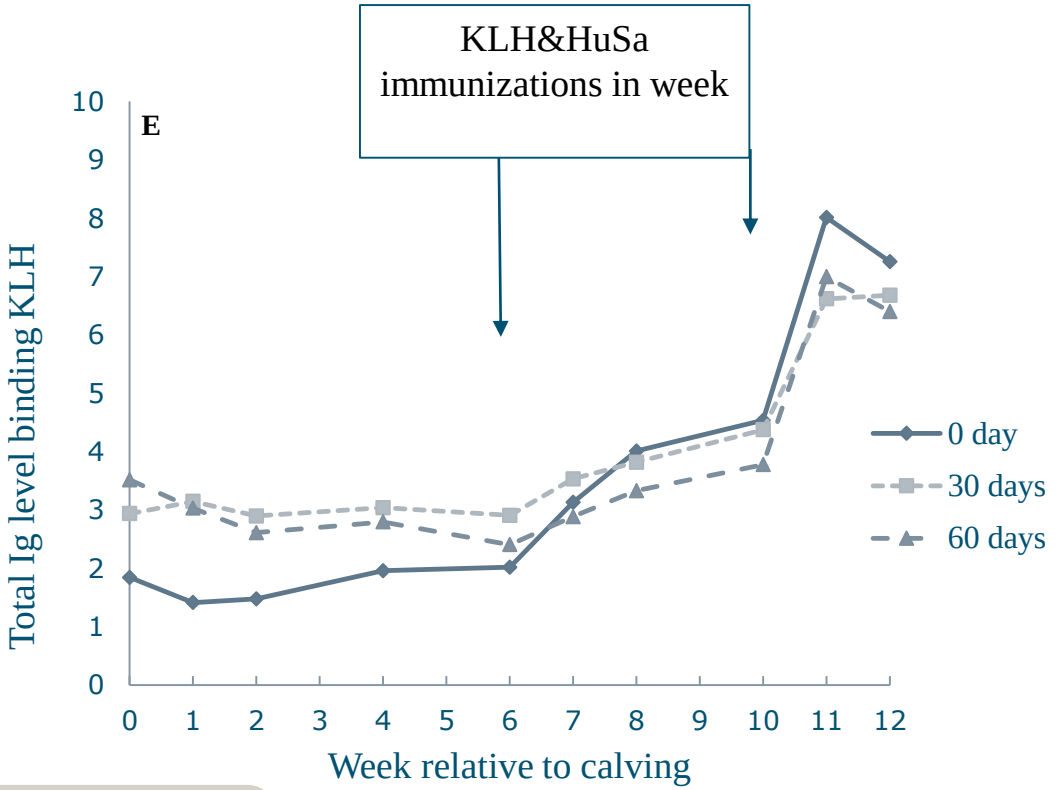
No dry period reduces colostral IgG



(Mayasari et al., 2015)

Lower plasma antibodies in first weeks, later no effect

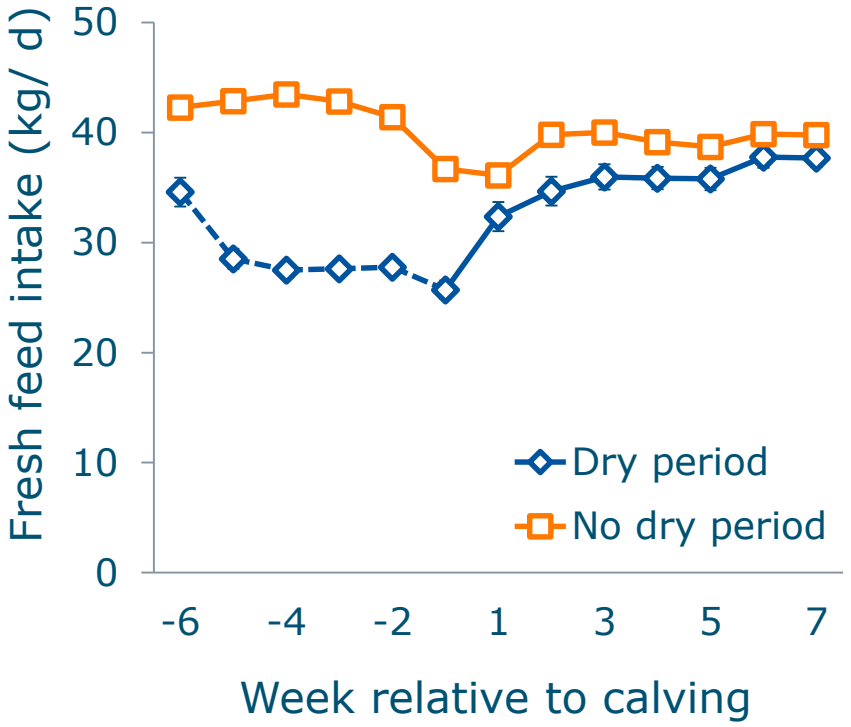
- Calves received colostrum of their own mother (2 x 2 ltr in first 24 hrs);
- Calves were immunized with model antigens (KLH and Husa) in week 6 and 10
- No effect on calf growth first 12 weeks

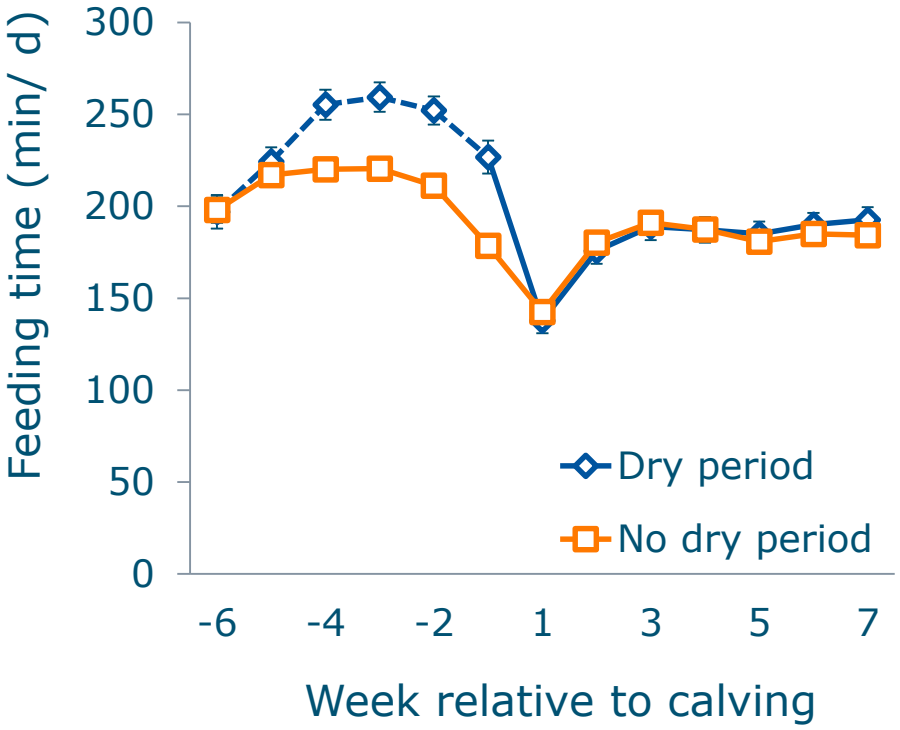


KLH : Keyhole Limpet Hemocyanin
HuSA: Human Serum Albumin
DPL: Dry Period Length

(Mayasari et al., 2015)

