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The effect of a number of novel supplementation strategies on milk production and fertility of high-yielding dairy cows

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EXECUTIVE SUMMARY

Today's high-yielding Holstein dairy cows are unable to consume enough food to meet their increased energy requirements for milk production. The resulting negative energy balance in early lactation has been associated with a decline in 'functional traits' such as health and fertility, and an increase in involuntary culling rates.

It is generally accepted that reducing the extent of negative energy balance (minimising loss of condition) in early lactation should result in improved cow health and fertility. To address this, a series of experiments were conducted to examine 'novel supplementation strategies' which were designed to reduce negative energy balance in early lactation.

Experiment 1 was designed to examine the effects of pre-calving and post-calving energy intake on feed intake, milk production, energy status and fertility.

This study demonstrated that it can be difficult to substantially alter body condition score during the dry period. If necessary, changes in body condition score should be made prior to drying off.

Cows which are over-fat at calving will have lower intakes and lose more body condition post-calving, while having an increased risk of health problems. Current recommendations are for high-yielding cows to be dried off at a body condition score of 2.75, and to maintain this condition score throughout the dry period.

Cows with a low energy intake pre-calving lost less body condition post-calving, and this is likely to have reduced the risk of metabolic disorders occurring during early lactation.

Experiment 2 examined if the energy balance of individual dairy cows could be improved through short term changes in dietary protein levels.

This experiment demonstrated that it is possible to improve the energy balance of individual cows through short term changes to the protein content of the diet, although fertility performance was not improved. Short term changes in dietary protein content had no negative effects on milk production.

Adjusting the energy balance of individual cows resulted in a more uniform group of cows in terms of body condition score (fewer overly fat and overly thin cows), thus simplifying late lactation/dry cow management.

Experiment 3 was designed to determine if the inclusion of protected methionine allows

the protein content of the diet to be reduced without any loss of performance, and to examine the impact of this on the efficiency of nitrogen utilisation.

Results from this experiment indicate there may be opportunities to reduce dietary protein levels without having a detrimental effect on cow performance, provided the diet is supplemented with the appropriate limiting amino acids (methionine in this case). However, expert nutritional advice is required to ensure that diets are correctly formulated.

Supplementing a lower protein diet with protected methionine improved the overall efficiency of nitrogen utilisation.

Experiment 4 was designed to investigate if the reproductive performance of Holstein dairy cows could be improved by offering a diet designed to promote early cycling (early oestrus) and improved embryo survival.

While there was some evidence that offering a 'high starch' diet post-calving reduced the interval to the first oestrous cycle, this study provided no evidence that the 'high starch-high fat' combination of treatments had any effect on overall fertility outcomes.

The objective of Experiment 5 was to examine the effects on food intake, milk production, body tissue reserves and cow fertility of introducing additional concentrates into the diet of dairy cows at week-3, week-7 and week-11 post-calving.

While offering additional concentrates promoted total dry matter intake and quickened the return to positive energy balance, no fertility benefits were observed. The milk yield response to additional concentrates was greatest when concentrates were offered in early lactation.

BACKGROUND

Intensive genetic selection for milk yield during the last few decades has dramatically increased the milk production potential of today's Holstein dairy cow. However, these higher yielding cows are unable to consume enough food to meet their increased energy requirements for milk production, and consequently cows frequently enter a prolonged period of negative energy balance in early lactation. This has been associated with a decline in 'functional traits' such as health and fertility, and an increase in involuntary culling rates.

It is generally accepted that reducing the extent of negative energy balance in early lactation should result in improved cow health and fertility. Thus a primary objective of this project was to examine a number of 'novel supplementation strategies' which were designed to reduce negative energy balance in early lactation. Approaches adopted included examining the effect of high and low energy intakes pre-calving, and using dietary protein levels to 'control' the energy status of individual cows.

In addition, it was also recognised that it may be possible to improve fertility by offering concentrates specially designed to modify reproductive hormone levels. This approach was also examined.

Finally, while the higher milk yields of high-yielding dairy cows are often sustained through increased concentrate feed levels, the adoption of higher concentrate input systems raise a number of issues. These include strategies to optimise the response to the additional concentrates offered, as well as the need to minimise the environmental impact associated with higher concentrate input systems. Both of these issues were examined within this project.

The research programme was undertaken at the Agri-Food and Biosciences Institute (AFBI), Hillsborough, and involved an examination of five 'novel supplementation strategies', as follows:

Experiment 1
The effect of the energy intake pre-calving and post-calving on dairy cow performance.

Experiment 2
The use of dietary protein as a tool to manage the energy status of high-yielding dairy cows.

Experiment 3
Are lower protein diets viable if cows are supplemented with specific 'limiting' amino acids?

Experiment 4
Can reproductive performance be improved by offering specifically formulated concentrates?

Experiment 5
The effect on cow performance of offering additional concentrates at weeks 3, 7 and 11 post-calving.

The main findings of each of these experiments are presented within this booklet.

EXPERIMENT 1

THE EFFECT OF THE ENERGY INTAKE PRE-CALVING AND POST-CALVING ON DAIRY COW PERFORMANCE

BACKGROUND

There are still many unanswered questions about transition cow management. However, it is known that cows which have a high body condition score at calving are likely to lose more body condition post-calving, and this will increase the risk of metabolic diseases in early lactation. There is also some evidence that if energy intakes are restricted during the dry period, cows will have higher intakes post-calving, and body condition losses will be reduced. However, this effect has not been observed in all studies. In addition, it is unclear if these benefits will be observed in a situation where cows are offered a poorer quality diet after calving.

Thus the current experiment was conducted to examine the effects of pre-calving and post-calving energy intake on feed intake, milk production, energy status and fertility.

