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

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 Bates’s Fearing Food (Butterworth-Heinemann, 1999) and Douglas Powell and William Leiss’s Mad Cows and M’other’s Milk (M GILL-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, consumer 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.

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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 elabo-
rate 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 (Polypondium
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 mol-
luscs. 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 con-
nection 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 con-
centrates 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 para-
sitize insects. The nematode penetrates the
insect, releases immunosuppressive sub-
stances 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 bacte-
ria, then leaves the insect to find a new victim.

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 ecosys-
tems 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 recombin-
a: 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 pur-
port 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 exam-
pies. For someone not familiar with the area,
a glossary explaining some of the terminolo-
y would have been helpful, and could have
alleviated some of the heavy footnotes.

In a nutshell, if you want to be introduced
to the marvelous consequences of the evolu-
tion 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.

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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).