No dry period increases peripartum feed intake



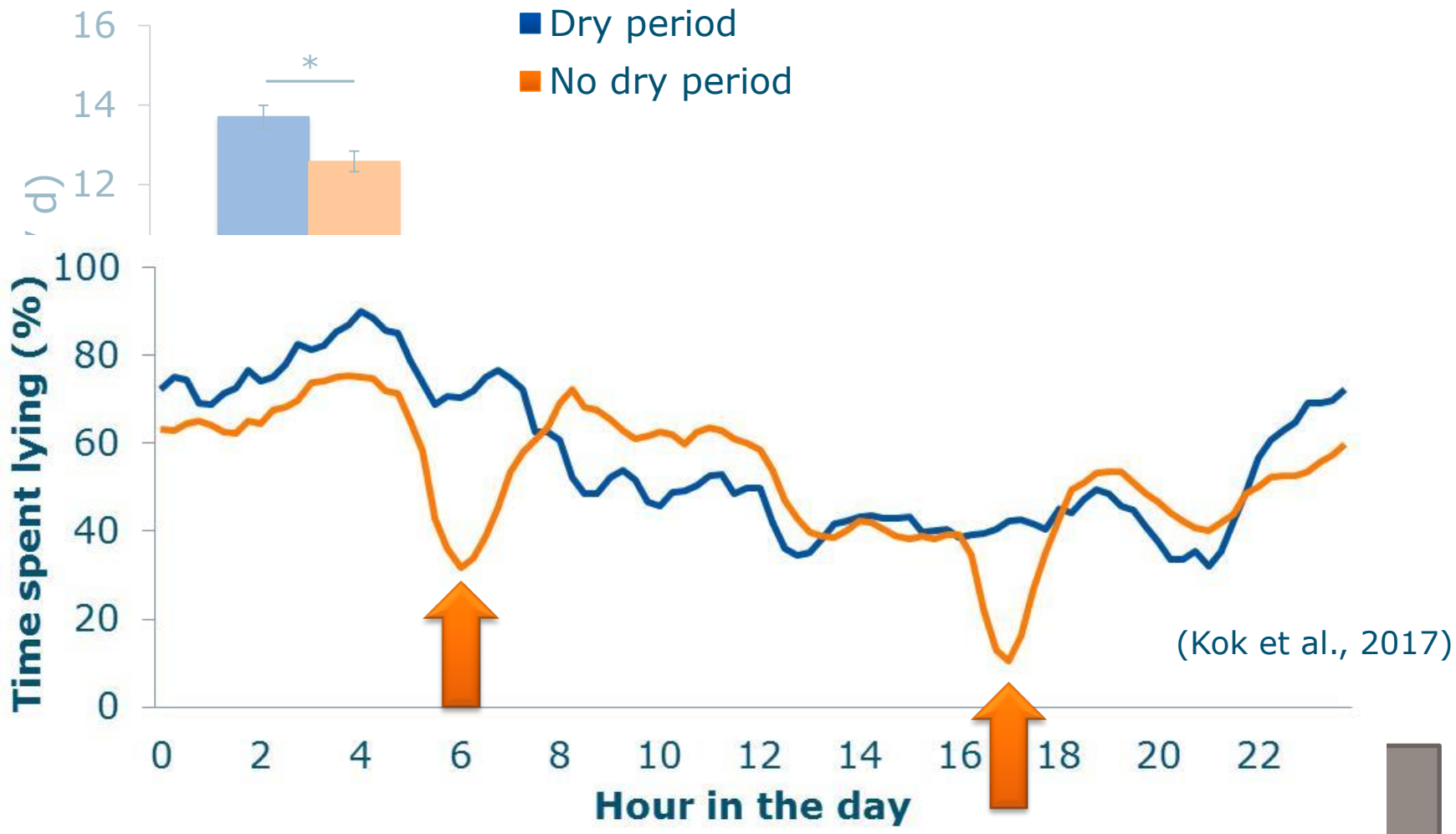


Cows with no dry period:

- Higher feed intake, before and after calving
- Shorter feeding time before calving

(Kok et al., 2017)

Is the dry period an essential 'rest period?'



(Kok et al., 2017)

Co

- Shorter lying time and more locomotion before calving
- Longer lying time after calving

Shorter interval till first ovulation pp and next calving

(Gumen et al., 2005; Chen et al., 2015; Kok et al., 2016)

Table 2. **Milk production** and **intercalving interval** of second parity cows from 16 commercial farms with a shortened/no dry period management strategy.

	Dry period		
	Conventional	Short	No
	FPCM[3]	FPCM[3]	FPCM[3]
305-d milk yield (kg/d)	30.8[a]	28.4[b]	23.8[c]
Effective lactation yield (kg/d)[1]	25.4[a]	24.9[a]	22.4[b]
Intercalving interval (d)	**385[a]**	**368[b]**	**359[b]**

[1]Effective lactation yield = milk yield from 60 d before calving to 60 d before next calving (in kg/d), i.e. lactation yield corrected for milk yield before calving and differences in intercalving interval.

Consequences for the farmer (and more)

- labour costs (healthier cows, less transitions)
- milk yield at herd level
- cash flows
- GHG emissions

Milk effects at **herd level** are lower than at **cow level**

At cow level, milk yield losses are:[1]

4.5% for shortening the dry period

19% for omitting the dry period

At herd level, milk yield losses are:[2]

3% for shortening the dry period

3.5% for omitting the dry period

Relatively small effect of dry period length at herd level, due to:

1. Lactations are longer, than monitored in most studies
2. Heifers have no reduction in milk yield, but more DIM
3. Increased fertility[3], shorter calving interval[4]
4. Effect of culling on milk yield is reduced[4]

[1]Van Knegsel et al., 2013; [2]Kok et al., 2017;[3] Gumen et al., 2005; [4]Kok et al., 2016)

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Impact on cash flows and GHG emissions?

- Modelling study including data of network of dairy farmers
- Simulate 50 herds, with 100 cows each, over 5 years
- Comparing **no dry period** with a **8 wk dry period**

		Ref. model	*-5% culling*	*+1 kg milk/d*
	cow^{-1} $year^{-1}$	-€16	-€6	+€43
	per t milk	+4 kg (0.4%)	-19 kg	-11 kg

Kok et al. 2017b

Customising dry period management based on individual cow characteristics

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Customising dry period length

Why customising dry period length?

- limit milk yield losses
- metabolic benefits
- treat cows with persistent intramammary infections

DPL effects depend on individual cow characteristics

- Parity[1]
- Udder health status[4]
- Milk yield level, e.g. high-producing cows:
  - can better be continuously milked (more additional milk)
  - are difficult to dry off -> welfare and udder health[2,3]
  - (proportionally) lowest milk yield losses

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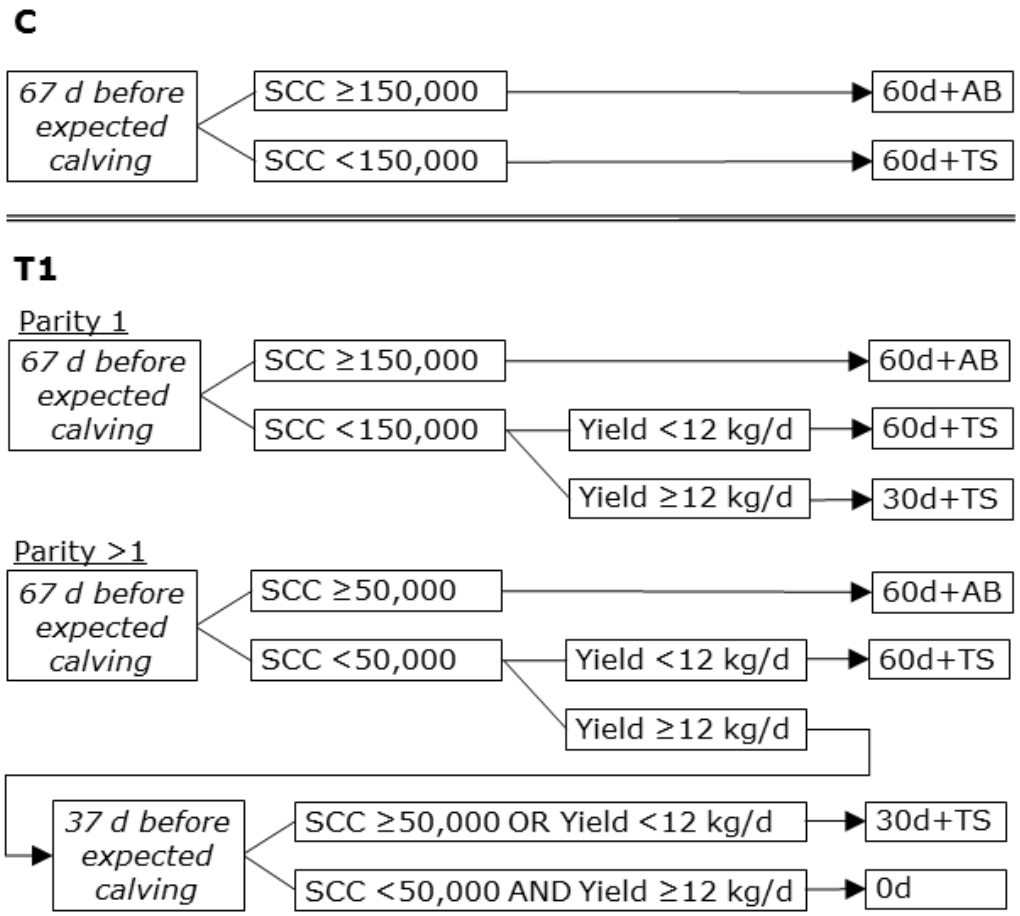
([1]Kok et al., 2018; [2]Zobel et al., 2015 ; [3]Rajala-Schultz et al., 2005; [4]Van Hoeij et al., 2016; 2017)

Decision tree for dry period management

Dry period length and use of **dry cows antibiotics** based on:

- parity
- udder health status
- milk yield level



(Kok et al., 2019 . EAAP session 56)

T2: Same as T1, altough SCC level for AB use at dry off is elevated to 200,000 cells/ml for both parity 1 and older cows

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Milk and milk composition after calving

	Decision tree		
	C	**T1**	**T2**
Milk , kg/d	40,08[a]	37,11[b]	35,14[b]
Lactose, %	4,57	4,57	4,56
Fat, %	4,20	4,13	4,24
Protein, %	3,44[a]	3,54[b]	3,62[b]
Somatic cell count *10^3 cells/ml	77[b]	61[a]	80[b]

-> after calving **less milk** for cows on decision tree 1 and 2

-> greater **protein%** for cows on decision tree 1 and 2

-> after calving **lower SCC with decision tree 1**

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[a,b,c] verschillende superscripten betekent dat groepen significant van elkaar verschillen

Disease incidence

-> Tendency for **less disease cases** in the next lactation after decision tree 2.

	Decision tree 1	Decision tree 2	Control	Total
Milk fever	6	3	3	12
Mastitis	4	5	5	14
Claw- and legproblems	9	3	8	20
Retained placenta	4	3	7	14
White vaginal discharge	11	8	15	34
Endometritis	9	7	8	24
Cystic ovaries	6	1	4	11
Other	1	4	5	10
Total disease cases (n)	50	34	55	139
Total cows (n)	59	63	61	183

Concluding remarks

WHY DRY or WHY NOT? *consequences for cows and calves*

Omitting/ Shortening of the dry period has clear advantages at **systemic level of the cow**, but not at level of **mammary gland**

PROS at **systemic level**:

✓ Less ration and group transitions -> better feed intake
✓ Better energy balance and metabolic status
✓ Improved fertility

PROS and CONS at **mammary gland level**:

✓ Less (no) problems to dry off
✓ No new intramammary infections during the dry period
× No treatment of existing intramammary infections
× Lower IgG in colostrum
× Reduction in milk yield in the next lactation

WHY DRY or WHY NOT? *considerations for the farmer*

- ✓ Healthier cows
- ✓ Less labour, different type of labour
- ✓ Reduction in antibiotic use

customising **dry period length** ánd **dry cow antibiotic use**

✓ Benefit from pros and cons

But:

- How to evaluate economic consequences?
  - 305d milk yield, 365d my, effective lactation yield, lifetime yield,...?
  - Economic value of improved health?
  - Second lactation, herd level effects
- Adjustment of feeding strategies
- Insemination strategy (-> short calving interval!)
- Consequences for productive lifespan (?)

