

# Shinescreen Case Study

## *Abstract*

The survey served to collect information about people's perceptions of a potential new probiotic sunscreen which is genetically engineered and contains live harmless bacteria.

The initial idea for the survey came from the recently introduced bans on oxibenzone and octinoxate in Hawaii. This was a revolutionary step towards coral reef preservation but other countries where coral bleaching is equally severe did not introduce such restrictions. Our team wanted to understand how such policy influence people's environmental awareness and demand for sustainability products. The initial locations were Hawaii (USA), Hainan (China), TJUSLS (China) and Queensland (Australia), as Hawaii being the only one with a ban.

However, we could not reach a large enough number of participants and had to alter the aim of the survey. Therefore, we decided to change the emphasis from the efficiency of political measurements and educational campaigns towards the market potential of the product. We also wanted to focus on the local market and added one more location – the UK. Even though people living in the UK are not near warm water coral reefs, they might travel to such destinations. For this reason, their opinion was of an equal importance. We had to adjust to the global pandemic because of Covid-19 and distribute the survey entirely online, using the most popular local social media networks.

The participants were asked to complete an online survey including ten short questions and a brief description of the probiotic sunscreen. Since participants might not have been familiar with GMOs we explained the term, as well as, the concept of our potential product. In addition, we described the biosafety measurements we planned to take in order to prevent any environmental or health risks from the use of 'Shinescreen'. People were asked if they would buy our alternative sunscreen before the informative paragraph and if they have changed their opinion after reading it.

In order to reach the target group of participants, we collaborated with other iGEM teams – UNSW (Australia), Hainan (China), TJUSLS (China) and Manchester (UK). They helped us distributing the survey and we shared the results once they were collected.

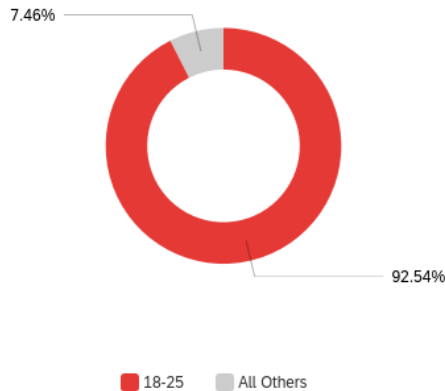
The survey was open for responses in the period August – September 2020. After the 67 responses were analysed, highly optimistic results were obtained. The majority of the participants said they do use sunscreen when being at the beach and were positive towards the use of probiotic alternative. Besides, there was high level of awareness about the environmental harm imposed by human activity and the problem of chemical pollution. Nevertheless, the opinion about GMO was still controversial.

It should be noted that we could not reach diverse group as more than 90% of the participants were at the age between 18 and 25, probably students. The well-educated and young audience might account for the prevalence of positive responses since this group of people are usually more concerned about the environment. This information helped us identify the potential type of customers which would be most likely to buy a ‘Shinescreen’.

## *Results from Hawaii, Queensland and the UK*

### **General Questions:**

*Q1 Which age group are you in?*



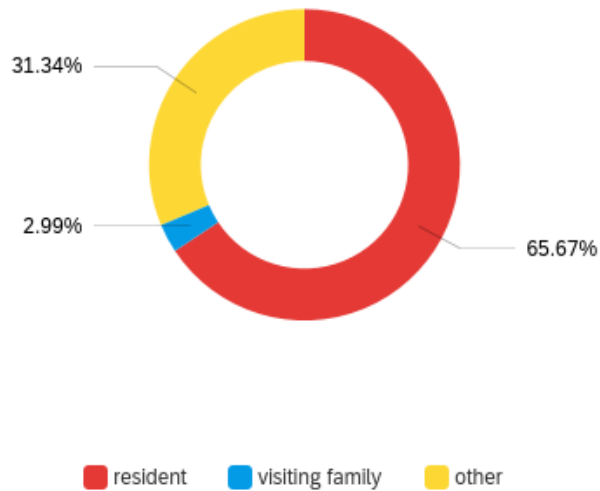
The majority (92.54 %) of the participants were between 18 and 25 years old. All of the rest age categories formed 7.46 %, which is relatively low. The reason for the prevalence of the younger age group is the way of distribution of the survey – through social media in pages, mostly visited by students.

*Q2 (a) Which city are you currently in?*



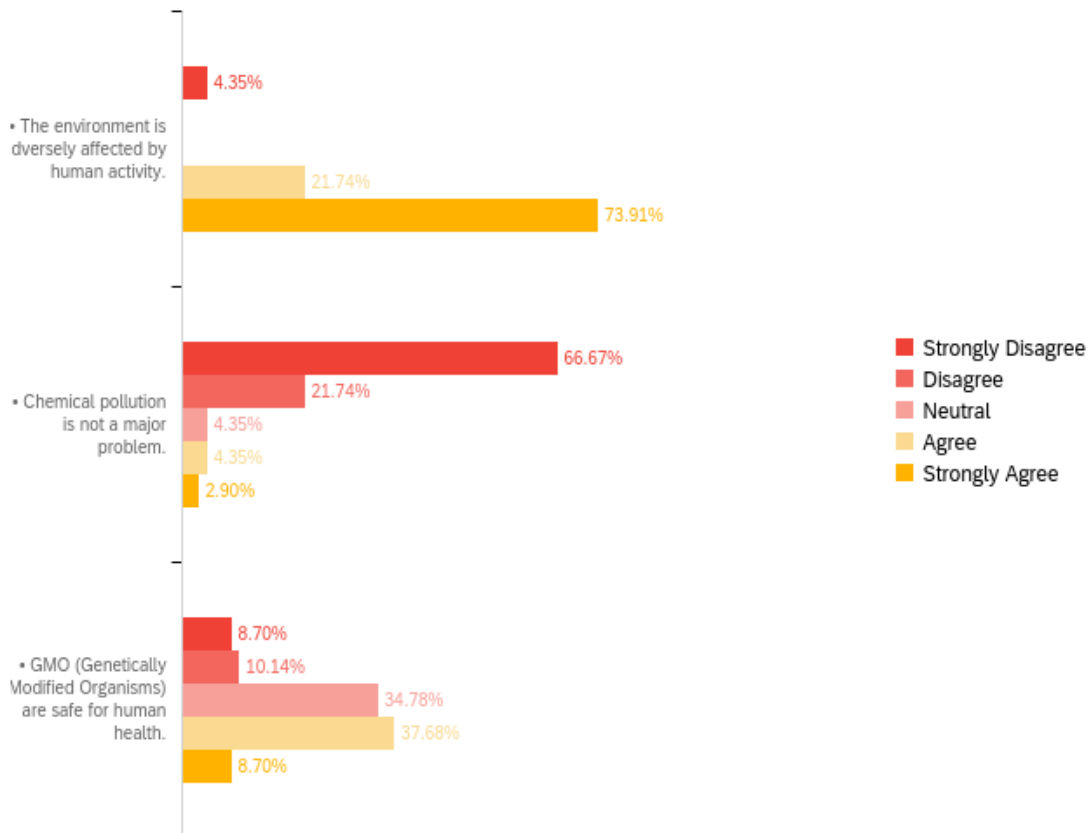
The participants were from the target location we chose as most of the people were in St Andrews, Honolulu and Sydney.

