©IDOSR Publication
International Digital Organization for Scientific Research ISSN: 2579-079X
IDOSR JOURNAL OF SCIENCE AND TECHNOLOGY 5(1): 21-28, 2020.

Bioethics in Contemporary Biological Research

Sahana Mishka and Naksh Mohammad

Department of Biotechnology, Faculty of Science Chaudhary Charan Singh University, Meerut, Uttar Pradesh, India.

ABSTRACT

In current biological research, there is an important turning point in the relationship between ethics or bioethics and science, notably due to both public interest and the gradual tightening of the gap in time between scientific discoveries and ethical reflection. Today, science happens and bioethics reflects on the possibilities, considers the risks, and advances proposals, which, without being scientific, can also imprint a mark on the path of scientific development. Agricultural biotechnology and, specifically, the development of genetically modified (GM) crops have been controversial for several reasons, including concerns that the technology poses potential negative environmental or health effects, that the technology would lead to the (further) corporatization of agriculture, and that it is simply unethical to manipulate life in the laboratory. The morality comes into picture when the acceptability of biotechnological invention has to be determined on the basis of the weightage of its propitious and detrimental uses. The aspect of ethics also comes into picture when patenting biotechnological inventions, since biotechnology has the power of manipulating even the natural attributes and incorporating novel ones, thereby hitting directly at the inherent dignity, and natural integrity of living beings, besides challenging nature itself. A moral argument against biotechnology is that animal testing for genetic engineering purpose is wrong because pain and suffering are inflicted upon animals for ends that appear frivolous in contrast. Another criticism frequently received by biotech patents is that allowing patenting of new human or animal traits means condoning the commercialization of life which is considered morally unacceptable.

Keywords: Bioethics, Biotechnology, Recombinant DNA technology, Synthetic Biology, Stem cell.

INTRODUCTION

Technology is neither good nor bad in itself but it is its use that determines its character. In the context of biology, when Recombinant DNA technology (rDNA) was first introduced back in 1970s, it was considered a revolutionary technology. At that point of time, it was hard to describe whether this rDNA technology was good or bad which rested much upon its immediate use. With its immense power to redesign life, on one hand it can be utilized to tweak a gene sequence to make a protein that prevents a human disorder. On the other hand it can also be utilized to know-how to produce one that's viral and deadly.

Similarly, with its tremendous power, biotechnology can be used to make algae capable of producing energy. Yet with its aid, it is possible to introduce some tailored life-form capable of interrupting natural cycles of the environment with unimaginable consequences. Here comes the morality to decide the acceptability of biotechnological invention on the basis of the weight age of its propitious and detrimental uses. [1]

Biotechnology and genetic engineering inspire ethical and moral dilemmas. In general, biotechnology is a large field of a wide range of processes that involves modifying living organisms for the benefit of humanity. The domestication of animals and cultivation of plants and improvements to these organisms through selective breeding by artificial

selection and hybridization are the origins of biotechnology. Today, Bioengineering is the application of the principles of engineering and natural sciences to tissues, cells and molecules. It is the use of knowledge from working with and manipulating biology to achieve a result that can improve functions in plants and animals.

Bioethics studies questions bearing on progress in the life sciences; it is life-science ethics. Ethics is that part of philosophy which concerns good behaviour; it is the theory of morality. It could be said that the practice of bioethics is related to survival as an effective social institution [2]. Although it includes all levels of the hierarchy of the life organisation from cells to biosphere, recent bioethics seems to be focused on new biotechnologies in biomedicine, mainly in, but not limited to, cell and molecular biology [3].

Bioethics is an emerging field that looks at the ethical and moral dilemmas that are beginning to arise with the continuing advancement of biotechnology. Through genetic alteration, humanity can now determine their continuing evolution. But with such power, ethical and moral dilemmas arise. With new technologies developing so fast, ethical problems start to come to light. If we can alter the genetic makeup of an embryo in the womb and assign desirable traits to the unborn human, to what extent do we pursue perfection? What qualifies as a desirable trait? Are the lives of those with "undesirable" traits less valid? Is it ethical to use the stem cells from aborted fetuses? Are only those with financial means able to pursue genetic alteration? Is it ethical to raise animals or even human clones for replacement organs?

Since biotechnology has the power of manipulating even the natural attributes and incorporating novel ones, it is often looked as hitting directly at the inherent dignity, and natural integrity of living beings, besides challenging nature itself. Moreover, these days "cosmetic genetics" is gaining much popularity for its ability to pack our children with physical and perhaps intellectual and emotional traits, like athletic and intellectual prowess, of our choosing. Here, comes the aspect of ethics in shaping man's behaviour while developing biotechnological invention, considering the fact that such inventions hit directly at moral principles of society [4]

Great advances in cell biology research have provoked a number of ethical studies. We can identify several areas within these topics such as genetically modified organisms (GMOs), synthetic biology and stem cell among others.

