Toxic Bites : Are We Eating Smart?

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Our lives are inherently full of risks. Living without any risk is simply impossible. From air travel to driving a car, from walking to crossing the street, all simple and complex tasks may encounter some level of danger. While we are aware of risks in certain areas, such as driving, we are often unaware of many other vulnerable areas, like falling ill from contaminated food. We all remember the approximately 700 million people being affected by the last pandemic (COVID-19). But how many of us know that an estimated 600 million people contract foodborne illness each year?

Our world is filled with microbes, which are the source of most diseases. Microbes can be found everywhere—in the environment where food originates, on the machinery used for processing the food, and with the people working inside and around food processing facilities. Contamination can happen at any stage, from primary production to the consumer. Maintaining personal hygiene, such as washing hands before eating, is a good practice but that does not guarantee complete protection from falling ill after consuming food. There are methods to reduce the number of microbes in food products, such as pasteurization of cow's milk. However, these treatments cannot fully eliminate microbes; they only limit their concentration to a certain level.

Ideally, every bit of food we eat should be free of pathogens (disease-causing microbes). However, the task of obtaining a hundred per cent microbe-free food is not easy and reminds us of the story of Sisyphus. As per Greek mythology, Sisyphus was a cunning king of Ephyra. He offended the gods in many ways and was punished by them by being condemned to the act of pushing a boulder up a hill, only for it to roll back down each time he neared the top. Metaphorically, it means unending labour against an impossible task. We see a similar reflection in trying to make food products completely free from contamination.

Fortunately, not all microbes are harmful. Some products, like yogurt or cheese, exist because of the presence of microbes. In such cases, a complete lack of microbes is not only unachievable, but also undesirable. But there are microbes like *Listeria monocytogenes* and *Salmonella*, which may cause serious illness, such as tuberculosis, brucellosis, listeriosis and typhoid fever.

When microbes are too widespread and food passes through a complex chain of systems, eliminating them becomes a Sisyphean task. In a paper presented at an ASM Microbe 2025 seminar (ASM–American Society of Microbiology) held in Los Angeles during 19-23 June 2025, Martin Wiedmann, Professor of Food Safety at Cornell University's College of Agriculture and Life Sciences, proposed a practical approach that advocated moving away from trying to eliminate microbial risk entirely. He suggested adopting instead a data-driven strategy to prioritize risks and guide actions.

This will help food regulators and companies focus their resources more effectively, leading to food safety systems that are less Sisyphean and more sustainable.

All food processes have a residual risk; some are small, some very small and some are extremely small. Residual risk is the risk that remains even in a fully compliant food safety system. There can be nothing as 'zero risk'. Achieving 'zero risk' is impossible, while moving from 'zero risk' to 'zero tolerance' is a more practical approach. In 'zero risk' mode, the slightest presence of a hazard (pathogen) prompts regulatory action. The US follows this so-called 'hazard-based' approach when it comes to *L. monocytogenes* in ready-to-eat products; a positive result for any bacterium leads to a recall of the entire batch of a product, even if only one bacterial cell is detected in a sample of a million. This approach evokes wastage of food, with huge monetary loss. That is why 'risk-based' approaches, which focus on preventing the most serious health risks by categorizing hazards based on their likelihood to occur and potential impacts, are particularly attractive. However, their implementation requires recognition and comprehension of residual risk. Understanding and assessing residual risks for different products is essential for the different actors involved in the food production system.

The task now is to develop a strategy for a risk-based approach. For this, scientists collect complete data about food on how it is grown, processed, and transported, and feed them into mathematical models. The models estimate the likelihood of contamination, the severity of the consequences, and evaluate the effectiveness of different preventive measures in minimizing risk. Risk managers then use the results to decide on controlling or reducing risk.

Promoted by scientists like Wiedmann,'risk-based' food safety is increasingly adopted by the food industry at large. The method weighs all the factors to understand the impact of a pathogen in a given food context—its prevalence, the consumer of the food, and how the food will be prepared/eaten—to tailor interventions. The approach hinges on the recognition that not all risks in food, as in life, are the same.

An example cited by Wiedmann says that the presence of *L. monocytogenes* within a processing plant is a hazard. 'However, the level of risk associated with that *Listeria* can differ substantially,' said Wiedmann. If the organism lives on a surface covered in condensation that drips onto food, the associated risk becomes high.

Research on assessing residual risk for different pathogen-food combinations is essential at both the company and governmental levels to further fine-tune food safety systems within the limit of acceptable residual risk. Scientists are now working in this important yet indistinct area.

'There is not unlimited money in food safety, nor is there anywhere else,' Wiedmann said. 'So, we really have to be careful and use our science to help everyone involved, to invest money where there's the biggest impact and where we can drive continuous improvement.' ■

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