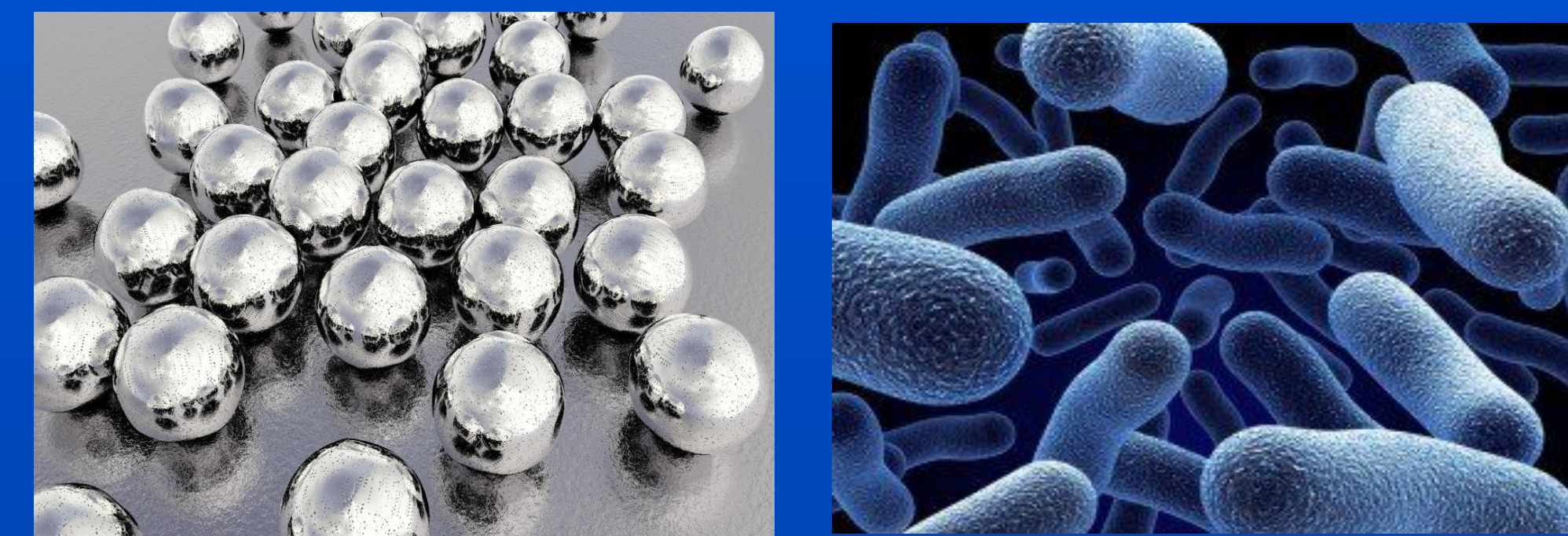


Investigating the Effect of Silver Nanoparticles on Probiotics

Summary:

- Silver nanoparticles are in many different products and materials. They have many antibacterial purposes.
- Probiotics are good bacteria that are extremely beneficial for our bodies in many ways.
- The aim of our project is to see if silver nanoparticles have an effect on probiotics as well as harmful bacteria.
- We grew our probiotics on agar plates and tested silver nanoparticles on them.
- We used a control of E.coli as silver nanoparticles have a proven effect against E.coli.
- After our experiments, we concluded that silver nanoparticles do have an effect on probiotics.

