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food for thought

Biomedical and chemical engineer Irwin Adam Eydelnant of Future Food Studio in Toronto is boldly going where no chef has gone before — creating such culinary curiosities as vaporous food and edible balloons.

By Roberta Staley

For most people, pushing the boundaries of culinary experience might mean switching to an Italian Vermentino after years devoted to drinking chardonnay, switching to organic produce at the supermarket or, if really adventurous, ordering an appetizer of African grasshoppers called *senene* at an East African restaurant.

For Irwin Adam Eydelnant, pushing the boundaries of eating means experimenting with new materials to create food that can only be described as avant-garde. A biomedical engineer and chemical engineer by training — and food inventor by choice — Eydelnant's first quirky creation was edible clouds, masterminded at Toronto's Future Food Studio, where he is principal and creative scientific director. Corporations like PepsiCo, Kraft and Campbell's, as well as groups like Norwegian Cruise Lines, hire Eydelnant to concoct evocative new culinary experiences for their consumers and clientele that are as far-fetched as his consumable gas. "This is a new way to fund my research: 50 percent is spent creating things and 50 percent is spent doing client work," says Eydelnant.

The invention of vapour as a food was inspired in part by Eydelnant's research at McGill University while undertaking his master's degree in chemical engineering. (His biomedical engineering PhD is from the University of Toronto.) During his master's, Lee studied ways of coating materials destined for implant — in catheters, for example — to prevent them from being colonized by harmful

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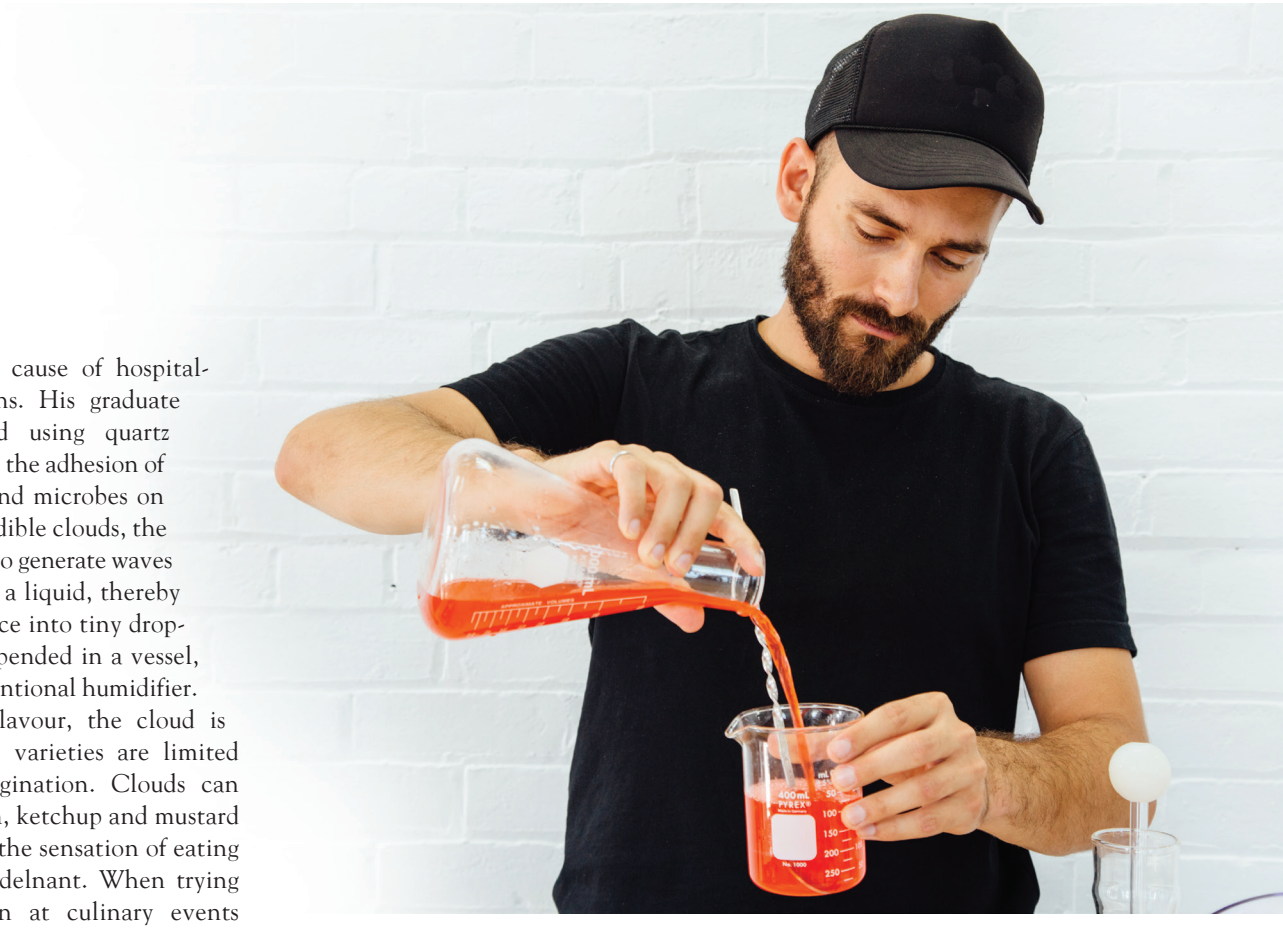
Future Food Studio's edible clouds are made using a piezoelectric element to disrupt the surface tension to create vapour. The vapour is then flavoured to interact directly with the olfactory system. The taste varieties are limited only by the imagination.



