



# An evaluation of the effect of nutritional strategy in early lactation on performance and energy status in Holstein Friesian dairy cows

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## *Introduction*

- ◆ **High yielding dairy cows experience excessive and prolonged negative energy balance (NEB)**
- ◆ **Effects on liver are detrimental to production and fertility (Newbold, 2006)**
- ◆ **Reproductive failure is predominant reason for culling cows**
- ◆ **Nutrition may have a role in overcoming this problem**

## *Objectives of the study*

- ◆ To examine the effect of a range of nutritional strategies on dairy cow fertility (Gilmore et al., BSAS, 2009)
- ◆ To examine effects of these nutritional strategies on dairy cow performance and energy status

# *Materials & Methods*

- All diets were based on a Total Mixed Ration
  - 60% concentrate
  - 40% forage
    - 60% grass silage
    - 40% maize silage
- Diets offered immediately post calving
- 94 lactating Holstein Friesian cows
  - 36 primiparous
  - 58 multiparous – mean parity = 2.6
- Study conducted over the first 210 days of lactation

# *Experimental Design*

## Four nutritional strategies

1. Control treatment (high quality TMR diet)
2. Individual cow management regime
3. High starch followed by low starch/protected fat
4. Reduced protein concentration in diet plus protected methionine

# *Control*

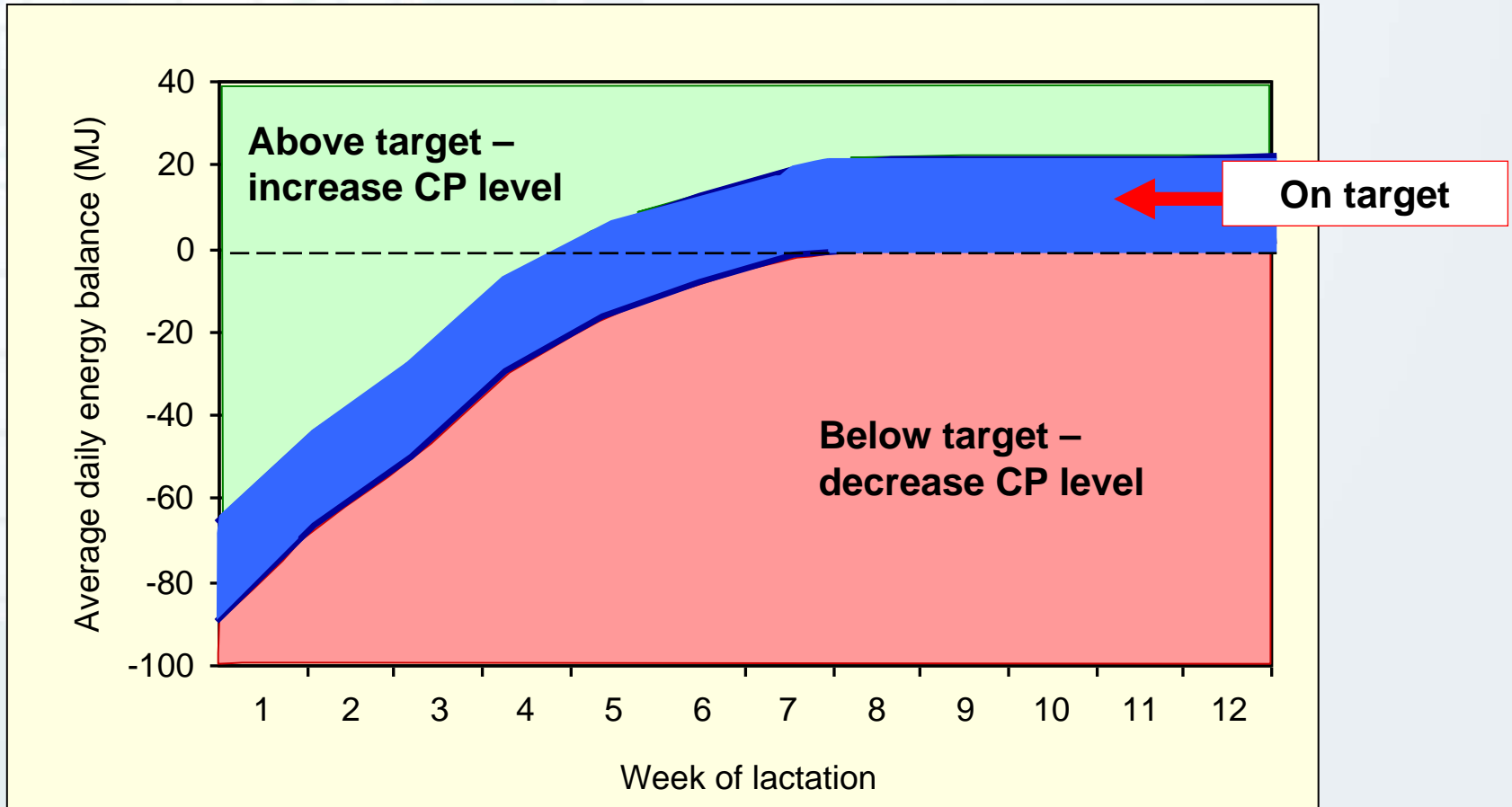
- ◆ Diet was formulated using Feed into Milk rationing programme

Total ME (MJ/kg DM)	12.4
Total CP (g/kg DM)	176
ERDP (g/kg DM)	116
DUP (g/kg DM)	51.3
Starch (g/kg DM)	199
NDF (g/kg DM)	288

