COMMUNICATION

# Dietary Docosahexaenoic Acid as a Source of Eicosapentaenoic Acid in Vegetarians and Omnivores

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**ABSTRACT:** The utilization of dietary docosahexaenoic acid (DHA; 22:6n-3) as a source of eicosapentaenoic acid (EPA; 20:5n-3) *via* retroconversion was investigated in both vegetarians and omnivores. For this purpose, an EPA-free preparation of DHA was given as a daily supplement (1.62 g DHA) over a period of 6 wk. The dietary supplement provided for a marked increase in DHA levels in both serum phospholipid (from 2.1 to 7.1 mol% in vegetarians and 2.2 to 7.6 mol% in omnivores) and platelet phospholipid (from 1.1 to 3.4 mol% in vegetarians and 1.4 to 3.9 mol% in omnivores). EPA levels rose to a significant but much lesser extent, while 20:4n-6, 22:5n-6, and 22:5n-3 all decreased. Based on the serum phospholipid data, the retroconversion of DHA to EPA *in vivo* was estimated to be 9.4% overall with no significant difference between omnivores and vegetarians.

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Previous animal and *in vitro* studies in isolated rat liver cells have demonstrated that docosahexaenoic (DHA; 22:6n-3) can be retroconverted to eicosapentaenoic acid (EPA; 20:5n-3) (1–3). Human studies (4,5) using supplemented fish oil-derived preparations rich in DHA have supported the *in vivo* retroconversion of DHA to EPA based on the appearance of EPA in plasma phospholipid (4,5) as well as platelet phospholipid (5). However, the DHA concentrates employed in these studies contained some residual EPA (4,5). The 6-d study by Von Schacky and Weber (4) observed a rise in EPA in plasma, but not platelet, phospholipid following DHA ingestion. On the other hand, in the study by Sanders and Hinds (5), the EPA rise in plasma as well as platelet phospholipid occurred with a dietary DHA concentrate having 22% DHA and 8.5% EPA. Further support for the *in vivo* retroconversion of DHA to EPA was published recently by Brossard *et al.* (3) after giving a single dose of $^{13}$C-DHA. In addition to the importance of DHA in brain and retinal phospholipid for neuronal functioning and optimal visual performance, respectively (reviewed in Ref. 6), DHA levels in serum/plasma phospholipid (7,8) and EPA levels in platelet phospholipid (9) have been inversely correlated with cardiovascular disease. The primary purpose of the present study was to evaluate the potential for an EPA-free preparation of DHA (DHASCO™; Martek Biosciences Corp., Columbia, MD: derived from an algal source) to provide for EPA as derived *via* retroconversion when the DHA supplement was consumed by vegetarians and omnivores over a 6-wk period, and the fatty acid composition of both plasma and platelet phospholipid was measured. The inclusion of vegetarian subjects in this study was of interest since they consume very minor amounts of EPA/DHA relative to omnivores (10), and various studies have shown that vegetarians have lower serum and/or platelet levels of DHA (11–14). Thus, a comparison of the estimated potential for human retroconversion of DHA to EPA in vegetarians vs. omnivores was of added interest.

## MATERIALS AND METHODS

*Subjects and experimental design*. The subjects were 20 healthy persons [12 vegetarian (6 female, 6 male) and 8 omnivore (4 female, 4 male)] selected from the Guelph community. The vegetarians reported having no meat, poultry, or fish for a period of at least 6 mon. Approval for this study was granted by the Human Ethics Committee of the University of Guelph, and written informed consent was obtained from each subject. Both groups (vegetarians and omnivores) consumed 9 capsules (500 mg each) per day, with meals, of an algae-derived triglyceride oil (DHASCO™) (total 1.62 g DHA/day as measured by quantitative gas–liquid chromatography). The fatty acid composition of the DHA supplement is given in Table 1. Each group consumed the capsules for a period of 42 d beginning on day 0. After 42 d of capsule ingestion, both groups completed a washout period for 21 d during which there was no supplementation. Subjects were weighed on each visit (days 0, 21, 42, 63), and height was measured at entry. Subject characteristics ($n$ = 20) at entry were age (26.8 ± 1.6 y; mean ± SE), weight (67.5 ± 3.4 kg), height (1.73 ± 0.03 m), and body mass index (22.5 ± 1.2 kg/m$^2$) with no significant differences in these parameters between the groups ($P > 0.05$). The overall weight of the subjects was not significantly affected throughout the supplementation period in either group. All subjects completed the study. Compliance was monitored by a capsule count at the end of the study as well as by determining the fatty acid composition of serum and platelet phospholipid at 3 and 6 wk.

