A nutritional solution to match the performance and profit potential of genetically improved Holsteins.

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Summary:

The modern Holstein can produce large amounts of milk but issues of poor milk composition, increased lameness and mastitis, poor fertility, increased health issues and reduced longevity occur on many farms. These impact on profitability, many blame the Holstein, and breeding initiatives to produce a more suitable cow, even to the extent of cross breeding, are being advanced as a possible solution. Yet there are many well-managed herds that have far fewer of these problems.

From a review of these issues, it is concluded that the way cows are fed and managed is as much, or possibly more, to blame than the cow's genetics. Many systems of heifer rearing are unacceptable given the spread in age, weight and body condition at first calving seen in many herds. Poor rumen function as a consequence of poor ration formulation, impacts on overall performance and milk composition, and the importance of measuring and improving feed conversion efficiency of the herd is established. Dry cow nutrition is overlooked on many farms. Poorly managed dry cow nutrition impacts on cow and calf health, subsequent milk production and herd fertility. It is contended that excessive body condition loss seen in many higher yielding cows is not an inevitable consequence of the Holstein breed and can be significantly reduced, provided the dry cow is adequately fed throughout the whole dry period. There also exists a number of nutritionally-related risk factors which affect cow fertility; better nutrition can have a significant impact on both submission and conception rates.

It is concluded that many nutritional strategies being used to feed the modern day Holstein are 'unsuited for purpose' and in need of serious revision. The Keenan Hi-Fibre Dairy system, with its several elements was specifically designed to deliver consistent and improved nutrition for all livestock. It is a strategy available to all dairy farmers who wish to achieve the performance and profit potential of the genetically improved Holstein. Adopting The Keenan Hi-Fibre Dairy system brings improved feed efficiency, with lower total feed costs per litre at a time of record-high feed prices, increased longevity, lower culling rates and better fertility, all contributing to a conservatively estimated improvement in overall margin per cow of as much as £250 (300 Euros) per year.

Introduction:

Over the last 2 decades or so, pronounced improvements in average lactation yields of dairy cows have occurred in most developed dairying countries, exceptions being New Zealand and Southern Ireland where pasture-based systems still dominate. Much of this is attributable to the introduction of the Holstein at the expense of most other breeds and aggressive selection of Holsteins for milk yield. There are probably few Holstein cows, provided they are well reared as heifers and suitably managed thereafter, not capable of producing over 9000 litres per average lactation and in countries such as USA, Denmark, Holland and Israel, most cows produce over 10,000 litres per lactation. But with single trait selection for milk production, the Holstein genetic base has narrowed, with fears of possible inbreeding effects. Most importantly, as yield potential has increased, a number of issues have emerged which are beginning to threaten the health, performance and profitability of Holstein dominant herds.

Roche (2006) drew attention to low fertility in modern Holsteins, addressing key issues of compromised oestrus behaviour and reduced conception rates, often associated with excessive post-calving body condition loss. Poorer fertility means longer calving intervals and increased breeding costs, with increased involuntary culling due to failure to rebreed.

Poorer fertility and the ability to get cows back in calf as required is now recognised as a major management issue. Higher milk yields are cited as a possible cause yet poor fertility exists in lower yielding herds. In Ireland, where pasture-based systems require tight spring calving patterns to meet grass availability, Mee, (2004) reported the incidence of abnormal progesterone profiles had increased from 13 to 26% in 15yrs, first service conception rate had declined by 1% per yr over 8yrs and calving interval had increased by 1 day per yr over the same period.

Poor fertility in dairy herds is unlikely to be due to one single factor. Some blame the type of cow, and aggressive single trait selection for milk yield in Holsteins may be a contributory factor. This has led some to consider breeding a different type of cow, whilst cross breeding has become popular in some pasture-based systems of milk production. Equally there are management issues. Increased herd sizes have resulted in more cows being managed per labour unit whilst reduced availability of skilled staff has added to the problem, including issues of heat detection and appropriate implementation of the breeding programme. The third factor is nutrition and against current systems of nutritional management, there appears considerable opportunity to improve overall herd fertility through better feeding strategies.