## *Individual cow*

- ◆ Diets were adjusted to achieve a target NEB threshold
- ◆ Dietary protein levels used to adjust the energy balance of individual cows

# *Energy balance target*



# *High / Low Starch Treatment*

- **Days 0-35 post calving**  
Control diet (200g starch/kg DM)
- **Days 36-50 post calving**  
High Starch (300g starch/kg DM)
- **Days 51-120 post calving**  
Low starch (100g starch/kg DM)  
High fat diet containing approximately 750g protected fat per day
- **Days 121-210 post calving**  
Control diet (200g starch/kg DM)

## *Low protein*

- ◆ Reduced protein diet (150 g CP/kg DM)
- ◆ Plus protected methionine (40g/cow/day)
- ◆ Lysine to methionine ratio = 3.0 : 1

# *Measurements*

- ◆ Daily - dry matter intake, milk yield and live weight
- ◆ Weekly - milk fat, protein and lactose concentration
- ◆ Energy balance calculated on a weekly basis (Thomas, 2004)

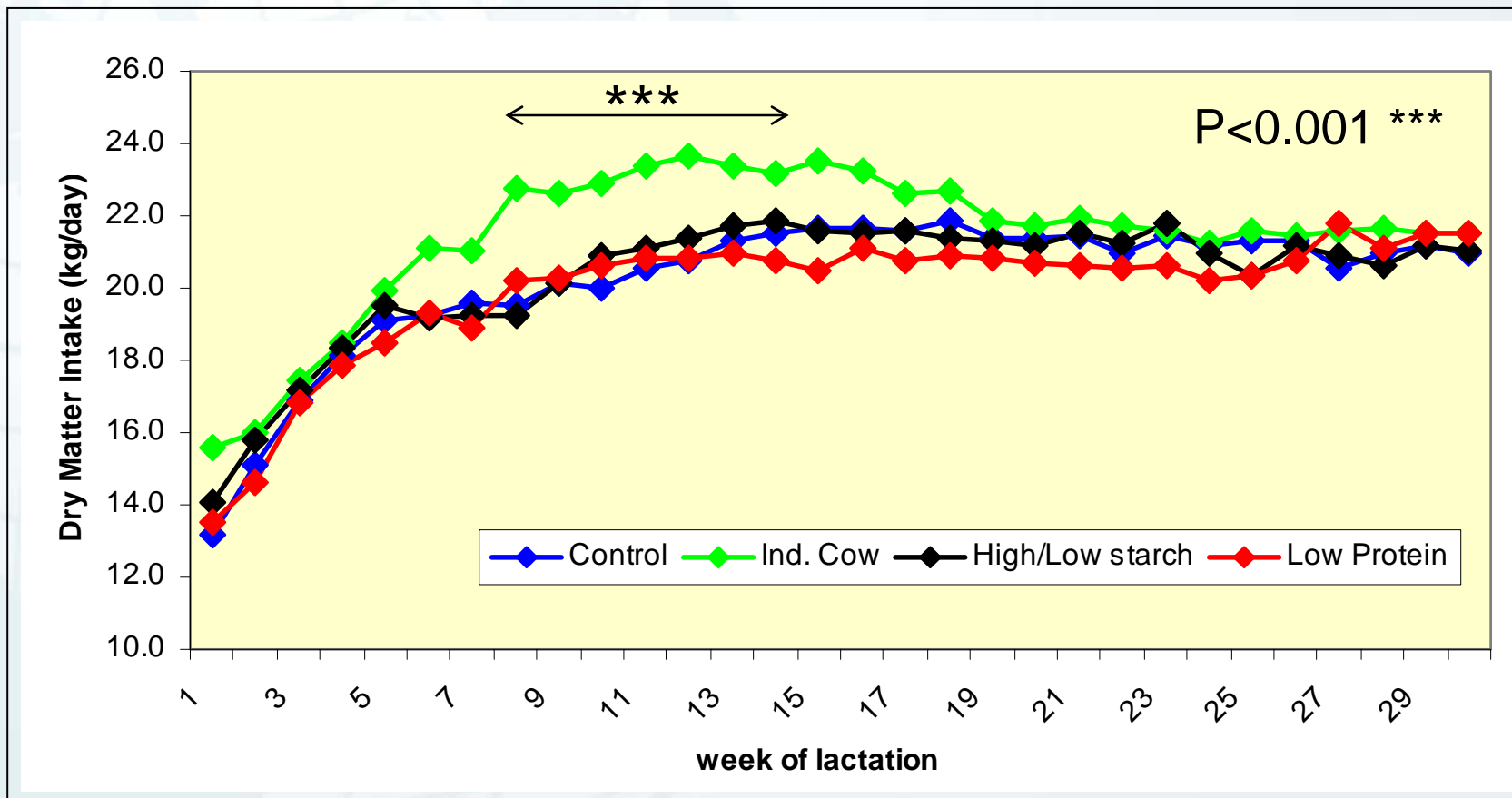


# *Results*

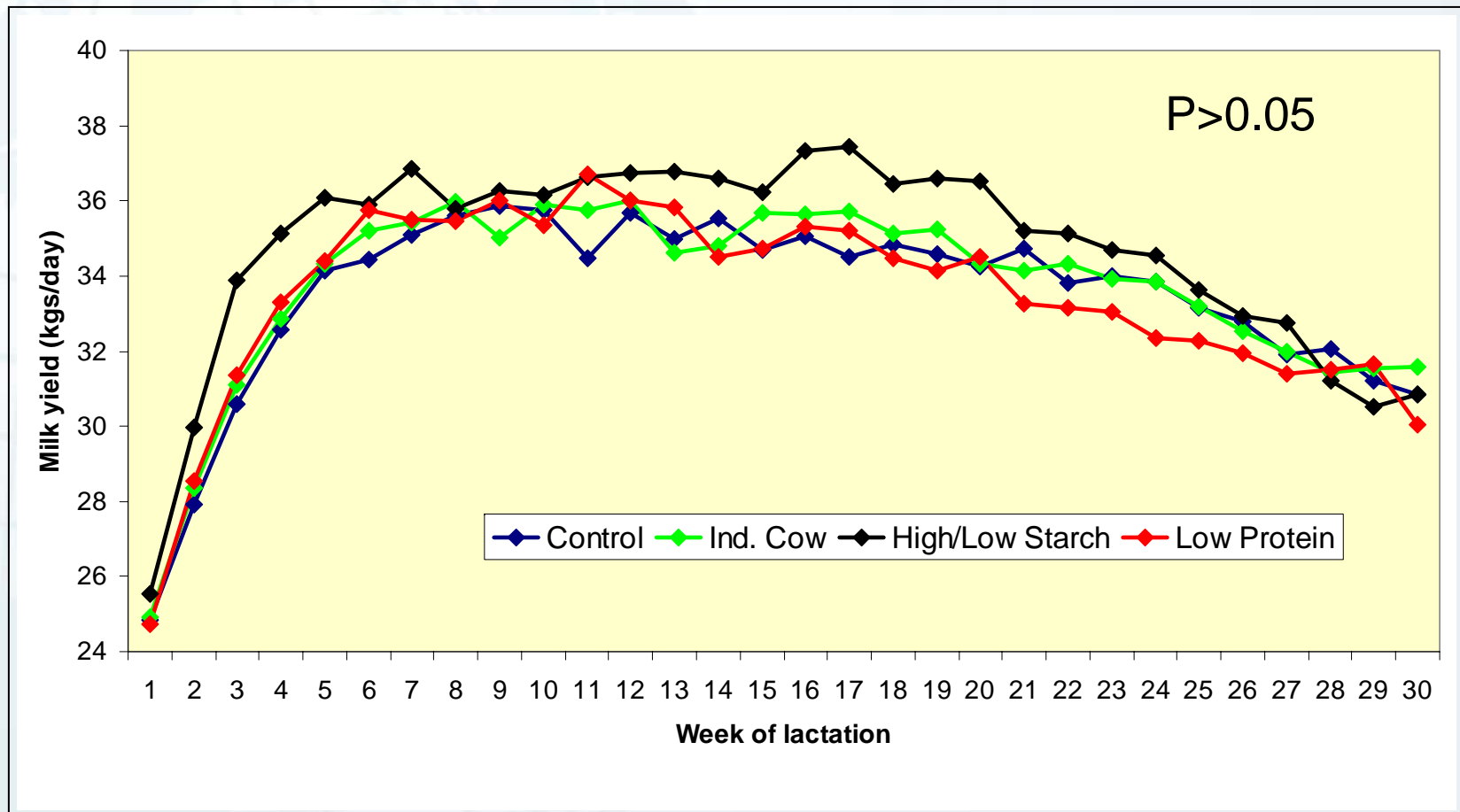
## *Effect of Dietary Regime on Food Intake and Milk Production (210 day average)*

	<b>Control</b>	<b>Ind. Cow</b>	<b>High/Low Starch</b>	<b>Low Protein</b>	<b>SED</b>	<b>sig</b>
<b>DM Intake (kg/day)</b>	<b>19.8</b>	<b>20.6</b>	<b>19.7</b>	<b>19.6</b>	<b>0.67</b>	<b>ns</b>
<b>Milk yield (kg/day)</b>	<b>33.5</b>	<b>33.7</b>	<b>34.7</b>	<b>33.4</b>	<b>1.63</b>	<b>ns</b>
<b>Milk fat (g/kg)</b>	<b>38.1</b>	<b>39.2</b>	<b>38.4</b>	<b>38.5</b>	<b>1.38</b>	<b>ns</b>
<b>Milk protein (g/kg)</b>	<b>34.0</b>	<b>33.9</b>	<b>33.8</b>	<b>33.8</b>	<b>0.50</b>	<b>ns</b>