Dry period length - work

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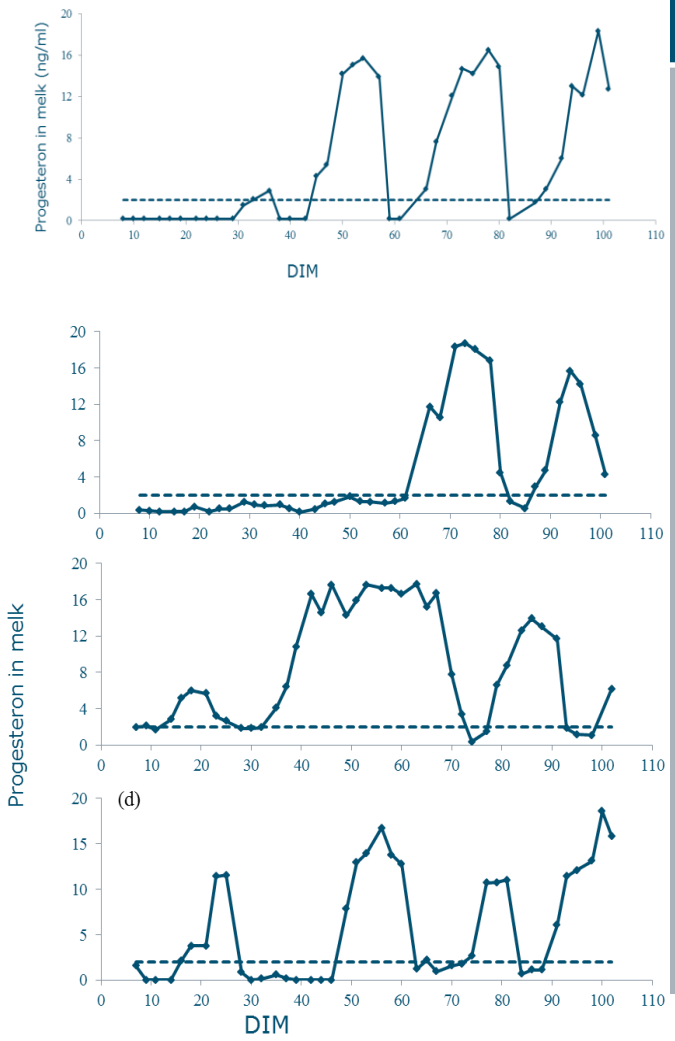
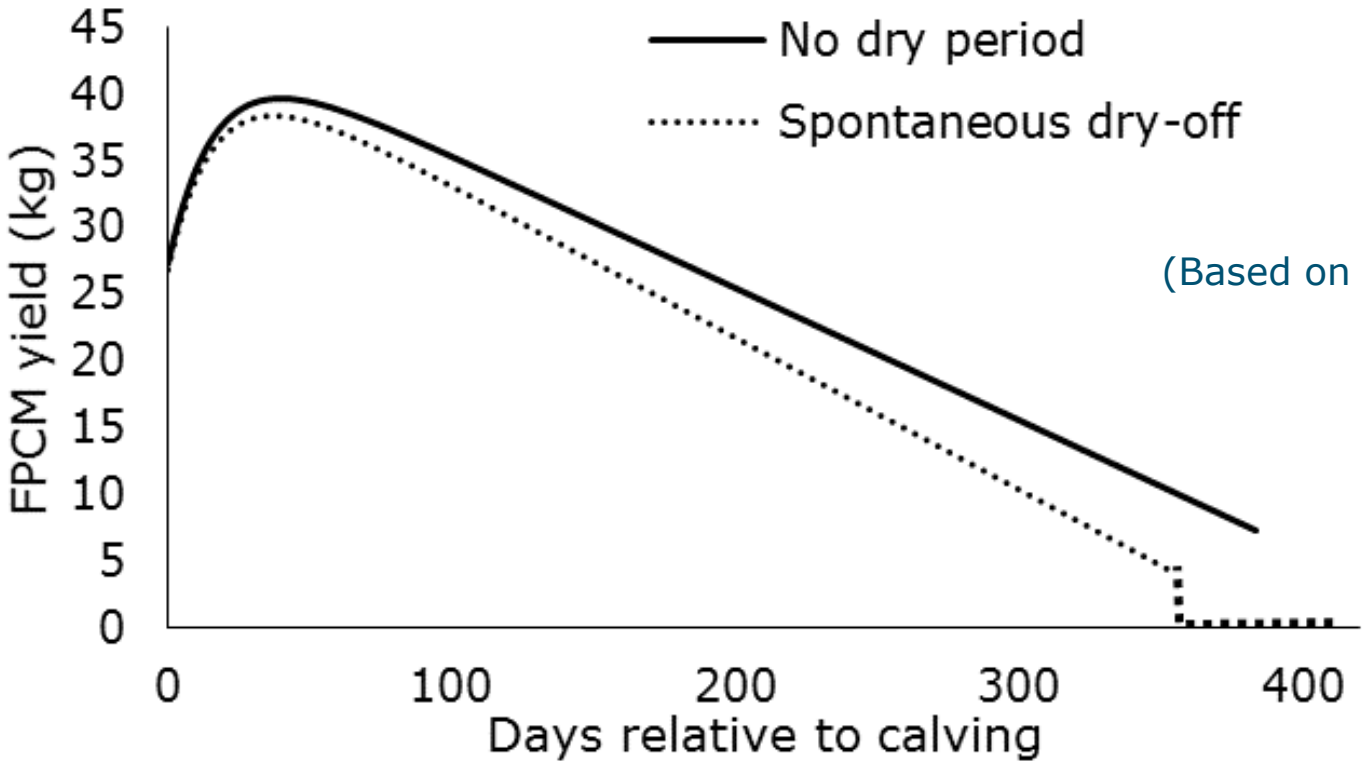
0 days dry: → ovulate earlier post calving (23 vs. 28 vs. 29 d)

→ had more regular cycles (Chen et al., 2015b)



Variable	Dry period length		
	0 days	30 days	60 days
Normal resumption of ovarian cyclicity (%)	53.2 (25/47)[a]	47.7 (21/44)[ab]	26.0 (13/50)[b]
Abnormal resumption of ovarian cyclicity:			
Type I: late ovulation or anovulation (%)	2.1 (1/47)	18.2 (8/44)	16.0 (8/50)
Type II: long luteal phase (%)	44.7 (21/47)	34.1 (15/44)	50.0 (25/50)
Type III: cessation of cyclicity (%)	0.0 (0/47)	0.0 (0/44)	8.0 (4/50)

Achievement of dry period omission for a second time



(Based on Chen et al., 2016)

Cows which dried themselves off:
- had lower milk yield
- were less persistent
- had longer calving interval (410 vs. 383 days)

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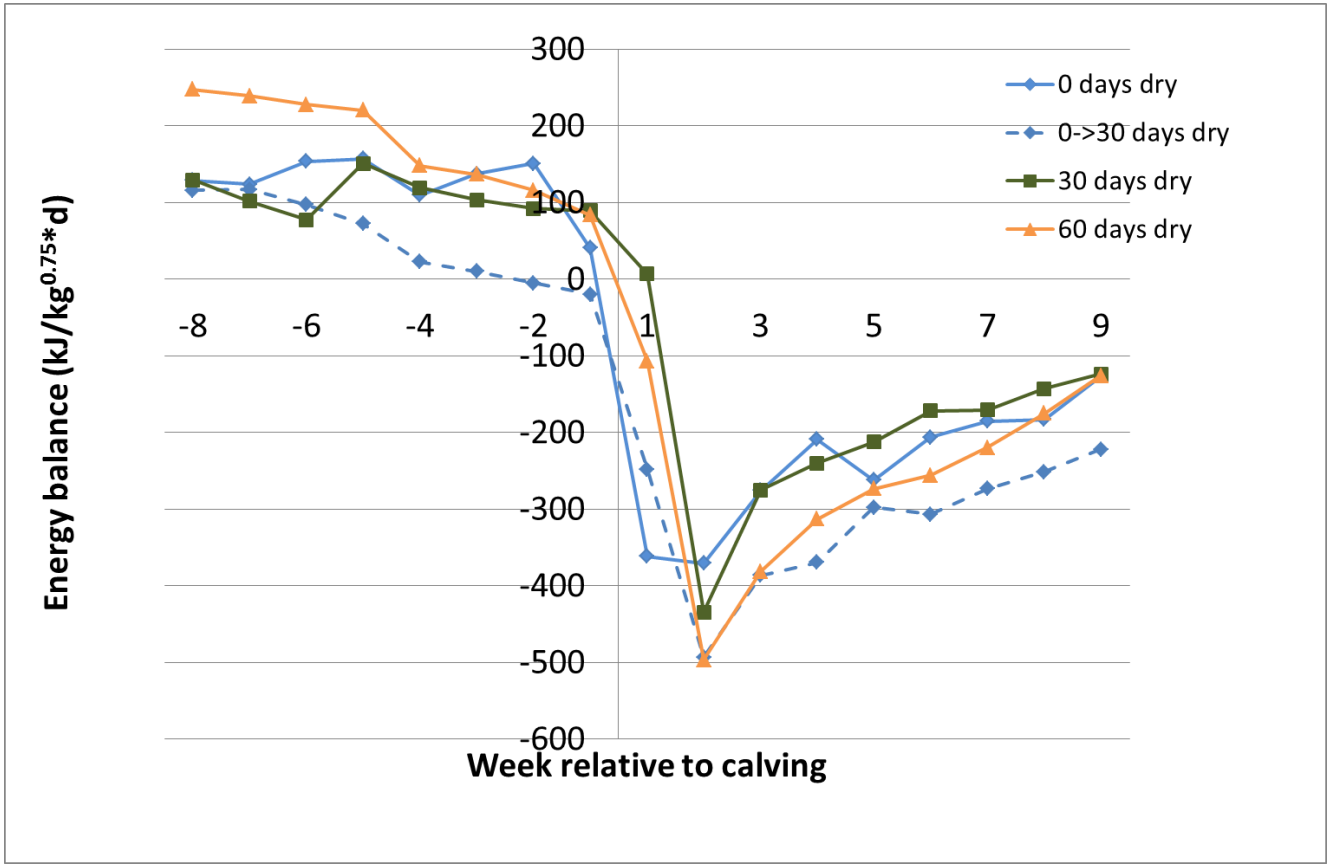
Second lactation: **Differences in energy balance much smaller**

Energy balance for cows with conventional (60d), short (30d) or no dry period (0d). (N.B. Cows in the 0->30 days dry group were planned for 0 d dry period, but dried themselves off)



(Chen et al., *2016a)*

Dry period length: $P<0,01$
Ration: $P = 0.84$

Energy balance is **not** improved in second lactation...