Data for average cow longevity is difficult to obtain; numerous estimates for different countries exist but in 1976, cows in the UK enjoyed an average 4.6 lactations. Some estimates suggest this has declined to 3.3 lactations, or as low as 3.0. Similar effects have been seen in Dutch herds whilst in the USA, the figure is closer to 2.5. Recently, Garcia, (2001) urged USA farmers to ensure all cows survived until 48 months of age, a possible admission of the magnitude of the problem on some farms. Meanwhile, Weigel and Palmer, (2002) noted that higher yielding cows were more likely to be culled prematurely in larger herds, in herds with higher staff/cow ratios, where % of family labour was lower and where maternity accommodation was inadequate.

Even cows producing in excess of 10,000litres per lactation will only have lifetime productions of 25,000 to 30,000litres if culled prematurely. Minimum lifetime yields of 50,000litres should be targeted for all cows and whilst there are cows in many countries with recorded lifetime yields of 100,000litres, these remain the exception rather than the norm. Rearing a heifer to 2 years to produce only 25,000 litres milk in 2 to 3 lactations equates at most to 1 kg energy corrected milk (ECM) per kg total feed DM consumed. Contrast this with a cow producing 50,000litres over 5 lactations, where overall production is increased by at least 0.1 kg per kg feed DM, an efficiency gain of 10% with associated lower total feed costs per litre milk sold.

In the late 1980s/early 1990s, poor fertility and longevity were not regarded as major problems, rather prices worth paying to achieve the gains possible through better genetics. But after these large gains in milk potential have been achieved, many farmers are now questioning the real costs of poor fertility and poor longevity on overall margins. Producing milk is the prime driver of farm income, but poor fertility and longevity can easily erode these margins, and, unlike milk price, these are within the farmer's control.

There is equal concern over the costs of heifer rearing and farm profitability. Where cows average only 3 lactations, a third of the milking herd has to be replaced annually. This may fall to 25% in better performing herds with only the best achieving below 20%. For a 100 cow herd, the maximum number of dairy heifer calves born annually is unlikely to exceed 45. A recent survey by The Royal Veterinary College (Wathes, unpublished observations) showed 8% of all dairy heifers were either born dead or failed to live beyond 24hrs. Of those that lived, 14% failed to reach their first lactation, providing, at best, 36 heifers suitable for recruitment to the herd. This leaves little opportunity for selection or selling surplus heifers and no opportunity for herd expansion with homebred stock, against an annual replacement rate of over 30%. The survey also showed age at first calving ranged between 23 and 29 months, confirming a previous study by the same organisation of 21 to 31 months. Furthermore, down-calving heifer weight averaged 639kg but ranged between 518 and 786kg. Probably their most disturbing finding, however, was that variation within individual farms was as great as that between farms, with many farms having highly disparate down-calving heifers in terms of age, weight and body condition.

This situation is not unique to the UK with many heifer rearing systems producing animals less than ideally suited for efficient and profitable milk production. Accepting the genetic base of the Holstein has narrowed, it is concluded that the way heifers are reared is having a significant impact on this problem. There is little evidence to suggest age of first calving, accepted by most as 24 months, needs to be revised, but there is considerable scope to reduce the variation in all aspects of heifer development, with better management and improved nutritional strategies.

On many dairy farms animal health issues associated with calving and the production of milk can lead to significant problems, possibly resulting in premature culling, and all reducing overall profitability. Mastitis, high somatic cell counts and lameness are recurring problems but equally issues such as milk fever, retained foetal membranes, displaced abomasums, ketosis and fatty liver occur too frequently. A plethora of potential cures exists, when in reality the only solution is problem avoidance. Some contend such issues are the inevitable outcome of keeping higher producing cows and that concern still prevails in some minds. More recently breeding initiatives have been aimed at producing a more robust cow, and along with fertility, other selection criteria have been included. But perhaps these moves need to be challenged when many of the problems may be more related to the way the modern Holstein is managed. The last 20 years or so have seen significant increases in both herd and cow size, yet on many farms the necessary improvements in cow housing have not accompanied such changes. Equally, many cows are still being fed according to feeding standards published over 20 years ago and largely unchanged, apart from minor modifications. Much of the feeding advice available to farmers is governed by the feed companies, whose aim is to sell product and where necessary solutions, rather than aiming to avoid problems. In this context Cunningham, (2004) was correct when he stated, ‘Genetics have created the potential, nutrition has failed to deliver it’. So before considerable sums of money are spent on new breeding initiatives, it may be prudent to examine how the overall performance in present-day cows can be improved.