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Abbreviations: ACD, acid citrate dextrose; DHA, docosahexaenoic acid; EPA, eicosapentaenoic acid.

**TABLE 1**
**Fatty Acid Composition of DHASCO™ Capsules[a]**

| Fatty acids | Total fatty acids (wt%) |
|---|---|
| 8:0 | 0.05 |
| 10:0 | 1.53 |
| 12:0 | 8.50 |
| 13:0 | 0.01 |
| 14:0 | 21.0 |
| 14:1 | 0.21 |
| 16:0 | 15.8 |
| 16:1 | 1.63 |
| 18:0 | 0.44 |
| 18:1 | 11.2 |
| 18:2n-6 | 0.74 |
| 20:5n-3 (EPA) | n.d. |
| 22:5n-3 | 0.27 |
| 22:6n-3 (DHA) | 38.6 |
| 24:0 | 0.04 |
| Total saturated | 47.3 |
| Monounsaturated | 13.1 |
| n-6 Polyunsaturated | 0.74 |
| n-3 Polyunsaturated | 39.6 |
| n-6/n-3 Ratio | 0.02 |

[a]n.d., not detected; EPA, eicosapentaenoic acid; DHA, docosahexaenoic acid.

*Blood collection.* At day 0 (presupplementation), and days 21 and 42 (supplementation) and day 63 following a 21-d washout, blood was collected by antecubital venipuncture into siliconized tubes (containing no anticoagulant or the anticoagulant ACD [2.5% Na citrate, 2% dextrose, 1.4% citric acid (all from Fisher Chemicals, Nepean, Canada)]. In the tube without anticoagulant, whole blood was centrifuged at 1250 × *g* for 15 min to obtain serum. Serum was used for measurement of the fatty acid contents of total phospholipid. Serum was stored at −20°C until all samples were collected and thawed just before lipid analysis. In the tube containing ACD, washed platelet suspensions were prepared according to the method of Turini *et al.* (15) and stored at −20°C until analysis of total platelet phospholipid.

*Fatty acid analysis of phospholipid.* The fatty acid compositions of total phospholipid from serum and washed platelet suspensions were determined following lipid extraction, thin-layer chromatography, transmethylation, and gas–liquid chromatography by procedures similar to those previously described (16,17). Gas–liquid chromatography of the fatty acid methyl esters was performed using a Varian 3800 gas chromatograph (Palo Alto, CA) with a 30 m DB-23 capillary column (0.32-mm internal diameter).

*Statistical analysis*. All data is reported as mean ± SEM. Data was analyzed by Student's unpaired *t*-test. Significance is reported if $P < 0.05$.

## RESULTS AND DISCUSSION

Table 2 shows the levels of fatty acids (mol%) in the total phospholipid of human serum before and after supplementation with DHA. Serum total phospholipid fatty acid profiles at entry, including EPA and DHA levels, were not significantly different between the two groups. Changes were seen in various n-3 and n-6 fatty acids after 3 wk of DHA supplementation and those neared maximal changes in some, but not all, cases when compared to the 6-wk data. Relative rises (at 6 wk) in the DHA content (by 247% overall in vegetarians and 240% in omnivores) and the EPA content (by 122% overall in vegetarians and 58% in omnivores) over baseline occurred with DHA supplementation. This was coupled with a rise in the DHA/AA (arachidonic acid; 20:4n-6) ratio (by 414% overall in vegetarians and 318% in omnivores) and the EPA/AA ratio (by 228% in vegetarians and 94% in omnivores). AA (−32 and −19%) and the n-6/n-3 fatty acid ratio (−62 and −60%) decreased in vegetarians and omnivores, respectively. In contrast to the other n-3 fatty acids, the levels

