

## Wiki GMO project

### Summary

Agricultural GMOs have a bad reputation in Switzerland and Europe. In 2013, the Swiss Federal Council has placed a moratorium on the use of agricultural GMOs, which has been extended several times. In order to understand if the bad reputation of agricultural GMOs could have an impact on our project and what were the concerns of the population regarding medical GMOs, we decided to set up a survey. It was distributed via social networks and collected 244 replies from different age groups and backgrounds. This allowed us to have representative answers of the Swiss opinion on agricultural and medical GMOs.

It shows that the agricultural GMO controversy does not affect medical GMOs. Moreover, the main concerns about medical GMOs are their environmental and health impacts. Finally, the participants seem to agree with the use of medical GMOs to treat themselves. This survey had a significant impact on our project because it allowed us to target the concerns of the population about medical GMOs and pushed us to develop a biosafety system to avoid health and ecological problems (see “Integrated Human Practices” and “kill switch” parts).

### Introduction

Since the 1990s, consumers have been seeing new products from genetically modified organisms appearing on their plates. In 1994, the U.S. Food and Drug Administration approved the FLAVR SAVR tomato, making it the first genetically modified crop to be commercialized [1]. Genetically modified crops have since become a common commodity with 58 GMOs currently authorised in the European Union for human and animal food production [2] and more than 90% of certain crops being GMOs in the US (e.g. soybean or rapeseed) [3]. Despite their omnipresence in society, food GMOs are not unanimously accepted. Growing opposition from public opinion, particularly in Europe, is even leading some major companies to withdraw their applications for authorization to grow GMOs in the European Union [4]. In Switzerland, the situation is similar: a moratorium on the use of GMOs in agriculture, which began in 2013, is constantly being extended and should end in 2021 [5]. In 2015, a demonstration gathering more than 4'000 people took place in Morges, Basel and Bern (three Swiss cities) to protest against “Monsanto and the GMO and pesticide multinationals” [6].

However, this anti-GMO opposition seems to have only a minor impact on medical GMOs, and there are few movements or demonstrations criticizing drugs derived from genetically modified organisms. This absence of medical GMOs in the public debate has led us to wonder whether the population is against the use of drugs based on genetically modified organisms or whether, conversely, it accepts their marketing and use. Moreover, if GMO drugs were indeed treated differently from GMO crops, we wanted to understand what the causes were. To answer these questions, we decided to create a survey where medical GMOs are confronted with food GMOs. The main objectives of this survey were to analyse whether a difference in treatment between medical and food GMOs did indeed exist, to understand where this difference comes from if there is one, and to study the acceptability of our B.O.T. therapy by society.

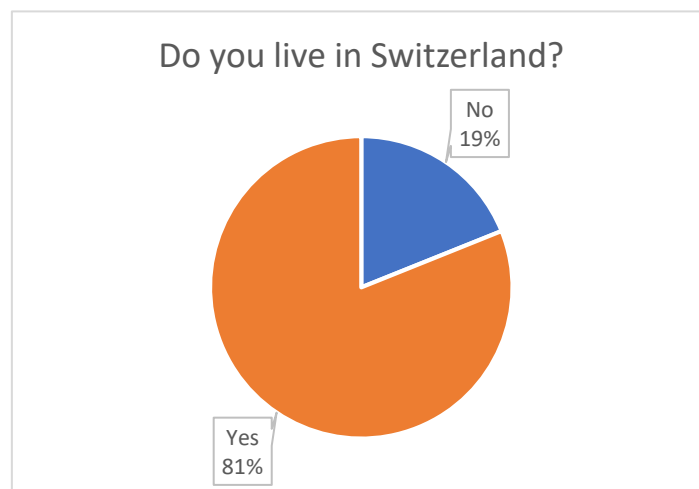
Our survey was approved by our supervisors and was anonymized. Two versions were available, one in French and one in English, in order to reach as many people as possible. The survey was conducted using Google Forms software and the results of both versions were then aggregated to obtain the results. The survey is divided into several parts: the first one consists in collecting information on the public's knowledge about GMOs (6 questions), the second one is about food GMOs (7 questions), the

third one about medical GMOs (6 questions) and the fourth one allows a comparison between medical and agricultural GMOs (7 questions including 3 open questions). The first part has very general questions and allows to have some information on the participants (gender, age, level of education, ...). The second section allowed us to understand the public opinion on agricultural GMOs without considering medical GMOs. Conversely, the third section made it possible to understand the public's opinion on medical GMOs without considering agricultural GMOs. Finally, the last part was designed to try to understand the reasons for the difference in treatment between agricultural and medical GMOs.

## Survey results and analysis

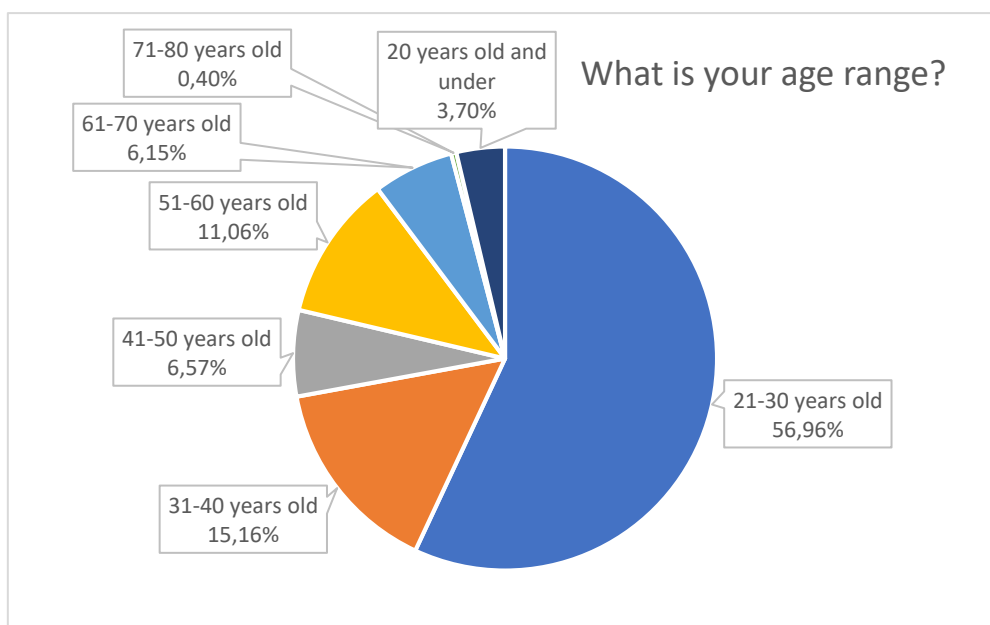
### Part 1: General Questions

#### Question 1: Do you live in Switzerland?



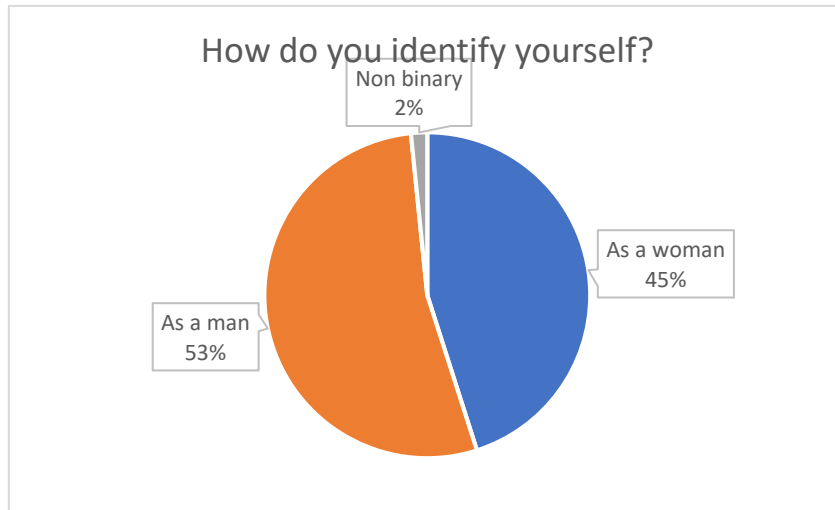
A total of 244 participants responded to our survey with a majority living in Switzerland (81%). Our results therefore represent a majority Swiss opinion.

