The Role of the Bovine Practitioner in Cattle Welfare

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Abstract

If the bovine practitioner is to make a positive contribution to cattle welfare then he/she must have a clear understanding of what constitutes welfare as perceived by the cow, and where the main problems are likely to arise. Welfare can be defined by the ability of an animal to sustain fitness and avoid suffering. The high-yielding dairy cow is genetically fit at the onset of her first lactation but then faces physiological demands that are abnormal not in intensity, but in duration. Too many dairy cows culled after only 1-4 lactations are chronically lame or emaciated and appear to be "worn out" by sustained hard work. The main welfare problems for dairy cows in northern Europe can be attributed to systems of feeding, housing, milking and management that are unfitting to the genotype of the high yielding cow. New technologies for the control of breeding or the hormonal manipulation of lactation should be controlled by legislation that gives better protection not just to the veterinary profession but also to the animals. Cattle used for commerce should receive equal protection in the law to that given to animals used for scientific purposes. In each case any cost to the animal must be justified in terms of any potential benefit to society.

Key Words: Welfare; Mastitis; Lameness; Metabolic demand

Introduction

The constant endeavour of the veterinary practitioner is to ensure the welfare of animals comitted to his/her care. A comprehensive review of the role of a bovine practitioner in ensuring the welfare of the dairy cow could involve the whole of cattle husbandry and medicine. This paper has more modest objectives; to propose mechanisms for definition and comprehensive analysis of welfare problems as perceived by cattle, to identify the most important problems (as perceived by the cow) and to suggest some approaches to their control. The welfare of a sentient animal such as the dairy cow should be defined both by its ability to sustain physical fitness and to preserve a sense of mental well being or, at least, avoid suffering (Webster, 1995). Thus, infertility constitutes a clear failure to sustain fitness (in the strict Darwinian sense) but cannot be called a welfare problem. Lameness, on the other hand, is a welfare problem because the lame cow experiences a loss of fitness *and* suffers pain. For many years, discussion of animal welfare was dominated by the concept of behavioural freedom and the extent to which this might be compromised in intensive husbandry systems. The Brambell Committee (1965) proposed that all farm animals should, at least, have the freedom to "stand up, lie down, turn around, groom themselves and stretch their limbs". These minimal standards (which have yet to be achieved) came to be known as the 'Five Freedoms'. This is a very inadequate definition of freedom since it concentrates almost exclusively on one aspect of behaviour (comfort seeking) to the exclusion of everything else that might contribute to good welfare, like good food, good health, security etc. By this definition there are no welfare problems for the dairy cow. In my early days on the Farm Animal Welfare Council (FAWC) I proposed a more comprehensive 'Five Freedoms' for first analysis of *all* the factors likely to influence the welfare of farm animals, whether on the farm itself, in transit or at the point of slaughter. These definitions have evolved somewhat with time and have recently been revised by FAWC so that they now read:

1. *Freedom from thirst, hunger and malnutrition* - by ready access to fresh water and a diet to maintain full health and vigor.
2. *Freedom from discomfort* - by providing a suitable environment including shelter and a comfortable resting area.
3. *Freedom from pain, injury and disease* - by prevention or rapid diagnosis and treatment.
4. *Freedom to express normal behaviour* - by providing sufficient space, proper facilities and company of the animal's own kind.
5. *Freedom from fear and distress* - by ensuring conditions which avoid mental suffering.

Using the five freedoms as a check list, one can identify the following as potential contributors to poor welfare in the dairy cow.

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1. Hunger or acute metabolic disease; due to an imbalance between food availability and requirement (as defined by genotype or physiological manipulation).
2. Chronic discomfort; through bad housing, loss of condition etc.
3. Chronic pain or restricted movement due to injury or distortion of body shape.
4. Increased susceptibility to infectious or metabolic disease.
5. Metabolic or physical exhaustion after prolonged high production.

These potential sources of poor health and welfare are interdependent. For example, the large, genetically superior Holstein cow consuming a ration based largely on grass silage may suffer pain or chronic discomfort in a cubicle house partly because the quality of feed has been inadequate to meet its nutrient requirements for lactation and it has lost condition. Partly because the wet silage has contributed to poor hygiene and predisposed to foot lameness, and partly because genetic selection has created a cow too big for cubicles. The aetiology of most herd health and welfare problems is complex and attempts by welfarists or producers to attribute them to single causes should be treated with grave suspicion.