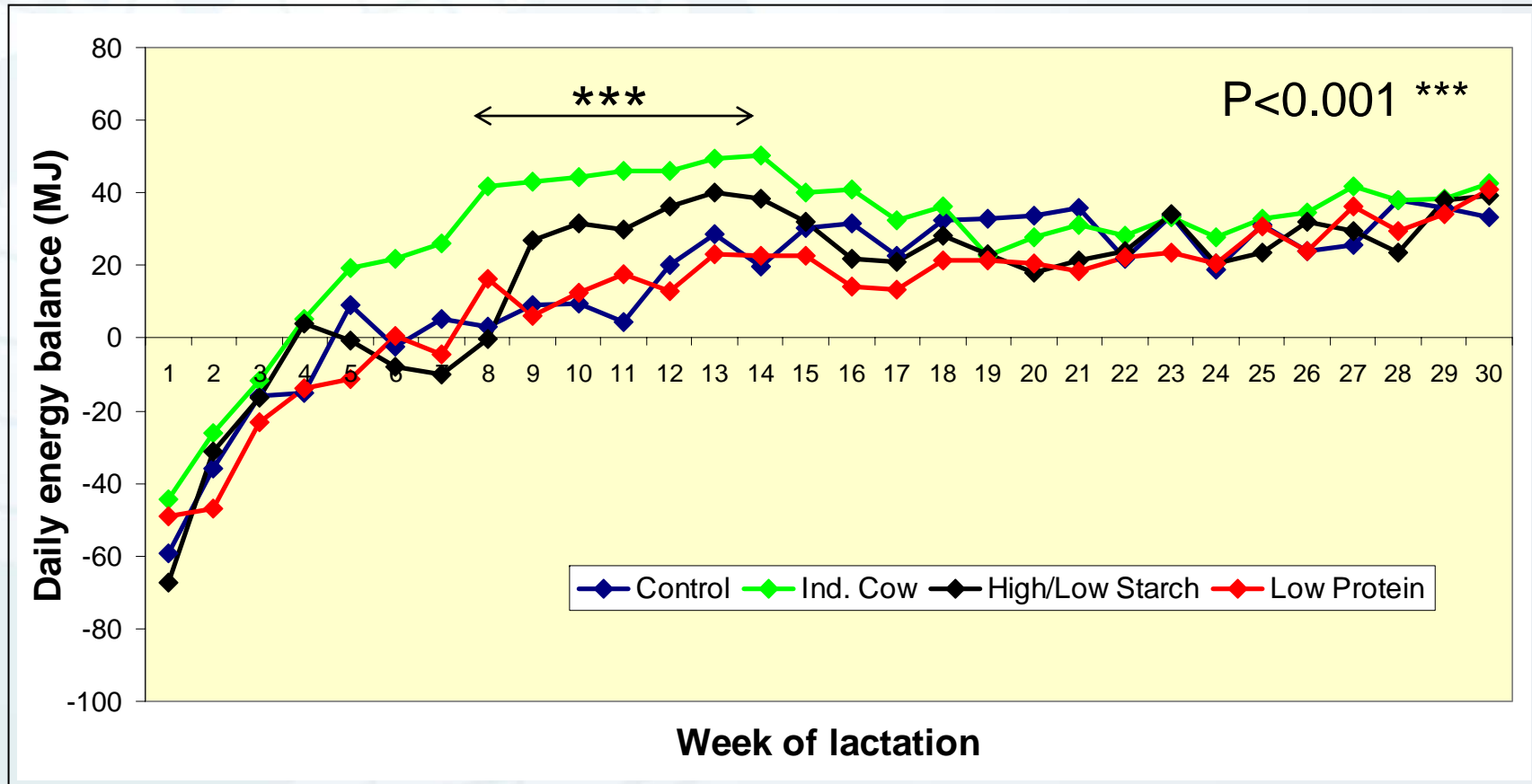
# Dry Matter Intake



# Milk Yield

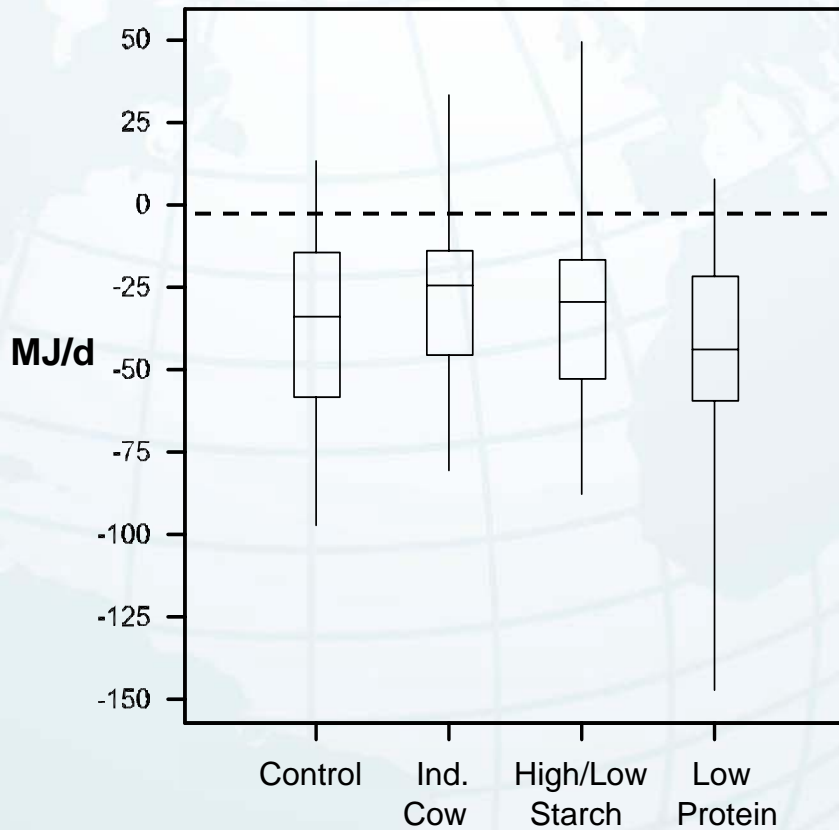


# Daily Energy Balance



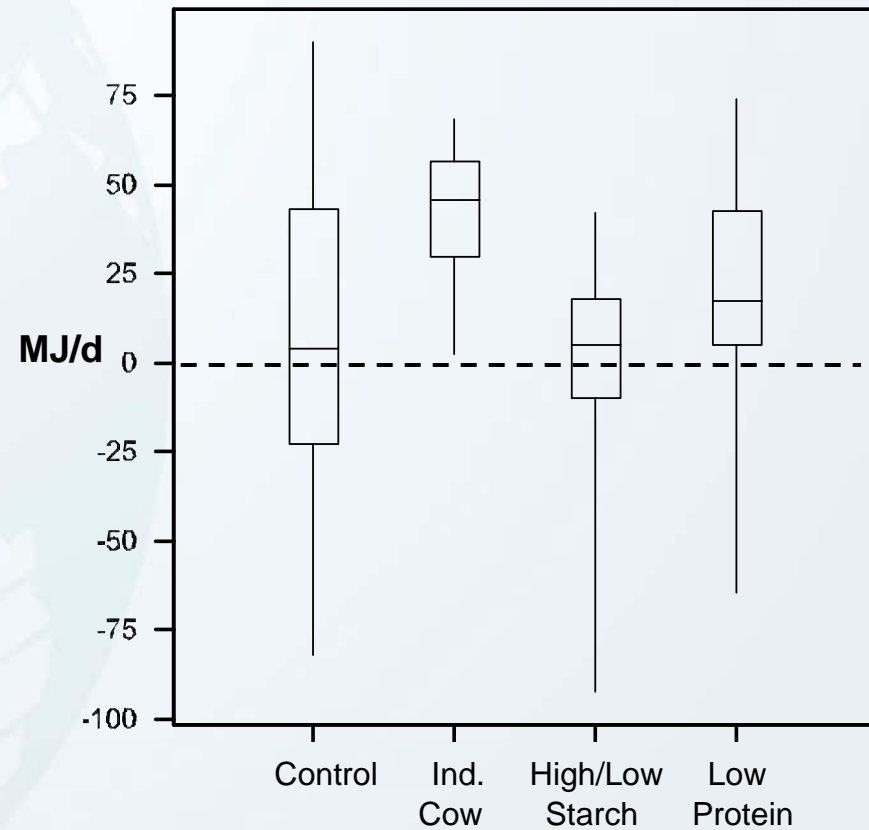
# Daily Energy Balance

## Daily energy balance week 2



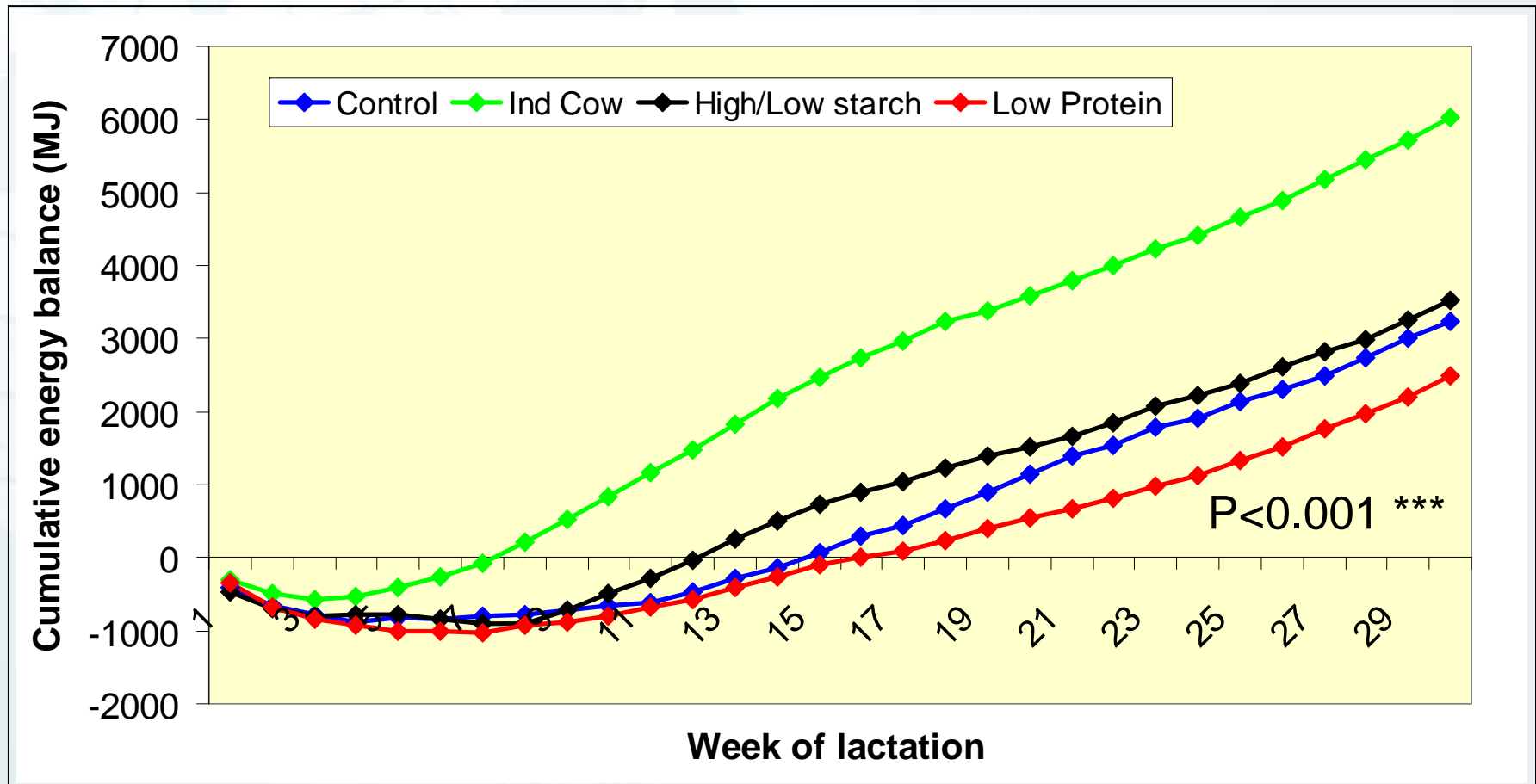
$P > 0.05$

## Daily energy balance week 8



$P < 0.001$

## Cumulative Energy Balance



## *Effect of Dietary Regime on Fertility Parameters*

	<b>Control</b>	<b>Ind. Cow</b>	<b>High/Low Starch</b>	<b>Low Protein</b>	<b>se</b>	<b>sig</b>
