

Beauty is in the fisheye of the beholder

Does eating colourful plants make you a better parent? Neil Metcalfe and colleagues have been looking at links between diet and breeding performance in fish.

Why are the males (and sometimes the females) of many animals brightly coloured during the breeding season? What are they signalling, and to whom? If brighter individuals in the population are assumed to be better, exactly what measure of quality is being shown by, say, the brightness of a blackbird's beak?

Carotenoids have played a key role in this debate. They are pigments synthesised predominantly by plants, which are eaten by animals. While their original role centres on photosynthesis, they have many other properties. Many animals use them to produce yellow, orange and red ornamentation – but they also stimulate the immune system and act as antioxidants, mopping up reactive molecules that can otherwise cause damage to cells and accelerate the aging process. Given this range of functions, some researchers have suggested that carotenoid-based coloration could be providing an honest signal that indicates the quality or health of the animal: since carotenoids may be limited in the diet, only individuals in the best condition can afford to use them for ornamental colours rather than as

antioxidants or boosters for the immune system.

Along with Tom Pike and Jan Lindström at the University of Glasgow and Jon Blount at the University of Exeter, I have been looking at whether carotenoid coloration can signal an individual's ability to withstand oxidative damage, and hence its rate of ageing. For various reasons we

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tested this idea using threespine sticklebacks: each male uses his carotenoid-based red throat patch to attract females to lay eggs in the nest that he has built; he then takes exclusive care of the eggs and young fry. Adults usually die either during or shortly after their single breeding season, therefore females are entrusting their eggs to a male that must devote considerable energy to their care, yet may only have a short time to live, so females could be using the colour of a male to assess his health and ability to withstand the aging process.

We tested this prediction by feeding fish on diets that had relatively low versus high carotenoid contents but were otherwise identical. Males on the low diet produced a throat patch that was almost as

Aging and antioxidants

Oxidation is a chemical reaction resulting from exposure to oxygen or other electron-seizing atoms. Oxidation reactions can produce free radicals (highly reactive chemicals) which start chain reactions that damage cells. Antioxidants are molecules such as polyphenols (found in tea) that slow or terminate these chain reactions.

red as those of high-diet males – but only by diverting almost all of their carotenoids away from the rest of the body, with the result that their cells showed more signs of old age, they were less able to provide parental care (measured as their ability to aerate the eggs by vigorous fanning) and they were much more likely to die before the end of the breeding season. Females seemed able to spot the difference, preferring to mate with males that had eaten more carotenoids – and preferring the male that subsequently lived the longest. Moreover, it seems that the red coloration indicates overall antioxidant status (rather than only that of carotenoids), since males that were given vitamins C and E supplements (which are colourless) developed redder throats (and were preferred by females), even though they had not been given extra carotenoids.

So it seems that males are able to use carotenoids to signal to females that they are healthy and well equipped to fight the ageing process. Maybe I will have that extra portion of carrots ... ■



Not all male sticklebacks go equally red – those with greater access to carotenoids (below) can produce redder throat patches.

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