

# Review Report on PhD Thesis

Faculty: **Central European Institute of Technology  
Brno University of Technology in Brno**

Academic year: **2024/2025**

Student: **Vishakha**

Doctoral study program: **Advanced Materials and Nanosciences**

Field of study: **Advanced materials**

Supervisor: Prof. RNDr. Josef Jančář, CSc.

Reviewer: Doc. Ing. Evžen Šárka, CSc.

**PhD thesis title:** Cell-Carriers by Chemical Modification of Polysaccharides

## Topicality of doctoral thesis:

Vishakha Vishakha, MSc. 's dissertation is a collection of data and results obtained during study and research until the end of 2024. The work is devoted to cell carriers based on chemically modified starch. The study is valuable because of their possible technological use in medicine, pharmaceutical industries, and cosmetics, where selenium nanostructures based on carboxymethyl ether of starch can be used.

## Meeting the goals set:

The main objective of the thesis was to develop an environmentally friendly hydrogel carrier for wound healing using sustainable materials with multifunctional properties. The researcher first studied the problem addressed in the literature review, which includes 10 pages of text. In it, she focused on starch's functional properties and tailoring, preparation of selenium nanoparticles, and hydrogel application in topical wound dressing. Although this reading includes about 60 literary references, I think it could be somewhat more detailed. The experimental part consists of 13 pages containing chemicals used in experiments, a description of instrumentation, preparation procedure of carboxymethyl starch, nanocomposites CMS / Se NPs, cell viability test, and a detailed overview of methodologies of selected laboratory analyses and separation methods. All procedures and methodologies proposed by the author described in the methodological and experimental parts were chosen correctly and correspond to the level of capabilities of the training centre, Central European Institute of Technology BUT. The objective of the work was achieved.

### **Problem solving and dissertation results:**

The dissertation was prepared overall carefully; the measurement results are factual and comprehensive, and specific and correct conclusions are drawn. The Results and Discussions chapter contains a characterization of modified starch, selenium nanoparticles, influences that affect their size and stability; composites, the possibility of hydrogel-containing nanoparticles for use in printing, and cell viability results. It includes a big range of measured data and spectra, e.g. NMR, FTIR, XRD, TGA, DLS, etc. Vishakha, MSc. also compares XPS spectra with the results of previous authors dealing with similar issues. This chapter is the most extensive and contains 69 pages including graphs, pictures, and photographs.

### **Importance for practice or development of the discipline:**

I positively evaluate the intention of the researcher to study the given issue regarding the usability of the achieved results in modern medical technology.

### **Formal adjustment of the thesis and language level:**

Graphical presentations of the results, including the output of measuring instruments, illustrate the achieved results. The dissertation is written in a professional language (English) and is clearly and understandably formulated.

- Inconsistent way of citing (the point in the sentence is sometimes before the reference number, sometimes after, sometimes both), e.g.:  
page 4: ...resistance and stiffness of starch [22, 33]  
page 5: ...resulting in a decrease in DS.[45].  
page 6: ...potential of these nanoparticles.[51]  
page 7: ... such as nanobelts, nanowires, and nanorods [52]
- Sometimes there are unnecessary capital letters inside the text, e.g. (page 7): „...reducing agents such as bovine serum albumin, D-Glucose, and Soluble starch...“
- Czech abstract:  
...syntézu Williamsonovým éterem...  
Nakonec se PVA a CMS s odpovídajícím množstvím... - verb is missing  
Diskuse fyzikálního parametru na velikost nanostruktur... - - verb is missing
- 1.3 Preparation of Selenium Nanoparticles Using Different Techniques (some sentences are unnecessarily repeated in the text):  
page 6: Starch, ... consists of polymers containing amylose and amylopectin.  
page 7: Starches are composed of polymers such as amylose and amylopectin [53].

From a professional point of view, I did not find any serious problems in the work and have no significant reservations about it.

## Questions and comments:

The comments and discussion points below are rather formal:

### - Introduction

page 1: ...amylose ... is a linear and crystalline polymer, and amylopectin ... a branched and amorphous polymer - When are amylose and amylopectin crystalline? Which parts of amylopectin in native starch are crystalline and which are amorphous?

page 3: The gelatinization of starch occurs when starch is heated at high temperatures, where the transition from amorphous to crystalline form occurs; moreover, water and oil also affect the properties of starch – does the crystalline form arise as a consequence of gelatinization? What changes does gelatinization cause in the crystallinity of starch?

### - 1.4 Hydrogel and Its Application in Topical Wound Dressing

Fig. 1 is taken from the literature? Which reference?

### - 3.2 Green Synthesis of Carboxymethyl Starch

drying conditions (temperature...) of the resulting material?

### - 3.5 3D-Printed Hydrogel Carriers

The resin was ... filtered using a 0.45 m syringe filter of 0.45 $\mu$ m ???

### - 3.7 Cell Viability Test

should rather be part of Chapter 3.8

### - 3.8 Metrology Techniques

What instrument was used to measure zeta potential? (chap. 4.3.4)

The description of the rheological measurement is very brief. What magnitudes were measured? The procedure?

### 4.1.1 Degree of Substitution

Literature [59] does not contain this methodology, where is it taken from? Does the dry matter of the sample play a role?

How do you explain low DS at 60 °C (Table 5), did gelatinization really decrease the degree of substitution?

Calculation of the “molar ratio” of starch?

The values in Table 4 are the average of how many measurements?

Table 5: what is 13C NMR?, units?, insufficiently described in the methodology

### - 4.3.1 - 4.3.3

Figure 34b, Figure 36 and others - Each point is the result of how many repetitions?

### - 4.3.4 Effect of Se-ion Concentration

This was correlated with the DLS measurement. Where was the correlation calculated?

### 4.6 Effect of PVA: CMS Ratios and the Concentration of the Selenium Nanoparticles on Hydrogel

The method for swelling ratio determination should be in the chap. 3.8; what are Ww and Wd?



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**Conclusion:**

In my opinion, the reviewed thesis fulfill all requirements posed on theses aimed for obtaining PhD degree. This thesis is ready to be defended orally, in front of respective committee.

In Prague....., date...30 January 2025.....

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Doc. Ing. Evžen Šárka, CSc.