...because of a greater milk yield

What are the reasons?

- **Parity**: cows were older in the second lactation
- **Selection**: part of the cows (19 out of 40) dried themselves off and were not continuously milked for a second time

Which cows dried themselves off?

Energy balance is **not** improved[1] in second lactation...

...because of a greater milk yield[1,2]

What are the reasons?

- **Parity**: cows were older in the second lactation
- **Selection**: part of the cows dried themselves off and were not continuously milked for a second time
- ? More **regeneration of mammary cells** during first lactation after omission of the dry period?
  - Due to better EB? [3]
  - Due to lower milk yield in precalving weeks?

([1]Chen et al., 2016; [2]Kok et al., 2017; [3]Capuco et al., 2001)

Conclusion: **Customised dry period management**

customising **dry period length** ánd **dry cow antibiotic use**

✓ Benefit from metabolic effects of short/no dry period
✓ Limit milk yield losses
✓ Treat cows with high SCC

Individual cow characteristics can be used in a decision support model for dry period management:
- somatic cell count, milk yield level, parity, genotype, BCS -

Other aspects relevant for **implication**:
- Feeding strategy
- Insemination strategy (-> short calving interval)
- Colostrum quality of cows with 0-d dry period
- Consequences for productive lifespan (?)

Feeding strategies for cows with a short or no dry period

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Reconsidering feeding strategies for cows with no/short dry period

Adjustment of feeding strategies is justified due to:

- Improved energy balance and metabolic status
- Fattening in mid and late lactation
- Low milk yield and limited lactation persistency

Studied feeding strategies are:

- Increasing dietary energy level (De Feu et al., 2009)
- Decreasing dietary energy level (Van Hoeij et al., 2017)
- Altering dietary energy source: lipogenic vs. glucogenic nutrients (Chen et al., 2016; Van Hoeij et al., 2017; Van Knegsel et al., 2014)

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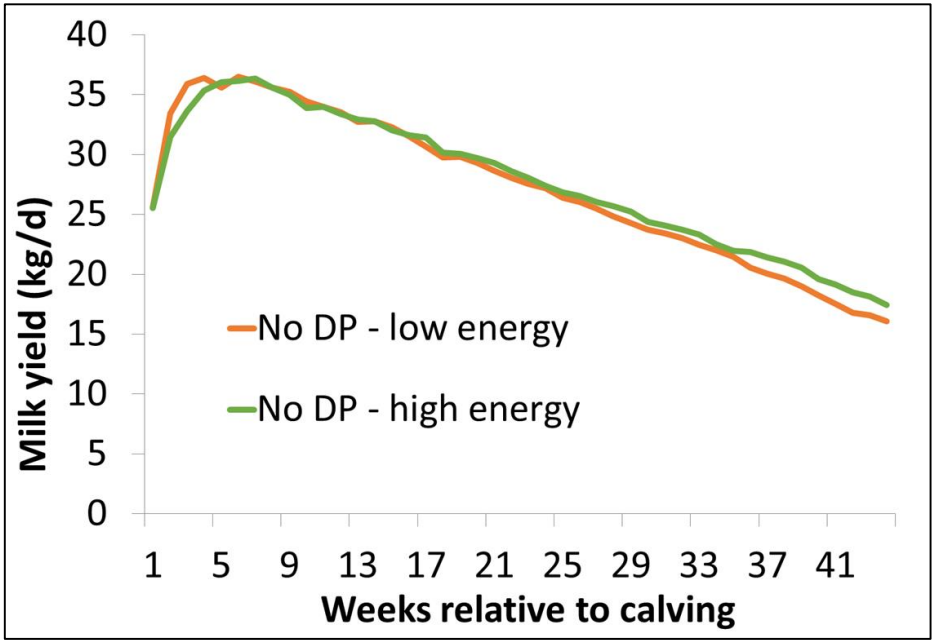
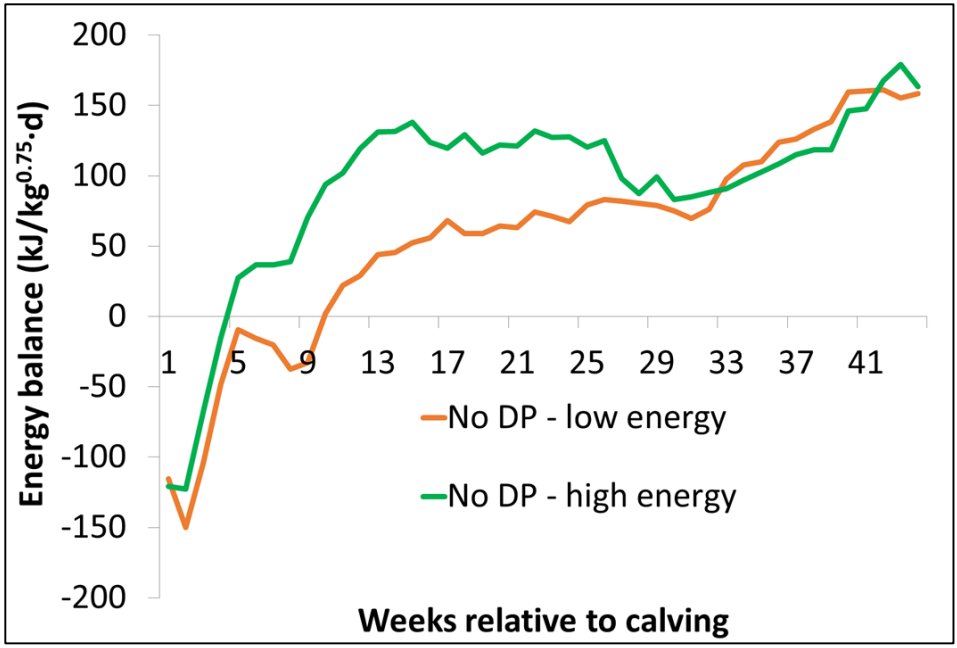
Reducing dietary energy level for cows with no DP:

- did not affect **milk yield** or **persistency**
- reduced **energy balance** in early and mid lactation





N.B. **Low energy diet**: energy level adjusted for the expect milk yield of cows with no dry period; **High energy diet**: energy level for the expected milk yield of cows with a dry period

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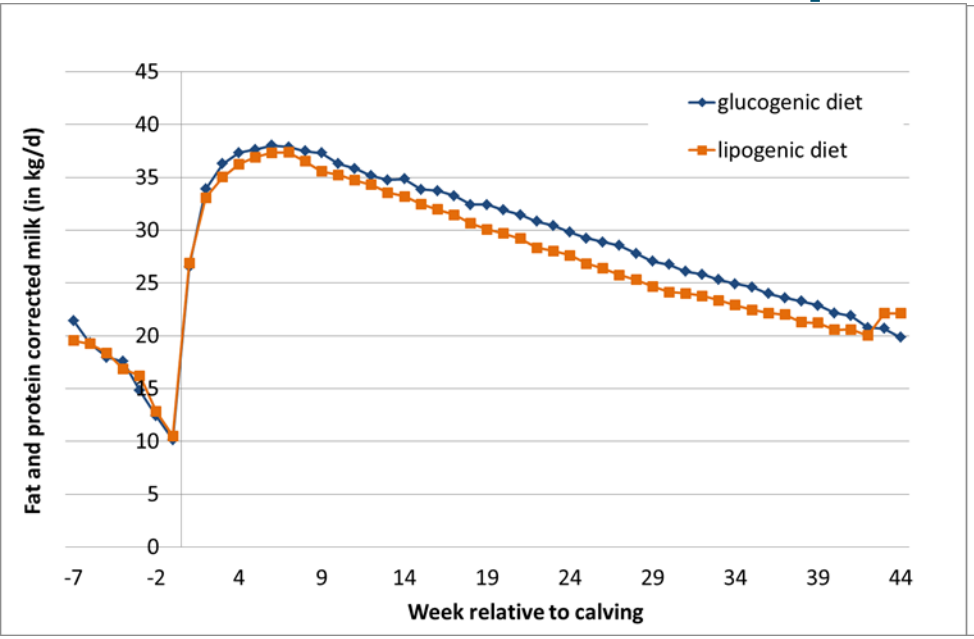
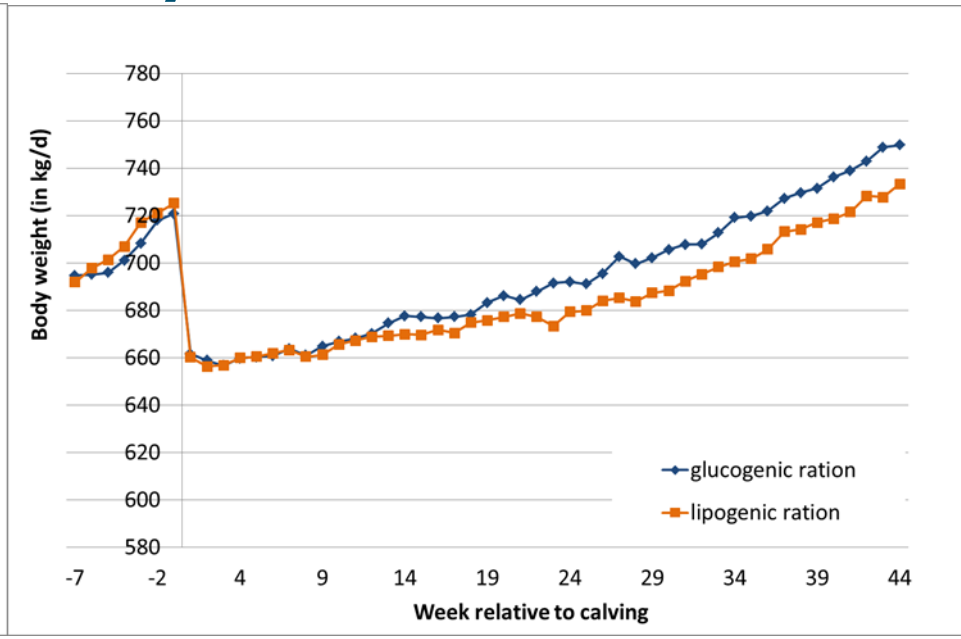
(Van Hoeij et al., 2017)