*Q2 (b) What is your reason for being there?*



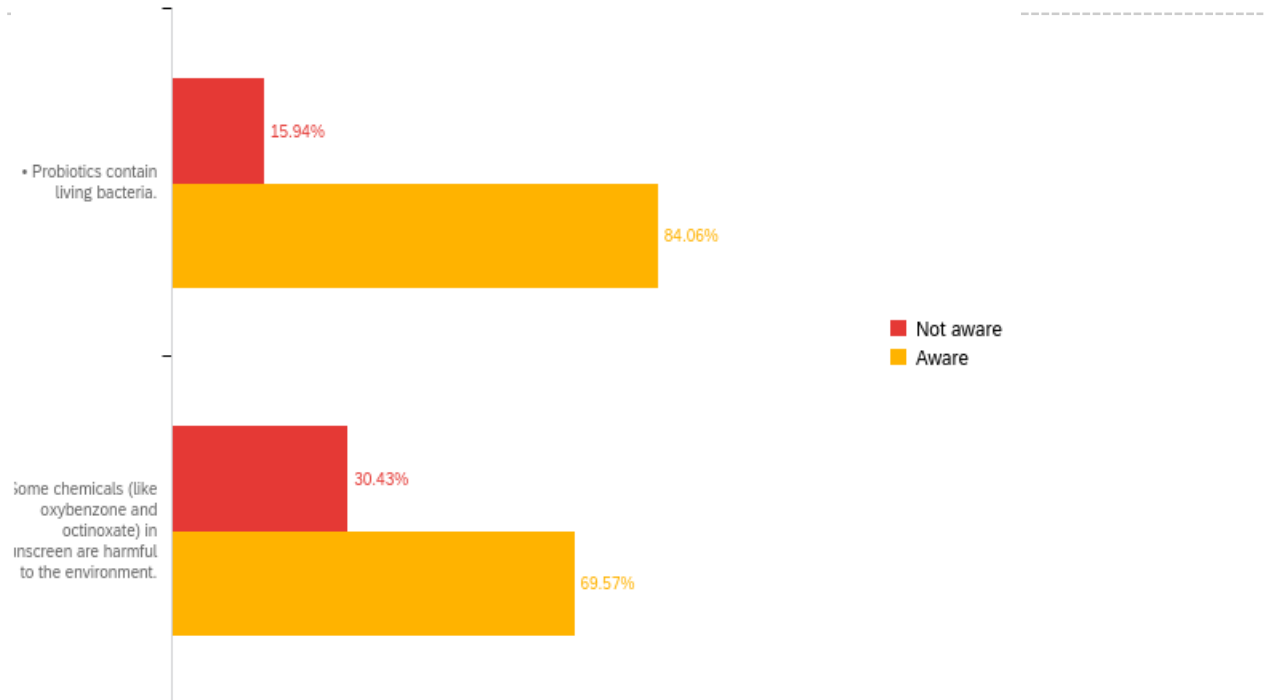
**Environmental awareness and SynBio knowledge:**

*Q3 (a) To what extent would you agree or disagree with the following statements?*



The opinion of the participants about first and the second statement was similar – the majority agreed/strongly agreed that the environment is adversely affected by human and disagreed/strongly disagree that chemical pollution is not a major problem. The third statement produced controversial answers with the highest percentage of the participants agreed (37.68 %) with or were neutral (34.78 %) towards GMO being safe for human health. Interestingly, equal percentage of the participants answered either strongly agree or strongly disagree (8.70 %). Around 10 % disagreed.

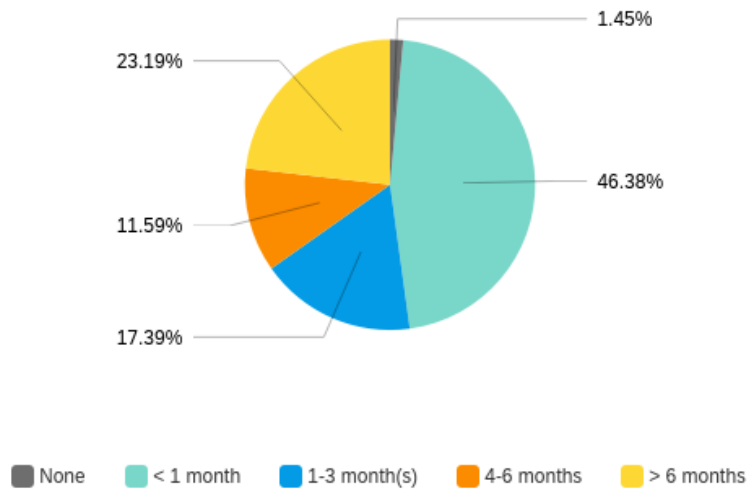
**Q3 (b) How aware are you of the following statements?**



The participants were in general aware of the facts that probiotics contain living bacteria (84.06 %) and that some chemicals in sunscreen are harmful to the environment (69.57 %).

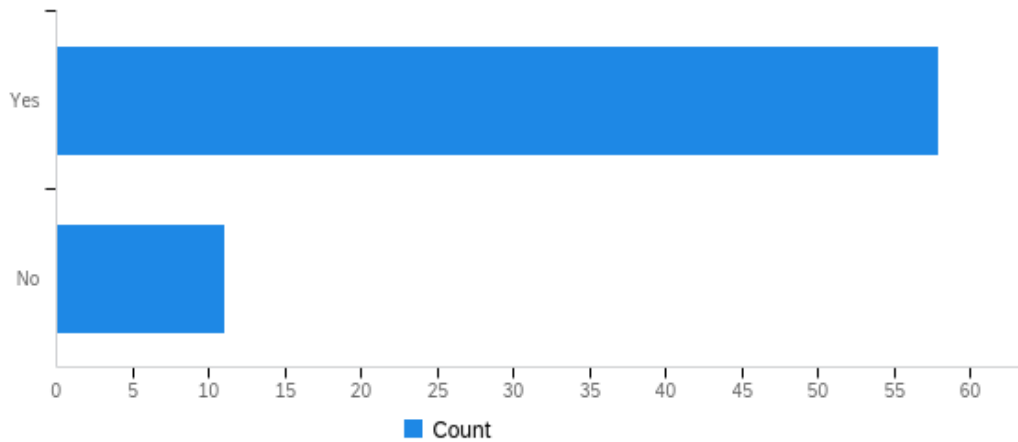
**Sunscreen Use:**

*Q4 How much time on average do you spend at the seaside per year?*

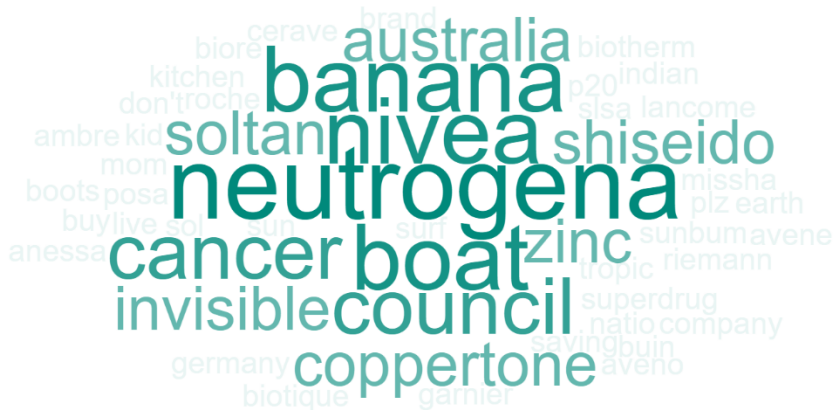


*Q5 Do you apply sunscreen when you are at the beach?*

Most of the participants (83.58 %) said they applied sunscreen when being at the beach. Only 16.42 % said they did not.



