Birth to Calving (beta)

This paper is due for completion Summer 2020

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Introduction

Research into heifer rearing is an area of farm livestock production that has tended to be over-shadowed by the attention given to feeding the lactating cow when it comes to development of optimal systems.
That is not to say that nothing at all has come out of the research establishments in the last twenty years, but it is true to say that heifer rearing systems have been pushed firmly into the background behind research into dairy production and baby calf rearing system research.
It is therefore refreshing to see evidence of new work emerging from Hillsborough, Harper Adams, Nottingham University and the USA on heifer rearing systems.

Targeting the growth rates of heifer calves has been shown to have a very significant effect on the yield and milk quality performance of the animals once they enter the dairy herd. The key to successful rearing is to control the rate of growth at all the stages right through to calving, whilst paying due attention to health and welfare issues throughout.

It is generally accepted that setting a target calving date at just under 24 months is the prime objective of the heifer rearing program. It is also accepted that we need to aim at a healthy well developed animal achieving around 600Kg liveweight (Holstein). Other dairy breeds will vary but the message is the same.

Meta analysis of effect of increased milk during early life (difference of >75% in early milk intake) on subsequent milk yield

Effect on 1st lact. milk, kg	SE, kg	Lower limit, kg	Upper limit, kg	*P* Value
+ 435	117	205	664	<0.001

(Odds ratio of effect was 2.1 times greater for increased milk intake)

Soberon et al., 2012

Recent work by Trouw Nutrition and Nutreco in Holland has highlighted the gene sequence changes that occur significantly in the first 50 days of life.
The importance of baby calf nutrition in this early stage should not therefore be under estimated.

Put simply, if the animal is born into a life of hardship, the gene sequences adjust to prepare the animal for a hard life and consequently it will reduce its potential for production.
On the other hand, if the animal is born into a life of plenty the gene expression is improved in favour of a more productive life.

This evidence supports the high plane of nutrition approach, and it has been shown that provided the rest of the heifer rearing program focuses on health and achieving growth targets; these animals produce more milk, get back into calf sooner and live longer than their less fortunate cousins reared on our current lower input sytems.

There is no doubt that investment in the high plane of nutrition will pay dividends in the productive life of the heifer and in reducing the cost of poor health during the growing stages.

The Nutrition of the Calf

The main philosophy driving baby calf nutrition is to encourage rapid growth into a strong, healthy and sizeable calf at weaning. This objective is essential if the animal is to continue its development into a productive calving heifer.

This is an area where there has recently been a flurry of research. Most of the work concludes that attention to detail with regard to early intakes of colostrum and milk powder need to be generous and that some of the past practises have been much too limiting on subsequent performance.

The baby calf has a very different digestive mode to that of its adult form. It starts its life with a **monogastric** system, just like pigs and humans, and gradually over the weaning period from about 3 weeks of age to around 6 months, it evolves into a fully operational **ruminant.**
The feeding regime therefore has to be carefully designed to optimise and exploit the animal's own genetic potential for growth and development within this evolution of its ruminant form.

The baby calf is able to convert food into growth of its own body tissues extremely efficiently. When born it can convert nearly every kilo of food dry matter (Milk) into growth, this can be expressed as a food conversion ratio of 1:1.
As it gets older its food conversion efficiency decreases to anything up to 7 or 8:1.
By the time it reaches its mature weight, its nutritional needs change; from just maintenance and growth, to maintenance, condition management, produce a calf, and produce its potential milk yield.
This may require a very efficient food conversion typically expressed as kilos of milk per kilo of dry matter intake. Average cows recording figures of 1:1 but super cows of over 1.5:1
(note: - this expression of food conversion efficiency is specific to milk production and should not to be confused with that used to express growth.)

Colostrum

At birth it is essential that the calf has a good feed of colostrum, (first milk) within 6 hours. Colostrum is rich in the essential nutrients and antibodies needed to protect the young calf from the environmental disease loading on the farm into which she is born.
The calf's mother will have developed a good level of immunity to these local disease challenges and will pass the immunity on to its calf via this mechanism.

Currently the recommendation is to feed 4 to 6 litres of Colostrum in the first 6 hours after birth. At least 3 litres in the first 2 hours!

Colostrum quality is important. Its specific gravity should be measured using a colostrometer. (This tells us how rich the colostrum is). The target density should be 75mg per ml of Ig

Concentration of IgG (the main immunoglobulin) in colostrum varies according to many factors, including a cow's disease history, volume of colostrum produced, season of the year, and breed.
Research has shown that IgG levels vary widely from one cow to the next and range from less than 20 to over 100 mg/ml. The difference between 20 and 100 mg/mL of IgG in colostrum can mean the difference between failure and success in passive transfer of immunity.

Colostrum containing 75 mg/ml or more of IgG is considered to be a high quality feed for new born calves. Measurement of IgG concentrations in colostrum can be very useful in managing colostrum quality and monitoring colostrum feeding practices.
Although high quality colostrum is typically very thick and creamy, appearance alone does not reliably predict IgG content.

Volume of first milking colostrum also can be misleading and is not a recommended method for estimating colostrum IgG content. In addition, although IgG concentration can be measured very accurately in a laboratory, these tests are time consuming and not typically available to farmers. Hydrometers and refractometers can be used on the farm to estimate colostrum IgG, separate high quality colostrum from low quality colostrum, and improve your ability to provide calves with enough IgG to attain successful passive transfer of immunity.

