

Introduction

The European Food Safety Authority (EFSA) published an important report entitled *Effects of farming systems on dairy cow welfare and disease*, plus a set of scientific opinions, on the welfare of dairy cattle on the 9th July 2009.

These were produced by their Animal Health and Welfare Panel (AHAW), a group of key animal welfare, veterinary and cattle scientists.

The key recommendations of the EFSA scientific opinions include:

- Cows should be bred for robustness instead of milk yield
- Pasture should be provided, at least during summer or dry weather
- Alternatives to cubicles for housing such as straw yards are needed, with improvements to cubicle design a short-term objective
- Balanced diets including the requirement for fibre are needed to maintain health and welfare
- Management and stockmanship are also key to reducing mastitis and lameness

A minority report recommended that tie-stalls, in which cows are tethered for part of the day, should not be used routinely.

The key finding of the EFSA opinion is that breeding for high milk yield is the major factor causing poor welfare to cows, especially in relation to health problems. It is associated with increased risk of lameness, mastitis, infertility and metabolic disorders. A particular concern is that high yielding cows lose excessive body condition in the early stages of lactation, “milked to starvation” as it has been described in the media by one of the key authors.

It is often argued that high yielding cows can be maintained with high welfare if the management is right. The report argues it the other way around. Welfare risks caused by selection for high milk yield are increased if they are not compensated for by good housing, nutrition and management.

Genetic selection for high milk yield with insufficient emphasis on other traits relating to fitness increases the risk of suffering from metabolic and reproductive problems. This risk is greater when housing, nutrition and management are unable to compensate for the adverse effects of genetic selection. The increased inbreeding of recent years may lead to, or be associated with, increased reproductive problems, reduced lifetime milk production and a reduction in breeding performance if it continues. Excessive or prolonged negative energy balance in dairy cows is more likely to occur in the highest producing animals and has been found to be associated with reduced fertility, digestive, metabolic and infectious disease, especially mastitis.

From Summary of scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems

Some farmers use hormonal treatments to deal with fertility problems caused by the loss of body condition which results from high milk yield in early lactation. The report argues that delaying pregnancy is a coping strategy for an animal in poor condition, so hormonal treatments can cause poor welfare. It recommends that they are not used. It also suggests that extending calving intervals for high yielding cows from 12 to 15 or 18 months may improve welfare by giving time for the cow to recover condition. The report suggests that such strategies, along with breeding cows for health and fertility and not just for yield, would be economic since cows would have longer productive lives.

The management and nutrition of high-yielding cows required to prevent loss of body condition in early lactation can itself present welfare problems. Concentrated diets high in starch can help prevent emaciation as well as metabolic diseases such as ketosis and fatty liver resulting from high levels of fat metabolism. Unfortunately, such diets can cause acidosis as a result of excessive fermentation in the rumen. High fibre diets are required to prevent acidosis. Keeping high yielding cows indoors so they can be fed on carefully balanced diets to manage all of these conditions can also risk welfare through denying access to pasture.

the selection for high milk production has produced a cow that is dependent on a high level of management in order to maintain its health, and which requires certain management practices to maintain its high milk output, which may themselves reduce animal welfare e.g. high-starch grain-based diets, and minimal grazing

From *Effects of farming systems on dairy cow welfare and disease*

The report also argues that welfare of cows is better on pasture than for cows kept indoors. Lameness and other health and welfare problems are greater for animals which are zero-grazed throughout the year.

As regards housing, the report argues that there is less welfare risk in straw yards than in cubicles or tie-stall systems. Lameness is more frequent in cubicle systems than on straw yards. A short-term solution is to improve cubicle design, but leg and foot disorders remain a problem even in well-managed cubicle houses. Alternatives such as straw yards are needed.

When dairy cattle are kept in cubicle houses, foot and leg disorders are substantially more frequent than they are in straw yards. Since leg and foot disorders are the major welfare problem for dairy cattle and leg and foot disorders are a problem even in well-managed cubicle houses, alternatives to cubicles, e.g. straw yards, are needed and in the short-term improvements to cubicle house design should be made.

From *Scientific opinion on welfare of dairy cows in relation to leg and locomotion problems*

Welfare problems in tie-stall systems include lack of freedom of movement, exercise and space. Cows may be reluctant to be tied.

Dairy cattle are reluctant to be tied, both initially and after a period of exercise and tied cattle have more lameness than those free to move with good flooring and resting facilities.

From Scientific opinion on welfare of dairy cows in relation to leg and locomotion problems

A minority report suggested that there was sufficient evidence that tie stalls cause poor welfare and that they should not be used routinely.

Minority Opinion by Bo Algers, Harry Blockhuis, Donald Broom, Joerg Hartung, David Morton, Mohan Raj: In contrast to the Panel majority opinion, it is our opinion that there is sufficient evidence for poor welfare in dairy cattle held in tie-stalls. It is recommended that dairy cattle should not be routinely kept in tie-stalls as a housing system.

From Scientific opinion on the overall effects of farming systems on dairy cow welfare and disease

The methodology of the report

In addition to producing a referenced scientific report, The AHAW Panel developed four risk analyses of the effects of farming systems on the welfare of dairy cows in relation to:

- Metabolic and reproductive problems (eg poor body condition ie emaciation due to over-production and infertility)
- Leg and locomotion problems (eg lameness)
- Udder problems (eg mastitis)
- Behaviour, fear and pain (eg freedom to carry out natural behaviours, proper social interaction, fear of other cows due to poor housing design, pain due to lameness and disease, hunger due to poor body condition)

The methodology involved asking a range of experts to identify and assess key risk factors for welfare, taking into account both the magnitude of the welfare problem and the risk of it occurring. Values obtained were compared and discussed within the expert working group to reach consensus scores.

Risk factors for welfare were classed into four groups of hazards associated with:

- Genetic selection for high yield
- Housing
- Management
- Nutrition and feeding

The results were published in four separate reports plus summaries on the effects of farming systems on dairy cow welfare and disease and These were published at the link:

http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1211902666211.htm and are saved on our server at:
<X:\Cattle\Dairy cattle\Library\External\Reports\EFSA>.

A referenced scientific report was published separately along with a summary opinion based on both the four risk analyses and the scientific report.

This analysis of the report and opinions will concentrate on the key recommendations regarding genetics and housing before going into detail on the four groups of welfare concern and other more general conclusions.

The four opinions based on the risk analyses are entitled:

1. *Scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems*
2. *Scientific opinion on welfare of dairy cows in relation to leg and locomotion problems*
3. *Scientific opinion on welfare of dairy cows in relation to piece on behaviour, fear and pain*
4. *Scientific opinion on welfare of dairy cows in relation to udder problems*

The report is entitled:

Effects of farming systems on dairy cow welfare and disease

The summary opinion based on all of the above is entitled:

Scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease

Key risk factors for welfare

Risk factor 1 - Genetics

According to the report, the following welfare issues are affected by genetics. These include:

1. Lameness
2. Mastitis
3. Infertility
4. Loss of body condition
5. Lack of rest associated with need to consume and process forage to maintain production and condition

6. Metabolic and other diseases including:
 - a. Lipomobilisation syndrome leading to the two syndromes below
 - b. Fatty liver (severe in 25% of cows, moderate in 35%)
 - c. Ketosis (5% suffer clinical ketosis, 10-20% subclinical)
 - d. Abomasal displacement
 - e. Acidosis (8-38% likely to have subclinical)
 - f. Laminitis
7. Size and shape of:
 - a. The animal (may affect comfort in cubicle housing and size may affect weight, ability to keep on pasture in wet weather, risk of claw damage and lameness)
 - b. The udder (may affect ability to walk and comfort whilst lying down)
8. Producing a cow which has to be kept indoors during early lactation in order to maintain body condition and health

The milk yield of dairy cows has doubled in many European countries over the last 40 years, partly as a result of genetic selection and management. Cows have also changed in shape and increased in size.

