Consuming Fish to Reduce Mercury Intake While Optimizing Omega-3 Fatty Acid Status

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ABSTRACT

The specific aim for this ongoing study is to determine whether female subjects (18-40 years of age, target=120) who enroll in the study with elevated hair mercury levels (>0.8 ppm) and are then fed low mercury fish (farmed salmon or farmed tilapia at 6 ounces [170 g]/week for 12-13 weeks), while avoiding other seafood, will significantly decrease their hair and blood mercury concentrations while maintaining or increasing their plasma omega-3 fatty acid (EPA/DHA) levels.

INTRODUCTION

Infants are sensitive to the adverse long-term health effects from exposure to environmental toxicants. Exposure to methylmercury, a developmental toxicant found primarily in fish, has been predicted to impact the health of up to 300,000 newborns every year in the U.S. with effects (abnormal memory, attention and language skills) possibly lasting past childhood (Mahaffey et al., 2004). Fish is nutritionally important for providing long chain omega-3 fatty acids that are important for perinatal health. Since maternal transfer of mercury and omega-3 fatty acids are the primary routes for fetal (placental transfer) or infant (maternal milk) exposure, there is a critical need to develop specific advice for childbearing-aged women based upon the 2005 Dietary Guidelines Advisory Committee's recommendation i.e., consume 8 ounces of fish per week (DHHS, 2005).

Hypothesis: *Childbearing-aged women who consume fish that is high in long chain omega-3 fatty acids and low in mercury will improve or maintain their omega-3 fatty acid status while lowering their mercury body burden during a 3-month trial.*

METHODS

Free living women (18-40 years of age) were asked to complete a brief seafood consumption survey. Those that had consumed fish species that are higher in mercury were asked to allow us to collect a scalp hair sample (cut with scissors, at least 100 mg of 1 cm length, close to the scalp). Subjects with hair mercury >0.8 ppm were invited to join the study. Subjects were randomly sorted into one of two groups and fed either salmon or tilapia (170 g/wk for 12-13 wks) and asked to avoid consuming any other seafood products for the duration of the study. At the start of the study and at monthly intervals, hair and blood (10 mL venous blood into tubes with ethylene diamine tetraacetic acid after an 8-10 hour overnight fast) were collected.

Fatty Acids Analysis: Lipids were extracted from plasma or fish tissue by a modified method of Folch et al. (1956). Internal standard, 0.4 mL of 1 mg/mL (methyl ester C23:0) dissolved in isooctane was evaporated under nitrogen. Plasma (0.5 mL) and 5 mL of chloroform/methanol (2:1) were added and samples were washed with 1 mL of 0.88% KCl. The lower layer was collected, evaporated under nitrogen and the omega-3 fatty acids were derivatized as described elsewhere (AOAC Method 991.39). The final combined isooctane extracts were mixed with 20 µL of 10 mg/mL methanolic BHT and evaporated under nitrogen. The residue was redissolved in 100 µL isooctane and 1 µL was injected to the gas chromatography and analyzed using conditions described previously by Shim et al. (2003). Modifications to the method included use of a CP-3800 instrument and a CP-8410 autosampler (Varian, Walnut Creek, CA) and a temperature gradient start at 170°C. The gradient was held at 240°C for 9 min and the injection temperature was 250°C. Concentrations of EPA plus DHA in salmon and tilapia were 2000 and 90 mg/100g, respectively.

Mercury Analysis: Total mercury was measured in hair and fish tissue by Thermal Decomposition-Amalgamation/Atomic Absorption Spectrophotometry (DMA-80 Mercury Analyzer, Milestone, Inc, Monroe, CT). Analyzer was calibrated with mercury solutions (AccuStandard, New Haven, CT) and standard reference material (TORT-2). Mercury concentrations in cooked tilapia and salmon were 9 and 82 ppb, respectively.

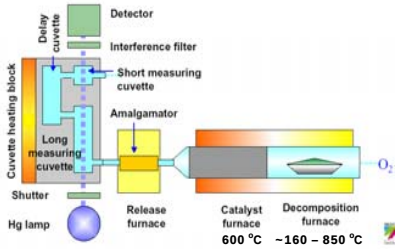

Figure 1. DMA-80 Mercury Analyzer, Milestone, Inc, Monroe, CT (courtesy of Milestone, Inc.)

RESULTS

Preliminary findings – 56 subjects have completed the feeding portion. Hair mercury and plasma fatty acid concentrations for 19 subjects have been analyzed. The average starting and ending hair mercury concentrations were 1.32 and 1.12 ppm, respectively. The average reduction in mercury was 15% over the 12 week study (Figure 2). The average starting plasma EPA and DHA concentrations for the salmon-fed were 12 and 59 mg/L, respectively (Figure 3). The average ending plasma EPA and DHA concentrations for this group were 26 and 76 mg/L, respectively. This represents an average increase in EPA and DHA of 117 and 29%, respectively. The average starting EPA and DHA concentrations for the tilapia-fed group were 9 and 46 mg/L, respectively. The average ending EPA and DHA concentrations for this group were 8 and 42 mg/L, respectively. This is an average reduction in EPA and DHA of 11 and 9%, respectively.

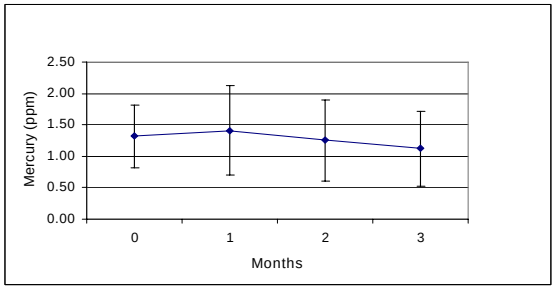

Figure 2. Mean hair mercury for both feeding groups over 3 months (n=19).

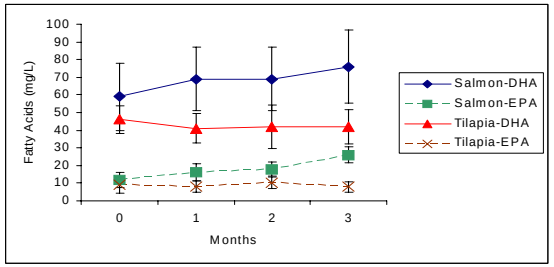

Figure 3. Plasma DHA and EPA over 3 months (n=9 fed tilapia and n=10 fed salmon).

CONCLUSIONS

- Hair mercury decreased 15% over 3 months when subjects were fed low-mercury fish species
- Plasma EPA and DHA concentrations were higher in subjects that were fed salmon
- Consuming just 6 ounces/wk of a fish species that is higher in EPA/DHA (i.e., salmon) increases plasma EPA/DHA concentrations

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