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Who's a pretty polyenal lipochrome?

For more than a century, biochemists have known that parrots produce their dazzling plumage colours using an unusual set of pigments, but the biochemical identity of the pigments has remained elusive.



Now, an Arizona State University researcher has uncovered the chemistry behind the colours of parrots, describing on a molecular level what is responsible for their bright red feathers.

The work casts a new light on what is chemically responsible for the colours of birds, and defies previous assumptions and explanations for colour variations in parrots, said Kevin McGraw, an assistant professor in ASU's School of Life Sciences.

"Evolutionary biologists have not really thought hard about parrot coloration," said McGraw. "This research is exposing a whole new world of colour communication in parrots and the potential physiological and biochemical roles of the new molecules we found in our work."

Details of the work are in a paper, 'Distribution of unique red feather pigments in parrots,' by McGraw and Mary Nogare, a parrot fancier from Snoqualmie, Wash., published in today's issue of *Biology Letters*.

Animals, like birds and fishes, commonly use biochromes like carotenoids to acquire red, orange or yellow coloration, but McGraw and Nogare found that these compounds are not responsible for the red colours found in the parrot species they sampled.

The researchers used high-performance liquid chromatography (HPLC) to survey the pigments present in red parrot feathers. McGraw and Nogare collected and analyzed samples from 44 parrot species that have red feathers. Overall, there are some 350 species of parrots, 80 percent of which have red in their plumage.

They found a suite of five molecules, called polyenal lipochromes (or psittacofulvins), which colour parrot plumage red in all of the species studied.

"We've uncovered a system where all red parrots use the same set of molecules to colour themselves," McGraw said. "It is a unique pigment found nowhere else in the world. We are fascinated at how parrots are able to do this."

"The fact that there is a single set of molecules unique to and widespread among parrots, suggests that it is a pretty important evolutionary novelty, and one we should carefully consider when we think about why parrots are so strikingly colourful," McGraw said.

He added that an interesting aspect of the five polyenal lipochromes that provide the red in parrots, is that the pigment is found only in the bird's feathers and nowhere else in the body of the bird, indicating that parrots manufacture these molecules internally and directly at the maturing follicles of the growing, colourful plumage.

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In addition, these pigments may play a valuable role in maintaining the health of parrots. McGraw cites an independent study on the parrot pigments that suggests that they can act as anti-oxidants to quench free radicals and potentially protect cells and tissues in the body from oxidative damage. Now, McGraw says, he's interested in learning more about the connection between the red colours and anti-oxidants within and among parrot species, as well as "to specifically explore the balance of naturally and sexually selected costs and benefits to becoming colourful.

"Parrots are unusual among birds, in that they almost without exception display fantastic colours but exhibit very little variation in colour within a species - at least in colours visible to us. Parrots in general may not be using colour in the classic cases of mate choice or competitive ability," he said. "Exactly why they are so uniformly coloured remains an interesting mystery to us - one we want to investigate."

"There is a sea of colours in birds," he added. "Our goal is to learn why there is such a diversity from an evolutionary standpoint."

Illustration shows Green-winged macaws

