A submission to the Review of the National Gene Technology Scheme 2017 - Phase 2.

GM food: What could possibly go wrong?

Question under consideration:

As new techniques for genetic modification (GM) appear, is it appropriate for the regulator and/or the regulations to exclude the products of some GM techniques from regulation? Should the regulator and/or the regulations maintain a narrow or a broad definition of genetically modified organisms (GMOs)?

Response:

Australia's Office of the Gene Technology Regulator (OGTR) needs to maintain a broad and inclusive definition of GM and GMOs to protect the public, the environment, and its own integrity and authority. The GMOs that GM technology creates, whether using current techniques, developing techniques or future techniques, need to continue to be regulated, without further exemptions. Technologies for altering genetic sequences and gene expression (for example) produce GMOs and it is appropriate that they are all regulated. Such GM techniques include, but are not limited to, SDN, SDN-1, SDN-2, ODM, RNAi, and developments include, but are not limited to, gene drives, and synthetic biology.

Broad and inclusive regulation means that GM techniques, by default, fall within the net of regulation.

Eight reasons why the OGTR needs to maintain a broad and inclusive definition of GM and GMOs:

1. Public distrust of GM technology.

There is already a general public distrust of GM technologies. This distrust is global. A recent survey of consumers (N > 23,000) in seventeen countries reported that an important consideration for food choice is that "It is free from GMO (genetically modified) ingredients" (GfK 2017) (Fig. 1).

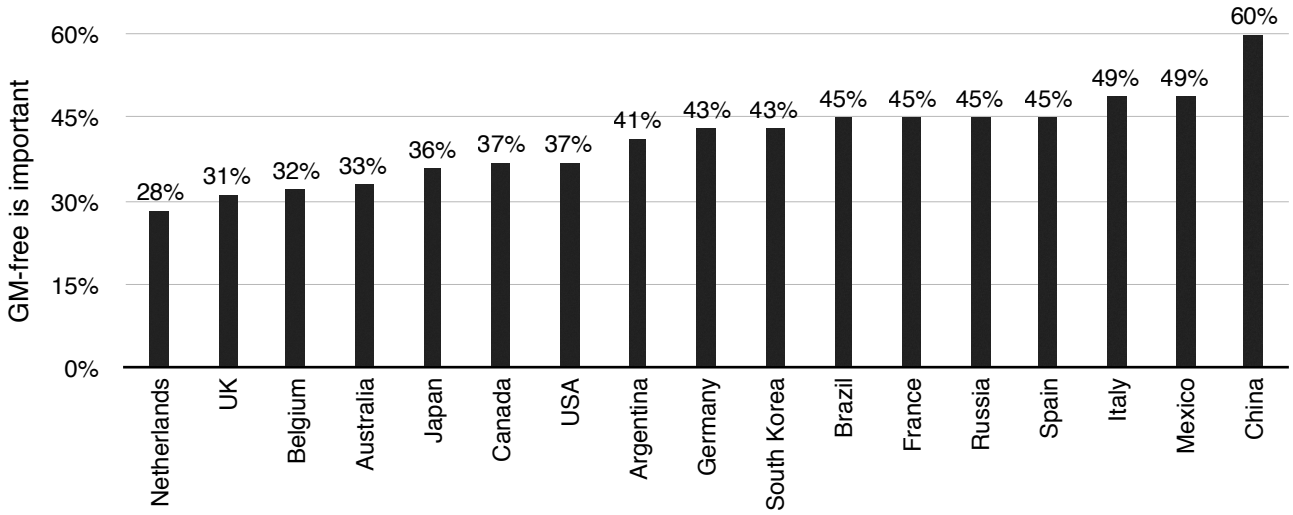

Figure 1: Global consumer rejection of GM food (Data source: GfK 2017).

2. No Social Licence.

GM, GE (genetic engineering) and GMOs lack a social licence. For example, US food manufacturers spend generously to counter proposed labelling of GM food in USA (Paull 2012). The preference of multinational food processing and GM companies is for GM products to 'fly under the radar' and to be indistinguishable and un-identifiable to consumers, and that is because of the lack of a social licence and they fear that consumers will exercise choice and avoid purchasing GM products.

When Australian farmers sell GM canola, they consistently receive ten percent less for their produce compared to the price for non-GM canola (Fig. 2). Non-GM consistently sells at a price premium because some buyers and some countries, refuse GM produce.