OBJECTIVES OF THE STUDY

To examine the effect of pre-calving energy intake on changes in body condition during the dry period, and during the subsequent lactation.

To examine the effect of pre- and post-calving energy intake on feed intake, animal performance, and energy status during lactation.

DETAILS OF THE STUDY

Cows

This study involved 80 winter calving Holstein-Friesian dairy cows (40 heifers and 40 cows).

Treatments

The treatments examined are summarised in Table 1. For approximately 90 days prior to calving, half of the animals had free access (ad libitum access) to a high energy diet, while the remaining animals had restricted access to a lower quality diet. Thus animals had either a high or low energy intake pre-calving.

After calving, cows on the high and low energy intake diets pre-calving were offered either a high concentrate diet (70% concentrate, dry matter basis) or a low concentrate diet (30% concentrate, dry matter basis).

All post-calving diets contained 18% crude protein (DM basis). Cows remained on these diets until day 250 of lactation.

Table 1. Details of treatments examined during the pre-calving and post-calving periods

Pre-calving management (40 animals per treatment)	**Post-calving management** (20 animals per treatment)
High energy intake (Free access to high energy diet)	**High concentrate diet** (70% concentrate)
	Low concentrate diet (30% concentrate)
Low energy intake (Restricted access to low energy diet)	**High concentrate diet** (70% concentrate)
	Low concentrate diet (30% concentrate)

OUTCOMES

In general, heifers and cows showed similar responses to the management regimes imposed. Thus, this section will focus primarily on the performance of the cows. Full details of heifer performance are described within the final report for this study on the AgriSearch website (http://www.agrisearch.org/).

Effects of pre-calving management

In contrast to some previous studies, pre-calving nutrition had no effect on dry matter intake, milk yield or milk composition after calving. On average, cows with a high or low energy intake pre-calving consumed 115 and 72 MJ per day, respectively, during the pre-calving period.

Cows with a high energy intake pre-calving had a mean body condition score of 2.7 at calving, while those with a low energy intake pre-calving had a mean body condition score of 2.3 at calving. This demonstrates that it can be difficult to substantially alter the body condition score of dairy cows during the dry period, even when offered two very different diets. However, cows with a high energy intake pre-calving lost more body condition after calving than those with a low energy intake (Figure 1).

Energy balance and fertility was unaffected by pre-calving diet, although there were trends for cows with the lower energy intake pre-calving to have improved fertility (Table 2).

Effects of post-calving management

Offering a diet containing a high level of concentrates post-calving increased dry matter intake (and the energy density of the diet), and this resulted in an increase in milk yield. The milk yield response was 0.55 kg milk per kg additional concentrate offered. However, cows offered the high concentrate diet produced milk with a lower fat content, with this due to the effect of the concentrate on rumen fermentation. Milk protein content was unaffected by post-calving diet (Table 3).

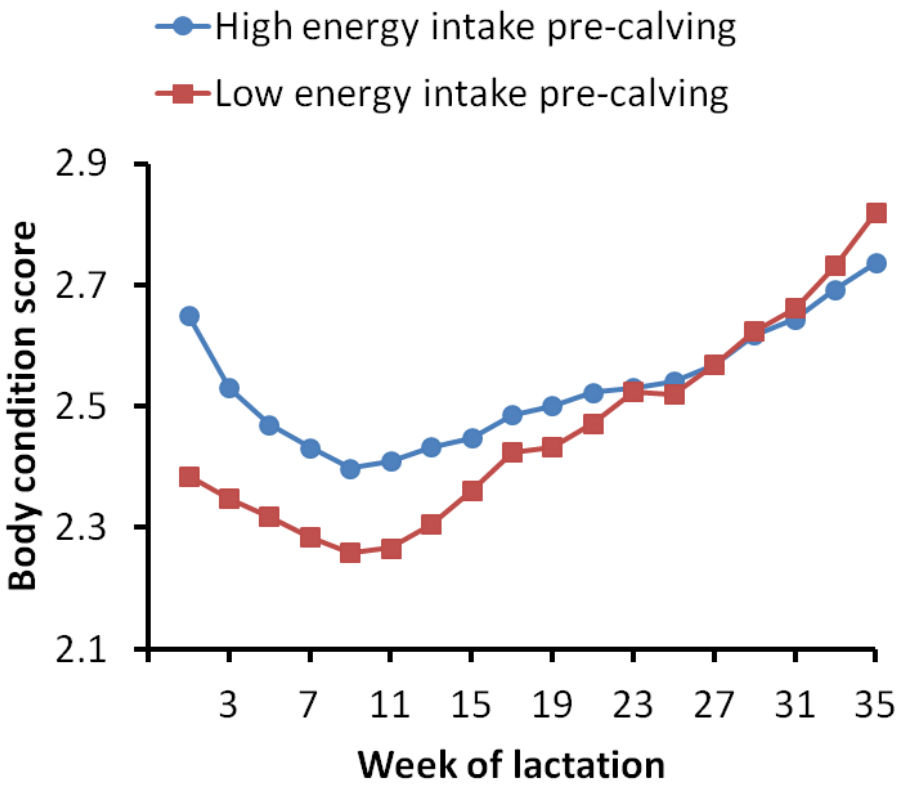

Figure 1: The effect of energy intake pre-calving on body condition score loss post-calving (cows)

Table 2. The effect of energy intake pre-calving on fertility performance

	Pre-calving treatment	
	High energy intake	Low energy intake
Conception rate to 1st service (%)	20	30
Cows pregnant after 100 days of breeding (%)	51	65
Calving Interval (days)	415	402
Days to conception	135	122

Cows offered the diet containing a high concentrate level had a higher body condition score (Table 3) throughout the experimental period than those offered a diet containing a low concentrate level. Furthermore, cows offered a high concentrate diet post-calving had an improved energy balance (Figure 2) and reached positive energy balance during week-4 of lactation, compared to week-33 of lactation for cows offered the low concentrate diet.