**Q6** Could you tell us the sunscreen brand you are currently using? (if applicable)



As expected, the most common brands on the market were dominating within the responses of the survey.

Information Provided to Participants:

*Coral reefs support **25% of all marine species**, but conventional sunscreens contain chemicals that can increase the risk of **coral bleaching** (an indicator of stress that could eventually **kill coral populations**). To help **conserve** coral reefs, the St Andrews iGEM team 2020 plans to develop a **probiotic sunscreen** called ‘Shinescreen’.*

*Using synthetic biology, we will genetically engineer *E. coli* to produce molecules that protect the skin from UV radiation. Unlike commonly available lotions, our sunscreen will reduce the risk of skin cancer, whilst preserving marine ecosystems.*

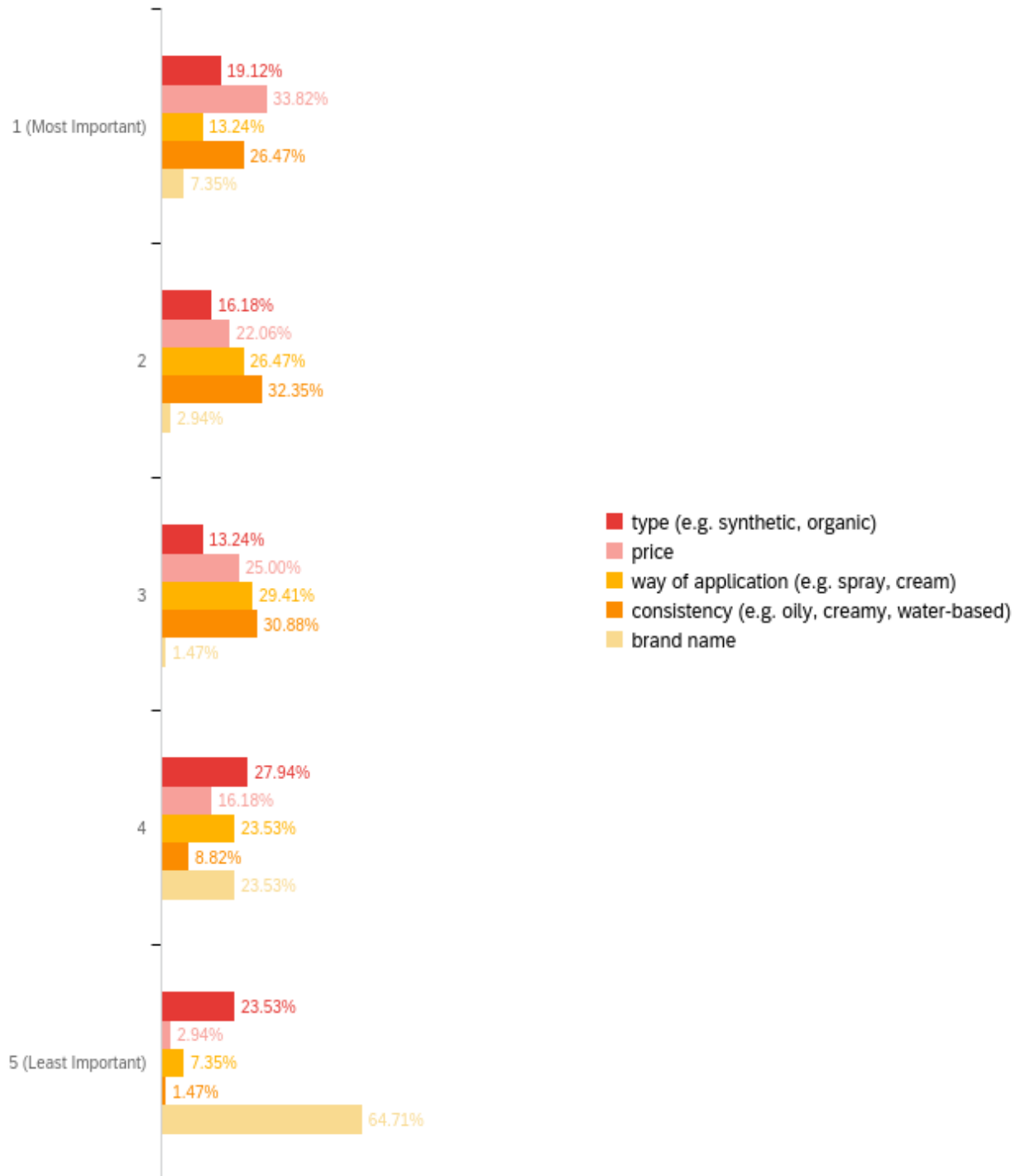
*Product Market:*

**Q7** Please rank the importance of the following factors when purchasing a sunscreen. (please click and drag the 5 factors in the order of decreasing importance from 1 to 5)

*1 - Most Important*

*5 - Least Important*

- *type (e.g. synthetic, organic)*
- *price*
- *way of application (e.g. spray, cream)*
- *consistency (e.g. oily, creamy, water-based)*
- *brand name*

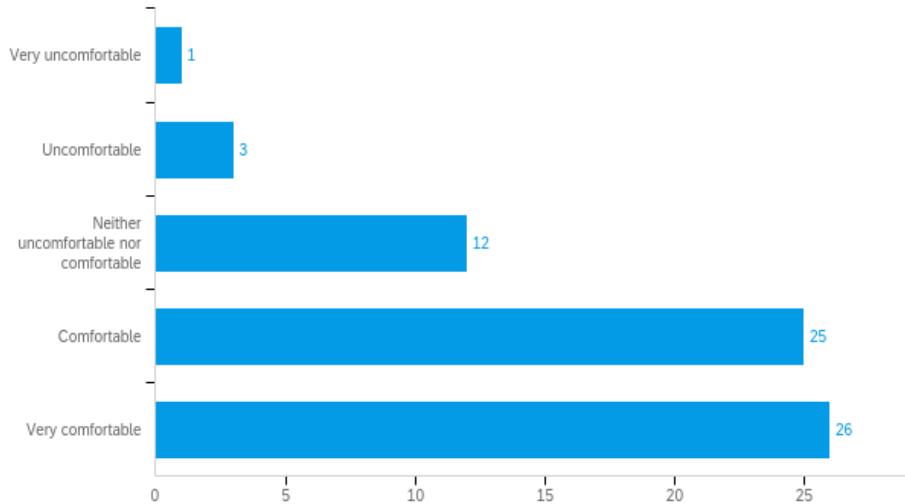


Most of the participants regarded price (33.82 %) as the most important factor when buying sunscreen, followed by consistency and type. The least important factor was the brand name (64.71 %), leaving opportunity for small or new brands to be successful.

