How E.coli react to Ethanol & SDS shock?

“Have you ever used hand sanitizer to clean your hands? Do you know what chemicals are inside? Are you sure it kills the bacteria?”

During our last week of sensing the environment we decided to study the bacterial reaction to a couple of cleaning products that are found in our everyday life. We started this project because we wondered why products with the same use had different active products that are never used together and if they are really efficient.

The most common one, and the one that usually comes to your mind is alcohol, particularly ethanol. It is a very effective bacteria killer which denatures their proteins and is used in a wide range of household products such as disinfectant (for humans and surfaces). We compared ethanol to SDS (sodium dodecyl sulfate), a chemical used in many household products but mainly as a detergent or hygiene product.

The aim of our experiment was to see the impact of a mix of ethanol and SDS at different ratios to see if we can create a really powerful anti-bacterial solution with low detergent concentration.

To do this, we started by doing preliminary experiments with only ethanol and only SDS in order to determine which concentrations were best to have a response from *Escherichia Coli* (a specie of bacteria) without killing them all (here is a video if you want to understand how alcohol kills bacteria). Initially, we considered a solution of 100% ethanol that we diluted in LB medium to have solutions with concentrations of ethanol between 100% and 30%. For the SDS, we did a serial dilution with a 10 dilution factor from our initial SDS solution concentrated at 1%.