**TABLE 2**
**Fatty Acid Composition (mol%) of Total Phospholipid in Human Serum Before and After Supplementation with DHA[a]**

| | Omnivore ($n = 8$) | | | | Vegetarian ($n = 12$) | | | |
|---|---|---|---|---|---|---|---|---|
| | Week 0 | Week 3 | Week 6 | Week 9 | Week 0 | Week 3 | Week 6 | Week 9 |
| 16:0 | 30.6 ± 0.4 | 31.5 ± 1.0 | 32.0 ± 0.5 | 31.6 ± 0.7 | 29.3 ± 0.7 | 30.4 ± 0.5 | 30.6 ± 0.4 | 30.9 ± 0.4 |
| 18:0 | 11.9 ± 0.4 | 12.2 ± 0.5 | 11.9 ± 0.8 | 12.4 ± 0.7 | 12.7 ± 0.4 | 12.4 ± 0.4 | 12.2 ± 0.3 | 12.7 ± 0.3 |
| 18:1 | 12.4 ± 0.4$^{a}$ | 11.3 ± 0.4$^{b}$ | 11.0 ± 0.4$^{b}$ | 11.3 ± 0.3$^{b}$ | 13.2 ± 0.6$^{a,c}$ | 12.3 ± 0.7$^{a,b}$ | 11.7 ± 0.4$^{b}$ | 14.1 ± 0.5$^{c}$ |
| 18:2n-6 | 22.3 ± 0.9$^{a}$ | 19.9 ± 0.6$^{b}$ | 19.9 ± 0.5$^{b}$ | 21.7 ± 0.7$^{a,b}$ | 22.1 ± 0.7$^{a}$ | 21.5 ± 0.7$^{a,b}$ | 21.8 ± 0.7$^{a,b}$ | 22.7 ± 0.60$^{a}$ |
| 18:3n-3 | 0.37 ± 0.03$^{a}$ | 0.27 ± 0.03$^{a,b}$ | 0.25 ± 0.02$^{b}$ | 0.27 ± 0.03$^{a,b}$ | 0.25 ± 0.03$^{b}$ | 0.23 ± 0.03$^{b}$ | 0.23 ± 0.03$^{b}$ | 0.29 ± 0.06$^{a}$ |
| 20:3n-6 | 2.6 ± 0.2$^{a}$ | 2.0 ± 0.2$^{b}$ | 2.0 ± 0.2$^{b}$ | 2.6 ± 0.2$^{a}$ | 2.9 ± 0.2$^{a}$ | 2.0 ± 0.1$^{b}$ | 1.9 ± 0.2$^{b}$ | 2.6 ± 0.2$^{a}$ |
| 20:4n-6 (AA) | 8.5 ± 0.5$^{a}$ | 7.5 ± 0.3$^{a,b}$ | 6.9 ± 1.3$^{b,c}$ | 7.4 ± 0.5$^{a,b}$ | 9.0 ± 0.4$^{a}$ | 6.8 ± 0.3$^{b,c}$ | 6.1 ± 0.2$^{c}$ | 7.4 ± 0.5$^{a,b}$ |
| 20:5n-3 (EPA) | 0.73 ± 0.10$^{a}$ | 1.00 ± 0.10$^{b}$ | 1.16 ± 0.10$^{b}$ | 0.74 ± 0.06$^{a}$ | 0.54 ± 0.07$^{a}$ | 0.96 ± 0.09$^{b}$ | 1.19 ± 0.18$^{b}$ | 0.69 ± 0.0$^{a}$ |
| 22:4n-6 | 0.25 ± 0.07$^{a}$ | 0.20 ± 0.01$^{a}$ | 0.14 ± 0.01$^{a,b}$ | 0.21 ± 0.02$^{a}$ | 0.34 ± 0.04$^{a}$ | 0.11 ± 0.02$^{b}$ | 0.14 ± 0.01$^{b}$ | 0.14 ± 0.03$^{b}$ |
| 22:5n-6 | 0.17 ± 0.04$^{a}$ | 0.08 ± 0.02$^{a,c}$ | 0.06 ± 0.01$^{b,c}$ | 0.11 ± 0.03$^{a,c}$ | 0.25 ± 0.04$^{a}$ | trace$^{b}$ | trace$^{b}$ | 0.06 ± 0.02$^{b,c}$ |
| 22:5n-3 | 0.68 ± 0.11$^{a}$ | 0.42 ± 0.05$^{b,c,d}$ | 0.37 ± 0.04$^{c}$ | 0.55 ± 0.07$^{a,d}$ | 0.79 ± 0.06$^{a}$ | 0.34 ± 0.05$^{b}$ | 0.37 ± 0.05$^{b,c}$ | 0.52 ± 0.07$^{a,d}$ |
| 22:6n-3 (DHA) | 2.2 ± 0.2$^{a}$ | 6.8 ± 0.3$^{b}$ | 7.6 ± 0.3$^{b}$ | 4.0 ± 0.3$^{c}$ | 2.1 ± 0.2$^{a}$ | 6.8 ± 0.3$^{b}$ | 7.1 ± 0.4$^{b}$ | 4.2 ± 0.3$^{c}$ |
| n-6/n-3 | 7.8 ± 0.4$^{a}$ | 3.5 ± 0.1$^{b}$ | 3.1 ± 0.1$^{b}$ | 5.6 ± 0.2$^{c}$ | 9.4 ± 0.6$^{d}$ | 3.7 ± 0.2$^{b}$ | 3.4 ± 0.2$^{b}$ | 5.9 ± 0.3$^{c}$ |
| EPA/AA ratio | 0.09 ± 0.01$^{a}$ | 0.13 ± 0.01$^{b}$ | 0.17 ± 0.01$^{c}$ | 0.10 ± 0.01$^{a}$ | 0.06 ± 0.01$^{a}$ | 0.15 ± 0.01$^{b}$ | 0.20 ± 0.02$^{c}$ | 0.09 ± 0.01$^{a}$ |
| DHA/AA ratio | 0.26 ± 0.03$^{a}$ | 0.91 ± 0.03$^{b}$ | 1.10 ± 0.04$^{c}$ | 0.54 ± 0.03$^{d}$ | 0.23 ± 0.03$^{a}$ | 1.00 ± 0.10$^{b}$ | 1.16 ± 0.13$^{c}$ | 0.57 ± 0.06$^{d}$ |