#### Question 2: What is your age range?



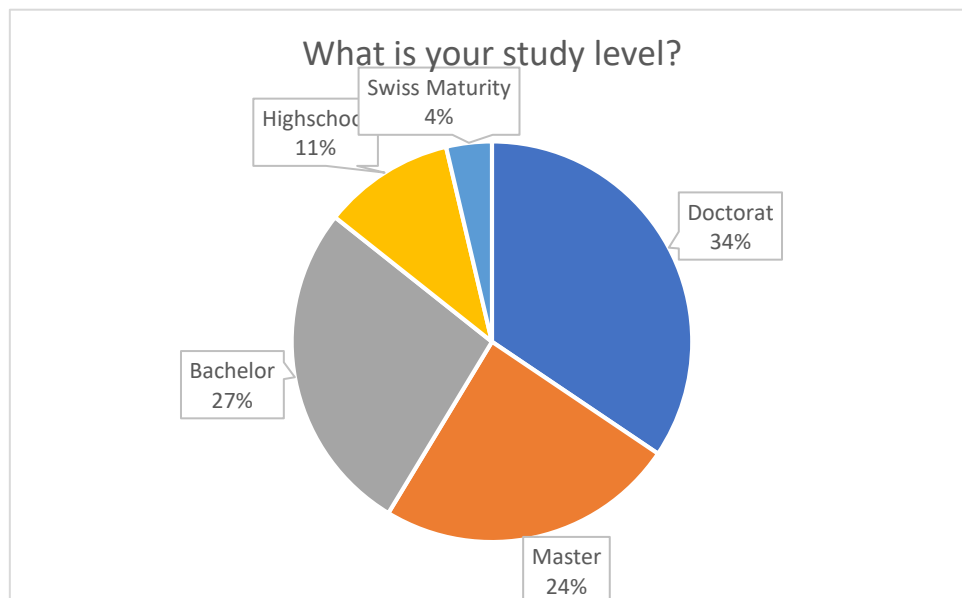
The age group most represented in this survey is the "21-30" age group, followed by the "31-40" age group. This high representation of young people is due to the way this survey was disseminated: mainly through social networks. According to the Federal Statistical Office, the "40-64 years old" age group is the most represented in Switzerland with 34.5%, followed by the "20-39 years old" age group with 23.4% [7]. Despite this bias in our data, we still believe that our results are relevant since the "20-39" and "31-40" age groups are significantly represented in the Swiss population.

**Question 3: How do you identify yourself?**



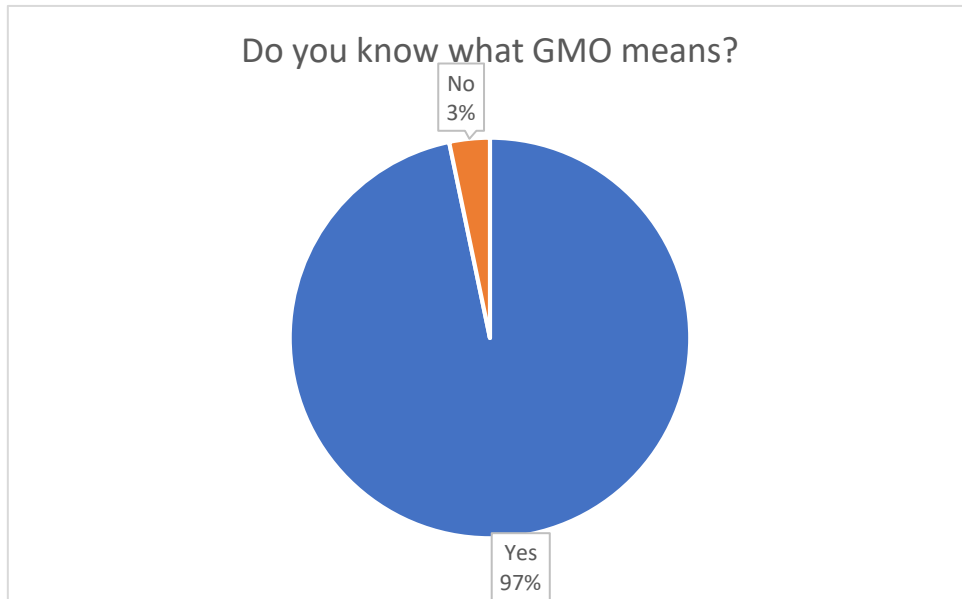
Our data show that 53% of the participants are male, 45% are female and 2% are non-binary. There is therefore a weak gender bias towards men, but our data is still close to parity.

**Question 4: What is your level of education?**



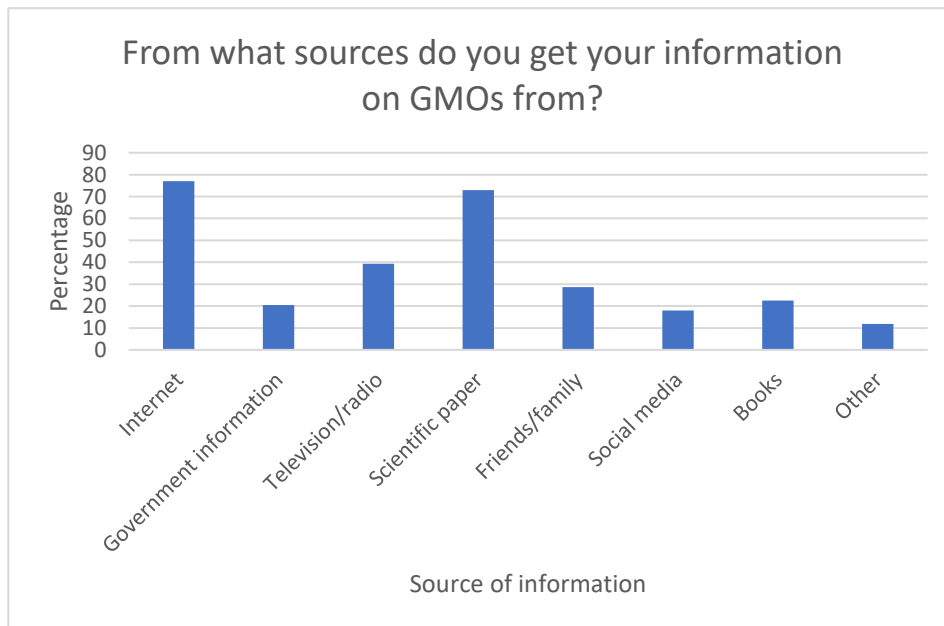
We can see here that 27% of the participants have a Bachelor's degree, 24% have a Master's degree and 34% have a PhD. Most of the participants therefore have a higher level of education. In Switzerland, the number of people with a Bachelor's degree or higher is just over 30% [8], which means that our survey has a bias coming from the level of education of the participants. Once again, the way in which this survey was shared is the cause.

**Question 5: Do you know what GMO means?**



Most of the participants know what GMOs mean and have therefore already heard about GMOs. With 97% positive responses, we know that the answers come from people who know what a GMO is. For those who answered "no", an explanatory paragraph was introduced in the survey.

**Question 6: From which sources do you get your information on GMOs?**

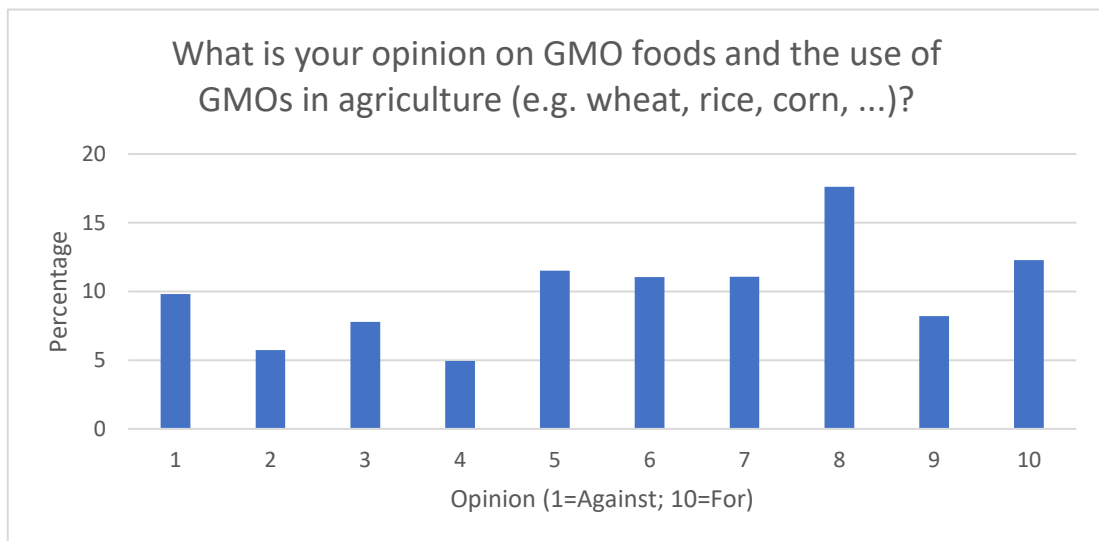


The three main sources of information on GMOs are the internet, scientific articles and television/radio with 77%, 73% and 39% respectively (note that this question was multiple choice). These responses are not surprising, as the internet and television/radio are the source of information for a large part of the population. Given the level of education of the participants, the source of information "scientific articles" is not surprising either. 28.6% of participants get their information from friends or family and 22.5% of participants get their information from books. Only 20.5% of participants say they get their information from the government, which is like the percentage using social networks (18%).