Feeding more lipogenic diet for cows with no DP:

- reduced **body weight gain**
- resulted in lower plasma **insulin** and **IGF-1**
- tendency for greater **growth hormone**
- resulted in lower **milk yield** (due to lower DMI)
- did not affect **lactation persistency**





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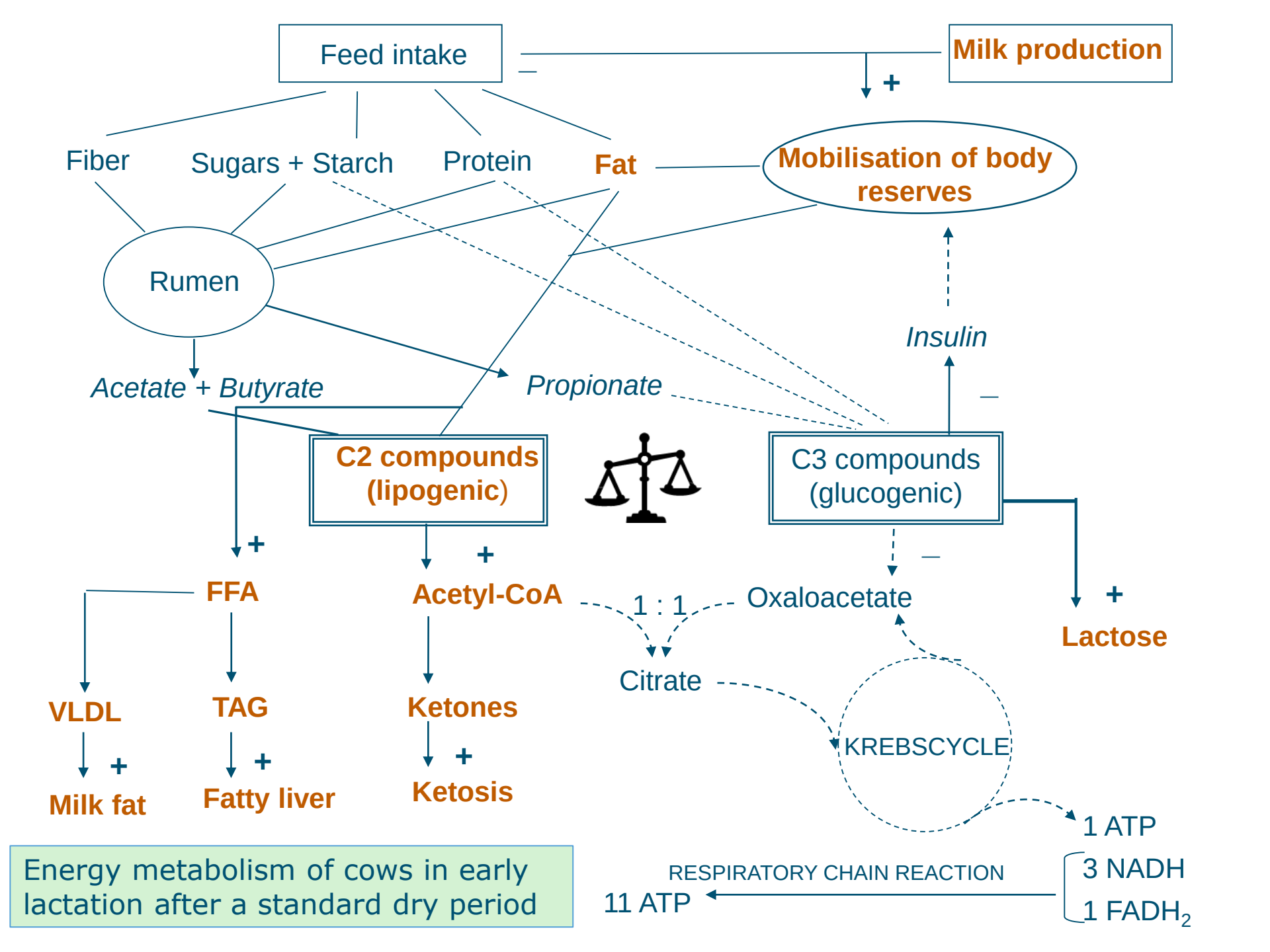
(Van Hoeij et al., 2017)

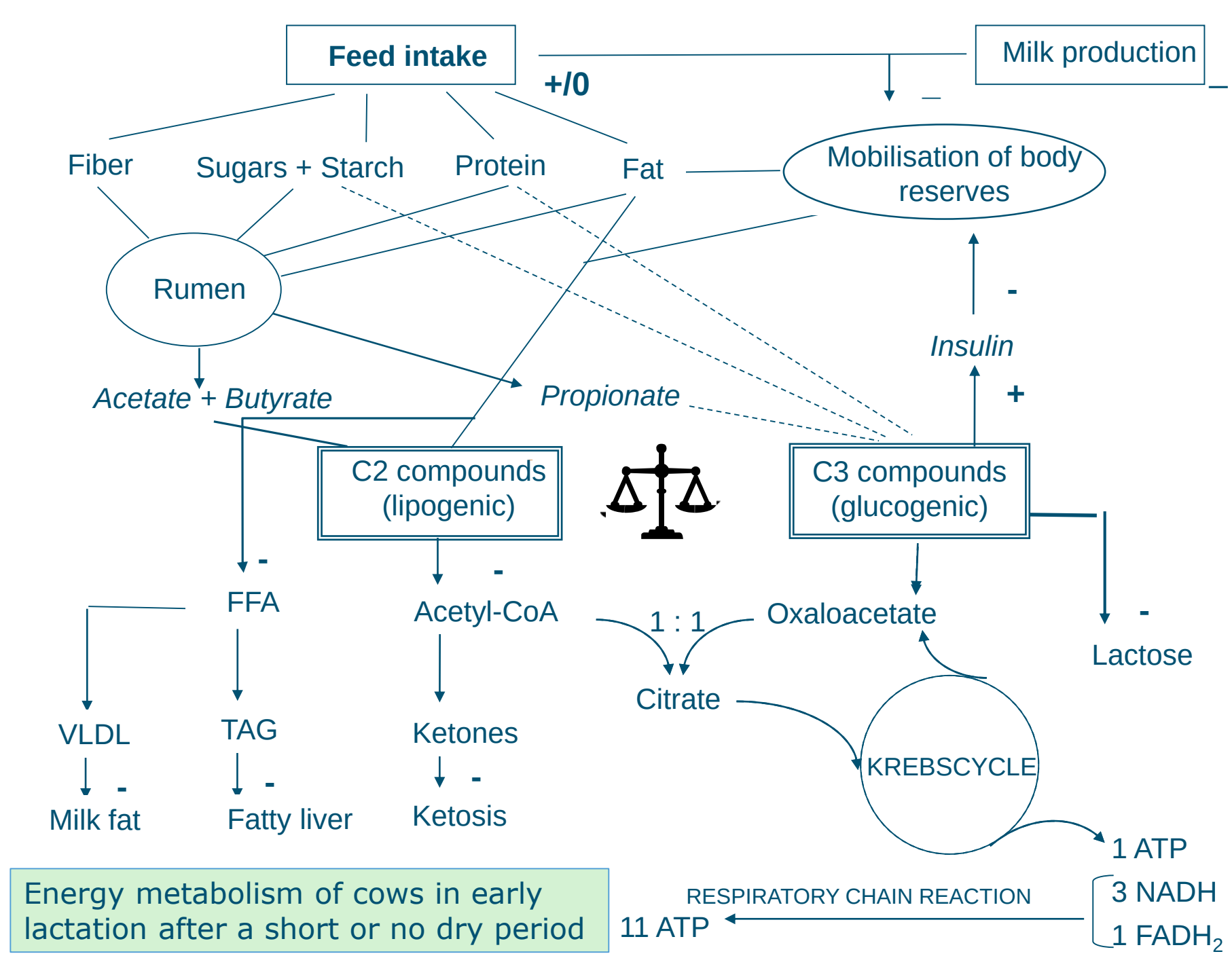
Metabolic effects

1. Energy metabolism of cows in early lactation after a standard dry period
2. Energy metabolism of cows in early lactation after a short or no dry period

References
Slide 1: based on Van Knegsel et al., 2005.
Slide 2: Andersen et al., 2005; Chen et al., 2015; Chen et al., 2016; DeFeu et al., 2009; Jolicoeur et al., 2014; Klusmeyer et al., 2009; Lucy et al., 2004; Pezeshki et al., 2007; Rastani et al., 2005; Schlamberger et al., 2010; Van Hoeij et al., 2017; Van Knegsel et al., 2015.

