Rhamnolipids are surfactants, and, as the name implies, they interact with surfaces (phases) such as solid-liquid, liquid-liquid, and liquid-gas. They behave in such a way because they are amphiphilic, which means that one part of the molecule is hydrophilic (likes water), and the other is hydrophobic (does not like water). When it comes to rhamnolipids, the hydrophilic part is the rhamnose molecule, while long-chain fatty acids are the hydrophobic part (Fig.1.).

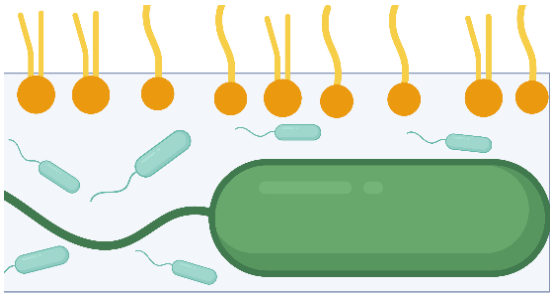

Figure 1. Graphical representation of a *Pseudomonas aeruginosa* culture with rhamnolipids.

These compounds are produced by microorganisms such as bacteria or fungi. However, the largest producer of rhamnolipids is *Pseudomonas aeruginosa*. The bacterium uses the surfactants it produces to take up water-insoluble carbon sources or reduce surface tension to swarm on semi-solid media.

It is worth pointing out that humans have also begun to use rhamnolipids. These compounds can be used in various agricultural, chemical, and pharmaceutical industries or for environmental protection. Moreover, the most extensive use of rhamnolipids is in the cosmetic industry. Unfortunately, the production cost is the biggest problem in the industrial application of rhamnolipids as an alternative to conventional surfactants. Therefore, researchers aim to find production methods that significantly lower the price of biologically produced compounds.

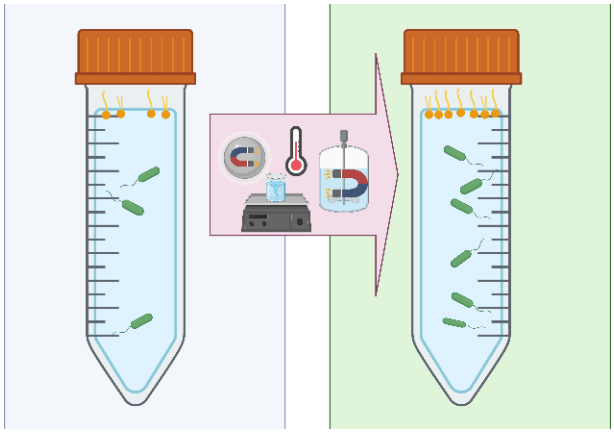

Figure 2. Graphical representation of the project.

For this reason, the proposed research project aims to investigate the effect of ferromagnetic nanomaterial (i.e., iron oxide nanoparticles) and electromagnetic fields and the combination of both factors on the production of rhamnolipids by *Pseudomonas aeruginosa* (Fig. 2.). Mathematical methods will be used to plan the experiments and reduce the number of tests and the amount of plastic, electricity, and water used during the research. In addition, such mathematical methods allow selecting the best possible (optimal) conditions for the process. The influence of the factors mentioned above on the rhamnolipids produced by the bacteria will also be studied. Such changes in the structure of the compound affect its properties. Therefore, physicochemical and antimicrobial analyses are planned to determine changes in the properties and structure of these bacterial surfactants. Some of these studies will be carried out in international collaboration with researchers from Ecole Nationale Supérieure de Chimie de Rennes in France. The research will provide data on the effects of ferromagnetic nanomaterial and/or electromagnetic fields on the production of rhamnolipids by the *Pseudomonas aeruginosa*, which will contribute to optimising the production of these surfactants. In addition, the project may provide information on how to increase the production of other compounds produced by the bacteria.