

## **CATTLE WELFARE ASPECTS OF ANIMAL HYGIENE**

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### **SUMMARY**

Industrialized cattle production is presently the subject of great changes, which in some respects have great detrimental impact on the animals. Modern intensive production systems often disregard the animals' behavioural needs, causing unnecessary stress and disease. In the light of Swedish cattle husbandry standards, housing, management, feeding, transport and slaughter practices, and animal welfare legislation are discussed, focusing on some specific welfare-related problems. Implications for future cattle husbandry are presented, heading for a sustainable food production.

### **BACKGROUND**

In modern cattle production, there are a multitude of interests that the individual farmer has to consider when making decisions. Laws and regulations constitute boundaries within which everybody must fit. The government and different companies, organizations and pressure groups put environmental, human health and safety, animal rights or other ethical interests in focus. Tradition and diverse practical farm-related and personal conditions limit the possibilities for change and development. And last but not least, the production must be profitable. When maximizing profit and competing for market-shares, farmers may sometimes put excessive priority on short-range economical interests, neglecting important issues which may in fact have long-range negative effects on the animals, the consumer confidence and, thus, the production economy.

In most industrialized countries the cattle production is presently the subject of great changes, which have a significant impact on the animals. The milk production per cow increases rapidly and dairy herds get larger – mainly through the disappearance of the smaller ones and the construction of new large barns. Tie-stall barns are replaced with cubicle systems, equipped with milking robots, intelligent selective closures, transponder-controlled feeders, activity meters, and other high-tech equipment. To an increasing extent, farmers become employers, managers and businessmen with employed staff. Transport distances and times to slaughter also tend to increase. And although the proportion of the population that is dedicated to agriculture and the awareness of conditions in primary production is diminishing, the animal food industry is exposed to serious concerns and demands from the consumers, focusing on biosecurity (mainly food safety and environmental protection) and ethical and moral aspects of farm animal husbandry. Ethical quality has become an issue in agriculture and adds significant value to agricultural products. Yet, diseases remain a major problem to cattle production, causing animal suffering and substantial economic losses.

Table I summarizes some important aspects of so-called natural conditions vs. intensive housing conditions. Cattle are genetically adapted to conditions where they graze on vast plains with almost unrestricted space and a high degree of comfort, the herd contains adult and young animals of both sexes, there is a coordination of behaviour within the herd – resulting in a relatively

marked daily herd rhythm, the growing rate and milk production is low, there is almost no risk of contact with dropped manure, the risk of injuries and production diseases is low, and the turnover rate of herd members is low, with a long average life-span.

**Table 1.** Important comparative aspects of natural and intensive housing conditions for cattle.

Natural conditions <sup>1</sup>	Intensive housing conditions
Free roaming on vast plains	Confinement to a building, forced transport
Almost unrestricted space	Restricted space
Exposure to all types of weather	Shelter from bad weather
Exposure to predators	Protection from predators
Natural behaviour	Modified and abnormal behaviour
Herd composed of all ages and both sexes	Herd composed of a few animal categories
Frequent social encounters within herd	Restricted social encounters within herd
Marked daily herd rhythm	Herd rhythm less marked or disrupted
Unrestricted and natural breeding	Controlled breeding, artificial insemination
High degree of eating and resting comfort	Limited eating and resting comfort
Free grazing	Seasonal and restricted grazing
Diet based on pasture	Diet based on silage and/or concentrates
Low growing rate and milk production	High growing rate and milk production
Nursing	Mechanical and automatized milking
Gradual weaning over several months	Forced weaning at early age
Small risk of contact with droppings	Constant contact with manure, poor hygiene
Low risk of production diseases and injuries	High risk of e.g. mastitis and hoof diseases
No health management intervention	Systematic health management intervention
Long life-span	Short life-span and high herd turnover rate
Dying from starving, disease or predation	Slaughter

<sup>1</sup> Conditions to which the animals are genetically adapted.