Metabolic Demand and Metabolic Exhaustion

It is often assumed that the modern Holstein dairy cow has been selected to produce milk at a far greater rate than is 'normal' for a cow or other mammal. Table 1 (from Webster, 1993) compares the yield and composition of milk from different mammals and shows that when yields are expressed for comparative purposes in terms of metabolic body size, ($W.kg^{0.75}$), a typical yield of Holstein of 31 1/day is similar not only to that of the smaller Jersey cow and Saanen goat but also to that of the sow or bitch. There are less prolific milkers, such as the human female or Hereford cow, but peak lactation yield in the highly selected dairy cow is not conspicuously greater than that of many other mammals who have not been selected for milk production *per se*. The most unusual feature of the metabolic load on the lactating cow (or goat) is not the intensity of the metabolic load but the length of time it must be sustained.

Peak yield is constrained by genotype, nutrient supply, (itself constrained by appetite), exogenous hormones (e.g. growth hormone), frequency of milking, and the psychological stimulus of suckling a calf. Recent studies in Israel (Knight, 1995) compared milk yields in early lactation in Holsteins on three treatments; milked three times daily (39 1/d), six times daily (46 1/d) and combined thrice-daily suckling with thrice-daily milking (52 1/d). Typical dry matter intakes of such cows are 24-26 kg/d. Peak milk yields of these superior Holstein were not limited primarily by the genetic and physiological potential of the mammary gland to synthesize milk, but by the artificial nature and infrequency of the stimulus to release milk. It would have been interesting to have extended these treatments to see how long these very high milk yields could have been sustained. Almost inevitably, yields would eventually have been constrained by a shortage of substrate supply to the mammary gland from absorbed nutrients and mobilized body reserves.

Table 1. A comparison of the yield and composition of milk of different mammals according to metabolic body size. ($W,kg^{0.75}$).

	Holstein cow	Jersey cow	Saanen goat	Sow	Bitch	Woman
Body weight (kg)	600	400	6.5	200	26	60
Metabolic size	121	89	22.9	53	11.5	21.5
Milk yield (l/d)	31	21	5	7.5	11.3	1
Composition (g/l)						
protein	33	37	35	60	83	12
fat	27	49	42	83	97	38
lactose	45	46	43	52	41	70
Yield/kgM.per day						
energy (kJ)	745	820	700	770	715	132
protein (g)	8.4	8.7	7.6	8.4	9.4	0.6

In northern Europe the first limiting factor to sustained high yield is ME intake particularly when the main forage source is grass silage, which is slowly fermented and usually contains a relative excess of quickly degradable nitrogen. In these circumstances the cow may be simultaneously hungry for nutrients but full up with undigested fibre. This may induce suffering. Acute welfare problems of metabolic origin (i.e. metabolic diseases and any sense of suffering associated with the impossibility of resolving the conflict between metabolic hunger and digestive overload) need not be attributed to high yields *per se* but to nutrition that is inappropriate to the genotype. In this context therefore, the primary cause of metabolic stress is not productivity *per se* but imbalance between the metabolic demand of the mammary gland for nutrients and the capacity of the cow to eat and digest food in comfort. In these common circumstances injections of recombinant growth hormone (bovine somatotropin or rBST) to increase milk yield may increase metabolic stress by increasing demand for nutrients. However, poor quality grass silage may be said to constitute an equal insult to welfare by compromising the ability of the cow to meet its metabolic needs. High genetic merit cows who formerly consumed about 18kg dry matter/day when fed crude, imbalanced winter rations based on grass silage and dairy cake have increased intake to 24-25kg DM/day when offered well balanced Total Mixed Rations. This is clear evidence that clear dietary inadequacy can be not only a major constraint to performance, but also a potential source of distress. It is, however, possible to run a high genetic merit cow at a slow speed (i.e. relatively low milk yield) without causing metabolic stress. A full nutritional explanation of how this can be achieved is beyond the scope of this paper (see Alderman, 1995, Webster, 1993). Very briefly, the extent to which the cow can be made to increase yield without experiencing an energy deficit, and so losing condition depends on the balance of metabolizable energy (ME) and metabolizable protein (MP) in the diet. If the MP:ME ratio is too high, cows will tend to 'milk off their backs'; if MP:ME ratio is too low, yield will be reduced and cows may get too fat. The trick is to achieve the optimal MP:ME ratio to meet the needs of the genotype and the needs of quota. Chronic welfare problems of metabolic origin arise when the cow becomes unable to meet the sustained physiological and metabolic demands of lactation and suffers a severe loss of body condition, perhaps a reduced resistance to infection and, almost certainly a feeling of exhaustion. A significant proportion of dairy cows that are culled after only 1-4 lactations are very thin and/or chronically lame and it is difficult to escape the conclusion that such animals are "worn out" by sustained hard work.