In general, this first part shows that our survey is representative of the Swiss population but has certain biases. Indeed, a large proportion of participants have a Bachelor's degree or higher and the most represented age group is the "20-30 years old". These two biases can be explained by the way this survey was distributed: via social networks and mainly in the university. However, as explained earlier, the age groups "20-30 years" and "31-40 years" are rather well represented in Switzerland. Moreover, the probability that all graduates of this survey are in an environment close to GMOs remains low. We therefore believe that our survey remains a reliable source of information that can be used to get a first glimpse of the Swiss population's opinion on medical and agricultural GMOs.

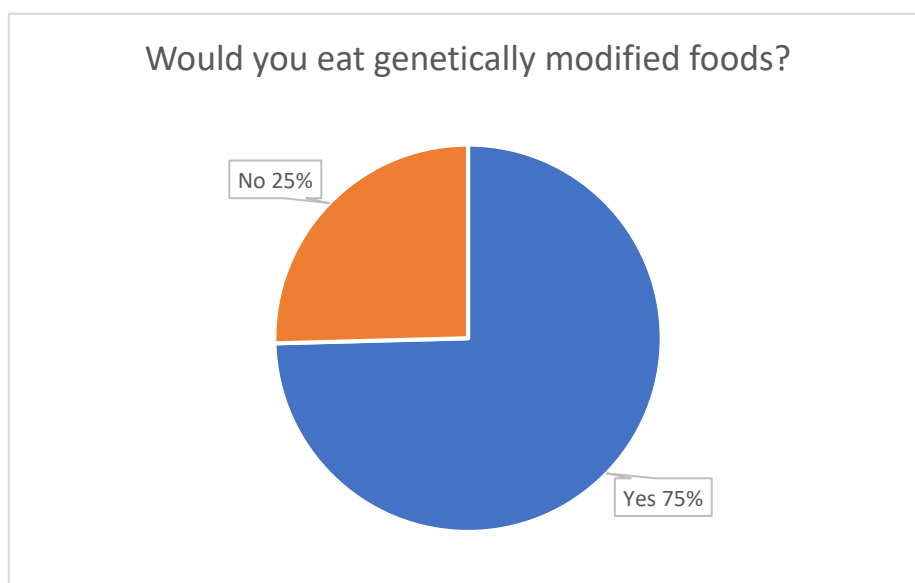
## Part 2: Food GMOs

### Question 1: What is your opinion on GMO food and the use of GMOs in agriculture?



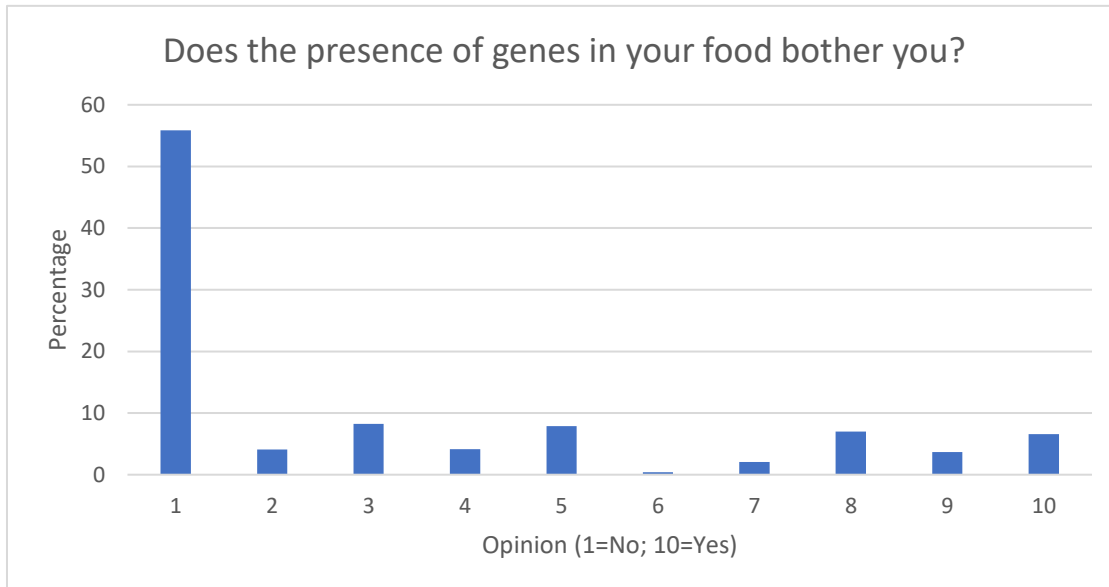
As we can see on this graph, there is no clear trend. The results are really spread on the scale from 1 to 10. The answer "8" (17%) received most votes. The results reflect the controversy around the GMO crops in Switzerland. They are currently prohibited as a moratorium is still going on in our country.

### Question 2: Would you eat genetically modified foods?



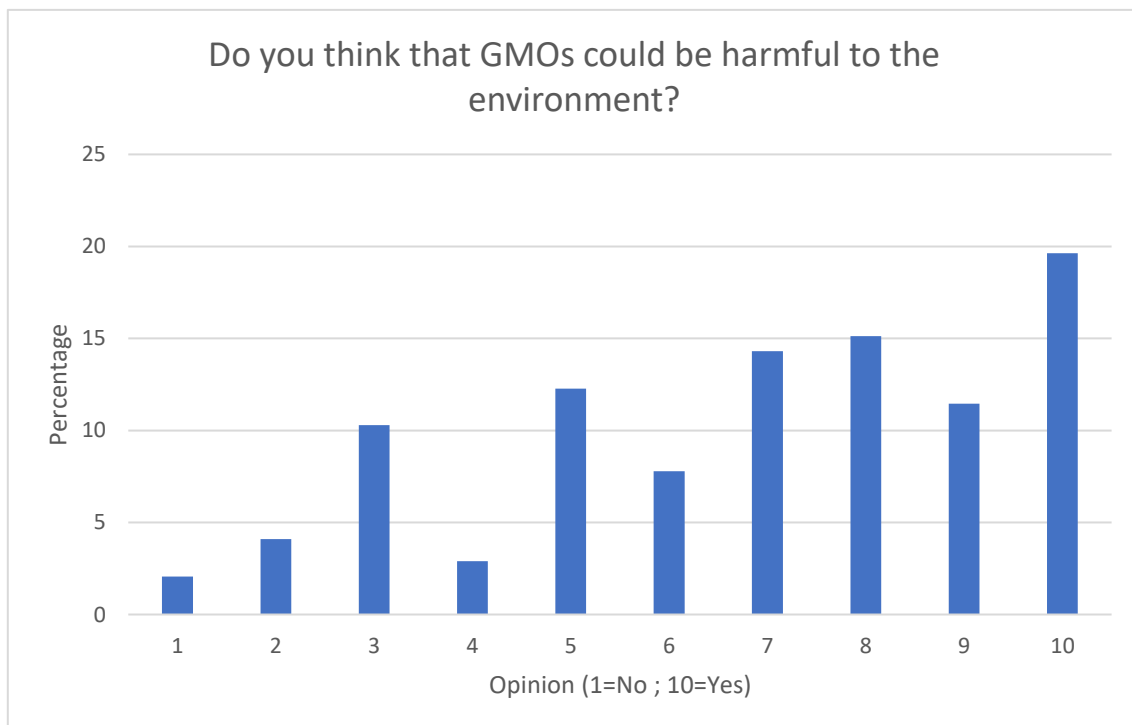
This next graph shows that 75% of the population is ready to eat genetically modified food. If we compare it with the results of the question 1, where the results seem quite spread and balanced, we see a difference in this graph with a higher proportion being positive. Nevertheless, 25% of the participants do not agree to eat GMOs, which remains a relatively large part of the population.