**Q8** Roughly, how much do you pay for your sunscreen on average?  
(Please write the price followed by the currency. Example: 20 GBP)

The average amount of money the participants would pay was equal to £10.

**Q9 (a)** How comfortable are you with the idea of using a probiotic sunscreen (probiotic means it contains living microorganisms), as long as this is harmless for your skin?



**Q9 (b)** Could you briefly explain your optional choice?

From the 68 participants 35 responded to the open question. The answers are shown below, as each colour corresponds to the sentiment of the opinion – positive, positive with safety concerns, neutral/slightly positive with texture concerns, neutral, negative.

Open Answers:

Would like more specific information on the E Coli bacterium

As long as it's better for the coral reefs, I am happy to switch to this type of sunscreen.

I'm not against it, I'm just not sure what it would be like. I'll feel more comfortable when I've tried it out.

I don't mind

it's good for the health of skin and environment. a great idea

It makes me think would the life of the lotion be less, also would it mold, how would the consistency be, such as grainy or mushy.

I think it really depends on how alike the probiotic is to the sunscreen we use now. If it had a weird texture/odour, that maybe not as much.



As long as it's proven to be safe by a regulatory body

The idea of applying bacteria to my skin makes me uncomfortable, although I would use it anyway if the science was sound. In particular, before buying I would look for evidence that the microorganisms won't cause infections if applied to damaged skin or near orifices, as well as evidence that the E coli will be always be outcompeted by natural skin flora taking into account that skin flora varies greatly between individuals.

doesn't bother me either way, so long as it's effective

I mean u eat yoghurt, right?

i would be more comfortable but i would be cautious about the effect the sunscreen has on skin microbiota

would be comfortable as long as appropriate testing is done of course.

thousands if not millions of bacteria exist on the skin naturally anyway

if it's guaranteed harmless for my skin, I wouldn't hesitate to put it on my skin.

If it is harmless I don't care what it contains

if it's not harmful for my skin i am ok with using it on my skin

As long as it isn't dangerous it's fine, but are there long term effects and are they known?

On average, we already have a large number of living microorganisms on our skin. I don't see why using a sunscreen with probiotics will be any different from that.

Well already have so many microorganisms living on us, if the lotion is harmless then I don't have a problem with more beneficial microorganisms living on my body

Makes no difference

I couldn't give a monkeys what's in it if it's good for the environment and does it's job - we eat probiotic yoghurt so where's the big difference

If it's good for the environment then why not

Don't care tbh I like yoghurt too

If it works and doesn't do anything bad to me I would use it

Very unknown, feel like I wouldn't know what was on my skin.

I would be happy to wear something if trials have shown it is harmless

I would be comfortable using a probiotic sunscreen.

If it is safe for my skin and does not hurt the environment I'm okay with it

We already have a microbiota on our skin so as long as this sunscreen doesn't disrupt the existing communities, it seems like a good idea!

As long as it is harmless, I think its a great alternative to using chemicals harmful to environment

Know nothing about it so I'm neutral.

I would pay higher price if need to in order to use something that does not harm our beautiful planet and humanity consequently.

It'll be a new product but I can try it if it's good for me and the sealife.

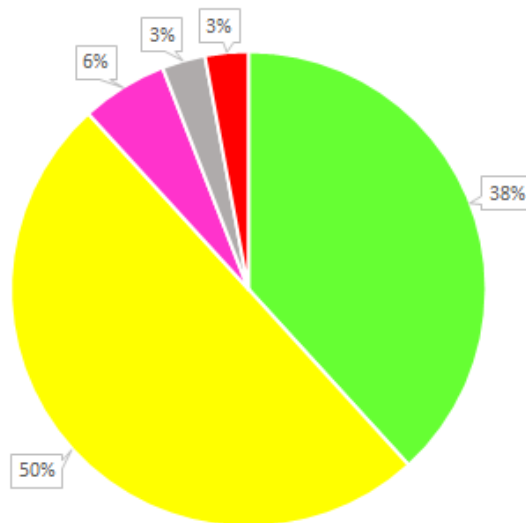
As long ad it works and is safe ill use it

I am willing to use it if it can save the environment.

As long as it's safe for me and safe for the environment then I'm ok with jt

Concerned about possible damage from the organism because unfamiliar with the technology behind it but otherwise fine

Summary Chart:

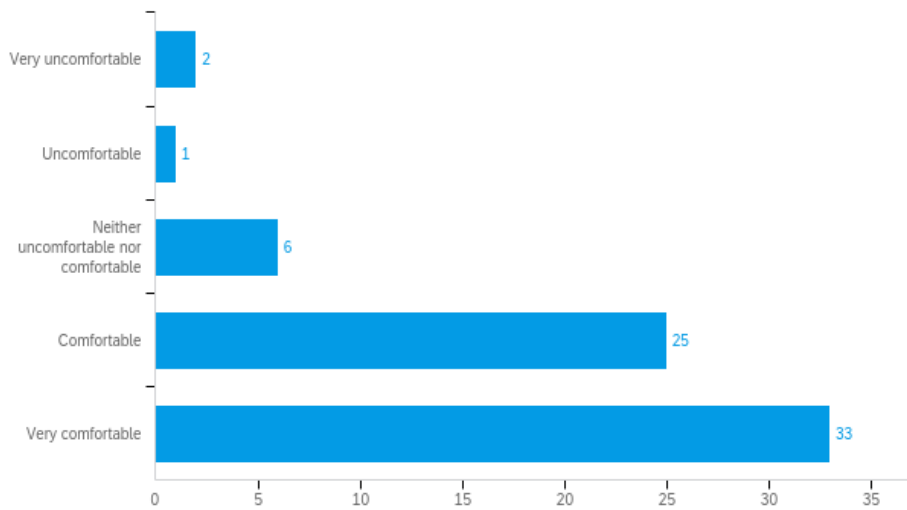


As seen, yellow is the prevailing colour (50%), followed by green (38%). The other three colour indicators formed less significant part of the overall group. Consequently, the general opinion of the participants is that they would use it as long as it does not impose any risks for human and the environment.