Breeding for high milk yield is the major factor causing poor welfare to cows, especially in relation to health problems.

It is associated with increased risk of lameness, mastitis, infertility and metabolic disorders.

“ Long term genetic selection for high milk yield is the major factor causing poor welfare, in particular health problems, in dairy cows. The milk yield of dairy cows has risen steadily over the last thirty years in Europe with approximately 50 % of this increase estimated to be attributable to genetic selection for milk production efficiency. This selection has also changed the form and size of dairy cows and hence demands on their behaviour and other adaptive mechanisms. The spatial requirements of the dairy cow have increased as well as its vulnerability for mechanical impacts and wounds on the exterior parts of the body, the skin, limbs and claws. The genetic component underlying milk yield has also been found to be positively correlated with the incidence of lameness, mastitis, reproductive disorders and metabolic disorders. In order to improve dairy cow welfare there is an urgent need to promote changes in the criteria used for genetic selection in the dairy industry.”

From Summary of scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease

There is additional concern about the effect of genetics on the shape of the udder.

Udder shape and volume are of specific concern, with respect to normal locomotion, prevention of lameness and comfort during resting in the most common housing types.

From Summary of scientific opinion on welfare of dairy cows in relation to leg and locomotion problems

Excessive loss of body condition is a key issue which connects genetically induced welfare problems.

Cows lose body condition and can become emaciated in the early stages of lactation as a result of “excessive tissue mobilisation early in lactation to support milk secretion.” The risk of this is particularly severe in cows bred to produce large quantities of milk.

In the early stages of lactation, the dairy cow faces a sudden increase in the metabolic demands. It takes time for the digestive system, especially the rumen, to process the increasing amounts of dry matter required to sustain the requirements of milk production.

The report argues that in order to adjust the imbalance between food intake and nutrient needs for maintenance and milk production, changes in body hormones allow increased mobilisation of lipids from fat tissues and protein from muscle. Unfortunately, this can lead to metabolic diseases such as fatty liver and ketosis:

During episodes of excessive lipomobilisation fatty liver and ketosis develop when the hepatic availability of lipogenic and glucogenic products is imbalanced.

From Effects of farming systems on dairy cow welfare and disease

Problems associated with emaciation and other metabolic imbalances could be addressed by increasing the starch content of the diet and by keeping high yielding cows indoors on a Total Mixed Ration (TMR) of known nutrient content rather than outside on grass which has a variable nutrient composition. However, this solves one set of welfare problems whilst creating others.

Increasing the starch content of the diet is a means of increasing food intake to maintain production of milk without excessive loss of body condition whilst at the same time preventing metabolic imbalances connected with fat mobilisation. Unfortunately, high levels of starch intake can lead to ruminal acidosis. Rapid fermentation of easily digested carbohydrate by microbes in the rumen results in the formation of acid.

High levels of acid in the stomach prevent growth of microbes in the rumen, so interfering with digestion. The report states that sub-acute ruminal acidosis (SARA) has been linked to a range of signs of poor welfare including poor body condition and laminitis. Severe acidosis, which can lead to a range of clinical conditions including acute laminitis, is usually fatal.

recurrent acidosis may eventually lead to ruminitis; abscesses in the liver and other tissues. Moreover, SARA has been linked to other signs of poor animal welfare such as loss of body condition, suboptimal appetite or cyclic feed intake, diarrhoea, milk fat depression (MFD), low milk fat/protein ratios, laminitis, immunosuppression, Pneumonia - Posterior Vena Cava Syndrome and high herd culling rates

From *Effects of farming systems on dairy cow welfare and disease*

Ruminal acidosis is avoided by ensuring that there is both sufficient high quality fibre in the diet and not too much easily fermentable carbohydrate such as starch. These need to be kept in balance throughout the day. Since grass can vary considerably in its nutrient composition, including sugar and fibre levels, high-yielding cows are often kept inside during the peak of their lactation to ensure they can be fed a diet which maximises dry matter intake to maintain production and body condition whilst minimising risk of acidosis.

Keeping animals indoors raises additional welfare risks such as lameness. Access to pasture is in other respects good for health and welfare.

The risk of loss of body condition is greater if problems caused by genetics are not compensated for by good housing, nutrition and management.

Cows are in negative energy balance during early lactation, when functional body tissues may be metabolised to excess, causing poor welfare. This risk is particularly severe in high-producing genetic strains ...

Excessive or prolonged negative energy balance in dairy cows is more likely to occur in the highest producing animals and has been found to be associated with reduced fertility, digestive, metabolic and infectious disease, especially mastitis.

From *Summary of scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems*

The report argues that “the increase in milk yield has generally been accompanied by declining ability to reproduce, increasing incidence of health problems, and declining longevity in modern dairy cows, all of which may be indicative of reduced animal welfare.” It adds that with increasing time spent eating there is less time for other things including important activities such as resting.

Infertile cows are likely to be culled.

The most serious welfare problem is substantial decrease in length of productive life of modern dairy cow due to high involuntary culling, and subfertility is the main reason for involuntary culling.

From *Effects of farming systems on dairy cow welfare and disease*

The report argues that infertility is an adaptive response to metabolic stress, with cows delaying conception until they have recovered body condition. It argues that this may not be a welfare problem if the cow is given this time to recover by allowing a longer calving interval (we might argue with this - that hunger and tiredness associated with loss of body condition remain a welfare problem).

However, infertile cows are often brought into oestrus through hormonal intervention, risking welfare as this adaptive response is undermined.

Lower fertility reflected by such reproductive measures as longer interval to onset of cyclicity postpartum and lower conception rate earlier in lactation, are indicative of the cows coping with metabolic stress. This may not be a welfare problem if the cows are allowed to cope normally with this stress through a longer calving interval. Unfortunately, intensive production systems seldom provide this allowance. In some countries hormonal and other invasive interventions are used to kick start the reproductive system postpartum, which increases the stress and leads to increase risk of health problems during the transition period of subsequent calving.

From *Effects of farming systems on dairy cow welfare and disease*

The reports recommend that hormonal treatments should not be used in this way.

Hormonal treatments to improve fertility should not be used to compensate for deficits in management.

From *Scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease*

Animals selected for high milk yield suffer increased levels of health and fertility problems. These are even worse if these animals are kept in less intensive systems where levels of nutrition are lower. In other words, the levels of adaptability of the animals in terms of their capacity to cope with varying food availability has been reduced.

Dairy producers in several grazing countries have expressed concern regarding the declining fertility of cows with an increased proportion of Holstein genes. Harris and Winkelman (2000) and Verkerk et al. (2000) reported significant differences between cows of New Zealand origin and North American origin for conception rate, services per conception, and days to first service. These studies indicate that the negative genetic correlations between production, fertility and health in modern dairy cows, already large when producing in an

intensive production environment, are even larger when cows are producing in a less intensive production environment. The increase in negative genetic correlation between production and fitness traits in less favorable environments is indicative of a decline in adaptability associated with selection for increased yield in the modern dairy cow.

