

Fluorimetric vitamin B2 sensor study using CQDs synthesized by thermal method

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Abstract – In this study, carbon quantum dots (CQDs) were synthesized through the thermal method and it is aimed to test the sensor sensitivity to vitamin B2 in fluorimetric measurements with CQDs. Therefore, for this study, CQDs were synthesized from glutathione by the thermal method, and to observe the distribution of CQDs among B2 vitamins in AFM, their nano size was measured by atomic absorption microscopy (AFM) and their morphological structure among B12 vitamins was examined by scanning electron microscopy (SEM). After these characterizations, the fluorimetric study will be carried out and the limit of detection (LOD) and limit of quantification (LOQ) will be calculated by taking fluorescence peaks against vitamin B2 at different concentrations. LOD and LOQ values are expected to be around 12-20 and 36-40 μM , respectively. This study is a study that will shed light on sensor studies for vitamin B2, its derivatives and other vitamins.

Keywords – B2 Vitami;N Cqds; Flourimetric Study Thermal Method; Sensor Studies;.

I. INTRODUCTION

The body's daily need for vitamin B2 is met mostly from riboflavin, which is naturally found in foods ¹. Vitamin B2's functions include supporting growth and development in the body, taking part in the digestion of nutrients, and contributing to brain functions ². Vitamin B has various functions. It is vitamin B2 synthesized by riboflavins in the body. Other derivatives of vitamin B are B12, B1, B3, B6, B7 and B9 ³. Vitamin B derivatives are generally found in various foods such as red meat, fish, white meat, grains, and avocado ⁴. Vitamin B12 cannot be taken into the human body insufficiently from foods, so supplementary vitamin capsules are extremely important ⁵. Researchers have placed emphasis on the sensory activity of vitamin B ⁶.

Sensors are devices that produce a permanent signal against the analyte to be analyzed. The signals obtained from these devices must be always continuous ⁷. These signals are converted into digital data through a transducer and recorded with a detector ⁸. Sensors are divided into various types, including fluorimetric, electrochemical, optical, biosensors, etc. Analyte-sensitive catalysts in sensors are important for the formation of signals. Nanosized elements are widely used as catalysts ⁹.

Nanotechnology is a branch of science that studies sizes between 1 and 100 nm ¹⁰. Nanotechnology is a highly preferred field of study in sensors, catalytic studies, medicine and health ¹¹. For example, in a sensor study, a sensor against the tuberculosis drug rifampicin was developed by synthesizing MWCNT-supported iron nanoparticles ¹². In another study, a sensor system

was developed against the cancer drug idarubicin by using nanotechnology¹³.

In this study, carbon quantum dots (CQDs) were synthesized from thermal metamaterials. It is planned to conduct studies to determine whether the synthesized CQDs show sensitivity in the presence of vitamin B2 in fluorimetric media. For this reason, the CQDs we had previously synthesized were characterized and examined using atomic absorption microscopy (AFM) and scanning electron microscopy (SEM).

Materials and Method

A. Materials

All products were supplied from Sigma & Aldrich. Natural resources were obtained from a local commercial organization.

B. Methods

Natural plant peels (banana, pistachios, garlic) were exposed to thermalization in a mixture of ethanol and distilled water in a Teflon-walled container at high temperature at 200 °C for 2 hours. Then the sample was filtered through Whatman filter¹⁴. Fluorimetric studies have not been performed yet. For this reason, which CQDs obtained from plants provide more effective results will be determined as a result of the planned experiments.

C. Characterizations

Characterizations were taken from the devices of Selcuk University ILTEK unit.

II. RESULTS & DISCUSSION

SEM and AFM characterization of the synthesized CQDs was performed. Figure 1 shows the SEM image of CQDs.

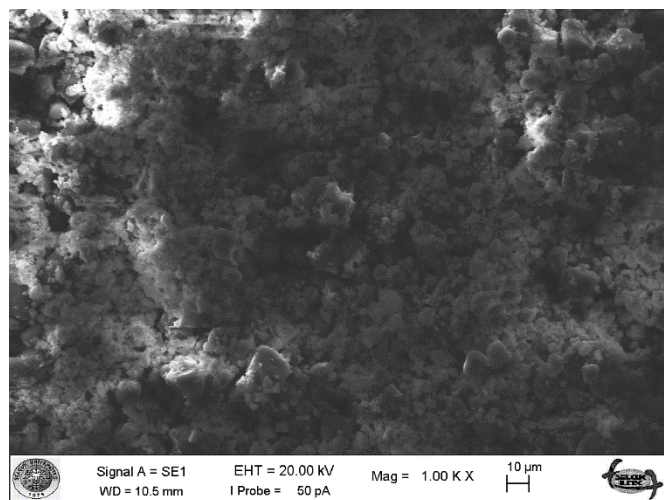


Figure 1. SEM image characterization of CQDs with B2 vitamin.

According to Figure 1, among the B2 vitamins, CQDs are observed as partially embedded and some agglomerated. This characterization was also supported by AFM. AFM image of CQDs is as in figure 2.

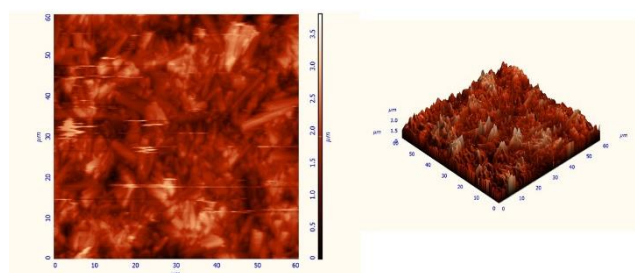


Figure 2. AFM characterization of CQDs (at 60 μm-left and CQDs 3D images (right)).

According to Figure 2, CQDs are located in the spaces between the vitamins and in clusters (left). This situation is more clearly revealed in the 3D image (right) and therefore gave images similar to the SEM characterization. This image is viewed from the 60 μm perspective.

Fluorimetric measurements of CQDs against vitamin B2 have not yet been started. However, in the planned experiments, LOD and LOQ values are expected to be 12-20 and 36-40 μM, respectively, and it is expected to give fluorimetric analysis results similar to the studies belong to Preethi et al¹⁵.

III. CONCLUSION

IN THIS STUDY, CQDS WERE SYNTHESIZED FROM NATURAL SOURCES USING THE THERMAL METHOD. AS A RESULT OF THE SYNTHESIS, SEM AND AFM CHARACTERIZATION MEASUREMENTS OF CQDS WERE TAKEN AND THEIR MORPHOLOGICAL STRUCTURES WERE EXAMINED. IT WAS OBSERVED THAT SEM AND AFM PARTIALLY SUPPORTED EACH OTHER AND CQDS WERE FOUND TO BE AGGLOMERATED AND CLUSTERED. FLUORIMETRIC MEASUREMENTS OF THIS STUDY HAVE NOT BEEN CARRIED OUT YET, AND LOD AND LOQ VALUES ARE EXPECTED TO BE 12-20 AND 36-40 μM , RESPECTIVELY, IN THE PLANNED ANALYZES.

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