



Climate change could destroy your cheese



Author: Andrew Firbank

*As our climate degrades, the consequences are felt even on a microscopic level. *E. coli*, a bacteria responsible for severe food-poisoning, seems to be benefitting from the crisis.*

Andrew Firbank speaks with PhD researcher **Styliani Roufou** to discover the consequences that this could have for dairy.

Rivers flood, oceans rise, glaciers melt, and wildfires burn with new-found ferocity due to climate change. Most media coverage focuses on these large catastrophes because there is a very clear and visceral human toll. But what if we take a look through a microscope? PhD researcher Styliani Roufou (University of Malta) is studying how the climate crisis impacts one of our planet's tiniest organisms, *Escherichia coli* (better known as *E. coli*). Her findings point to an important prospect — this bacterium and some of its strains could thrive thanks to climate change. *E. coli* flourish in cattle and dairy products, making them particularly vulnerable. Roufou and her colleagues are investigating the ramifications for our cheese.

Surprisingly, *E. coli* is actually essential for our health. It forms part of a gut's healthy microflora, providing us with Vitamin K₂ which helps our blood to clot. Unfortunately, other strains of *E. coli* can cause serious food poisoning when ingested. Symptoms range from mild diarrhoea to death. In 2011, almost 3,000 people were infected and 55 died from an *E. coli* outbreak in Germany. The source was Fenugreek seeds from Egypt. More recently in 2018, Arizonan romaine lettuce spread *E. coli* across the US. Around 210 people were infected, and of those, 5 died.

Although these outbreaks weren't directly linked to dairy, the cause is often animal manure. '*E. coli* mainly comes from waste and manure in farms,' Roufou explains. 'Contamination

from this waste can then spread through the entire food chain.' Thankfully, *E. coli* can't normally survive for long without a host. They persist in feces for just a few hours or days before they die. Using manure to fertilise crops is therefore normally safe. Likewise, cow udders and milking equipment may come into contact with *E. coli* on a farm, but this rarely endangers the dairy. 'There are some strains of *E. coli* that can produce toxins, and they are very strong, surviving for a long time outside of a host,' Roufou notes. Some of these strains may manage to reach consumers.

TURNING UP THE HEAT

Since the 1860s, the dairy industry has had an action plan to kill contaminating bacteria. The key is pasteurisation. Raw milk is quickly heated (typically to 71.7°C) for just long enough (15 seconds) to destroy any harmful microorganisms. Drinking milk straight from the udder or eating raw-milk cheeses therefore carries greater risk. High-temperature treatments act as a screen between our bodies and the farm. Unfortunately climate change may render that screen ineffective.

Roufou is testing *E. coli*'s ability to adapt to new and extreme environments. For most organisms, we assume that the instability and adversity caused by climate change will limit their chances for survival. For *E. coli*, that doesn't seem to be the case. 'So far, we can say that *E. coli* still grows' ➔



well under climate change conditions,' warns Roufou. 'And we are using a simple strain, not one of the more resistant ones.' Her findings indicate that rising atmospheric CO₂ at certain levels benefit *E. coli*, enabling it to survive for longer in harsher conditions. The danger is that they have the potential to adapt to withstand the pasteurisation process.

SAVING OUR STILTON

So, how is the dairy industry addressing this? That's exactly where Roufou comes in. Working alongside her research supervisors Prof. Vasilis ValDRAMIDIS and Dr Sholeem Griffin (Faculty of Health Sciences, Department of Food Sciences and Nutrition University of Malta), Roufou is part of Protect ITN, an EU Marie Skłodowska-Curie initiative to predict and prepare for food challenges caused by the climate crisis. Eight early stage researchers and their universities across Europe are leading projects to safeguard our future food safety, with participation from dairy giants like Nestlé.

