Chapter 5

NUTRITION AND ANIMAL WELFARE

Merel Ritskes-Hoitinga\textsuperscript{1,2} and Jan H. Strubbe\textsuperscript{2}
\textsuperscript{1}Biomedical Laboratory, University of Southern Denmark, Odense, Denmark and
\textsuperscript{2}Department of Neuroendocrinology, University of Groningen, Haren, The Netherlands

1. INTRODUCTION

One of the concepts of good animal welfare focuses on the fact that animals should function and feel well (Carter et al. 2001). There are two categories of basic values (see the text by Sørensen in this book). The first category is more or less objective, in that an animal should function well biologically and/or has the possibility to perform natural behaviours. This can be assessed by e.g. the absence of pathology and behavioural abnormalities such as stereotyped behaviour. The second category refers to the subjective approach, which relates to the inner mental state of the animals. An increased welfare is then related to an increased positive subjective state and reduced negative mental state (Fraser et al. 1997). In scientific research attempts are made to measure these subjective states indirectly by e.g. preference testing.

Each organism strives to maintain homeostasis, both physiologically and mentally. Homeostasis refers to a regulated state of internal stability or balance (Strubbe 2003). Such a state can never be a stable permanent situation, as there will always be fluctuations, such as activity versus resting, eating versus not eating, social interaction, etc., and it is essential that the homeostatic state is reached again. Eating a meal will automatically lead to a certain disturbance of the homeostasis (e.g. the thermogenic effect), but as long as this stays within certain limits, this offers no real threat. It is probably even stimulating animal welfare when fluctuations arise, as biological rhythms are at the basis of virtually all natural processes. Many functions show circadian rhythms, i.e. rhythms of approximately 24 hours.
But these fluctuations should probably remain within an upper and lower boundary, otherwise the organism has more difficulties to return to the homeostatic state. In order to maintain welfare, it is possible that a certain amount of species-specific natural fluctuations in the feeding process have to be introduced in the laboratory setting in order to improve the welfare of laboratory animals.

Our goal in this chapter is to evaluate several aspects of nutrition in relation to the welfare of animals (focused on rodents) in experimental conditions. The aims are further to present essential knowledge and data that are known to prevent the occurrence of pathological and behavioural disorders. This knowledge can also contribute to a better standardisation of experiments. When doing animal experimentation, it is important to strive for standardisation within and between experiments, between institutes, nationally as well as internationally, in order to make data comparable (see also Haseman 1984, Roe 1994). In the more subjective approach, examples from results of different types of tests like e.g. preference testing will be provided, with a discussion of the possible welfare implications for the animal species involved. It is hypothesised that the more the environmental factors fit into the species-specific adaptive capacities (for being able to return to homeostasis) the better the welfare (Crok 2003).

By presenting the already published knowledge from animal experiments on nutrition and related animal behaviour, the insight into the laboratory animal in an experimental situation can be improved. By comparing the guiding principles of the concept of standardisation versus the natural rhythmicity, tools are given to researchers to make conscious and well-based decisions about the experimental design. Directly and indirectly this improved understanding can contribute to optimising the experimental conditions, leading to simultaneous improvement of animal welfare and experimental results.

2. GOOD BIOLOGICAL FUNCTIONING

Since this chapter focuses on nutrition and animal welfare, we first pose the question why eating is necessary. Food needs to be ingested, as many processes in the body depend on the (continuous) supply of energy and nutrients. Moreover, to maintain the body temperature at a certain level, which is critical for many vital functions in mammals, it is necessary to supply energy to the system. Nutrients like proteins and amino acids are necessary to build muscle tissue and keep it in good health, and minerals need to be a part of the diet e.g. for a proper bone mineralization as well as good muscle function. Certain trace elements and vitamins are essential