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15 Consequences of Biological Engineering for Resource Allocation and Welfare

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1. Introduction

One of the major aspects of the functioning of all animals, including humans, is that they have to attempt to cope with a wide range of actual and potential adversities (Lazarus and Folkman, 1984; Broom, 2001a). In order to do this they have an array of coping systems with components including organ physiology, cellular mechanisms such as the immune system, brain function and behaviour (Broom and Johnson, 2000). Some of the brain mechanisms involve the cognitive and emotional components of positive and negative feelings. Feelings, such as pain, fear and the various forms of pleasure, are important parts of coping systems. Hence, they are generally adaptive and, like other biological mechanisms, they have evolved by natural selection (Broom, 1998). The extent to which the various mechanisms helping individuals to adapt to their environment (Broom, 2006) are successful and the degree to which the coping is easy or difficult has a major effect on the welfare of the individual (Broom and Fraser, 2007). The welfare of an individual is its state as regards its attempts to cope with its environment (Broom, 1986). Welfare ranges from very good, when needs are satisfied (Hughes and Duncan, 1988a,b; Dawkins, 1990; Toates and Jensen, 1991) and there are usually positive feelings, to very poor when some needs are not met and there are indicators of harms or coping difficulty or suffering. A question considered in this chapter is how the welfare of animals might be affected by biological, largely genetic, engineering.

One possible reason why welfare could be poorer in some animals changed by one of the forms of genetic engineering is that the change in the animal involves more utilization of resources for one part of its functioning and, since resources are limited, this results in less resource availability for other functioning. The possible links between resource availability, genetic change and welfare is a specific question considered here.

In the following sections on genetic engineering and its effects on welfare, some of the changes involve impacts on the possible limits of resource availability,

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while others do not. The general issue of how such limits may have important effects is therefore considered in more detail after the various examples have been presented.

2. Conventional Breeding and Welfare

Conventional breeding methods need not affect welfare, but they can sometimes change animals in such a way that they have more difficulty in coping or are more likely to fail to cope (Broom, 1994, 1995, 2001b). Examples of such effects are the sensory, neurological or orthopaedic defects found commonly in certain breeds of dog. Others are the effects of the genes promoting obesity in mice, double muscling linked to parturition problems in cattle and many examples of selection promoting fast growth and large muscles in farm animals. Modern strains of pigs have relatively larger muscle blocks, more anaerobic fibres and smaller hearts than have the ancestral strains (Dämmrich, 1987). They are more likely to die or to become distressed during any activity. Modern broiler strains grow to a weight of 2–2.5 kg in 35 days as compared with 12 weeks 30 years ago. Their muscles and guts grow very fast, but the skeleton and cardiovascular system do not. Hence, many of the birds have leg problems, such as tibial dyschondroplasia or femoral head necrosis, or cardiovascular malfunction, such as that which gives rise to ascites.

It is clear that for meat-producing animals that are growing too fast for their legs and heart, the welfare is becoming poorer and poorer because of this genetic selection and the continuation of this trend is morally wrong. The competitive nature of the industry makes it difficult for individual producers to take action to reverse the trend. There is pressure on those concerned with genetic engineering to make such animals grow even faster.

An example of conventional breeding leading to a substantial change in production in a farm animal, with consequential risks of poor welfare for the animals, is the dairy cow. The average energy corrected milk yield for Swedish dairy cows increased from 4200 to 9000 kg between 1957 and 2003 (see Pryce and Veerkamp, 2001). On many farms the average production per cow is over 10,000 kg of milk and individual cows may produce twice as much. The beef cattle average is 1000–2000 kg (Webster, 1993). The dairy animal is producing considerably more than its ancestor would have. This raises questions of whether it is at or beyond its maximum production level and the extent of any consequent welfare problems. The peak daily energy output of the dairy cow per unit body weight is not very high in comparison with some other species such as seals or dogs, but the product of daily energy output and duration of lactation is very high indeed. Hence, long-term problems are the most likely to occur (Nielsen, 1998). This is what we see because, although some cows seem to be able to produce at high levels without welfare problems, the risk of poor welfare indicated by lameness, mastitis or fertility problems is greater as milk yield increases.

