

**REVIEW ARTICLE**

# The 100-year legacy of the Institute of Medical Chemistry: a century of chemistry education at the Faculty of Medicine, University of Belgrade

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**Summary**

The Institute of Medical Chemistry one of the oldest institutes of the Faculty of Medicine University of Belgrade, was founded in 1923. Recognizing the role of chemistry in understanding medical sciences, the founders of the Faculty of Medicine engaged leading authorities of the time in the field of chemistry: Sima Lozanić, Milivoje Lozanić, and Petar Matavulj, establishing a solid foundation for the quality education of future doctors. Over more than a century, the teachers and associates of the Institute have successfully addressed specific challenges in medical education, adapting to contemporary trends in science and education.

**Keywords:** Institute of Medical Chemistry “Prof. Dr. Petar Matavulj”, Faculty of Medicine University of Belgrade, 100-year legacy



## INTRODUCTION

Institute of Medical Chemistry “Prof. Dr. Petar Matavulj”<sup>th</sup>, 2023, marked the 100<sup>th</sup> anniversary of its establishment with a festive symposium, where lectures on the history of the institute were held (1, 2).

## BRIEF HISTORY OF THE INSTITUTE

Faculty of Medicine, the University of Belgrade, established in 1920, did not initially have all its teaching bases; they were consecutively formed. Professors Đorđe Joannović and Richard Burian recognized the importance of understanding medicine at the molecular level and accordingly engaged chemistry professors to provide students with chemistry education. In 1922, Professor Petar Matavulj was invited to teach chemistry. At that time, he was an assistant at the Chemistry Institute in Lausanne. Until the establishment of the Institute of Chemistry of the Faculty of Medicine in 1923, lectures in chemistry were held by professor Sima Lozanić and his son Milivoje Lozanić at the Faculty of Philosophy, the Department of Chemistry. Sima Lozanić was a chemist, scientist, professor, president of the Academy of Sciences, rector of the Great School, and the first rector of the University of Belgrade. He graduated in law at the Belgrade High School and then spent four years in Zurich and Berlin studying chemistry with the famous scientists Wislicenus and Hoffmann (3).

The Institute of Chemistry was founded in 1923 in two rooms located in a wooden barrack at Guberevac, where the Internal Propaedeutic Clinic was also located. One of the rooms was used for student laboratory practice, and the other was the professor’s laboratory. The course lasted for two semesters, with five (5) lectures and ten (10) hours of practical laboratory classes per week. The first generation that completed the entire chemistry course at the Faculty of Medicine under professor Petar Matavulj enrolled in 1925 (4).

In 1925, the Institute of Chemistry was relocated to the building of the Institute of Pathology. From 1925 to 1932, practical laboratory classes were conducted at today’s Institute of Microbiology, and in 1932 they were relocated to the Institute of Chemistry, when the first proper chemical laboratory with 24 seats was equipped. In 1938, the Institute was relocated to the Institute of Histophysiology’s building, situated on the left, above the Institute of Histology. When the Faculty of Medicine founded the Department of Pharmacy in 1939, the Institute expanded, and a larger number of laboratories were placed in the building’s basement for the needs of the analytical chemistry of the Department of Pharmacy. The building of the Institute of Histophysiology was destroyed during the bombing on April 6<sup>th</sup>, 1941, and together with it, the Institute of Chemistry was complete-

ly burned down. Part of the salvaged material, extracted from the ruins, was transferred to the Institute, which was relocated to the ground floor of the Institute of Pathology. During the occupation, classes were not held at the Institute. In 1947, the Institute of Chemistry moved to the Internal “B” Clinic. After the restoration of the Institute of Histophysiology in 1950, the Institute of Chemistry moved to the premises it occupies today (5).

From 1948 to 1994, the Institute of Chemistry provided education not only to medical students but also to dental students. In the first few years after the establishment of the Faculties of Medicine in Novi Sad (1960), Niš (1960), Priština (1969), and Kragujevac (1976), the staff of the Institute of Chemistry participated in organizing and conducting chemistry classes at these faculties.