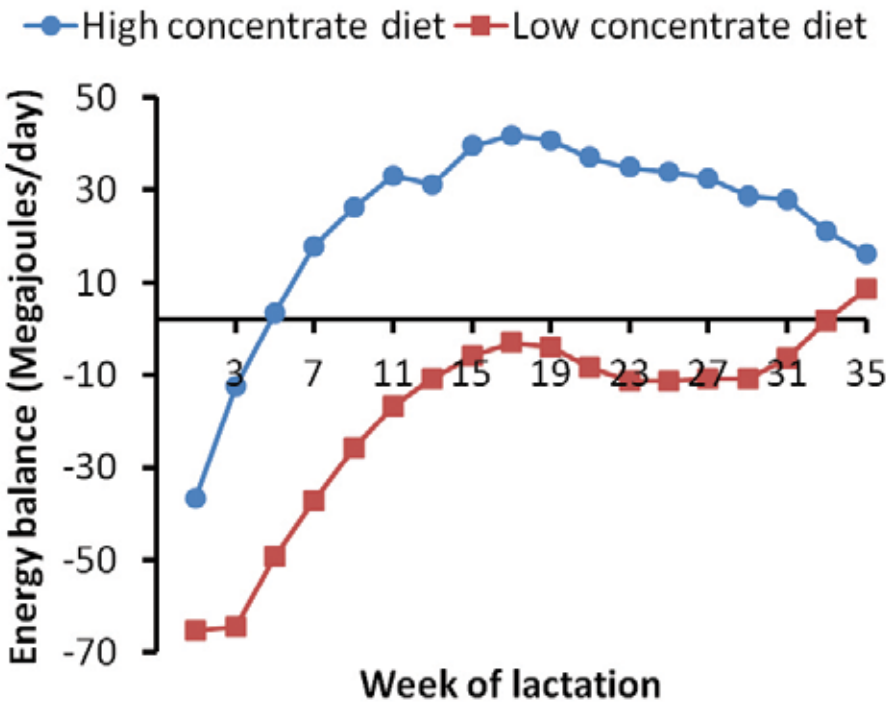

Figure 2: The effect of offering a high or low concentrate diet post-calving on the daily energy balance of cows from calving until day 250 post-calving

In general, cows with a higher energy balance post-calving have been shown to have improved fertility performance, although no such effect was observed within the current experiment (Table 3). This may reflect the small number of cows involved in this experiment.

Table 3. The effect of offering a high or low concentrate diet post-calving on dry matter intake, milk yield, body condition score and daily energy balance during the post-calving period (day 1-250)

	Pre-calving treatment	
	High Concentrate	Low Concentrate
Cow performance		
Dry matter intake (kg/day)	20.7	17.0
Milk yield (litres/day)	32.5	27.4
Milk fat (%)	3.68	4.20
Milk protein (%)	3.30	3.40
Mean body condition score	2.7	2.3
Daily energy balance (Megajoules/day)	+24	-17
Fertility performance		
Conception rate to 1st service (%)	23	27
Cows pregnant after 100 days of breeding (%)	58	59
Calving interval (days)	410	407
Days to conception (days)	130	127

Relationships between pre- and post-calving diets

There was a significant inter-relationship ('interaction') between pre- and post-calving nutritional regimes. Cows with a high energy intake pre-calving, and which were then offered a low energy diet post-calving, produced less milk from approximately week-10 of lactation onwards than those offered a low energy diet pre-calving, followed by a low energy diet post-calving (Figure 3). This may be due in part to a much greater loss of body condition during the early post-calving period by cows with a high energy intake pre-calving.

KEY MESSAGES

Within 'high concentrate input-high milk output' systems (typical of those common within Northern Ireland) it is recommended that cows be dried off at a body condition score of 2.75, and maintain this condition score throughout the dry period.

Cows which are over-fat at calving will have lower intakes and lose more body condition post-calving, while having an increased risk of health problems. However, cows with

a low energy intake pre-calving lost less body condition post-calving, and this is likely to have reduced the risk of metabolic disorders occurring during early lactation (in agreement with previous research conducted in USA and Denmark).

Results from this study indicate that it can be difficult to substantially alter body condition score during the dry period. If necessary, changes in body condition score should be made prior to drying off.

