THE ROLE OF N-3 POLYUNSATURATED FATTY ACIDS IN NORMAL VISUAL DEVELOPMENT IN THE GUINEA PIG

H.S. WEISINGER, A.J. VINGRYS and A.J. SINCLAIR*

Docosahexenoic acid (DHA) is found in abundance in the mammalian retina (Connor et al. 1992). Previous studies in rats and monkeys fed diets deficient in n-3 fatty acids (FA) have reported depletions of retinal DHA of about 50-60% which were associated with abnormalities in the electroretinographic (ERG) patterns (reduced a-and b-wave amplitudes) (Wheeler et al. 1975; Neuringer et al. 1986). In 1986, Leat et al. reported that guinea pigs fed laboratory chow and n-3 FA deficient diets reported no differences in their ERG patterns, although analysis of the retinal FA profiles in these animals suggested that the n-3 FA deficient animals were almost completely lacking DHA in the retinal lipids.

The aim of this study was to examine whether dietary manipulation of n-3 FA levels could alter the retinal FA profile and ERG function in guinea pigs. We have examined the fatty acid composition of the retina and the ERG function in guinea pigs fed a commercial diet or one of three semi-purified diets containing three different levels of n-3 FA (n=12 per group). The diets comprised a diet deficient in n-3 FA (semi-purified diet containing safflower oil), two diets containing α-linolenic acid (standard commercial laboratory diet and semi-purified diet containing canola oil), and a diet containing α-linolenic acid, eicosapentaenoic acid and DHA (semi-purified diet containing canola oil, safflower oil and fish oil). The guinea pigs were given the diets from birth to six to nine weeks when their ERG patterns were examined and following sacrifice their retinal tissues were extracted and analysed for FA content by gas liquid chromatography. Fatty acid analyses of the retinal phospholipids revealed that the group fed DHA (from the fish oil) had the highest level of DHA (31%) compared with values of 21% and 12% for the groups fed canola oil diet and commercial diet, respectively, and 2% for the group fed the diet deficient in n-3 FA. The levels of 22:5n-6 in the retinal lipids were inversely related to the DHA values, being 1, 7, 11 and 21% for the fish oil, canola oil, commercial diet and safflower oil diet groups, respectively. The data suggest that the guinea pig has a reduced capacity for DHA synthesis from α-linolenic acid compared with other mammals. The ERG readings were obtained at six light levels spanning the rod-cone domains. The ERG waveforms showed significant reductions in the a- and b-wave amplitudes for the safflower oil group compared with the canola oil-fed animals.

We find guinea pigs are a viable model of n-3 FA deficiency. Such deficiency can produce altered retinal function in six to nine week old animals. The question of whether a permanent deficit ensues requires further investigation.

CONNOR, W.E., NEURINGER, M. and REISBICK, S. (1992). Nutr. Rev. 50: 21.
LEAT, W.M.F., CURTIS, R., MILLICHAMP, N.J. and COW, R.W. (1986). Ann. Nutr. Metab. 30: 166.
NEURINGER, M., CONNOR, W.E., LIN, D.S., BARSTAD, L. and LUCK, S. (1986). Proc. Natl. Acad. Sci. 83: 4021.
WHEELER, T.G., BENOLKEN, R.M. and ANDERSON, R.E. (1975). Science 188: 1312.

Department of Optometry, University of Melbourne, Carlton, Victoria 3052 *Department of Food Science, Royal Melbourne Institute of Technology, Melbourne, Victoria 3000