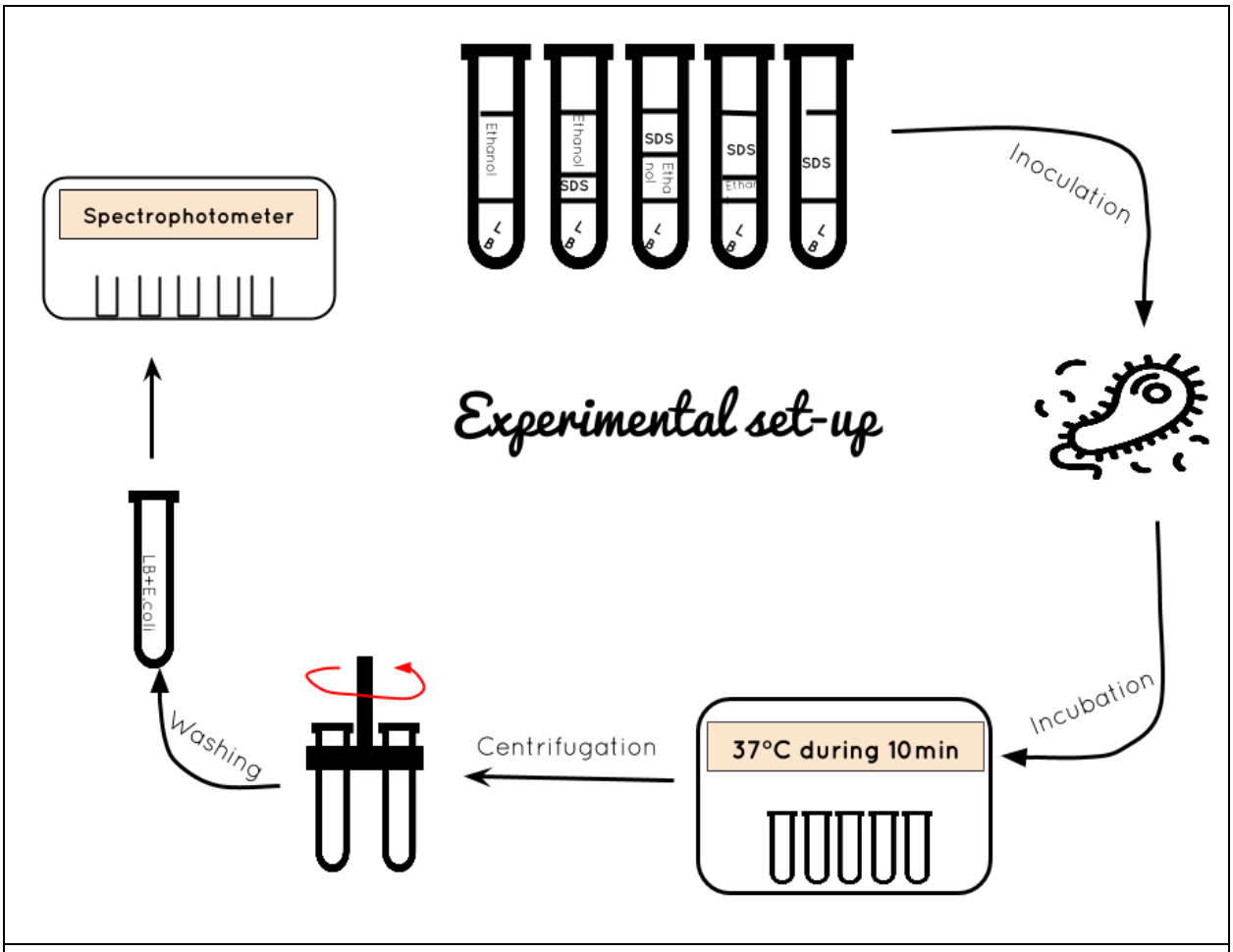

Figure 1 : Experimental Set-up

Thanks to the different growth curves of the preliminary experiment, we chose our two concentrations, 40% for ethanol and 0,01% for SDS. Then, we made several solutions with different ratios : 0/100, 25/75, 50/50, 75/25 and 100/0. After the preparation of the ratios, we inoculated them with *E.coli* bacteria and we put our falcons in an incubator at 37°C during 10 minutes. During these 10 minutes, bacteria began their growth if they were still alive, or were killed by the detergent.

To observe the impact of the different solutions with conditions that are close to the real ones, we decided to wash *E.coli* with LB and we did several measurements with a spectrophotometer at three time points (0min, 1h and 2h). The spectrophotometer is an instrument that measures the transmittance of light of the solution. Therefore, the more bacteria there is in a solution, the cloudier the solution will be, and less light will be transmitted which is measured as a higher absorbance value.

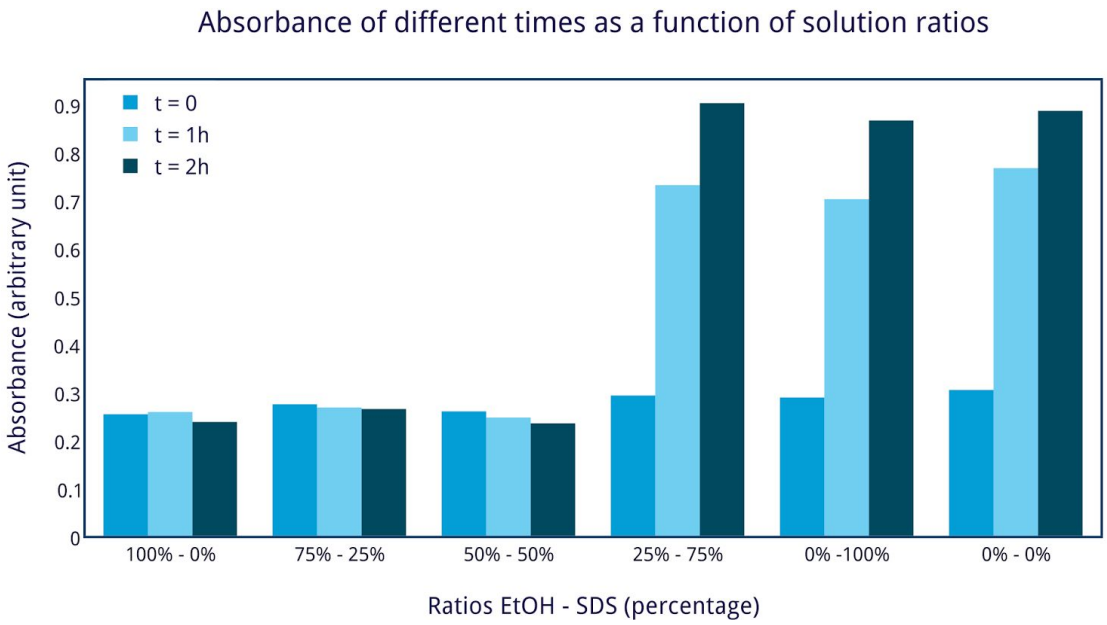

Figure 2 : Absorbance at different times as a function of solution ratios
EtOH (ethanol)

The graph above shows how the bacteria grew according to the ratios of ethanol and SDS they were inoculated in. As we can see, the higher the the concentration of ethanol there was, the less bacteria grew. Their concentration in the solution actually decreased. When there was more SDS than ethanol the bacteria grew exactly the same way as they did when there was nothing in the solution.

We can draw several conclusions from our result. First, ethanol is more effective than SDS to slow down bacterial growth in the concentrations that we used. That means that if you use an ethanol-based hand sanitizer and wait 10 minutes, there is a good chance that the bacteria on your hands will have been killed. The second conclusion is that a 50:50 mixed solution of ethanol and sodium dodecyl sulfate (SDS) is more efficient than just SDS or just ethanol. This could lead us to think that we could create a really powerful hand sanitizer using multiple chemical agents. Though this is sometimes the case, the reality of manipulating, producing and purchasing SDS and ethanol is very different, and creating one product with both would be impractical. We could of course redo the experiment more times and with other ratios and concentrations to understand this phenomenon better. If you want to learn more about the scientific process and the effect of SDS on bacterial membranes, you can read this article.

Written by Clara Haas, Adèle Nevot, Pauline Gasquet & Alexandra Perron