Researchers to prevent livestock belching methane

Mention the phrases "greenhouse gases" and "global warming" and most people will think of the carbon dioxide produced by burning fossil fuels such as coal and oil. But CO_2 is not the only greenhouse gas and fossil **fuels** are not the only **source** of such gases. A surprising and **neglected** one is the world's ruminant **livestock**—cattle, sheep and so on. Ruminants play host to bacteria that **digest** the otherwise indigestible grass and other cellulose-rich plants those animals eat.

The complicated ecosystem of a ruminant's stomach **includes** other creatures, too. Many are methanogens—organisms that **react** carbon dioxide with hydrogen made by the cellulose-digesting bugs to create water and methane. According to the United Nations' Food and Agriculture Organisation, a hundred million tonnes of methane is created a year by all the world's **domesticated** ruminants. Moreover, methane is a **greenhouse** gas 25 times more powerful than CO_2. Altogether, according to **estimates** by the New Zealand Agricultural Greenhouse Gas Research Centre, methane **emitted** from livestock is responsible for about 14% of global warming since the beginning of the Industrial Revolution.

New Zealand is one of the guilty parties. Its 40 million head of sheep and cattle mean that a third of its **contribution** to global warming is ruminant-belched methane. But Peter Janssen of AgResearch, the country's main farming-science institute, hopes to change this. He and his colleagues are looking for ways to **reduce** the amount of methane the country's animals burp up.

Their first **approach** is to develop methanogen-specific drugs. Though methanogens look like bacteria, they belong to a completely different **branch** of life, the archaea. That means their enzymes are different from bacterial ones, so there is a **reasonable** hope of finding chemicals which **interfere** with methanogen enzymes while leaving those of both bacteria and host animal **unaffected.** Dr Janssen and his team have thus been screening thousands of **compounds** that might block the action of enzymes methanogens need to survive. So far, the best of them reduce methane emissions by 20-30%, with no **apparent** harm to the animal.

The problem with this approach is that it **requires** animals to be **treated** continuously, to stop the methanogens returning to full strength. This is fine when beasts are being farmed **intensively**, as is often the case in Europe. However, cattle in New Zealand, and sheep everywhere, are normally put out to pasture, so Dr Janssen has a second string to his bow: vaccination.

To do this, his team **identified** and synthesised proteins found on the surface of ruminant methanogens, and injected these into sheep and cattle to try to **raise** antibodies to those proteins. In that they have **succeeded**. The desired antibodies **turn up** in both the blood and the **saliva** of injected animals. At the moment, however, these antibodies work against methanogens only in test tubes. The **vaccinations** that raise them do not seem to reduce methane **output**.

A third approach is to breed animals with a lower tendency to burp methane. Among sheep, for example, some animals emit as much as 10% less of the gas than others. These low emitters have smaller rumens, meaning the contents pass through faster. This limits production of the hydrogen that is methanogens' food source without, **apparently**, limiting that part of the digestive **process** which feeds animals—for sheep with small rumens do not grow more slowly than those with large ones. Rumen size, moreover, is heritable. This means that a breeding programme for low-emission sheep is a plausible idea.

Dr Janssen's fourth approach is to **alter** what animals eat. Certain food plants **limit** methane emission by as much as 25% compared with the belchings of animals fed on grass and clover. However, though rape and beet are planted by some farmers as **supplementary** food crops, **particularly** for winter forage, they do not, unlike grass and clover, keep growing after being grazed. They also have a **mixture** of nutrients different from grass and clover, and take more **effort** to **establish**. Most farmers, therefore, would require quite a lot of persuading to use them more **widely**.

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