Food scientists as heroes

Words by Deon Mahoney

In a recent edition of *food australia*, AIFST's CEO, Fiona Fleming, described food scientists and technologists as heroes. While this may sit awkwardly with some professionals, it is pretty close to the truth because it recognises their ongoing contributions to a safe and suitable food supply.

Australians enjoy a very safe food supply, and this is due in no small part to the efforts of our food scientists and technologists who strive every day to maintain the safety and suitability of our food. It is everything from the research and development that underpins our knowledge of how to produce safe food to the front-line action of quality assurance and management personnel that implement and then monitor the veracity of our food control systems.

The food scientists and technologists involved in the day-to-day management of the safety of our food supply play a critical role in safeguarding public health, maintaining consumer confidence and securing market access. The value this provides to the domestic and global food supply should be neither underestimated nor overlooked. Everyone should be congratulated.

What is important to acknowledge is all that has gone before to support contemporary approaches to managing food safety. As Sir Isaac Newton once said, *if I have seen further, it is by standing on the shoulders of giants.* The endeavours of our growers, fishers, processors, quality managers, quality assurance officers, food microbiologists, analysts and epidemiologists to ensure the safety of our food supply are based upon precepts and insights that are grounded on learnings from the late nineteenth and early twentieth century.

Brief moments in public health history

Historically, societies have adopted various strategies for extending the shelf-life of foods and avoiding illness and poisoning. Sun drying, salting, freezing or cooking food have been practiced for millennia with varying degrees of success. But understanding why they are effective, and attempts to improve and monitor these processes, are a relatively recent occurrence.

Many of the important breakthroughs have been made in the last 170 years. We can go back to the mid-1800s when anaesthesiologist John Snow undertook investigations during a cholera outbreak in London. His mapping of the outbreak and subsequent removal of the pump handle from the Broad Street pump signalled the end of the outbreak and foreshadowed the science of epidemiology. His studies, which involved the characterisation of cases by time, place and person, led to hypothesis generation, hypothesis testing, and application. It is classic epidemiology and resulted in prompt and appropriate public health action.

This all occurred at a time when the existence of microorganisms was still under discussion and before the advent of a microscope of sufficient power and utility to routinely detect bacteria.

Plus, the water in the pump had tasted and smelled normal, and this led to the insightful reasoning that good taste and smell alone do not guarantee the safety of drinking water. As a result, Snow's findings motivated changes to water supply and waste handling systems, resulting in significant improvements in public health. Notably, authorities started to install municipal water filters, explore methods of decontamination, and consider the need for regulation and oversight of drinking water.

Early methods of water disinfection involved the use of ozone and chlorine. In 1908, Jersey City was the first jurisdiction in the United States to disinfect public drinking water. Over the next decade, many cities and towns across the United States introduced chlorination, leading to a dramatic decrease in waterborne diseases such as typhoid fever and cholera.

The Centers for Disease Control and Prevention (CDC) considers public drinking water disinfection and treatment to be one of the greatest public health achievements of the 20th century.[1] Even so, the ability to access safe water still remains a major issue for the food industry, especially in the production of fresh produce.

Concomitantly there was the introduction of regulations designed to control and assure the safety of the water and food supply. The introduction of pure food acts moved the dial, with the food industry required to address the challenges of the day, which included adulteration, fraud and communicable diseases such as diarrhoeal diseases and tuberculosis.

In Australia, Victoria led the way in consumer protection with the introduction of the Meat Supervision Act, 1900, the Milk and Dairy Supervision Act, 1905, and by the Pure Food Act, 1905.[2] Four more states passed similar legislation over the next five years. These Acts sought to address disease and mortality patterns as well as food adulteration from both a public health and fair-trading perspective.

The next stage involved the creation of microbiological standards for food and water and the introduction of testing requirements. This heralded the development and advancement of laboratory methods of analysis, and the importance of test results in guiding food control decisions. But while the range of analytical tools available to food scientists have exploded exponentially in recent decades, research to create reliable, timely and cost-effective rapid methods of analysis for relevant analytes and key foodborne pathogens remains an enduring pursuit.

An important advance in the past twenty years has seen the application of novel 'omics' technologies to gain insights into microbial communities along the food supply chain. Omics tools such as genomics map the structure and functions of genes, while proteomics studies the biochemical properties and functions of proteins, and metabolomics studies cellular processes and metabolites produced by cells. These technologies are increasingly being employed by research scientists to identify markers which can be used to determine information about the types of microbes present in a food and establish their implications for human and health.