Genetically Modified Organisms (GMOs)

There appears to be a fundamental philosophical division in the ethical debate about GM crops. One view is that GE of crops is an inappropriate interference with life itself. A contrasting view is that there is nothing new in our manipulation of the physical world through production of novel chemicals and of the living world through animal and plant breeding and that GM technology is simply one more step in this process (56, 77). This latter view accepts that science and technology have benefited humans in many ways and that the lessons of the past have put adequate mechanisms in place to monitor scientific innovation and to mitigate potential risks (56). The gap in this ideological division is exacerbated by the prominent role of large corporations in developing and commercializing GM crops, which introduces the additional dimensions of who is making decisions as to how life forms are engineered and who benefits from these genetic modifications.

GM crops have been controversial since their inception for several reasons. First, concerns have been continuously voiced over the potential of GM crops to threaten environmental or human health, which are issues that can be addressed scientifically and through risk-benefit analysis. In addition, important drivers of this controversy have been ethical issues related to the act of modifying the DNA of living organisms; the ownership of biological innovations; and issues of equity between corporations, farmers, and the consumers. Although many of these issues would be expected to arise in

the use of genetic engineering (GE) of microbes for pharmaceutical applications, they seem to be much more prominent when the application of the technology is the modification of food and especially when the benefits of the genetic modification accrue to seed companies and farmers rather than to the public. The ethical issues range from the ideological view of life itself to very practical issues of the legal frameworks for intellectual property ownership, the regulatory frameworks for assessing the risk and benefits of GM crops, and the distribution of benefits of GM crops especially in the context of food security [5] [6].

Synthetic Biology

Synthetic biology consists of significantly reworking an organism's metabolism both by eliminating genes that control for unwanted metabolic pathways and by inserting genes, or sometimes suites of genes drawn from several different kinds of organisms, to create new metabolic pathways. The primary idea in "synthetic biology" is not merely to alter biological systems but to develop and employ strategies for doing so that make possible the rational design and synthesis of biological systems that serve human ends.4 Under this broad understanding, synthetic biology might encompass the fairly limited alteration of plants and animals that once would have been labeled simply "gene transfer" or "genetic modification."

Synthetic biology is widely thought, by both proponents and critics, to have the potential to lead to very significant industrial, medical, agricultural, and environmental applications. It is frequently described as a socially transformative technology that will usher in what amounts to a new industrial revolution, in which modified microorganisms become the new means of production [7] [8] [9]. Some of the leading spokespersons for synthetic biology also believe that it will help bring about a democratization of the means of production, as people with relatively modest biological training will be able to assemble biobricks to create innovative and useful biological constructs.

For those who aspire to balancing alteration of nature with accommodation of nature, synthetic biology presents an interesting case. On one hand, synthetic biology can be seen as inherently throwing down the gauntlet. The most general definition of synthetic biology that is, the application of engineering to biology with the goal of turning organisms into machines for human purposes and maybe even of creating life sounds like the clearest case imaginable of adjusting nature to accommodate human ends. Also, the growing social prominence of synthetic biology might have the effect of promoting a discourse of adjusting nature over a discourse of adjusting to nature [10]. Perhaps it would even encourage us to think that our power to adjust nature means we don't have to adjust to nature.

On the other hand, there are reasons to think that biological engineering does not necessarily change the human relationship to nature, and that what matters is simply the environmental impact. To start with, the general definition of synthetic biology is arguably not a good basis for a moral assessment of synthetic biology. One problem with it is that it may be misleading; biological systems may not ever submit to engineering and organisms may not ever be like machines except in the trivial sense that they can be modified to do things that are useful for humans [11].

Another problem with the general definition is that it forces us to think in abstract, purely conceptual terms to ask whether the idea of synthetic biology will lead to a new understanding of nature, life, or humanity [12]. Yet the very idea of aiming for a balance in our relationship to nature encourages us to think concretely, rather than in abstractions: the goal is to think about which activities to condone, constrain, or ban and which to permit. It may be more helpful, then, to consider specific applications, lines of research, or ways of conducting research and not to be overly concerned with a general definition of synthetic biology [13].