#### Information Provided for Partiipants

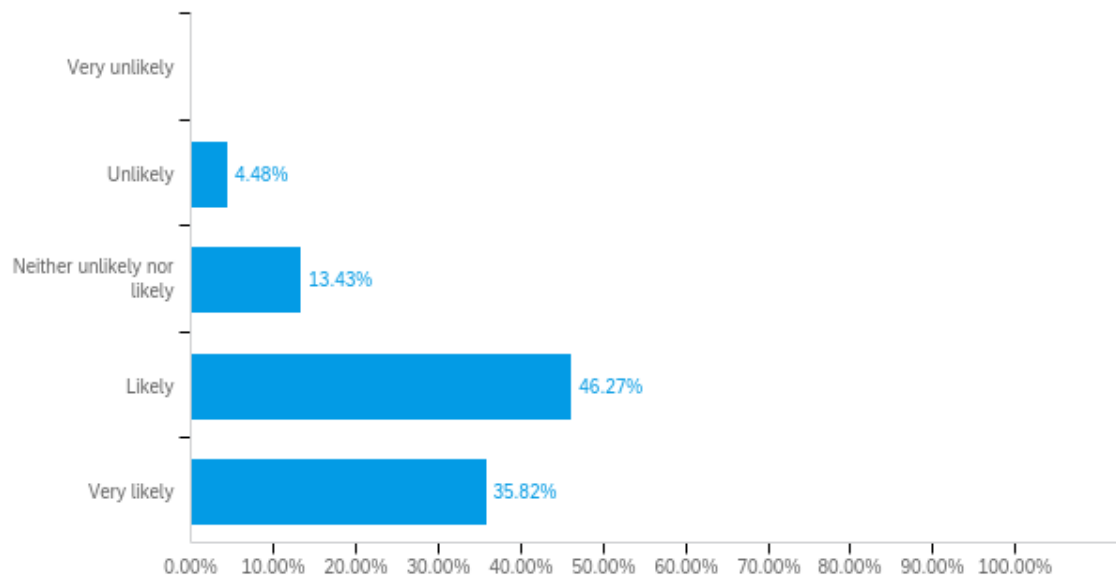
*Probiotics are present in food such as yoghurt. Such probiotics only **temporarily** change the microbiome in the gut (the harmless bacteria already found there). Our bacterium will **not change the skin microbiome long-term**, as well. We will ensure the sunscreen will **not have environmental impact**, either. To achieve this we will insert a safety mechanism in the genes of *E. coli* so as to make it survive only while needed.*

**Q9 (c)** After you know that our bacteria will not survive long-term on your skin or in the environment, do you feel more comfortable with using probiotic sunscreen?



From Q9 (a) to Q9(c) there was a tendency of the responses becoming more positive, which confirmed the importance of the incorporation of safety mechanisms.

**Q10** If there were a probiotic sunscreen, such as "Shinescreen", on the market at a similar price to your current favourite, how likely would you be to buy it?



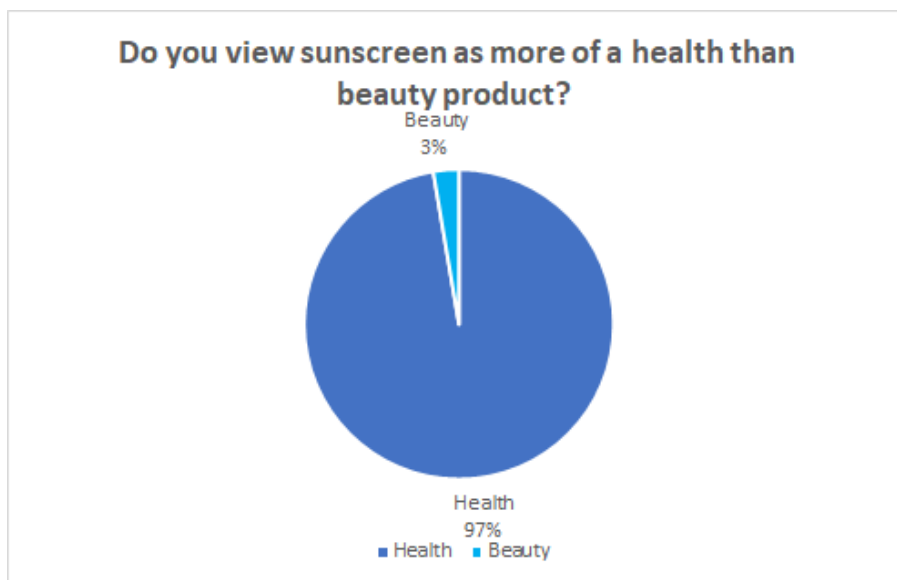
## Conclusion

Even though we could not achieve the initial aim of the survey and compare governmental policy, we still collected valuable data about the potential market of the product and what should be done to ensure that it is well accepted by the customers. The results confirmed our suggestion that people would use the product as long as it has been approved safe by the respective authorities. These findings were consistent with the opinion of the experts (Prof Firbank and Louisa Laing) regarding the importance of biosafety of the product. Therefore, the survey showed that the killswitch we have designed would increase the acceptance of the product on the market.

## Collaboration with Manchester

Both St Andrews and Manchester iGEM teams conducted sunscreen/synthetic biology related surveys and shared the results with each other. The Manchester team was mainly interested in the data that we collected regarding the price participants would pay for sunscreen and the importance of different factors when buying it. Our team benefitted from the two surveys created by the Manchester team - Synthetic Biology and Sunscreen Use, as we could implement the results in our market research and they enriched the information about GMO that we already collected through Twitter Sentiment Analysis and SynBio Forum.

The following questions from Manchester survey were chosen as most relevant to our project and the results were presented graphically:



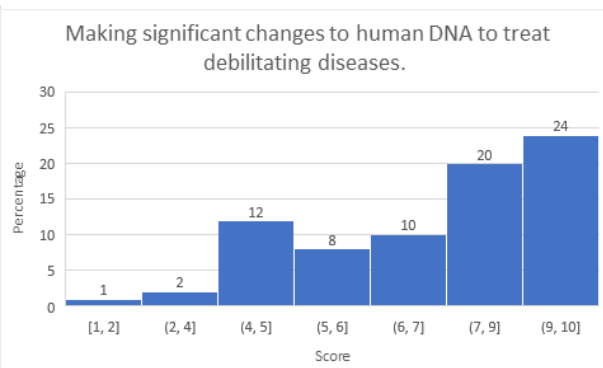
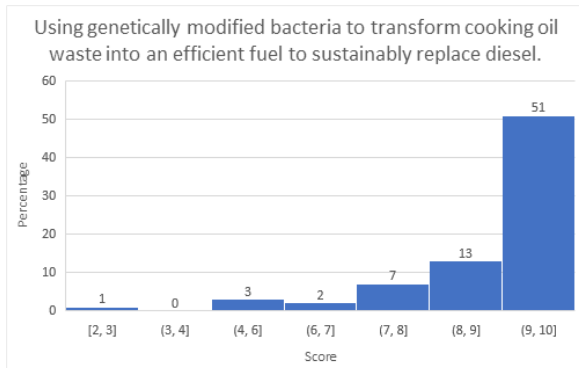
The overall number of analysed responses was 75. There was one question taken from the sunscreen use survey, while the rest were part of the synthetic biology survey.