**Question 3: Does the presence of genes in your food bother you?**



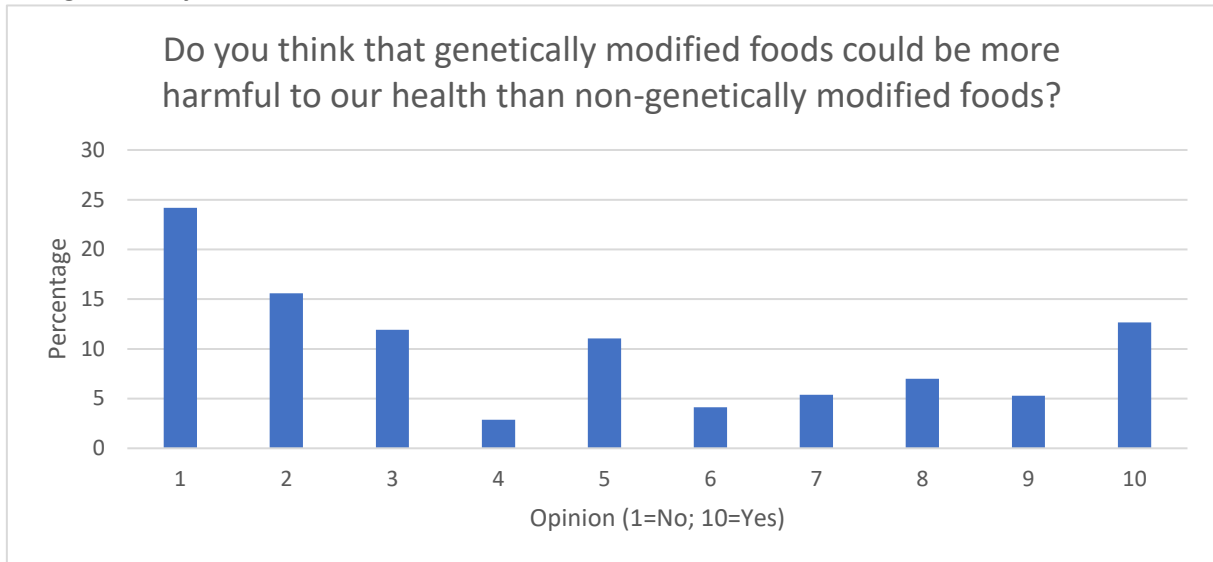
The purpose of this question is to analyse whether participants are aware that genes are found in much of what we eat. With 56% of the responses, most of the participants say that the presence of genes does not bother them, which still means that 44% of the participants are more or less bothered by their presence.

**Question 4: Do you think that GMOs could be harmful to the environment?**



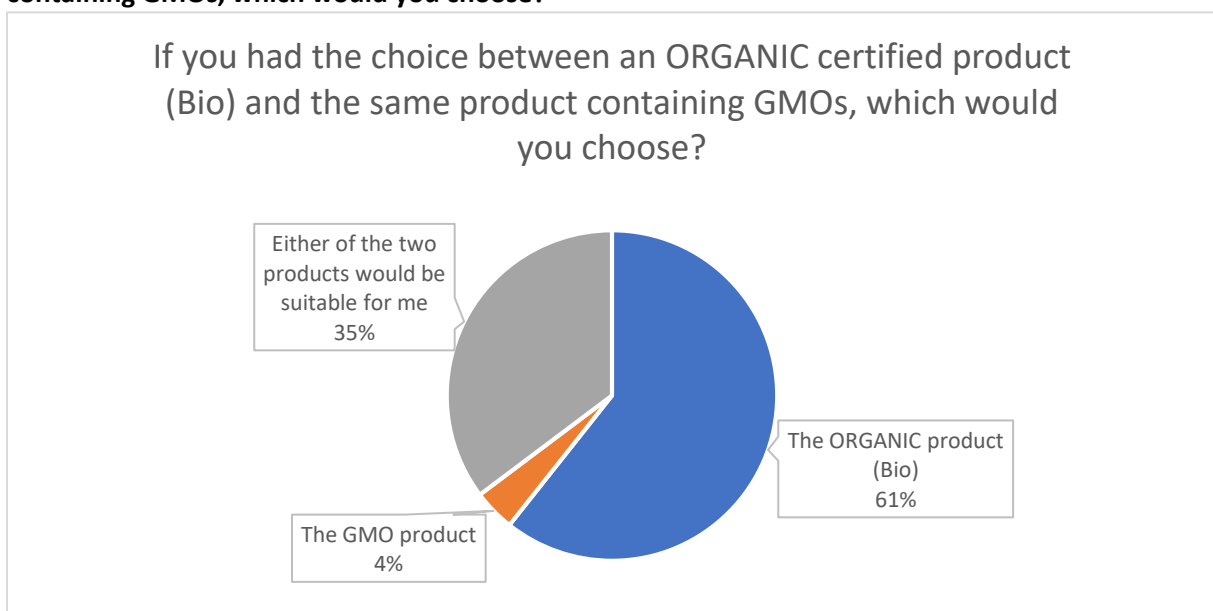
Here we have some interesting results. With the previous questions, people were not afraid for themselves about the potential effects of the GMOs. But when we change the point of view and talk about the environment, people are more worried. Most of the people (from 5 to 10) think the GMOs could be harmful for the environment. The concerns about the environment might also be one of the reasons for the moratorium that prohibits the use of GMOs in Swiss agriculture.

**Question 5: Do you think that genetically modified foods could be more harmful to our health than non-genetically modified foods?**



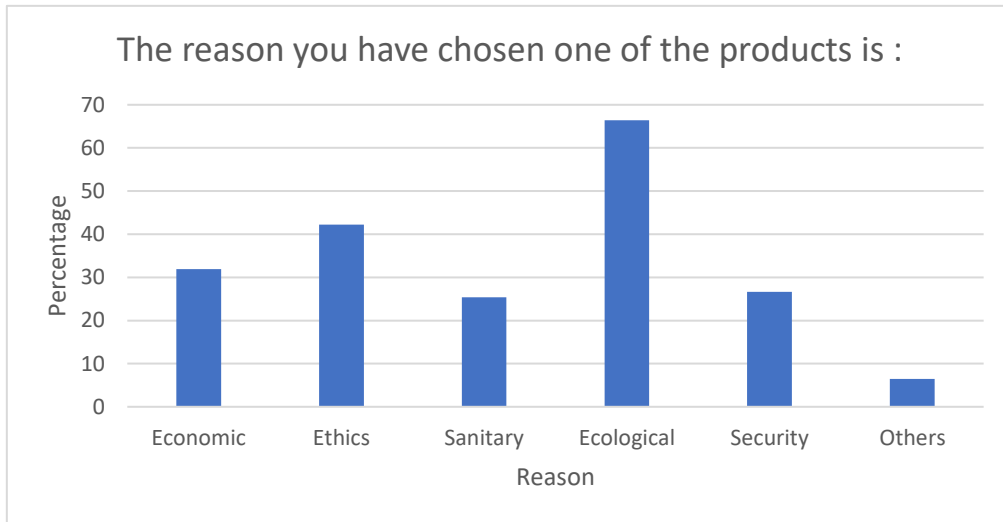
We can see that people are more divided on that question. We see a peak at 1 with 24% of the replies. There is also a group of nearly 13% (reply “10”) that think that genetically modified foods could be more harmful to our health than non-genetically modified foods. Overall, the replies are more spread than for question 4 and we can say that the principal concern about agricole GMOs is probably the impact on the environment.

**Question 6: If you had the choice between an ORGANIC certified product and the same product containing GMOs, which would you choose?**



We see a strong preference for the organic product compared to the GMO. More than 60% prefer the organic product when given the choice. We also have 35% who do not see a strong difference between the two products or accept both. Very few people prefer to take the GMO product (4%). In a case of a market competition, if the price is not taken into account, the organic product would have more success, but the GMOs could still be viable.

**Question 7: The reason you chose one of the products is:**

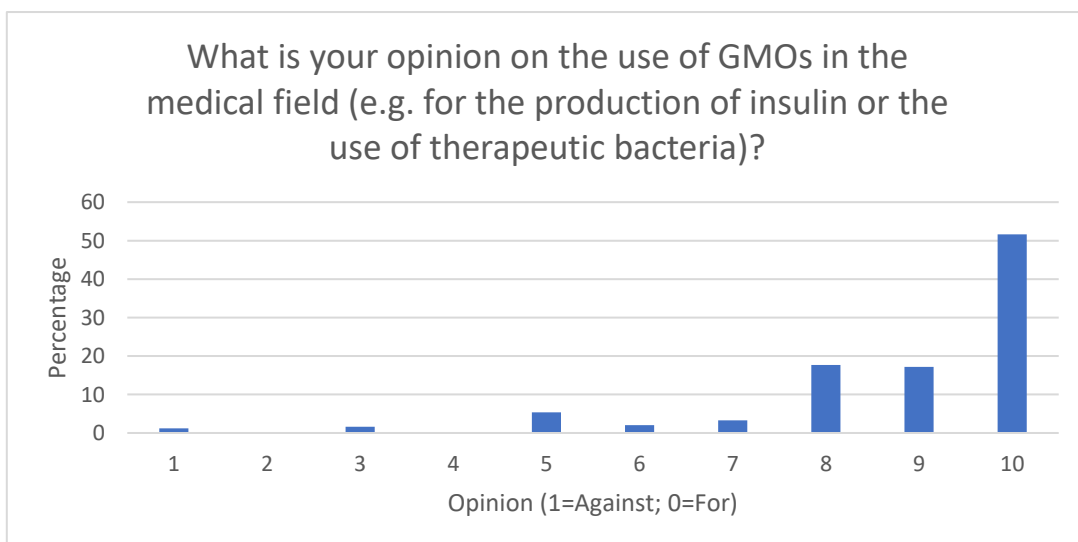


We can see the most important factor in the participant's choice is the impact that the product would have on the planet (66%). The ethical and economical reasons are also relatively high with 42% and 31.9% respectively. Finally, sanitary and security reasons come after with 25% and 26% respectively.