Data from National Milk Records in the UK show an increase in average yields of dairy cows of about 200 kg/year from 1996 to 2002 and 50% of the increase in milk yield is attributed to genetics (Pryce and Veerkamp, 2001). The situation is similar in the USA where, between 1993 and 2002, the average milk production per cow increased by 1287 kg and 708 kg of this increase, or 55%, was due to genetics. This increase in dairy cow productivity has been associated with increases over the expected levels resulting from veterinary progress, in leg and foot problems, mastitis, reproductive problems and metabolic disorders (Broom, 2004).

For a review of lameness, including the extent to which it is a welfare problem, see Greenough and Weaver (1996). Almost all animals which walk with a limp, or reduce walking to a low level, or avoid walking whenever possible suffer from some leg or foot pain. Their ability to carry out various preferred behaviours is generally impaired and there may be adverse consequences for other aspects of their normal biological functioning. Lameness always means some degree of poor welfare and sometimes means that welfare is very poor indeed. Measurements of the extent to which some degree of lameness occurs in dairy cows include 35–56 cases per 100 cows per annum in the USA, 59.5 cases per 100 cows per annum in the UK and more than 83% of examined cows in The Netherlands. The actual figures depend upon the method of assessment and most of these cases were not treated by veterinary surgeons, but there is no doubt that lameness is often a severe welfare problem.

Mastitis in mammals is a very painful condition. The sensitivity to touch of affected tissues is clearly evident and there is obvious damaging of normal function. Mastitis prevalence in dairy cows should have declined greatly with improved methods of prevention and treatment, but it has not declined as much as it should have done. Webster (1993) reports 40 cases of mastitis per 100 cows per year as an average for the UK.

The steady increase in reproductive problems of dairy cows as milk yields have increased is well known. As Studer (1998) states, 'despite programmes developed by veterinarians to improve reproductive herd health, conception rates have in general declined from 55–66% 20 years ago to 45–50% recently (Spalding *et al.*, 1975; Foote, 1978; Ferguson, 1988; Butler and Smith, 1989)'. Reproductive problems in dairy cows result in large numbers of cows being culled because of failure to get in calf. In a study of 50 dairy herds in England, Esslemont and Kossaibati (1997) found that farmers reported failure to conceive as the predominant reason for culling with 44% of first lactation, 42% of second lactation and 36.5% of cows in total being culled for this reason. However, mastitis, feet and leg problems, ketosis and other disease conditions can lead to reproductive problems and it is difficult to discover their initial cause from farmers' records. A report by Plaizier *et al.* (1998) concerning Canadian herds indicated that reproductive culling risk varied between 0% and 30% with a mean of 7.5%. Studies showing that milk yield is positively correlated with the extent of fertility problems have come from a range of different countries (van Arendonk *et al.*, 1989; Oltenacu *et al.*, 1991; Nebel and McGilliard, 1993; Hoekstra *et al.*, 1994; Pösö and Mäntysaari, 1996; Pryce *et al.*, 1997, 1998). Studer (1998) explains that high producing cows which are thin and whose body condition score declines by 0.5–1.0 during lactation often experience anoestrus. A loss of condition score of about 1.0 during lactation was normal in the review presented by Broster and Broster (1998). Many published studies (Oltenacu *et al.*, 1991; Dematawewa and Berger, 1998; Royal *et al.*, 2000; Pryce and Veerkamp, 2001; Roxstrom, 2001; Veerkamp *et al.*, 2003) show negative correlations between milk yield and fertility measures, indicating that the decline in fertility observed on dairy farms is, at least in part, an unwanted consequence of successful selection for higher yields. Data on the relationships between milk yield and production measures from two large-scale studies are presented in Tables 15.1 and 15.2.

