DIETARY FATS AND EXERCISE

K.J. AYRE

During strenuous exercise, potassium ions leak out of muscle cells at a faster rate than they can be returned by Na^+, K^+ -ATPase (the "sodium-potassium pump" of cell membranes). This loss of potassium has been suggested as a possible explanation for the feelings of fatigue following strenuous exercise or work. If this is so, then a mechanism for increasing the concentration of Na^+, K^+ -ATPase may lead to increased resistance to fatigue.

Changes in dietary fats have been shown to increase the the concentration of Na^+, K^+-ATPase in the membranes of rat kidney and liver cells (Lin et al. 1979). The aim of this study was to determine the effects of dietary manipulation on (i) concentration of Na^+, K^+-ATPase, and (ii) contraction characteristics and resistance to fatigue in rat muscles.

Three groups of male rats were maintained on experimental diets for six or nine weeks following weaning. The diets were based on other well-tested diets and contained all essential nutrients and the same total amount of fat. The three diets were: (i) deficient in the essential fatty acid, linoleic acid (18:2); (ii) high in the polyunsaturated fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (20:5 and 22:6); (iii) a control diet.

An initial study showed a significant increase ($P<0.02$) in Na^+, K^+-ATPase concentration for rats maintained on the diet deficient in essential fatty acids for six weeks, but not the diet high in polyunsaturated fatty acids. Soleus and extensor digitorum longus (EDL) muscles were removed for analysis of Na^+, K^+ -ATPase concentration. This was done using a vanadate-assisted ^3H-ouabain binding assay (Norgaard et al. 1983). Consequently, a second experiment was conducted in which after 9 weeks on these diets, rats were anaesthetized and soleus and EDL muscles were removed for both isolated muscle preparations (Carlsen and Walsh 1987) and Na^+, K^+ - ATPase assays. Parameters tested included twitch and tetanic tensions, contraction and relaxation times, post-tetanic potentiation and fatigue. Preliminary analysis of these data indicate that the soleus muscles of essential fatty acid deficient rats have both reduced contraction times (86% of controls, $P< 0.05$) and relaxation times (93% of controls, $P< 0.01$). Again, a high polyunsaturated diet appears to have no effect on any of these parameters.

These studies are continuing at present and the findings indicate that dietary manipulation can affect muscle function.

LIN, M.H., ROMSOS, D.R., AKERA, T. and LEVEILLE, G.A. (1979). Experientia 35(6): 735.
CARLSEN, R.C. and WALSH, D.A. (1987). Pflugers Arch 408: 224.
NORGAARD A., KJELDSEN, K., HANSEN, O. and CLAUSEN, T. (1983). Biochem.Biophys. Res.Commun. 111: 3 19.

Departments of Biology and Human Movement Science, University of Wollongong, POBox 1144, Wollongong, NSW, 2500