Why natural may not equal healthy

Many believe that the natural toxins in their food are safer than synthetic ones.

Naturally Dangerous: Surprising Facts about Food, Health, and the Environment
by James P. Collman
University Science Books: 2001. 280 pp. $29, £19.99

John Krebs

If you ask people what they fear about their food, typically the top half-dozen concerns are food poisoning, BSE, growth hormones used in animals, animal feed, pesticides and genetically modified (GM) food (www.food.gov.uk). But how do these perceived risks stack up with the estimates of deaths caused by food? Acknowledging that these are only approximate, and that great uncertainties surround some of the numbers, two food risks tower above the rest — the dietary contributions to cardiovascular disease and to cancer. These risks, taking a fairly conservative estimate, probably account for more than 100,000 deaths per year in Britain. Food poisoning probably accounts for between 50 and 300 (similar in range of magnitude to the risk of choking to death on food or suffering a fatal accident while getting into or out of bed). As far as we know, growth hormones (banned in Europe) and pesticides in food, as well as GM food, are not responsible for any deaths.

A generally accepted psychological explanation for the discrepancy between perceived and actual risk is the one based on Paul Slovic's identification of the range of factors that make risks seem more frightening. Thus, for example, risks that are under someone else's control, potentially catastrophic and unfamiliar are perceived as greater than those with the opposite features. That is why most of us view riding our bicycle in a busy street as a more acceptable risk than living near a nuclear power station, although rational analysis says that you should stay off your bike.

James Collman writes about another important dimension of risk perception — naturalness: "Many Americans are under the mistaken impression that if something is 'natural' it is safe." As far as food is concerned, Collman covers similar ground to that in Julian Morris and Roger Bate's *Fearing Food* (Butterworth-Heinemann, 1999) and Douglas Powell and William Leiss's *Mad Cows and Mother's Milk* (McGill-Queens University Press, 1997).

Perhaps one of the most telling arguments against the 'natural equals safe, man-made equals dangerous' view of foods is the one put forward by Bruce Ames and colleagues. Fundamental to the safety assessment of any potentially toxic substance is the maxim attributed to Paracelsus, that the effects on the body of any substance, good or bad, depend on the dose. Ames pointed out that if the same precautionary criteria that are used to set pesticide safety levels — toxicological data, including tests on rodents for carcinogenicity — were applied to the natural toxins in plants that have evolved to deter predators, many foods would be deemed unsafe. For example, potatoes, grilled food and peanuts would be banned if they underwent the same kind of scrutiny as pesticide residues.

According to Ames, half of the natural toxins that have been tested (most have not) are rodent carcinogens, and each year the average American consumes about 10,000 times more of these natural pesticides than of synthetic residues. A single cup of coffee contains natural carcinogens equal at least to a year's worth of carcinogenic synthetic residues in the diet. The organic sector has claimed that its produce is lower in synthetic residues (fewer pesticides are used) but higher in natural toxins. From Ames's line of argument, consumers of organic produce may well be trading a minute amount of synthetic residue for equally — if not more — dangerous natural pesticides. This should, of course, be kept in perspective: any potentially detrimental effect of natural pesticides or synthetic pesticide residues is far outweighed by the health benefits of consuming five portions of fruit and vegetables per day.

Collman's quirky and erratic account, more a series of vignettes than a narrative, makes an effective case for not accepting the simple equation 'natural = safe'. In addition to food, he covers herbal medicines, environmental pollution, global warming, electromagnetic radiation and radioactivity. I would have liked a slightly less triumphalist tone, in recognition that there are still many uncertainties in our understanding of both environmental and diet-related impacts on human health. For instance, the toxicological consequences of exposure to cocktails of residues and the potential effects of long-term exposure are not well documented. As new data emerge, the experts, quite correctly, sometimes change their minds about safety limits. This recently happened for dioxins, for which the safety level has been reduced by a factor of five.

When viewed from the perspective of scientific uncertainty, some of the fears about unknown consequences may seem less irrational. A challenge for those responsible for translating science into regulatory policy is to find an effective way of taking people's concerns into account without straying from the bedrock of scientific evidence. There are no easy answers, but a start may be for scientists both to explain the uncertainties more fully, and to emphasize that evidence is dynamic and evolving rather than a set of ineluctable facts. ■

John Krebs is chairman of the UK Food Standards Agency and in the Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK.

Healthy debate: does natural really equal safe?