<b>Interval to first P4 rise (days)</b>	<b>29.7</b>	<b>29.8</b>	<b>29.7</b>	<b>29.8</b>	<b>3.4</b>	<b>ns</b>
<b>Conception to 1<sup>st</sup> and 2<sup>nd</sup> service (%)</b>	<b>59.0</b>	<b>65.8</b>	<b>54.1</b>	<b>58.8</b>	<b>9.0</b>	<b>ns</b>
<b>Proportion of cows in calf after 100 days of breeding</b>	<b>72.3</b>	<b>77.7</b>	<b>70.9</b>	<b>70.8</b>	<b>12.0</b>	<b>ns</b>

## *Conclusions*

- ◆ Animal performance was not significantly effected by treatment
- ◆ Negative energy balance can be reduced in early lactation by managing cows on an individual basis
- ◆ Supplementation of a reduced protein diet with protected methionine maintained animal performance
- ◆ Fertility was not significantly effected by treatment strategy

# *Acknowledgements*

- ◆ Department of Agriculture and Rural Development
- ◆ AgriSearch
- ◆ Adisseo
- ◆ AFBI Dairy Unit Staff





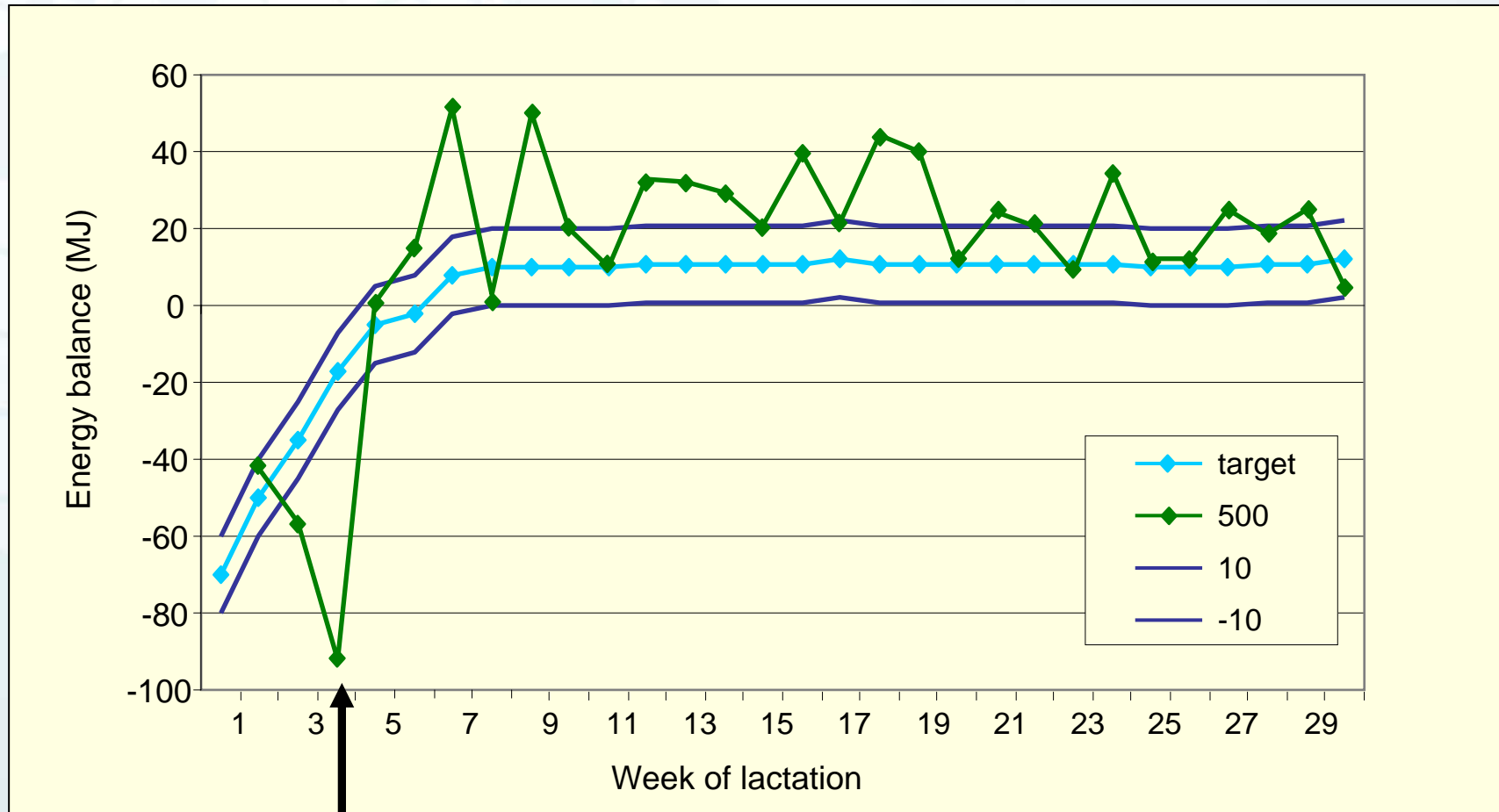
## Ingredient composition of concentrate (g/kg fresh)