From Effects of farming systems on dairy cow welfare and disease

For these reasons, high yielding cows are increasingly kept for longer periods indoors, zero-grazed and on concentrated diets. The report argues that this too can reduce welfare.

the selection for high milk production has produced a cow that is dependent on a high level of management in order to maintain its health, and which requires certain management practices to maintain its high milk output, which may themselves reduce animal welfare e.g. high-starch grain-based diets, and minimal grazing

From Effects of farming systems on dairy cow welfare and disease

The scientific opinion recommends a selection programme for better health and welfare. Selection for improved fertility, health and longevity would be good both for cows and farmers.

A multi-trait selection programme in which health, fertility and welfare traits are included in the breeding objective is recommended. Genetic selection for improved fertility, health and longevity is likely to improve welfare and lead to greater profit for the farmer.

From Scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems

Inbreeding is also an issue which should be addressed:

4.2.5. Inbreeding

Inbreeding has been estimated to be increasing at 0.17 - 0.2% per year in dairy cows. It may also result in small numbers of sires, perhaps with undesirable characteristics, being widely used. This increase may lead to, or be associated with, increased reproductive problems, reduced lifetime milk production and a reduction in breeding performance if it continues.

In order to avoid poor welfare, such as that associated with reproductive disorders and loss of robustness, the breeding procedures for dairy cattle should be designed to reduce inbreeding.

From Scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems

More research is needed:

Multi-disciplinary research aimed to clarify the relationship between production, negative energy balance, metabolic stress and welfare indicators and to develop practical methods for measuring negative energy balance and metabolic stress is needed. This research should identify traits and selection criteria to provide better selection tools to improve welfare in dairy cows.

From Scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems

Risk factor 2 - Housing

The report argued that welfare is better on pasture than for cows kept indoors. For winter housing, straw yards cause less welfare risk than cubicle systems or tie-stalls.

The environmental needs of cows include:

- Opportunities to feed
- A comfortable space to rest
- Shelter from adverse weather conditions and shade from the sun
- A chance to exercise
- Opportunities for social interaction, yet space to avoid agonistic encounters
- Clean air

Cows are generally kept on pasture, in cubicle systems, on straw yards or in tie stalls.

Tie stalls

Cows in tie-stalls are tied up on a tether for much of the day except for milking and, sometimes, for a period of exercise. Tie stalls generally enable cows to avoid aggression and to rest, but they prevent a range of natural behaviours. Cows are not provided with enough space. The risk of lameness is higher.

According to the scoring system used in this analysis, the most important hazard in relation to the housing was the lack of space in tie-stalls. Larger space allowance, in the walking area as well as the lying area, is beneficial for the welfare of cows with respect to decreased aggression, injuries, and occurrence of lameness. Tied cattle have more lameness than those free to move with good flooring and resting facilities.

From Scientific opinion on welfare of dairy cows in relation to leg and locomotion problems

Cows are often reluctant to be tied. Tying cows up limits their choices and their opportunities for social interaction, voluntary movement and exercise. Poorly designed and managed tie-stalls may provide insufficient space, bedding and fibrous food.

The report argued that cows in tie stalls should be provided with daily exercise and that periods tied up should be limited to allow natural behaviours.

Tie-stalls restrict the voluntary movement and social behaviour of dairy cows. When periods of exercise are possible some of the adverse effects are reduced. Therefore, systems of husbandry and management should involve a minimum time of restricted movement in order that all dairy cows are able to meet their need to show certain behaviours such as grooming, social interaction and exercise. While tie-stall use continues, cows should have daily exercise that involves walking freely inside or outside (except where there are adverse climatic conditions) and also the freedom to carry out other behaviours.

From summary of scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease

A minority of the committee were of the view that tie stalls should not be used routinely:

Minority Opinion by Bo Algers, Harry Blockhuis, Donald Broom, Joerg Hartung, David Morton, Mohan Raj: In contrast to the Panel majority opinion, it is our opinion that there is sufficient evidence for poor welfare in dairy cattle held in tie-stalls. It is recommended that dairy cattle should not be routinely kept in tie-stalls as a housing system.

From scientific opinion on welfare of dairy cows in relation to disease

Cubicle systems

In cubicle systems, cows are free to walk around the shed, usually along concrete walkways between resting, feeding and milking areas, and can rest in individual cubicle stalls which usually contains a mat or mattress or loose bedding material. Where mats or mattresses are used, the report states that these should be “covered with some litter to absorb moisture (urine, sweat).”

In addition to providing passage between feeding, resting and milking areas, the floor of the house is an area where cows can “stand, walk and idle”; it is a place for collecting manure; it “should allow space for specific behaviours like grooming, defaecation and urination, and social spacing.”

The welfare risks in cubicle systems include:

- Hard concrete increases the risk of lameness and injury, especially if the surface becomes slippery
- Walkways can be blocked by dominant cows, obstructing access to resting or feeding areas by subordinate cows
- Some systems do not have sufficient cubicles for all to rest at the same time (like seats on crowded trains, some will always be left unoccupied, so you need more cubicles than cows)
- Cubicles must be designed to be the right size for the cow; however, cows have become much larger over recent years causing problems of comfort resting and difficulties in getting up and down

- Quality of bedding (this is a problem in all indoor systems)

In cubicles the most important magnitudes of the adverse effect and risk estimates are associated with inadequate floor in the walking area, poor cubicle design and inadequate bedding

From Scientific opinion on welfare of dairy cows in relation to disease

These problems do not apply to the same extent in pasture and straw yard systems where the surface is softer and where there can be plenty of space for feeding and resting.

Concrete flooring can lead to lameness.

In general, concrete flooring has a higher risk of claw disorders than pasture and straw-yards, since standing and walking for prolonged periods on concrete floors, or floors that are wet or covered in slurry cause severe foot disorders.

From Summary of scientific opinion on welfare of dairy cows in relation to leg and locomotion problems

Lameness causes pain. Poor walkway design can cause behavioural problems.

6.1.4 Walking areas Conclusions

The risk assessment showed that, in cubicle houses, inappropriate flooring in passageways, feeding and milking areas posed the largest risk for welfare associated with behavioural problems, fear and pain.

From Scientific opinion on welfare of dairy cows in relation to behaviour, fear and pain

Risk of lameness is lower in straw yard systems than cubicles. Lameness is painful and can result in loss of body condition (emaciation), infertility, mastitis and metabolic disease.

*When dairy cattle are kept in cubicle houses, foot and leg disorders are substantially more frequent than they are in straw yards.
...Most lame cows are in pain and have greater difficulty in coping with their living conditions than non-lame cows because of the effects of the foot or leg disorder on walking, lying comfort, standing up and avoidance behaviour.
Lame cows are more likely to become subordinate, lose body condition and are more prone to show reduced fertility and to develop mastitis and metabolic disease.*

From Scientific opinion on welfare of dairy cows in relation to leg and locomotion problems

Narrow walkways can lead to aggression as cows try to move past each other. Subordinate cows may be restricted in their access to resting or feeding areas by a desire to avoid aggression.