Developments in food processing

The introduction of controlled heat processing was a major innovation in food technology during the nineteenth century, along with mechanical refrigeration. These industrial processes significantly extended the shelf-life of foods. This continued during the twentieth century which heralded significant advances in the way we produce, process and store food. Requirements such as inspection and testing of incoming raw materials, carcass evaluation and the pasteurisation of milk focussed on hygiene and resulted in dramatic reductions in the incidence of foodborne illnesses.

Alongside improvements in technology was the introduction of systems designed to oversee how the food industry assures food safety and quality. It was in the 1920s that quality control systems began to be introduced into manufacturing. Quality control focussed on the identification of defects, through inspection, sampling, and testing of finished products.

The next iteration was quality assurance which saw a shift from end-product inspection to the development of practices which concentrated on the prevention of defects earlier in the manufacturing process, bestowing confidence that quality and safety requirements would be met.

Over time, new quality management initiatives emerged and the 1950s saw the concept of total quality management (TQM) become fashionable with its emphasis on business-wide efforts to improve the quality of processes and products. The ISO 9000 series of quality management standards were first published in 1987, establishing systems for manufacturers to meet customer needs, consistent with regulatory requirements. These standards continue to be revised, with increasing emphasis on customer satisfaction.

Subsequently, food safety programs based on the principles of the hazard analysis and critical control points system were introduced as a means of managing product safety. This evolution has resulted in food industry personnel addressing product quality and safety in real time, at the appropriate point along the food supply chain. This has also occurred at a time where there is increasing regulatory scrutiny imposed by regulators and the markets, and the expectation that food processors are responsible for the marketing of safe and suitable food.

Current and future developments

In the third decade of the twenty-first century, our food scientists and technologists are observing a revolution in the way control over our food supply is being managed. Technological innovations, digitisation and smart sensors are enabling food scientists to more efficiently monitor and document parameters significant to product safety and support enhanced traceability, leading to safer products entering the food supply chain.

Technological innovations are changing how food is grown, processed and marketed. While robotics are augmenting processes such as sorting and inspection, product packaging and the movement of inventories.

Increasingly, sensors are being employed to scrutinise inputs and ingredients, monitor processing attributes, tally inventories, maintain environmental control during storage and transport and facilitate timely distribution of perishable foodstuffs. The contemporary food scientist utilises this real-time data to inform evidence-based decisions on the way to handle, process and distribute foods. The associated benefits include reduced likelihood of product surpluses or delays, with reductions in both costs and food waste.

There is also exploration of novel food processing technologies such as high-pressure processing, ohmic heating, pulsed light, electron beams and cold plasma to improve food safety and extend shelf life. Similarly, nanotechnology is assisting in the creation of food packaging materials that can extend the shelf life of food products. While improving safety is a key consideration, an additional need is for technologies which maintain a perception of product freshness and can be clean labeled.

Artificial intelligence is also starting to gain traction in the food industry. Applications can address the entire food ecosystem from sourcing to consumption, supporting the automation of processes and enabling food scientists to generate forecasts, track demand and phase processing to meet demand.

Conclusions

Whilst advancements in science, technology and food safety systems over the past 170 years have served the food industry well, assuring the safety of the food supply remains an ongoing challenge. Ahead of us is the impact of climate change, the environmental footprint of our food systems, new and evolving pathogens, increasing antimicrobial resistance, a rising number of vulnerable consumers and contracting resources.

Our food scientists and technologists diligently evaluate incoming raw materials, water, products and surfaces and supervise processing operations to guarantee the production of safe food.

Advancements in new technologies, smart sensors and artificial intelligence will underpin future transformation of the food industry, and the next generation of food scientists and technologists will need to manage rapidly evolving food supply chains and be skilled in how to best utilise new technology to control food safety hazards. They will need to be as clever, innovative and perceptive as their predecessors in addressing current and emerging food safety challenges and implementing innovative solutions that assure the safety of our food supply.

Our food industry heroes will need to double-down on the application of technologies and strategies for addressing future food safety challenges.

References

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Deon Mahoney is Head of Food Safety at the International Fresh Produce Association.