Based on her findings so far, Roufou recommends a multi-pronged approach to tackle the future. 'We cannot just increase pasteurisation temperatures, because that could destroy vitamins and other beneficial components of the milk,' she points out. 'We may need to combine different techniques: pasteurisation, filtration, etc. to make sure we can produce a safe dairy product.' With quick and comprehensive action, Roufou believes that the European dairy industry can handle the dangers of enhanced microorganisms like climate adaptable *E. coli* strains.



Styliani Roufou
Photo by James Moffett

Unfortunately, *E. coli* isn't the only problem that climate change presents for dairy. Rising temperatures will inflict heat stress on cattle, reducing their milk yields. Extreme weather events like flooding will endanger animals whilst spreading disease. Heightened levels of atmospheric CO₂ will dissolve into our water systems, forming carbonic acid. This water acidification could harm all levels of the dairy supply chain as well as causing a myriad of other environmental dangers, like acid rain. To combat or even just comprehend the breadth of climate-induced difficulties this industry faces, skilled young researchers like Roufou are desperately needed.

GROWING PAINS

By 2050, the UN predicts our population will reach 9.7 billion. That's roughly a 26% increase from today. If the average person continues to consume dairy as they do now, then land requirements for dairy may be unsustainable. Already, over 264 million cows are used worldwide for dairy production. To meet present demands, another 69 million cows would be needed by 2050.

The problem is: we're a little short on land. Cities are expanding, and coastlines are being engulfed by rising seas, leaving our food supplies and wildernesses to compete for what's left. Those 69 million cows would need swathes of land to rear and feed. Finding that space in a rapidly shrinking world is going to be difficult.

Despite everything, the future of dairy is less determined by the climate crisis than it is by us — the consumers. The dairy industry likely has enough resources and influence to preserve itself, but it is our purchasing habits that drive its expansion to satisfy demand.

But in order for our consumer decisions to trigger change, governments and the industry itself also need to be receptive and willing to develop long-term solutions. Through research, they are proactively seeking the knowledge required to meet buyer demands, even down to a microscopic level. The question remains whether these solutions will consider environmental impact or be purely-profit driven.

Scientists like Roufou and her colleagues strive to protect our future food safety, but much of the strain could be eased if we were willing to make more sustainable food choices. 'As consumers, I think that we shouldn't be so dependent on single food sources. We should also be considering balanced diets that include both animal and plant-based products.' Roufou ends our interview with a common saying too often ignored: 'In life, I believe in balance.' 

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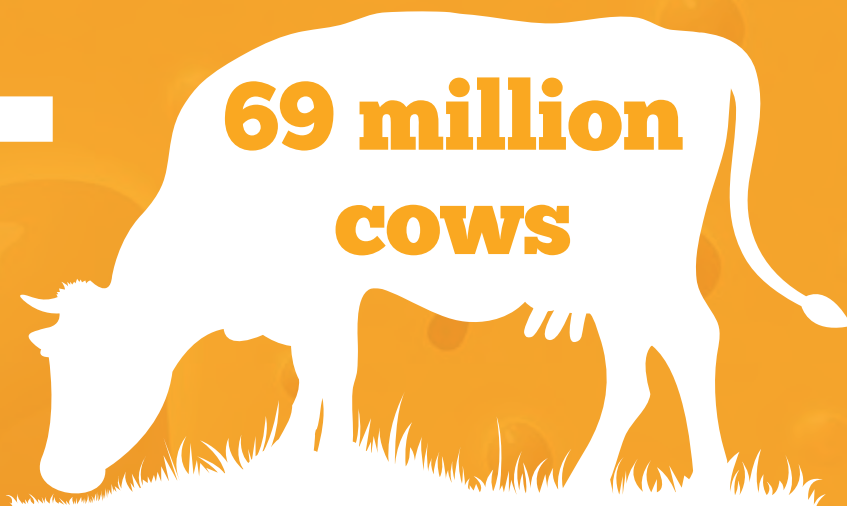


consumes **dairy** the
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+

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will be required to
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