[a]Values are reported as mean ± SEM. Similar superscripts within individual rows are not significantly different (within and between groups). Lipids were analyzed according to the methods referenced in 16,17; AA, arachidonic acid; see Table 1 for other abbreviations. Significance is reported if $P < 0.05$.

of 22:5n-3 were also lowered (by –53 and –46% in vegetarians and omnivores, respectively) as were those of 22:5n-6. By week 9 (following 3 wk of DHASCO™ withdrawal), DHA levels, as well as n-6/n-3 EPA/AA and DHA/AA ratios, in the serum phospholipid of both vegetarians and omnivores were returning to presupplementation levels although they were still significantly different from week 0 (Table 2).

The levels of fatty acids (mol%) in platelet phospholipids before and after supplementation with DHA are shown in Table 3. At entry, omnivores had a significantly ($P < 0.05$) higher level of DHA (1.4 vs. 1.1 mol%) than vegetarians. EPA and 22:5n-3 levels were similar between the two groups. The alterations in the n-3 plus n-6 fatty acids noted at 3 wk were near maximal in most cases when compared to the 6-wk values. After 6 wk of DHA supplementation, a rise was noted in the DHA content of platelets (by 218% overall in vegetarians and 193% in omnivores), as well as in the EPA content of platelets (157% in vegetarians and 151% in omnivores). This was coupled with a rise in the DHA/AA ratio (245% in vegetarians and 199% in omnivores) and the EPA/AA ratio (179% in vegetarians and 156% in omnivores). A decrease in AA (–8% in vegetarians) and the n-6/n-3 ratio (–44% in vegetarians and –41% in omnivores) was noted. Following the pattern in serum phospholipid, there was a decrease in 22:5n-3 levels (–61% in vegetarians and –57% in omnivores) as well as in 22:5n-6. Most fatty acids approached (but not to completion) baseline values after a 3-wk washout period (Table 3).