One final issue that concerns many dairy farmers is milk composition, principally poorer milk fats and milk proteins, often attributed to increased milk yields. When selling on a constituent basis, these, as well as higher somatic cell counts, affect final milk price. Whilst breeding companies claim to be selecting for higher protein bulls, genetic selection over the last 20 years within Holsteins has at best had no negative effects of milk proteins. Yet many still see more genetic opportunity, through increased selection within the Holstein or by crossbreeding with breeds with inherently higher milk solids contents, as the route for improving milk fat and protein levels. In reality increasing milk composition by improved nutritional practices may be more attractive, given this can be achieved over a much shorter time frame. The principles of milk fat and protein synthesis are well known (MacRae et al, 1987) yet the importance of optimising both fibre digestion and microbial protein synthesis in the rumen is often overlooked. Central to this is rumen acidosis. Feeding large amounts of grain generally increases rumen acid levels causing rumen pH to fall and leading to sub-acute, and sometimes, acute rumen acidosis. Providing starch in a mixed ration rather than as discrete meals and a more balanced supply of starch sources with respect to rates of rumen degradation can reduce this risk. This has beneficial effects on both rumen fibre digestion and feed intake with associated improvements in milk yield, milk solids content and milk solids yield.

This paper will outline some of the nutritional strategies in The Keenan Hi-Fibre Dairy system designed to address these issues, focussing on optimisation of rumen and animal health with respect to heifer development, the dry cow, fertility and improved feed utilisation, with concomitant improvements in milk solids content.

Heifer Rearing:

The issues:

It is not intended to provide a comprehensive review of heifer rearing, rather to consider some opportunities with respect to current feeding practices. The aim of all heifer-rearing programmes should be to produce healthy and even cohorts of animals, suitable for sustained milk production over successive lactations.

Achieving a targeted calving weight of 625kg at 24 months requires an average daily growth rate of only 0.8kg after accounting for calf birth weight. Under normal circumstances this is easily achievable. All calves require colostrum for the passive transfer of Immunoglobulins (Ig) during the first days of life before the calf's own active immunity develops. But quantity and timing of colostrum intake is important, as is colostrum quality. The issue of quality is not fully recognised yet can have a major effect on calf survival and performance. Several factors affect colostrum quality, specifically Ig levels, including age of dam, with older cows generally producing higher quality colostrum, milk volume with higher producing cows having lower quality and level of nutrition, particularly protein, at calving. Pre-partum milking reduces Ig levels whilst pre-partum diet may be important. Feeding rations of moderate energy levels with high amounts of forage has been shown to improve colostrum quality. Inexpensive and easy-to-use equipment is available for on-farm determination of colostrum quality and where unacceptable levels of calf mortality or poor early growth rates exist, investment in such is recommended.

During the milk-rearing phase, the aim is to keep calves healthy with satisfactory growth rates, whilst controlling the amount of milk replacer fed. But with higher expected lifetime levels of milk production, the economics of restricted milk feeding and early weaning should be questioned. Studies by Wathes & Beever, (unpublished) compared three milk rearing treatments for Holstein heifers, comprising warm ad lib milk replacer (WA) and the same product fed cold ad libitum (CA) or warm but restricted according to manufacturers recommendations (WR). At one month, when all calves were still receiving milk, WA fed calves had higher growth rates and higher IGF1 levels than either CA or WR fed calves, the difference between WA and WR being statistically significant. All calves were weaned at 6 weeks and fed the same ration. When subsequently sampled at 6 months of age, IGF1 levels were still higher in WA and CA heifers compared with WR heifers although the differences were not significant. Interestingly a study involving almost 500 heifer calves, (Wathes, unpublished) noted lower IGF1 levels and lower body weights at 1 month of age in calves (3.4%) that died during the rearing period to 6 months, both effects being statistically significant.

From Alderman & Cottrill, (1993), the metabolisable energy (ME) requirements of growing heifers can be computed for both non-pregnant juvenile and post-service pregnant heifers. For maintenance and 0.8kg average daily liveweight gain, the ME requirements of pre-bred heifers increase progressively from 34 to 51 and 73MJ/day at 100, 200kg and 350kg liveweight, (lwt) respectively. At a ration ME density of 11MJ/kgDM, this equates to average daily DM intakes for 200 and 350kg heifers of 2.3% and 1.9% lwt respectively, with lighter animals needing to consume

3.1% bwt. Such levels of performance can be achieved using high forage-based rations, provided good quality forage is supplied, the possible exception being lighter calves where a higher ration energy density may be required.

