Are genetically modified organisms the future?

A discussion evening surrounding innovations in synthetic biology
iGEM Leiden 2021

Science and our project specifically is working towards a future where genetically modified organisms (GMOs) can be used safely outside of the laboratory. As these scientific developments are highly impactful for the general public, it is important for scientists to engage in conversations with them about GMOs. Both to educate the general public on GMOs and the safety regulations surrounding them, but also to discuss the ethical and societal issues arising with these scientific innovations. At the event, participants were free to share their opinion with us and a panel of experts, which resulted in an interesting and dynamic discussion. The expert panel consisted of three scientists in the field of synthetic biology, namely Dr. Lennart Schada von Borzyskowski, Renée Kapteijn and Marjolein Crooijmans. Furthermore, Marie-Louise Bilgin from the Dutch ministry, who is a Senior Policy Advisor Biotechnology, Nanotechnology and Safe-by-Design. This document will provide a summary of the discussion and can be a source of inspiration to future iGEM teams for similar events.

Since the pandemic is still ongoing, we organized this event in a hybrid fashion. We welcomed participants both in real life, as well as online. To ensure that the online audience could equally engage in the discussion, we had a mobile live stream camera in the middle of the room, which guaranteed the audio quality was up to standard. If someone online wanted to add something to the discussion, they could either raise their hand in zoom. Alternatively, they could type a message to our online moderator, who could then bring up the point for them in the discussion.

The evening was structured as follows; the host started with a brief explanation what iGEM and a GMO is. Whereafter, each statement was briefly introduced by the host and a member from the expert panel. To gauge the opinions in the audience, we used the online platform Kahoot to let the audience vote anonymously whether they agreed or disagreed with the statement. This engaged both the physically present and online audience. Subsequently, the discussion started, which lasted approximately 25 minutes per topic. Lastly, the audience could vote again on Kahoot to determine whether opinions changed due to the discussion.

Statement 1: GMOs pose a real threat to humans, animals and/or the environment
Voting before the discussion - 72.7% agrees and 27.3% disagrees
Voting after the discussion - 72.7% agrees and 27.3% disagrees

A specific outlook on this statement of some audience members is that GMOs are not the way nature intended our agriculture and ecosystems to be. Why should we have the power to change the natural balance? But do GMO plants actually disrupt the natural balance, another audience member argued. Seedless plants are not spreading and thus will not lead to a loss of biodiversity. Moreover, it has not been proven that GMO food is unhealthy to consume, according to a member of our expert panel. While another expert stated that there has been a case of a severe allergic reaction to an inserted fish gene in a tomato. Adding to this, someone mentioned that currently GMO plants are made in a very unspecific way, namely with mutagenesis. Why would inducing random mutations with mutagenesis be less harmful than methods with surgical precision to generate GMOs. Still, from the viewpoint of some audience members this is different and could be more dangerous, since there is a lack of knowledge on what could happen.

Overall, most people agreed that there are (at least some) risks involved with GMOs, especially if we are going to let them loose more often. However, in certain cases the gains might outweigh the risks. Regulators should be a moral gatekeeper on what is an acceptable risk for specific gains we can achieve by using GMOs, according to the audience.

Statement 2: The regulations surrounding the application of GMOs should be more lenient
Voting ratio before the discussion - 66.6% agrees and 33.3% disagrees
Voting ratio after the discussion - 66.6% agrees and 33.3% disagrees

Arguments were made to make the legislation more lenient both within the laboratory and outside of it. However, we could set a trend towards more lenient rules, which might not be something good for some countries. Someone in the audience specifically argued that in the Netherlands we might be able to adhere to safety standards to ensure the risks are indeed minimal, but not every country is able to do that. Possibly we could start a motion towards very dangerous situations in countries with less strict rule adherence. Eventually, most agreed that it is better to treat everything as a threat, until proven safe. Since, even one slight moderation could potentially cause a lot of harm. However, how do you definitively prove the safety of GMOs outside of the laboratory when we can only work within the laboratory? Would kill switches be enough to try this out in a safe manner outside of the lab? Or can we upscale a laboratory to mimic a situation outside? Potentially, it could be made easier to prove something is safe, for example with clear guidelines on what needs to be proven and how.

Statement 3: It is ethical to make genetically modified humans
Voting ratio before the discussion - 20% agrees and 80% disagrees
Voting ratio after the discussion - 50% agrees and 50% disagrees

To start, most of the audience agreed that genetically modifying humans is not ethical, as it would divide rich and poor people even more. People who could not afford it would fall behind. However, the point was made that cancer medications are almost the same currently. They are so expensive that it is impossible for poor countries and people to pay for them. Therefore, could this not become restricted to the health care sector only? Although, plastic surgery started out the same way and is clearly not only used for medical treatments anymore. It can become a slippery slope quite easily, if we start with modifying humans for diseases it will not stop there. Moreover, if we genetically modify embryos those modifications will be in the germline as well, so they will be handed on to future generations. We do not know what consequences that can have, we could accidentally change human evolution, someone in the audience argued. A member of the expert panel, however, stated that due to genetic variation mutations will always come back. Moreover, we could alter only very specific cell lines instead of the entire embryo, which would make this less of a problem. Would changing the point mutation of cystic fibrosis not be considered ethical, as that would greatly improve the quality of life of that child?

Another side to the argument is the lack of knowledge on this subject, for example on the off-target mutations and the dangers that would bring. However, would it be ethical to study this by genetically modifying 30 embryos and sequencing them? How else will we ever study this to the level, we would be able to do this in a safe manner?

At the closing remarks, some audience members had changed their mind on the subject. They stated that because of the discussion, they now thought that it could be ethical in certain cases. Moreover, the fact that it can be abused later does not mean that we should not explore it. We cannot be held responsible for what people do with it generations from now.

Conclusion

The discussion night provided a great opportunity for us to learn from the opinion and viewpoints of the general public. Additionally, we were able to provide them with valuable insight in the opinions, viewpoints and daily practice of scientists and policy advisors in the biotechnology field, who deal with innovative GMOs on a daily basis. Interestingly, we found that the opinion of the general public is slowly shifting to understanding the potential of GMOs. However, we should not go too quickly with this, as it needs to be done in a safe manner. There were a lot more well thought-out and considered arguments both in favour and against the use of GMOs than we would have expected. This evening taught both us and the general public a lot about each other's viewpoints. Therefore, we would highly encourage other iGEM teams to set up an event like this themselves.