Colostrum containing > 75 mg/mL of IgG can be fed to new born calves or stored for future use. Avoid feeding any other colostrum during the first or second feeding; lower quality colostrum can be mixed with transition milk and fed to calves that are at least two days of age.
Some of the older research sets target density at > 50mg/ml but the recent more ambitious target of > 75mg/ml will naturally give a much better response.

At birth, the calf is able to absorb the antibodies contained in the colostrum via the gut wall. This mechanism becomes switched off after a few hours. Hence it is essential for the calf to suckle as soon as possible after birth in order to gain as much immunity protection against the environmental disease challenge that it is exposed to as soon as it is born.

Bought in calves are at much greater risk of infection than those that remain on the farms where they were born. When they arrive on a new farm, they come into contact with a whole range of “foreign” diseases. So unless they received colostrum and are injected with a booster, they may well succumb to the new diseases.

It was a worry that farms that were meticulously disinfected after the 2001 Foot and Mouth epidemic had virtually eliminated background disease. As a result the animals used for re-stocking were not been exposed to the usual disease challenge and calves subsequently born on these farms did not received a particularly antibody rich colostrum. This made them much more susceptible to infection from the natural disease build up occurring on these farms. It was worth taking steps to protect these calves with extra antibodies from artificial colostrum or injections.

There is already evidence that relocated calves are very susceptible to the effects of changes to their environment. This shows up as behavioural changes in adult cows to reduced performance in calves and young stock. It is essential to ensure that the mineral and vitamin intake of these animals is adequate to promote good levels of immune response.

Colostrum has a very high level of protein, fat and lactose. It is a fantastic nutrient source so it is readily converted to tissue by the calf.

Feeding Milk / Milk Replacers

From birth to around 3 weeks the young calf's milk intake by-passes its rumen and the milk is directed straight into its hind stomach (Abomasum) using a folded tissue pipe called "the Oral Groove".
After 3 weeks this groove starts to open allowing some milk to drop into the developing rumen.
From about 3 weeks the animal can start to ferment foods in this part of its stomach. (**but, not very efficiently** at this stage.)

The Oral Groove is selective so it allows dry feed and roughages to drop in to the rumen but most liquid will pass in to the Abomasum. Calves that have to drink from buckets or troughs will tend to allow more liquid into the rumen than calves that have to curve their necks as they suckle naturally. This means that calves on bucket systems may be more prone to bloat. The height of the teats and buckets containing liquid feeds should be typically around 70 cm from ground level.
It is worth paying attention to this aspect of management, older calves are less affected but calves in the first 3 weeks benefit from the "Swan Neck" attitude whilst drinking milk.

Milk replacer powders may offer a better prospect of consistent growth than cow's milk because they are more consistent in their quality.
It is very bad practise to feed waste milk containing antibiotics because if any of this milk enters the developing rumen it is likely to kill off the developing rumen bugs, delay weaning, and reduce the efficiency of digestion of the dry feeds.

Milk powders should be high quality and mixed at a minimum of 150 grams per litre. (=135 grams into 0.9Litre)
Up until recently during the first 20 days calves do not grow fast, they struggle to maintain their birth weight. This is all the more reason why the feed rate of milk can be set high to a minimum of at least 6 litres per day until around 48 days when the rate can be reduced as weaning starts to occur.
This more intensive approach will achieve rapid liveweight gain and produce stronger calves at weaning.

Feeding even greater amounts of milk at this stage may inhibit the development of the rumen papillae, delaying effective problem free weaning at the 56 day target.
The system works better if weaning is delayed to 63 days. The larger calves have greater appetites than smaller ones so they will consume more creep in the later stages of weaning.
This will allow the rumen development to effectively catch up and avoid a post weaning check in growth.

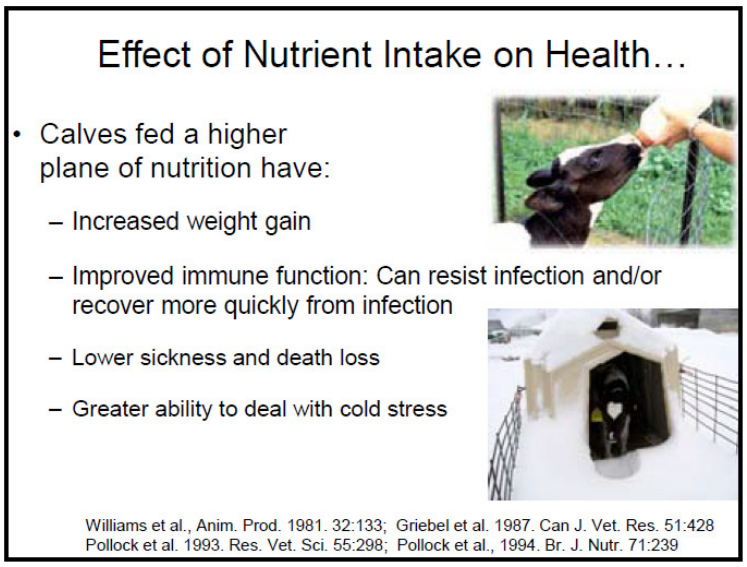
Consider this:
Recent research has found that feeding calves around 900 grams to 1050 grams of milk substitute has given much better results than less intense levels.
This is now thought to be essential.