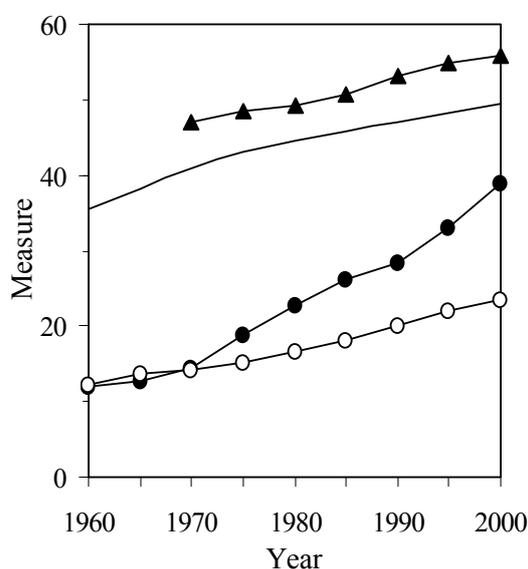
In modern intensive production systems, on the other hand, the space is restricted with a limited freedom of movement, the comfort is usually unsatisfactory due to suboptimal designs of buildings and fittings, the hygienic conditions are often poor and the animals are in constant contact with wet and dirty surfaces, the floors in alleys and holding areas are hard, feeding is intensive with high-protein and low-roughage diets, the milk production and turnover rate of animals are extremely high, and the milking equipment and milking technique often incorrect causing stress, injuries and disease. Because the space for housed cattle is restricted and the animals themselves hardly avoid contamination with manure, they easily get dirty. In any type of cow stall, there is in fact a conflict between demands for cleanness and the cow's freedom of movement, i.e. the more space given, the higher the risk of contamination with manure (Figure 1). Poor cleanliness reduces the animals' comfort and well-being in terms of skin lesions, itch, pain, uneasiness, restlessness, poor thermoregulation, and secondary diseases. Moreover, milk quality may be impaired, and consumers may consider the production conditions ethically unacceptable.



**Figure 1.** When cattle are confined to a given space, there is a conflict between demands for cleanness and the animal's freedom of movement.

The turnover rate of dairy cattle is extreme; around 38% of all Swedish cows are culled each year and replaced by heifers. The age at culling of a Swedish dairy cow is on average 61 months, which corresponds to an average number of lactations of approximately 2.4 among all productive cows. There is some discussion regarding the optimal recruitment rate, because it has been argued that most cows do not get old enough to show their full productive capacity, and that the present high recruitment rate, although perhaps short-term cost-efficient for the individual farmer, might not be beneficial from a wider and longer perspective.

Figure 2 illustrates the almost linear increases in herd size, milk yield, live body weight and manure production in Swedish herds between 1960 and 2000. Between 1970 and 1995, the estimated average labour time per Swedish dairy cow was reduced by almost 50% (SHS, 1996), and Danish dairy farmers spent approximately 30% less labour time per tied dairy cow in 1994 than in 1983, according to Agger and Alban (1996). Together these factors demand increasingly efficient and animal-friendly dairy-cow housing.



**Figure 2.** Average herd size (—●—), milk yield (kg ECM per cow and day; —○—), estimated live body weight of first-calvers (x10 kg; —▲—) and estimated manure production (kg faeces and urine per cow and day; —) in dairy herds enrolled in the Swedish official milk recording scheme 1960 to 2000 (Larsson, 1955; Overcash et al., 1983; Swedish Board of Agriculture, 1995; Swedish Dairy Association, 2002).