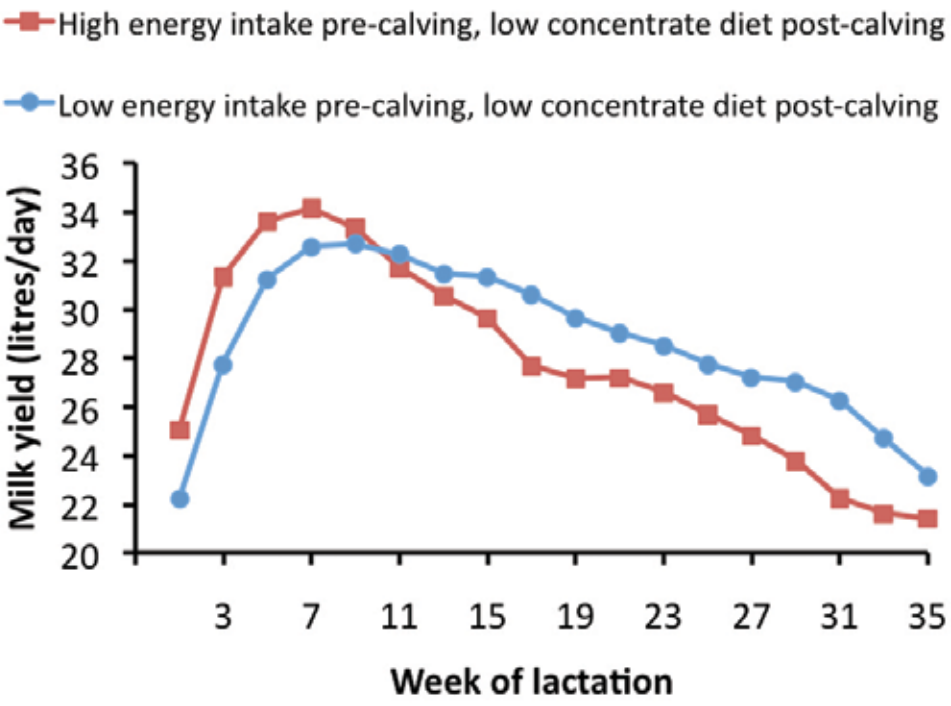

Figure 3: Milk yield response of cows with either a high or low energy intake pre-calving, followed by a low concentrate diet post-calving

EXPERIMENT 2

THE USE OF DIETARY PROTEIN AS A TOOL TO MANAGE THE ENERGY STATUS OF HIGH-YIELDING DAIRY COWS

BACKGROUND

In a previous Hillsborough study (AgriSearch Booklet No. 16) the energy balance of dairy cows was improved by offering a diet containing 14.5% crude protein (dry matter basis) during the first 150 days of lactation. However, cows offered this 'low protein' diet produced 3.5 kg less milk per day compared to cows offered a diet containing 17.5% crude protein.

Nevertheless, while a low protein diet may be unacceptable over a prolonged period of time, it may be possible to improve the energy balance of dairy cows by reducing the protein content of the diet for a short period of time, without incurring a significant loss in milk yield.

Thus the current experiment was conducted to examine if short term changes in dietary protein levels could be used as a tool to regulate the extent of negative energy balance experienced by individual cows in early lactation, without a significant reduction in milk production.

OBJECTIVE OF THE STUDY

To examine if the energy balance of dairy cows, and their subsequent fertility, could be improved through short term changes in dietary protein levels, without a significant reduction in milk production.

DETAILS OF THE STUDY

Cows
This study involved 54 winter calving Holstein-Friesian dairy cows (20 heifers and 34 cows).

Treatments
Two treatments were examined over a 210-day period:

Control treatment:
Cows were offered a total mixed ration containing 60% concentrates and 40% forage on a dry matter basis. The protein content of this diet was maintained at 18% (dry matter basis) throughout the experiment.

Individual cow management treatment:
Cows on this treatment were offered a total mixed ration containing 45% concentrates and 55% forage on a dry matter basis. In addition, these cows were offered 6 kg of concentrate per day in the parlour. Three concentrates differing in dietary protein content (15%, 18% and 42% crude protein on a dry matter basis) were available in the parlour, and this allowed the protein content of the total diet to be changed to either 15%, 18% or 21% crude protein, depending on which of the three concentrates was offered. Cows were initially offered a diet containing 18% protein after calving, with this effect the same as the Control treatment diet.

The objective of the Individual cow management treatment was to maintain the energy status of each individual cow on a pre-set target energy balance line (the heavy black line in Figure 4). In order to achieve this, the energy balance of each cow was calculated weekly during weeks 1-30 of lactation. If the energy balance of any cow was found to be below the target energy balance line shown in Figure 4 (i.e. in the red area), the concentrate offered in the parlour was changed to the low protein concentrate, thus reducing the protein content of total diet. This resulted in a short term reduction in milk yield, and an improved energy status of that cow.

If the energy balance of any cow was found to be above the target energy balance line in Figure 4 (i.e. in the blue area), the concentrate offered in the parlour was changed to the high protein concentrate, thus increasing the protein content of the total diet. This resulted in a short term increase in milk yield, and a reduction in the energy status of that cow.

After any adjustment to the protein content of the diet (either an increase or decrease), cows remained on the new protein level as long as energy balance remained on the target line.

OUTCOMES

Cows on the Individual cow management treatment had a higher dry matter intake than those on the Control treatment (Table 4). The reason for this is unclear.

Despite the higher intake of cows on the Individual cow management treatment, treatment had no effect on milk yield, milk composition, cow live weight or body condition score (Table 4).

This study highlights that low protein diets can be offered for relatively short periods of time during lactation without having a detrimental effect on cow performance.