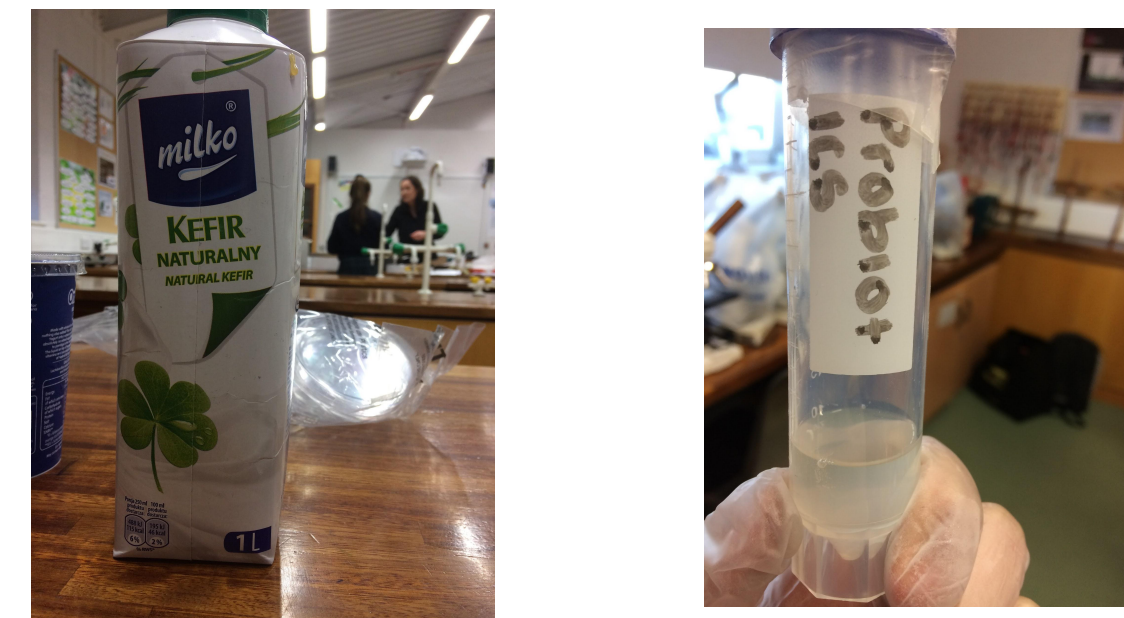


Introduction:

- Our project aims to investigate the effect of silver nanoparticles on probiotics.
- Nowadays silver nanoparticles are used in various ways such as antibacterial coatings and lining different fabrics. They have great antibacterial effects.
- However, we began to wonder: could silver nanoparticles kill probiotics too?
- Probiotics are good bacteria that are extremely beneficial for our bodies in many ways, so we don't want them to be removed.
- We did some research and found that silver nanoparticles have been tested in marine environments, and they are harmful to the different plant and animal species.
- We decided to see how they affected probiotics.

Method:

- We carried out a series of experiments testing silver nanoparticles on probiotics.
- We used kefir (which contains probiotics) and probiotic capsules.