Alderman & Cottrill, (1993) suggested it was only necessary to adjust ME requirements for the developing foetus of older heifers from week 24 of pregnancy in response to exponential foetal growth in the last trimester. Thus heifers weighing 550kg and 15 weeks from calving, still only modest daily intakes are required (1.7% lwt), with a small increase to 2 to 2.2% lwt as calving approaches. Again such performance targets can be achieved by feeding good quality forages, yet on many farms this is often not the case.

Many reasons can be advanced why many heifer rearing systems often result in highly disparate animals with respect to age, weight and body condition at first calving, as well as the number of heifers failing to ever produce a calf. At its simplest, heifers are often forgotten, possibly receiving even less attention than dry cows. Both underfeeding and overfeeding can occur, and over-reliance on pasture when both quality and amount are either in excess or declining are contributory factors. Feeding inferior conserved forages and poor housing with inadequate feed space also affect heifer development. When both forage quality and feed space are compromised, dominant heifers prevail leaving timid heifers struggling to meet their daily needs, with a concomitant reduction in growth and development.

Keenan Hi-Fibre for dairy heifers:

Much can be gained by adopting a nutritional and feeding regime for targeted heifer growth which is strictly adhered to. Pasture can be important but, as with milking cows, it must be managed to provide adequate quantity and quality for the stock for as long as possible. In the early post-weaning period, supplying some of the milker's total mixed ration has been successful, provided it contains adequate amounts of physically effective fibre to promote rumen development.

Recently, Hoffman, (2007) examined feed efficiency in heifer management, focussing on achieving targeted weights with respect to age. Birth, weaning, vaccination, breeding and pregnancy check were identified as opportunities to check development and adjust nutritional strategies accordingly. More importantly, expressing heifer body weight in relation to mature body weight (MBW) to assess environmental raher than genetic variation was proposed. A surrogate assessment of MBW was developed, based on dam weight, adjusted to lactation number. A heifer of 290kg of a dam weighing 625kg in her second lactation, would be estimated to be 43% of MBW ([290/{625*1.087}] where 1.087 is the lactation adjustment. Judged against tabulated MBWs with respect to age, this would indicate that this heifer should be approximately 10 months of age. In reality prediction of MBW would be improved if sire MBW could be included but these data are generally not available. An obvious strength of the approach is that it applies across all breeds whilst suitable adjustments have been proposed for crossbreds.

Applying such measurements to several heifer cohorts in the USA showed a large but not unexpected variance in %MBW with respect to age. Older cross-bred heifers were generally found to be above their respective MBW, suggesting many were over-conditioned. Use of %MBW in respect to ideal breeding date had a major effect on reducing age, weight and body condition at calving.

One problem raised by Hoffman, (2007) with respect to variation in %MBW was feed management. Ensuring adequate feed space for all animals to consume feed at the same time is crucial, as is the avoidance of stale feed. Hoffman suggested limit feeding heifers with a more nutrient dense ration but noted this needs careful management, and animals can be highly vocal when first introduced to this regime. Alternatively, it may be possible to achieve more consistent growth rates between animals by feeding lower nutrient dense rations ad libitum. This is usually achieved by adding lower quality forages. However, as not all animals are likely to eat at the same time, these rations need to be well mixed with full incorporation of the forages to avoid ration sorting at the feed space. In both several countries, considerable success with significant reductions in age, weight and body condition variation at first calving has been achieved using rations containing over 30% cereal straw (DM basis); all being processed in a Keenan Klassik mixer wagon. Equally when heifers are at pasture, strategic supplementation to complement grazed pasture is advisable, with cereal straw fully incorporated into the ration along with limited energy-rich feeds to ensure satisfactory intakes of nutrients and physically effective fibre.

Improving Rumen Health

The issues:

The rumen will always be the main driver affecting the performance and profitability of ruminant livestock. It accounts for about 80% of total digestion within the animal, and accounts for over 50% of the animals energy supply as volatile fatty acids. It makes a significant contribution to the animal's protein supply through the production of microbial biomass, whilst processes in the rumen influence voluntary feed consumption. The rumen is a complex anaerobic fermentation system (Beever, 1993) in which microbial digestion is the main contributor to the dissimilation of feed particles, along with physical reduction of feed particles, during rumination. Strong muscular contractions of the rumen wall mix the rumen contents and move undigested feed particles to the lower parts of the digestive tract, whilst control of temperature and pH within the rumen digesta mass are also important.

