Bacteria breakthrough is heaven scent

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Bacteria are well-known to be the cause of some of the most repugnant smells on earth, but now scientists have revealed this lowest of life forms actually has a sense of smell of its own.

A team of marine microbiologists at Newcastle University have discovered for the first time that bacteria have a molecular "nose" that is able to detect airborne, smell-producing chemicals such as ammonia.

Published today in *Biotechnology Journal*, their study shows how bacteria are capable of 'olfaction' - sensing volatile chemicals in the air such as ammonia produced by rival bacteria present in the environment.

Led by Dr Reindert Nijland, the research also shows that bacteria respond to this smell by producing a biofilm - or 'slime' - the individual bacteria joining together to colonise an area in a bid to push out any potential competitor.

Biofilm is a major cause of infection on medical implants such as heart valves, artificial hips and even breast implants. Also known as 'biofouling' it costs the marine industry millions every year, slowing ships down and wasting precious fuel. But it also has its advantages. Certain biofilms thrive on petroleum oil and can be used to clean up an oil spill.

Dr Nijland, who carried out the work at Newcastle University's Dove Marine Laboratory, said the findings would help to further our understanding of how biofilms are formed and how we might be able to

manipulate them to our advantage.

"This is the first evidence of a bacterial 'nose' capable of detecting potential competitors," he said.

"Slime is important in medical and industrial settings and the fact that the cells formed slime on exposure to ammonia has important implications for understanding how biofilms are formed and how we might be able to use this to our advantage.

"The next step will be to identify the nose or sensor that actually does the smelling."

This latest discovery shows that bacteria are capable of at least four of the five senses; a responsiveness to light - sight - contact-dependent gene expression - touch - and a response to chemicals and toxins in their environment either through direct contact - taste - or through the air - smell.

Ammonia is one of the simplest sources of nitrogen - a key nutrient for bacterial growth. Using rival bacteria Bacillus subtilis and B.licheniformus, both commonly found in the soil, the team found that each produced a biofilm in response to airborne ammonia and that the response decreased as the distance between the two bacterial colonies increased.

Project supervisor Professor Grant Burgess, director of the Dove Marine Laboratory, said that understanding the triggers that prompt this sort of response had huge potential.

"The sense of smell has been observed in many creatures, even yeasts and slime moulds, but our work shows for the first time that a sense of smell even exists in lowly bacteria.

"From an evolutionary perspective, we believe this may be the first example of how living creatures first learned to smell other living creatures.

"It is an early observation and much work is still to be done but, nevertheless, this is an important breakthrough which also shows how complex bacteria are and how they use a growing number of ways to communicate with each other.

"Bacterial infections kill millions of people every year and discovering how your bacterial enemies communicate with each other is an important step in winning this war. This research provides clues to so far unknown ways of bacterial communication."

More information: 'Bacterial Olfaction ' by Reindert Nijland and Grant Burgess. *Biotechnology Journal*, September 2010. Available online : 16 August, 2010. DOI: 10.1002/biot.201000174

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