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# INFRARED-TRIGGERED SYSTEMS FOR DRUG DELIVERY

Omiyale O.C. (ITMO)
Scientific supervisor – Candidate of Chemical Sciences, Leading Researcher, Associate Professor Ulasevich S.A.
(ITMO)
Supervisor - Candidate of Chemical Sciences, Prof. E.V. Skorb.

## Introduction.

This work investigates the development of a biomimetic system based on hydroxyapatite, which is combined with amino acids and infrared-sensitive polyelectrolytes to prolong drug release. The goal of the investigation is to develop a drug delivery platform that has an increased capacity to load drugs and utilizes controlled release mechanisms and can serve as a preliminary base for further research on more complex systems that is based on tetracycline physiosorbed on hydroxyapatite then placed in titanium nanotubes. The study of the mechanisms of these systems as model study for a more complex one is very relevant due to the need to explore synergistic interactions and fine-tune the release dynamics, aiming to addresses the current limitations of drug delivery systems, set the stage for further advancements in the design and functionality of biomimetic platforms and contribute significantly to the ongoing evolution of drug delivery platforms, fostering innovation and paving the way for transformative applications in the field of healthcare [1].

Hydroxyapatite ($Ca10(PO_4)_6(OH)_2$) (HA) is of great interest as a promising material for bone implants fabrication, design biomaterials for hard tissue repair and replacement due to its excellent biocompatibility & close composition and structure similarity to the main inorganic component of bones. The ability of HA to form the Liesegang rings (LRs) under slow and controlled conditions in agar matrix can be used as a simplified model system for simulation of the growth in human body and all the necessary properties for use as a local drug delivery bio coating. [2]

## Methodology

The model system involves the sol–gel process, where gradual ion diffusion and phase transitions of calcium phosphates to aggregate the inorganic Liesegang rings (LRs). HA is prepared through the diffusion of $CaCl_2$ through $Na_2HPO_4$, eventually resulting in the generation of Hydroxyapatite. The $Na_2HPO_4$, (0.072g) was dissolved in 0.1g agar solution, glycine of various concentrations (0.5, 1 and 2mg/ml) is also added and stirred while heating until the mixture becomes homogeneous.
Then, this solution was added into a petri dish and cooled down at room temperature 25°C till agar gelation, without any disturbance. [2]
A solution of 1M calcium chloride solution (50 µL outer electrolyte) was poured into the dishes with gelled agar and $Na_2HPO_4$. Incorporation of the composite with tetracycline was performed by absorption of the adequate amount of tetracycline hydrochloride (0.5 g tetracycline/10 g composite) as an aqueous solution for 24 hours. [3] Then deposition of infrared-sensitive polyelectrolytes. Visual observations and characterization is then carried out.
The release kinetics was investigated under the action of Infrared light @808nm. The IR-free release was used as a control. Aliquots are taken from solution after 1, 3, 5, 7, 10, 20 and 30 min to analyze drug release. The amount of released substance was determined spectrophotometrically.

Physical and Chemical Characterization of HA was carried out on the dried powder of calcium phosphates (at 60°C for 3 hours) obtained from the petri dish by different techniques such as optical fluorescence microscopy, electron scanning microscopy, infrared spectroscopy and energy dispersive X-ray analysis.

**Conclusion.**

Thus, the crystalline and elongated needle-shaped nanocrystals of HA and polyelectrolytes bound tetracycline systems was obtained and tested. IR-trigger provided controlled release of antibiotics at a faster rate compared to control. This highlights the ability of Infrared irradiation to penetrate the human body and make it possible for delayed release of the antibiotic as desired clinically.

**List of sources used**:


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