Once the calf has had colostrum in the first 6 hours of its life, the calves passive immunity mechanism shuts down.
This means that it needs to develop active immunity but it takes around 3 weeks for this mechanism to really work.

Recent work by Lance Baumgard and his team at Iowa State University, has uncovered a mechanism they call “Leaky Gut Syndrome”. This was part of a huge project looking into Heat Stress in lactating dairy cows.
They found that general stress can also cause the syndrome.

In simple terms, ***when an animal is under stress the spaces between the cells lining the gut from mouth to anus, become open and this allows any passing pathogens to migrate through the gut wall into the tissues.***
Calves under stress (nutritional, environmental, management etc.) would be more susceptible to infection.

A key factor in preventing this is to make sure that the calf is receiving a rich source of milk, rich enough to ensure that it is growing at the best rate.



Note:- Environmental temperature has a big influence on the calf’s growth rate. Optimum temperature is between 10°C and 20°C, as the temperature drops, the calf diverts energy away from growth and more to keeping warm (Maintenance), at -1°C its requirement increases by nearly 40%!

Amount of 20:20 Milk Replacer/Milk Dry Matter (kg) Required for a 100 lb (45 kg) Calf to Meet Maintenance Requirements and Gain 1 lb (.45 kg) per Day

	Ambient Temperature (°C)						
	20	10	0	-9	-15	-20	-29
kg DM	0.64	0.73	0.82	0.91	1.0	1.04	1.1

Modern dairy cows and Holsteins in particular have been bred for milk production. Unlike the native beef breeds, their milk is not as rich but there is plenty of it.

Now this might suit the human race but it means that if that calf has only Holstein milk to drink, it has to drink much more than its suckler calf cousin.

The use of calf milk replacers mixed at the right concentration solves this problem.

The Plane of Nutrition has the following affects

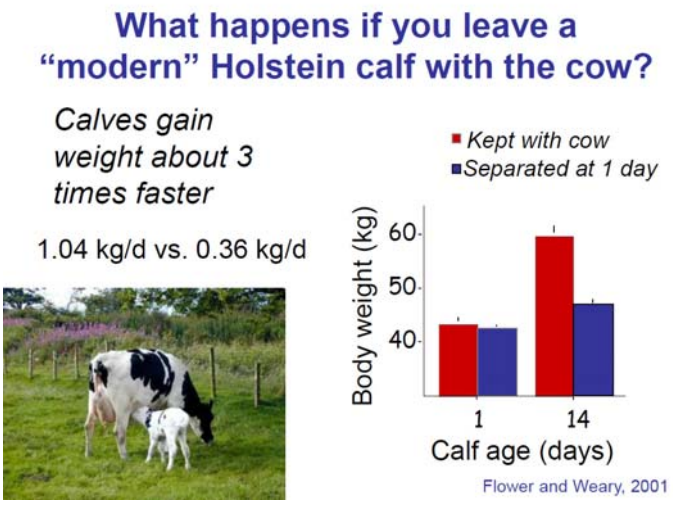
- **Calf:** – Growth
  – Ability to cope with cold stress
  – Immune function / health

- **Adult cow:** – Age at first calving
  – Milk production
  – Longevity
  – Lifetime economics

- **Goal:** Double birth weight by 56 days of age 40 kg Birth Weight => 80 kg at weaning (Average Daily Gain = 0.71 kg/day or 1.6 lb/d) (Van Amburgh, AABP)

  Some would say more than double the birth weight by day 63.

Hereford milk contains about 135% of the solids of Holstein milk. The Hereford calf suckles rich milk for around 6 to 9 months and weans itself. It grows very effectively in those first few months of life with very low mortality rates or health issues.



MN Field Study: Pasteurized Milk vs 20:20 Milk Replacer

Parameter	Milk Replacer	Pasteurized Milk	P value < 0.05
Calves enrolled (n)	217	222	
Serum Total Protein (mg/dl)	5.7	5.8	
Arrival Weight (lb)	88.3	87.5	
Age at Weaning (d)	47	46	
Weaning Weight (lb)	133.9	146.3	*
Preweaning Gain (lb)	45.0	58.9	*
Avg. Daily Gain (lb/d)	0.76	1.04	*

The trial above highlights the problems with feeding low volumes of average quality milk replacers.
Typical dairy heifer calves are fed colostrum, moderate quality milk replacers and have to wean at about 8 weeks, when in most cases their rumens are not fully functioning.
The result is that any calf that has not quite managed to cope with the system will check or at worst will succumb more readily to environmental and disease threats.

This can be avoided, **it is a management problem,** and whilst nutrition is only a part of the system, it is not really difficult to get right.