Limited space is an important factor affecting the level of aggression. If the space is limited the cows will more often be at a closer distance and possibilities for avoidance will be more limited. There is only very limited information about the effects of the dimensions of the walking areas in loose housing systems. However, it is likely that too narrow alleys can restrain the cows' freedom of movement from one area in the barn to another as well as increase the level of aggression. Metz and Mekking (1984) found a higher level of aggression and subordinate cows spend more time standing in cubicles when the width of the alley behind the cubicles was 2 m versus 11 m. Furthermore, Henneberg et al. (1986) also found increased level of aggression when the width of the alley between the cubicles was reduced from 2.0 m to 1.2 m. Blind alleys properly increase the risk of cows not being able to avoid aggressive interactions with other cows.

From *Scientific opinion on welfare of dairy cows in relation to disease*

There need to be enough cubicles for each cow.

A number of studies have shown that lying time decreases, the level of aggression increases and the risk of low ranking cows lying on the walking alleys increases when the stocking is increased to more than one cow per cubicle

From *Scientific opinion on welfare of dairy cows in relation to disease*

Cubicles must be the right size for the cow. If the cubicles are significantly larger than the cow, she is more likely to dung in the cubicle. If they are too small, she is less likely to be comfortable resting and is likely to have more difficulty getting up and down.

It is important there is sufficient amount of space for forward motion not to hamper cows' movement when changing position from standing to lying and vice versa. Restrictions in the space in front of the cow for instance rails in the area of the head lunge can lead to interrupted attempts to lying down or getting up and abnormal behaviour. Cubicles that are too long may lead to more dung in the cubicles. Furthermore, if the dimension of the cubicles is not adjusted to the size of the animal, it can be difficult for the cow to rest in natural positions and her movement may be restricted.

From *Scientific opinion on welfare of dairy cows in relation to disease*

Unfortunately, breeding for high milk yield has resulted in an increase in the average size of Holstein cows. This means they often cannot fit comfortably into cubicles originally designed for smaller Friesian types.

Apparently, breeding for milk production has caused an increase of body size of dairy cows, especially of the height, as is best noticed in specialised dairy breeds such as Holsteins and Holstein-Friesian ...

Changes in body form and specially an increase of size and weight affect the mechanics of movements of the cow at least in two aspects: a) the space that is needed for the cow to execute her movements freely and b) the scale of forces to be exerted for movement as standing up and lying down. In both respects the welfare of the bigger dairy cow may be at stake in the restraining environment of a cubicle house ...

Mechanical stresses on limbs and rump surfaces of cows when lying on hard surfaces are known to distract cows from lying and may cause hairless patches and injuries on skin and joints. Body shape and weight determine the magnitude of the effect. Hypothetically, changing the lying posture would limit the effect, but those changes are unlikely to occur if the cubicle space is insufficient for free standing up and lying down or lying on different sides.

From Scientific opinion on welfare of dairy cows in relation to disease

In the long run, alternatives to cubicles (the most common kind of housing in the UK), such as straw yards, are needed. The report argued that welfare problems arose even in well-managed cubicle systems. It therefore argued for alternatives to cubicle systems such as straw yards to be developed. In the short run, cubicle designs should be improved.

When dairy cattle are kept in cubicle houses, foot and leg disorders are substantially more frequent than they are in straw yards. Since leg and foot disorders are the major welfare problem for dairy cattle and leg and foot disorders are a problem even in well-managed cubicle houses, alternatives to cubicles, e.g. straw yards, are needed and in the short-term improvements to cubicle house design should be made.

From Summary of scientific opinion on welfare of dairy cows in relation to leg and locomotion problems

Straw yards

A straw yard is a “loose-housing system with a straw bed as the lying area.” As discussed earlier, EFSA recommend that systems such as straw yards are developed as an alternative to cubicles.

Advantages of straw yards include:

- Lower levels of lameness and foot disorders (presumably due to soft non-slippery surfaces to walk on)
- Animals can choose comfortable lying spaces irrespective of their size
- The existence of straw bedding means that cows always have access to fibre

This assumes that stocking densities are sufficiently low, that plenty of bedding is provided, that animals have access to pasture when conditions allow and that such walkways as are still needed have suitable flooring.

The risk assessment showed that the highest ranked hazards associated with straw yards were inadequate bedding, lack of space, zero grazing and inadequate flooring where cows walk.

From Scientific opinion on welfare of dairy cows in relation to behaviour, fear and pain

There is a higher risk of mastitis in straw yards and they have to be managed well to avoid this risk. This requires the provision of sufficient clean and dry bedding.

In relation with the development of udder problems, the risk assessment showed that the inadequate bedding has a high magnitude of the adverse effect in all systems but the risk is higher in straw yards, followed by tie-stalls then cubicle housing and very low in pasture.

And

Udder infections may occur more in straw-yards where insufficient attention is given to hygiene of the bedding. If stocking density in straw yards is too high, this may lead to teat-trampling.

From Scientific opinion on the overall effects of farming systems on dairy cow welfare and disease

All systems, including straw yards, need to be designed to avoid injury and risk of aggressive interactions between cows:

The design of cubicle houses and straw yards should allow all the cattle to have access to lying, feeding and drinking areas without danger of injury or of difficulty with social interactions.

From Scientific opinion on the overall effects of farming systems on dairy cow welfare and disease

However, a range of these kinds of risk are lower for straw yards than for other indoor systems.

Inadequate ventilation, temperature and humidity were the highest ranked hazard in straw yards. However, the risk estimate and magnitude values in straw yards were much lower than in cubicles and tie-stalls.

And

The risk assessment showed that the risk for improper fibre traits (chemico-physical aspects) is quite high in cubicles and tie-stalls but lower for straw yards.

And

In the risk assessment, the risk estimates for behavioural problems, fear and pain associated with the housing/environment conditions were highest for tie-stalls, relatively high for cubicle houses, much lower for straw yards and very low for pasture.

From Scientific opinion on the overall effects of farming systems on dairy cow welfare and disease

Pasture

The report states that dairy cows are housed indoors for part of the year because of lack of forage, to avoid damage to forage through cattle treading on it or “most commonly, for protection against climatic influences during the cold part of the year.

They are also kept indoors to increase nutrient intake. “Higher milk production can be achieved with controlled grain feeding.” However, the report also points out that fairly high milk yields can be achieved from pasture alone in countries such as Australia and New Zealand.

The development of robotic milking systems may also limit practical access to pasture.

The report went on to list the findings of these studies as follows:

- Summer access reduces dairy cow mortality
- Lack of access to pasture increased summer health problems including:
 - Mastitis
 - Metritis
 - Tramped teats
 - Salmonella enterica infections
 - Dystocia
 - Retained placenta
 - Ketosis
 - Hock and knee injuries

Perhaps most important of all, access to pasture reduces the levels of lameness.

The most commonly reported welfare problem associated with restricted grazing is lameness ... A large epidemiological survey of 4 516 dairy farms in the US, found that a lack of access to pasture in winter was a significant risk factor for a high incidence of digital dermatitis, and that providing access to a dry-lot was not sufficient to overcome this (Wells et al., 1999).

From *Effects of farming systems on dairy cow welfare and disease*

The report went on to list a range of further studies which found lower levels of lameness or foot damage to be associated with pasture access.

Conversely, zero-grazing increases the risk of a range of conditions including lameness, mastitis and metabolic disorders.

If dairy cows are not kept on pasture for parts of the year, i.e. they are permanently on a zero-grazing system, there is an increased risk of lameness, hoof problems, teat tramp, mastitis, metritis, dystocia, ketosis, retained placenta and some bacterial infections.

From *Scientific opinion on welfare of dairy cows in relation to leg and locomotion problems*

The report added one word of caution. The studies don't isolate the reasons why pasture access protects cows from lameness.