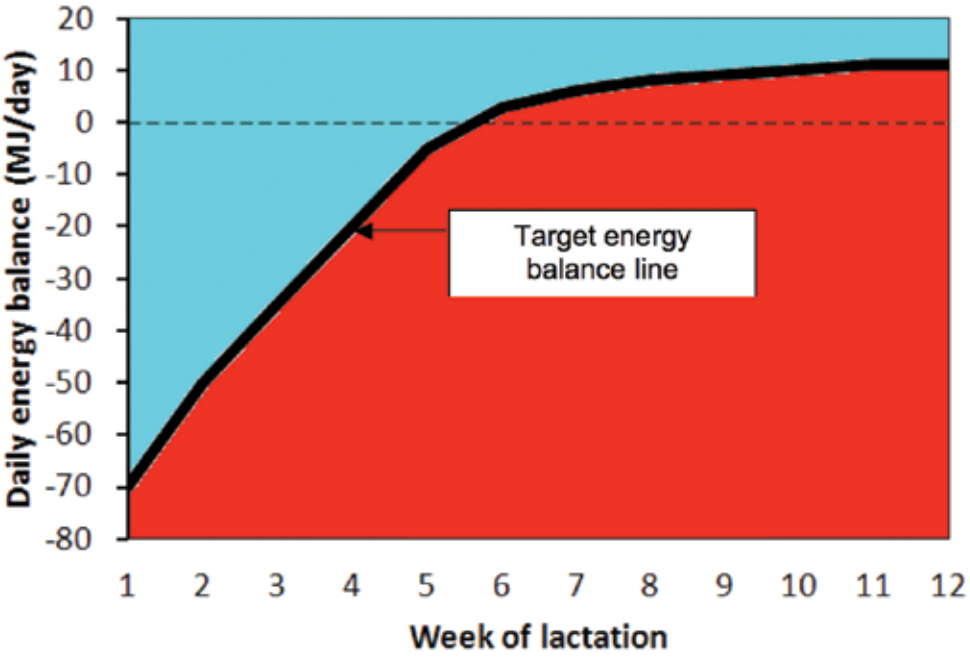

Figure 4: Target energy balance line (heavy black line) against which decisions were made to either increase or decrease the protein content of the total diet with the 'Individual cow treatment'

Table 4. Production performance and fertility performance of cows managed on the Control diet (common herd management), compared to cows managed on an Individual cow management treatment, during the first 210 days of lactation.

	Treatment	
	Control	Individual cow management
Cow Performance		
Dry matter intake (kg/day)	19.7	21.5
Milk yield (litres/day)	31.8	31.7
Milk fat (%)	3.77	3.94
Milk protein (%)	3.39	3.43
Mean live weight (kg)	563	557
Mean body condition score	2.7	2.6
Daily energy balance (Megajoules/day)	+17	+32
Fertility performance		
Days to first oestrous cycle	32	26
Conception to 1st and 2nd service (%)	62	60
Cows pregnant after 100 days of breeding (%)	71	79
Overall pregnancy rate (%)	86	96

Short term changes in the protein content of the diet can be used as an effective tool to modify the energy balance of individual cows (Figure 5), a key objective of this experiment. For example, the energy balance of cow 842 (red line) was below the target energy balance line (heavy black line) at week 3 of lactation, at which stage the protein content of the diet was reduced. This improved her energy status. In contrast, the energy balance of cow 699 (blue line) was above the target energy balance line at week 4 of lactation, at which stage the protein content of the diet was increased. This reduced the energy status of the cow.

Cows on the Individual cow treatment had an improved energy balance compared to those on the Control treatment, with this largely driven by higher food intakes. However, this did not improve any of the fertility parameters examined, with this perhaps a reflection of the low number of cows on the experiment.

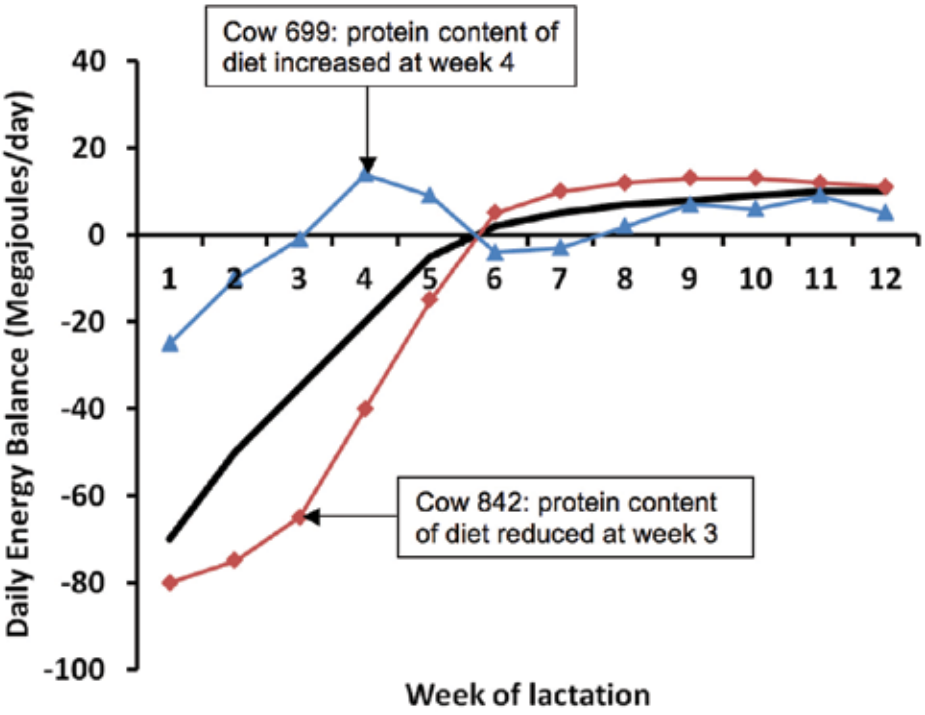

Figure 5: Example of how the energy balance of two individual cows changed after the protein content of the diet was adjusted

KEY MESSAGE

It is possible to alter the energy balance of individual cows through short term changes in the protein content of the diet. This resulted in a more uniform group of cows in terms of body condition score (fewer fat and thin cows), thus simplifying late lactation/dry cow management. However, no positive effects on fertility performance were observed within this study.

EXPERIMENT 3

ARE LOWER PROTEIN DIETS VIABLE IF COWS ARE SUPPLEMENTED WITH SPECIFIC 'LIMITING' AMINO ACIDS?