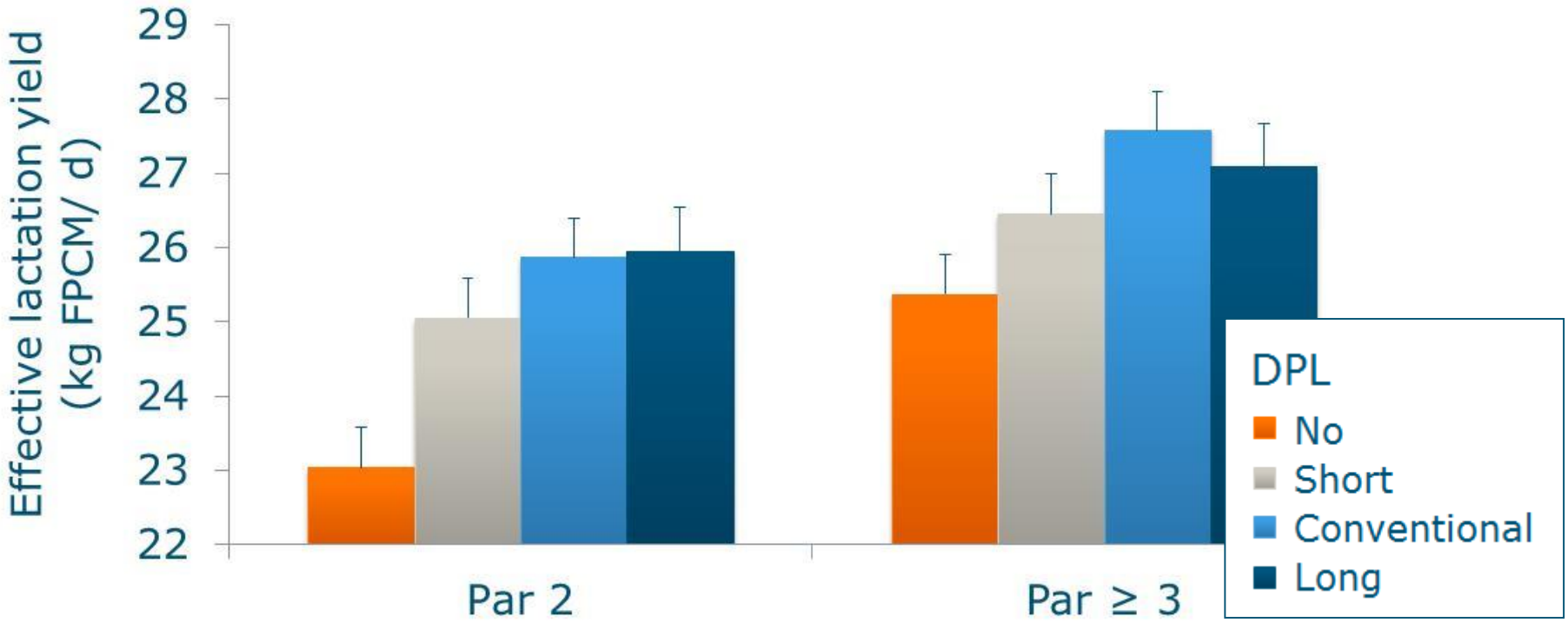


Energy metabolism of cows in early lactation after a standard dry period



Energy metabolism of cows in early lactation after a short or no dry period

Optimal dry period length depends on parity?

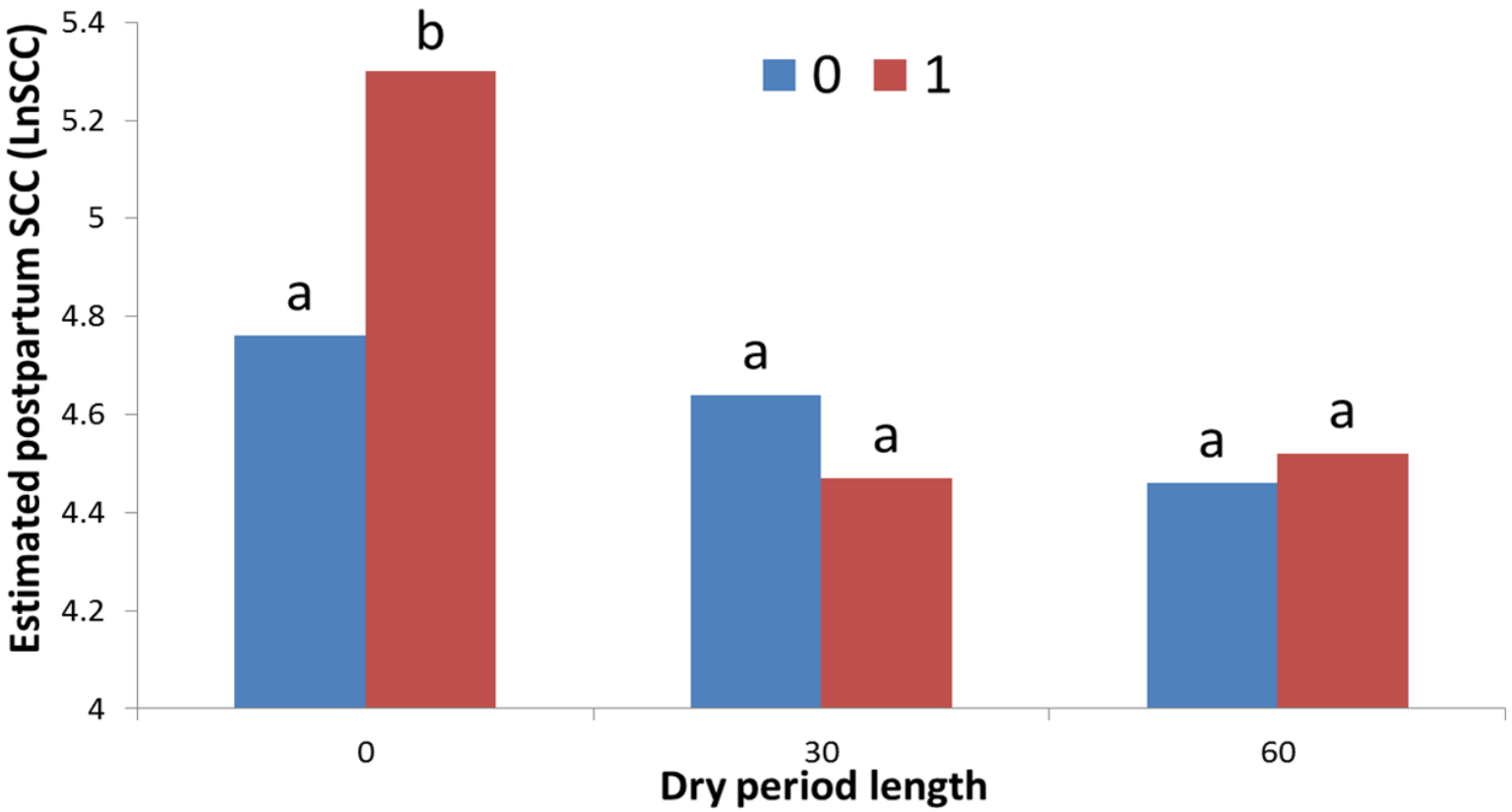


- Data from 16 commercial farms
- Short DP: -1 kg/d
- No DP: -3 kg/d - primiparous,
  -2 kg/d - multiparous

(Kok et al., 2017)

Optimal dry period length depends on somatic cell count?

→ Omitting the dry period increases SCC in cows which had **a SCC elevation in the previous lactation** .

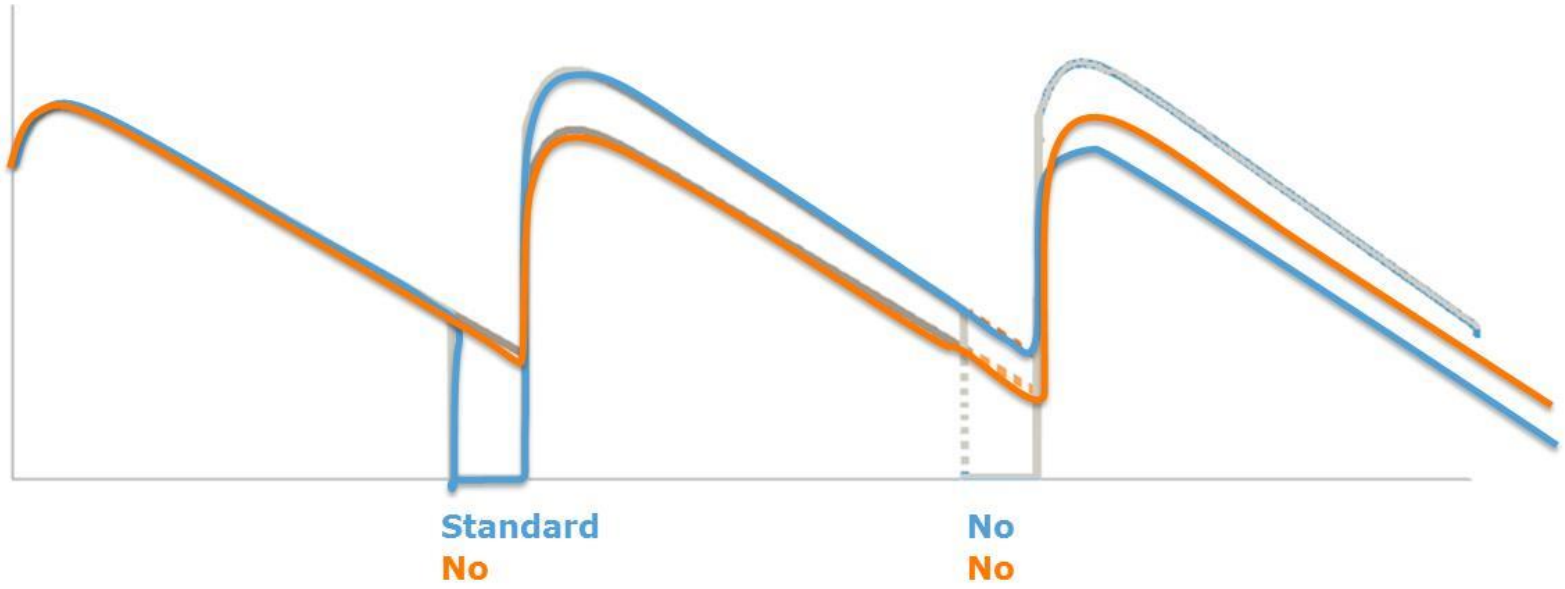


(Van Hoeij et al., 2016)