This second part shows the current controversy around agricultural GMOs. It highlights society's perception of the impacts they may have on the environment. Moreover, it is possible to see from question 1 that opinions are still very divided.

**Part 3: Medical GMOs**

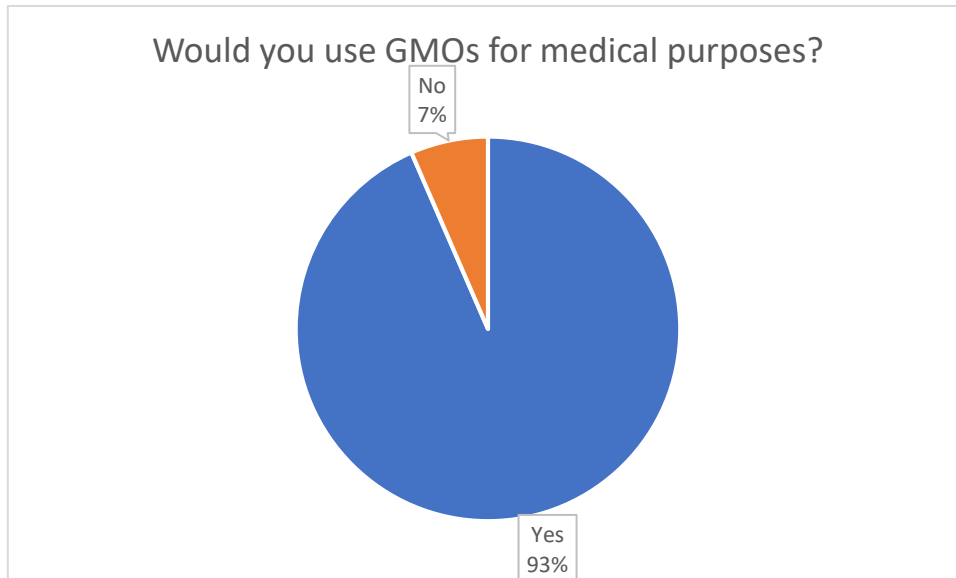
**Question 1: What is your opinion on the use of GMOs in the medical field (e.g. for the production of insulin or the use of therapeutic bacteria)?**





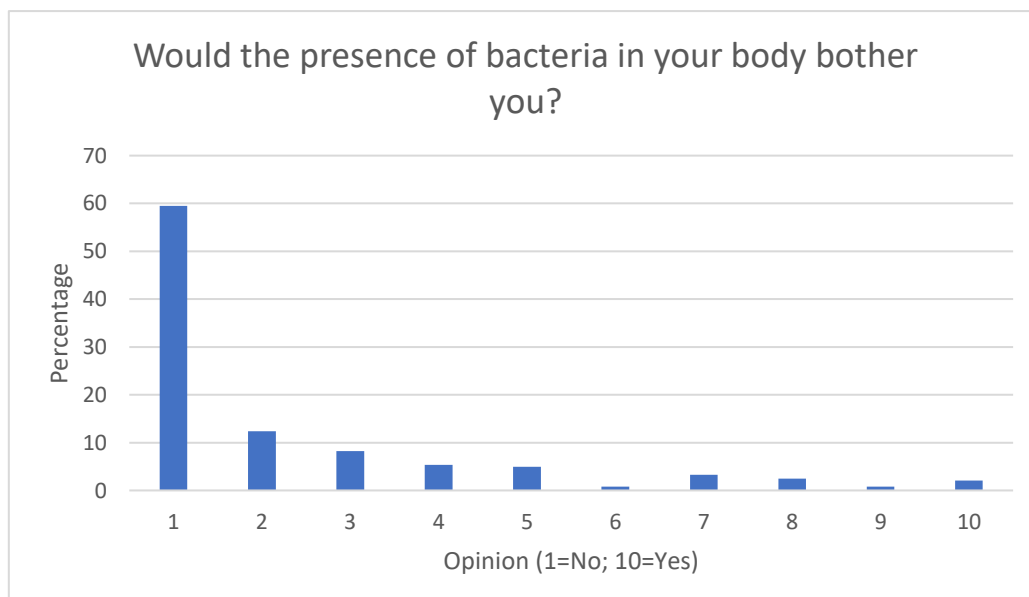
More than 50% of the participants in the questionnaire stated that they were totally in favour of the use of GMOs in the medical field. Overall, more than 85% of the responses were between 8 and 10, while less than 3% were between 1 and 3. The general opinion of the participants is oriented towards the use of GMOs in the medical field. These answers contrast sharply with question 1 in part 2 (part on agricultural GMOs). There is a strong difference of opinion regarding the acceptance of agricultural GMOs and medical GMOs.

**Question 2: Would you use GMOs for medical purposes?**



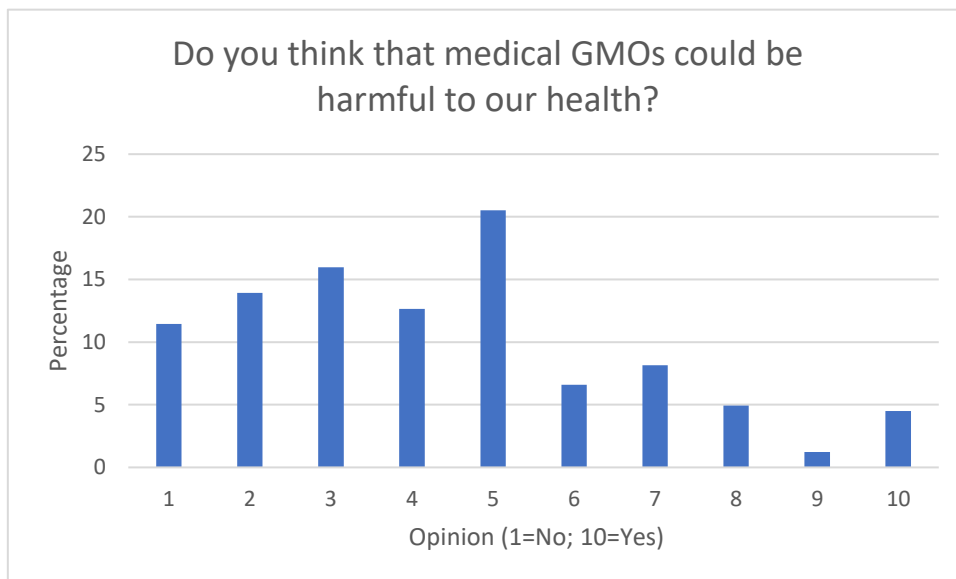
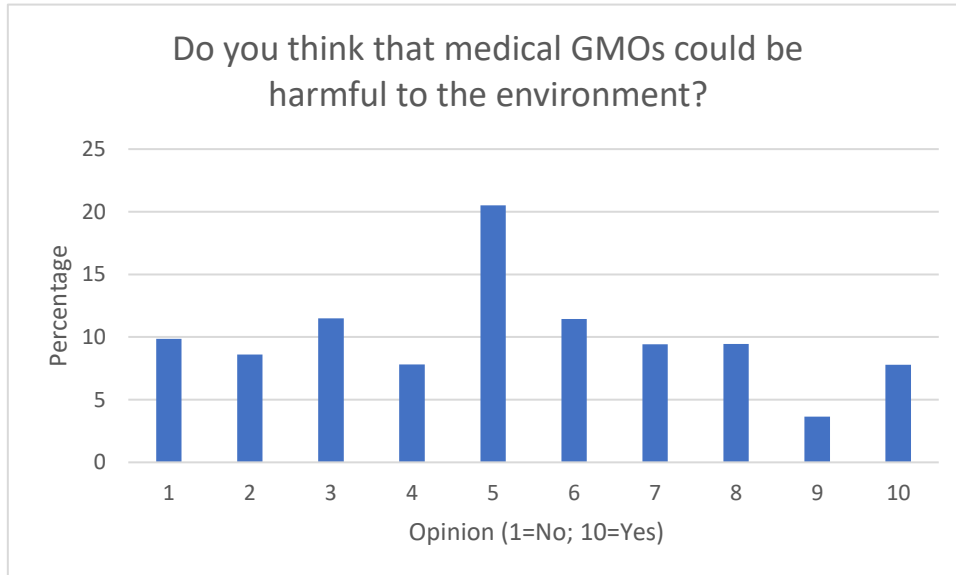
An overwhelming majority of participants are in favour of the use of GMOs for medical purposes. Indeed, the question concerning genetically modified organisms in the world of health received a 93% positive response. Once again, these answers are very different from the one in question 2 of part 2: 25% of the participants said they do not want to eat GMOs but only 7% do not want to use GMOs as medicines. This shows that the controversy around agricultural GMOs does not seem to have a negative impact on people's opinion about medical GMOs. Our B.O.T. therapy, if marketed, should not have a problem with the public opinion.

