# Raman spectroscopy study of calcium and strontium phytate as a material to prolonged release of risedronate

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## Abstract

**Statement of the Problem:** Risedronate is a bisphosphonate drug that is mainly used to treat osteoporosis. Its main disadvantages include very poor bioavailability and a short half-life in plasma. Using modern drug carriers may offer a solution to this problem. For this purpose, a carrier based on calcium and strontium phytate particles was prepared. Calcium and strontium are non-toxic and have positive effect in the treatment of osteoporosis. The obtained materials were analyzed using various spectroscopic techniques, including Raman spectroscopy.

**Results:** The conducted Raman spectroscopic research confirms the successful sorption of the drug onto the prepared materials (Figure 1). The distribution of risedronate in calcium phytate and strontium phytate particles was presented using the Raman mapping. Risedronate is evenly retained on both materials, without any noticeable drug agglomerates (Figure 1). It means that the same amount of drug will be released from the same amount of carrier.

**Conclusion**: Calcium and strontium phytate particles were used for the first time as a drug carriers for the bisphosphonate drug sodium risedronate. The performed analysis confirmed successful drug sorption on the surface of the prepared materials. Raman mapping shows that drug is distributed almost equally on the entire surface of the synthesized phytates. Furthermore, other techniques indicate that the material with $Ca^{2+}$ ions retained higher amounts of drug compared to the material with $Sr^{2+}$ cations. Drug release study shows that both prepared carriers are able to successfully release risedronate from their surface, however drug is released more gradually from calcium phytate material.

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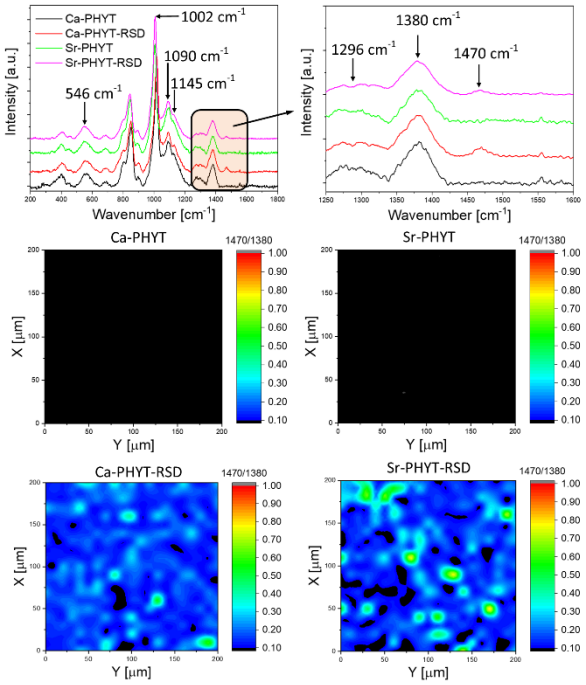


**Figure 1.** Raman spectra of carriers before and after drug sorption (top) and Raman maps for the ratio of the 1470 $cm^{-1}$ band intensity (risedronate) to the 1380 $cm^{-1}$ band intensity (Ca-PHYT, Sr-PHYT) recorded on the surface of Ca-PHYT, Sr-PHYT, Ca-PHYT-RSD, and Sr-PHYT-RSD (middle and bottom) [1].

## Recent publications:

1. M. Sandomierski, M. Jakubowski, M. Ratajczak, T. Buchwald, R. E. Przekop, Ł. Majchrzycki, A. Voelkel, Calcium and strontium phytate particles as a potential drug delivery system for prolonged release of risedronate, Journal of Drug Delivery Science and Technology 80 104176 (2023).
2. T. Buchwald, Z. Buchwald, A. Daktera-Micker, The fluorescence background in Raman spectra of sound enamel, Vibrational Spectroscopy 115, 103275 (2021).
3. T. Buchwald, Z. Buchwald, Assessment of the Raman spectroscopy effectiveness in determining the early changes in human enamel caused by artificial caries, Analyst 144(4), 1409-1419 (2019).
4. T. Buchwald, Z. Okulus, M. Szybowicz, Raman spectroscopy as a tool of early dental caries detection - new insights, Journal of Raman Spectroscopy, 48 (8), 1094-1102 (2017).
5. J. Szczuka, M. Sandomierski, A. Voelkel, K. Grochalski, T. Buchwald, Surface Modification of Ti6Al4V ELI Titanium Alloy by Poly (ethylene-alt-maleic anhydride) and Risedronate Sodium, Materials 16 (15), 5404 (2023).

Photograph

## Biography

Specialist in the study of biological materials such as bone tissue, teeth, and biomedical materials including dental fillings and modified titanium alloys with potential use as materials for prostheses, utilizing Raman spectroscopy. One area of research involves the application of Raman technology in disease diagnosis, such as dental caries.

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