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Diet and the evolution of the brain

Fish and no chips

The wonders of docosahexaenoic acid

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Smarter than the average zebra

TO PIN one big evolutionary shift on a particular molecule is ambitious. To pin two on it is truly audacious. Yet doing so was just one of the ideas floating around at "A Celebration of DHA" in London this week. The celebration in question was a scientific meeting, rather than a festival. It was definitely, however, a

love-in. It was held on May 26th and 27th at the Royal Society of Medicine to discuss the many virtues of docosahexaenoic acid, the most important of that fashionable class of dietary chemicals, the omega-3 fatty acids.

DHA is a component of brains, particularly the synaptic junctions between nerve cells, and its displacement from modern diets by the omega-6 acids in cooking oils such as soya, maize and rape is a cause of worry. Many researchers think this shift—and the change in brain chemistry that it causes—explains the growth in recent times of depression, manic-depression, memory loss, schizophrenia and attention-deficit disorder. It may also be responsible for rising levels of obesity and thus the heart disease which often accompanies being overweight.

Michael Crawford, a researcher at the Institute of Brain Chemistry and Human Nutrition in London, believes, however, that DHA is even more important than that. He suggests that it was responsible for the existence of nervous systems in the first place, and that access to large quantities of the stuff was what permitted the evolution of big brains in mankind′s more recent ancestors.

Fish-eye lenses

According to Dr Crawford, DHA′s first job was to convert light into electricity in single-celled organisms. This gave them a crude form of vision, allowing them to move in response to light and shade, but also brought into biology a way of controlling electrical potential. If organisms are to be multicellular, cells must be able to talk to each other. Electrical potentials, the basis of every nervous system, are one way of doing this. And DHA was the enabler.

The molecule is certainly ubiquitous. Some 600m years after

animals became multicellular, more than half of the fatty-acid molecules in the light-sensitive cells of the human eye are still DHA, and the proportion of DHA in the synapses of the brain is not far short of that, despite the fact that similar molecules are far more readily available. Indeed, Dr Crawford thinks that a shortage of DHA is a long-term evolutionary theme. The molecule is most famously found in fatty fish. He suggests this might explain why, for example, dolphins have brains that weigh 1.8kg whereas zebra brains weigh only 350g, even though the two species have similar body sizes. Furthermore, he argues that the dramatic increase of the size of the brains of humanity's ancestors that happened about 6m years ago was not because apes came out of the trees to hunt on the savannahs, but because they arrived at the coast and found a ready supply of DHA in fish.

Not everyone, it must be said, agrees with this interpretation of history. For one thing, humanity's ancestors do not seem to have been exclusively coastal. What they do agree about, though, is that substituting DHA with other, superficially similar molecules is a bad idea.

Accept no substitute

Joseph Hibbeln, a researcher at America's National Institutes of Health, has been looking at the supply to babies of DHA from breast milk and at genetic variation in the ability to produce this molecule from other omega-3s. A study that began in the early 1990s has shown that children who are breastfed have the same range of IQs, regardless of whether they have the ability to make their own DHA. In the case of those fed on formula milk low in DHA, though, children without the DHA-making ability had an average IQ 7.8 points lower than those with it.

Nor is intelligence the only thing affected by a lack of DHA. There is also a body of data linking omega-3 deficiencies to

violent behaviour. Countries whose citizens eat more fish (which is rich in DHA) are less prone to depression, suicide and murder. And new research by Dr Hibbeln shows that low levels of DHA are a risk factor for suicide among American servicemen and women. Actual suicides had significantly lower levels of DHA in the most recent routine blood sample taken before they killed themselves than did comparable personnel who remained alive. More worryingly, 95% of American troops have DHA levels that these results suggest put them at risk of suicide.

America's department of defence has taken note. It will soon unveil a programme to supplement the diets of soldiers with omega-3s. The country's Food and Drug Administration may change one of its policies, too. Thomas Brenna, a professor of nutrition at Cornell University, has written a letter (co-signed by many of the scientists at the meeting) urging the agency to revise its advice to pregnant and fertile women that they limit their consumption of fish. This advice, promulgated in 2004, was intended to protect fetuses from the malign effects of methyl mercury, which accumulates in fish such as tuna. The signatories argue that this effect is greatly outweighed by the DHA-related benefits of eating fatty fish.

They may, however, be swimming against the tide. The popularity of omega-6-rich foods based on cheap vegetable oils will be difficult to reverse. Indeed, if another of Dr Hibbeln's studies proves true of people as well as rodents, it may be self-fulfilling.

In this experiment he fed rats diets that were identical except that in one case 8% of the calories came from linoleic acid (an omega-6 fatty acid) while in the other that value was 1%. These percentages reflect the shift in the proportion of omega-6s in the American diet between 1909 and the early 21st century.

In the 8% diet, levels of rat obesity doubled. It turns out that in rats (and also in humans) linoleic acid is converted into molecules called endocannabinoids that trigger appetite. Those who eat omega-6s, in other words, want to eat more food. And since, in the human case, omega-6-rich food is much cheaper than omega-3-rich food, that is what they are likely to consume.

The way out of this vicious circle is not obvious. Eating fish is all very well, but the oceans are under enough pressure as it is. Biotechnology might be brought to bear—creating genetically modified crops such as soyabeans with higher levels of DHA. Until that day, though, the best advice is probably that which was posted over the oracle at Delphi: "Nothing in excess".

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