Due to the fibrolytic bacteria in the rumen, ruminants can digest and utilise considerable amounts of forage. But fibre, the main carbohydrate fraction of forages is inherently less digestible, in both rate and extent, than cereal grains and similar feeds. Optimal forage digestion in the rumen can only be achieved with the requisite residence time. As the milk yield potential of dairy cows has increased however, so has the need to supply more nutrients, inevitably resulting in feeds of higher digestibility (e.g. grains) replacing significant amounts of forage in the total ration. There have been concerted efforts to improve overall forage digestibility, by harvesting earlier or by breeding as well as the current interest in high-sugar grasses. Both have inevitably led to lower levels of structural fibre being consumed, but with possible negative as well as positive effects. Reducing the particle size of forages prior to ensiling has also occurred, with shorter chop lengths considered important for improving clamp consolidation and minimising feed spoilage. Meanwhile, feeding grains or similar feeds as a finely ground meal or in a pellet, has continued, adding to the general reduction in particle size of ruminant rations which has occurred.

Both research and on-farm experience has however started to challenge such practices and the importance of providing adequate amounts of physically effective fibre has been shown to have positive benefits on rumen function (Mertens, 1997). Recently Yang & Beauchemin, (2007) found inclusion of physically effective fibre increased the apparent digestibility most ration nutrients, whilst Beauchemin, (2007) reported positive effects on chewing and rumination times. Efficient fibre digestion is important as it ensures maximum utilisation of a valuable feed nutrient, whilst it ensures optimal clearance of digesta from the rumen, an important balance between the competing processes of digestion in and passage out of the rumen. Feeding increased amounts of small and fine particles increases the rate of digestion but also the opportunity for partially digested materials to leave the rumen before being completely digested. Enhanced rates of digestion have implications with respect to higher acid levels and lower rumen pHs. The fibrolytic bacteria become metabolically less active and in worst-case scenarios they die, to be replaced by other microorganisms more suited to lower pHs and starch utilisation. The second implication of poorer fibre digestion is lower levels of feed consumption, counter to the achievement of high and consistent intakes.

Low pH can lead to sub-acute and in some instances acute rumen acidosis. Implications for feed utilisation, milk composition and animal health can be considerable. Reduced fibre digestion reduces milk production per kg feed consumed, with the obvious implication of needing to increase feeding rate to avoid any potential yield loss. Reduced fibre digestion impacts on milk fat content with possible implications on realised milk price. Both of these phenomena exist on many USA dairies with a significant number of cows producing milk of lower fat than protein content, known as milk inversion, when in reality the fat:protein ratio in Holstein milk should be closer to 1.25:1. Also higher levels of feeding to achieve satisfactory levels of milk production, impact negatively on feed conversion efficiency. In theory cows producing 40kg (90lbs) EC milk per day and not losing body condition should achieve this with 22.5kg ration DM intake/day at a feed efficiency of 1.76kg EC milk/kg feed DM. But if ration digestibility is reduced by 10% due to poor rumen function and reduced fibre digestion, an extra 2.5kg feed DM are required to achieve the same milk output, with a resultant drop in feed efficiency to 1.59kg/kg. Against many herds, this level of efficiency may be considered impressive, but the costs of the extra 2.5kg feed DM/day impact directly on overall margin and could have been avoided if rumen function and feed digestion had been optimised. The third implication of poor rumen function is animal health. Whilst Beauchemin, (2007) concluded that the risk of rumen acidosis is not equal for all cows and all herds, issues such as feeding practice (large discrete meals at milking), eating rate, DM intake and ration sorting are pre-disposing factors. Repeated bouts of sub-acute rumen acidosis damage the rumen wall (Krause & Oetzel, 2005). This allows bacteria as well as bacterial toxins to enter portal circulation causing liver abscesses and an inflammatory reaction. These toxins are also believed to be associated with the development of laminitis, causing disruption to the mechanical strength of the connective tissue within the hoof, resulting in well-known conditions including white line disease and sole ulcers.