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Toronto's Irwin Adam Eydelnant designs new foods based upon chemical engineering principles.

bacteria, a major cause of hospital-acquired infections. His graduate research involved using quartz crystals to measure the adhesion of small molecules and microbes on surfaces. For the edible clouds, the crystals were used to generate waves of energy through a liquid, thereby breaking the surface into tiny droplets that hang suspended in a vessel, not unlike a conventional humidifier.

Piquant with flavour, the cloud is sipped. The taste varieties are limited only by the imagination. Clouds can merge wiener, bun, ketchup and mustard flavours to create the sensation of eating a hotdog, says Eydelnant. When trying out his invention at culinary events around the globe, however, he uses more orthodox flavours, sometimes serving just the cloud itself, other times layering a variety of clouds on top of an alcoholic beverage. The drinker's experience is different with each sip. "Let's say I have a glass of Prosecco and I layer it with a citrus cloud — you have citrus-infused Prosecco," Eydelnant says. "The next sip is a lavender cloud, so suddenly you have lavender-infused Prosecco."

The world is — and always has been — obsessed with food. Little wonder, food is fundamental to life and is the glue holding cultures together. Often, "breaking bread" is the first shared experience between strangers or first-time travellers in a new land — an act affirming our common humanity. New foodstuffs were part of the jewels of discovery that ancient explorers brought back with them to Europe: noodles from Asia were carried along the Silk Road, corn and potatoes from the Americas.

French cuisine meanwhile, evolved from medieval times to epitomize modern gastronomy. While it is highly unlikely that French classics like clafouti, confits and truffles will ever go out of style, scientific advances have sparked a food revolution that promises to radically alter the way that people think about food. "What does it mean to consume a cloud? No one knows because no one had done it before," Eydelnant says.

The partnering of food and technology is being celebrated this June in New York City at the inaugural FOOD LOVES TECH three-day exposition that Eydelnant is co-curating. Organizers have crafted provocative terminology to describe the conference — phrases normally associated with technology's dark side, such as "hacking our food chain." But when one looks at what Eydelnant is trying to do with food, the word hacker — meaning someone who disrupts systems — is a perfect description. "My philosophy," says Eydelnant, "is to create new food consciousness."

Eydelnant's reputation as food iconoclast is strengthened by his eclectic Future Food Studio team, which includes a chef, chemist, computer programmer, photographer, designer and social worker. Joseph Lee is the company chemist, and holds the title of chef scientist. Lee obtained a chemistry degree at McGill University in 2004 but, upon graduation, took the path less travelled. Rather than enrol in a master's program, he opted for a nine-month course at Le Cordon Bleu Ottawa Culinary Arts Institute, which is affiliated with its Parisian counterpart. Lee's chemical laboratory skills gave him an edge when it came to basic science principles like diffusion, osmosis, thermodynamics, viscosity, elasticity and freezing point depression that must be mastered — even if only intuitively — by chefs. "When

Chemistry and food go together like sugar and spice

Chemical innovation is key to good-tasting food as well as food security.

At Carleton University's Department of Chemistry in Ottawa, associate professor Maria DeRosa is studying how to make test strips that detect "boar taint" in pork, a highly unpleasant odour caused by the male pheromone androstenone and the intestinal chemical skatole. This problem can be overcome by castrating the pigs before they reach puberty. In Canada, however, for economic reasons, anesthetic isn't used during castration. This practice is deemed cruel and inhumane and the European Union is moving towards a full ban on castration; Canada is expected to follow suit. If legislation prevents producers from castrating their young male pigs, the likelihood of boar-tainted meat increases.

Even with castration, boar taint is a problem for Canadian producers. In order to detect it in individual pigs cheaply and efficiently, DeRosa's test strips employ aptamers, which are short synthetic strands of DNA that specifically bind to pre-selected molecular targets — in this case androstenone and skatole. The binding agents are laboratory-tested nucleic acid sequences that can then be coated on to gold nanoparticles that are infused into the strips. Pig fat is biopsied from either a live or processed animal, placed in a solution, and then a drop is placed on the strip. If boar taint is present, the test strip turns blue, says DeRosa, who expects to start small-scale field testing in 2017.

A bounty of breadfruit

On the Okanagan campus of the University of British Columbia, Department of Chemistry associate professor Susan Murch cultivates a form of food that first gained notoriety in the late 18th century when Captain William Bligh of the H.M.S. Bounty sailed for Tahiti to collect and propagate breadfruit (*Artocarpus altilis*) for export to the West Indies as slave rations. Shortly after departing Tahiti, Bounty officer Fletcher Christian led a mutiny against Bligh and more than 1,000 breadfruit plants were thrown overboard.