To date, the most promising applications of synthetic biology are probably better

described as involving the modification of existing kinds of organisms rather than the development of new ones. Also, the applications to date are mostly about microbes. The concern about human control over living things is arguably best understood not as a general concern about the human relationship to all living things. Instead, it varies as we consider different categories of living and near-living things. There are prions, viruses, prokaryotes, single-celled eukaryotes, plants, fungi, and animals with varying kinds of biological and moral complexity, from nematodes to humans. When we consider this array of entities, it may become hard to resist the thought that, just as intervening to end the life of a living thing may have a different moral valence depending on the kind of thing it is, so we may draw moral distinctions about intervening in the way it goes about its life or how it comes to be alive or the properties it has while it lives [14].

Synthetic biology's rather modest effect on the human relationship to nature, at least when we look at it concretely, is also partly a function of the kinds of applications at stake. Most synthetic biology applications envisioned so far would be located in industrial or medical contexts contexts in which human alteration of nature is already a given and amount to replacing one form of alteration with another [15] [16]. One way of considering whether producing fuel by "synthetic organisms" changes the human relationship to nature is to try to explain just how it is fundamentally different, in terms of the extent of human intervention into the natural world, from extracting, processing, and transporting oil.

Synthetic biology may not be intrinsically attractive to someone who has a preservationist mindset, but is making fuel with synthetic organisms really worse than how it's done now? There are two ways of thinking about that question. One has to do with whether making fuel with human modified microbes is inherently more at odds with a nature-accommodating discourse than is making fuel by extracting and processing raw materials. Another is about the effect on particular parts of the natural world that a nature-accommodating person would likely want to conserve naturally occurring species, places, ecosystems, and so on [17] [18].

The creations of synthetic biology might end up simply standing alongside the realm of nature as we know it, and might, just possibly, offer nature-benefiting, even nature-preserving, opportunities. Whether synthetic biology turns out to be nature-destructive will depend on what applications are developed and how they are executed. These applications are intended specifically to alter natural environments, and the organisms would be designed to survive in natural environments [19]. These applications warrant particularly careful evaluation. However ambitious the applications of synthetic biology become, they will arguably never amount to "creating Life" or "playing God." Protocells and "mirror life" would be the best candidates for the label "new forms of life" and would therefore provide the best reason to think that humans have engaged in "creation," but what even that could prove about human powers is limited [20].

If Life is a category above and beyond the material world, and if the material world marks the limits of human agency, even for scientists, then nothing that occurs in a laboratory is plausibly understood as creating it. Similarly, if divine powers are by definition powers that categorically exceed those of humans, then scientists can play God only in the way a child can play at being an adult; they cannot actually become Gods [21]. There might be a deeply unattractive hubris involved, but not a new world order. Scientists cannot recreate Creation [22].

Stem Cell

Mitosis of stem cells either leads to self renewal or produces more differentiated cells [22]. These more differentiated cells can also be stem cells, and knowledge of several types of stem cells has increased and others have yet to be discovered. Put simply, pluripotential stem cells are an origin for all cell populations in the organism, multipotential stem cells for several relative cell types (e.g. CFUGEMM

for all blood lines), and unipotential/committed progenitor stem cells for one cell population (e.g. BFU-E for red blood cells). Several lines of stem cells have been discovered from germ cells, the embryo, foetus and adults [23].

The essential characteristics of all stem cells are their ability for self renewal and the ability to form one or more specialised cell types over time. A distinction is usually made between the different types of stem cells according to origin, degree of differentiation and especially developmental potential. With regard to differentiation properties, there are different types of stem cells: pluripotent, multipotent and unipotent.

The first stem cells to have been applied clinically were adult (hematopoietic) stem cells, which have been used for decades in bone marrow transplantation, ironically with the expression 'stem cell' being associated with this procedure many years after it was proven highly successful. Unsurprisingly, adult stem cells are currently at the forefront in potential future transplantation strategies. In the most recent studies, research has been essentially based on the use of mesenchymal stem cells isolated from the umbilical cord blood, umbilical cord matrix and bone marrow [24] The debate on stem cell research, together with the ethical questions the respective technologies have raised, has entailed intense and passionate discussions within the most diverse sectors of society. These discussions, often highlighted by interests that are neither scientific nor ethical, must not necessarily be considered as good exercises in either ethical reflection or scientific education [25].

We now have more knowledge about the relevant ethical issues [26], and global trends in stem cell research are less likely to directly engage concerns about the moral status of the embryo. Valuable experience about appropriate oversight and the practical challenges associated with the relevant research ethics has been accrued [27]. In light of this expanded knowledge base and the evolution of the field itself, the ethics review process is worth reconsidering. Here, we consider the practice of heightened research ethics review for stem cell research through the lens of the Canadian stem cell research environment, with a focus on the issue of whether the 'dual review model' is still an appropriate approach.