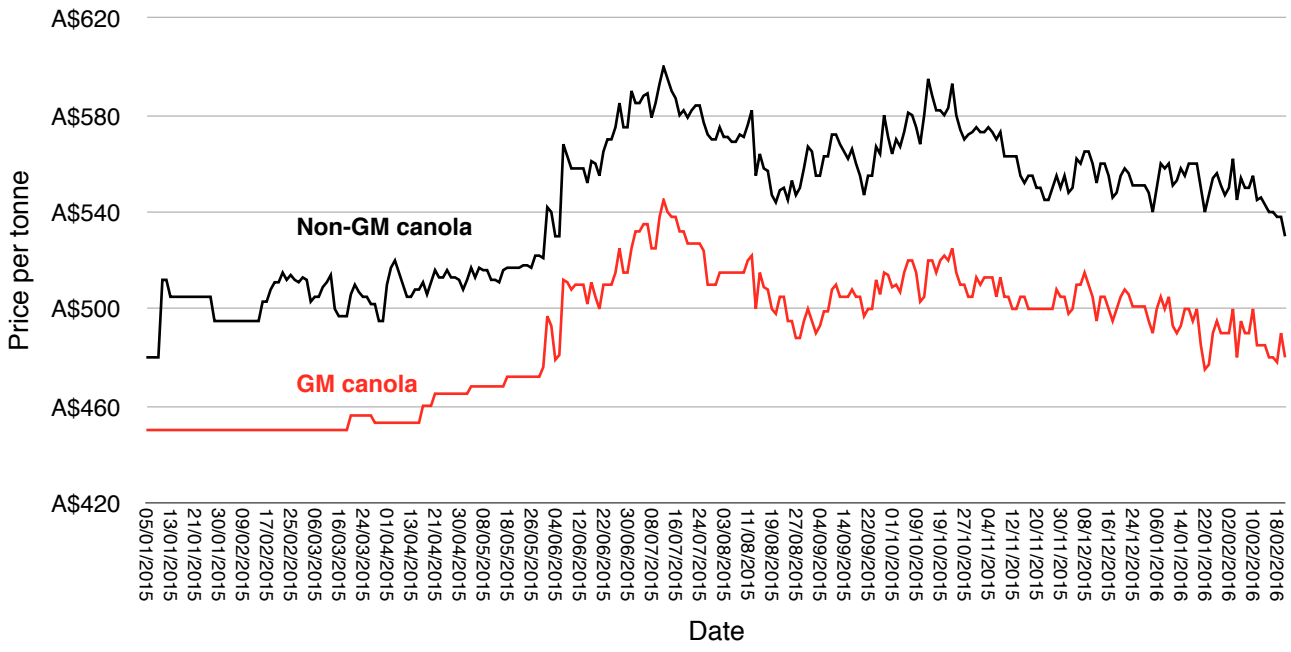

Figure 2: Canola Contract Prices in Western Australia (2015-2016) (Data supplied to author by CBH Group).

The avoidance of GMOs by both bulk buyers and consumers is a reflection of the lack of social licence for GMOs in the market place.

3. The myth of small edits.

Consider the following two lines of text that are Dorothea Mackellar's poetry with some 'small edits' applied:

> *I love a sunburnt country,*
> *A land of swooping planes*

The word count is unchanged, the letter count is unchanged, a few characters have been the subject of 'small edits' (viz. several vowels have been swapped out). However, after these 'small edits', what we are left with is some text, that while it appears somewhat familiar and is certainly reminiscent of Dorothea Mackellar, it is no longer the poetry of Dorothea Mackellar. The poet would

doubtless disown it, and rightly so. Passing it off as Mackellar's poetry would be offensive and quite improper.

In a similar way, edited genomes ought not to be passed off as the 'real thing', as 'equivalent to', or as a facsimile of the unedited genome. Rather, they ought to be flagged as edited genomes, i.e. as GM genomes, and be regulated as such under GM regulations.

4. Successive small edits transform.

Lewis Carroll (1879) invented the game of Doublets where he set the challenge of transforming one word into another via a series of successive small edits. Examples that Carroll offers are the transformations of FISH to BIRD, MAN to APE, HEAD to TAIL and BLACK to WHITE.