Table 4 shows the net mol % increase in DHA (Δ DHA) and EPA (Δ EPA) in the serum and platelet phospholipids of vegetarians and omnivores. After 6 wk of consumption of DHA capsules, DHA levels in total phospholipids of serum increased from 2.1 mol% in vegetarians to 7.1% (net 5.1 mol% increase) and from 2.2% in omnivores to 7.6% (net 5.4 mol% increase). In platelets, DHA values increased from 1.1 mol% to 3.4 mol% (net 2.3 mol% increase) in vegetarians and from 1.4 to 3.9% (net 2.6 mol% increase) in omnivores. In vegetarians, EPA levels increased by 0.7 mol% in serum and 0.3% in platelets. EPA levels increased by 0.4 mol% in serum and platelets of omnivores. Thus, the total net mol% increase in EPA + DHA (Δ EPA + Δ DHA), after 6 wk of supplementation with DHA, was 5.7% in the serum of vegetarians and 5.8% in the serum of omnivores and 2.6 and 3.0% in platelets of vegetarians and omnivores, respectively. The (net mol% rise in EPA/net mol% rise in EPA + DHA) × 100 can provide an estimated percentage retroconversion of DHA to EPA. Based on this approach (Table 4), the estimated retroconversion of DHA to EPA is 7.4–11.4% (based on serum phospholipid data) and 12.3–13.8% (based on the platelet phospholipid data) with no significant differences between omnivores and vegetarians. Since DHA retroconversion is considered to actively occur in liver (2), and serum phospholipid is derived primarily from hepatic sources, the value of 9.4% (mean of both groups at week 6 based on serum phospholipid data) may be a better estimate of *in vivo* retroconversion in humans. This estimate does not take into consideration possible differences in oxidation of EPA vs. DHA or the levels of these fatty acids in different lipid classes. Furthermore, it is possible that a plateau in the EPA/DHA levels are not completely reached even by 6 wk although the levels of these fatty acids at 3 and 6 wk were not significantly different from each other (Table 2). Our estimated value for retroconversion (9.4%) is much higher than that estimated recently in human subjects by Brossard *et al.* (3) (1.4%); however, this difference may be due to the duration of DHA supplementation (6 wk in our trial vs. a one time dose of $^{13}$C-DHA). Interestingly, the latter authors also reported a 9% retroconversion of DHA to EPA based on their rat trial (3). Measures of EPA and DHA in serum/plasma phospholipid have been considered to provide useful biological indicators for EPA/DHA intake and nutritional status (18–20).

**TABLE 3**
**Fatty Acid Composition (mol%) of Total Phospholipid in Human Platelets Before and After Supplementation with DHA[a]**