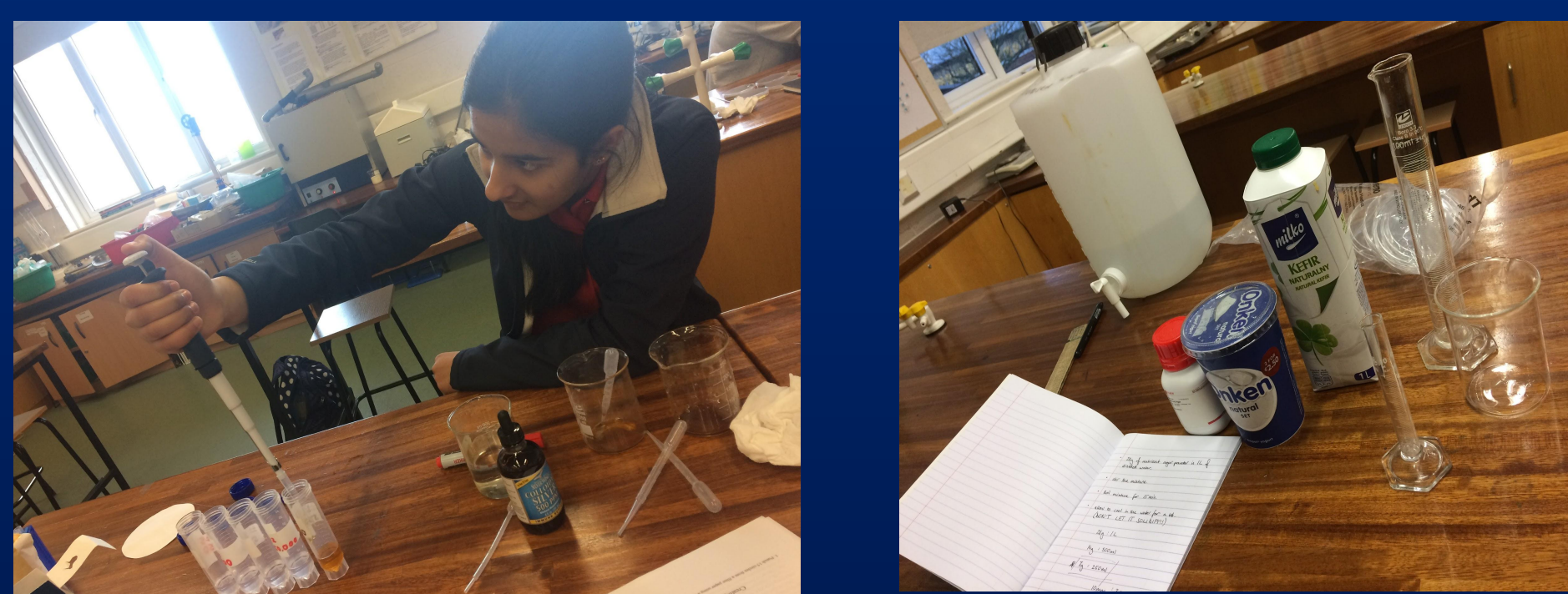
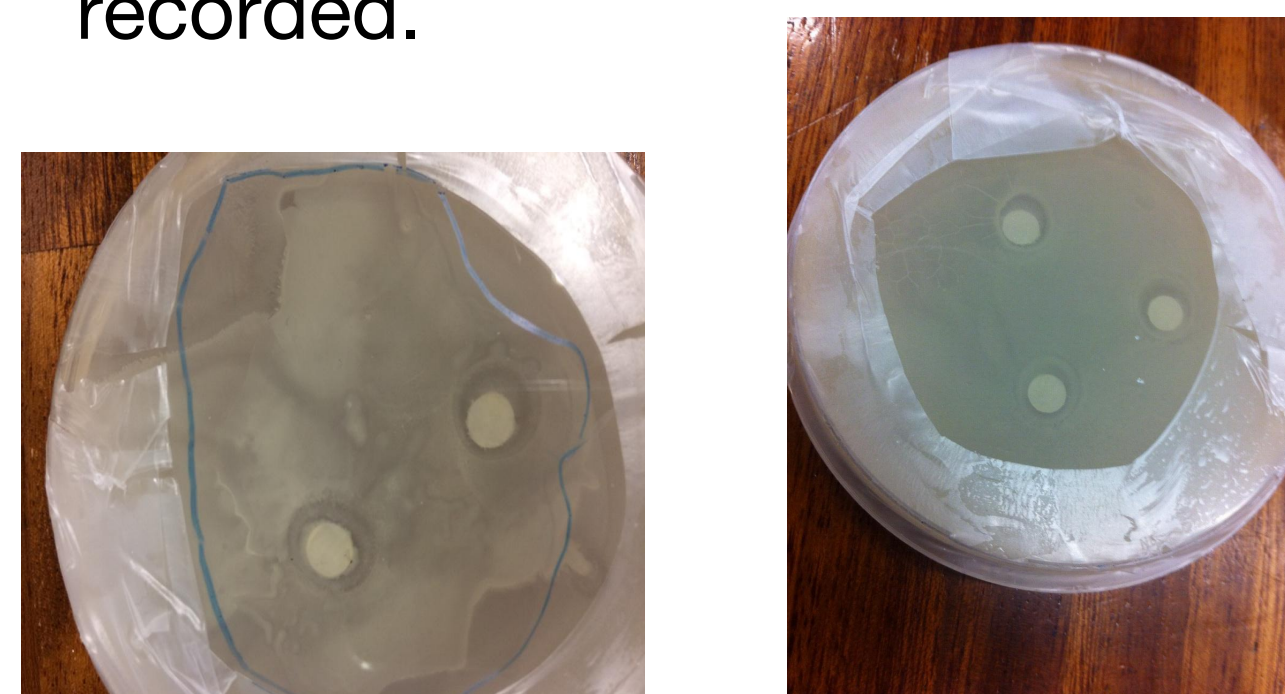
- We used a control of E.coli as silver nanoparticles have a proven effect against E.coli.
- We made serial dilutions of colloidal silver (liquidized silver nanoparticles).



