A Case Study of Fucoxanthin Uptake Kinetics

Neal E.Craft and Francisco X. Arredondo
Craft Technologies Inc., Wilson, NC 27893
www.crafttechnologies.com

BACKGROUND

Fucoxanthin (FX) is a nonprovitamin A carotenoid that is common in several types of edible seaweeds, including wakame. It is the second most prominent carotenoid in the earth's biomass accounting for about 10 million tons annually. Various types of seaweed are commonly consumed in East Asia and have been attributed to resistence to some diseases. FX has been reported to have antioxidant (Yan, et al, 1999), anticancer (Kotake-Nara, et al 2001), and antiobesity (Maeda et al, 2005) activities. Recently the dietary supplement (DS) industry has taken interest in the reports that FX consumption may lead to weight loss in humans and abdominal adipose tissue loss in rodents. This increase in thermogenesis and decrease in white adipose tissue appears to be the result of increased expression of uncoupling protein 1 (UPC1). DS containing FX for weight loss are appearing on the market but very little is known about FX absorption and metabolism in humans. As such, a case study was planned to examine the uptake of FX (or metabolites) in an adult male.

METHODS

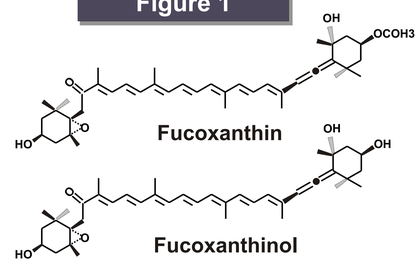
- 11mg of FX was consumed as 5 softgels containing 2.2mg FX/gel.
- Blood was collected at 0, 4, 8, 24hr and serum was harvested.
- A urine sample was collected during the first 24hr to examine for FX or metabolites.
- Chronic doses of 6.6mg/day were consumed on 6 subsequent days.
- Fasting blood was collected on days 1-4.
- Serum was precipitated with alcohol and extracted with hexane and THF/hexane.
- The extracts were dried using a SpeedVac and dissolved in solvent miscible with the mobile phase.
- FX was hydrolyzed to Fucoxanthinol to compare to the metabolite observed in the serum and urine.
- Serum and urine were incubated with glucuronidase/sulfatase to determine if any conjugates were present.
- To examine FX-metabolites, C18 SPE was used to collect concentrated fractions.

Column: YMC C30, 250 x 4.6mm, 3µ
Detection: Diode Array from 270-520nm, monitoring 450nm
Mobile phase: Initial- Water 12.5/Methanol 85/Ethyl Acetate 2.5
Final- Methanol 22/Ethyl Acetate 78
Flow rate: 1.0 mL/min
Temperature: 35°C

OBJECTIVES

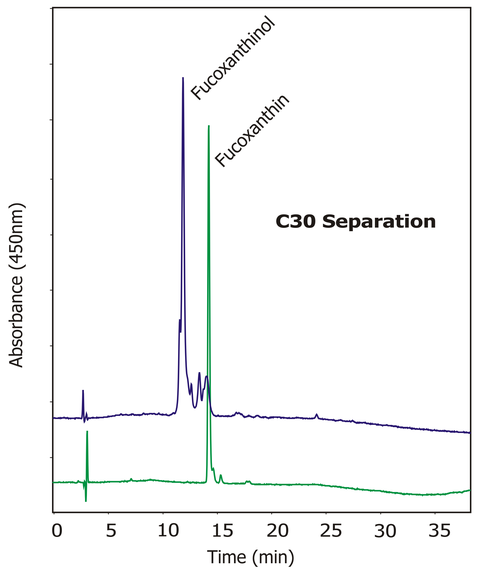
- To consume a known amount of FX on a daily basis while monitoring carotenoids in blood (and urine).
- To identify FX or possible metabolites in blood (and urine).
- To observe the kinetics of FX or metabolite appearance in blood under acute and chronic consumption.

Figure 1



Fucoxanthin was hydrolyzed to Fucoxanthinol upon incubation with cholesterol esterase. Figure 2, below, illustrates the separation of the two carotenoids using a C30 HPLC method.