Milk yield losses in early lactation reduce over multiple lactations

- Short and no DP reduce total milk yield
- Repeated short DP: similar losses
- Repeated omission DP: similar losses, different *timing*

  which affects ***energy balance*** *and* ***metabolic status***



(Kok et al., *2017)*

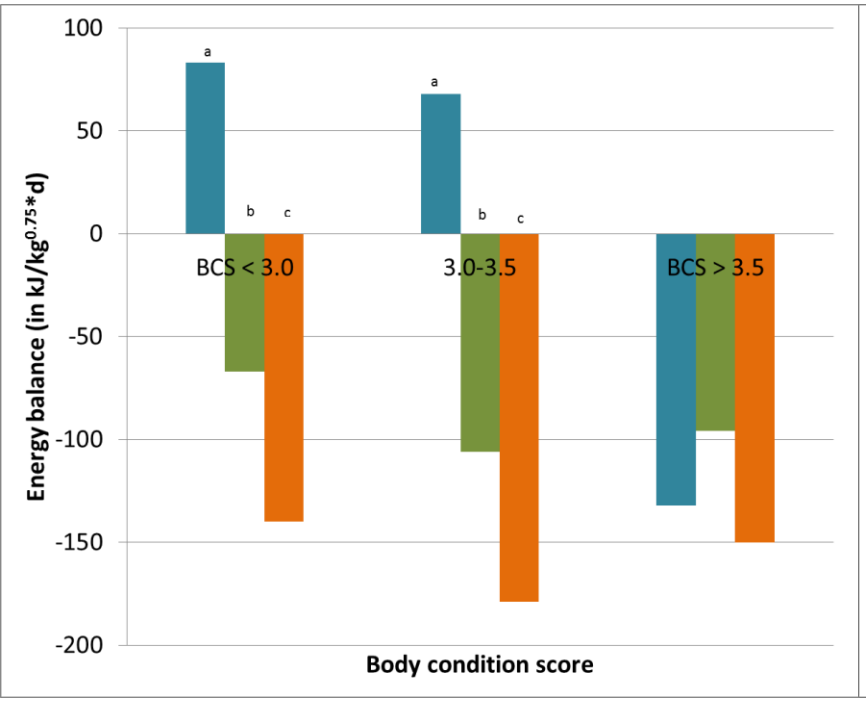
Parity 2 cows have more reduction in milk yield (and improvement of EB) when DP is omitted

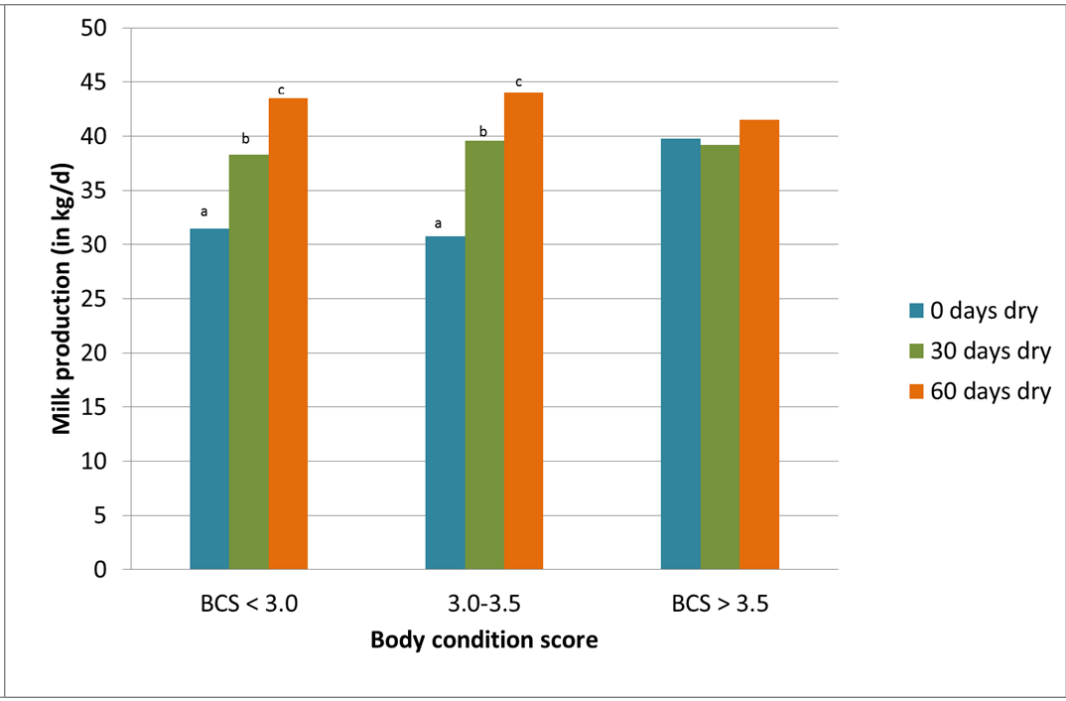
Milk yield (kg/d) of young (parity = 2) or older (parity > 2) dairy cows after a standard (55 - 60 days), short (28-35 days) or no (0 days) dry period.

Study	N	Weeks in milk	Young cows (parity = 2)			Older cows (parity > 2)		
			Standard	Short	No	Standard	Short	No
Annen et al., 2004	69	wk 2-17	44.1	38.3	35.1	47.7	46.6	43.4
Rastani et al., 2005	65	wk 1-10	39.8	36.1	31.6	43.4	39.9	36.3
Pezeshki et al., 2007	71	wk 1-44	39.1	34.6	-	35.6	36.7	-
Santschi et al., 2011	850	wk 1-48	31.5	30.1	-	32.7	32.7	-
Van Knegsel et al., 2014	167	wk 1-14	41.8	37.9	28.6	44.1	39.2	34.8

Optimal dry period length depends on BCS

→ Shortening or omitting the dry period has no effect on the energy balance and milk yield after calving in fat cows (BCS > 3.5 before calving).





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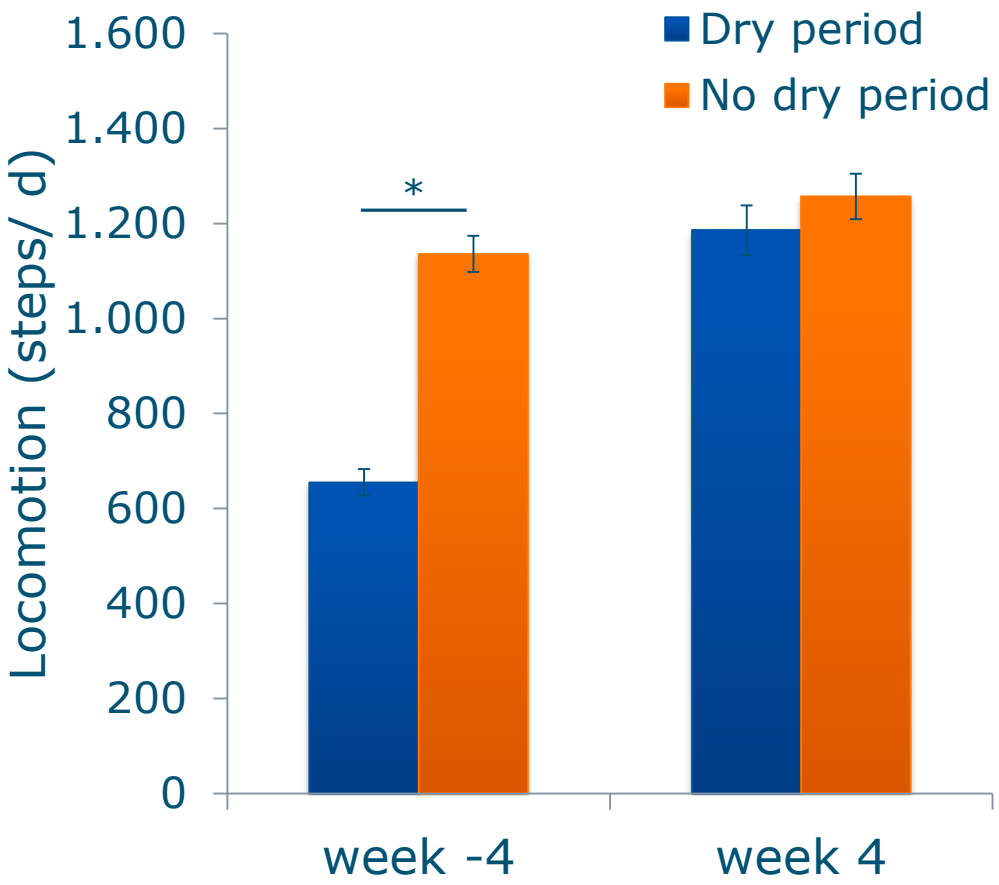
(Chen et al., 2015)

Dry period length effect on locomotion



(Kok et al., 2017)

Cows with a dry period: less locomotion before calving.