Keenan Hi- Fibre for dairy cows:

The impact of nutrition on feed efficiency was recently reviewed by Colman & Beever, (In press) using data obtained from over 500 dairy farms in UK and France which had adopted improved nutritional strategies, principally the Keenan Hi:Fibre Dairy System. Designed to optimise rumen function through the provision of well-balanced and suitably mixed rations, the system continually tracks individual farm performance and provides annual summaries of progress. Colman & Beever noted average feed efficiency gains of 0.18 and 0.10kg/kg for French and UK herds respectively, with increased milk yields of 2.5 and between 1.0 and 1.6kg/day respectively. In France this was achieved with a 1.0kg DM/day reduction in feed intake, in UK a smaller reduction of 0.42kgDM/day was noted. After standardising the responses for any changes in feed or milk price over the 12 month period, this improved nutritional strategy increased margin (milk income less total feed costs) by 21% and 13% in France and UK respectively.

Probably the most important outcome of improved feed utilisation is an overall reduction in total feed costs per litre milk produced. At a time of rising costs of feed, fertilisers and fuel, such gains are crucial to business survival. Conservatively, Colman & Beever concluded such gains in feed conversion efficiency noted above were alone worth an additional £100/cow/year for UK herds, and possibly as much as 250 Euros/cow/year in France. Colman & Beever also showed that improving feed efficiency significantly reduced methane emissions per litre milk by as much as 20% for a 0.2kg/kg increase in feed use.

Undoubtedly most of the gains in feed efficiency which have been and can be achieved on many farms are due to a focussed approach on optimisation of rumen function. The importance of optimising rumen fibre digestion for satisfactory milk fat levels has already been mentioned. For milk protein, starch intake is the major driver for increased levels of true protein, principally casein. But the form of the starch (grain) is important as well as method of feeding if rumen acidosis is to be avoided. Casein levels affect the efficiency of cheese production. A recent initiative between a cheese company and farm milk suppliers (Colman, unpublished), showed substantial improvements in both milk fat and protein levels due to adoption of the Keenan Hi:Fibre Dairy System. This resulted in significantly increased cheese yields per tonne milk and restored over 70% of the loss in cheese yield that had occurred at the factory over the previous 10 years due to processing milk of inferior composition.

Providing adequate amounts of physically effective fibre in the ration to improve rumen function and feed utilisation relies on a manual separation of samples of the ration and its ingredients, using a series of sieves of different particle size (Penn State Particle Separator). This approach has merits but also some limitations and debate exists over the suitability of the materials on various sieves as being representative of physically effective fibre, coarse forage particles that improve rumen mat formation, stimulate rumen motility and promote rumination. Incorporating adequate amounts of physically effective fibre into the ration to ensure satisfactory levels of consumption and avoidance of ration selection is also important. Given the ability of the Keenan Klassik mixer to fully process and incorporate forages into mixed rations for dairy cows, the characteristics of the physical fibre component of forages has recently been examined. This led to the development of methodologies to isolate a unique fraction (Keenan Mech FiberTM) in respect to length, structure and functionality required to promote rumen mat formation, rumen motility and rumination. The concept, recently launched by Keenans, is a patented technology and the requirements of animals in terms of amounts to be incorporated into the ration have been established. It is contended that the significantly improved description provided by Mech FiberTM is key to achieving the necessary improvements in rumen function, feed utilisation and better margins; an important synergy of forage type and functionality of the mixer wagon to consistently produce rumen optimal rations.

Preparing For Lactation:

The issues:

Calving represents the biggest insult to a dairy cow and whilst many cows get through this period with few if any problems, a significant number are less fortunate. At best this may result in loss of the calf, lower milk production and poorer fertility, at worst death or premature culling of the cow.

Management of dry cows on many farms is inadequate when judged against lactational expectations. A plethora of systems to overcome problems around calving exist, with a range of feed additives, all claimed to make calving easier. But in reality few of these systems are bringing the desired level of success.

On many farms, dry cows are kept in two groups. From normal drying off, they enter the ‘Far off’ group and fed a modest quality silage or pasture according to time of year. At approximately 3 weeks prior to expected calving, they join the ‘Close up’ group and receive additional feed of higher quality, including some of the intended lactation ration and dry cow minerals. The extra feeding is provided to ‘steam-up’ the cow, to accustom the rumen to higher levels of concentrated feeds and to avoid the expected drop in intake as calving approaches. But problems of assisted calvings, retained foetal membranes, milk fever, displaced abomasums, ketosis and fatty liver still persist, with incidence rates being too high on many farms.