BACKGROUND

In a recent Hillsborough study, cows offered a diet containing 14.5% crude protein produced substantially less milk than cows offered a diet containing 17.5% crude protein. However, this reduction in performance may not be due to an overall deficit of protein in the diet, but rather due to a shortage of one or two specific amino acids (protein is made up of lots of different amino acids). The two amino acids that are normally most limiting in dairy cow diets are lysine and methionine. While diets offered in Northern Ireland will generally supply sufficient quantities of lysine, in most cases there is a shortage of methionine. Thus it may be possible to reduce the overall protein content of dairy cow diets without any loss in performance, when additional methionine is provided.

OBJECTIVE OF THE STUDY

To examine if the inclusion of protected methionine allows the protein content of a dairy cow diet to be reduced without any loss of performance, and the impact of this on the efficiency of nitrogen utilisation.

DETAILS OF THE STUDY

Cows
This study involved 54 winter calving Holstein-Friesian dairy cows (20 first lactation heifers and 34 cows).

Treatments
Two treatments were examined over a 210-day period:

Control treatment:
Cows were offered a total mixed ration containing 60% concentrates and 40% forage (dry matter basis). The crude protein content of this diet was maintained at 18% (dry matter basis) throughout the experiment.

Low protein diet + methionine:
Cows on this treatment were offered a total mixed ration containing 14.5% crude protein. However, this diet was supplemented with protected methionine ('MetaSmart', Kemin UK, Ltd.) at an inclusion level of 40 g per cow per day (supplying approximately 8.8 g of methionine per cow per day). This inclusion rate was designed to achieve an optimal lysine to methionine ratio of 3:1, and was specific to the rations offered in this experiment.

OUTCOMES

- Cows offered the Low protein + methionine diet had similar intakes, milk yields, milk composition, live weight and body condition score as cows offered the Control diet (Table 5). Thus, in contrast to an earlier study, performance was not reduced with a diet containing 14.5% crude protein.

- Cows offered the Low protein + methionine diet had a lower nitrogen intake than cows offered the Control treatment. However, nitrogen output in milk did not differ between treatments. As a result, there was an improvement in nitrogen utilisation with the Low protein + methionine treatment, with 38% of nitrogen consumed excreted in milk, compared with 31% with the Control treatment.

- An improvement in nitrogen utilisation will result in less nitrogen being excreted in manure.

Table 5. Production performance and the efficiency of nitrogen use of cows offered a Control diet or a Low protein + methionine diet

	Treatment	
	Control	Low protein + methionine
Cow performance		
Dry matter intake (kg/day)	19.7	19.4
Milk yield (litres/day)	31.8	31.6
Milk fat (%)	3.77	3.84
Milk protein (%)	3.39	3.37
Milk Urea (milligrams/litre)	164	134
Mean liveweight (kg)	563	566
Mean body condition score	2.7	2.6
Efficiency of nitrogen utilisation		
Nitrogen intake (grammes/day)	569	466
Nitrogen output in milk (grammes/day)	180	180
Milk nitrogen as a % of nitrogen intake	31	38

KEY MESSAGE

The results of previous experiments have highlighted that milk production responses to methionine supplementation are highly variable. Nonetheless, the results of this experiment suggest that there may be opportunities to reduce dietary protein levels without having a detrimental effect on cow performance, provided the diet is supplemented with the appropriate limiting amino acids. However, expert nutritional advice is required to ensure that diets are correctly balanced.

EXPERIMENT 4

CAN REPRODUCTIVE PERFORMANCE BE IMPROVED BY OFFERING SPECIFICALLY FORMULATED CONCENTRATES?

BACKGROUND

Offering a diet which is high in starch (cereals) has been shown to encourage cows to 'cycle' earlier (earlier first heat), although high starch diets have also been shown to have a detrimental effect on the developing embryo. In contrast, offering a diet which contains a higher level of fat has been shown to have positive effects on embryo growth and subsequent survival. In a recent experiment undertaken at the University of Nottingham, dairy cow fertility was increased when a 'starchy diet' was offered in early lactation, followed by a 'high fat diet' at the time of breeding.

The current experiment was undertaken to see if these positive effects on cow fertility could be replicated at Hillsborough.

OBJECTIVE OF THE STUDY

To examine if the reproductive performance of Holstein-Friesian dairy cows could be improved by offering a diet designed to promote early cycling (early oestrus) and improved embryo survival.

DETAILS OF THE STUDY

Cows
This study involved 54 winter calving Holstein-Friesian dairy cows (20 first lactation heifers and 34 cows).

Treatments
Two treatments were examined over a 210-day period:

Control treatment:
Cows were offered a total mixed ration containing 60% concentrates and 40% forage (dry matter basis). The protein content of this diet was maintained at 18% (dry matter basis) throughout the experiment.

Fertility improver treatment:
Cows were offered:

- A high-starch diet until day 50 post-calving (27.5% starch in the diet),
- Followed by a diet high in protected fat (7.2% fat) and low in starch (10%) from day 51 to day 120 post-calving,
- Followed by the Control diet from day 121 to day 210 of lactation.

OUTCOMES

Treatment had no effect on food intake, milk production, milk composition, live weight, body condition score or daily energy balance (Table 6).

There was a trend for cows offered the Fertility improver diet to start to cycle earlier than those offered the Control diet, although this difference was not 'statistically significant'.

Offering a 'high fat', 'low starch' diet from day 51 to day 120 post-calving had no effect on pregnancy rate in the current study.

While the number of animals involved in this study was small, this study provided no evidence that fertility outcomes could be improved by offering a specially formulated concentrate.

