Predicting the Impact of Foods on Mercury Bioavailability

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ABSTRACT
The effects of phytochemical-rich foods or food components on bioaccessibility of mercury from fish were investigated by using an in vitro digestion coupled with a Caco-2 cell model to predict absorption. Mercury uptake by Caco-2 cells (TC7 clone) from the aqueous phase digesta was measured following a 6 h incubation at 37 °C. Black tea powder (31 and 62.5 mg) reduced mercury uptake by 90% compared to green tea. Soy protein powder (100 mg) and sodium copper chlorophyllin powder (1-25 mg) both decreased cellular mercury uptake; whereas, grapefruit juice (0.5-10 mL) had no effect on cellular mercury uptake. Wheat bran reduced cellular mercury uptake greater then oat bran; however, psyllium had no significant effect on mercury uptake. Our study supports an effect of foods and phytochemicals on mercury bioavailability.

INTRODUCTION
Fish is a source of high-quality protein, vitamin D, selenium, omega-3 fatty acids, and other nutrients. Fish consumption, however, has also been identified as the main source of methylmercury exposure in humans (Marsh et al., 1995; NAS, 2000). In order to reduce the body burden of methylmercury, chelating agents such as 2, 3-dimercapto-1-propanethiol (DMPS) have been used (Apohsian et al., 1992; NAS, 2000). However, the use of a chelating agent to treat chronic methylmercury exposure by fish-eating populations is not practical. Alternatively, many studies have suggested that dietary factors can reduce methylmercury exposure to humans. (Chapman and Chan, 2000). Bioaccessibility is defined as the amount of a compound released from an ingested food matrix into gastrointestinal tract juice and which is available for absorption by the intestinal mucosa (Garrett et al., 1999; Versantvoort et al., 2005). When coupled with a simulated gastrointestinal digestion, a rapid and inexpensive approach to estimate bioavailability of chemical toxins is possible (Versantvoort et al., 2005).

METHODS
Food component & King mackerel (1 ppm Hg) ↓
in vitro digestion ↓
aqueous fraction (1 mL) cell medium (3 mL) ↓
Uptake by Caco-2 cells, at 37°C, 6 hr ↓
harvest cells ↓
total Hg analysis

RESULTS

CONCLUSIONS
• Phytochemical-rich foods or food components, such as green tea, black tea, soy protein, SCC, or wheat bran, reduced mercury bioaccessibility and inhibited methylmercury uptake by human intestinal cells.
• These phytochemical sources may be more efficient than synthetic chelating agents (e.g., DMPS) for treating methylmercury exposure.
• This in vitro digestion model coupled with Caco-2 absorption may be a rapid and cost-effective alternative for evaluating total bioaccessibility of methylmercury in fish.

REFERENCES
• Marsh et al., 1995. Neuroxic. 16: 583-596.

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