The decline in fertility, reflected in increased calving interval, and in longevity, measured by proportion of cows alive at 48 months of age, in Holstein cows in the North-eastern USA from 1957 to 2002 are shown in Fig. 15.1.

The review by Ingvartsen *et al.* (2003) examined the relationship between milk production and production-related diseases as defined by Kelton *et al.* (1998): dystocia, parturient paresis, ketosis, displaced abomasum, retained placenta, ovarian cyst, metritis, mastitis and lameness. The review of 11 epidemiological studies showed clear evidence that cows with high yield in the previous lactation are at increased risk of mastitis and ovarian cysts in the subsequent lactation, but for other diseases the phenotypic association was weak because of the large variability between studies. It was concluded that cows producing more milk are also likely to eat more and make greater use of their body reserves in early lactation (Veerkamp, 1998).

3. Embryo Transfer

There are two areas for investigation in relation to embryo transfer. The first is the immediate effects of the procedures themselves and the second is the effects during pregnancy, at parturition and soon afterwards.

Table 15.1. Positive correlations between milk production level in England and indicators of poor welfare. (From Pryce *et al.*, 1997.)

Milk yield from 33,732 lactation records	
Calving interval	0.50 ± 0.06
Days to first service	0.43 ± 0.08
Mastitis	0.21 ± 0.06
Foot problems	0.29 ± 0.11
Milk fever	0.19 ± 0.06

Table 15.2. Positive correlations between milk production level in Scotland and indicators of poor welfare. (From Pryce *et al.*, 1998.)

Milk yield from 10,569 lactation records	
Calving interval	0.28 ± 0.06
Days to first service	0.41 ± 0.06
Mastitis	0.29 ± 0.05
Somatic cell count	0.16 ± 0.04
Foot problems	0.13 ± 0.06

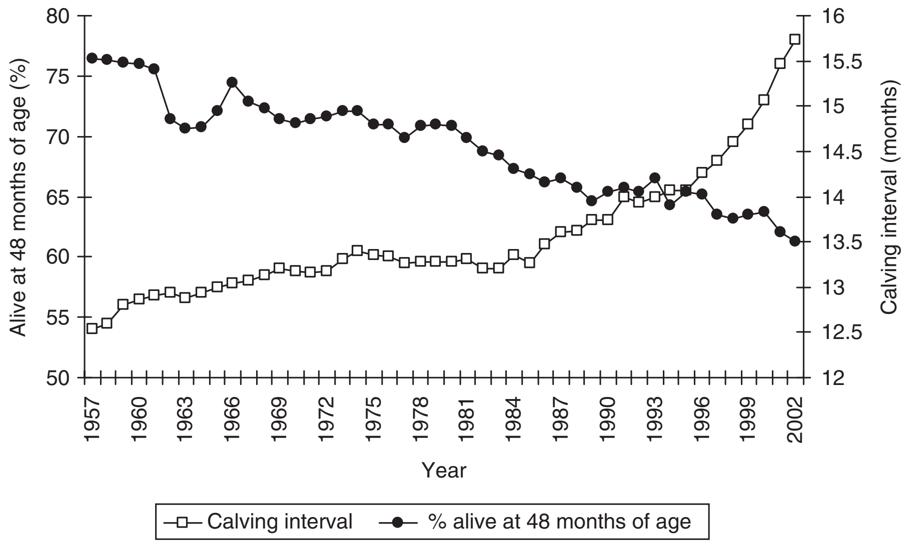

Fig. 15.1. Average calving interval and proportion of cows alive at 48 months of age between 1957 and 2002 for Holstein cows in the North-eastern USA. (After Oltenacu and Algers, 2005.)

