Princeton Alumni Association of Maine

Sybil's Homepage

This past September a lobsterman working for *Ship to Shore Lobster Co*., in Owls Head (http://www.shiptoshorelobster.com) caught the chromatically bilateral animal we have named ***Sybil.*** According to Anna Mason, of *Ship to Shore*, and as described by Seth Koenig, a staff writer for the Bangor Daily News, the lobsterman took her home to show his family, and then agreed to let *Ship to Shore* donate it to the Gulf of Maine Research Institute in Portland. As soon as she arrived she was the center of much attention....as you can see in this clip from WMTV last fall.

http://www.wmtw.com/news/maine/twotoned-lobster-has-home-in-portland/-/8792012/21725760/-/cbghgp/-/index.html

Carl Wilson, a state lobster biologist with the Department of Marine Resources estimated that split-colored lobsters are found about once out of every 50 million animals. The rarest colored lobsters are believed to be white ones, which occur perhaps once in every 100 million of the creatures, while blue ones and calico ones are comparatively more frequent — perhaps 1 in just 2 million and 1-in-30 million, respectively, according to previously published reports.

The basis for the color of crustacean shells is a complex carotenoid pigment known as ataxanthin. Ataxanthin is one of over 600 known carotenoids. In general, all of these molecules absorb blue light. As a result, if ataxanthin or any other carotenoid is isolated and extracted (whether from a crustacean shell or from a carrot) it will appear to be reddish-orange….about the color of a cooked lobster.

There is, however, another molecule involved in crustacean color determination. In 2009 Nicholas Wade and his colleagues in Brisbane, Australia, published an article in *Molecular Biology and Evolution* that identified a unique coloration system in crustaceans which results from changes in the physical shape of the *in situ* ataxanthin molecule (see Mol.

Biol. Evol. 26(8):1851–1864. 2009). The researchers described a protein they called crustacyanin which can bind to astaxanthin and cause the molecule to twist into a different shape. The shape of the resulting molecular complex, which is stable and maintained in the life if each individual animal, determines what wavelengths of light will be reflected from the crustacean's shell. Depending on how the molecules interact, the animal's color can be anywhere along the visible light spectrum, from short-waved reds to the longer wavelengths of blue light. Just how the protein and the carotenoid interact is a currently under intense investigation. (To see how intense, google "crustacyanin" or click on the link below:

http://www.pnas.org/content/99/15/9795.full.pdf+html.

The shape of the crustacyanin/astaxanthin complex is stable in any individual, as is the shape of the isolated astaxanthin molecule. And, regardless of the shell color of the living animal, when it is cooked the crustacyanin protein will be destroyed and the astaxanthin pigment in its shell reverts to its stable shape…which is that well-recognized reddish-orange color of a boiled lobster…or a carrot.

Wade and his colleagues looked for the crustacyanin protein in many different animals but could only find it in crustaceans. They point out in their article that there are several other factors that influence the color of crustaceans, including their dietary intake and the background color of their environment. These factors, along with acidity and temperature, are also known to affect protein-pigment complexes. Expression of the gene that produces the shape and the binding characteristics of crustacyanin protein is subject to all these factors but is also subject to genetic selection. Because animal color patterns are an important aspect of habitat adaptation, and because crustaceans occupy a bewildering diversity of habitats, Wade and his colleagues note that what they really are studying is the genetic basis of biodiversity. However, if you need a more practical reason to justify this research they point out that crustocyanin could probably be genetically engineered to produce a whole new variety of new color-based products, including food additive dyes and dyes for medical diagnostic purposes.

But if after reading all that you just want to look at some more pretty lobsters you can follow this link to the University of Maine's Lobster Institute…and learn a lot more about these icons of our Maine coastline:

http://umaine.edu/lobsterinstitute/sample-page/colorful-lobsters

Meanwhile, Sybil has dreams of becoming an entrepreneur!

"Welcome to Sybil's Seafood Shack!
May I take your order, please?"