While the focus is on Canada, the analysis has clear relevance to other jurisdictions that have adopted a heightened review process. In Canada, many areas of research are subject to a specific or heightened degree of ethics oversight. Many forms of genetic research have been subject to particular and enhanced research ethics rules, with the most notable example being gene transfer research. Research that involves animals has long required compliance with specific regulations. Similarly, research involving radioactive materials requires separate licensing from the federal government. The use of specific oversight for stem cell research is not unique, and, as such, arguments based on this concern alone are not persuasive [28] [29].

Although the justifications for unique oversight of stem cell research differ from jurisdiction to jurisdiction, there is little doubt that concerns over the destruction of human embryos were, in most cases, the dominant motivator for such policies. Other common justifications in the past have included concerns over the co modification of human reproductive materials; the potential for exploitation of donors (e.g. women donating eggs for the derivation of hESC lines); fears about the possibility for human reproductive cloning; and, finally, uncertainties relating to the creation and use of human–animal hybrids and chimeras for research [30]. While all of these issues are, no doubt, relevant to stem cell research policy, it should not be forgotten that the sensitized political climate seems to have played a significant role, at least in some countries, in how these issues were framed and perceived by policymakers.

The highly polarized nature of public debates facilitated exaggerated claims about both the potential risks and benefits associated with stem cell

research [30], thus contributing to the creation of a social and political environment that made heightened ethics oversight appear essential [31]. The science was portrayed as producing near-future breakthroughs that would revolutionize the practice of medicine. And the potential harms be they in relation to the risks associated with women donating reproductive material for research, or to broader and more amorphous social norms were often portrayed as grave and potentially imminent. This trajectory of public controversy is not unique to stem cell research but rather reflects a normal development cycle for new and promising areas of science and technology innovation.

It is worth considering how this hype cycle in the area of stem cell research may have influenced the development of particular frameworks for ethics oversight. The research ethics frameworks served to develop knowledge and expertise among oversight bodies and helped to build public trust [32]. They promoted scientific integrity and contributed to an environment in which public and private funding entities could invest with a degree of confidence that social controversies were being considered and addressed [33]. In addition, their existence may have helped create norms of practice for both researchers and research ethics boards that ensured research in this controversial area was done carefully and thoughtfully [34].

CONCLUSION

GM crops have become a major tool for pest control. They include three major crops (maize, cotton, and soybean) with two major traits (insect resistance and herbicide tolerance). These major GM crops have increased the supply of these commodities substantially and have reduced the price of feed and, indirectly, the price of food, thus providing a significant economic benefit to millions of consumers. The controversy surrounding the development, deployment, and adoption of GM crops has multiple dimensions. One dimension is simply an objection to manipulation of life, and another is the recognition of GE as a simple extension of tradition technologies of plant breeding. Other ethical dimensions include the increased role of large corporations in agricultural research and in the ownership of intellectual property, which can supersede traditional practices of seed saving and may constrain innovation leading to the underdevelopment of varieties to meet the needs of specialty crops as well as the poor in developing countries. Ethical conflicts of interest in modern cell biology represent the greatest part of current bioethics. New biotechnologies demand new ethical and legal rules and this not a biological or medical problem, but a socio-cultural one.

REFERENCES

1. Alan, B., Bennett, C. C., Geoffrey, B., Steven, S. and David, Z. (2013). Agricultural Biotechnology: Economics, Environment, Ethics, and the Future. *Annu. Rev. Environ. Resour*, **38**: 249 – 279.
2. Alonso, C. (2004). An ontological view of the human embryo. A paradigm. *Eur. J. Endocrinol*, **151**(3): 17 – 24.
3. Ana, S. C., and Joa˜o, R. (2013). How can ethics relate to science? The case of stem cell research. *European Journal of Human Genetics*, **21**: 591 – 595.
4. Aubel, D. and Fussenegger, M. (2010). "Mammalian Synthetic Biology—From Tools to Therapies," *Bioessays,* **32**: 332 - 45.
5. Barrows, G., Sexton, S.E. and Zilberman, D. (2013). Agricultural biotechnology: the promise and prospects. CUDARE work. pap. 1133, Univ. Calif., Berkeley
6. Berger, J. (2003). Ethical conflicts of interest in modern biomedicine? *J. Appl. Biomed*, **1**: 181–182.
7. Boldt, J. (2013). "Creating Life: Synthetic Biology and Ethics," in Synthetic Biology and Morality:

Artificial Life and the Bounds of Nature (Cambridge, MA: MIT Press, 2013), 35-50.

