

# Academic Attention of Synthetic Biology

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## Description

Current cancer therapies target a limited set of tumor features, rather than considering the tumor as a whole. Systems biology aims to reveal therapeutic targets associated with a variety of facets in an individual's tumor, such as genetic heterogeneity and its evolution, cancer cell-autonomous phenotypes, and micro environmental signaling. These disparate characteristics can be reconciled using mathematical modeling that incorporates concepts from ecology and evolution. This provides an opportunity to predict tumor growth and response to therapy, to tailor patient-specific approaches in real time or even prospectively. Importantly, as data regarding patient tumors is often available from only limited time points during treatment, systems-based approaches can address this limitation by interpolating longitudinal events within a principled framework. This review outlines areas in medicine that could benefit from systems biology approaches to deconvolve the complexity of cancer.

Although some risk-related and ethical concerns were raised by the public, there was little evidence showing that people had an inherently negative perception of synthetic biology. The results demonstrated the importance of perceived benefits, perceived risks and ethical issues in shaping public acceptance of synthetic biology applied to agrifood production. Where analysis focused on specific applications, people tended to be more positive about medical and environmental applications compared to those in the agrifood sector. This is also the case for other areas of technology application, such as nanotechnology and genetic modification. However, at present, the literature is focused on synthetic biology as an enabling technology rather than on its specific applications. Given some evidence that people's attitudes varied by product types, more research on specific applications is therefore needed to further investigate public attitudes and co-develop societal preferences for agrifood products.

Synthetic biology is a novel multidisciplinary area of research that has attracted considerable academic attention due to its numerous potential applications across different domains. In common with other emerging technologies, such as nanotechnology, there

is no standardised definition available to date. The European commission (2005) has defined synthetic biology as “applying the engineering paradigm of systems design to biological systems in order to produce predictable and robust systems with novel functionalities that do not exist in nature” (p. 10). The Royal Academy of Engineering (2009) has proposed that synthetic biology involves “the design and construction of novel artificial biological pathways, organisms and devices, or the redesign of existing natural biological systems” (p. 13). Alternatively, synthetic biology can be described as “the design and construction of new biological parts, devices, and systems, and the redesign of existing, natural biological systems for useful purposes” (Springer Nature, 2019). All definitions encompass the notion that applications of synthetic biology involve the creation of novel living systems through synthesizing and assembling artificial and/or natural components.

There are both technology and application differences between synthetic biology and Genetic Modification (GM). Synthetic biology constructs living systems by synthesizing and assembling DNA according to engineering principles, whilst GM simply inserts a piece of foreign DNA into host organisms to produce desired traits. Consequently, synthetic biology may involve the use of larger amounts of DNA, which can be naturally occurring or synthetic, and the constructed parts could be standardised and shared within the community to establish more complex system. The sharing and rebuilding based on standardised living systems could facilitate the development of new applications, but may simultaneously increase the risks of releasing synthetic biological agents into the environment. A serious challenge for scientists and policy-makers can relate to risk assessment and governance, as the complexity of synthetic biology-based applications constantly grows, including those within the agrifood sector. In addition, the “bottom-up” approach of synthetic biology, which aims to create artificial or semi-artificial life de novo, has evoked strong ethical controversy. Thus, it is important to investigate public perceptions of and attitudes towards synthetic biology separately rather than intermingle the two technologies.

At present, around 700 organizations are engaged in synthetic biology-related research across 40 countries; and more than 350 companies have been established, which apply synthetic biology as part of their activities. The global

market value of these companies was estimated to be \$3.9 billion in 2016. A number of applications have been developed for use within the agrifood sector. However, future commercialization of these applications could be uncertain due to societal concerns about potential risks and ethical issues. Companies which align their products with consumer preferences and priorities may gain commercial success. In this context, the present study attempts to review the existing literature for understanding public perceptions and attitudes regarding synthetic biology, including those linked to agri food applications. In addition, we attempt to compare the results with research on other emerging technologies, such as GM and nanotechnology, to identify differences and similarities in public perceptions and attitudes, and to assess whether it is possible to learn how best to commercialize applications of synthetic biology from other enabling technologies in the agrifood sector.

This paper applied a mapping review methodology to answer the proposed research questions by analysing and integrating existing research findings, and simultaneously identify current knowledge gaps. The relevant literature was identified using a two-stage search strategy between 1st July and 30th October 2018. In the first stage, 3 databases were searched to retrieve literature published between January 2004 and December 2018. The terms, (a) "synthetic biology"; (b) "attitude"; (c) "perception"; (c) "media coverage"; and (d) "press coverage" were used, in which (a) was separately combined with the other keywords. The returned references were screened and literature that was technical, unempirical, in languages other than english, or "misunderstood" the concept of synthetic biology was excluded. In the second stage, additional references were obtained from the reference list of eligible studies identified in the first stage. A total of 24 studies were included, of which 8 were focused on analysis of media reportage of synthetic biology, and 16 were empirically-based public attitudes related research.