Successful dry cow management requires that they neither gain nor lose body condition over this period. This means drying the cows off in the condition they are expected to calve. But contrary to well-held views, dry cows do not limit their intakes to meet their daily requirements. A recent study (Drackley pers comm.) showed multiparous dry cows, with ad libitum access to rations of moderate energy density, ate on average 17kgDM/day at week 6 prior to calving, and 14kgDM/day just 2 weeks before. This over-consumption of between 50 and 80% of their daily energy requirements resulted in an overall gain of 0.3 body condition score gain, followed by excessive body condition (0.6 units) loss in the first 5 weeks post-calving.

Noticeable body condition gain during the dry period was shown by Nikkhah, et al, (2008) to increase omental, peri-renal and mesenteric fat by 86% in cows fed the moderate energy ration, compared with limit-fed cows. As a consequence, these cows had increased b-hydroxy buytrates (BHBs) from calving, which remained elevated for 60 days, indicative of increased body fat mobilisation, increased non-esterified fatty acids (NEFAs) being presented to the liver and compromised hepatic metabolism.

Keenan Controlled Energy:Hi Fibre for dry cows:

Given conventional systems of dry cow feeding were not delivering the necessary benefits in improved cow health and fewer issues around calving, a systematic review of the situation led to the development of a one group system, based on Controlled Energy:Hi Fibre (CEHF) feeding (Beever et al, 2006). The aim was to control total energy intake by dilution of ration energy density, to increase the amount of structural fibre in the ration to promote good rumen fill and function and to control dietary sodium and potassium levels, negating the need for anionic salts to counter high ration Dietary Cation:Anion Differences (DCAD). This was achieved by including up to 50% (DM basis) cereal straw in the ration, along with suitable amounts of intended lactation forage and concentrates. But satisfactory levels of consumption are only achieved when the straw is suitably chopped and fully incorporated into the ration, to present an homogenous mix to all cows. This was provided using a Keenan Klassik mixer with recorded intakes of upto 12.5kgDM/day and a less discernable reduction in DM intake towards calving. At such levels of intake, the energy needs of the pregnant cow are fully met, confirmed by little or no change in body condition throughout the whole dry period, and no significant rise in blood NEFAs prior to calving. Most noticeably, after calving, cows fed the CEHF ration showed much less body condition loss and BHB levels were elevated for only 11 days.

When this approach was applied on farm, some major gains in terms of reduced calving issues, with fewer assisted calvings, fewer retained foetal membranes (both by 60%), less milk fever, less ketosis and fewer displaced abomasums (all by over 80%) were noted.

It is concluded, based on parallel research by Drackley et al, (2008), that the CEHF strategy has major effects on cow metabolism. When cows over-consume during the dry period and show increased body condition, circulating insulin levels are significantly elevated, due to cows becoming insulin-resistant. This condition, also seen in humans, has consequential effects on certain metabolic events including hepatic lipid and glucose metabolism, vitamin D and calcium metabolism and cytokine production. In contrast, cows fed the CEHF ration throughout the whole dry period, have normal insulin levels, lower plasma NEFA and BHB levels and, most importantly, markedly improved health.

Improving Fertility.

The issues:

Achieving high reproductive efficiency requires high submission rates and high conception rates to each service. Submission rate is defined as the percentage of eligible cows, according to the desired post-calving commencement date for breeding (when most cows should be cyclic), that are presented, on the basis of observed oestrus, for artificial insemination in a 24 day period. Percentage of anoestrus cows and heat detection efficiency affect submission rates. A useful target is 80% of eligible cows presented within a 24 day period of the breeding season. This requires full uterine involution by day 50 post-partum, with over 90% of cows resuming cyclity and having normal oestrus cycles (Roche, 2006).

Table 1 summarises these events including targets and possible risk factors.

Table 1. Postpartum reproductive targets and potential risk factors (from Roche, 2006).