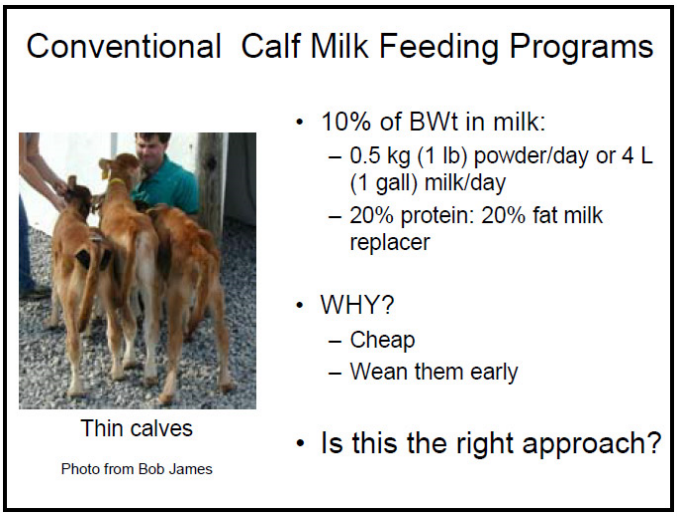
Recent work developed in Holland has resulted in a re-assessment of the formula specification for calf milk replacers. It was conclusively proved that high quality formulation of 25% fat and 22.5% protein (surprisingly like milk!) gave the best results.
This formula puts more emphasis on supplying the baby calf with a high energy milk which helps the animal by providing a strong growth from the start. This reduces stress levels and makes them more resilient to disease challenges.

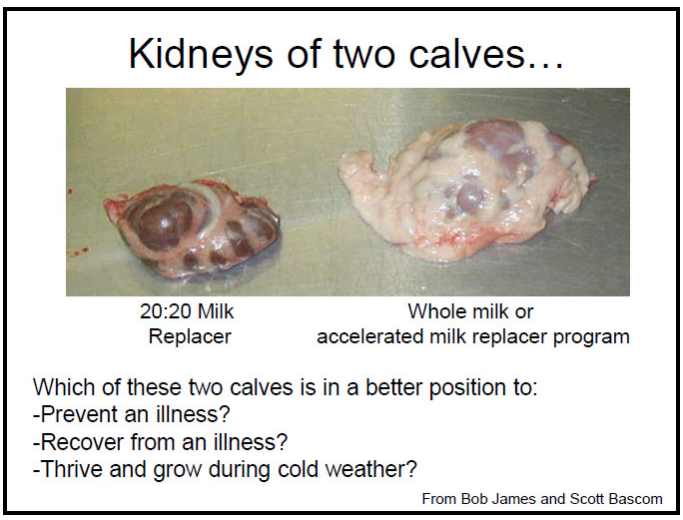
Calf Milk Replacers should revolve around skimmed milk powder rather than be based on whey. It was decided that non milk protein sources were not metabolised efficiently and resulted in an extra energy cost in order to deal with higher metabolic waste.

There has also been a large amount of research showing that nutrition scour can be reduced by matching the osmolality of the milk replacer more closely to that of milk. This is particularly important when a generous milk feeding program is to be used.
Feeding this specification after colostrum has been administered is now highly recommended.

Pasteurised whole milk is a growing popular alternative choice. It certainly gives better results than the 23% protein: 19% fat milk replacers!

This trial compares a 20:20 milk replacer to whole milk or an accelerated milk replacer program





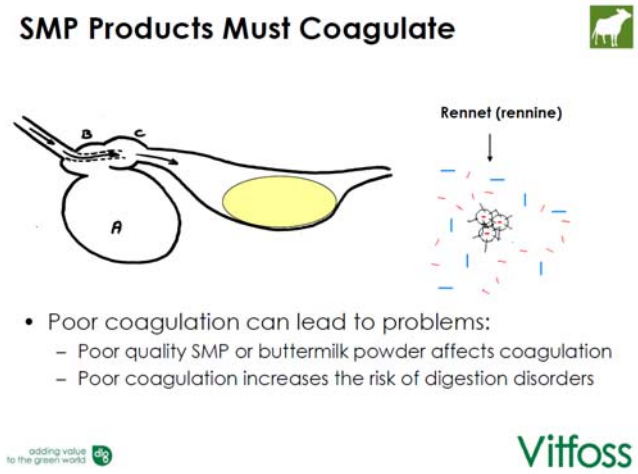
The only real negative aspect of feeding pasteurised whole milk is that it tends to be fed in high quantities to promote good growth and this tends to restrict dry feed intake and prolong weaning
One way of avoiding this is to top up the milk with milk replacer powder in order to supply enough nutrient in a smaller volume.
This can be haphazard because the specific gravity of the milk should be checked each time in order to ensure quality

Feeding a 25% fat: 22.5% protein milk replacer at 800 grams to 1050 grams per day has been shown to be constant and optimal. Currently we recommend "**Britannia**" the best version of this calf milk replacer formula.

It is really important to select a high quality product. Like most things you expect the choice to be simple but the manufacturers have been trying to attract business by developing lower priced formulas.
This is understandable but risky.

The quality of the skim milk powder should be good enough to ensure good coagulation properties.
Coagulation happens when the calf abomasum gels the milk by secreting rennet.
This results in a more controlled digestion.
Poor coagulation aggravates scour and reduces live-weight gain.

The only practical guarantee that the buyer has of quality is not to buy cheap versions.



High melting points and large fat globule size make for poor mixing.

Milk protein is very high quality and plant proteins generally have the wrong amino acid profiles and are of much lower digestibility, but of course they are much cheaper than skimmed milk powder.

Fat is added back in using predominantly coconut oil and usually a much lower proportion of soya oil and palm oil.
Most manufacturers use a combination in order to get close to the fatty acid profile of milk fat.
Manufacturing techniques have a significant effect in the subsequent digestibility of the fat. The best quality milk replacers feature the use of homogenised fat with a globule size not exceeding 2 microns (µm). This makes it much more digestible and effectively increases the energy contribution to the baby calf.

