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Food microbiology: current and future topics of investigation

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This edition of *Microbiology Australia* is dedicated to food microbiology. The field of food microbiology is very important as microorganisms can be used in a positive way to make and enhance food products, or, from a negative perspective, microorganisms cause both food spoilage, with subsequent food wastage, and foodborne disease, with potentially life-threatening consequences. The multidisciplinary field of food microbiology is of great interest due to the possibility of studying food microorganisms in the context of food safety and hygiene, classic and new food preservation technologies, traditional and novel food fermentations, functional foods and probiotics, rapid automated methods of analysis, epidemiological and molecular investigations[1] and the future use of microbes as a sustainable food source and for recycling.[2] Therefore, this edition of *Microbiology Australia* focuses on articles related to food safety, advances in microbial food analysis, and novel microbes for new fermented food products that are relevant for the future.

An important topic in this edition relates to omics and its role in food microbiology. Omics (such as genomics, transcriptomics, proteomics, and metabolomics) generates data that can extend the range of information from a single system and increase detection, tracking and adaptation of foodborne microbes in processing environments.[3] The articles by both Gray and Pillidge *et al.* discuss the use of omics to better understand microbial communities in food systems. Gray reviews the use of omics to study leafy vegetables from farm to fork. Leafy green vegetables are well known as a source of foodborne illness such as *E. coli* 0157 infections.[4] Pillidge *et al.* describe the use of metagenomic analysis to study the stages in the production of cheese and the changes in cheese microbiota during fermentation and cheese ripening. Both articles discuss historical culture-based methods compared with high-throughput sequencing methods to obtain whole genome sequencing (WGS) data to develop an understanding of metagenomics, including microbes that might be missed using culture-dependent methods and how the microbiota changes during processing.

In addition to cheese, bread is another classic fermented food that has been made for thousands of years.[5] However, dietary preferences are changing due to the increased demand for gluten free and low fermentable oligo-, di-, monosaccharides and polyols (FODMAP) bread. Wittwer and Howell describe research into diverse breadmaking yeast that may cater for these demands using novel yeasts from potentially non-food environments in sourdough production to develop interesting flavour properties and as a support to the lactic acid bacteria (LAB) degradation of gluten and breakdown of fructans.

Another area of fermentation research is in plant-based products. According to the Bloomberg Intelligence Report, plant-based food sales are expected to increase fivefold by 2030.[6] Fermented plant-based foods are important as a potential replacement for fermented dairy products as they are naturally lactose-free and have a good source of bioactive compounds. However, there is a need for new strains of LAB that are more suited to fermentation of plants than dairy products and that could produce acceptable flavour, texture and nutritional value if proved safe. Huang *et al.* describes Citizen Science as a way to help identify new species of LAB that may be best suited to plant fermentation.

Laboratory analysis of suspected contaminated food is essential to maintain food quality, safeguard consumer safety and ensure emerging pathogens are identified.[7] In late 2021 public health investigations across Australia detected cases of gastroenteritis caused by *Vibrio parahaemolyticus*, linked to eating raw oysters from South Australia.[8] *Vibrio parahaemolyticus* is a bacterium found in marine and coastal waters where oysters normally grow. Outbreaks in Australia have been rare. However, in the last few years *Vibrio* infections have been sporadically reported and are now a notifiable infection in Tasmania.[9] The article by Hedges addresses the possible issue of *Vibrio* spp. as an emerging issue for Australia and discusses advances in molecular methods of analysis using PCR and gene sequencing.

As stated earlier, WGS is increasingly becoming a routine tool to detect and track foodborne outbreaks within hours to days.[10] The article by Bramwell *et al.* discusses the changes in analytical laboratories as traditional methods of detection of foodborne pathogens and spoilage microbes are replaced by rapid automated molecular technologies, such as WGS, as they become more accessible and affordable.[10] However, it explains the reasons why there is still a place for more traditional culture-based methods, in particular for food microbiology analysis in complex food matrices and processed food.

A key limitation when testing food is time-to-detection.[7] Therefore, another area of food microbiology related to rapid analytical technology is rapid *in situ* screening assays for foodborne pathogens, known as Point of Management (POM) assays, similar to 'Point of Care' diagnostics in the medical field. Most raw poultry contains *Campylobacter*.[11]

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Templeton *et al.* describes their work on a POM assay to detect *Campylobacter* in poultry production that uses a dipstick for molecular screening of *Campylobacter* DNA. They describe the advantages and disadvantages of this technology and how it could be extrapolated for other relevant pathogens in the poultry industry, such as *Salmonella*.

In recent years, novel processing and treatment methods such as high-pressure processing, ultrasound, cold plasma, and pulsed electric field have been developed to minimise the risk of unwanted microorganisms being present in food.[12] These new processing techniques have less impact on the organoleptic and nutritional qualities of food by preserving the characteristic properties.[13] Seididamyeh and Sultanbawa describe the use of photodynamic inactivation as an emerging technology on microbial safety in foods. They describe how this treatment can be used to inactivate both pathogenic and spoilage microbes in food, showing promise for the future in minimising nutritional and sensorial changes in a cost-effective and environmentally friendly way.

Another issue related to food processing is the production of biofilms in food processing facilities. Biofilms have been shown to be a source of transmission of pathogens from surfaces and equipment, where they adapt to, and successfully colonise, niche environments.[1] Omics can broaden the scope of knowledge gained studying biofilms, including identification and remediation of strains that persist in the processing plant environment.[3] Biofilms are addressed in Dykes' article, including difficulties in studying pathogen biofilms in food processing facilities *in situ* and issues related to the way biofilms are currently investigated.

In conclusion, the above knowledge can be used in practice to ensure there is a constant, plentiful and safe food supply for the future rapidly growing human population. And as our future is reliant on food availability and good nutrition,[14] experts in all food microbiology fields are essential for improving global health and wellbeing.

Biography

Prudence Bramwell is an Honorary Associate Professor at RMIT University. She has over 30 years' experience in food microbiology. Prior to her 25 years at RMIT as an academic educator in the fields of food microbiology and food safety, she has held positions in Microbiology at both the University of Melbourne and University of Sydney and at the Australian Government Analytical Laboratories (the latter now amalgamated into the National Measurement Institute) in the field of microbiological analysis. While at AGAL she was a registered NATA auditor of Biological Laboratories. While at RMIT she held certificates as an advanced food safety auditor and associate quality auditor with Exemplar Global. Her research interests are in methods for the isolation and identification of foodborne microbes.

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