One of Carroll's examples is the transformation of HEAD to TAIL as follows:

HEAD
HEAL
TEAL
TELL
TALL
TAIL

Each 'link' of the 'chain' involves a small edit of the word above. At each edit only a single letter is changed. A succession of such small edits creates a 'chain' in which the starting word (of the 'doublet') is successfully transformed into the very different final word (of the 'doublet').

In a similar way, by a succession of 'small edits' a genome can be transformed into something very different from its starting genome. If the threshold for regulation of GMOs was that 'small edits' are exempt from regulation then the system can be gamed by genetic engineers.

The threshold for regulation needs to be any GMO, i.e. where there has been any edit. Otherwise the system will surely be gamed, as per Lewis Carroll's game of Doublets, to progressively transform an organism via a sequence of small edits into something quite different.

5. Thin edge of the wedge.

An exemption of selected GMOs from regulation would create two classes of GMOs (Regulated GMOs and Unregulated GMOs).

Such a class system would generate further distrust for the public. It would likely produce perverse outcomes where GM companies seek to stay on the unregulated side of the boundary. It would create a minefield for determining, maintaining and adjudicating such a boundary. The nature of boundaries is that they are expensive to maintain and they are contentious.

Exemptions from regulation would be viewed by consumers and genetic engineers alike as the 'thin edge of the wedge'. It would pit consumers and genetic engineers against each other, with

consumers seeking to dislodge the wedge, and GM companies seeking to entrench and 'hammer home' the wedge.

6. The catastrophe of irreversibility.

The release of viable GMOs into the environment is irreversible.

Painting a house purple might perhaps seem like a good idea at the time to a homeowner. In the event that the result disappoints, then a few cans of paint can quickly erase the folly.

However, there is no mechanism to reverse the release of GMOs - they can be self perpetuating, propogating within themselves, and interbreeding with their non-GMO analogues.

The intentional release of cane toads into Australia illustrates the catastrophe of irreversibility. These novel organisms were released into the Australian environment with the endorsement, at the time, of government departments, the CSIRO and others. There are currently estimated to be 1.5 billion cane toads in Australia. The release has been an ecological and financial catastrophe for Australia (Mercer 2017, Robinson, Walshe et al. 2017).

There is no recall mechanism for cane toads and there are no recall mechanisms available for GMOs. The lesson of the cane toad needs to be learned.

7. Risk of reputational damage to OGTR.

The definition of GMOs needs to be maintained - and strengthened when and where necessary to ensure that it is not overtaken by technical GM developments or slick rhetoric by GM corporations.

In the event that the definition of GMOs is weakened by the OGTR then the reputation of the OGTR is potentially weakened in the eyes of the public as being less than an 'honest broker' and seen as regulating GMOs in a grace-and-favour manner.

Two classes of GMOs (Regulated GMOs and Non-regulated GMOs) would erode public confidence in the OGTR.

8. What could possibly go wrong?

The risks of GMOs are the great unknown. There are the risks of the unforeseen and unintended consequences. There are no fool-proof tests of prospective and long-term safety. The OGTR needs to err on the side of caution (rather than of commerce or wishful thinking) in considering the approval and release of GMOs.

I have heard it argued that 'Americans have been eating GMOs for years and it has done them no harm'. This overlooks the fact that the American diet is dysfuctional. It has created a nation of obesity with the world's highest expenditure on health care and complexity of cases. The causes of this dystopia are multifactorial. Just what can be sheeted back to GMOs is uncertain and is certainly confounded with other variables. There are main effects and multi levels of interactions

with other factors. In this ‘real world’ experiment disentangling those effects is probably beyond the whit of statistics, at least in the short term. What is clear is that the US population is fatter than ever and sicker than ever, and does not present a model to be emulated. In the meantime, GMO ingredients are in virtually all US processed food products and are consumed daily by the majority of US consumers.

It may be decades or generations before there is a definitive answer on the safety or otherwise of GMOs (think of the timeline for the smoking debate).

What could possibly go wrong with the release of GMOs into the environment and the foodscape? That is the great unknown - and as new GMOs appear it is a moving target.

In summary:

These are some reasons why the OGTR must maintain a broad and inclusive definition of GMOs, and err on the side of caution in approving (or not) any proposed release - perhaps always keeping in mind the cane toad - which seemed like a good idea at the time.

References

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