NZASE scientist profile

Hemi Cumming

Born where and when

Gisborne, 1983; Ngāti Raukawa ki te Tonga, Ngāti Toa, Ngāti Koata.

Schools

Te Poho-o-Rawiri Kohanga reo, Waikirikiri School, Lytton High School; studied Science, Chemistry and Biology.

Training and jobs

MSc in organic chemistry, University of Canterbury; **PhD** in organic chemistry, Victoria University of Wellington.
Experiment designer for Magritek, a company co-founded from New Zealand research that manufactures portable nuclear magnetic resonance spectroscopy machines.
Scientist, NZ Institute for Plant & Food Research, Nelson.

Field of science

Organic and materials chemistry, biochemistry, Kaupapa Māori. He supports Plant & Food's engagement and outreach with hapū and iwi, and provides internal advice to the organisation. "Kaupapa Māori is a challenge to the culture of science and scientists, encouraging them to recognise cultural assumptions in their projects."

Examples of research topics

Re-creating a cancer-fighting compound

In his PhD research, Hemi created a variant of a natural chemical compound made by a Fiordland marine sponge, *Mycale hentzcheli*. Sponges are immobile and make toxins to defend themselves; some of these, including paeteamine, are known selectively to kill cancer cells. However, few sponges make this compound so it cannot be harvested from the wild, and sponges are difficult to farm, so paeteamine has to be synthesised in the lab.

Hemi was able to create a simplified version of paeteamine A in the lab, but it was less toxic to cancer cells than the original. The results suggested that a sulphur-based chemical left out of the copy was important for binding the toxin to target cells.

Hemi, in the front seat, paddles air during the gruelling 40km Round Raro relay race in the 2017 Vaka Eiva in Rarotonga.

Improving ways to make microcapsules

Hemi works in a team that is improving technologies for making microcapsules that are the thickness of a human hair (~50µm). Hemi describes the capsules as "a polymeric shell around a small oil droplet – it's 70 percent oil and the final product is a fine white powder."

"We didn't invent the technology, but we're extending the process and ingredients and

Hemi on basalt columns on Rēkohu/ Chatham Islands, during a work trip.

applying it to new things. One such area is how to apply capsules as fish larvae feed in marine farms. Currently fish larvae require live feed such as microscopic brine shrimp (Sea-monkeys), but feeding the shrimp to then feed fish larvae is complicated and expensive. We hope to mimic features of the brine shrimp in the microcapsules to simplify marine farming."

Using enzymes to make antioxidants

Hemi is using non-toxic chemical processes to modify caffeic acid, a potent water-soluble antioxidant that is found in coffee beans, so that it is suitable for oil products. Anti-oxidants, such as vitamins C and E, stop chemical chain reactions that damage cells, and cause high-value omega-3 oil to go rancid.

The process allows caffeic acid to dissolve in oil so that it can be used in creams or oil capsules. Hemi has synthesised antioxidants that perform much better than common oil-soluble anti-oxidants, such as vitamin E, at protecting oil from going rancid.

How he finds things out

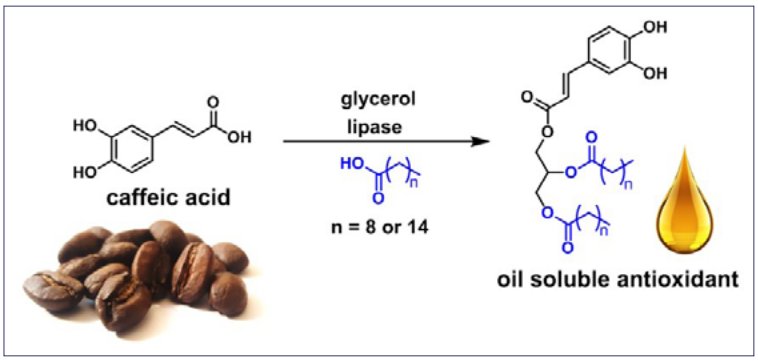
To recreate a naturally occurring compound, Hemi starts by identifying its chemical structure. "Then you work backwards, finding obvious chemical bonds that link parts of it," says Hemi. "You use the rules of chemical reactions to design a pathway to create it from individual chemicals that you can buy commercially. Then you trial it, and if it doesn't work you find another pathway, and another - it's like solving a puzzle."

To make microcapsules, Hemi's team have tested a variety of natural polymers, including marine ones, for the capsule shell, and incorporated a range of marine oils and anti-oxidants.

Ngā Kupu

Kiriwaho – Capsule
Honohono matū - Chemical bonds
Huinga ira - Genome
Mātai iranga - Genetics
Pūhui matū - Chemical compound
Pūmua whākōkī - Enzyme
Pūngorungoru - Sea sponge
Waerau - Polymer

From Te Aka Maori Dictionary and Paekupu



Synthesising the antioxidant from caffeic acid using fatty acid chains attached to glycerol, which resembles natural lipids.

To synthesise new antioxidants, Hemi uses commercial enzymes, immobilised lipase, "and we're also investigating lipases from fish. By using different lipases, and attaching fatty acids of different chain lengths to glycerol and caffeic acid, antioxidants can be made to suit watery or fatty applications."

Mātauranga Māori

Work across Plant & Food Research relates to Māori interests. An example is marine resources: "Māori are huge stakeholders in fishing, shellfish and aquaculture," Hemi says. "Research into native fish species can involve mātauranga Māori and tikanga about those species, and engagement with iwi. The snapper genome has also been sequenced, which involves consideration about ownership and use of that data."

Plant & Food Research is a member of the Genomics Aotearoa consortium, which aims to enable Māori to manage indigenous genomics data. "It's important that Māori values are part of research decisions, and how we recognise taonga - they're not just lab rats or DNA pieces."

What he likes about science

"I enjoyed the mental challenge of Science at school. It feels meaningful and exciting - doing things that haven't been done before. I like the freedom to think creatively and solve problems that could potentially benefit lots of people. It can be a challenge, and you have to be quite determined and persistent."

Links

- Hemi Cumming, *Project Matauranga* (video)
- Hemi's PhD story, VUW (short article)
- Sea sponges, Science Learning Hub