Introduction

The welfare of an animal is a measure of its state of health and well-being. This includes both physical and psychological aspects. The welfare of animals is of great concern to many people, and there is a growing awareness of the importance of animal welfare in society.

There are several factors that contribute to animal welfare, including the animal's environment, diet, and medical care. The management of animals also plays a crucial role in determining their welfare. It is important to provide animals with appropriate care and to ensure that they are maintained in a clean and healthy environment.

In recent years, there has been a growing interest in the welfare of animals used in research and for educational purposes. This has led to the development of new approaches to animal welfare, which are designed to minimize animal suffering and to improve the quality of life for animals.

Techniques for the assessment of animal welfare have also been developed. These techniques include the use of observational methods, such as behavioral monitoring, and the use of physiological measures, such as heart rate and blood pressure.

Summary

Assessing the Welfare of Transgenic Animals

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The Welfare of Transgenic Animals

... grow even faster. Progress is often concerned with genetic manipulation to make such animals produce more protein to take action to reverse the trend, but many of them are still products of the industrial model. The competitive nature of the industry makes it difficult to improve the welfare. The conventional model of the industrial model is necessary. This section will be about the implications of the industrial model on welfare.

It is clear that the welfare of transgenic animals, which are growing...
Genetic manipulation could affect: - sensory functioning; the structure of bones or muscles; hormone production; detoxification ability; neural functioning etc. The question which must be considered is not whether or not there is a change, but whether there is a change which 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 of transgenesis on welfare, control animals which have not been modified should also be used. A wide range of measures of welfare are necessary because the actual effects on the individual will seldom be known and also because species and individuals vary, both in the methods which 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, then a spurious result could be obtained. The choice of measurements should include the main methods of assessing poor welfare which are mentioned here. 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 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.

**Measures of Welfare**

**Preference Studies**
As listed in Table 1, an important technique in welfare research is the measurement of the strength of animal preferences. Studies of positive preferences involve choice tests, often with some operant technique being used to indicate how hard the individual will work to obtain a particular resource or have the opportunity to carry out a certain behaviour (Dawkins 1983, Arey 1992, Manser et al. 1995). A possible problem which must be considered when using such methods is that the sensory or motor ability of the animal might be altered by the transgenesis. Positive preferences could on occasion give ambiguous results, but in general it would be expected that what is important to normal animals would also be important to transgenic animals. Studies of aversion and its strength would be of value in studies of transgenic animals. If, for example, the modified animal were changed so that bright light was aversive, the extent of the aversion could be measured in studies of actual movement away from light, of reluctance to be moved towards a well lit place or of some specific task which had to be performed in order to avoid the onset of bright light.

**Reproductive Success**
Some zoo animals cannot breed when potential breeding partners are present, because of an inadequacy in their environment. The welfare of these animals is less good than that of animals which can breed. Inability to reproduce would be an indicator of poor welfare in transgenic animals.

**Growth, Weight Loss, Mortality and Life Expectancy**
If control animals can grow or maintain weight in a given situation but modified animals fail to grow or lose weight, this would indicate poorer welfare in the latter. Abnormal weight gain could also indicate a problem. It is important to use a biologically relevant control in such studies. An animal could be losing weight because it is lactating or is a reproductively active male, like a red deer in rut. On the other hand, an animal which is in the pre-hibernation condition could put on a great deal of weight.

Measures of mortality rates have long been used in studies of the effects of housing conditions or management methods on animal welfare. As Hurnick and Lehman (1988) have pointed out, a housing condition, management method or treatment which resulted in the animal having a lower life expectancy indicates poorer welfare with that condition or treatment. Indeed a human who died early because of some form of self abuse or an energetic life style would be considered to have been under greater stress than a similar but longer lived person. Other examples include cetaceans which die early in poor zoo conditions and dairy cows which do not live as long under the very high production conditions of recent years as they did when their metabolic pace of life was lower (Agger 1983, Broom 1993).

**Physiological Measures**
Aspects of normal physiological functioning, for instance of the kidneys, could be affected in some genetically modified animals. Some of the abnormalities would be detected by clinical examination but others require specific tests to be carried out for detection.

Several physiological measurements are of value in assessing the extent to which emergency responses have been used by an individual. When there is a short-term problem, the individual may increase its heart rate and adrenal activity. Transgenic animals could be tested in situations in which control animals would show a known mean level of physiological response in order to ascertain whether or not those situations caused them more problems. It
Progress in Welfare Assessment of Transgenic Animals

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