

The effect of dietary linoleic to linolenic acid ratio on docosahexaenoic acid levels in the guinea pig

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The tissue levels of n-3 long chain polyunsaturated fatty acids (PUFA) are influenced by the dietary intake of n-3 PUFA and also by the dietary linoleic acid (LA) to linolenic acid (ALA) ratio. We have shown that increasing the linoleic acid/linolenic acid ratio from 71:1 (safflower oil) to 2.5:1 (canola oil) increased the retinal and brain docosahexaenoic acid (DHA) values by about 6 fold, while having an inverse effect on the 22:5n-6 levels in albino guinea pigs maintained on semi-synthetic diets (1).

The aim of this study was to determine the influence of the ratio of dietary EFAs and preformed 20:4n-6 and DHA on brain and retina DHA levels in guinea pigs. Female pigmented guinea pigs (3 weeks old) were fed semi-synthetic diets containing 10%(w/w) lipid for 12 weeks (1). The linoleic acid content in the diet was kept constant (at 17% of total fatty acids) with the LA/ALA ratio varying. Diets with LA/ALA ratios of 323:1 (diet S), 17.5:1 (diet A), and 2.3:1 (diet C) were used. A fourth diet (LA/ALA 17.7:1) was also used which contained 1% AA and 0.7% DHA (% of fatty acids). At the end of the study period, the animals were sacrificed and their tissues taken for fatty acid analyses.

The results in the table show that the main effect of the diet on both tissues was on the 22 carbon PUFA, rather than on 20:4n-6 levels. For both brain and retina, there was little difference in 22 carbon PUFA levels between diets with LA/ALA ratios of 323:1 and 17.5:1. However, both the diet with the LA/ALA ratio of 2.3:1 and that containing LCP (17.7:1+ LCP) showed substantially increased levels of DHA and significantly reduced levels of 22:5n-6 relative to the 323:1 and 17.5:1 diets.

Diet	Ratio	Brain (Phosphatidylethanolamine) ^{1,2}			Retina (Phospholipid) ^{1,2}		
		20:4n-6	22:5n-6	DHA	20:4n-6	22:5n-6	DHA
S	323:1	13.1 ± 0.5	9.6 ± 1.0	8.6 ± 0.3	9.1 ± 0.3	17.3 ± 0.6	8.7 ± 0.7
A	17.5:1	12.5 ± 0.6	9.2 ± 0.9	8.3 ± 0.7	9.1 ± 0.2	15.2 ± 0.6	9.6 ± 0.6
C	2.3:1	12.9 ± 0.8	6.9 ± 0.9	11.5 ± 1.1	8.7 ± 0.2	9.3 ± 0.9	16.4 ± 1.0
A+LCP	17.7:1	12.7 ± 0.6	6.9 ± 1.3	11.5 ± 1.2	9.2 ± 0.3	9.3 ± 0.7	17.6 ± 1.0

¹% of phospholipid fatty acids; ²mean ± SD

These data show that :

- (1) reducing the ratio of LA/ALA from 323:1 to 17.5:1 had little effect on tissue DHA and 22:5n-6 levels;
- (2) reducing the ratio from 17.5:1 to 2.3:1 increased the brain DHA levels and nearly doubled the retinal DHA levels, with inverse effects on 22:5n-6 levels;
- (3) a LA/ALA ratio of 2.3:1 led to similar brain and retinal DHA levels as a diet containing preformed 20:4n-6 and DHA.

In conclusion, in this animal model the canola oil LA/ALA ratio provided DHA levels in the brain and retina equivalent to those found when preformed DHA was fed at 0.7% of dietary fatty acids.

1. Weisinger HS, Vingrys AJ, and Sinclair AJ. Dietary manipulation of long chain polyunsaturated fatty acids in the retina and brain of guinea pigs. *Lipids* 1995; 30:471-473.