From around two weeks of age the calf will show an interest in dry feeds. It will start to nibble straw and concentrate mixes.
The dry mixes should be around 18% crude protein (as fed) and be complimented with straw rather than hay.

There has been a considerable amount of research into the role of the dry creep feed that is offered to the baby calf.

We now know that the initial intakes are very important and creating an early appetite for good well balanced creep feeds is a vital part of the successful rearing and weaning program.
The key function of the creep is to contribute to and take over from milk as the main nutrient supply.

There should always be a supply of fresh and (rattling) dry creep available to the baby calf. Any left-over feed should be discarded each day.

The rumen relies on a well-developed papillae structure to maximise the surface area for absorbtion of nutrients through the rumen wall in to the blood stream.

The growth of the rumen papillae is stimulated by butyrate.

Butyrate is formed from the breakdown of carbohydrates which comprise lactose in milk and starches and sugars from the dry feed (creep).

Initially the calf is unable to ferment or digest forage! So there is no point in trying to get them to eat hay at this early stage, even if they like it!
We can see from the photographs above that hay does nothing for rumen development and if anything will slow down growth rates.
A little clean straw or sweet clean hay can be offered after 3 weeks of age, but the focus should be in achieving target intakes of high quality dry creep feed.

Creep feeds that feature milk lactose and starches are therefore the preferred choice.
One recent advance has shown that creep feeds featuring “protected” butyrate will actively promote rumen papillae development. This is a technique which in trials showed an average increase in weaning weight of around 5Kg.

The real benefits of promoting rumen papillae development, is post weaning. Calves that have a more advanced development will be much less likely to check growth rates or suffer from stress related conditions at weaning.

This can be further borne out by looking at 16 week weights when it can be seen that calves fed under the accelerated system are much heavier and better developed.
This advantage should be maintained through to first bulling where the well grown animal can be served at target weight around 14 months.

Normally the calf is weaned only when it is consuming at least 2 kilos of dry concentrate mix per day. The accelerated programs weaning at 63 days will normally have calves consuming around 3 kilograms of creep per day because they are heavier!

This is essential because if the calf is weaned consuming less than 2 kilos, it will be more likely to suffer a check in growth while its developing rumen adjusts to the change from milk to dry feed.

Always make sure that the calves have access to “clean” water because this will help to improve intakes of dry feed and its digestibility.

A common management problem involves group weaned calves.
The groups frequently contain individuals that are consuming less than 2 Kilos of dry feed and these calve invariably check. Good stockmanship is vital in order to judge which calves’ need that extra week on the pre weaning diets. Some calves may need to be fed individually in order that we can be sure that they are eating enough dry feed before they are weaned.

Starter dry matter intake (DMI) required to support various rates of gain in weaned calves

BW (kg)	ADG (g/d)	Starter required (kg/d)
60	600	1.53
60	800	1.90
80	600	1.80
80	800	2.18

Based on starter containing 3.1 Mcal ME/kg DM (NRC 2001)

NRC, 2001

BW = Body weight
ADG= Average daily gain

I am a big fan of using complimentary biotechnical additives such as Bio-Mos © and Yea-sacc 1026 ©, also polyclonal antibodies.
These natural biological supplements help to maintain protection and healthy development of the gut microflora (Rumen Bugs).

This is especially important at weaning, since the changeover can be considerably cushioned when these products are used. This helps to maintain momentum and avoid a check in growth.
New generation creep feeds feature the use of dried milk pellets as a great way of maintaining continuity and high density nutrition as the calf increases dry feed intake at the expense of milk.

Research has shown this enhancement to work best at @ 10% inclusion in a maize starch and high quality protein creep feed.

Our current advice is to use high starch low fibre creeps with protected butyrate and or lactose. (See above)

Soya is not a good feed for young calves as it can interfere with delicate enzyme balances. The use of hydrolysed soya avoids this problem but it tends to be excluded on cost grounds.

Once the calf has weaned it should be offered a calf mix with high inclusions of Sugar Beet Pulp, and maximum 26% starch / sugar levels. This specification can be mixed 50: 50 with the baby calf creep during weaning.
This approach helps to avoid any digestive upsets as the diets change towards forage based rations..

Animals that check at the weaning stage seem to be especially susceptible to **PWSS. Peri-Weaning Scour Syndrome.**

PWSS is a chronic diarrhoea and wasting syndrome of dairy calves. It commences at around 8 to 10 weeks of age and coincides with weaning. The calves remain bright and continue eating, they show a pasty scour, and occasionally appear pot bellied, eventually they waste and either die or get culled.
No consistent form infection has been found, but it is recognised that management and nutrition have a profound effect. Feeding home mixes with high cereal inclusions was shown to increase the risks of contracting PWSS, so current best practice shows that post weaning calf diets should revert to lower starch / sugar inclusions as shown above.

Abrupt weaning seemed to increase the risk of PWSS. Animals check consumption for a while and then consume large amounts of the cereal-based mix, pre-disposing them to scouring. Gradual weaning over a week is a far less risky strategy.

In a recent study focused on PWSS, over two thirds of the calves were found to be consuming less food at weaning than had been predicted. Dairy bred calves should certainly not be weaned at less than 65 Kilos (I prefer a target of 90 Kilos), and they should be consuming the target of 2 to 3 kilos of dry feed per day.