Murch's UBC laboratory has established tissue culture protocols for mass propagation of breadfruit trees in a sterile environment. Free from pathogens, the breadfruit can be distributed worldwide, says Murch, a co-founder of Global Breadfruit, which has planted 77,000 trees in 37 countries as a way to combat hunger in tropical regions. Key chemistry principles are behind Murch's successful cultivation of breadfruit, including experimentation to find the best pathogen control with food-grade antimicrobials. Murch's group also developed inhibitors to control the tree's release of phenolics in response to stress, which affects growth.

Why breadfruit? Similar in taste to a potato, breadfruit can be turned into chips, boiled, roasted, fermented as beer and is a replacement in gluten-free baking. Yielding up to 400 kilograms of fruit a year when mature, breadfruit is key to future food security in the tropics, Murch adds.

I was in the kitchen it felt very akin to being on the lab bench," Lee says.

Lee undertakes research with various food items and different recipes, adding or removing variables to see what emerges. Recently, Lee began exploring the possibility of making edible, helium-filled balloons. Pioneered by Chicago molecular gastronomy restaurant Alinea, Lee obtained the balloon recipe and tweaked it for his own purposes. His balloons are made by combining isomalt (a mixture of two disaccharides often used as a sugar substitute) glucose, cellulose and xanthan gum for thickening. Mixed with water, the powders form a thin, rubbery substance strong enough to contain a gas. The helium gas, which can be inhaled, has a flavour complementary to the balloon skin. Combinations include an apple balloon paired with cinnamon-flavoured gas. "You can dehydrate apple or make an apple puree and incorporate that into the sugar solution," says Lee, who is planning to try a combo of strawberry balloon and peanut butter helium.

To create such pairings, Lee went back to chemistry basics, dusting off his Erlenmeyer sidearm flasks that are normally used for vacuum filtration. In this case, Lee used the sidearm to force the helium gas to bubble through a flavoured liquid in the flask. The balloon is created by having the sugar solution coating the end of a tube. To fill it, gas is passed to expand the exposed area of film at the end of the tube, similar to blowing a bubble from bubble gum. The buoyancy of the helium causes the balloon to float, at which point Lee secures the end by cinching the film with a straw.

One beverage company recently asked Future Food Studio to come up with a new spin on the classic 1950s soda shop. Staff

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Chemist Joseph Lee is chef scientist at Future Food Studio.

decided to experiment with Versawhip, an enzymatically treated soy protein that becomes foamy when hydrated with water and can be flavoured. Lee tried matching a citrusy soda with vanilla-flavoured foam and "the combination tasted like birthday cake."

Future Food Studio is also experimenting with spherification, the culinary process of shaping a liquid into a sphere. The spheres are formed using alginate, a natural polymer derived from the cell walls of brown algae. Alginate, in the form of an anionic salt, is mixed with a liquid like tomato sauce. When drops of this solution are deposited into a solution of calcium, the alginate molecules combine and polymerize into spheres of clear gel skin. "You put it in your mouth and it bursts," says Lee. Chocolate can also be used for spherification, with the end result looking "like fish caviar."

Such concoctions sound wickedly decadent. But Eydelnant says that gourmet — not gourmand — is a Future Food Studio principle. Good health, he believes, is achieved by changing people's attitudes to "create food intent and consciousness. We have this real struggle with obesity. We need to make people think." Eydelnant's concerns with health hearken back to his earlier academic research. During his master's degree, while studying how to reduce the biofilms that colonize catheters, Eydelnant looked to cranberry juice, which helps fight urinary tract infections. Theorizing that cranberry juice might contain a new material in the fight against hospital-acquired infections, Eydelnant began trying various concentrations of cranberry-derived molecules proanthodyanidins on the biofilms. Preliminary results showed that they did indeed prevent the adhesion of bacteria. (Work to commercialize the finding is ongoing.) Eydelnant also discovered similar properties in compounds derived from maple syrup.

Spherification is a process whereby foods and liquids are enveloped by polymerized alginate.

Food, indeed, is our friend — not our enemy, despite what an increasingly obese and diabetes-, heart disease- and cancer-ridden society may believe. For Eydelnant, food is also a new frontier and a new canvas, as well as a means to explore and titillate the senses. For Eydelnant, a flan isn't just a dessert, it is a miracle of science — a perfect balance of molecular composition. But the most exciting thing about food is its potential. Eydelnant often employs new technologies, such as IBM's Chef Watson, to help him discover new food combinations; he recently paired Portobello mushrooms with cocoa. "It was incredible together." He is also exploring such culinary incongruities as savoury — rather than sweet — beverages. "My tool set is very different than that of a traditional chef," Eydelnant says. "So working with that tool set in this medium allows me a different range of opportunities in creating amazing things." accn