Although these studies indicate that lameness and hoof problems of various sorts are less common for cattle with some access to pasture, they do not allow us to isolate the cause of this difference. Cows in indoor housing are more likely to be standing in manure and on concrete, and eating more grain than cows at pasture, all of which increase the likelihood of lameness

From *Effects of farming systems on dairy cow welfare and disease*

A connected idea, not listed here, is that it has already been stated that "The genetic component underlying milk yield has also been found to be positively correlated with the incidence of lameness" and higher yielding cows are less likely to have access to pasture.

Given these uncertainties, the report then states:

For these reasons, any results concerning the effect of grazing on the welfare of cattle must be interpreted with care. It should not be assumed that providing cows with access to pasture will automatically improve their welfare, or that a high level of animal welfare cannot be achieved in zero-grazing systems (Rushen et al., 2008). However, at present, it is not possible to guarantee that indoor housing without access to pasture will result in the same or better level of welfare that could be achieved if the cows could have access to pasture.

From *Effects of farming systems on dairy cow welfare and disease*

In other words, despite these caveats, the overall recommendation remains clear. Cows should have access to pasture when possible.

When possible, dairy cows and heifers should be given access to well managed pasture or other suitable outdoor conditions, at least during summer time or dry weather.

From *Scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease*

Robotic milking systems

The report states that there are some potential benefits in using robotic milking systems if properly managed.

Robotic milking systems have the potential to improve cow welfare, provided that they are accurately adjusted and carefully supervised, because some cows can select the milking time and the equipment can be accurately adapted to the cow. However, robotic milking systems can be badly managed and some cows may be subjected to long waiting times.

From *Summary of scientific opinion on welfare of dairy cows in relation to udder problems*

However, they make it more difficult to keep cows on pasture and pasture is good for the health and welfare of cows.

Over the last decades robotic milking systems have been developed and spread throughout ... These make it more difficult to keep the cows on pasture, because an individual cow has to take a decision to walk back to the milking parlour at regular intervals without being synchronised with the rest of the herd. It has been shown that dairy cows do not walk all the way out to pasture when it is too far from the milking robot, but rather lie down in the passage ways out to pasture, probably so that the distance they have to walk back will not become too large (Spörndly and Wredle, 2004). ... The robotic milking system puts a demand on the farm to have enough pasture close to the barn so that the cows can combine grazing with being milked and also feeding on concentrate and silage in the barn.

From *Effects of farming systems on dairy cow welfare and disease*

General housing summary

There can be problems in any system. Risk of mastitis can be higher on straw yards. Animals on pasture can suffer from heat stress (the provision of shade is particularly important), poor weather, parasite levels and flies and inadequate energy intake.

However, animals kept on pasture, and/or wintered on straw yards, are more likely to:

- get enough fibre in their diet
- spend less time walking on hard and/or wet concrete which can increase the risk of lameness

Animals on pasture or straw yards are less likely to suffer a range of welfare problems which are specific to badly designed cubicle systems including:

- inadequate space due to the increasing size of modern cows
- lack of rest due to the provision of inadequate numbers of cubicles
- difficulties walking between feeding and resting areas due to passage-ways being blocked by dominant cows
- inadequate bedding

Compared with animals in tie-barns, they have freedom of movement and exercise.

Animals on pasture and/or over-wintered in straw yards are likely to suffer less from a range of health and welfare problems, especially lameness. Animals on pasture need access to shade.

Risk factor 3 - Management and stockmanship

It has already been stated that the report argues that “breeding for high milk yield is the major factor causing poor welfare to cows.” Some of these problems can be exacerbated by poor nutrition and management. For example, emaciation and infertility in cows bred for high milk yield will be exacerbated if the cows are kept in extensive systems without additional concentrates. The risk of lameness due to high milk yield or poor housing will be increased in the absence of good foot care.

The reports make this kind of point repeatedly, for example:

Genetic selection for high milk yield with insufficient emphasis on other traits relating to fitness increases the risk of suffering from metabolic and reproductive problems. This risk is greater when housing, nutrition and management are unable to compensate for the adverse effects of genetic selection.

From Summary of scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems

Key management issues include an effective system for monitoring lameness and a mastitis prevention plan. Farmers need to be trained to recognize signs of disease.

There should be systems for monitoring the prevalence of lameness by scoring locomotion and foot lesions every 3 to 6 months in all dairy herds. Because of the high risk of lameness in dairy cattle all dairy farmers should implement a lameness prevention programme. On farms with a high prevalence of recognisable locomotor difficulties, e.g. approaching 10%, there should be improvement of housing conditions, genetic strain and management practices. In addition to improved methods for genetic selection, the prevalence of mastitis should be reduced also through: treatment of clinical and subclinical disease, dry cow therapy, identification and elimination of carrier cows, prevention of transmission of infection from cow to cow or through the environment, and improvement of the immune system by minimising stress factors and by a controlled and nutritionally-balanced feed intake. Pain management should be part of the treatment of severe lameness and clinical mastitis.

Farmers should be well trained in recognizing signs of disease at early stages and veterinary advice should be sought at an early stage of disease in dairy cattle. Recommendations in this opinion for disease prevention and management should be followed.

From Scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease

Good sympathetic stockmanship is vital for welfare.

Cow welfare is also poor when stockpersons behave harshly or inconsistently to cows during collection of cows, milking and post milking movement.

From Scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease

Risk factor 4 – Nutrition and feeding

The report covers the nutritional needs of cows to provide for production and prevent a range of health and welfare conditions in depth. The need for nutrients to maintain body condition and production, for fibre to prevent acidosis and maintain ruminal health and for a balance between high energy and high fibre foods have already been discussed.

The report stresses the importance of transitional diets, from after the cow has been dried off to before she calves and starts to lactate again, in preventing a range of metabolic problems developing later. Strategies for preventing milk fever (parturient paresis), caused by blood calcium imbalances, are discussed. The report also stresses the importance of water – high-yielding cows will need a substantial amount of potable water to produce those large quantities of milk.

The reports' recommendations on nutrition include:

All dairy cattle should be fed a diet that provides sufficient energy, nutrients and dietary fibre to meet the metabolic requirements in a way that is

consistent with digestion. When diet is changed there should be carefully controlled transition feeding in order to prevent poor welfare in the cattle. Feeding systems should allow every individual cow to meet her needs for quantity Overall effects of farming systems on dairy cow welfare and disease and quality of feed. Dairy cows should be provided with drinking water whatever their diet. This water should be in sufficient quantity to prevent any dehydration and should be: free from repellent odour and taste, harmful infectious agents, toxic substances and contaminants that can accumulate in body tissue or be excreted in milk. Both indoors as well as outdoors, continuous access to water should be provided.

From Summary of the scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease

Risk analysis issues

Reproductive and metabolic problems

Reproductive and metabolic problems referred to in the report include:

- Loss of body condition
- Lipomobilisation syndrome including
 - Fatty liver
 - Ketosis
- Ruminal acidosis
- Abomasal displacement
- Parturient paresis (milk fever)
- Dystocia (difficulties in giving birth)
- Infertility

Loss of body condition

Cows are likely to lose body condition, particularly at the beginning of lactation, as a result of:

- High milk yield
- Processing insufficient feed
- Lameness and other diseases

Milk yields of cows have been steadily increasing over the last 30 years, partly as a result of selective breeding. A key problem is that there is a limit to the ability of the cow to process feed at the beginning of a lactation, so milk is produced at the expense of body reserves. High levels of production can result in a loss of body condition (cows become thin) as "*functional tissues may be used to excess.*"

Poor body condition in turn is likely to be a key factor leading to infertility. Indeed, the report argues that infertility may be adaptive in an animal which doesn't have sufficient body reserves of nutrients. Hormonal treatments used to bring infertile cows into oestrus may cause poor welfare by preventing cows from delaying a pregnancy they are not ready for.