**Question 3: Would the presence of bacteria in your body bother you?**



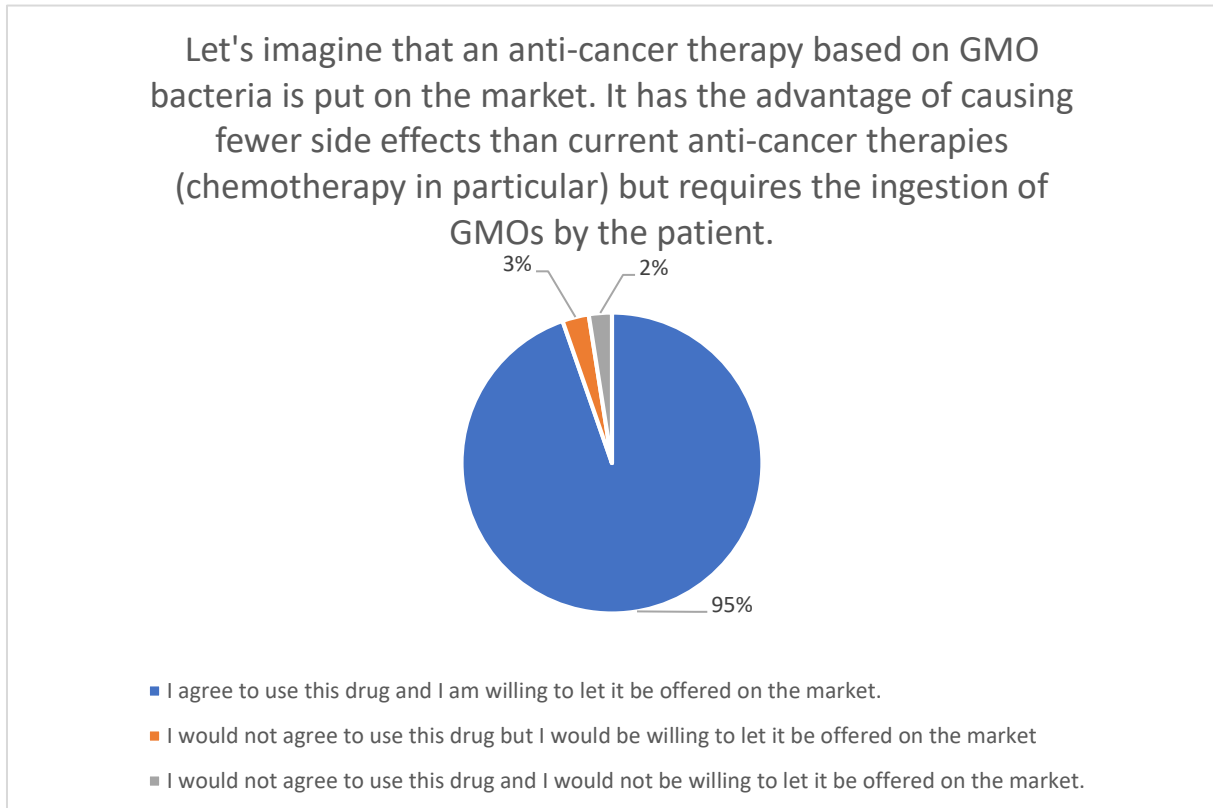
Similar to question 3 in Part 2, this question is designed to see if participants know that our bodies are full of bacteria. 59.5% said they are not bothered at all by the presence of bacteria in their bodies.

**Question 4 and 5:**



The answers to question 4 and 5 had a significant impact on our project. Indeed, as we can see, the participants are very divided as to the impact that medical GMOs can have on the environment. With most replies (20%) for the answer "5", the participants do not have a clear-cut opinion. Similarly, the participants are very divided as to the impact that medical GMOs can have on health. Once again, most responses (20%) are at "5". It should be noted, however, that there is a tendency towards "no" (answers 1, 2, 3 and 4) but the answers are still very spread out on the scale. Faced with ambiguous answers to those questions, we decided to think about how to secure our B.O.T. therapy in terms of the potential ecological and health problems that it could generate. Therefore, we decided to implement a "kill-switch" to our bacteria (see "Kill-switch" and "Integrated Human practices" sections).

**Question 6: Let's imagine that an anti-cancer therapy based on GMO bacteria is put on the market. It has the advantage of causing fewer side effects than current anti-cancer therapies (chemotherapy in particular) but requires the ingestion of GMOs by the patient.**

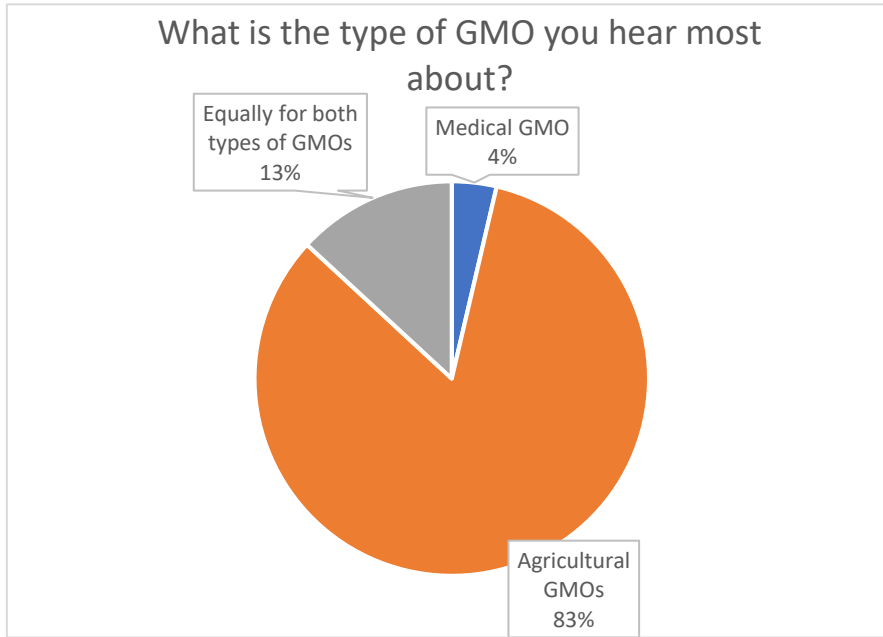


This last question puts the participant in a situation that could be soon real and helps to understand the general reaction when a therapy such as B.O.T. is marketed. 95% of the participants say they are ready to use the therapy and would agree that it should be marketed. The conclusions that can be drawn with this question have a direct impact on our "Business Plan" project since they give it legitimacy: we can see here that the controversy around food GMOs does not seem to have a direct impact on the vision that society has of our product.

This third part shows very different trends from those in Part 2 (agricultural GMOs). The participants are much more in favor to the use of GMO drugs and the last question shows that they would be willing to use our product. However, the answers regarding the environmental and health impact that GMOs could have are very mixed. This part was essential to the project as it pushed us to develop a kill-switch in our bacterium to address health and environmental issues. It is following the company's concern that we decided to design this innovative system (see Kill-switch part).