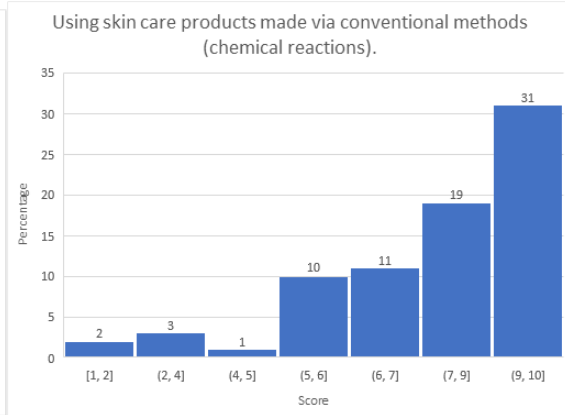
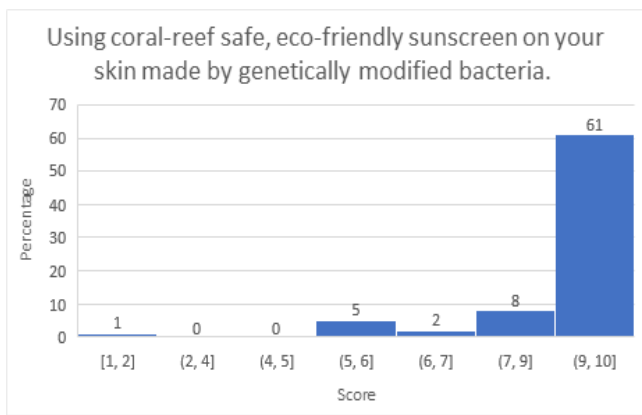
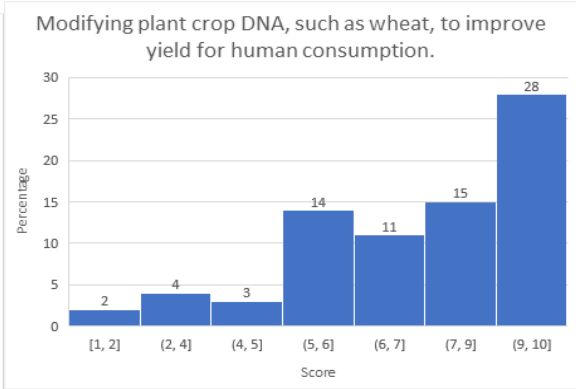
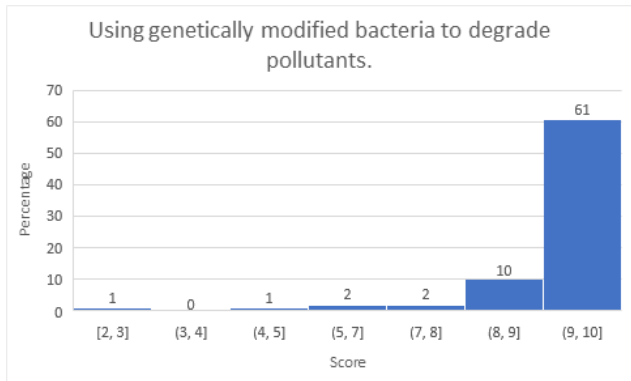
To the question from sunscreen use survey nearly all of the participants regarded sunscreen as a health than as a beauty product. This implicated that reliable UV-protection is not only an advantage in terms of our product contributing to the decrease of UV-induced diseases but also regarding its market potential.

The questions from synthetic biology survey were in the format shown below (1-10 grade scale). There was a tendency of people feeling more comfortable towards the use of GMO in a way which does not reach human directly. Therefore, most of the participants felt comfortable about using GMO for sustainable purposes such as eco-friendly sunscreen, biofuel and pollutants degradation. However, there was controversial opinion regarding the use of GMO in food and for treating diseases.

Similarly to the results of Q9 from our survey, the participants in Manchester survey were comfortable with using sunscreen, involving the use of GMO (as present on the skin in our case or as producing UV-filter in the lab and extracting it). When comparing only the questions about the use of eco-friendly sunscreen and conventional skin care products, the reef-safe sunscreen seems to be accepted better. It can be noticed that more of the participants (ca. 80%) ranked the former between 9-10, compared to the latter (ca. 40%), where the opinions were rather diverse. This finding was surprising since conventional cosmetics occupies a large part of the market and is widely used. At the same time, it showed that there is a potential demand for sustainable products.

**On a scale of 1 (strongly uncomfortable) to 10 (completely comfortable) how comfortable are you with the following application?**





# Survey conducted in China

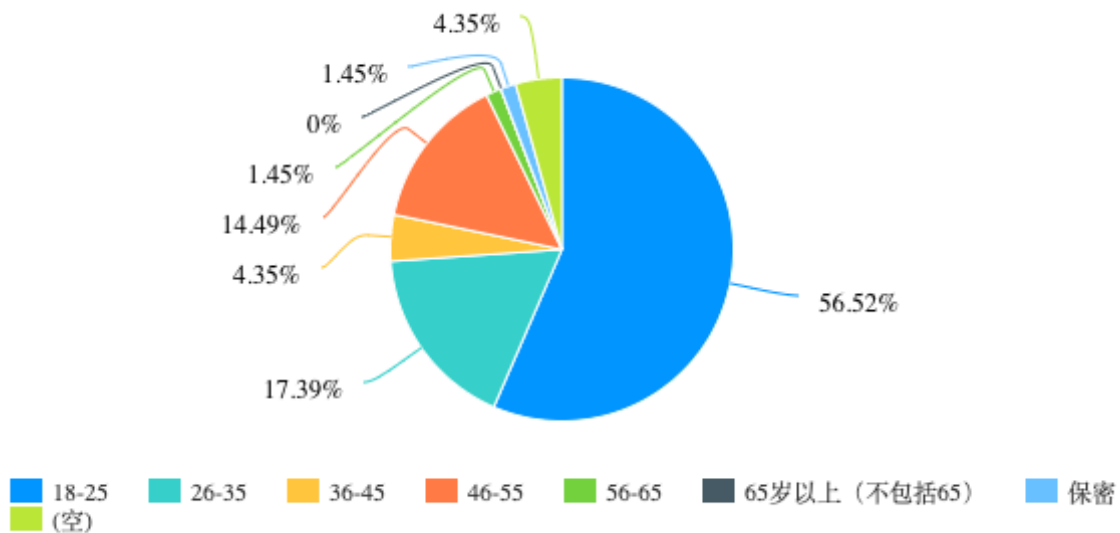
## Summary

In order to conduct the survey in China different platform had to be used. In addition, the structure and content of the questions had to be edited. Therefore, our team decided to present the results separately so as to avoid any bias coming from translation and the edition.

We could recruit 68 participants, forming more diverse age group with significant part of it using sunscreen. Compared to the other locations, the participants here demonstrated lower level of environmental awareness but probiotics were well-known. The results were positive as most participants were open to the use of sunscreen but expressed safety concerns.

The good impression of probiotics in China, as well as, the common use of sunscreen make the country another potential market for our product. However, the demands of the market there are different from those in the other locations of the survey, as seen by the question regarding the factors influencing the choice of sunscreen..