Many farmers intensively manage the reproductive biology of the dairy cows by using hormonal treatments, such as oestrus synchronization and timed insemination, in order to achieve a calving interval of 12 to 13 months which they perceive as economically optimal. This results in poor welfare as it deprives the animals of a coping mechanism at their disposal, to delay the onset of the reproductive process postpartum, to cope with metabolic stress caused by high production ...

From Scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems

The report recommends that "*Hormonal treatments should not be used to compensate deficits in management*".

The report also recommends changes to the selection criteria to favour robustness instead of milk yield (discussed earlier) and the provision of balanced diets.

Strategies to maintain body condition and production include feeding animals inside on Total Mixed Rations (TMRs) with a higher starch content. As discussed earlier, this risks other welfare problems since pasture is good for the health of cows and high starch diets risk acidosis.

Lipomobilisation Syndrome

In early lactation, high yielding cows produce more milk than they can sustain from the food they eat and process. This is partly because milk production is high and partly because the rumen takes time to adjust to processing the much larger quantities of food needed once lactation begins. Body reserves have to be mobilised to produce this milk, including significant quantities of fat.

Excessive mobilisation of fat, together with an imbalance in the proportions of fat and carbohydrates used in metabolism, can lead to fatty liver and ketosis.

During episodes of excessive lipomobilisation fatty liver and ketosis develop when the hepatic availability of lipogenic and glucogenic products is imbalanced. Thereby the hepatic capacity for complete oxidation of fatty acids is exceeded and hepatic metabolism of NEFA is directed alternatively towards formation of ketone bodies (beta-hydroxybutyrate, acet-acetate, and acetone) or re-esterification of NEFA to triacylglycerol (TAG) (Drackley, 1998).

From Effects of farming systems on dairy cow welfare and disease

In these circumstances, ketone bodies build up in the blood (ketosis) and excess fats are stored in the liver (fatty liver).

Ketosis affects milk yield, fertility and welfare.

Lactational incidence rates of subclinical ketosis vary between 10 and 25% between herds. During episodes of subclinical ketosis milk yield and fertility is reduced. Subclinical ketosis may change into clinical ketosis. In case of clinical ketosis cows are off feed and appear depressed or in some cases show nervous symptoms. About 5% of dairy cows develop signs of clinical ketosis (Herdt, 2000).

From *Effects of farming systems on dairy cow welfare and disease*

Fatty liver is even more widespread.

Approximately 25% of dairy cows develop severe ... and 35% moderate... fatty liver (Jorritsma et al., 2002).

From *Effects of farming systems on dairy cow welfare and disease*

Since these conditions are associated with a range of other health problems which affect the fertility of cows, they are collectively called lipomobilisation syndrome. Together they shorten the lives of cows.

Negative energy balance, excessive lipomobilisation, ketosis, and fatty liver are associated with reduced reproductive performance, increased risk for abomasal displacement, and reduced immune competence and thereby with increased susceptibility for infectious ... Since negative energy balance and excessive lipomobilisation are closely related to each other and to the above mentioned health disorders, the whole complex is also called lipomobilisation syndrome. The lipomobilisation syndrome during early lactation is one of the major risk factors for decreased average life time in cows (Drackley, 1999; Bobe et al., 2004).

From *Effects of farming systems on dairy cow welfare and disease*

Early lactating cows need rations with a significant carbohydrate content so that energy needs can be met at least in part. However, easily digestible carbohydrate must be balanced with fibre which takes longer to digest, to prevent acidosis (see below). Getting enough energy into high-yielding cows is therefore challenging.

Feeding early lactating cows balanced rations which meet energy requirements and provide sufficient amounts of fiber in order to avoid subclinical ruminal acidosis is an essential precondition in the prevention of the lipomobilisation syndrome, and is currently the greatest challenge in dairy cow management. Since formulation of well balanced diets limit energy density to about 7.4 MJ NEL/kg DM energy requirements of fresh dairy cows can only be met when all management tools available are used to maximise feed intake.

From *Effects of farming systems on dairy cow welfare and disease*

This ties in with the key conclusion of the report we started with:

Genetic selection for high milk yield with insufficient emphasis on other traits relating to fitness increases the risk of suffering from metabolic and reproductive problems. This risk is greater when housing, nutrition and management are unable to compensate for the adverse effects of genetic selection.

From *Summary of scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems*

Ruminal acidosis

Acidosis is caused by a diet high in concentrate and low in fibre.

The transient acidosis of the ruminal environment occurs due to the feeding of a large proportion of concentrate feed, high in rapidly fermentable carbohydrate, or a diet relatively deficient in long fibre.

From *Effects of farming systems on dairy cow welfare and disease*

Highly digestible foods such as starch are very rapidly fermented by microbes in the rumen of the cow. In the process, various organic acids are produced, reducing the pH. This causes acidosis which is bad for health, digestion and welfare. Fibre is less digestible, is more slowly digested and is protective against acidosis.

The milder form of acidosis, subacute ruminal acidosis (SARA), involves a ruminal pH around 5.5. The report states that "recurrent acidosis may eventually lead to ruminitis; abscesses in the liver and other tissues." According to the report, various studies have suggested that "the proportion of cows with low ruminal pH ... ranged between 8% and 38%.

SARA may also be linked to a range of other health and welfare problems.

Moreover, SARA has been linked to other signs of poor animal welfare such as loss of body condition, suboptimal appetite or cyclic feed intake, diarrhoea, milk fat depression (MFD), low milk fat/protein ratios, laminitis, immunosuppression, Pneumonia - Posterior Vena Cava Syndrome and high herd culling rates (Garrett, 1996; Nocek, 1997; Oetzel, 2000; Enemark 2008)

From *Effects of farming systems on dairy cow welfare and disease*

The more serious form of acidosis, lactic ruminal acidosis, occurs when the pH drops below 5. This causes a severe digestive disturbance and is likely to be fatal.

Severe ruminitis, disturbance of the gastro-intestinal barrier, bacteraemia or septicaemia, liver abscesses and vena cava thrombosis, dehydration, metabolic acidosis and acute laminitis may result from lactic acidosis. The majority of affected cows will die despite treatment from lactic acidosis (Dirksen, 1970; Nocek, 1997).

From *Effects of farming systems on dairy cow welfare and disease*

Fibre is particularly important for ruminant digestion. The report argues that a lack of fibre is a key cause of ruminal acidosis which the report argues can cause very poor welfare in cows.

Carefully balanced diets are required to maintain body condition as far as is possible without acidosis.

All dairy cattle should be fed a diet that provides sufficient energy, nutrients and dietary fibre to meet the metabolic requirements in a way that is consistent with digestion ...

Concentrate feeding facilities on dairy farms should be adequately maintained and diets carefully balanced so as to maintain optimal ruminal fermentation and to minimise negative energy balance.

