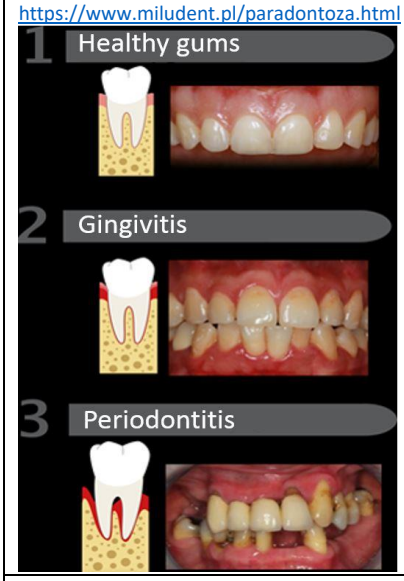
https://www.miludent.pl/paradontoza.html



DO YOU KNOW THAT:

-Epidemiological studies have shown that in Poland, 50% of 7-year-olds, 75% of 12-year-olds and 99% of adults have the periodontal disease;

- In an advanced state, lesions occupy the periodontal bone and ligaments, eventually leading to loosening and loss of teeth;

- Currently, the treatment of periodontal disease consists of non-surgical and surgical procedures. The actual treatment phase includes the so-called non-surgical treatment (deep cleaning of the affected area, temporary or permanent fixing of the teeth (splinting) and oral pharmacotherapy in the form of antibiotics), followed by surgical procedures if necessary.

WHAT IS THE PROBLEM?

An orally/intravenously/intramuscularly administered antibiotic disrupts the microflora throughout the body. Only a small portion of the drug mass reaches the actual inflammatory site. Topical administration of drugs in the treatment of periodontal disease is complicated due to the site's configuration and the oral cavity's moist environment.

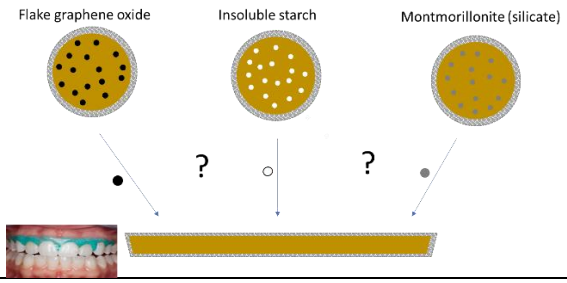
WHAT CAN WE DO ABOUT IT?

Whenever possible for inflammatory conditions, also in dentistry, it is advisable to act locally. A carrier can be developed for the drug(s) selected with selectivity to the strain(s) causing the inflammation. Drug release from the carrier should occur over a relatively long period (several days/weeks); hence the carrier must be a sufficient reservoir of drug mass(es) for the duration of the therapy.

HOW DOES THE PROJECT RELATE TO THIS PROBLEM?

The project proposes to develop the drug carrier as a three-phase structure. A sorbent, for which the dispersion environment will be a hydrogel, will provide an adequate (sufficient for the duration of the therapy) drug mass. The polymeric layer will be primarily responsible for the rate of drug release. Its thickness and porosity will determine the diffusing mass flux. The sorption equilibrium dictating the maximum drug concentration in the hydrogel (the driving force behind the diffusion process) will also be responsible for the mass flux. Therefore, the choice of a sorbent is one of the carrier's key parameters. The project will consider flake graphene oxide, insoluble starch, and silicate - montmorillonite.

Hydrogel structure with sorbent will be printed on a 3D printer and surrounded with a polymer layer in a coating machine. The shape of the carrier will match the splints currently used to support teeth for treatment. For modelling purposes, a quadrilateral prism shape on a trapezoidal base will be assumed.



WHAT TASKS DO WE NEED TO ACCOMPLISH?

The project requires:

- the selection of drugs (antibiotics) effective in controlling inflammation and determination of lethal doses for selected strains causing periodontal inflammation;
- the selection of sorbent - determination of sorption equilibrium;
- the design and manufacture of a three-phase carrier;
- the development of a multiphase transport model and its verification, including identification of the dominant resistance(s);
- the analysis of drug release under oral conditions - application of computational fluid dynamics (CFD) taking into account the flow of saliva in the mouth;
- the manufacturing of a carrier with given parameters as indicated by optimisation and its use to remove inflammation-causing bacteria under conditions simulating the oral cavity (artificial saliva, the flow rate corresponding to wetting of the gums with saliva);
- the excluding the cytotoxicity of the manufactured carrier;
- the mass transport modelling from an irregularly shaped structure (approximating the rail structure to a quadrilateral prism based on a trapezoid).