Milking and Mastitis

A typical beef cow naturally rearing a single calf at pasture may produce 10 1 milk per day which will be consumed by her calf in 5-7 meals of 1-2 litres. In northern Europe, it is conventional to confine dairy cows for much of the year in houses with cubicles or free stalls, give them free access to grass silage and milk them twice daily. A typical Holstein dairy cow may yield 15-25 litres at a single milking. The conventional, but abnormal process of twice-daily milking allows 10 times the normal amount of milk to accumulate in the udder. This undoubtedly reduces milk yield, (Barnes *et al*, 1990: Hillerton *et al*, 1990) and may predispose to both mastitis and lameness. The association between increasing milk yield and mastitis is complex. Broad epidemiological surveys tend to suggest a positive association but can be used to reinforce any number of prejudices depending on which predisposing factors one chooses to ignore (e.g. Emanuelson, 1987; Morse *et al* 1987). The greatest incidence of mastitis is at the time of peak yield but there is little convincing evidence to link yield *per se* to reduced immunocompetence or predisposition to infectious disease. One would obviously expect to observe a reduction in immune competence in emaciated or exhausted cows. The incidence of environmental mastitis correlates with milk flow rate for largely mechanical reasons. Hillerton, 1991, has studied the effects of four-times daily milking on mammary health. The results are equivocal but promising, a transitory increase in somatic cell count and an increased rate of clearance of experimental infection with *Streptococcus agalactiae*. Hypertrophy of the cistern of the udder may predispose to environmental mastitis by increasing the exposure of the teat canal to environmental pathogens such as *Escherichia coli*. On the other hand, more frequent milking could increase the risk of teat damage and increase opportunities for invasion by environmental pathogens after each milking. There is a real need for further experimental (as district from epidemiological) research into the effects of frequent milking on the pathophysiology of mastitis. The development of automatic milking systems using robots for placing the teat cups offers an exciting opportunity to rethink the husbandry of dairy cows in a way that could be consistent both with increased productivity and with improved health and welfare. The cow that can, without having to queue, enter an automatic milking station of her own volition 4-6 times daily to be fed and/or milked as appropriate will certainly have the potential to produce more milk. She may also be less prone to not only mastitis but also to lameness because of the reduced distension of the udder. However, her demand for nutrients will increase with any welfare problems associated with an imbalance between nutrient supply and demand will become worse. Thus, a robot that milks cows 4 to 6 times daily may reduce the stresses on the udder but it would only improve overall welfare if feeding and management were also modified to ensure that the cow received a properly balanced diet of sufficiently high quality to provide the extra nutrients required to meet the increased yield within a working day that also gave her time to rest. If these needs can be met then one of the most extreme symbols of the factory farm, the milking robot, may prove to be one of the most successful marriages between high technology and animal welfare. One problem revealed by my colleague, Neville Prescott, is that accumulation of milk in the udder does not necessarily constitute a sufficient stimulus to motivate the cows to enter the milking unit. In other words, many cows offered free choice milking may dry themselves off.

