Beans means methane for some

Methane has been identified as making up about one fifth of Australia's greenhouse emissions. About half of this methane is produced by agriculture, in particular the methane belched by cows and sheep (see 'Digesting the farmyard effect', *Ecos* 87). The gas is produced by microbes fermenting some of the plant matter in the animals' forestomachs. But many other mammals in Australia are herbivores. Might they too be methane-producers?

The ability of an animal to produce methane depends on the presence somewhere in its digestive tract of microbes called methanogens, which a first glance through the microscope were thought to be bacteria. It is now known that their structure and biochemistry is so radically different that they are classified as Archaea, a group separate from true bacteria.

Methanogens are anaerobic: they don't need oxygen and indeed are poisoned by it. What they do need is a source of carbon, usually in the form of carbon dioxide (CO_2), and hydrogen. The methanogens derive their energy from adding hydrogen to carbon dioxide (in chemical parlance, 'reducing' the CO_2) to form methane. In an animal's gut the CO_2 and the hydrogen are produced by other microbes from the breakdown of organic molecules.

Not all CO_2 ends up as methane (CH_4). Some is used by other microbes to produce acetic acid (CH_3COOH), butyric acid (CH_3-CH_2-CH_2-$COOH$) and propionic acid (CH_3CH_2COOH). These compounds are usually absorbed into the bloodstream and metabolised to yield energy. Methane is not. It's belched out, which is why it is seen as a 'waste' of carbon in the food.

Methane production in ruminants (cows and sheep) – and ways of inhibiting the process to improve feed-conversion efficiency – has been well researched by scientists at CSIRO and elsewhere. Until recently, however, little attention had been directed to marsupials such as kangaroos and wallabies.

Two researchers from the United States, Dr Terry Miller and Dr Mike Wolin, have been examining this issue during a visit to the laboratory of Dr Sue Baker at the Division of Animal Production in Perth, part of CSIRO's Centre for Mediterranean Agricultural Research. (Dr Miller is visiting Australia as a Sir Frederick McMaster fellow, and Dr Wolin is an OECD fellow.)

Dr Baker has been working on methanogens in ruminants for some time, but has also been interested in whether the microbes are important in Australia's native herbivores. She instigated the visits of the American researchers so that they could sample the gut contents of kangaroos and search for methanogens.

Robert Dickens

So far, they have isolated few. But that doesn't mean that herbivorous marsupials are not methane-producers. About a year ago Dr Baker found methanogens in the forestomach of bettongs. It could be that methane is only produced under certain as yet unknown conditions. When there's no methane being made, the gut flora would instead send more carbon down other pathways to produce more acetic, butyric and propionic acids, compounds which the animals could use rather than vent to the outside.

This raises the question of whether the lack of methane production under certain conditions may make kangaroos more 'efficient' at extracting energy from their food. Further study is needed to understand the differences between the various species and how changes in the diet and other external influences may affect the picture.

What about us?

Grass-eaters are not the only creatures to have vast numbers of resident bacteria dealing with the material inside the gut. Microbes by the million also flourish in the large intestines of humans. Does this mean we are guilty of methane-production too?

Compounds that human enzymes cannot digest finish up in the large bowel, where the bacteria set to work. The result of their labours are, as in kangaroos and cows, compounds that can actually be absorbed and used by our systems, as well as a surfeit of the gases hydrogen and carbon dioxide that pass out. (Incidentally, readers may like to know that some foodstuffs – such as certain beans – contain a large quantity of unusual carbohydrate that our enzymes can't break down, but those of the bacteria can. So, yes, it is true that the result of eating the beans is a sudden large production of gas.)

As part of their research in the US, Miller and Wolin have found that a small proportion (about 10%) of humans regularly produce methane and pass it out in the same way that the rest of us vent our intestinal gases.

These lucky types have well-established colonies of methanogens in their bowels. The rest of us don't, but the reason for the difference is not clear. Some people acquire the methanogens early in life, probably from their parents, and may pass the culture on to their children, rather like a family heirloom.

But the methane-producers needn't worry unduly. They are 'normal' in every other respect, and it's unlikely that governments will put a greenhouse tax on their emissions because, compared with cows, their contributions are remarkably small: a trifling 0.3 to three litres of methane a day.

That may seem a lot of wind for a person to break, but it's pretty small beer really. Cows, being much bigger animals, can easily belch a massive 200 litres of methane per day. In its biology at least, *Homo sapiens* is way behind as a greenhouse threat, but not, of course, in its industrial and technological activities.

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