Reproductive event	Target to be achieved	Risk factors
Normal uterine involution	Day 50post partum	Dystocia Retained foetal membranes Uterine infections
Resumption of cyclity	90% by day 42pp	>0.5 BCS loss Low feed intake Uterine health
High oestrus detection	85% per cycle	Infrequent checks Sub-oestrus High yield
High conception rate	>50% per breeding cycle	>0.5 BCS loss Prior uterine problems Low progesterone days 4-7 of pregnancy

Accepting these targets, it follows that several of the risk factors could be due to inadequate nutrition. Many cases of dystocia and retained foetal membranes are a consequence of inadequate dry cow nutrition. Fat cows and heifers generally have more difficult calvings whilst poor attention to supplementary selenium and vitamin E levels increases the incidence of retained membranes. Uterine infections may be a result of poor management but compromised immunity at this time may also be a contributory factor. Recent research showed over-conditioned cows at calving, particularly with excess amounts of internal fat, had reduced immunity to an experimental mastitis challenge at 7 days post-calving, compared with cows fed the CEHF dry cow strategy (Graugnard et al, 2008). It is possible that similar mechanisms apply to the manifestation of uterine infections.

There is general agreement that fresh calved cows losing excess body condition post-calving are more difficult to rebreed, with both extent and duration of the negative energy balance being important. Over-conditioned cows at calving generally lose more body condition during early lactation, whilst feeding excess protein, as occurs when cows are on fresh spring pasture, promotes milk production but stimulates body condition loss. Excess body condition loss in early lactation is not inevitable, neither is it simply a function of cow genetics. The way cows are fed both during the dry period and the early stages of lactation can have a major impact on reducing body condition loss, with associated improvements in fertility.

Poor appetites post-calving are seen on many farms, resulting in low levels of feed intake and increased body condition loss. It is well recognised that over-conditioned cows at calving have poorer appetites, again indicating that dry cow nutrition can have a major bearing on feed intake, body condition loss and subsequent fertility. With respect to the levels of milk produced during the first few weeks after calving, higher yielding cows have a much greater challenge to minimise body condition loss at this time, but for a variety of reasons, cows of lower yield potential may also experience poor appetites after calving. Again it follows that nutrition both during the dry period and the first few weeks of lactation needs to be managed well if such problems are to be avoided.

In respect to low progesterone levels at day 4-7 post-calving, evidence suggests these may be associated with increased hepatic clearance of this important hormone at this time. One factor which may affect this, and also possibly lead to an increased clearance of oestrogen, is increased blood supply to the liver seen in higher yielding cows, whilst it is suggested the increased propensity of over-conditioned cows to metabolise and store lipid in the liver immediately after calving may be contributing to sub-optimal progesterone levels.

Keenan Controlled Energy:Hi Fibre for dry cows:

Against this background, the Keenan CEHF strategy for feeding dry cows has shown some major improvements with respect to controlling body condition gain before calving with associated reductions in post-calving body condition loss. There is growing on-farm evidence showing earlier resumption of oestrus, more overt oestrus behaviour, improved conception rates and reduced calving intervals as an outcome of this approach. Contrary to this, the practice of steaming up cows prior to calving may stimulate early milk yields but exacerbation of body condition loss could seriously impact on subsequent fertility.

Conclusions.

This paper has provided a considered opinion of some of the production-related issues affecting many dairy herds throughout the world and impacting on overall profit levels. Rather than blame the modern day Holstein for all of these ills, the paper has examined how both management and nutritional practices may be adversely affecting overall herd performance. It has focussed on four key areas, heifer rearing, rumen function, dry cow feeding and fertility, and how the overall efficiency of these important events can be improved through the adoption of better nutritional practices. It is concluded that the wastage in terms of % of heifer calves born that never produce a live calf can be significantly redcued, that poor rumen function is seriously impacting on feed conversion efficiency, milk composition and total feed costs per litre milk whilst most systems of dry cow feeding are contributing rather than overcoming many of the health issues noted around calving. Proven nutritional opportunities to improve the metabolic health of the cow in order to achieve more satisfactory herd fertility rates are now available.

There are however no ‘silver bullets’ for achieving these gains. Farmers first need to recognise the importance of rumen and animal health as the cornerstones to better cow health and better feed utilisation. Many of today’s nutritional practices were developed when cows were less demanding and any changes which have occurred have been reactive rather than proactive. With the knowledge base that is available, nutritional strategies need to recognise that feeding the modern dairy cow is a serious challenge but one that can be successful. Above all, problem avoidance has to be accepted as a much smaller price to pay than problem solution.

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