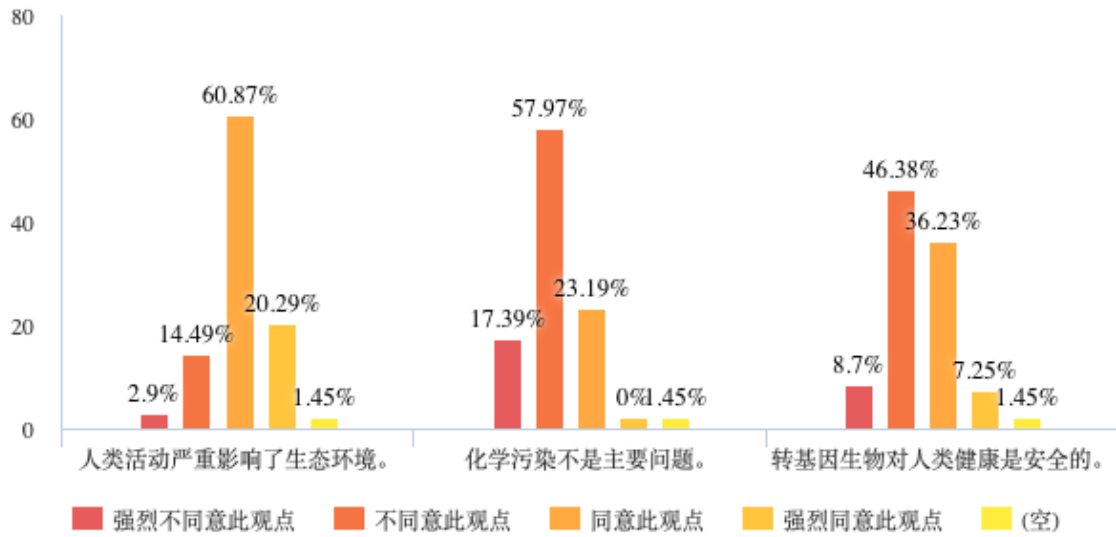
### 1. Which age group are you in?



18-25; 26-35; 36-45; 46-55; 56-65; over 65; prefer not to say; no answer

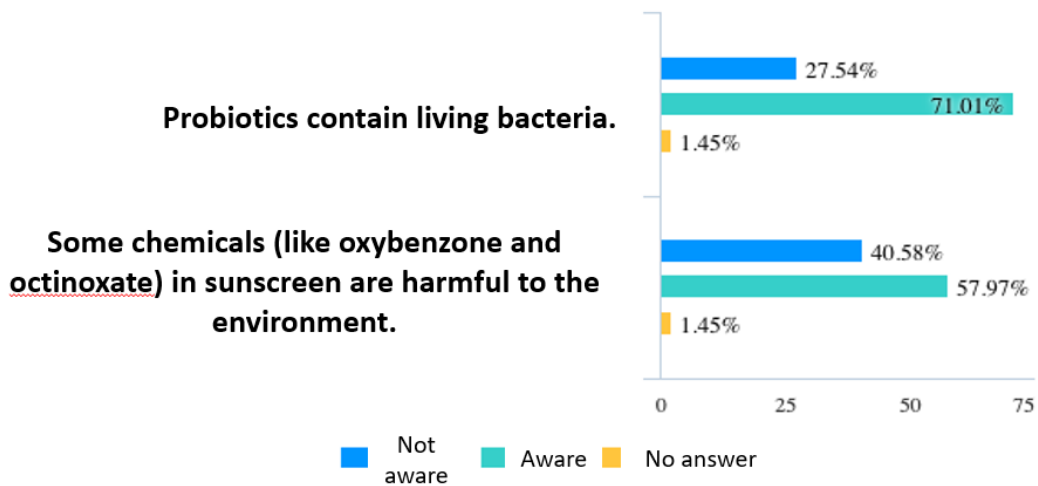
More than half of the participants (56.52 %) were at the age between 18-25, followed by people aged 26-35 (17.39 %) and 46-55 (14.49 %). No people over 65 took part and the 56-65 year old were only 1.45 %.

2. To what extent would you agree or disagree with the following statements?



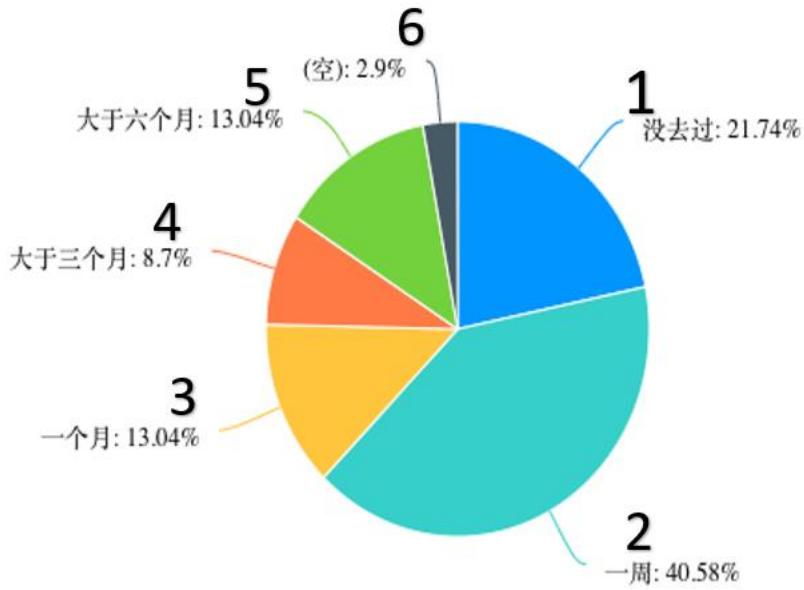
1. The environment is adversely affected by human activity.
  2. Chemical pollution is not a major problem.
  3. GMO (Genetically Modified Organisms) are safe for human health.
- Strongly Disagree; Disagree; Agree; Strongly Agree; Empty

3. How aware are you of the following statements?



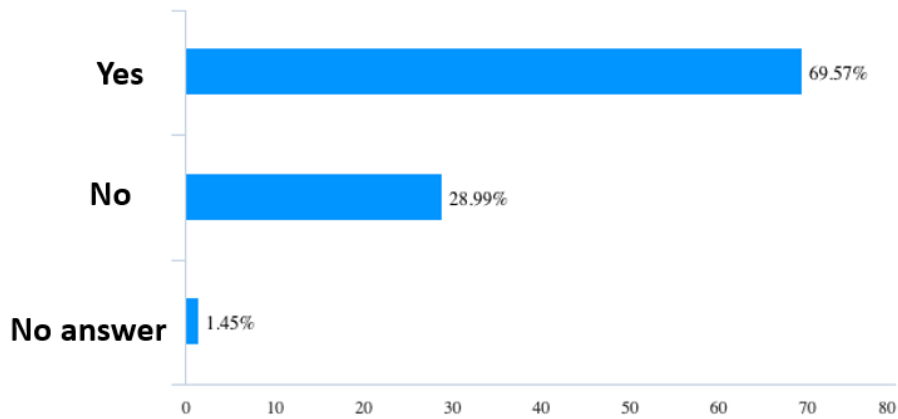


4. How much time on average do you spend at the seaside per year?

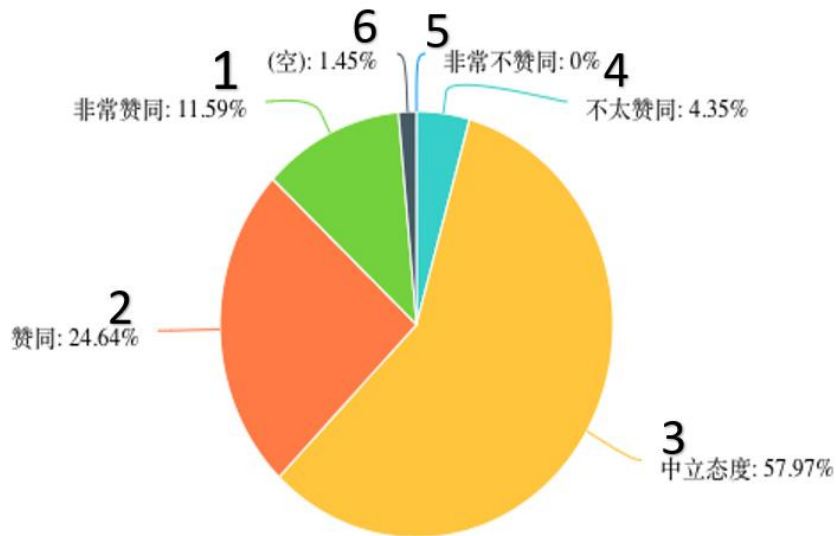


1: None; 2: one week; 3: one month; 4: more than 3 months; 5: more than 6 months; 6: empty