8. Brookes, G. and Barfoot, P. (2009). Global impact of biotech crops: income and production effects 1996–2007. *AgBioForum,* **12**(2): 184 – 201.
9. Carpenter, J. E. (2010). Peer-reviewed surveys indicate positive impact of commercialized GM crops. *Nat. Biotechnol,* **28**: 319 – 21.
10. Caulfield, T., Rachul, C. and Zarzeczny, A. (2012). The evolution of policy issues in stem cell research: an international survey. *Stem Cell Rev Rep* **8**: 1037 – 1042.
11. cells. *Hum Reprod*, **25**: 2175 – 2180.
12. Combes, R. D. (2004). The use of human cells in biomedical research and testing. *ATLA*, **32**(1): 43 – 49.
13. Devolder, K. (2010). Complicity in stem cell research: the case of induced pluripotent stem
14. Dryzek, J. S. (2011). "Global Democratization: Soup, Society, or System?" Ethics & International Affairs **25**: 211 - 34.
15. Gina, K., Sui-Lee, W. and Pam, B. (2018). Chinese Scientist Claims to Use Crispr to Make First Genetically Edited Babies, *The New York Times*, 5 – 6.
16. Gore, A., Li, Z., Fung. H. L. and Young, J. E. (2011). Somatic coding mutations in human induced pluripotent stem cells. *Nature,* **471**: 63 – 67.
17. Gregory, E. K., Michael. K. G. and Thomas, H. M. "The Ethics of Synthetic Biology: Next Steps and Prior Questions," Synthetic Future: Can We Create What We Want Out of Synthetic Biology?, special report, Hastings Center Report 44, no. **6**: 4 - 26.
18. Haimes, E., Taylor, K. and Turkmendag, I. (2012). Eggs, ethics and exploitation? Investigating women's experiences of an egg sharing scheme. *Sociol Health Illn,* **34**: 1199 – 1214.
19. John, R. (2014). Patents and Biotechnology. *U.S. Chamber of Commerce,* **40**: 46 – 53.
20. Lemaux, P. G. (2008). Genetically engineered plants and foods: a scientist's analysis of the issues (Part I). *Annu. Rev. Plant Biol,* **59**: 771 – 812.
21. Lemaux, P. G. (2009). Genetically engineered plants and foods: a scientist's analysis of the issues (Part II). *Annu. Rev. Plant Biol,* **60**: 511 – 59.
22. Mackey, T. (2003). An ethical assessment of anti-aging medicine. *J. Anti-Aging Med,* **6**: 187 –204.
23. Michael, I. (2018). Birth of world's first gene-edited babies triggers ethical outcry. *New Atlas*, 37 – 48.
24. Nielsen, J. and Keasling, J. D. (2011). "Synergies between Synthetic Biology and Metabolic Engineering," *Nature Biotechnology,* **29**: 693-95.
25. Rahul, G. (2018). Morality and Ethics Embracing Biotechnology Patents. *Universal Review*, **7**(11): 666 – 670.
26. Ramalho-Santos, J. (2011). Human procreation in unchartered territory: new twists in ethical discussions. *Hum Reprod,* **26**: 1284 – 1287.
27. Robillard, J. M., Roskams-Edris, D. and Kuzeljevic, B. and Illes, J. (2014). Prevailing public perceptions of the ethics of gene therapy. *Hum Gene Ther* **25**: 1 – 7.
28. Ronald, P. (2011). Plant genetics, sustainable agriculture and global food security. *Genetics,* **188**: 11 – 20.
29. Shi, G., Chavas, J. P., Lauer, J and Nolan, E. (2013). An analysis of selectivity in the productivity evaluation of biotechnology: an application to corn. *Am. J. Agric. Econ,* **95**: 739 – 54.
30. Smale, M. (2012). Rough terrain for research: studying early adopters of biotech crops. *AgBioForum,* **15**(2): 114 – 24.

31. Tristram, E. H. (2012). Bioethics critically reconsidered: living after foundations. *Theor Med Bioeth,* **33**: 97 – 105.
32. Whitney, S. N. and Schneider, C. E (2011). A method to estimate the costs of lives in ethical board review of biomedical research. *J Int Med*, **269**: 392 – 406.
33. Whitney, S. N. and Schneider, C. E. (2011). A method to estimate the costs of lives in ethical board review of biomedical research. *J Int Med,* **269**: 392 – 406.
34. Znidarcic, Z. (2004). Ethical problems in cytology. *Cytopathology*, **15**: 49–52.