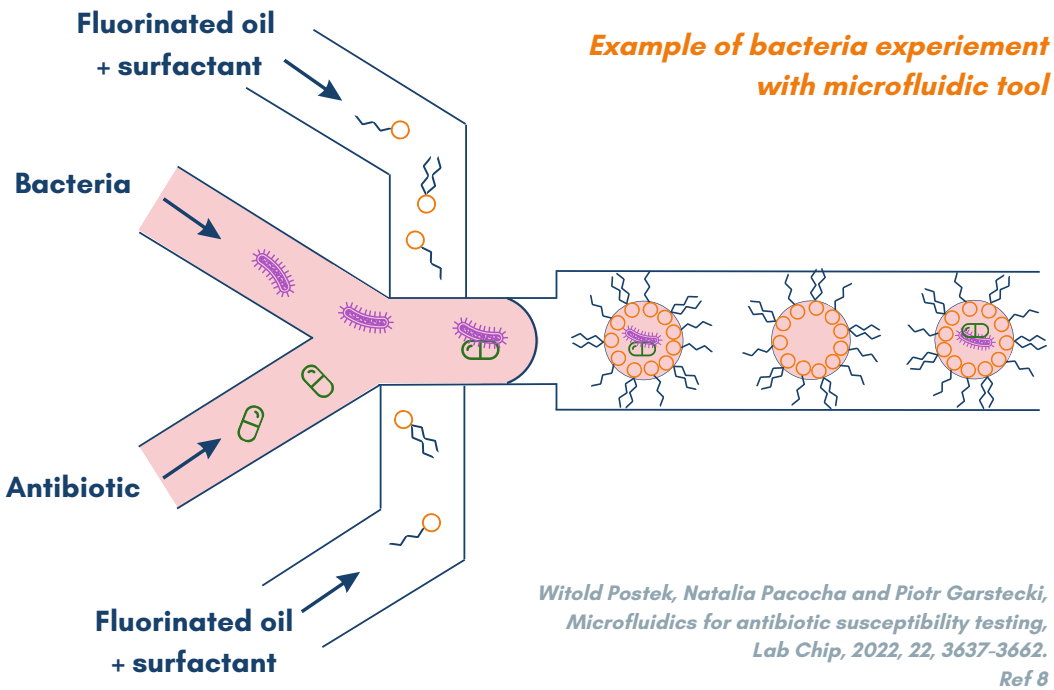
European Antibiotic Awareness Day, November 18

Antibiotic resistance is a serious concern throughout the world. More than 33000 and 35000 deaths per year are caused by bacteria infection in European Union[1] and in the USA[2] respectively. The World Health Organization (WHO) is even predicting 10 million bacteria induced deaths per year by 2050.[3] The increase of antibiotic resistance of bacteria is one of the biggest challenges for today and tomorrow health. The WHO defines antibiotics as "medicines used to prevent and treat bacterial infections".[4] Bacteria change in response to antibiotics use leads to antibiotic resistance. Despite the natural process of resistance, the misuse of antibiotics in both humans and animals speeds up the process. The infections caused by bacteria become harder to treat as they become resistant to antibiotics, which leads to longer hospital stays, higher medical costs and higher mortality. It is currently considered to be one of the most significant threats to global health. It is imperative that we take immediate action to discover new antibiotics and quickly diagnose bacteria resistance profile.[5]

Over the past years, the use of droplet-based microfluidics has allowed huge scientific breakthroughs in rapid diagnosis of the bacteria resistance profile, which gives insights on the sensitivity of a specific bacterium to a wide range of antibiotics. Quantifying the bacterium resistance to a specific antibiotic is achieved by generating aqueous droplets containing the living bacterium cell and the antibiotic to test. Using a surfactant such as FluoSurf™ is required to ensure the stability of the droplets from their generation to their detection.[6,7] The bacterium cell can be monitored to determine whether there is a growth or not in the presence of different antibiotic concentrations. Thanks to this method, the lowest concentration of a drug that prevents the growth of bacteria can be determined. This minimum inhibitory concentration (MIC) sets whether the bacterium is susceptible, intermediate or resistant to the antibiotic. When the bacterium is susceptible, the antibiotic has a high probability of being effective whereas at the contrary, when the bacterium is resistant, the antibiotic is unlikely to be effective.[8] Testing different antibiotic concentrations also allows to establish the most appropriate concentration to kill the bacterium and so the medication dosage.



Example of bacteria experiement with microfluidic tool

Witold Postek, Natalia Pacocha and Piotr Garstecki, Microfluidics for antibiotic susceptibility testing, Lab Chip, 2022, 22, 3637-3662. Ref 8

European Antibiotic Awareness Day, November 18

Sometimes, a single drug is inefficient and multiple drugs are necessary to kill bacteria. This is called combination therapy.[9] Thanks to droplet-based microfluidics, rapid screening of a large collection of molecules for bioactivity testing can be achieved and permit to select the more effective drug combination to kill the bacteria. To select the most efficient treatment, hundreds of thousands of experimental samples are subjected to simultaneous testing under given conditions.

To conclude, droplet-based microfluidics is a highly sensitive, fast and accurate technology with a high potential for automation. Therefore, this is a powerful and very promising tool for research on antibiotic resistance of bacteria. Its versatility makes it suitable for every step of antibiotic discovery and development.

1. *ECDC/EMEA, The bacterial challenge: time to react, 2009.*
2. *CDC, Antibiotic Resistance Threats in the United States, 2019.*
3. *Nils Daulaire, Abhay Bang, Göran Tomson, Joan N Kalyango and Otto Cars, Universal Access to Effective Antibiotics is Essential for Tackling Antibiotic Resistance, J Law Med Ethics, 2015 Summer, 43 Suppl 3:17-21.*
4. *https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance*
5. *Witold Postek and Piotr Garstecki, Droplet Microfluidics for High-Throughput Analysis of Antibiotic Susceptibility in Bacterial Cells and Populations, Acc. Chem. Res., 2022, 55, 5, 605–615.*
6. *Artur Ruszczak, Paweł Jankowski, Shreyas K. Vasantham, Ott Scheler, and Piotr Garstecki, Physicochemical Properties Predict Retention of Antibiotics in Water-in-Oil Droplets, Analytical Chemistry, 2023, 95, 1574-1581.*
7. *Lena Le Quellec, Andrey Aristov, Salomé Gutiérrez Ramos, Gabriel Amselem, Julia Bos and al., Measuring single-cell susceptibility to antibiotics within monoclonal bacterial populations, bioRxiv, 2023.*
8. *Witold Postek, Natalia Pacocha and Piotr Garstecki, Microfluidics for antibiotic susceptibility testing, Lab Chip, 2022, 22, 3637-3662.*
9. *Geraldine J Sullivan, Natasha N Delgado, Ram Maharjan and Amy K Cain, How antibiotics work together: molecular mechanisms behind combination therapy, Current Opinion in Microbiology, 2020, 57, 31-40.*

To learn more about surfactants and other formulation products for droplet microfluidics, please visit www.emulseo.com

EMULSEO, Parc AMPeRIS - Bâtiment BAYA, 8 rue Adrienne Bolland, 33600 Pessac, FRANCE
Email: contact@emulseo.com / Tel: +33 (0)5 35 54 10 06 / Website: www.emulseo.com