→ 90% of the difference caused by lack of walking trough the milking parlour

Lactation persistency & hormones

Effect of **dry period length** and **dietary energy source** on lactation persistency, lactogenic hormones and energy balance during week 8 till 44 of lactation (Van Hoeij et al., 2017)

	Dietary energy source		**Dry period length**	
	Glucogenic	Lipogenic	0-days	30-days
Decline of lactation curve	0.0041	0.0042	0.0047	0.0031
Insulin (µU/mL)	23.9	20.6	22.3	18.0
IGF-1 (ng/mL)	164.8	150.7	165.2	142.9
GH (µg/L)	3.47	3.77	3.43	4.01
DMI (kg/d)	21.7	20.4	20.9	21.3
EB (kJ/kg$^{0.75}$ · d)	50	48	72	4

- *Palatability of the lipogenic diet?*
- *Possibly dietary effects would have been more prominent when the isocaloric diets had an equal energy intake*?

Mammary health

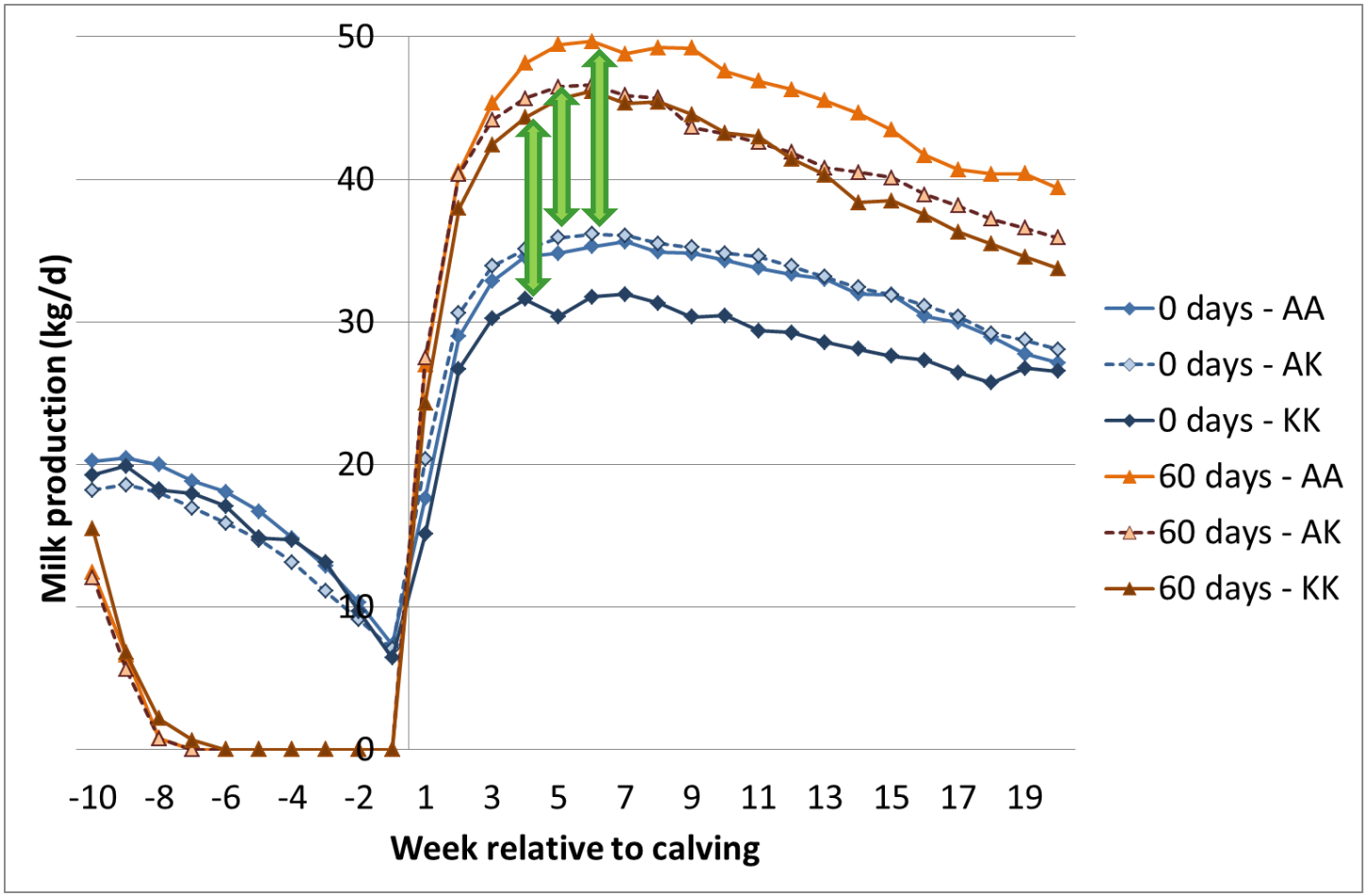
-> before calving no difference in somatic cell count

-> after calving **lower SCC with decision tree 1** (61 vs. 77 vs. 80 *10^3 cells/ml for B1 vs. C vs. B2)

-> no effect of decision trees on the dry period evaluation

	Beslisboom[1]			
	B1	**B2**	**C**	**Totaal**
Hoog celgetal prepartum[2]				
chronisch	1	1	3	5
hersteld	5	8	3	16
Laag celgetal prepartum				
verhoogd	4	8	3	15
niet verhoogd	34	30	34	98
Totaal	44	47	43	134

Dry period length effect on **milk yield** depends on **DGAT1** genotype



→ An AA or KK cow has a greater reduction in milk yield after 0-d dry period than an AK cow.

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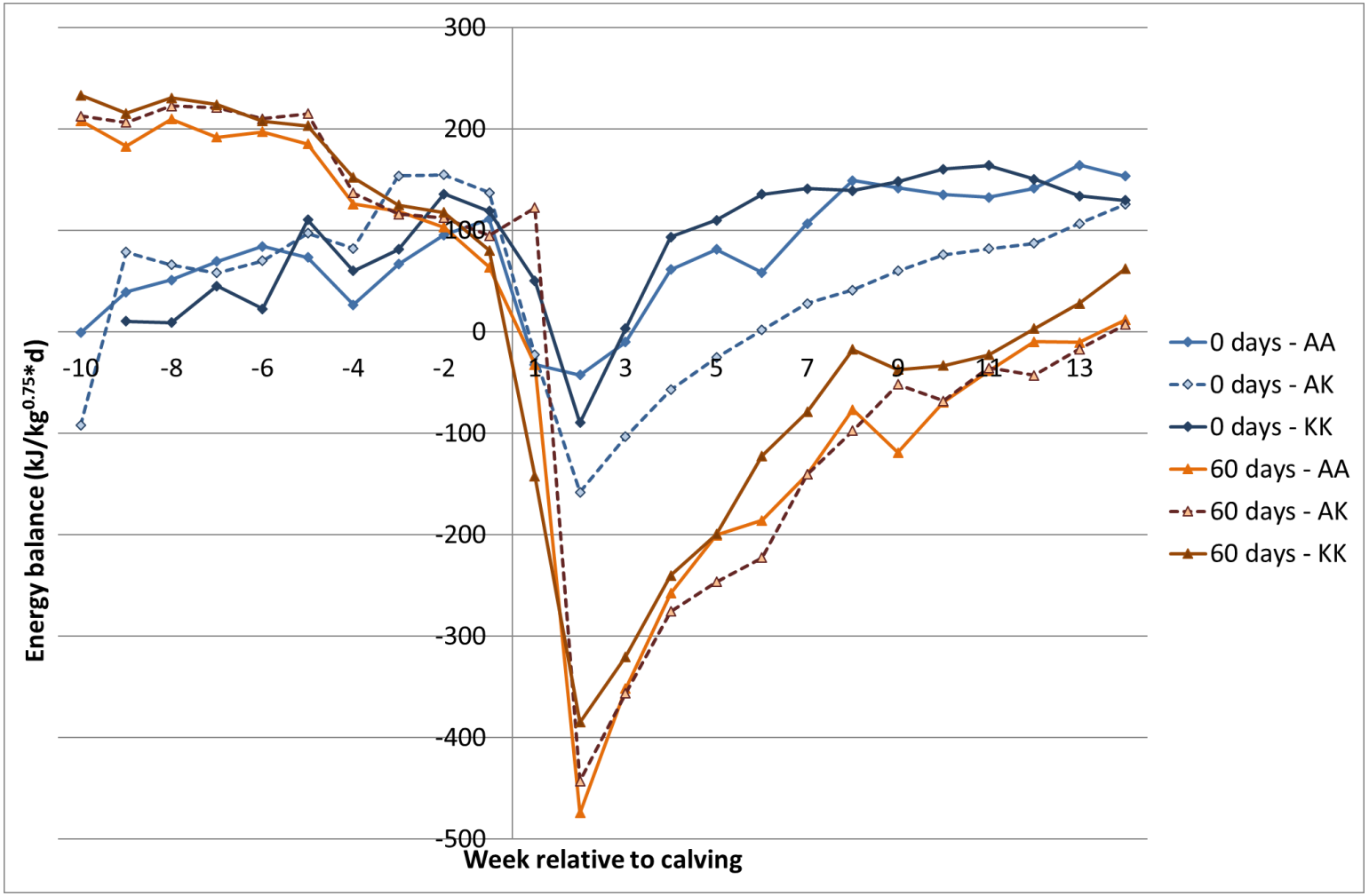
Dry period length effect on **energy balance** depends on **DGAT1**



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Dry period length effect on **NEFA** depends on **DGAT1**

-> Difference between DGAT genotypes in **metabolic response** to omission of the dry period was completely due to a difference in **milk yield** (and not feed intake)