From Scientific opinion on welfare of dairy cows in relation to metabolic and reproductive problems

A lack of fibre is less likely to be a problem in straw yards or on pasture (except during the first spring flush of grass).

Abomasal displacement

The abomasum is the fourth or final stomach of the cow. It can be displaced to the left or right. According to the report, abomasal displacement (AD) primarily occurs in specialist dairy breeds including Holstein, Brown Swiss, Guernseys and Jerseys.

The report states that some studies suggest a positive correlation between milk yield and this condition, others were unable to find a relationship. However, "it is generally accepted that genetic predisposition is an important risk factor for the occurrence of AD."

There is also "a correlation of high-concentrate and low-fibre diets with the incidence of AD."

Although the primary cause is unknown, the report suggests levels of AD are a good measure of welfare due to its correlation with so many other dairy welfare issues.

AD is seen as a kind of indicator disease for good farm management, since common risk factors are negative energy balance and ketotic metabolic states, development of obesity during the dry period, dietary compositions leading to ruminal fermentation patterns similar to those found in SARA and the occurrence of other production diseases such as milk fever, dystocia, retained placenta or endometritis.

Providing well balanced diets and good control or at least early and rigorous treatment of production diseases are effective prevention measures for AD.

From Effects of farming systems on dairy cow welfare and disease

Parturient paresis (milk fever)

The report argues that milk fever, caused by low levels of blood calcium in early lactation, “has an acute severe effect on animal welfare.” The report recommends good dietary management of dry cows to avoid this.

Dystocia (difficulties in giving birth)

It is common for cows to have difficulties in giving birth, especially heifers. The report recommends that heifers should not be inseminated until they are of a mature weight. Semen should come from bulls known to produce low levels of dystocia.

Infertility

Infertility can be caused by stress and disease. It is also associated with higher levels of milk production. It is a welfare issue in two ways. Firstly, many health and welfare problems lead to infertility. Secondly, many reproductive problems cause poor welfare.

Forms of stress which have been shown to affect reproduction include transportation stress, aversive human handling, heat, the use of electronic cow trainers in tie stall and slippery flooring in loose housing.

Clinical diseases which affect fertility include mastitis, lameness, milk fever and dystocia. Fertility is also lower after caesarean operations.

Early calving can increase the risk of many reproductive disorders.

The age of first calving is negatively related to the risk of reproductive disorders except dystocia. Furthermore the incidence risk of all these disorders except dystocia are higher in more efficient herds, where cows are younger at first calving (Lawson et al., 2004). Reproduction disorder variables (incidence risks of dystocia, retained placenta, uterine infections, and ovarian cysts) were all related positively with each other (Lawson et al., 2004).

From *Effects of farming systems on dairy cow welfare and disease*

Increasing milk yield may lead to infertility and reproductive disorders.

There is a growing concern that increase in milk yield is associated with reduced fertility (Dobson et al., 2001). Lawson et al. 2004, found a moderate positive relationship of milk yield with various reproductive disorders (retained placenta, uterine infections, ovarian cysts, induction of estrus, and induction of birth). Inclusion of reproductive management variables showed that these moderate relationships disappeared, but the directions of almost all those variables remained the same.

From *Effects of farming systems on dairy cow welfare and disease*

Selective breeding for high milk yield without sufficient attention to robustness and fertility traits is one of the factors affecting fertility as cows attempt to cope with metabolic stresses in early lactation.

It is generally accepted that the decline in reproductive performance of modern dairy cows is one of the undesirable consequence of unbalanced selection for increased production. Through selection for greater milk production we created dairy cattle that undergo a high level of nutrient partitioning and adipose tissue mobilization during early lactation (Bauman and Currie, 1980) and the decline in ability to reproduce is one consequence of cows coping with metabolic stress associated with excessive tissue mobilization in early lactation. However, there are also health, management and environmental factors contributing to declining fertility in modern dairy cows.

From *Effects of farming systems on dairy cow welfare and disease*

The report states that “as a strategy to cope with declining fertility, many farmers resorted to intensive management of the reproductive biology of the dairy cow.” As discussed elsewhere, this has welfare consequences since delaying oestrus is a coping strategy for an animal which has lost condition in the process of producing milk.

The report suggests that farmers should consider longer calving intervals (CIs) as one solution to the problem.

A major reason why intense reproductive management strategies are adopted is based on the paradigm that a calving interval of 12 to 13 months is economically optimal. With modern high producing cows, metabolic stress due to excessive tissue mobilization and increased risk of production and reproductive disease in the early postpartum are important contributing factors to poor welfare. A reproductive management strategy with extended calving interval (CI) of 15 to 18 months may offer significant advantages for the welfare of modern dairy cow by reducing the number of stressful calving periods a cow passes through.

From *Effects of farming systems on dairy cow welfare and disease*

It suggests that any loss of milk production would be more than compensated by the advantages of longer productive life and better welfare.

We suggest that even if a planned extended CI may result in slightly lower daily milk production within the CI, the production loss are more than compensated by better fertility and health, longer productive life, lower feed and replacement costs, and improved welfare.

From *Effects of farming systems on dairy cow welfare and disease*

The report also argues that selection for health and fertility is also more profitable than selecting for milk production alone:

Animal welfare is often portrayed as opposed to animal production (Rushen and de Passille, 1998) and selecting for welfare traits is assumed to be uneconomical. This is not the case. The current breeding goal in the UK

includes milk, fat and protein yields plus lifespan. These traits are combined into Profitable Lifetime Index, or £PLI. Calculations suggest that expansion of £PLI to include mastitis resistance and measures of fertility (calving interval) could increase economic response to selection by up to 80%, compared with selection for milk production alone (Pryce et al., 2000). Selection based on such an index could also halt the decline in fertility and mastitis resistance, compared with selection for milk production alone.

From *Effects of farming systems on dairy cow welfare and disease*

They go on to say that it should “be possible, through genetic selection, to address welfare without a reduction in profitability.”

Mastitis and udder problems

Mastitis is an udder inflammation characterised by visible alterations to milk or udder. It is usually caused by bacterial infection, though a range of other micro-organisms have been implicated as causes. The cow’s immune response causes an increase in somatic cell count (SCC) in the milk. The EU has set limits for both SCC and bacterial content of the milk.

The report argues that the causes of mastitis are multi-factorial. These include:

- Hygiene in the barn and milking parlour
- The immune status of the cow
- Overall management of dry and transition cows
- Nutritional status of the cow
- General treatment of the cow by stockpeople (“Negative actions by the milker affect the occurrence of intramammary infection. Shouting and beating increases rest milk in the udder.”)

Stockmanship is stated to be the key factor affecting levels of mastitis. In terms of housing, there is a greater risk in straw yards if bedding is not kept in a hygienic state (but note that straw yards have less risk for other welfare factors such as lameness). Access to pasture reduces risk (see earlier section on pasture).

Whilst genetics was regarded as a lower risk factor for mastitis, the reports were also clear that there genetics do affect mastitis levels and that high milk yield may increase the risk.

In the risk assessment, genetic selection for high milk yield with insufficient emphasis on other traits relating to fitness showed a relatively low risk of causing udder problems in comparison with some management factors and no differences were observed among the different housing systems analysed. The genetics of mastitis resistance in dairy cattle has been studied for a long period. Most studies have focused on milk somatic cell count or clinical mastitis records as the phenotypic measure to account for mastitis resistance. Somatic cell count and clinical mastitis have a large genetic component, are genetically correlated, and many data on them are readily available. Mastitis resistance is genetically antagonistic to production traits, and there is increasing economic

justification to include the trait in the breeding objectives for the breeds. Therefore many breeding programmes have included somatic cell count, clinical mastitis, or both, in recent decades, as a way to improve resistance to intra-mammary infections.

