Towards an Affordable and Sustainable Food Supply - Recent Advances and Future Prospects

Looking to the future, the agri-supply chain faces two grand challenges: feeding a growing population, and ensuring that food is nutritious and healthy. They are grand because of their complex, multifaceted nature, involving demand and supply side drivers.

On August 31, 2017, ILSI SEAR Australasia in conjunction with the American Association of Cereal Chemists International (AACCI) hosted a seminar, Towards an Affordable and Sustainable Food Supply - Recent Advances and Future Prospects, in Sydney, Australia to discuss what these challenges mean and some of their innovative solutions.

New Agricultural Technologies and Sustainability

On the supply side, the rate of increase of crop improvement for production of food will not meet forecasted demand. Constraints on land, water and other inputs, as well as evolving threats including biosecurity, climate change and social license are all production hazards. Additionally, the right type of production and processing needs to occur. While many people in the world are undernourished, there just as many who over eat. This is where supply melds into demand. Even if a sustainable, healthy and tasty product is available, consumers need to want it. Thus, solutions to these problems will need careful planning, collaboration and integration across the supply chain with health officials, government bodies, researchers, industry and consumers.

An obvious question in meeting these challenges is what do consumers want? It turns out authenticity is the latest in a growing list of consumer needs. To be authentic, a product must be what it says it is. It must be safe, of high quality and have integrity. The latter two aspects can refer to a broad range of things, including the technologies used to make a product, its origin, or its sustainability. Importantly, there must be a way to prove these qualities, for example, traceability through the supply chain or certification.

As new technologies emerge at the farm gate, how they are regulated and represented to the consumer will be critical to their profitability and success. Technologies that give yield gains may be at odds with desirable traits of authenticity. Take for instance, genetically modified (GM) crops. When these crops entered the Australian supply chain two decades ago, regulators and consumers approached this new technology with caution. Responding to this concern, legislation was passed requiring pre-market assessment and approval, as well as mandatory food labelling.
Now, even though 30 years of research has proven their safety, regulations and disapproving consumer sentiment still persist. This has generated costs up and down the supply chain; from companies developing these crops who need approvals, to the certification systems put in place by logistics companies to sell and store GM and non-GM grain.

This is why all eyes are on the regulators for the new generation of breeding techniques. Lines are being blurred between the definitions of traditional and the newer gene technology based breeding techniques. Crispr Cas-9, for example can make single base pair changes in DNA, with no foreign DNA inserted. There is no way to distinguish this manipulation from natural variation. Responding to this, Food Safety Australia New Zealand (FSANZ) and the Office of the Gene Technology Regulator (OGTR) are reviewing the regulations in regard to what techniques need pre-market approval and the definitions of gene technology as well as food produced by such technology.

It is impossible to predict how consumers will respond to new technologies. Researchers, industry and government must learn from the mistakes of the past and ensure information is communicated effectively to the public.

Regardless of how consumers and regulators respond to new gene technologies, parallel opportunities exist. Traditional plant breeding techniques are producing impressive crops. The CSIRO has recently made a gluten free, hull-less barley variety and a high amylose wheat. Advances including high throughput screening in breeding can reduce product development time drastically for new varieties. Additionally, novel “omics” approaches and big data are helping to link genotype and phenotype to better understand plant genetics at a fundamental level.

Breeding technologies share a common goal to increase yield. However, pests, diseases and weeds reduce actual yields by 40% (this goes up to 60% when no crop protection product is used). Accordingly, achieving yields close to the potential should be a top priority. The key to this is increased research and development output and ensuring growers use best practice. One new practice to emerge from digital agriculture is crop surveillance, whereby a grower can monitor for disease symptoms so they can be controlled quickly. The success of such technologies will depend on access to information and grower support for their implementation. New practices may also provide value adding opportunity, if they can be marketed in ways that appeal to consumers (e.g. “greener” practices).

**Food Processes & Improvements in Food Security**

The post-harvest supply chain suffers considerable losses too. Food processing is an exciting area for new techniques to help minimise loss, whilst improving nutrition, maximising resource use and enhancing flavour. New technologies involving high pressure and microwave radiation are being used to make ready-made meals that don’t need refrigeration. Other pressure-based techniques are being used to make nutritious unpasteurised juices and potentially safe to drink raw milk. Fortification of milk with vitamin D and encapsulation of omega 3 fatty acids are two of many examples of food processing to improve nutrition. Processing can also optimise extraction and minimise waste, for example, using ultrasound technology to increase extraction of oil whilst minimising water use.

The developments extend beyond the processing level. New technologies are giving consumers more information at their fingertips than ever before. The new smart label database allows consumers to search product information for things such as country of origin, allergen information, product claims
or traceability. Portable near infrared technologies allow consumers to obtain real time nutritional information about fresh produce, meat and dairy. These changes are allowing consumers to assess products for their authenticity and in turn may change consumer preferences.

**Conclusions**

Feeding everyone with the right foods are the two grand challenges whose solution will rest on how we handle and harness the unprecedented rate of technological change in the agri-food sector. New management strategies, breeding and processing technologies coordinated across the supply chain, enhanced by digital agriculture, will minimise input use and waste, whilst maximising efficiency. Demonstrating authenticity to consumers, who have ever increasing information about products, remains a challenge, and an opportunity for adding value. However, the degree of regulation on new technologies, especially for gene-related ones, may affect their profitability.

Demand side drivers appear to be the biggest risk. Consumer attitudes can make or break a new technology. Thus, proper consultation and research with consumers is paramount, and reinforces the need for integration across the supply chain.

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