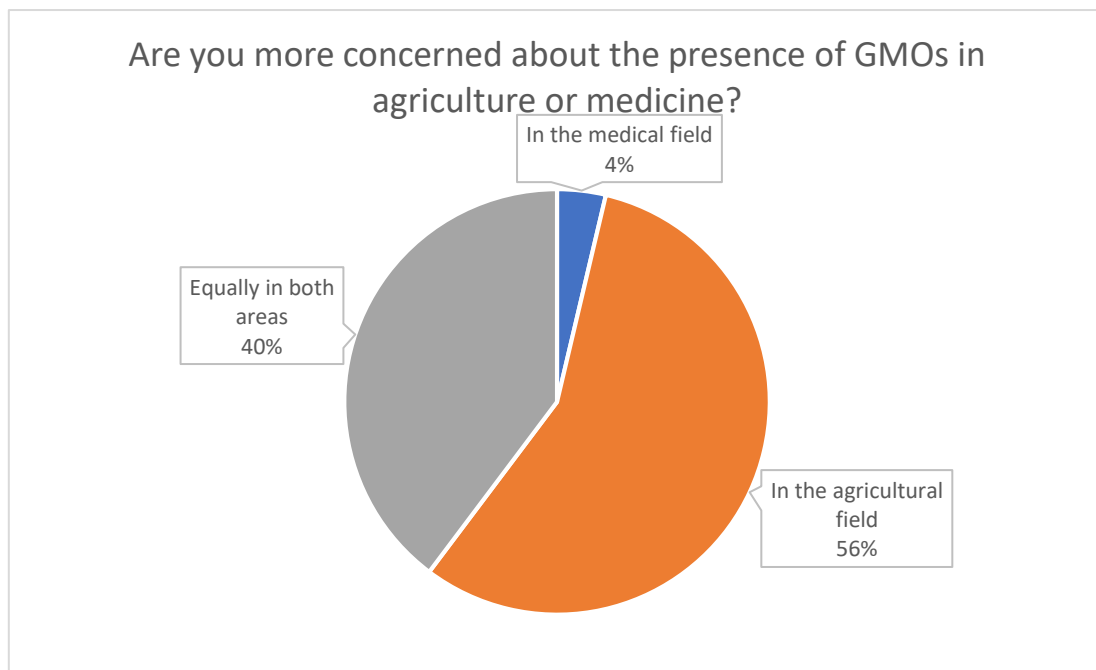
#### **Part 4: Comparison between medical GMOs and food GMOs**

**Question 1: What is the type of GMO you hear most about?**



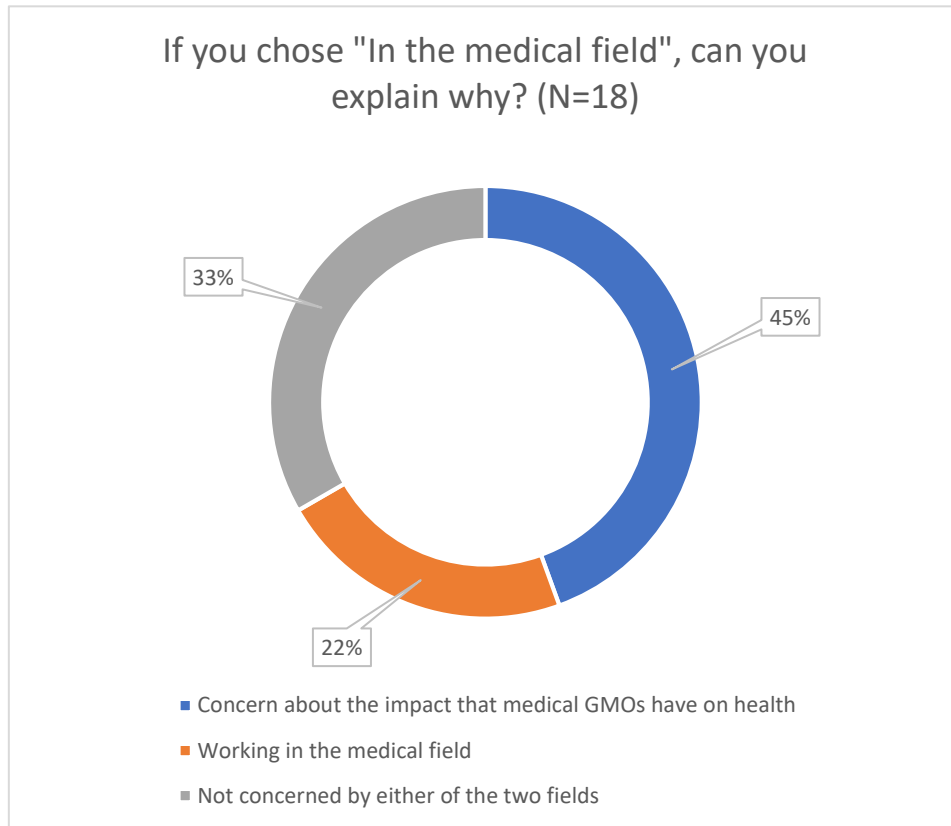
83% of the participants say they have heard more about agricultural GMOs than medical GMOs. As seen before, agricultural GMOs are omnipresent in society because of the controversies they generate in Europe and Switzerland. This result is therefore not so surprising. However, it allows us to give a first explanation as to why medical GMOs are less controversial than agricultural GMOs: simply because they are less highlighted by the media.

**Question 2: Are you more concerned about the presence of GMOs in agriculture or medicine?**



Interestingly, 40% of the participants expressed similar concerns about medical and agricultural GMOs. It is therefore not because medical GMOs are more "discreet" that they do not cause society to worry about the repercussions they may have. Nevertheless, 56% of the participants said they were more worried about the presence of agricultural GMOs, compared to only 4% for medical GMOs.

**Question 3 – Open question: If you chose "In the medical field", can you explain why?**

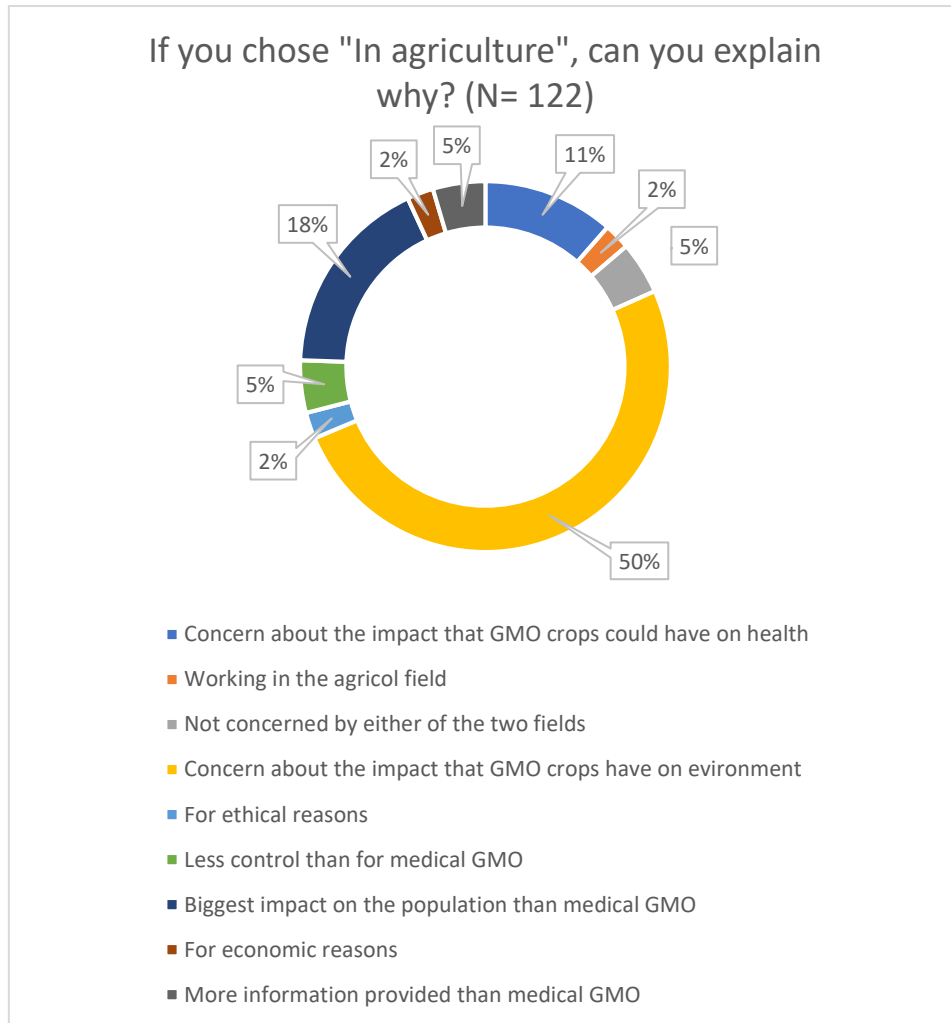


This one was an open question where the participants were free to reply with a short sentence. Afterwards, we classified the answers and made different groups. An example of a response for each group is given below:

- Concern about the impact that medical GMOs have on health:  
*"I think it is important to understand long-term effects on the individual's health"*
- Working in the medical field:  
*"I'm working in this domain"*
- Not concerned by either of the two fields:  
*"I'm not concerned with either"*

The answers were divided homogeneously into 3 groups. Importantly, the participants wrote about the potential impact that medical GMOs could have on our health (45%). These answers confirm the importance of developing health protection systems in medical GMOs.

