7 Summary

Ultrastructural changes in type IIB skeletal muscle fibres of the M. rectus femoris in laboratory mice following long-term selections

The goal of the present study was to use the transmission electron microscope to investigate the reaction of the type IIB skeletal muscle fibres to genetically differentiated growth processes as well as to growth-conditional changes in laboratory mice after three different long-term selections of more than 80 generations, in order to be capable of giving quantitative data on the influence of these selections on the ultrastructural organisation and selection-dependent changes in the muscle fibre components (e. g. myofibrils, mitochondria).

The investigations with the electron microscope were done on mouse lines selected for growth (line DU-6), for growth and physical stress capacity (line DU-6+LB) as well as for protein formation (line DU-6P) and an unselected control line (line DU-Ks) in two age groups each (43rd and 73rd day of life). Morphological characteristics were quantitatively collected from the rectus femoris muscle (e. g. cross-sectional areas as well as percental proportion of areas with myofibrils and mitochondria) using the image analysis system Quantimet 500 (company: Leica Cambridge Ltd.). The measurements were done on 5 mice per mouse line and age group, i. e. 15 skeletal muscle fibres were evaluated per line and age group. A total of 120 type IIB skeletal muscle fibres were investigated from 40 male mice using 1440 microphotograms. The preparation of the muscle assays was done according to the standard method for electron microscopes (embedding in epoxy resin, semi-thin sections, ultra-thin section photography in the transmission electron microscope at a magnification of 1 : 10000).

Changes were noted in the ultrastructural appearance of the type IIB fibres in comparison to the control line in all three selection lines. All of the selection choices lead to an increase in the number of myofibrils in the skeletal muscle fibres.
In the **DU-6 line** an increase in the percental proportion of the area of myofibrils across the entire fibre surface and therewith an increased myofilament accumulation

per fibre cross-sectional area in comparison to the control line DU-Ks can be ascertained at the age of 43 days of life. At the age of 73 days of life, the myofibrils and also the myofibrils with signs of division show significantly smaller cross-sectional areas in comparison to control mice of the same age due to a comparitively smaller increased formation of contractile proteins (myofilaments) in the myofibrils. The percentage of actively dividing myofibrils is, in contrast to the other two selection lines in this age group, not decreased in comparison to the control group: this means that the growth intensitiy of the myofibrils in the Du-6 line is the highest of the three selection lines. A disadvantage in respect to aerobic energy generation and stress tolerance of the DU-6 mice in both age groups could result from the decreased mitochondrial resources in comparison to the control line.

The **DU-6+LB line** displays a smaller percentage of actively dividing myofibrils in both age groups. Apparently, in order to achieve the selection goal of physical stress capacity, neither an increase in the myofibril cross-sectional areas nor an increased surface percentage of mitochondria in the type IIB skeletal muscle fibres is necessary. In the age group 73rd day of life, the surface percentage of myofibrils at the fibre cross-sectional area is decreased, the percentage of mitochondria and myofibril free structures is increased. The significantly improved physical stress capacity in comparison to the other mouse lines is probably associated with the better development of the sarcoplasmatic reticulum. Extramuscular factors such as the function of the cardiovascular system could also play a role here.

An increased protein formation can be detected in both age groups in the **DU-6P line**, characterised by an enlargement of the myofibril cross-sectional areas and an increase in the proportional percentage of myofibrils area on the fibre cross-sectional surface, whereby the proportional area of the mitochondria and myofibril free structures decreases. In the 73rd day of life age group the percental proportion of actively dividing myofibrils is under the control line value, i. e. the myofibril growth intensity is smaller. Whereas the younger DU-6P mice display less density of mitochondria in the type IIB fibres, the 73rd day of life age group in this line surprisingly shows the highest mitochondria density of all of the mouse lines. Investigations of this phenomenon are necessary.