A sustainable animal food production demands humane livestock husbandry systems. Organic farming is founded partly on such ethical concerns (Lund, 2002). It is adopted increasingly in Europe. Between 1993 and 1997, Sweden had the greatest increase in the percentage of organic agricultural land area in Western Europe. In 2001, the highest percentage of agricultural land area under organic management was seen in Austria, Switzerland, Liechtenstein, Finland and Sweden (IFOAM, 2002, <http://www.ifoam.de/>, accessed 22-January-2002). Similarly, the percentages of organic farms in Scandinavian countries are among the highest in Europe. In 2000, 4% of all Swedish dairy herds and cows were organic (Varhos, D., KRAV, Uppsala, Sweden, 2001, pers. comm.). However, hitherto there is not much evidence that cattle are healthier in organic than in conventional production (Lund, 2002). Whether or not their welfare is superior depends on how we choose to define it.

In the following, I discuss how welfare may be defined and assessed. Standards and practices for housing, management, feeding, transportation, slaughter and legislation are discussed, pinpointing some specific welfare problems. Because of its far-reaching legislation and detailed

regulations regarding animal welfare, Sweden serves as an example when looking closer at welfare aspects of animal hygiene in general.

## **ASSESSMENT OF WELFARE**

Welfare is an elusive concept, to a great extent formed by current ethical beliefs, including a perhaps strong but vague, yet agreeable, human urge to treat other living creatures well. Traditionally, the welfare concept is regarded to embrace both the physical and mental well-being of the animal. Generally, there is one view advocating that the welfare concept be defined based on the feelings of the animal (Duncan, 1996), and another that regards the animal's attempts to cope with its environment as a key factor to the definition (Broom, 1996). A third view has been advocated by Rollin (1996), stating that animals have a right to live according to their nature. According to Rollin, the moral basis for a relationship between humans and animals can be viewed as a contract between business partners.

For most purposes, including this text, it suffices to say that animal welfare refers to the fulfilment of basic needs, health and suffering of the animals, and that it can consequently range from 'high' to 'low' or from 'good' to 'bad'. However, there is still considerable uncertainty and disagreement regarding the correct interpretation and application of the concept in farm animal husbandry. Work is underway to hopefully clarify these matters. There is a growing awareness that animal welfare is a wider concept than animal health, and in fact encompasses the latter (Broom, 2001). The EU Farm Animal Welfare Council (2002, <http://www.europa.eu.int/>, accessed 16-Dec.-2002) has summarized the welfare concept in "the five freedoms": freedom from hunger and thirst, freedom from discomfort, freedom from pain, injury and disease, freedom to express normal behaviour, and freedom from fear and distress.

Given a precise functional definition, animal welfare may be assessed objectively. On-farm recording of animal welfare is the subject of great interest in many countries. Through international co-operation standardized recording methods are being developed and defined for practical use. There is a growing agreement that welfare should be recorded at the animal level, using direct measures, as opposed to indirect measures or indices at the group level (Keeling, 2001). Thus, housing conditions (e.g. space allowance, stocking density, cleanliness of flooring and fittings) form an important part of the conditions of life and may have a great impact on animal health and behaviour, but do not measure the animal's degree of suffering or happiness directly. Production results (growth rate, milk yield, fertility, survival, longevity) may be influenced by health and well-being, but are only indirect measures. Likewise, drug use is nothing but an imperfect measure of the amount of medical treatment. Instead, physiology, behaviour and disease occurrence are key elements of welfare assessment. The classical physiological stress reactions (increased heart rate, secretion of catecholamines and/or cortisol) are reliable but difficult to utilize in practice. Body condition, hair-coat condition, cleanness of the animal, disease occurrence and injuries are obvious and important elements of animal health. Herd health records, however, summarize disease occurrence at the herd level, which is not very helpful from a welfare perspective.

Due to the mediating role of the animals' behaviour, behavioural measures have been used as indicators of the detrimental or wholesome effects of housing and management factors (e.g. Wierenga and Peterse, 1987), regardless of the importance of the behavioural expressions themselves. Behavioural changes are usually early signs of animal discomfort. Behavioural measures include abnormal behaviours (tongue-rolling, inter-sucking, inter-suckling, abnormal rising or lying-down movements) and fearfulness to humans, innate objects or novel environments.