**Question 4 – Open question: If you chose "In agriculture", can you explain why?**



This one was an open question where the participants were free to reply with a short sentence. Afterwards, we classified the answers and made different groups. An example of a response for each group is given below:

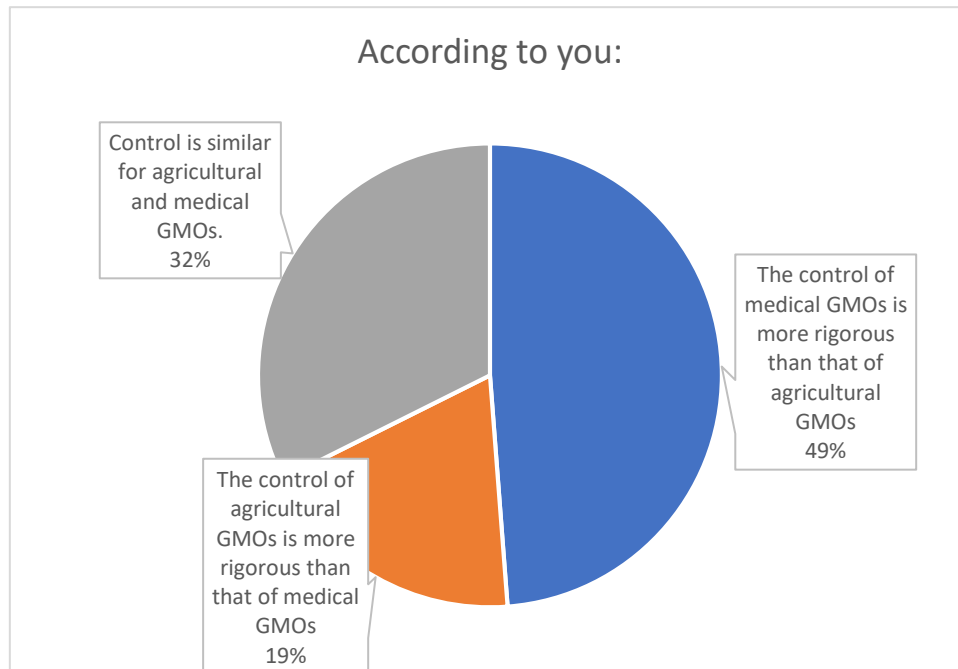
- Concern about the impact that GMO crops could have on health:  
*"A healthy diet keeps you healthy"*
- Working in the field:  
*"I am studying agronomy and not medicine"*
- Not concerned by either of the two fields:  
*"Not worried"*
- Concern about the impact that GMO crops have on environment:  
*"It worries me because it can be very harmful to the environment to use it"*
- For ethical reasons  
*"For ethical reasons, I do not agree with that"*
- Less control than for medical GMO  
*"I would assume there is a higher risk of uncontrolled spreading in agriculture compared to medical applications"*
- Biggest impact on the population than medical GMO  
*"Great impact on a wider population"*
- For economic reasons

*“Favors monoculture and especially firms that have an economic monopoly and disadvantages farmers”*

- More information provided than medical GMO  
*“Poor communication from biotech companies and stakeholders, louder and more emotive arguments from anti gmo groups. People don’t know about medical gmos”*

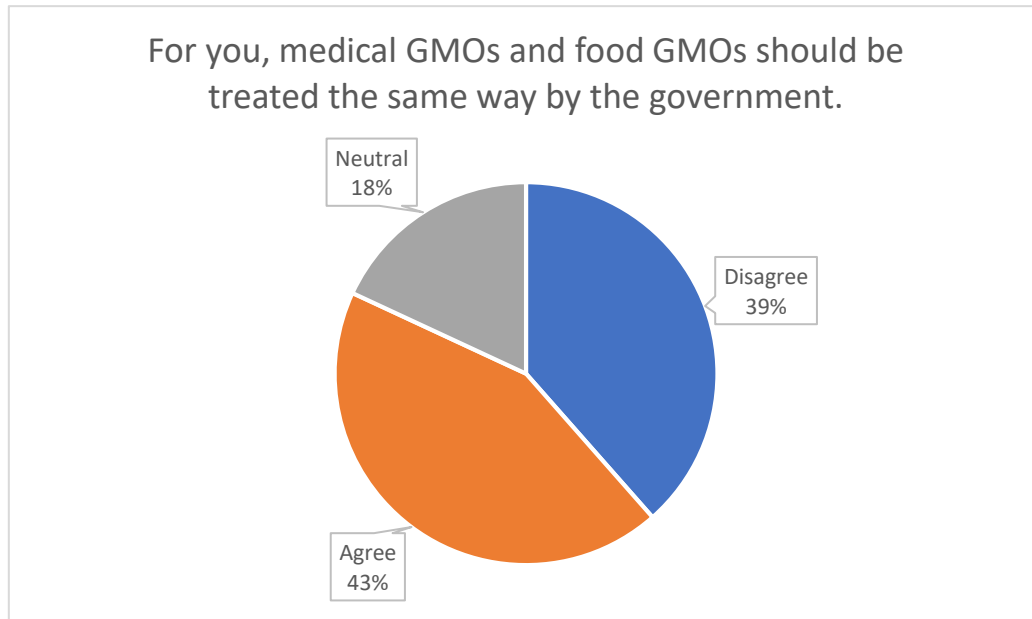
The answers were divided into 8 groups. Contrary to the previous question, the answers are not homogeneously distributed in the categories. Concern about the impact that agricultural GMOs may potentially have was the topic most commented on by participants (50%).

**Question 5: According to you:**



The answers to this question allow us to make a second point explaining why medical GMOs cause less concern in society than agricultural GMOs. For 49% of the participants, the control of medical GMOs is more important than that of agricultural GMOs (19%). Only 32% of the participants think that the controls are similar for both types of GMOs.

**Question 6: For you, medical GMOs and food GMOs should be treated equally by the government.**



Finally, this last question shows that there is no consensus on how to deal with agricultural and medical GMOs. 39% of the participants think that the government should separate these two types of GMOs and treat them differently against 43% who think that these two types of GMOs can be treated similarly. This clearly shows that discussions on the issue of GMOs are still necessary and is in line with the moratorium currently in place in Switzerland.

This last part aims to try to explain why GMO food and GMO agricultural products are perceived differently by society. The answers to the questions highlight a more important presence of agricultural GMOs in general (media, scientific research, ...) than medical GMOs and the perception of a better safety taken for medical GMOs. We also noted that the answers regarding the way agricultural and medical GMOs should be treated by the government are very scattered. Discussions between society-government-scientists could help resolve the current controversies on GMOs.

## Conclusion

Overall, the survey was a success. It pointed out the differences between agricultural and medical GMOs, highlighted the main concerns of the population about medical GMOs (environmental and health) and showed that people would be willing to treat themselves with our technology. Moreover, it pushed us to set up a biosafety system, our "kill-switch", which is one of the most essential parts of our project.

## Reference

1. G. Bruening, J.M. Lyons, "The case of the FLAVR SAVR tomato", *California Agriculture*, 2000.
2. European Parliament, "Huit choses à savoir sur les OGM", 2015, consulted October 24<sup>th</sup> on <https://www.europarl.europa.eu/news/fr/headlines/society/20151013STO97392/huit-choses-a-savoir-sur-les-ogm>
3. Food and Drug Administration (FDA), "GMO Crops, Animal Food, and Beyond", 2020, consulted October 24<sup>th</sup> on <https://www.fda.gov/food/agricultural-biotechnology/gmo-crops-animal-food-and-beyond>
4. RTS info, "Monsanto retire ses demandes de culture d'OGM dans l'Union européenne", 2013, consulted October 24<sup>th</sup> on <https://www.rts.ch/info/monde/5076323-monsanto-retire-ses-demandes-de-culture-dogm-dans-lunion-europeenne.html>



5. Le Conseil fédéral, « Cultures d'OGM : le Conseil fédéral veut prolonger le moratoire et préparer la réglementation », 2016, consulted October 24<sup>th</sup> on <https://www.admin.ch/gov/fr/accueil/documentation/communiques.msg-id-62442.html>
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