| | Omnivore ($n = 8$) | | | | Vegetarian ($n = 12$) | | | |
|---|---|---|---|---|---|---|---|---|
| | Week 0 | Week 3 | Week 6 | Week 9 | Week 0 | Week 3 | Week 6 | Week 9 |
| 16:0 | 19.0 ± 0.2$^{a}$ | 18.7 ± 0.3$^{a}$ | 19.2 ± 0.2$^{a}$ | 18.9 ± 0.2$^{a}$ | 19.3 ± 0.3$^{a,b}$ | 19.9 ± 0.3$^{b}$ | 20.1 ± 0.3$^{a}$ | 20.1 ± 0.4$^{a,b}$ |
| 18:0 | 17.2 ± 0.4$^{a}$ | 17.8 ± 0.4$^{a}$ | 15.9 ± 0.4$^{b}$ | 17.7 ± 0.3$^{a}$ | 17.2 ± 0.5$^{a}$ | 15.9 ± 0.2$^{b}$ | 16.5 ± 0.6$^{a}$ | 15.9 ± 0.3$^{b}$ |
| 18:1 | 17.2 ± 0.3 | 17.6 ± 0.4 | 17.4 ± 0.5 | 17.5 ± 0.3 | 17.5 ± 0.4 | 17.6 ± 0.5 | 18.4 ± 0.5 | 18.1 ± 0.3 |
| 18:2n-6 | 5.7 ± 0.4$^{a}$ | 5.6 ± 0.3$^{a}$ | 6.4 ± 0.3$^{a}$ | 5.8 ± 0.2$^{a}$ | 6.1 ± 0.2$^{a}$ | 6.9 ± 0.2$^{b}$ | 6.9 ± 0.3b | 7.1 ± 0.2$^{b}$ |
| 20:3n-6 | 1.3 ± 0.1 | 1.4 ± 0.1 | 1.6 ± 0.1 | 1.5 ± 0.1 | 1.2 ± 0.1 | 1.3 ± 0.1 | 1.5 ± 0.1 | 1.3 ± 0.1 |
| 20:4n-6 (AA) | 24.1 ± 0.7$^{a}$ | 22.7 ± 0.4$^{b}$ | 23.6 ± 0.5$^{a}$ | 23.4 ± 0.4$^{a}$ | 22.4 ± 0.7$^{a,b}$ | 22.3 ± 0.4$^{b}$ | 20.6 ± 0.7c | 23.2 ± 0.4$^{a,b}$ |
| 20:5n-3 (EPA) | 0.28 ± 0.05$^{a}$ | 0.52 ± 0.05$^{b}$ | 0.69 ± 0.05$^{c}$ | 0.44 ± 0.04$^{b}$ | 0.20 ± 0.04$^{a}$ | 0.45 ± 0.06$^{b}$ | 0.52 ± 0.06$^{c}$ | 0.35 ± 0.08$^{a,b}$ |
| 22:4n-6 | 1.9 ± 0.1$^{a}$ | 1.3 ± 0.1$^{b}$ | 1.1 ± 0.1$^{c}$ | 1.5 ± 0.1$^{d}$ | 2.1 ± 0.2$^{a}$ | 1.1 ± 0.1$^{b,e}$ | 1.0 ± 0.1$^{c,e}$ | 1.4 ± 0.1$^{d}$ |
| 22:5n-6 | 0.23 ± 0.04$^{a,b}$ | 0.09 ± 0.02$^{c}$ | trace$^{d}$ | 0.15 ± 0.03$^{c}$ | 0.14 ± 0.04$^{a}$ | trace$^{d}$ | trace$^{d}$ | 0.03 ± 0.02$^{d}$ |
| 22:5n-3 | 1.55 ± 0.21$^{a}$ | 0.73 ± 0.06$^{b}$ | 0.66 ± 0.04$^{b}$ | 0.99 ± 0.06$^{c}$ | 1.48 ± 0.10$^{a}$ | 0.57 ± 0.05$^{d}$ | 0.58 ± 0.07$^{b,d}$ | 0.96 ± 0.06$^{c}$ |
| 22:6n-3 (DHA) | 1.4 ± 0.1$^{a}$ | 3.4 ± 0.2$^{b}$ | 3.9 ± 0.2$^{c}$ | 2.5 ± 0.1$^{d}$ | 1.1 ± 0.1$^{e}$ | 3.2 ± 0.1$^{b}$ | 3.4 ± 0.2$^{b}$ | 2.3 ± 0.1$^{d}$ |
| n-6/n-3 | 8.7 ± 0.4$^{a}$ | 6.7 ± 0.2$^{b}$ | 6.1 ± 0.2$^{b}$ | 8.15 ± 0.3$^{c}$ | 11.4 ± 0.6$^{d}$ | 7.3 ± 0.3$^{b}$ | 6.7 ± 0.3$^{b}$ | 9.4 ± 0.4$^{c}$ |
| EPA/AA ratio | 0.01 ± 0.00$^{a}$ | 0.02 ± 0.00$^{b}$ | 0.03 ± 0.00$^{c}$ | 0.02 ± 0.00$^{b}$ | 0.01 ± 0.00$^{a}$ | 0.02 ± 0.00$^{b}$ | 0.03 ± 0.00$^{c}$ | 0.02 ± 0.00$^{b}$ |
| DHA/AA ratio | 0.06 ± 0.00$^{a}$ | 0.15 ± 0.01$^{b}$ | 0.17 ± 0.01$^{b,c}$ | 0.11 ± 0.01$^{d}$ | 0.05 ± 0.00$^{a}$ | 0.15 ± 0.02$^{b}$ | 0.17 ± 0.02$^{c}$ | 0.10 ± 0.01$^{d}$ |

[a]Values are reported as mean ± SEM. Similar superscripts within individual rows are not significantly different (within and between groups). Lipids were analyzed according to the methods referenced in 16,17. See Tables 1 and 2 for abbreviations. Significance is reported if $P < 0.05$.