With the intention to support objective assessment of animal welfare and make comparisons between animals and herds possible, a number of welfare indices have been proposed (e.g. Sundrum, 1996; Bartussek, 1997; Matthes et al., 1998). Such indices are designed to summarize information from several parameters, be they direct and individual measures of physiology, health and behaviour, or indirect and group-level measures. One problem of welfare indices is that incomparable quantities must be weighed and combined. For instance, which is worse, one case of footrot per year or a constant dirtiness on the hind-part? The way one would like to combine the measured quantities obviously reflects the applied (possibly implicit and unspoken) definition of the welfare concept. However, the most adequate definition may in fact vary from time to time, depending on the purpose. Therefore, the idea of a welfare index may convey a false and illusive impression of objectivity and simplicity. Instead, there are several objective elements that in different ways relate to animal welfare, that should be assessed separately and used parallelly to produce a more complete picture.

It is not possible to understand the nature of another species' life experiences without the introduction of some bias (Cook, 1995), and signs of pain may be less obvious in cattle than in other species. Nevertheless, cattle have the ability to feel pain and neural mechanisms of pain perception seem to be similar in cattle and humans (Iggo, 1984). Foot lesions are often painful, causing lameness and a disturbed gait, although Swedish cattle seem to be much less lame – with respect to both prevalence and degree – than the cows in most other countries (Greenough, 1997). Regardless a high prevalence of hoof lesions at preventive claw trimming of Swedish dairy herds, only 5% of the cows were lame (Manske et al., 2002), compared to e.g. 21% in the UK (Clarkson et al., 1996). Moreover, foot diseases are in many cases long-lasting. If the claws are not trimmed regularly, lesions are easily overlooked and often aggravate to incurable chronic conditions. Recent studies suggest that chronic lameness produces a long-term centrally mediated decrease in pain threshold (Ley et al., 1989, Whay et al., 1997 and 1998; Logue et al., 1998). Even non-lame dairy cattle with hoof lesions have a longer lying-down phase and longer lying bouts than cattle without lesions (Berry et al., 1998). Therefore, hoof health should be seen as an important component of cattle welfare, and probably even more so than e.g. udder health. Recent Swedish research (Manske et al., 2002) and practical experiences show that it is not possible to get complete records of hoof lesions by only examining clinically affected (lame) animals, because most lesions are found in connection with preventive claw trimming.

## **HOUSING**

Housing practices have far-reaching and important implications for animal health and behaviour. Climatic and farming conditions vary a lot between countries and regions, and a multitude of cattle husbandry systems have evolved. Due to the cold climate in northern Europe, all dairy cattle and most beef cattle are housed except for a grazing period of approximately 2-5 months. The diversity of husbandry systems is also matched by different cattle breeds, which may be of dairy, dual purpose or beef type. The predominant dairy breed worldwide is the Holstein-Friesian breed, with exceptions of e.g. Sweden, Norway and Finland, where traditional Nordic red breeds still are most numerous. In contrast, the beef herd is very diverse, with large variations between countries.

Approximately 75% of the Swedish dairy cows are tied, but the trend is towards loose housing. The predominant loose-housing system is cubicles or free stalls, while deep-bedded pack systems are less common. Long-stalls are a traditional North European housing system for tied cattle. As opposed to ordinary tie-stalls (short-stalls), where the cows have access to the manger 24

h per day, long-stalls are equipped with lockable feeding barriers. They are still popular in certain parts of Sweden, although decreasing in favour of short-stalls and loose housing. It appears that the vast majority of housed fattening cattle are accommodated in loose housing with slatted flooring, in Sweden and globally. Cattle kept solely on concrete slatted floors have difficulties to lie down, an increased incidence of abnormal postures, lesions to the carpal joint and tail, and may show abnormal behavioural changes (Andreae, 1979; Graf, 1979; Andreae and Smidt, 1982; Pougin et al., 1983; Wierenga, 1987; Lidfors, 1992; Metzner et al., 1994).