From Summary of scientific opinion on welfare of dairy cows in relation to udder problems

The report also stated that high milk yields impose stress on the udder leading to risks of injury and mastitis in older cows.

Selection for milk yield and milk practices imposes stress on the udder. With an average daily milk yield of 28 kg milk the suspensory ligaments of the udder have to support more than 70 kg tissue and stored milk. As animals age the support capacity of the ligaments is reduced resulting in pendulous udders that might be vulnerable to injury and mastitis.

From Summary of scientific opinion on welfare of dairy cows in relation to udder problems

The report made a range of recommendations for the reduction of mastitis including genetics, management and stockmanship.

In addition to improved methods for genetic selection, the prevalence of mastitis should be reduced also through: treatment of clinical and subclinical disease, dry cow therapy, identification and elimination of carrier cows, prevention of transmission of infection from cow to cow or through the environment, and improvement of the immune system by minimising stress factors and by a controlled and nutritionally-balanced feed intake.

From Scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease

In addition, the inadequate milking procedures (poorly designed or managed milking equipment) lead to teat injury, pain and udder disease in dairy cows. Cow welfare is also poor when stockpersons behave harshly or inconsistently to cows during collection of cows, milking and post milking movement.

From Summary of scientific opinion on welfare of dairy cows in relation to udder problems

Bedding must be maintained in a hygienic state.

Udder infections may occur more in straw-yards where insufficient attention is given to hygiene of the bedding. If stocking density in straw yards is too high, this may lead to teat-trampling. Bedding hygiene is important for udder health in all systems. The risk assessment showed that the inadequate bedding has a high magnitude of the adverse effect in all systems but the risk is higher in straw yards, followed by tie-stalls then cubicle housing and very low in pasture.

From Scientific opinion on welfare of dairy cows in relation to udder problems

The report also argued that pain relief should be provided for cows with severe mastitis stating that *“pain management should be part of the treatment of severe lameness and clinical mastitis.”*

The report made a general recommendation about the training of stockpeople to recognise disease of all kinds including mastitis and for the involvement of veterinarians.

Farmers should be well trained in recognizing signs of disease at early stages and veterinary advice should be sought at an early stage of disease in dairy cattle.

From Scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease

Leg health and lameness

Lameness causes pain. It affects a range of the cow's behaviour including walking, feeding, standing up and lying down. In turn these affect the cow's body condition, social relationships and susceptibility to diseases such as mastitis. The report argues:

Most lame cows are in pain and have greater difficulty in coping with their living conditions than non-lame cows because of the effects of the foot or leg disorder on walking, lying comfort, standing up and avoidance behaviour. Lame cows are more likely to become subordinate, lose body condition and are more prone to show reduced fertility and to develop mastitis and metabolic disease.

From Summary of the scientific opinion on welfare of dairy cows in relation to leg and locomotion problems

The report suggests that the causes of lameness are multifactorial including genetics, housing and management.

Genetics has altered the size and shape of the cow. Larger cows are more likely to suffer injuries, especially if kept in housing originally designed for smaller ones. The shape of the udder affects both walking and comfort while resting.

Careful management and design of housing are the two key factors affecting lameness:

the most important hazards and risks are those associated with inadequate provisions for lying, standing and walking in cubicle houses and tie-stalls, and management failures relating to locomotion monitoring and foot care.

From the Scientific opinion on welfare of dairy cows in relation to leg and locomotion problems

As stated elsewhere, the report recommends that alternatives to cubicle systems such as straw yards should be developed. In the short run, cubicle design should be improved.

The report makes key recommendations in relation to management including the development of lameness prevention programmes.

Weekly attention to foot hygiene in dairy cattle leads to reduction of infectious conditions of the foot. When the prevalence of recognisable locomotor difficulties in dairy cattle is above 10%, this indicates that the prevention programme is inadequate. Because of the high risk of lameness in dairy cattle all dairy farmers should implement a lameness prevention programme. Well-executed hoof-trimming can reduce the likelihood of lameness and improve cow welfare but poorly executed hoof-trimming can cause lameness.

From Scientific opinion on welfare of dairy cows in relation to leg and locomotion problems

There should be systems for monitoring the prevalence of lameness by scoring locomotion and foot lesions every 3 to 6 months in all dairy herds. Because of the high risk of lameness in dairy cattle all dairy farmers should implement a lameness prevention programme. On farms with a high prevalence of recognisable locomotor difficulties, e.g. approaching 10%, there should be improvement of housing conditions, genetic strain and management practices.

From Scientific opinion on welfare of dairy cows in relation to dairy cow welfare and disease

Problems relating to behaviour, fear and pain

Pain has been referred to already. It can be caused by:

- Lameness
- Metabolic diseases such as ruminal acidosis and milk fever
- Diseases such as mastitis
- Mutilations such as dehorning, disbudding, tail docking and branding
- Slipping on concrete floors or catching teats underfoot
- Insufficient bedding or discomfort lying due to poor udder conformation

The report recommends the use of pain relief for severe lameness and clinical mastitis.

On the subject of mutilations, the report recommends:

- Tails should not be docked. The procedure is painful, can lead to neuromas, stops the animals dealing with flies and can increase the risk of summer mastitis
- Hot-iron branding causes severe pain and should not be used. Cattle should be marked using micro-chips, freeze-branding or tags which involve small injuries
- If horn removal is necessary, anaesthesia and analgesia should be used. It should be carried out by disbudding. De-horning should be avoided wherever possible.

On the subject of behaviour, the report argues that cattle form complex long-lasting relationships. Mixing should be avoided wherever possible as it causes aggression and increases risk of lameness. Where mixing is unavoidable, it should take place on pasture.

In addition to avoiding mixing, the risk of bullying is reduced by ensuring cows have plenty of space to pass by each other on walkways. This is less of a problem in straw-yards and pasture-based systems, provided stocking densities are not too high, since the animals have plenty of space.

The separation of the cow from her calf is a cause of stress. This is less severe if the separation occurs quickly before a strong bond has been formed between them.

It is well documented that weaning and separation between a cow and her calf imposes stress on both ... Previous research has shown that when the calf is separated within 24 h after birth, the response by the cow and the calf is mild ... After the mother-young bond has been established, i.e. 2 days or more, both cows and calves show increased vocalisation, activity levels and place their head outside of the pen more often after separation ... It has also been shown that cows separated from their calves later after birth call with a higher fundamental frequency ... Cows separated after four days has also been reported to ruminate less often immediately after separation occurs

From *Effects of farming systems on dairy cow welfare and disease*

However, longer periods of suckling are good for growth of the calf. Suckling can also be good for the health of the udder.

Even a short suckling period of 10 days has been shown to result in a higher weight gain at two months of age (Metz, 1987). However, positive effects on the cow behaviour, health and physiology from nursing the calf has not been much investigated. The few studies that have been carried out have found that dairy cows nursing their calf get a better udder health.

From *Effects of farming systems on dairy cow welfare and disease*

The report does not refer to recent research which suggests that a period of suckling is good for the calf's social skills. For calves which are suckled for a longer period, it raises concerns that some teats may be under-suckled, leading to udder problems.

Phil Brooke, Compassion in World Farming, 2009