The collection of eggs and the insertion of eggs into another female animal can be carried out without the necessity for surgery in a large animal like a cow. The procedure in cattle is mainly carried out by superovulation and non-surgical recovery and involves the transfer of embryos, which may have been fertilized in vivo or in vitro. Ovaries may also be collected from dead animals in the abattoir and the ova grown-on and fertilized in the laboratory before transfer. These embryos may be transferred directly or frozen for storage and future use. The procedure for transferring single embryos to carefully selected recipients does not normally cause welfare problems. The continued use of superovulatory drugs can result in subsequent fertility problems. However, in animals of the size of sheep, pigs or smaller, an incision must be made in the abdominal cavity to carry out the procedures. This will always cause a greater degree of poor welfare in the animals than would occur in cattle. The effects of these procedures in all mammals can be monitored in the same ways as those described for transgenic animals.

In cattle, embryo transfer is carried out at 7 days after the onset of oestrus, so the technique is more difficult than artificial insemination and requires considerable training and experience. Caution must be exercised if this practice is to become widely available in the commercial field, as embryos fertilized in vitro have been implicated in the production of oversize calves. The technique must be carried out using epidural anaesthesia. When an egg is inserted into a female mammal that results in the growth of a foetus, which is larger or a different shape from the foetus that the mother would produce after mating with a male of similar type, problems may occur during pregnancy and at parturition. Some problems during pregnancy and most problems at parturition result in poor welfare of the mother, the young animal or both.

4. Xenotransplantation

Xenotransplantation involves the transfer of tissues or organs from one kind of animal to another. In some cases (i) the material transferred is not cellular, for example, the placing of a pig heart valve into a human. In this case, the valve has no blood or other cells with it and can be cleaned so that no rejection of foreign proteins by the cells of the recipient animal will occur. In other cases (ii) whole organs may be transferred, so measures to prevent immunological rejection processes occurring are necessary. The example for case (i) is now frequent and involves the killing of the donor animal. Since this can be done in a humane way, no welfare problem is likely. The ethical issue requires consideration but is similar to that when the ethics of eating animals is considered. Case (ii) is much more risky and difficult. There could be substantial animal welfare problems associated with the immuno-modification of the donor, but donor animals would normally be kept in very good conditions. At present, there is substantial public resistance to the use of such xenotransplantation to humans because of the risk that new viral or other diseases may be passed to people.

5. Cloning

Cloning of vertebrates, i.e. the production of genetically identical animals by nuclear transfer, has been carried out since 1952 with frogs and is now used in the farming of fish for food (Gurdon, 1974). It was not until 1986 that the first cloned mammals (mice) were produced by transferring nuclear material from embryonic cells, and this was rapidly followed by successful nuclear transfer in sheep and cattle (Gurdon and Byrne, 2002). The techniques involved in the first production of clones in sheep by nuclear transfer required that oocytes were recovered by laparotomy from donor ewes, ewes were superovulated by the administration of hormone by injection and by insertion of a vaginal tampon and the oocyte DNA was removed by microsuction (Wilmut *et al.*, 1997). Oocyte donor ewes were used for only one surgical donation. Other sources of cells were foetuses taken post-mortem from ewes and mature cells grown in culture. Following nuclear transfer, the oocytes were cultured in vivo in the ligated oviduct of a live sheep for a period of 7 days when the ewe was humanely killed and two or three developed blastocysts transferred to synchronized recipient sheep by laparotomy. These were then allowed to develop to full term to be delivered. The success rates of these various methods have not been high.

There may be poor welfare associated with cloning for various reasons including: the procedures described above, adverse effects on the mothers carrying the cloned young, the production of extra-large offspring, reduced life expectancy of the cloned animals and the possibility of adverse effects on the cloned animals unless they receive extra care.

'Large offspring syndrome' or 'foetal oversize' is a phenomenon found occasionally in calves and lambs that are born following embryo manipulations. There may be increased incidence of developmental abnormality in cloned animals. The ability of stockpeople to meet the particular needs of animals produced by cloning is an important issue. These needs may be associated simply with the greater performance achieved by the animals, and the special care associated with such high performance. Alternatively, abnormalities may be generated through cloning, which go unrecognized initially yet may be stressful for the animals.