Ingredient	Control	Ind. Cow Base	Ind. cow Low nut	Ind. cow High nut	High Starch	Low Starch	Low protein
Barley	185	185	280	40	320	50	200
Wheat	185	185	285	40	320	50	200
Citrus pulp	135	185	135	40	70	255	185
Soya hulls	135	185	135	37	70	255	195
Soya bean (Hi Pro)	162	110	70	410	96	155	120
Rape meal	160	110	70	410	98	150	60
Protected Fat	15	15	0	0	0	63	15
Lo inclusion min	5	5	5	5	5	5	5
Salt	4	4	4	4	4	4	4
Limestone (CaCO <sub>3</sub> )	13	13	13	13	13	13	13
Calcined Mag.	5	5	5	5	5	5	5
Water	0	0	0	0	0	0	0
Molasses	0	0	0	0	0	0	0
CP (g/kg DM)	201	158	141	386	170	170	149
Starch (g/kg DM)	252.1	250.1	364.8	92.4	411.1	90.3	267.3
ME (MJ/kg DM)	13.3	13.3	13	13	13.1	14.4	13.3

## Forage Quality

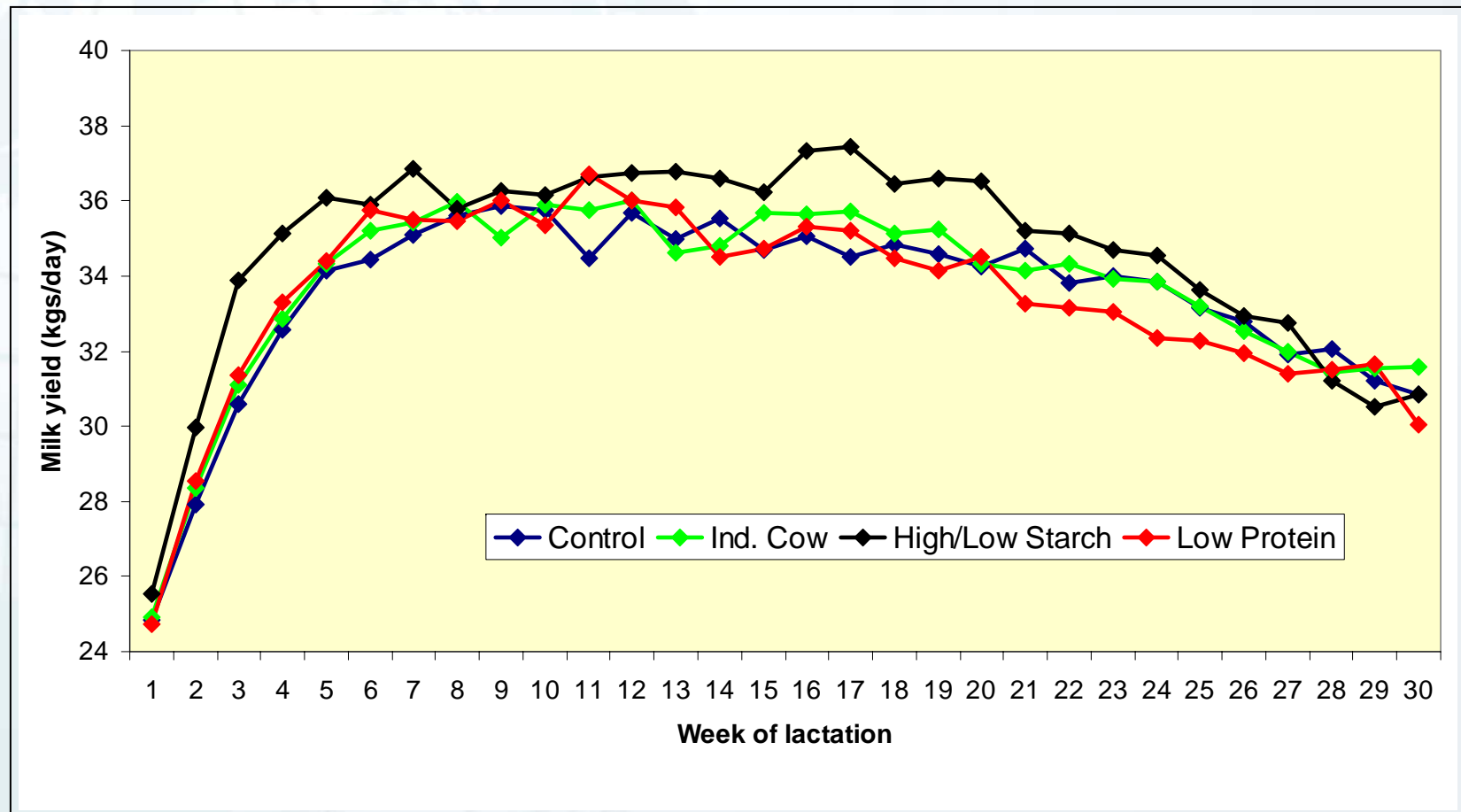
	<b>Grass silage</b>	<b>Maize silage</b>
Oven DM (g/kg)	279.4	305.2
VCODM DM (g/kg)	292.8	322.0
Crude protein	155.8	77.6
Ash	91.9	68.9
Gross energy (MJ/kg DM)	19.2	19.1
pH	3.8	3.7
Ammonia-N (g/kg total N)	64.4	77.4
Lactic acid	119.5	60.9
Acetic acid	14.3	19.3
Propionic acid	0.9	0.8
Butyric acid	1.0	0.5
Ethanol	11.3	5.8

