



Towards greater transparency: Digital opportunities to promote traceability in genetic engineering

Summary

- The UK is recognised as a major global hub for engineering biology, but the economic success of the field depends partly on public acceptance.
- There is insufficient evidence on attitudes within the general population towards recent genetic engineering (GE) tools and techniques. It is unclear whether attitudes towards these developments differ from attitudes towards genetic modification (GM).
- However, there is evidence that a number of factors shape individuals' attitudes towards technoscientific developments in agrifood, including trust in organisations, concerns about unnaturalness, safety, risk and impact on the environment, human and animal health.
- Further research is required to compare views on GM with attitudes towards novel GE developments. In the meantime, Government can take early steps to support traceability of GE products and transparency by biologists.

Recommendations for policy

Improving transparency and traceability in genetic engineering:

1. Publish voluntary best practice guidelines on the storage (and publication) of genetic engineering-related laboratory data. Laboratories and/or businesses should:
 - Establish or purchase a purpose-built digital cell engineering repository or version control system to archive all changes made to engineered strains, including safety-related information.
 - Establish an internal protocol for data management and storage.
 - Regularly review the efficacy of all processes involved in maintaining the repository or version control system.
2. Use research funding mechanisms to incentivise and support:
 - The creation and use of digital cell engineering repositories.
 - Research into UK attitudes towards recent advances in genetic engineering, and the contextual importance of social, cultural, political, historical and economic factors.

The challenge

The engineering of biology has been greatly enabled by recent developments like CRISPR, which is claimed to facilitate efficient and precise genome editing. Growing interdisciplinary connections between biotechnology and information and computer technologies have also paved the way for more routine 'reading and writing' of DNA, pushing research areas like synthetic biology closer towards the programming of biological organisms.

As genetic engineering advances, the topic of 'public attitudes' (implicitly, 'public acceptance') remains relevant. Attitude-related research on the GM controversy highlights that attitudes vary down to the individual level and are difficult to predict.

Some common determinants of negative attitudes may include lack of trust in institutions and their motivations, as well as concerns relating to risk, safety and 'unnaturalness', among others.

UK Research Councils have encouraged and supported the embedding of public engagement and responsible (research and) innovation in research projects. However, there is little evidence on attitudes within the UK population towards advances in GE, particularly compared to GM.

The method

In discussion with the Food Standards Agency and the Regulated Products Risk Assessment Team, the question below was raised as part of a portfolio of policy areas in need of research attention:

Do public perceptions of novel genetic engineering techniques differ from perceptions of GM?

The 'rapid review' protocol took an adapted PICOS (population, intervention, comparison, outcome, study design) format, where 'intervention' was excluded due to irrelevance to the subject matter, and study design was not defined:

1. *Population*: Global population - not restricted by age, gender, socioeconomic group, geographical location.
2. *Outcomes of interest*: Attitudes toward novel genetic engineering techniques.
3. *Comparison*: Compared to attitudes towards genetic modification around the world.

Web of Science, Scopus and Google Scholar were

searched. Reference lists of selected sources were hand-searched.

The results

In brief, results indicate that there is insufficient evidence to draw conclusions about similarities and differences in UK attitudes towards GM and novel GE. Research into both GM and novel GE developments suggests that views on technoscientific advances are nuanced and varied at the individual level. For this reason, views on novel GE developments cannot be predicted with any accuracy. Attitudes also vary dependent on social context and the researcher's framing of the topic.

However, there may be broad similarities in factors affecting attitudes towards GM and novel GE developments. These may include trust in organisations and their motivations, lack of transparency from organisations, concerns about corporate control of food production, 'unnaturalness', safety, risk to the environment, human health and animal welfare.

As applications in fields such as synthetic biology emerge, further attitude research should be supported through research funding mechanisms. Research must be UK-specific, exploring the contextual importance of the social, cultural, political, historical and economic factors involved.

In the meantime, an opportunity exists for the UK government to recommend improved transparency and traceability at the laboratory level. [Similar conversations have taken place in the EU](#). One option is to publish best practice guidelines for the storage of laboratory data on GE activities in digital repositories (similar to version control systems).

This may enable 'backtracking' from an engineered microorganism to the lab in a worst-case scenario. It would also support a market for software to facilitate such systems.

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