However, such adverse effects of cloning techniques may be counterbalanced by a reduction in the number of animals used in research, for at present, some of this research relies on more random genetic modification techniques.

6. The welfare of Transgenic Animals

Transgenesis can result in: (i) better welfare; (ii) no change from the average for unmodified animals; or (iii) poorer welfare:

1. Some genetic manipulations can be beneficial to the modified animals. If genes conferring disease resistance are inserted into the genome of an individual, for example, by making it possible for the modified animal to produce antibodies to bacterial toxins (Clark, 2001) or conferring avian leucosis virus resistance, then the welfare of the modified individual is better than that of the unmodified individual. If the animal can cope with disease challenge better than its welfare is slightly improved for most of the time and very much improved in the circumstance where disease challenge occurs.
2. When the transgenic animal is modified so that it can produce a novel protein in its blood or milk, there may be no effect at all on its welfare. No evidence of adverse effects on the behaviour of transgenic sheep was found (Hughes *et al.*, 1996). However, there could be some other adverse effect and the predictability of that effect will vary according to the precision of the transgenesis procedure. Gene transfer by introducing embryonic stem cells into a blastocyst are more predictable in their effects than the introduction of genetic material by microinjection.
3. The production of disease-susceptible animals by transgenesis, so that the animals can be used in medical research, will result in poorer welfare whenever the gene is expressed. The extent of the poor welfare will differ considerably according to the level of expression and the disease state. If the animals produced as a result of transgenesis were modified in a way that increased their growth rate, the growth of a particular organ, or differential growth in such a way that an already productive genetic strain was made even more productive, there is a serious risk that the welfare of the animals would be worse as a direct consequence of the manipulation. Those carrying out such work should consider whether the animals are already close to some biological limit to adaptability before proceeding. When Pursel *et al.* (1989) produced transgenic pigs with the human growth hormone gene added, the resulting animals had major joint and other limb disorders as they grew and so the study could not be continued.

Genetic manipulation could affect sensory functioning, the structure of bones or muscles, hormone production, detoxification ability, neural functioning, etc. In one line of transgenic mice, the production of oxytocin was altered (Crawley, 1999). The question which must be considered is not whether or not there is a change, but whether there is a change that affects the animal's welfare. In some cases, any effects of the genetic modification on the welfare of other individuals must be considered.

In a study of the effects on welfare of transgenesis or treatment with biotechnology products, control animals which have not been modified or treated should also be used. A wide range of welfare measures are necessary because the actual effects on the individual will seldom be known and also because species and individuals vary, both in the methods that they use to try to cope with adversity and in the measurable signs of failure to cope. A simple welfare indicator could show that welfare is poor, but absence of an effect on one indicator of poor welfare does not mean that the welfare is good. For example, if the major effect of a manipulation was a behavioural abnormality or an increase in disease susceptibility but only growth rate was measured, a spurious result could be obtained. The choice of measurements should include the main methods of assessing poor welfare (Broom and Johnson, 2000; Broom and Fraser, 2007), but often it will be obvious from a preliminary study of morphology, or a clinical examination, which measurements of function or of pathology will be most relevant.

The effects of genetic manipulation or treatment with biotechnology products may not be apparent at all stages of life, so the animal must be studied at different stages including the oldest age likely to be reached during usage. Some effects may be evident in the second generation but not in the first, so modified animals should be studied for two generations.

7. The Welfare of Animals Treated with Biotechnology Products

Biotechnology products could be identical with naturally occurring chemicals such as hormones. However, since they are often produced by bacteria they may not be identical. For example, most of the commercially available recombinant bovine somatotrophin (BST) differs slightly from the natural BST. Some biotechnology products may be completely different from any chemical normally found in the species. In addition to this possible difference, the quantities of the products, which can be given to animals are often much greater than normal physiological levels. As a consequence of these important possibilities for difference, the effects of biotechnology products on welfare should be assessed in the same way as the effects of transgenesis and should be subject to the same legislative controls. Somatotrophins have effects on tissue growth, hence the name ‘trophin’ which refers to growth, not ‘tropin’ which refers to direction of movement.