A housing facility for livestock may be regarded as being composed of several functional parts, corresponding to the different behavioural needs of the animals and the management demands of the stockman. Obviously, the animals have a need for a place to consume feed and water, a place to lie down and rest, a place to mate, a place to calve, a place to nurse or get milked, and a place to drop manure (Figure 3). There is also a need for social behaviour and movements between different functional parts. In a loose-housing system, most of these parts are separated physically. In that way, each functional part can be optimized relatively independently of the other, and loose housing has a great potential for future development and improvement.



*Figure 3. A housing facility for livestock may be regarded as being composed of several functional parts, corresponding to the different behavioural needs and management demands.*

In comparison, in a tie-stall system, the functional parts are to a great extent combined into multi-purpose stalls, where the animals and their stockman are supposed to perform most activities. Two different behavioural needs easily come into conflict with each other, if they rely on different stall designs. For instance, resting behaviour requires a lounging space for forward head movements when rising, which implies a low edge of the feeding table (the cows are supposed to swing their heads over the feeding table). Therefore, in Swedish regulations, the height of the edge may not exceed 20 cm. At the same time, a comfortable stance while eating and possibilities to reach the feed require the feeding table not to be too low, according to Swedish regulations not lower than 10 cm. Still, these figures are merely a compromise; more optimally designed resting- and eating-places are hardly possible to obtain within the tie-stall system. Another obvious example of a conflict of interests is the trade-off between space and cleanness, described above.

In summary, when compared to tie-stalls, loose housing allows for a more natural animal behaviour, greater flexibility and potentially higher functionality. On the other hand, in loose housing it seems to be less easy to offer animals individual care, there is probably a higher level of social stress and most certainly a faster spread of contagious diseases within the herd. The occurrence of diseases in general is lower in loose housing (e.g. Bakken et al., 1988; Bendixen et al., 1988a and 1988b; Krohn and Rasmussen, 1992; Saloniemi, 1995; Hultgren, 2002), with the

important and striking exception of hoof diseases in cubicle systems (e.g. Thysen, 1987; Alban et al., 1995; unpublished results). Management practices for diseased animals, e.g. separate housing of lame cattle and separate milking of mastitic cows, deserve special attention in large loose-housing systems.

All floors should be even and stable, and prevent slipping. In Sweden, concrete slats are not allowed in the lying area of heifers in late pregnancy and of cows. There must be a separate pen for calving, which should not be used for sick or injured animals, although this is often the case. Individual calving boxes are most common in Sweden (minimum 3.0 x 3.3 m). Calves are usually housed in individual boxes for the first weeks of life and then transferred to group housing on concrete slats or deep-bedded straw. On organic farms, calves must have access to a lying-place with solid flooring. Outdoor calf huts are rare in Sweden but common in certain parts of North America..

The trend towards larger cubicle-housed herds probably influences the risk of on-farm spread of contagious diseases and render sanitary actions more difficult. On the other hand, a reduced number of herds is expected to decrease the risk of spread between herds, also depending on e.g. routines for animal trade and transportation, slaughter, delivery of dairy products, and health management schemes.

## **MANAGEMENT AND FEEDING**

Cattle are highly social animals. Groups of cattle have a social hierarchy that determines priority of access to resources. Mixing of animals and housing animals in very large groups may disrupt the hierarchy and increase aggression. From a health perspective, frequent regrouping of livestock may increase exposure to pathogens and prolong disease outbreaks. Fraser and Broom (1990) suggest that cattle may recognize a maximum of 50-70 other individuals.

Swedish farmers are under the same economic constraints as other farmers in Europe, although those in Northern Sweden can be eligible for some economic rural development support from the EU. Sweden probably more than most other industrialized countries still has family-owned and family-run dairy farms, although this is changing with increasing dairy herd sizes. The fact that the farmer lives on the farm probably has an effect on the amount of time spent with the cows and interacting with them. Without doubt most farmers would notice and react to behaviour patterns that have some relationship to health or production, e.g. a loose-housed cow lying in a slatted alley. But it is less clear how the same farmer would react if the abnormal behaviour had no such implications, e.g. stereotyped tongue-rolling. Good management routines and skillful stockmen play a critical role in surveillance and care, thus promoting animal health and well-being.