The Nutrition of the Young Heifer

Setting Targets

“Once the heifer has calved it is very difficult to increase its skeleton weight. All of the development work has to be completed prior to first calving”.

This means that the key goal of the heifer rearing system should be to provide the best foundations for:

- Health,
- Production,
- Durability
- Optimum weight, before the animal has its first calf (small heifers tend to yield poorly).

This animal is **not** a baby calf so the emphasis on early nutrition has changed. We now want a fully functioning optimum rumen to do the bulk of the liveweight gain for us and because food conversion efficiency is now much reduced, we need that rumen to be supplied with enough balanced ration to enable the heifer to thrive.
Controlling the rate of growth from 4 months to 10 months has been shown to have very marked effects on lactation performance.

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“It’s all about the Rumen”

The developing rumen has only just started to become used to forage and concentrates. Excessively high starch diets at this stage can have some unfortunate side effects.

- Acid digestion, restricting the performance of fibre digesting bugs
- Restricted food conversion efficiency due to limitations on rumen papillae growth and recovery
- With lower protein diets, excess internal fat deposits resulting in poor Liver, Heart, Udder tissue and birth canal development.

The best policy is to limit the cereals and utilise high energy fibre feeds along with some good quality protein.

A target growth rate of 0.9 Kg daily liveweight gain should be achieved using a low starch and sugar diet (Maximum 28%) whilst maintaining overall dietary protein levels at @ 15% -17%. Traditionally British Friesian cows were fed 14% protein concentrates on straw systems and they achieved their target weights of 525 Kg at calving but suffered from internal fat deposits which usually inhibited performance.

The table below shows typical weight targets for a modern Holstein Friesian heifer.
It is evident that the target of 685 kg is worth achieving since the heifer will produce a better performance under less stress than her smaller counterparts.

There is some debate as to the optimum daily liveweight gain targets.
It may be more appropriate to drop the level from months 4 to 10 to 0.8 Kg per day and increase the rates from month 15 to 22 to 1.0 Kg per day.
This tactic would better reflect the expected performance responses after calving. Achieving the 15 month 470Kg target weights at bulling improves the ease of the first pregnancy and reduces calving problems.

Table 2. Revised Target weights for replacement heifers

Age (months)	Target weight (kg)		Holstein
	Historic (Friesian)	Modern High merit (Holstein)	Liveweight gain per day
0	40	45	1.1
4	125	135	1.0
10	245	315	0.9
12	285	375	0.9
15	345	455	0.9
22	495	645	0.4
24	525	675	

Keeping up with Breeding

It is also considered that as the yield potential of successive generations of heifers increases the target weight at calving needs to increase from currently around 630Kg for UK Holsteins up towards 700Kg.
This may sound ambitious, but consider that average yields in the UK have increased by around 2500 litres per lactation per cow over the since 1984; the year when milk Quotas were introduced.
In this context it does not seem to be so unreasonable to move the target calving weights forwards a little as I have done here.

Feeding the Successfully Weaned Calf

The prime objective of feeding the young weaned calf is to ensure optimum rumen development. Rations have to be capable of maintaining growth rates and switching the emphasis from by-pass nutrients to rumen degradable nutrients.

There has been a lot of research into finding out the optimum diet at this stage.
The baby calf does not really lay down any serious fat deposits in the first few weeks of life, It is programmed to grow muscle and frame, so fat is a low priority, however weaned calves start to be more susceptible to laying down some permanent fat and this is why heifer grower diets should be designed differently to those favoured by the beef growers.

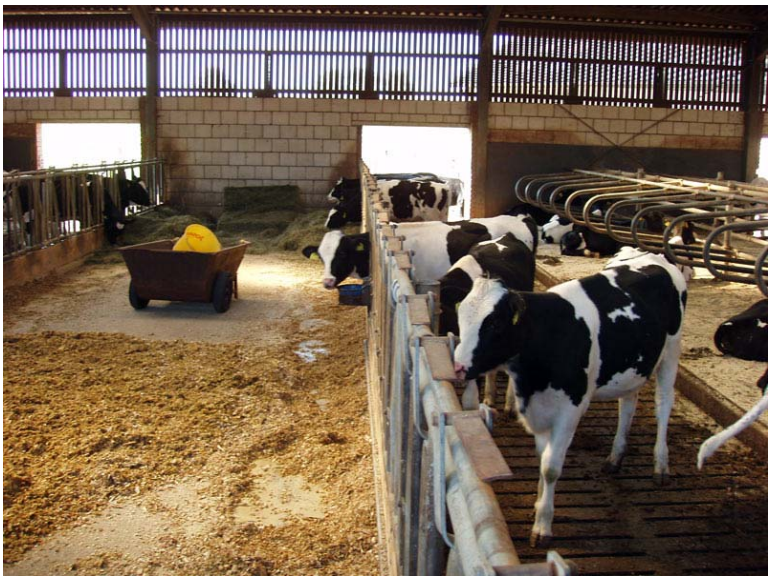
Certainly it has been shown that heifer replacements are capable of laying down permanent fat deposits in the Liver, Birth Canal, Heart, and Udder Tissues, at this early stage. The early deposition of fat is very undesirable. Fatty Liver will reduce the animal's ability to efficiently mobilise the nutrients needed for milk production. Fat deposition in the udder will reduce the animal's ability to produce milk protein and overall yield.