## Example cow (Cow No. 500)

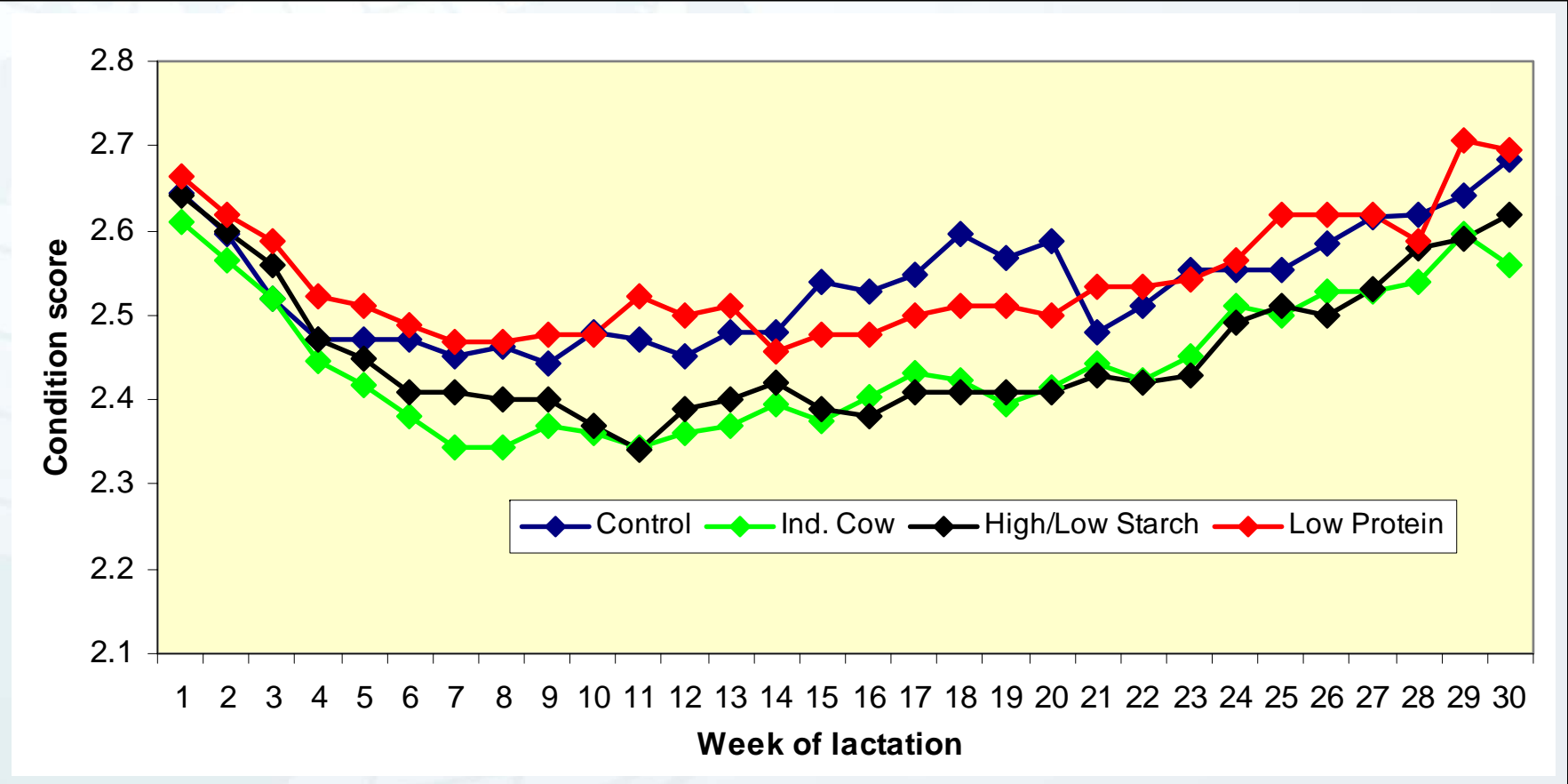


Diet reduced to 147 g CP/kg DM

# Milk yield



# Condition score



## *Environmental impact of dietary regime*

	<b>Control</b>	<b>Ind. Cow</b>	<b>High/Low Starch</b>	<b>Low Protein</b>	<b>sed</b>	<b>sig</b>
<b>Milk N/N intake (proportion)</b>	<b>0.31</b>	<b>0.28</b>	<b>0.34</b>	<b>0.38</b>	<b>0.02</b>	<b>***</b>
<b>Methane output Per cow (litres/day)</b>	<b>504</b>	<b>-</b>	<b>572</b>	<b>557</b>	<b>-</b>	<b>ns</b>
<b>Litres methane/kg milk</b>	<b>15.1</b>	<b>-</b>	<b>16.0</b>	<b>17.2</b>	<b>-</b>	<b>ns</b>