In Swedish farms, rubber mats are probably the most common type of floor covering in both cubicles and tie-stalls, although new types of mats and mattresses are rapidly coming into use. The lying-place should be littered. Straw is the usual litter material for small calves. It is also common for cows, but alternatives are sawdust or wood shavings, especially in the northern part of Scandinavia where grains with a straw appropriate for bedding cannot be cultivated easily and forestry is a major industry. Peat has a limited use. In the US, sand is the most common type of bedding for loose-housed dairy cattle. As already mentioned, sand bedding has recently been approved for cubicles in Sweden but is not yet common on farms. All animals should be kept clean.

In many countries, it is usual practice to remove the calf from the cow at day old, but on ecological farms it is required that the calf stays with its mother during the entire colostrum period, i.e. the first four days of life. This practice seems to become increasingly common on conventional Swedish farms, too. Foster cows are sometimes used as a means of cleaning the udder of cows

with slightly elevated cell counts. Teat buckets and automatic feeding of milk are used increasingly, although practices for sectioning and grouping are often far from adequate, which increases the risk of disease. In the US, beef cattle may spend 250 days in feedlots, where animals are collected in groups of 100 to 600 head and fed finishing rations. In feedlot pens, extreme heat or cold, and mud can cause serious health problems.

Swedish legislation prohibits most types of amputation (for instance tail docking) without veterinary reasons, but allows dehorning and castration of cattle. Castration causes severe pain and distress. In mainland Europe, the majority of male animals are fattened as young bulls, while they are generally castrated and fattened as steers in e.g. the UK, Ireland and the US. In Sweden, dehorning of calves is usually performed by technicians employed by the breeding organization before one month of age and under anaesthetic. As opposed to most other countries, surgery may only be carried out by veterinarians. There is a great awareness about the importance of preventive hoof care in Sweden, largely due to ongoing research in this area at the Department of Animal Environment and Health, and opportunities for practical education of hoof trimmers. All cattle need claw trimming when tethered for long periods or kept on excessively soft surfaces. In general, Swedish dairy cows are claw-trimmed once or twice a year, using either an electric grinder or a mallet and blade.

The possible negative influence of so-called electric cow-trainers has been the subject of lengthy discussions in several countries. Based on research in several countries, cow-trainers were banned in Sweden in 1995, although they are still in place and used on some farms. Apart from Sweden, only one of the German federal states have adopted a complete ban. Electric cow-trainers are common in Germany, Switzerland, Norway, Denmark and parts of the US, where tie-stalls are still used extensively.

Sweden has a restrictive view on the use of antibiotics and hormones. All antibiotics and most other medicines should be dispensed through veterinarians and the use of them is under veterinary control. Sweden does not allow the use of antibiotics as a growth promoter, as being practised in e.g. the US, and hormones are not allowed generally for growth promotion or oestrous synchronization.

Cattle are ruminant herbivores and mainly grazers. Rumination may account for a substantial part of cattle activity, approx. 8 hours daily. In high-producing dairy cattle, feeding is intensive and one problem lies in getting enough feed into the animals to support their high energy output. Feeding practices vary widely with breed and climatic conditions. In most cattle-producing countries, the quality of the roughage, including its structure and content of nutrients and fibre, is a major issue. In Sweden only approximately 10-15% of loose-housed dairy herds are fed a total mixed ration instead of roughage and concentrates separately.

## **TRANSPORTATION AND SLAUGHTER**

When animals are exposed to a novel situation such as transportation, they react by eliciting certain physiological and behavioural reactions in order to cope. Combined aspects of transport that contribute to stress in livestock include loading and unloading procedures, close proximity to stock handlers, deprivation of water or feed, noise, riding in a truck, mixing with other animals and being forced into unfamiliar environments. Major areas that dictate the standard of livestock transport are the adequate preparation of animals for transport, controlled prior access to water and feed, minimal disruption of social groups, considerate animal-handling skills, adequate handling and transport facilities, including good ventilation in trucks and a careful driving technique, and limited transport times (Atkinson, 2000).