Work on the effects of recombinant bovine (BST) and porcine somatotrophin (PST) injections has also been directed almost entirely towards finding out how to improve productivity in dairy cows and pigs. Any results, which indicate what the effects on the welfare of the animals might be, have been derived largely as an incidental by-product of the main study.

Since BST occurs naturally, low levels are unlikely to have any adverse effects on welfare, but even at low levels the effects need to be checked because of any differences in amino acid sequence from the natural form. BST injection results in increases in the amount of insulin-like growth factor-1 (IGF-1) in the blood and in milk (Prosser and Mepham, 1989; Prosser *et al.*, 1989, 1991). These increases can be substantial and it has been shown that high levels of IGF-1 can affect rat bone growth (Juskevich and Guyer, 1990). Low levels of IGF-1 are likely to have no adverse effect, but it is a potent mitogen and it is not known what effects high levels of it have on the cow, or on the calf that consumes the milk, or indeed on people who do so (Mepham, 1991).

The most clearly documented side effects of BST and PST are on disease incidence and reproduction (Broom, 1993; Simonsen, 1993; Willeberg, 1993). The effects of BST injection are similar to changes that occur during the rising phase of lactation; high-yielding cows, which are not treated with BST are particularly susceptible to disease at this time. Kronfeld (1988) states that high levels of BST result in subclinical hypermetabolic ketosis, which can lead to reduced reproductive efficiency and a higher incidence of mastitis and other production-related diseases. However, studies reviewed by Phipps (1989) provide no evidence for increased incidence of ketosis following BST treatment. Several of the studies of cows treated with BST, so that milk yields are particularly high, report that the incidence of mastitis can increase, while others do not. There are also some reports of increased incidence of lameness (Phipps, 1989; Craven, 1991). High production levels are associated with greater incidence of both mastitis and lameness (Broom, 1994), and BST use can result in high production levels, so effects will depend upon how great were the maximal production levels using BST. Increases in disease following BST use may be directly related to the metabolism associated with high production levels, but welfare is obviously poorer if mastitis and lameness occur, whatever the exact reason for it. Meta-analyses of studies of BST effects and studies using large data sets showed substantial increases in both mastitis and lameness (Willeberg, 1997). The increase in the risk of clinical mastitis above the risk in non-treated cows in five studies was 15–45%, 23%, 25%, 42% and 79%. In studies of foot disorders, a large-scale study with multiparous cows showed 2.2 times more cows affected and 2.1 times more days affected in BST-treated cows than in cows not treated with BST (EU Scientific Committee on Animal Health and Animal Welfare, 1999).

Surveys of the results of several studies of BST-treated animals by Epstein (1990) and Epstein and Hardin (1990) showed that the conception rates of treated and control cows were 89% : 59% and 95% : 50%, respectively. Assuming that the attempts to get the cows to conceive were equivalent, these results also indicate poorer welfare in BST-treated cows. Phipps (1989), in reviewing the evidence for effects of BST on reproduction, distinguishes, first, between the use of BST early in lactation and late in lactation and, second, between higher and lower doses of BST. If the BST is administered early in lactation and at higher dose levels, the reductions in pregnancy rate reported by Epstein can be produced. However, it seems that administration of lower dose levels of BST later in lactation are less likely to have any adverse effects on welfare. However the meta-analysis (EU Scientific Committee on Animal Health and Animal Welfare, 1999) showed that with BST usage, the pregnancy rate dropped from 82% to 73% in multiparous cows and from 90% to 63% in primiparous cows. In addition, multiple births substantially increased.

A further point, which may be very important to the cows, is that each injection has some effect on a cow and repeated injections may cause swollen and tender injection sites (Comstock, 1988). The EU Scientific Committee on Animal Health and Animal Welfare Report (1999) showed that there were severe injection site reactions in at least 4% of cows.