Table 6. Production performance and fertility performance of cows offered either a Control diet or a Fertility improver diet

	Treatment	
	Control	Fertility improver
Cow performance		
Dry matter intake (kg/day)	19.7	20.1
Milk yield (litres/day)	31.8	32.3
Milk fat (%)	3.77	3.84
Milk protein (%)	3.39	3.36
Mean liveweight (kg)	563	570
Mean body condition score	2.7	2.5
Daily energy balance (Megajoules/day)	+17	+19
Fertility		
Days to first oestrous cycle	32	22
Conception to 1st and 2nd service (%)	62	56
Cows pregnant after 100 days of breeding (%)	71	68
Overall pregnancy rate (%)	86	88

KEY MESSAGES

In a recent study at the University of Nottingham, cows offered a high-starch diet in early lactation followed by a low-starch diet had higher pregnancy rates by day-120 of lactation than cows offered either a high-starch diet or a low-starch diet throughout.

While there was some evidence that offering a 'high starch' diet post-calving reduced the interval to the first oestrous cycle, this study provided no evidence that the 'high starch'-'high fat' combination of treatments had any effect on overall fertility outcomes.

EXPERIMENT 5

THE EFFECT ON COW PERFORMANCE OF OFFERING ADDITIONAL CONCENTRATES AT WEEKS 3, 7 AND 11 POST-CALVING

BACKGROUND

As the milk yield potential of the Holstein cow has increased, concentrate feed levels have also increased as farmers attempt to meet the higher nutrient requirements of these cows. However, as concentrates represent approximately 60% of the total variable costs of milk production, it is important that the milk yield response to each additional kilogramme of concentrate offered is maximised. While research undertaken almost 40 years ago demonstrated that the largest response to concentrate supplementation is achieved in early lactation, this has never been repeated with today's higher yielding cows.

In addition, it has been suggested that offering additional concentrates in early lactation may promote milk production, and as such, increase the extent of negative energy balance experienced by high-yielding cows, as well as the risk of rumen disorders. Alternatively, delaying concentrate inclusion in the diet until after this critical period may delay the rise to peak milk yield, allow feed intakes to increase in synchrony with milk yield and thus reduce the extent of negative energy balance in early lactation.

OBJECTIVE OF THE STUDY

To examine the effects on food intake, milk production, body tissue reserves and cow fertility of introducing additional concentrates into the diet of dairy cows at week 3, week 7 and week 11 post-calving.

DETAILS OF THE STUDY

Cows
This study involved 80 winter calving Holstein-Friesian dairy cows (40 heifers and 40 cows).

Treatments
Cows remained on the study for the first 28 weeks of lactation. All cows were initially offered a common basal diet comprising 50% concentrate and 50% forage (dry matter

basis). This was offered as a total mixed ration. Four treatments were examined, as follows:

Basal diet (no extra supplement)
Basal diet + 4.0 kg extra concentrate from week 3 post-calving
Basal diet + 4.0 kg extra concentrate from week 7 post-calving
Basal diet + 4.0 kg extra concentrate from week 11 post-calving

The 4.0 kg of extra concentrate was offered through in-parlour feeders.

OUTCOMES

In general, heifers and cows showed 'similar' responses to the inclusion of additional concentrates in the diet, although the heifers did not show as large a response as the cows. Thus, this section will focus only on the performance of the cows. Full details of the heifer performance can be found in the final report on the AgriSearch website (http://www.agrisearch.org/).

Cow performance
Introducing additional concentrates into the diet resulted in a rapid increase in total dry matter intake, as highlighted in Figure 6. The size of this intake response was largely unaffected by the time of introducing the additional concentrates into the diet (week 3, 7 or 11).

When additional concentrates were introduced into the diet, cows responded by producing more milk (Figure 7). However, the milk yield response was greatest when the additional concentrates were introduced at week 3 of lactation, compared to when they were introduced at either week 7 or week 11 of lactation. Milk composition was unaffected by the inclusion of additional concentrate in the diet

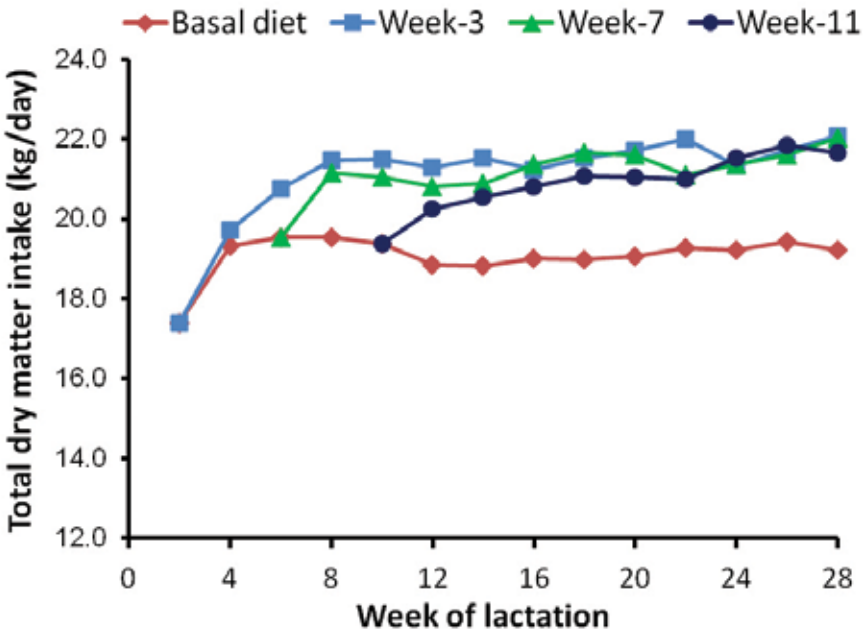

Figure 6: Impact of including additional concentrates in the diet at weeks-3, 7 and 11 post-calving, on total dry intakes during the first 28 weeks of lactation