Animal transport has been the focus of attention in the welfare debate during recent years, especially in the EU. In general, large amounts of movements of live animals occur between countries, which in a most evident way causes unnecessary animal suffering. Most of the specialized Swedish beef production with dairy breeds relies on the transfer of calves from dairy installations to beef units at the age of 1-2 months. However, traditionally, Sweden does not have an extensive system of markets for live animals, which is seen in many other countries. This means that Swedish cattle are not usually exposed to the stress of transport and mixing with unfamiliar animals, as occurs in for example the UK, and it also makes it less likely that disease spreads quickly. Continuing education of Swedish slaughter-house and transportation staff in animal care and handling has been initiated.

When livestock are taken to slaughter and during the slaughter, the animals must be protected from suffering. In keeping with other countries, there is unfortunately a decrease in the number of Swedish slaughter-houses, resulting in increased travel distances and times, and possibly reduced animal welfare. At normal slaughter, stunning should precede blood drainage. Traditional Jewish kosher slaughter is not allowed in Sweden.

Up until a few years ago there was a special system for slaughtering injured or lightly diseased animals in Sweden. For several reasons this system has now been removed, which may have resulted in farmers keeping injured animals for longer until they can be sent for normal slaughter. This may be viewed as a step backwards for animal welfare. Severely injured or diseased cows are culled on-farm and the carcass is transported to destruction facilities. There is an ongoing discussion in Sweden about the introduction of mobile slaughter-houses.

## **LEGISLATION**

Legislation regarding cattle housing and management should be based on scientific evidence, including animal health and welfare aspects. Sweden has among the most radical welfare legislations in the world (*SFS 1988:534 and 539; SJVFS 1993:129*, with complementary statutes) and the subject generally has a high profile, without the open conflicts that are seen in some countries. This level of public concern and awareness combined with a positive attitude of the dairy industry has facilitated legislation that is often in advance of that in the rest of the world. Key phrases in the Swedish animal welfare legislation are that animals shall be treated well, protected from unnecessary suffering and illness, and given the opportunity to perform their natural behaviour. This emphasis on natural behaviour and on promoting health has had major implications for details of the legislation and so on farm animal husbandry. There are also several quality assurance schemes, often aimed above the minimum level required by legislation. In some of these, the farmers may get a different price for their product depending on its quality. Although it is intended that welfare is a part of this, attention is often focused on those issues associated with health and economics, e.g. milk cell counts and milk quality. On the other hand, national characteristics of Swedes include an emphasis on safety and a willingness to accept legislation for the greater good of society. Such human traits have also influenced the development of Swedish cattle production.

Swedish animal welfare legislation includes regulations regarding pen, stall and alley dimensions, inspection and care of animals, indoor climate, daylight, noise, cleaning routines, transport, and slaughter, whereas most other countries have only recommendations. Space requirements for animals in a specific system are generally slightly more generous in Sweden than in other countries. According to the Swedish statute on animal protection, new technical systems and equipment for livestock must be pre-tested and approved officially from an animal health and welfare perspective before they are introduced commercially. The Swedish Board of Agriculture

decides upon when and how the pre-testing should be carried out, and upon final approval. In recent years, the pre-testing scheme has been applied to the introduction of e.g. sand-bedding cubicles, rubber-slatted tie-stall flooring, and automatic milking systems. A similar pre-testing procedure has been adopted in Norway (Norwegian Agricultural Inspection Service, 2002, <http://www.landbrukstilsynet.no/>, accessed 1-April-2002) and Switzerland (Wechsler, 2001), but is lacking in most other countries.