Lameness

The aetiology of foot lameness in dairy cattle is, once again, complex, involving genotype (conformation and hoof quality), nutrition, housing, behaviour (Blowey, 1993; Vermunt and Greenhough, 1995) and physical changes associated especially with parturition (Kempson and Logue, 1993). The most striking feature of foot lameness in dairy cows is that approximately 75% of the cases occur in the abaxial claws of the hind feet. Distension of the udder at calving and chronic distension of the cistern associated with infrequent milking may predispose to foot lameness by causing uneven load on the axial and abaxial digits. Cows that are fed on grass silage produce large quantities of very wet faeces. The wet slurry may contribute to foot lameness and environmental mastitis both directly and indirectly because a farmer feeding grass silage is more likely to build a cubicle house than a straw yard. One can argue that grass silage is not only one of the major constraints of productivity of dairy cows in northern Europe, (because intakes are low) but also one of the major contributors to poor welfare through poor hygiene and the relative discomfort of the cubicle yard. The bovine practitioner should be well aware of the clinical picture (if not the biological explanation) of the effects of housing and feeding on foot lameness in dairy cattle. However, epidemiological and anatomical evidence both support the contention that the biggest potential threat to the integrity of the cow's foot is calving *per se*. One way to ameliorate this problem is to house dairy cows and heifers on straw for at least four weeks before and after calving.

Emergent Technologies and the Practitioner

Some of the most difficult ethical questions for the bovine practitioner arise from the application of new science and technology to the cattle industry. The rate of genetic improvement can be increased by multiple ovulation with embryo transfer (MOET) and in theory at least by embryo splitting, gene insertion and cloning. New biology based on our ability to define and manipulate the genetic basis of life is powerful, complex and, to the general public, rather frightening. I suggest that the major issues involved in the exploitation of new technologies to manipulate breeding (e.g. MOET, genetic engineering) or phenotypic performance (e.g. BST), can be addressed by two simple questions. These are:

1. Will the animal suffer? If so, how much?
2. Who, if anyone will benefit? If so, how much?

In reviewing the impact of new biology on the welfare of farm animals, FAWC (1993) stated "We accept that scientific investigation aims to be impartial and without prejudice so that it is impossible to pronounce *a priori* how any particular piece of new knowledge will affect farm animals". Nevertheless they recognized certain procedures that may have harmful consequences. These include "the manipulation of body size, shape or reproductive capacity by breeding, nutrition, hormone therapy or gene insertion in such a way as to reduce mobility, increase the risk of pain, injury, metabolic disease, skeletal or obstetric problems, perinatal mortality or psychological distress". This implies that the welfare implications of new biology should be defined not by the method used to manipulate the animal, but by its consequences. The incidence of developmental disorders leading to moderate to severe loss of mobility in heavy breeds of broiler fowl developed by conventional selection exceeds 25% (Kestin *et al.*, 1992). In this example, conventional selection has created animals that are, by virtue of their size and shape, in pain for a substantial part of their short lives and FAWC has called for the industry to achieve a significant reduction in these conditions within 5 years. This problem has arisen mainly because the broiler industry has not had to select for genetic fitness in the adult animal. One of the reassuring consequences of the fact that milk comes from adult cows is the fact that it is essential to select for traits that equate to fitness in the adult. The superior dairy cow should, at the onset of her first lactation, be a very fit animal. She will however be expected to work very hard indeed in circumstances where nutrition, housing and management may be unworthy of her physiological potential. At worst, her hind feet may be ruined within the first four weeks of her working life. I list below four important welfare issues relating to the application of new scientific procedures to dairy production.

1. *Pain and/or fear associated with the procedure itself or its immediate consequences.* It is assumed for legal purposes that this problem can be overcome by use of appropriate anesthesia. There is however good evidence that following procedures such as laparoscopy in man, pain may persist for some days. It is, at least, necessary to address this possibility in cattle (or sheep, for whom laparoscopy is the method of choice for embryo transfer).
2. *Periparturient problems associated with unconventional breeding.* The obvious problem is that of foetal oversize. However, twinning in cattle carries other health and welfare problems (e.g. retained placenta).
3. *Physical or psychological problems demonstrable in all (or most) of the genetically modified offspring.* It should be possible to discover major anatomical defects leading to lameness or restricted mobility (and by implication, pain) within one generation although in the case of broiler fowl, it has not yet been a bar to further selection for the same traits.
4. *Increased incidence of disease or disability only demonstrate by observation of relatively large populations over several generations.*

Two of the most important, and most complex health and welfare problems of dairy cattle, mastitis and lameness, are influenced to some degree by genetics. However, when both the incidence and the heritability of these diseases are relatively low, it is not possible to judge whether a particular new technology is creating welfare problems until it has been put into practice on a large scale over a relatively long period.

