



Genomics to Improve Food Safety

In 2017, hundreds of heads of romaine lettuce were removed from Canadian and American grocery stores due to the threat of contamination from *E. coli* bacteria.

Recent studies have also shown that mislabelled sushi, horsemeat-tainted beef and egg-free bread... that actually contains eggs can all be found on the market. Here's what we can do about it.

Food product recalls are not new. In 2010, *Listeria* bacteria, which causes an illness known as listeriosis, made headlines and led to an extensive recall of deli meats and cheeses by the Canadian Food Inspection Agency. With the increase in global trade, however, it can be difficult to pinpoint the origin of the contamination, since tracking down a product from farm to fork is a challenge.

In response, most countries have adopted efficient food traceability systems that help them quickly recall from the market unsafe or potentially contaminated products. Canadian researchers have, however, demonstrated that not all of these systems are fully developed.



DETECTING MICROBES AND ALLERGENS

While genomics tools are not yet extensively used in agrifood here in Québec and Canada, they have the potential to improve food traceability. **DNA barcoding**, for instance, is effective at detecting, rapidly and accurately, pathogens such as *E. coli* and *Salmonella* and traces of allergens present in a food product.

All species (animals, plants, viruses, bacteria) have unique DNA segments that identify them as such. DNA barcoding is used to “read” these genetic barcodes in much the same way as product barcodes are scanned at the grocery store. Scientists are now using this technique more and more to ensure the quality of the food we eat.

AVOIDING FRAUD

DNA tests conducted in 2013 on fish products at the Université Laval genetics lab revealed that 47% of them were mislabelled¹. More specifically, 14 of the 15 samples of sole collected were actually plaice or flounder.

Food fraud is the partial or complete replacement, addition, removal or omission of ingredients in a product. It is done deliberately and intentionally to reduce production costs. Voluntary substitution makes it possible to use cheaper industry by-products and raw materials. Food fraud is a serious problem since false information about the origin of a food or its ingredients can put at risk the health of consumers.

Multiplex PCR technique is one of the genomics tools that can be used to identify the various animal species (targeted or unknown) in a meat product such as sausage or ground meat. Unlike certain traditional testing methods, multiplex PCR is fast, easy, inexpensive and capable of detecting even trace amounts of DNA in a sample.

REDUCING AGRICULTURAL WASTE

Genomics is also useful in fields and farms. According to Environment Canada, invasive species that damage crops and forests cost these industries \$7.5 billion in lost revenue every year². Farmers also need to manage microbes that attack their livestock. The *Neospora caninum*, for example, triggers abortions in cattle around the world.

This is where **metabarcoding** comes in. When combined with DNA barcoding, this technique lets researchers identify with a single test all the harmful species found in a given environment – and it does so much more quickly and accurately than traditional morphological identification.

With metabarcoding, short DNA markers or traces left behind by organisms in their environment during their life cycle can be used for analysis. This makes it possible to detect an organism even once it is no longer active in an area.



THE CHALLENGES

Despite the undeniable benefits of genomics tools, their use does come with some limitations. They cannot be used for cases of fraud involving the dilution of a product or the replacement of a wild fish with a farm fish of the same species (i.e. with the same DNA).

Moreover, the analysis and interpretation of DNA sequencing requires highly qualified staff and powerful computer resources and databases. Genomics technology is developing at a fast pace, and employees do not always have the training they need to perform the testing. In addition, many lab teams are reluctant to embrace new technology.

To make the most of genomics in agriculture and agrifood, the scientific community must work on developing standardized DNA sampling, storage, replication and validation techniques. Implementing a network of certified labs and developing a legal framework so that molecular evidence can be used for decision making are other ways that could help Canada and Québec take advantage of everything genomics has to offer.

¹ Dussault, S. (2017). Dans la moitié des cas, on nous a refilé un poisson d'une autre espèce et de moins bonne qualité. *Journal de Montréal* – Oct. 4, 2017

² Canadian Council on Invasive Species (2018) Impacts. Consulted on May 18, 2019: <https://canadainvasives.ca/invasive-species/>

To learn more about the subject, consult the [policy brief](#) prepared by the Quebec Centre for Biodiversity Science commissioned by Génome Québec.