Figure 2



In Figure 3, 3.2 mL of serum was precipitated with alcohol and extracted into hexane/THF. The solvent was evaporated then the extract was concentrated and fractionated using C18 SPE cartridges. Similarly, 20mL of urine was fractionated by SPE prior to C30 HPLC.

Figure 3

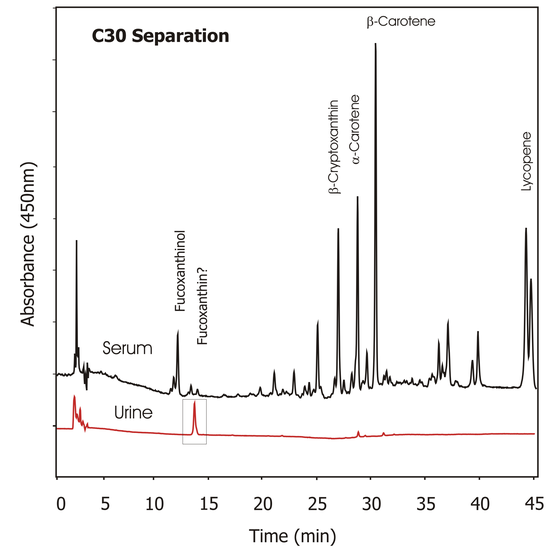


Figure 4

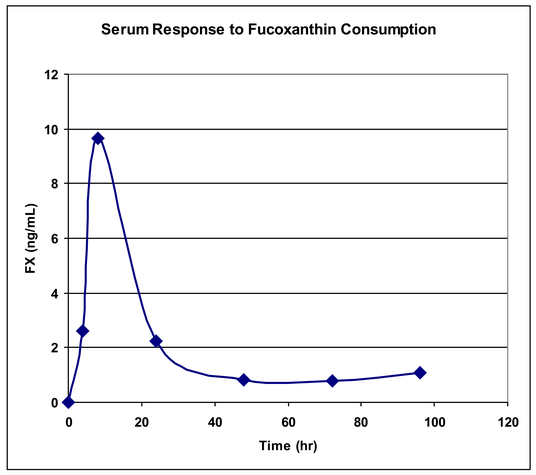


Figure 5

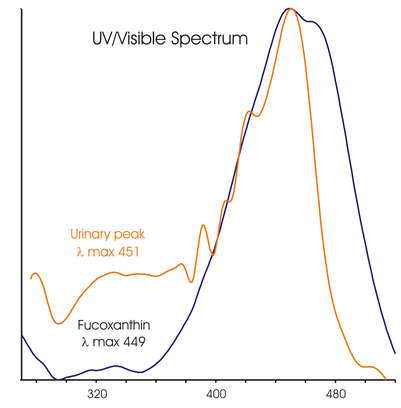


Figure 5 illustrates the UV/Visible spectrum of the peak in the urine that elutes with the retention time of Fucoxanthin. It is overlayed with the spectrum of Fucoxanthin to highlight the differences. The urinary peak is not Fucoxanthin and no Fucoxanthinol was observed upon hydrolysis with glucuronidase/sulfatase.

CONCLUSIONS

- Native FX was not observed in the serum or urine
- Fucoxanthinol was observed in the serum but not urine.
- Figure 4 illustrates that Fucoxanthinol in serum increased quickly to a maximum at ~8hr post-consumption and returned to the 4hr concentration by 24hr.
- Fucoxanthinol was detectable in daily serum samples at ~1ng/mL but did not accumulate on a dose of 6.6mg/day (Figure 4).
- Figure 3 illustrates a peak in the urine with retention time matching FX however did not match the UV/Visible spectrum (Figure 5).
- No conjugated forms of FX or Fucoxanthinol were detected in serum or urine.
- Data indicate that FX is hydrolyzed to Fucoxanthinol. A small amount is transported in the blood and rapidly metabolized. This is in agreement with Asai et al. 2008.