Control of New Technology

Although the welfare consequences of new technology for increasing productivity are not likely to present any fundamentally different welfare problems from those posed by conventional techniques of breeding, feeding and management in farm animals, there will undoubtedly be legislation to control these procedures because the public demands it. In the U.K. when scientific experimentation involves any procedure which may cause pain, suffering distress or lasting harm (however slight, like taking a blood sample) the animals involved in the procedure are protected by the Animals (Scientific Procedures) Act 1986. This applies a cost/benefit analysis to all procedures which weighs the cost to the animal in terms of suffering against the likely benefit to society (or other animals). Obviously, the greater the cost, the greater the need for justification. When procedures such as multiple ovulation and embryo transfer were first investigated scientifically, this was done under licence, (and justified). Commercial embryo transfer in cattle is covered by legislation which seeks to ensure that it is done competently, (i.e. under the supervision of a veterinary surgeon), but does not enquire whether the cost to the animal is justified. There can be no ethical reason why farm animals should not receive the same degree of protection from the law as laboratory animals. In the case of MOET, the cow used to advanced understanding receives more protection from the law than one used simply for food. I suggest that, in the specific cases of breeding technologies that involve some degree of non-therapeutic surgery, or other possible cause of suffering (e.g. abnormality of skeletal development) we need legislation that applies a form of cost/benefit analysis at least as rigorous as that applied by the Animals (Scientific Procedures) Act, (1986) before they are pronounced acceptable for commercial exploitation. We would then be faced with questions such as "are the surgical procedures involved in multiple ovulation and embryo transfer justified by an increase in genetic gain of a herd of dairy cows from a current rate of 1% to 3%?" (values from Woolliams and Wilmut, 1989). My personal opinion is that the procedure as currently practiced in cattle is justified but the procedure should not be committed for commercial purposes in sheep until a less severe technique can be developed than that currently based on laparoscopy. This is a specific example of the general question "How much does the animal suffer and what good will it do?" The same logic can be applied for the use of rBST to increase milk yield. The discomfort associated with regular injections and the increased risk of ill health may be small, but real (Chillard, 1989) but this small cost must be assessed against the potential 'benefit' to society of a drug which consumers in the developed world don't want, those in the undeveloped world cannot afford, a product which no dairy farmer actually needs and will drive some out of business.

A valid objection to the imposition of controls on the application of new science is that it holds up progress. This argument is only valid, of course, if the progress can be shown to be humane. The first three of the four welfare problems that I listed with respect to new technologies for cattle, can, I believe, be resolved (one way or the other) within two generations, or the length of time required for experimentation under the 1986 Act. The fourth problem, namely effects on complex, low incidence, conditions like mastitis and lameness, cannot be resolved without allowing the procedure to expand onto a commercial scale. I suggest therefore that all new technologies carried out initially under Home Office Licence should be subject to a two-stage review process. If the procedure passed according to the first three criteria, it should be given, in essence, a provisional licence for commercial exploitation, subject to a properly designed monitoring procedure for untoward effects in practice (such as an increase in the incidence of mastitis) and reviewed after (say) five years, the costs to be met by those promoting the procedure.

Conclusions

The welfare implications of pushing animals to the limits of productivity are a matter for real concern. Breeding females like the dairy cow have to be fit at least at the outset of their working life. The physiological demands on them are not abnormal in intensity but in duration. It is not realistic to expect this demand to be reduced. The main welfare problems for dairy cows can be attributed to systems of feeding, housing, milking and management that are unfitted to the genotype of the high yielding cow. Thus the best route to improved welfare is to improve nutrition and management with respect to the physiological needs of the genotype and to cull quickly when chronic welfare problems arise. **The role of the veterinarian in all this is to identify the welfare problems and work, by the most constructive and economically realistic route, to their reduction.** This presents few ethical problems to the veterinarian because his/her income is not directly at stake. More difficult ethical decisions arise when the veterinarian is paid to tinker with cows or their embryos. In this case, I suggest the veterinary profession and the cows need the protection of new law that seeks to balance any costs to the animals against the potential real benefit to man.

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