

## Astaxanthin: A Molecule That Allows You See Through Rose-Colored Glasses

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Astaxanthin is a red pigment originally contained in marine sources like algae and plankton. This molecule can be found in many species such as lobsters, salmons, shrimps, crabs, as well as birds, like flamingos. It is a lipophilic terpenoid which accumulates in oils and fat. The astaxanthin coloration is not visible in shell fish because it is surrounded by a protein giving them a black color. Therefore, when lobsters and shrimps are boiled, the protein chain gets modified and astaxanthin is freed giving shell fishes their well-known pink color<sup>1</sup>.



Today, synthetic astaxanthin is used a lot for aquaculture and most of the molecules are produced from petroleum sources. In fact, wild salmons have pink flesh as they eat plankton containing astaxanthin. When they are raised in farms, salmon have a light flesh which can be misleading for the customer. To recreate the natural coloration, commercial forms are used. This has been a problem as many companies don't properly label their product indicating that a synthetic pigment was used to give the food the "fresh" color.

However, there are high hopes for a synthetic astaxanthin alternative. KnipBio, a company

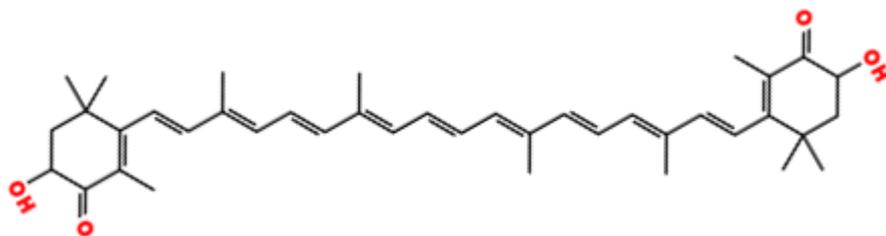
whose mission is to help secure the quality and safety of the global food supply in a sustainable, cost-effective way, recently launched a product created from a strain of the leaf symbiotic *Methylobacterium extorquens*, which produces astaxanthin in commercially relevant quantities. This breakthrough provides the aquaculture industry a new source of biologically produced astaxanthin that is competitively priced with synthetic versions of the product derived from petrochemicals.

According to Larry Feinberg, CEO of KnipBio: “For several years our research team has been working on a new technology for the aquaculture industry that we call protein-plus - immune-nutrients with premium protein to make KnipBio meal a superior feed ingredient. We have now developed a proprietary biological pathway that allows our microbe to produce astaxanthin in concentrations that make it effective for salmon and other species at inclusion rates of 5 percent or less of a formulated feed. This is great news for salmon, trout, and shrimp farmers looking for an affordable and natural alternative to synthetic astaxanthin. It’s also great news for consumers, as our research shows they prefer food products made from natural ingredients.”

However, before KnipBio’s product can be used regularly in farms, food monitors can use chromatography to discover whether a salmon is wild or raised in a farm to look for the real deal or synthetic astaxanthin.

This molecule has two chiral centers and hence 3 stereoisomers. Synthesis of this molecule gives a racemic mixture of the three isomers in 1:2:1 ratios (3S,3’S : 3R,3’S : 3R,3’R), while natural astaxanthin has a different ratio. In fact it varies depending on the organisms which synthesize it. (See **Figure 2**)

**Figure 2.**



The quantification of these isomers has been achieved by many authors using chiral liquid chromatography (Vecchi and Müller 1979, Maoka et al., 1985, Turujman 1993, Turujman et al. 1997, Østerlie et al. 1999)<sup>2</sup>. In these papers, the molecule is derivatized and analyzed on an achiral column.

Some approaches without derivatization on Pirkle L-leucine chiral column enabled a fast separation without derivatization<sup>2</sup>. Therefore, the salmon's origin has no secrets to hide!

1. Shah, M. M; Liang, Y; Cheng, J. J; Daroch, M (2016). "Astaxanthin-Producing Green Microalga *Haematococcus pluvialis*: From Single Cell to High Value Commercial Products". *Frontiers in Plant Science*. **7**: 531
2. Vittorio Maria Moretti, Tiziana Mentasti, Federica Bellagamba, Umberto Luzzana, Fabio Caprino, et al..Determination of astaxanthin stereoisomers and colour attributes in flesh of rainbow trout (*Oncorhynchus mykiss*) as a tool to distinguish dietary pigmentation source. *Food Additives and Contaminants*, 2006, 23 (11), pp.1056-1063

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