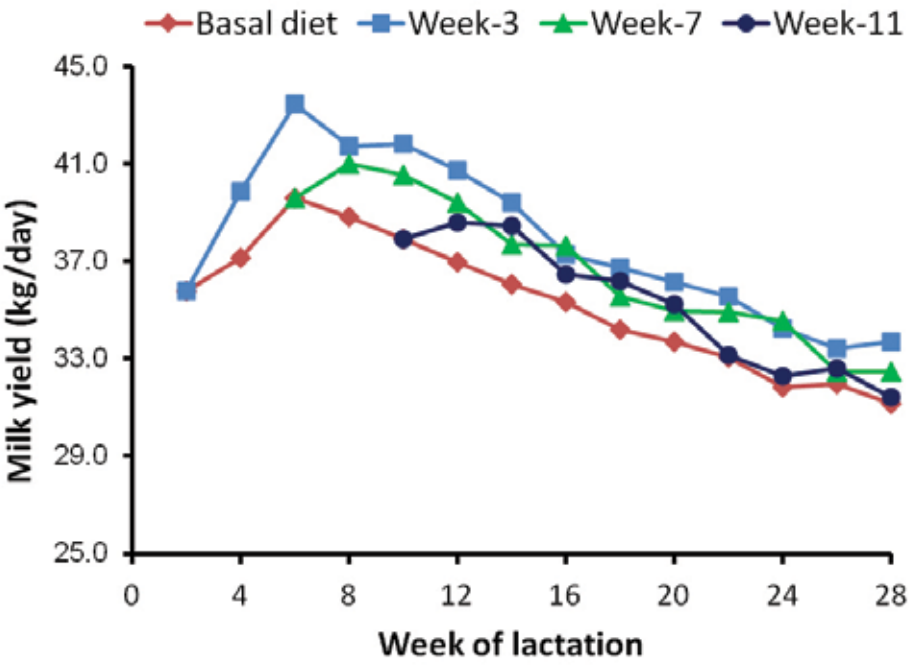

Figure 7: Impact of including additional concentrates in the diet at week 3, 7 and 11 post-calving, on daily milk yield during the first 28 weeks of lactation

Energy balance and fertility

Cows offered the additional concentrates returned to positive energy balance at approximately 12 weeks post-calving, irrespective of when the additional concentrates were offered (weeks 3, 7 or 11). However, cows that were offered the basal diet without additional concentrates did not return to positive energy balance until approximately week 22 post-calving (Figure 8).

This clearly demonstrates that additional concentrate feeding can enable cows to return to positive energy balance faster, provided all of the additional nutrients consumed are not used to produce extra milk. In this study part of the additional feed consumed was used for milk production, while part was used for liveweight gain.

Nevertheless, despite the improved energy status of the cows on this experiment, no aspect of fertility performance was improved by offering additional concentrates. While this is in agreement with many previous studies at Hillsborough, it is possible that this was due to the study involving too few animals to measure fertility robustly.

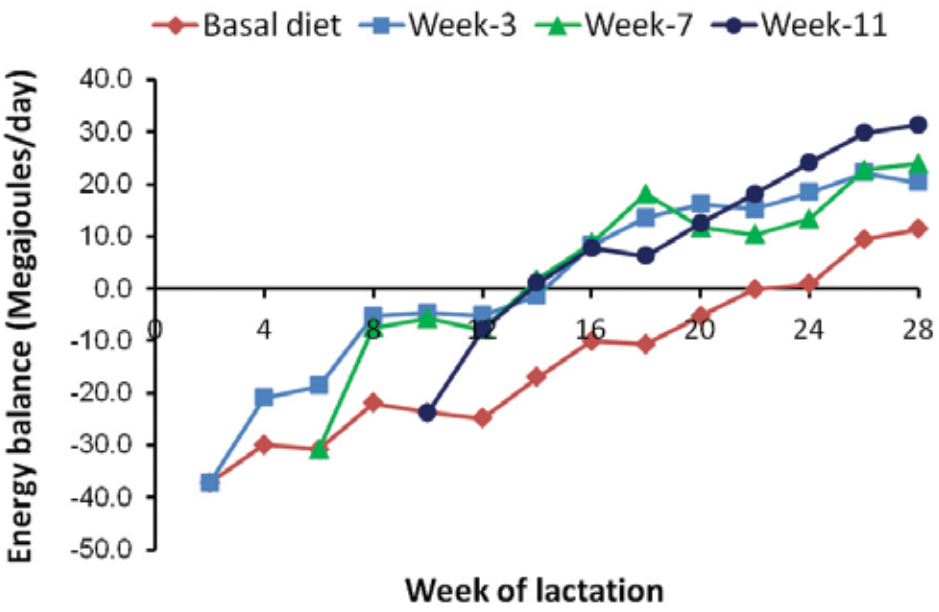

Figure 8: Impact of including additional concentrates in the diet at weeks 3, 7 and 11 post-calving on daily energy balance during the first 28 weeks of lactation

KEY MESSAGE

While offering additional concentrates promoted total dry matter intake and quickened the return to positive energy balance, no fertility benefits were observed. The milk yield response to additional concentrates was greatest when concentrates were offered in early lactation.

AGRISEARCH BOOKLETS

1 SHEEP
The Effects of Genetics of Lowland Cross-Bred Ewes and Terminal Sires on Lamb Output and Carcass Quality

2 DAIRY
A Comparison of Four Grassland-Based Systems of Milk Production for Winter Calving High Genetic Merit Dairy Cows

3 DAIRY
Dairy Herd Fertility - Examination of Effects of Increasing Genetic Merit and other Herd Factors on Reproductive Performance

4 SHEEP
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5 BEEF
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For further information or to request a copy of the the full scientific report detailing the experimental tests and statistical analysis contact

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