**TABLE 4**
**Effect of DHA Supplementation on the Net Increase in EPA and DHA Levels in Serum and Platelet Phospholipid[a]**

| | Omnivore ($n$ = 8) | | Vegetarian ($n$ = 12) | |
|---|---|---|---|---|
| Parameter | Serum | Platelet | Serum | Platelet |
| Δ EPA (mol%) | 0.43 ± 0.14[a,b] | 0.41 ± 0.07[a,b] | 0.65 ± 0.12[b] | 0.32 ± 0.05[a] |
| Δ DHA (mol%) | 5.4 ± 0.4[a] | 2.6 ± 0.2[b] | 5.1 ± 0.3[a] | 2.3 ± 0.2[b] |
| Δ EPA + Δ DHA (mol%) | 5.8 ± 0.4[a] | 3.0 ± 0.1[b] | 5.7 ± 0.3[a] | 2.6 ± 0.2[b] |
| Δ EPA/Δ EPA + Δ DHA (as relative %) | 7.4 ± 1.3[a] | 13.8 ± 1.6[b] | 11.4 ± 1.7[a,b] | 12.3 ± 1.8[b] |

[a]Values are reported as means ± SEM as a result of 6 wk of DHASCO™ supplementation. Similar superscripts within individual rows are not significantly different. See Table 1 for abbreviations. Significance is reported if $P < 0.05$.

Our 6-wk supplementation trial in vegetarians and omnivores employed an EPA-free preparation of DHA wherein all other n-3 polyunsaturated fatty acids were present at levels less than 0.3%. Our vegetarian subjects exhibited significantly lower levels of DHA in platelet phospholipid relative to omnivores as reported by others (13,14). Unlike previous studies (11–14), the lower EPA/DHA levels in the serum phospholipid of our vegetarian subjects (relative to the omnivores) did not reach statistical significance, perhaps because our subject group of healthy Canadian vegetarians was unlike the subject groups in the other studies (vegans, rheumatoid arthritis patients, people of Asian Indian background). Previous studies in omnivores employing DHA preparations containing residual EPA have shown significant rises of EPA in serum phospholipid (4,5) with (5) or without (4) a corresponding rise in EPA in platelet phospholipid. The study of Sanders and Hinds (5), which showed a rise in EPA in platelet phospholipid over 6 wk, employed a supplemented preparation which contained 22% DHA and 8.5% of residual EPA which does not allow for a calculation of retroconversion in humans. The study by Von Schacky and Weber (4) showed a rise in EPA in serum but not platelet phospholipid when a DHA concentrate was given orally for 6 d to human volunteers. The failure of the latter study to exhibit a rise in EPA in platelet phospholipid, in contrast to our present findings, likely lies with the duration of the study employed (6 d as compared to 42 d in the present investigation). Recent studies have indicated that the hepatic retroconversion of DHA to EPA is a peroxisomal function (2).

It remains to be established whether the rise in DHA and also EPA *via* retroconversion in vegetarian subjects upon consuming an algal source of DHA (DHASCO™) provides any health benefits. Future studies on varying dose levels of DHA in both vegetarians and omnivores likely will be of interest considering the accumulating evidence that DHA is an essential nutrient, in the brain and retina, for neuronal and visual functioning, respectively (6). Furthermore, the dietary intake of EPA/DHA from seafood has been associated with a reduced risk of primary cardiac arrest (21); also, DHA levels in serum phospholipid (7,8) and EPA levels in platelet phospholipid (9) have been inversely correlated with cardiovascular disease.

Interestingly, the dietary DHA supplement suppressed the levels of both 22:5n-6 and 22:5n-3 in both serum and platelet phospholipid. Whether these biochemical changes represent competition at the level of fatty acid esterification into the corresponding cellular phospholipid (at the level of *de novo* phospholipid synthesis or acyl transferase reactions) or other modification of polyunsaturated fatty acid metabolism (effects on 22:5n-6 and 22:5n-3) remains to be studied further.

In conclusion, the present results indicate that an EPA-free concentrate of DHA consumed over a period of 6 wk can significantly enrich the level of DHA as well as EPA in both serum and platelet phospholipid of omnivores and vegetarians. The estimated retroconversion of dietary DHA to EPA based on these studies is 9.4% with no significant differences apparent between omnivores and vegetarians. Future studies using deuterated precursors which study the metabolism and turnover of DHA and its fatty acid products *in vivo* will be of interest in further determinations of the estimated retroconversion as derived from our present study.

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