5. Do you apply sunscreen when you are at the beach?

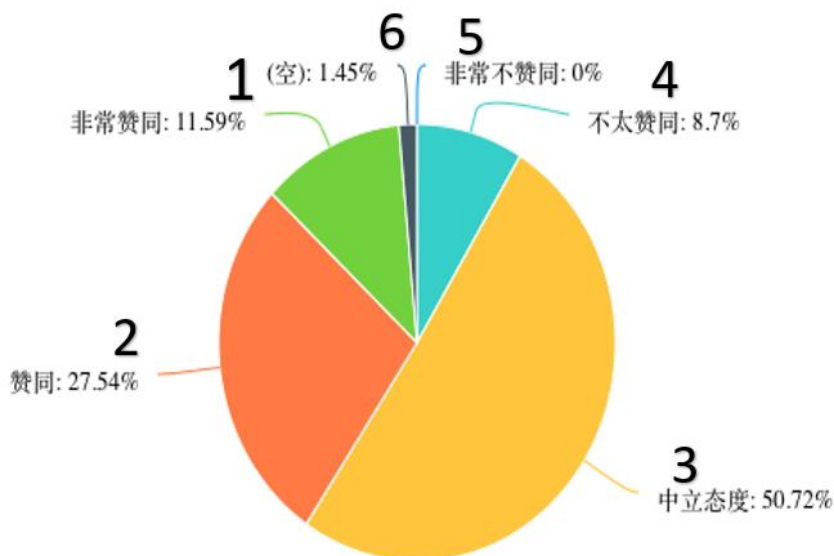


6. How comfortable are you with the idea of using a probiotic sunscreen (probiotic means it contains living microorganisms), as long as this is harmless for your skin?



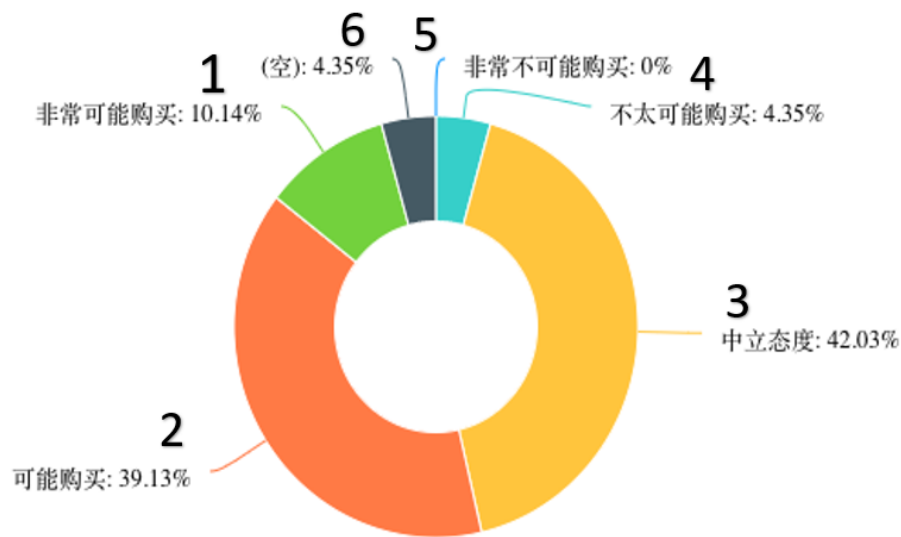
1: Very comfortable; 2: comfortable; 3: Neither uncomfortable nor comfortable; 4: uncomfortable; 5: very uncomfortable; 6: empty

7. After you know that our bacteria will not survive long-term on your skin or in the environment, do you feel more comfortable with using probiotic sunscreen?



1: Very comfortable; 2: comfortable; 3: Neither uncomfortable nor comfortable; 4: uncomfortable; 5: very uncomfortable; 6: empty

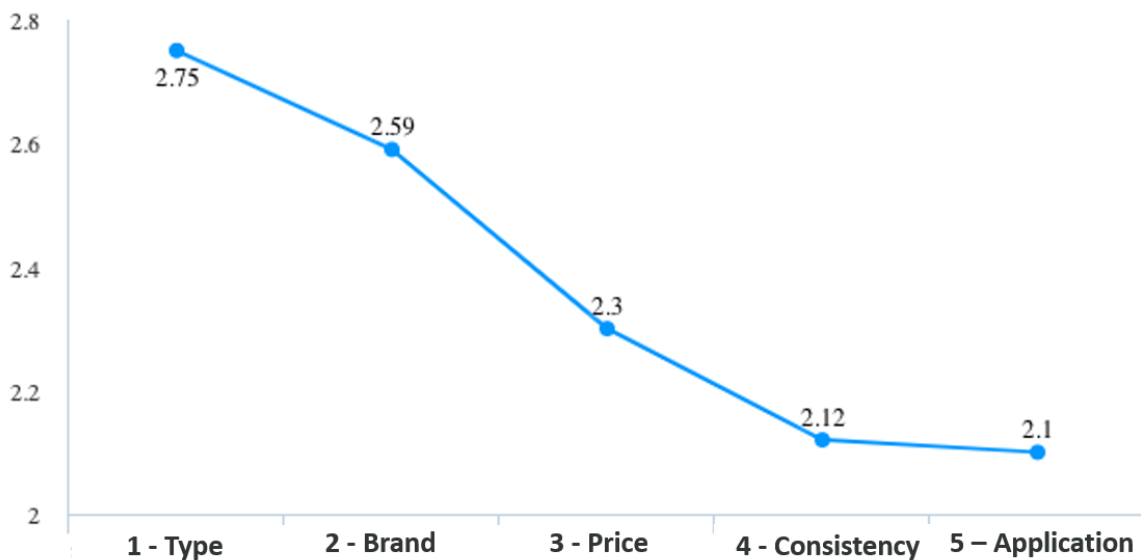
8. If there were a probiotic sunscreen, such as "Shinescreen", on the market at a similar price to your current favourite, how likely would you be to buy it?



1: very likely; 2: likely; 3: Neither unlikely nor likely; 4: unlikely; 5: very unlikely; 6: empty

9. Rank the following factors according to their importance:

Importance of different factors when buying sunscreen (China)



The graph shows the average score of each factor based on all the responses. If the score is higher people, consider this factor more important.

2.75 - type (organic, synthetic); 2.59 - brand name; 2.3 - price; 2.12 - consistency (cream, oil); 2.1 - way of application (cream, spray)