TIM ROSKE/AP

Life as a freeloader

Les associations du vivant: L'art d'être parasite
by Claude Combes
Flammarion: 2001. 21 euros

J. C. Koella and C. D. M. Müller-Graf

Parasites are not only the scare of today's anti-terrorist squads, but also a masterful work of evolutionary art. The tiny mite *Histiostoma laboratorium*, a parasite of *Drosophila*, launches itself as a miniature surface-to-air missile towards a fruitfly that is flying far above its head, an incredible feat of evolutionary engineering (the 'Star Wars' programme could learn a thing or two). Gravid mussels such as *Lampsilis ventricosa*,

when they are about to release their larval offspring from the gill tubes, display part of their mantle, waving and undulating excitedly, to imitate the little fish that are the main prey of predatory fish such as bass. Lured to the mussel with what seems to be a cheap and tasty meal, the greedy predator becomes the unfortunate host of the larvae, which are obligate parasites of fish.

'*The Art of Being a Parasite*' is an extensive collection of these and other wonderful and weird stories illustrating the various forms that parasitic life can take — and the elaborate ways of invading hosts and remaining in them — weaving the examples into a complex web to illuminate the ecology and evolution of interactions between species. It includes less-known examples, such as the only known cnidarian parasite (*Polypodium hydriforme*), which infects a developing egg of the beluga sturgeon (of course a French author would know the parasites of caviar) and goes on to develop into a stolon with miniature medusae, still within the egg, before being liberated into the water when the eggs are laid. Another gourmet example is the group of cestodes (*Amoebotaenia* spp.) in the gut of woodcock; this is the only bird eaten with its intestine, as the numerous cestodes growing within the gut give the bird its characteristic delicious taste (if you want to taste the worms while eating out in France, the bird is called a *bécasse*).

An extensive discussion focuses on the art of becoming — through evolutionary time — a parasite. The evolutionary progression of the parasitic way of life is particularly well illustrated with a group of prosobranch molluscs. This progression starts with a species called *Capulus*, a superficial ectoparasite of marine invertebrates that attaches itself to their outside wall to profit from the water flow created by its host. It proceeds through a series of more parasitic forms, which develop a more intimate association with their hosts (starfish, sea urchins and sea cucumbers) by invading their body cavities while maintaining a connection with the external environment, to a fully endoparasitic species that parasitizes sea cucumbers. Although this sequence is not a phylogenetic lineage, it is quite astonishing how well one example succeeds the other.

Although this is clearly a book that concentrates on parasites, Claude Combes does not forget to discuss mutualism as one end of a spectrum of species interactions, using among other examples the mutualistic bacteria–nematode complexes (such as *Heterorhabditis–Photorhabdus*) that parasitize insects. The nematode penetrates the insect, releases immunosuppressive substances into the insect's haemocoel, and then releases its bacteria. Uninhibited by the insect's immune response, these replicate extensively while producing antibiotics to keep out potential bacterial competitors. After several days the insect dies, and the nematode (which has benefited from the meal provided by the mix of the insect's tissue and the bacteria, and has reproduced) takes up and maintains a hundred or more bacteria, then leaves the insect to find a new victim.

PETER JOHNSON/CORBIS

Tasteful: the woodcock is the only bird eaten with its intestine, as parasites in the gut give it its flavour.

Many other aspects of host–parasite relationships are discussed: host defence mechanisms of hosts, counter-mechanisms of parasites, manipulation of host behaviour, and the importance of parasites in ecosystems and for humans in particular. Although the author is at his best when he illustrates these ideas with the natural history of the host–parasite associations, he also attempts to introduce the evolutionary foundation underlying host–parasite coevolution to the general public — for whom this book seems to be written. Although this attempt is praiseworthy, the book is at its weakest here. The discussions are sometimes circular and are often treated too lightly to be of much help. Perhaps the most striking example is the role of parasites in the maintenance of sexual reproduction and genetic recombination: this extensive field of evolutionary research is discussed in only one paragraph. This criticism is, however, not to be taken too severely. Combes's book does not purport to be a detailed scientific discussion of evolutionary parasitological processes; its strength is rather to illustrate the interactive forces involved in the coevolution of hosts and parasites with fascinating examples of their natural history. The book should be an asset to anyone teaching this subject.

On the practical side, an index would have made it easier to refer to earlier parts of the book and to find the interesting examples. For someone not familiar with the area, a glossary explaining some of the terminology would have been helpful, and could have alleviated some of the heavy footnotes.

In a nutshell, if you want to be introduced to the marvellous consequences of the evolution of parasites and their natural history, it would be difficult — despite some weaknesses in the evolutionary background — to find a more fascinating book. For the time being, however, you will have to read it in French. ■

J. C. Koella and C. D. M. Müller-Graf are at the Laboratoire de Parasitologie Évolutive, UMR 7103, Université Pierre et Marie Curie, 7 quai St Bernard, 75252 Paris, France.

Claude Combes's previous book *Parasitism: The Ecology and Evolution of Intimate Interactions*, has recently been published in an English translation (University of Chicago Press, $55).