The answer is to forget about Barley Beef, and start concentrating on the growth of lean muscle tissues using fermentable fibre feeds like Sugar Beet Pulp, Citrus Pulp, Nutritionally Improved Straw, Wheatfeed, Maize Gluten, and proteins like Soya and Rape.

Forages need to continue to provide scratch in order to help cudding; coarse straw should always be on offer on an ad-lib basis.

Spring vs Autumn Calving

Young calves born from New Year onwards tend to fair a lot better if they are not turned out to grass. This is due to the fact that grass can be very variable and is relatively inefficiently fermented in the developing rumen.
Autumn born calves generally fair better since they don't have the option of being turned out to grass until they are at least 6 months old, this may still be considered too young by some stockmen, and indeed keeping the animals housed throughout their first summer has the advantage of better nutritional control and normally better resulting growth rates.



The best system is to keep the calves in open and airy housing. They should be allowed access to ad-lib coarse silage, fermented wholecrop or straw. (Note when feeding fermented whole crop or maize silage it is a good idea to restrict these crops to no more than half of the total forage dry matter intake, since the starch content **may** be high enough to trigger the laying down of fat.) With lower starch whole crops like fermented barley whole crop, the lower starch content makes it ideal for growing heifer replacements. The animals should be weaned when eating at least 2 to 3 kilos of calf mix on to a 14% to 17% calf rearer mix. This may be allowed to increase where very low protein forages are fed.

The nature of this mix is vital to healthy development of the calf and to the achievement of its growth target. A mixed based on high digestible fibre feeds like sugar beet pulp, and good quality proteins like brewers grains, distillery grains, soya and rape seed meal, will give the best results. It is also very important to ensure that the calf continues to receive a healthy intake of essential minerals, this is all too often neglected in calves that are turned out to grass.

The protein level of the mix can be as high as 18% (as fed) when low protein forages like whole crop and straw are being fed but can drop to around 12 % when good, high protein silage or grass is on offer. The aim is to keep the calf growing at a steady rate and keep it lean until after bulling at around 14 to 15 months of age. Small adjustments in the diet may be necessary in order to tune in with the exact nutrient level of the forages.
In the spring of the second year most heifers will be turned out to grass. This is normal practise but it can result in a severe check in growth (especially for yearlings,) whilst the animal adjusts its rumen fermentation pattern.
Personally I think that this lack of control is often the undoing of a good program to get the heifer in peak condition for a productive, long and healthy life in the main herd.

Changeover should be made gradually by offering some of the winter diet until the animals become fully adjusted. I prefer the use of a little Sugarbeet pulp or molasses along with a little maize silage or whole crop to be offered right through the grazing season in order that minerals can be fed and grass utilisation is optimised. The use of products like specific strain yeast's (F 1 Yeast) can help to cushion the adverse effects of change over.

The continued feeding of a high quality young stock mineral is normally recommended to ensure that the animal develops a healthy and durable body capable of coping with the demands required during its working life. After calving the animal never really has the chance to recoup its lactation losses in full, so work done at this stage will have a real benefit in the long term.
It can be viewed as building a large reservoir of reserves ready for the times when we don't manage to top her up with what she really needs.

The use of mineral licks and boluses should be considered as a second best option to the day to day mineral supplementation capability of a third feed. The worst option is to ignore the animal's requirements and fail to provide a mineral supplement of any kind.

Remember boluses do nothing to supply the major elements like Calcium, Phosphorous and Magnesium!

Bulling & Turning out to grass in year 2

At 14 to 15 months the animals should have reached their target weights of around 440 Kg to 460 Kg and they are ready for bulling. It is not necessary to change anything in the supplement at this stage however the addition of some fish oil will help the release of good sized healthy eggs and aid conception rates. (Note D.E.F.R.A. and the EEC have **not** banned the use of Fish **Oil** in ruminant diets.)
The optimum amount of fish oil is somewhat vague at this time but seems to be around the 50 to 60 gram mark.

Zinc is known to affect gene expression so it is a good idea to make sure that adequate levels are fed throughout the life cycle of the heifer.

After bulling the young heifers can be kept on track by feeding a little more of the same mix as they are used to but it is only now that the use of say up to 25% cereal in the diet can be helpful, particularly for Holstein heifers. Supplementing at 2 to 3 kilo's of concentrates per day is normally about right though again this is very dependent on the forage quality and type.

The run up to calving

In recent years UK research budgets have been more limited than in the past and most pre-calving nutrition development work is now originated in the U S A and Holland.
Minnesota State University came up with some excellent evidence to show that animals fed on Lactose as opposed to cereal starch could actually increase the surface area for nutrient absorption by as much as 50%!
This is drammatic stuff since the ensuing improvements in food conversion efficiency meant that high genetic merit animals were effectively de-stressed in early lactation.
They were able to extract more nutrients from the diet and so they did not have to mobilise as much body condition to fill the appetite gap usually experienced in early lactation more severely by the best and highest yielding cows. As a result they peaked higher and maintained the high yields for much longer than animals fed on cereals during the dry period.

Not only that, they actually held to service better because they were not losing too much condition.
Note :- Lactose has the same papillae growth stimulating effect in young calves.
The only other critical nutritional consequences were that the high yields have to be supported by a very high quality diet, and mineral nutrition both in the dry and the lactating periods must allow for the extra strain on the system.