To ensure that housing facilities meet the legislation requirements, all Swedish barns for 10 or more adult cattle or 20 or more young animals must be checked and approved by the county administration before they are built or major reconstruction is carried out. Since the beginning of the 1990's, the number of dairy barns approved each year has corresponded to 2-5% of all existing Swedish dairy barns. When building or rebuilding a dairy barn, there is usually a substantial increase in herd size (almost 50%, on average, in Swedish barns approved during 2000). Loose-housed herds are usually considerably larger than tied herds.

New technical solutions that are introduced in animal husbandry may have unexpected and undesired effects, causing e.g. stress or disease, if they have not been tested previously. Disastrous effects may be evident after several years, when the technique has been applied to numerous farms, thus affecting a large number of animals. Beside approval for each building, all new equipment designs and techniques in Sweden have to be pre-tested from an animal health and welfare point of view before being made available for commercial sale to farmers. During recent years, systems for robotic milking, rubber-covered slatted flooring for tied cows, and cubicles with sand bedding have been tested. No milk robots were seen on commercial farms in Scandinavia a few years ago whereas the number of such farms was 138 in Sweden and 208 in Denmark in September 2002 (B. Everitt, Swedish Dairy Assoc., 2002, pers. comm.), approx. 400 in the Netherlands (H. Hopster, ID Lelystad, the Netherlands, 2002, pers. comm.) and maybe 20 in the UK (M. Seabrook, Univ. of Nottingham, UK, 2002, pers. comm.). The number of milking-robot farms in the world had passed 1,100 already in 2001 (van der Vorst and de Koning, 2002).

In Sweden, legislation is enforced by animal welfare inspectors and work is currently underway to standardize their evaluations better across the country. The county administration may prohibit a person that seriously violates Swedish animal welfare regulations from keeping animals.

In contrast to Sweden and other countries where the government has taken a relatively large responsibility for the animal welfare standard – as well as other aspects of social security – the animal welfare legislation of e.g. the US is very weak, almost non-existent. Only recently, the fast-food chains have brought welfare issues into focus, putting pressure on suppliers of animal food products. This is of course a positive trend.

## **CONCLUSIONS**

Present trends in intensive cattle production imply a higher milk production, larger dairy herds, introduction of advanced and automatized technical solutions, longer transports to slaughter, and a more business-oriented farm management style. In some respects, these trends contribute to a reduced cattle welfare. More research is needed to reveal consequences on e.g. animal health, behaviour and productivity, aiming at a sustainable animal food production. More optimal housing and management systems need to be developed, including improved routines for suckling in milk-producing herds, automatized milk-feeding, handling at transport and slaughter, biosecurity, and systematic health recording and management.

Because of their high prevalence, often chronic and painful course, and strong association with cubicle housing, hoof diseases should be recognized generally as an important threat to animal well-being and sound cattle husbandry. Hoof lesions should not only be recorded in lame cattle, but also in connection with preventive claw trimming of non-lame animals. In all types of cattle production, the importance of good flooring needs to be recognized more widely. New types of draining and resilient floors should be developed to promote clean, dry and comfortable flooring. Conventional slatted floors without access to littered lying-places should be replaced successively by more animal-friendly systems.

Veterinarians and animal scientists have many opportunities and a responsibility to promote a greater understanding and respect for cattle welfare aspects of animal hygiene. This can be achieved by letting personal ethical values leaven and colour our daily work, thus influencing animals and people we meet, by producing and spreading reliable evidence of relationships between specific cattle husbandry practices and indices of stress, impaired health and well-being, by influencing politicians, authorities, companies and organizations that are involved in farm animal husbandry, and by participating in the public debate on animal ethics, husbandry, health, behaviour and welfare, in that way conveying beliefs and views that are based on a broad perspective, scientific evidence and common sense. The concept of animal welfare may have a different meaning to different people and in different situations; therefore, to be useful in practice, it often needs to be defined more precisely, e.g. in terms of physiological changes, disease occurrence and/or behaviour.

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