More general effects of BST use are, first, that higher mastitis incidence may result in more antibiotic treatment and greater risk of the development of pathogen resistance and, second, that the possible change from smaller to larger dairy farms, which could result from widespread BST usage, could lead to poorer average stockmanship and less individual care of cows.

8. Resource Limitations, Genetic Selection and Welfare

The possible limitations to adaptation have been considered by evolutionary biologists in relation to natural selection ever since the writings of Darwin. A development of this approach is the idea presented by Beilharz *et al.* (1993) that selection of domesticated animals for certain characteristics that led to the utilization of a substantial proportion of available resources, could have consequences for how well other systems could function. The negative collateral consequences of selection for increased production were presented by Goddard and Beilharz (1997) who suggested the 'Resource Allocation Theory'. The resources an animal has are limited and as a result, if output is increased through one biological process, such as producing more milk, other functions such as fertility, maintenance, movement, immune defence, etc. will be affected. The resources that one process demands can be increased to a certain extent. Management factors, such as increasing access to feed and nutrients, could increase fitness of the animal until resources became limited again. Any further increase in fitness would imply a reallocation of resources and thus modify other outputs such as disease resistance or behaviour (Beilharz *et al.*, 1993). Reviewing the negative side effects of selection for high production, Rauw *et al.* (1998) concluded [AU1] that 'when a population is genetically driven towards high production, … less resources will be left to respond adequately to other demands like coping with unexpected stressors; i.e. buffer capacity is negatively affected'.

The actual limitations that might exist could involve the total quantity of a resource such as energy that is available, the amount of a raw material such as a micronutrient, the rate at which particular rate-limiting enzymes can be produced or any of several other kinds of biochemical and physiological limitations.

9. Can We Produce New Animals Whose Welfare Is Never Poor?

Domestication is the process by which a population of animals becomes adapted to man and to the captive environment by some combination of genetic changes occurring over generations and environmentally induced developmental events recurring during each generation (Price, 1984, 2002). Adaptation is discussed further by Broom (2004) and Broom and Fraser (2007). The widespread existence of poor welfare in domestic animals, however, shows that there are limits to how much animals can adapt to conditions imposed on them by humans. Genetic engineering could change animals further than has been possible so far with conventional breeding in this same direction. However, there will always be limits to change in animals that are required to actively feed themselves and otherwise regulate their interactions with their environment. If tissue culture is used, animal cells might be cultured without the need for a nervous system and supracellular regulatory systems. The welfare of such cell masses might never be poor.

10. Legislation Required

There is legislation about animal experimentation in the European Union (EU), which requires that some account should be taken of the welfare of the animal during experimentation on transgenesis, or on treatment with biotechnology products. Research workers need to consider the welfare of the animal carefully and should be able to justify all of their actions to a member of the general public. However, after the animal ceases to be experimental, or if a genetically modified animal or product of biotechnology for treatment of animals are brought in from another country, the animals are not covered by the animal experimentation legislation.

It will not be adequate to depend upon the moral consciences of those who use transgenic animals and specific legislation is needed concerning testing before usage. There is EU legislation relating to human health and preservation of the environment. There should also be legislation requiring that no genetically modified animals or animals treated with biotechnology products should be used commercially unless their welfare has been assessed using an adequate range of measures at suitable intervals throughout life and on through the next generation. If there is a net benefit for the welfare of animals, including humans, then the genetic manipulation should be permitted. This is a stricter criterion than just to say that any harm to the animal must be weighed against any benefit because this latter criterion could allow severe effects solely for financial gain. Modifications of animals which are carried out for commercial purposes only but which result in poor welfare should not be permitted. There is legislation in The Netherlands stating that genetically modified animals cannot be used unless specific permission is given. The EU and other countries should be following that lead. If such action does not occur quickly it will become more difficult as economic pressures build up.

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