This is good practise for dry cows and heifers alike.

I am sure that even the most commercial of cows, bred for good milk production are generally underfed to their genetic potential.
If we have done the birth to calving job properly and we have achieved an animal calving down with an optimum gut health and body weight; we should be able to feed that animal to its true potential without any real problems.

Spring Calving herds have the traditional advantage of calving when grass is at its best. This sounds ideal but the truth is that grass is only capable of supporting typically around 25 litres, so high potential animals have to be supplemented. Spring grass is usually high protein but rarely contains enough sugar, structural fibre or mineral to support healthy digestion or high yields.

The modern cow actually fairs much better on a controlled high-density diet supplied by a silage, and or hay base with plenty of highly digestible and fermentable nutrients sourced from rumen friendly or by-pass concentrates.

Farmers who advocate low inputs from bought in feeds can benefit from low costs but this has to be offset by the difficulty they have in feeding to yield and maintaining a regular calving pattern.
Spring calving herds tend to have low feed costs per litre so good gross margins per litre, but average to poor gross margins per cow. It almost goes without saying that the best spring calving herds have to be excellent grassland farmers who know how to maintain very high quality swards.

Heifers calving at this time of year have a tough time, not only is the grass imbalanced so that reservoir of body condition and minerals is called on heavily right from the start.
They also have to cope with boss cows and the new routines of milking and grazing paths etc.

Most farmers with spring calving herds that wish to adopt a more grass based system are recognising that the modern Holstein cow is not ideal because she struggles to get enough nutrition from this system to supply her genetic drive for high output.

The Autumn Calving herds need to adopt a high input / high output system and they know that they can justify the high feed costs provided the rations are properly balanced and succeed in maintaining high outputs.
The economic consequences of this regime are that margins per litre look moderate but margins per cow supported by high yields look good.

Heifers calving into either one of these regimes are usually suffering from the stresses of joining the main herd and after a bit of bullying, they have to their rightful place in the pecking order.
In the case of the autumn calvers the nutrition is generally better and the Holstein hefer copes much better than her spring counterpart.

Heifers do best if they spend their first year in an exclusive heifer group, but most farms are not able to have this luxury so they join the main herd.
They should be offered a lead feed where possible, and kept an eye on in order that the performance is judged realistically.

Autumn calving heifers definitely have less nutritional variation in the diets. Provided the diets are dense enough and well balanced they are unlikely to be underfed.
This is probably the best system for Holstein heifers.
Heifers calving on to poor autumn grass have the poorest performance rates of all so best to house them as soon as it is practical to do so.

Pre Calving "Hot" Rations

The practice of feeding the dry heifers a little of the TMR, or cake that they will get after they have calved, a few weeks before they calve can be risky in several respects.

- Production minerals in the TMR may help to increase the likelihood of milk fever
- Silage and grass frequently have very high potassium levels also increasing the chance of milk fever.
- The high density of the TMR and cake will only increase the likelihood of an oversized calf and difficult calving, and or the animal bagging up too early reducing the recovery of the muscles and ligaments holding the udder in place.

If farmers are set on feeding a Hot ration they should ensure that the cows are only fed dry cow minerals and that the proportion of Hot ration should be restricted to a maximum of 5Kg Dry Matter.

I recommend that for most farms, feeding should be principled on the Dutch system. Offering plenty of straw based roughage to keep the rumen as big as possible and only a small amount of targeted concentrate in order to help to precondition the gut and assist in getting the lactation off to a good steady start.

A daily intake of 6Kg of NDF and 1200 grams metabolisable protein should be the target at this stage.
Current research has shown that the rate at which the cows lift into their lactation is heavily influenced by these two targets.

Mineral supplementation should be designed to minimise any risk of milk fever and to supply generous allowances of the key trace elements needed by the developing calf and for the production of a good immune response, directly and via colostrum.

Milk fever can be avoided by locking up calcium with products like X-Zelit© or similar products. Alternatively, (some would say preferably), DCAD rations should be fed by checking the Calcium, Potassium, Sodium and Chloride levels and balancing accordingly.

Please refer to the F1 Dry Cow Blueprint for details of dry cow feeding systems.

Recent trials have also shown that there is considerable benefit to feeding probiotic yeast products prior to calving. I recommend this practise from at least 3 weeks before the due calving date.
The yeast acts in a very positive way by helping to increase intakes and encouraging cellulytic breakdown and energy release from fibre. It also encourages lactic acid utilising bacteria which in turn contributes to available energy supply and improves the condition of the rumen papillae improving food conversion.

Work published at the Alltech Symposium in Kentucky as early as May 2005 showed that cows also undergo a significant challenge from mycotoxins present in the diet.
Dry cows and heifers fed “Mycosorb A +©”, (a toxin absorbing feed additive) prior to calving, showed a significant appetite improvement after calving. The calves born to these cows also benefited fro significantly less mortality and disease during the first 12 weeks of life.

Mycotoxin contamination in dry feeds is probably a much more significant problem than farmers have realised. If High genetic merit cows are to be fed to potential, diets will tend to be fairly dry forages that are preserved between around 26% and 88% dry matter are very likely to carry a significant mycotoxin loading.
Currently we recommend using either Toxfin XL Dry © or Mycosorb A+©.