- Using filter paper discs, we soaked up the colloidal silver. We placed them on our plates with our probiotics.



- They were checked daily and any zones of inhibition (zones with no bacterial growth) were measured and recorded.



Results:

- Here is a sample of some of our results:

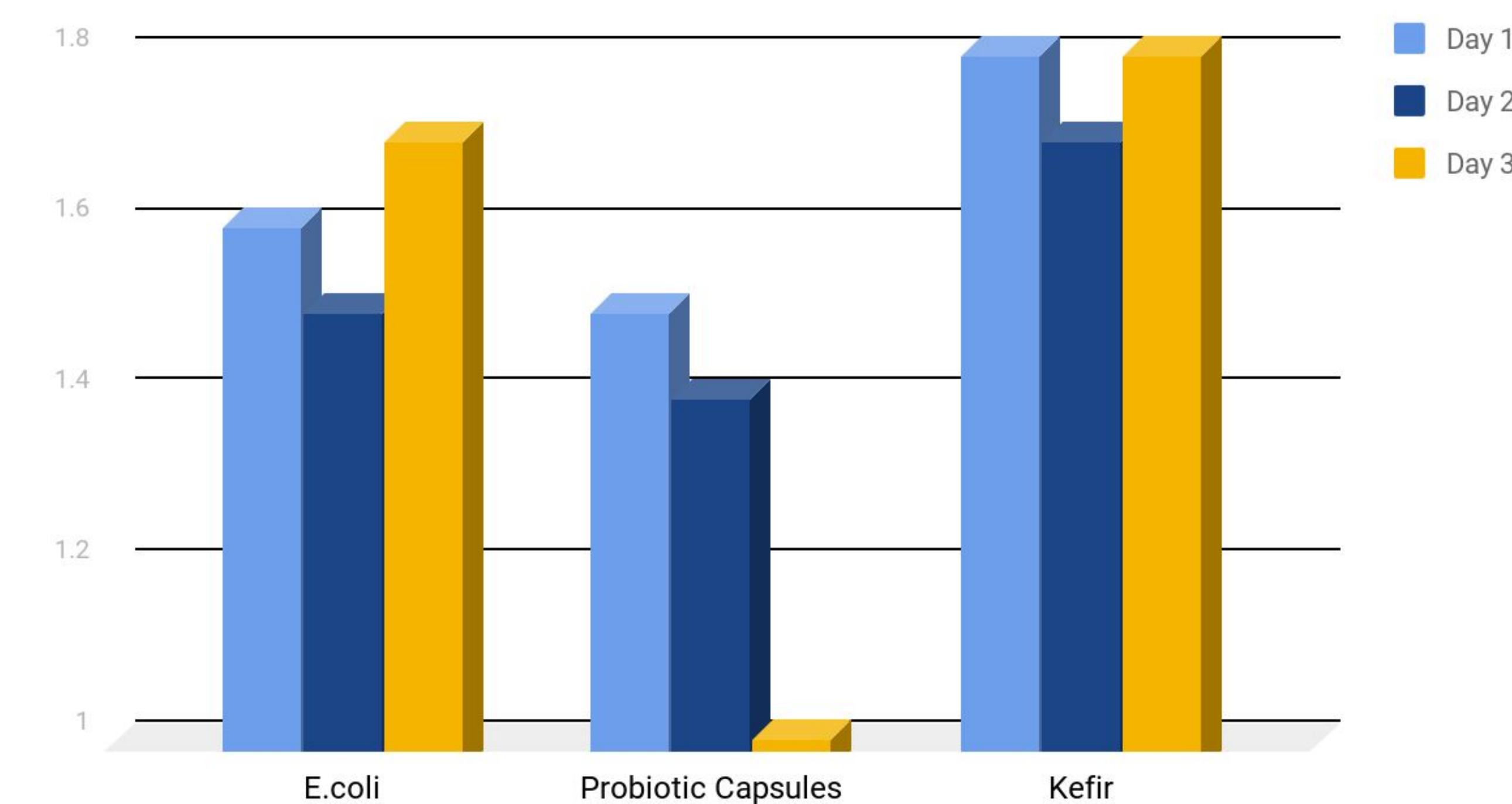
Measurements of Zones of Inhibition:

E.coli:	Control:	50,000 µg/L concentration discs:	5000 µg/L concentration discs:	500 µg/L concentration discs:	50 µg/L concentration discs:	5 µg/L concentration discs:
Day 1:	No Zones	Zones: 4mm 3mm 1 disc slipped	Zones: 3mm 2mm 1 disc slipped	Zones: 2mm 1mm 1mm	Zones: 2mm 1mm 0.5 mm	Zones: 1mm 0.5 mm No other zones recorded
Day 2:	No Zones	Zones: 4mm 3mm 1 disc slipped	Zones: 3mm 2mm 1 disc slipped	Zones: 2mm 1mm 0.5mm	Zones: 2mm 0.5 mm 0.5mm	Only one zone of 1mm
Day 3:	No Zones	Zones: 4mm 3mm 1 disc slipped	Zones: 3mm 2mm 1 disc slipped	Zones: 2mm 1mm 0.5mm	Zones: 1mm 0.5mm 0.5mm	No Zones

T-Test Results:

Capsules #1	Control	50,000 µg/L dilution	5000 µg/L dilution	500 µg/L dilution	50 µg/L dilution	5 µg/L dilution
Day 1	0mm 0mm 0mm	3mm 2mm 2mm	3mm 2mm 1mm	2mm 1mm 1mm	0mm 0mm 0mm	0mm 0mm 0mm
T-Test		0.00219213	0.025721421	0.01613009	No Difference	No Difference
Day 2	0mm 0mm 0mm	3mm 2mm 1mm	3mm 2mm 1mm	1mm 1mm 1mm	0mm 0mm 0mm	2mm 1mm 0mm
T-Test		0.025721421	0.025721421	Significant Difference	No Difference	0.158302423
Day 3	0mm 0mm 0mm	3mm 1mm 0mm	3mm 1mm 1mm	1mm 0.5mm 0mm	1mm 0.5mm 0mm	2mm 1mm 0mm
T-Test		0.205106455	0.066766545	0.158302423	0.158302423	0.158302423

Comparison Of The Average Zones Of Inhibition For All Dilutions Each Day



The experiment with kefir led to the largest zones. The average of the zones remained consistent for the E.coli and kefir but dropped for the probiotic capsules on day 3.

Conclusion:

- Our results show that silver nanoparticles do have a significant effect on the growth of probiotics.
- The E. coli plates had zones of inhibition present for all of the dilutions of silver nanoparticles as expected. We discovered that discs of colloidal silver on E. coli plates created zones of inhibition with significant differences when compared to the control for the following dilutions: the 500 µg/L (micrograms per litre) and 50 µg/L dilutions.
- The plates containing probiotic bacteria had zones of inhibition present for all of the dilutions of colloidal silver. The strongest dilutions of 50,000 µg/L, 5,000 µg/L, 500 µg/L and 50 µg/L all had significant results, with $p < 0.05$, when compared to the control. Examples of some of the p values are as follows: 0.002 for the 50,000 µg/L, 0.03 for the 5,000 µg/L, 0.02 for the 500 µg/L and 0.007 for the 50 µg/L.
- The kefir plates had zones of inhibition for all of the dilutions. The dilutions of 500 µg/L, 50 µg/L and 5 µg/L all had significant results, with $p < 0.05$, when compared to the control. Examples of some of the p values are as follows: 0.007 for the 500 µg/L and 0.03 for the 50 µg/L and 0.02 for the 5 µg/L.
- The conclusion we have reached is that silver nanoparticles have a negative effect on probiotics. As probiotics are beneficial for humans, the fact that their growth was inhibited is problematic for human health. We would like to open a debate about the use of silver nanoparticles and would encourage more research into their negative effects.

