Barista milk: climate-friendly and still dairy

A climate-friendly barista milk from cows that emit less methane has launched in selected UK coffee shops. The milk comes from livestock fed Mootral Ruminant, a cattle feed supplement by the Swiss-British agritech company Mootral. The food additive, developed by a team of veterinary researchers from Belgium, Denmark, Finland, Germany, Ireland, Japan, the Netherlands, the United Kingdom and the United States, cuts enteric methane emissions by up to 38%. It builds on the fact that microbial communities in ruminants' digestive systems ferment crude plant fiber to short-chain fatty acids, which the cow takes up through its gut. This fermentation, however, also produces methane, a major contributor of greenhouse gases. When added to feed, Mootral changes cows' gut methanogen content and microbial metabolic pathways to reduce methane in their burps. The supplement is a mix of garlic—known for the organosulfur compound allicin, which has antimicrobial properties—and flavonoids extracted from bitter oranges. In lab experiments, a team at the University of Veterinary Medicine in Hanover, Germany, found Mootral altered the composition of the microbial community of Archaea, the main producers of methane during rumen fermentation. In a farm study conducted in the Netherlands, Mootral boosted the cows' milk yield by 4% and increased fat content too, with no changes to the milk's taste and appearance. In Scotland, a commercial dairy farm with 400 dairy cows found that Mootral reduced methane emissions by 30% on average as measured with a hand-held methane laser detector. Another trial, conducted at the University of California Davis, measured a 23% drop in methane production. Thomas Hafner, CEO and cofounder of Mootral, says in a press release: "It's time for us to help cows become part of the solution in the global fight against climate change." Mootral next plans to focus on climate-friendly beef.

Published online: 12 May 2021
https://doi.org/10.1038/s41587-021-00930-7

as antibody-dependent cellular cytotoxicity, complement activation and phagocyte recruitment. Unravelling their contribution to SARS-CoV-2 immunity is an ongoing challenge. "There are assays to do that, it's just complicated to do," says Redd.

The same can be said for assaying T-cell-mediated immunity. The NIAID study relied on a complex laboratory test to identify T-cell epitopes specific to SARS-CoV-2, employing a combination of mass cytometry and combinatorial staining of peptide–major histocompatibility complex (MHC)-bound tetramers. The complexity of the assay and data generated necessarily confine the assay to use in specialist laboratories. "The data that it generates are massive. The analysis side of it is a big lift," Redd says.

The Adaptive Biotechnologies sequencing test provides a simpler option. In a clinical validation study, the T-Detect COVID assay attained 97.1% sensitivity (defined as positive percent agreement) and 100% specificity (defined as negative percent agreement) as compared with PCR testing from 15 days or more after diagnosis.

The test emerged from a longstanding collaboration between Adaptive and Microsoft to apply machine learning to define the 'rules' according to which T-cell receptors (TCRs) identify their cognate antigens. That, combined with extensive genomic characterization of the T-cell repertoires of people infected with SARS-CoV-2, allowed Adaptive to define a broad set of TCRs that are indicative of infection with the virus. The test sequences the total TCR repertoire present in a given sample and then calculates the relative enrichment for SARS-CoV-2–specific TCRs compared with predefined thresholds to determine the result, taking into account variation in individuals' immune responses.

Adaptive's test analyzes both the frequency and distribution of the TCRs that are present and the T-cell clonal expansions that have occurred. "The algorithm takes into account clonal breadth and depth," says Lance Baldo, chief medical officer at Adaptive.

Traditional T-cell testing methods, such as enzyme-linked immunosorbent spot (ELISpot) and intracellular cytokine staining, require scientists to directly measure T cells' cytokine production following antigen stimulation under specific conditions. "Live cells don't do well out of the body for very long times," says Baldo. "We're looking at the genomic DNA of T cells, which is a very stable analyte." Samples can be shipped at room temperature and frozen for long periods. The new test is also more accurate than traditional methods that only allow a small number of peptide antigens to be measured simultaneously. And because T-cell responses last longer than antibody responses, the test also provides a wider window for establishing whether or not an individual has been infected.

One immediate application of the test will be to monitor the effectiveness of the various vaccines that are being rolled out, particularly in vulnerable populations. "We don't know yet how long the immunity is going to last," says Joaquín Martínez-Lopez of Spain's National Cancer Research Center in Madrid, who collaborated with Adaptive on the development of the test.

Qiagen, of Hilden, Germany, is also developing a next-generation sequencing–based T-cell diagnostic, having signed an agreement with TScan Therapeutics, which will provide it with access to the latter's intellectual property and associated data for several panels of epitopes in SARS-CoV-2 that are recognized by $CD8^+$ T cells from patients recovering from COVID-19. TScan scientists have identified three to eight epitopes for each of the six most common human leukocyte antigen types in people convalescing from COVID-19. ❐

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Published online: 12 May 2021
https://doi.org/10.1038/s41587-021-00920-9