The number of chemistry classes has changed since the establishment of the department. Until 1977, students studied chemistry for two semesters i.e., 30 weeks, and since 1977 to 2004 for one semester, i.e., 15 weeks. Until the academic year 2003/04, the chemistry teaching was conducted in the first semester during the first year of studies with a total of 135 hours (Figure 1) (6).

Following the revised curriculum from 2004/05, the chemistry is a part of the joint subject “Medical Biochemistry and Chemistry” for second-year students of the integrated academic medical studies (both in Serbian and English). The first 9 weeks are dedicated to chemistry (during the third semester), with a total of 72 classes (45 theoretical-lectures and seminars, and 27 practical laboratory classes). Professors and assistants of the Institute also teach 13 elective courses for students in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> years of the integrated academic studies of medicine.

Within postgraduate studies, members of the Department of Chemistry in Medicine participate in the implementation of specialist studies in clinical biochemistry and laboratory medicine, and doctoral studies in biochemical and physiological sciences. Since 1995, our professors are engaged in the preparatory courses for the entrance exam in chemistry (60 classes), and in collaboration with chemistry professors from other medical faculties, the professors of the Institute prepare the entrance exam in chemistry.

## SCIENCE AT THE INSTITUTE

From its foundation to the 1980s, the most important issues of scientific research included: examination of RNA and DNA content and nuclease activity in the blood of patients with various malignancies, determination of the guanase activity in the blood in various neuropsychiatric and renal diseases, examining the properties and structure of nucleohistones during aging, the influence of insulin on the metabolism of proteins, lipids and carbohydrates, examination of the properties of sunflower oil

| PLAN NASTAVE MEDICINSKE HEMIJE |   |             |   |  |
|--------------------------------|---|-------------|---|--|
| Nedelja                        | PREDAVANJA  | Broj časova | KONSULTACIJE  | VEŽBE  |
| I                              | Struktura i hemijske veze<br>Oksido-redukcije i redoks sistemi<br>Osnovi elektrohemije  | 3           | Upoznavanje; uzimanje podataka; karton Zakoni hemijskog sje-dinjanja; periodni sistem elemenata; tipovi jedinjenja; stehio-metrijski zadaci |  |
|                                |   | 2           |   |  |
| II                             | Uvod u organsku hemiju<br>Struktura i klasifikacija organskih jedinjenja<br>Tipovi neorganskih jedinjenja<br>Voda i vodeni rastvori | 3           | Stehiometrijski zadaci  | Hemijske reakcije jona:<br>Ag <sup>+</sup> , Pb <sup>2+</sup> , Hg <sup>2+</sup> , Cl <sup>-</sup> , NO <sub>3</sub> <sup>-</sup>  |
|                                |   | 2           |   |  |
| III                            | Koncentracije rastvora, koligativne osobine<br>Energetika hemijskih reakcija  | 3           | Hemijske veze; stehiometrijski zadaci<br>Test I   | Hemijske reakcije jona:<br>Zn <sup>2+</sup> , Fe <sup>3+</sup> , Ca <sup>2+</sup> , Ba <sup>2+</sup> , NH <sub>4</sub> <sup>+</sup> , J <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , CO <sub>3</sub> <sup>2-</sup> |
|                                |   | 2           |   |  |
| IV                             | Hemijska kinetika<br>Ugljovodonici: alkani, alkeni, dieni; izomerije  | 3           | Diskusija testa I<br>Koncentracije rastvora   | Pravljenje rastvora odredjene koncentracije  |
|                                |   | 2           |   |  |
| V                              | Aromatični ugljovodonici<br>Halogenski derivati<br>Hidroksilni derivati<br>Hemijska ravnoteža                                       | 3           | Koligativne osobine rastvora<br>Test II (koncentracije)   | mol/l HCl  |
|                                |   | 2           |   |  |
| VI                             | Teorije kiselina i baza<br>Konstanta disocijacije<br>Suzbijanje disocijacije, amfoternost   | 3           | Oksidoredukcije<br>Diskusija testa II   | mol/l J <sub>2</sub>   |
|                                |   | 2           |   |  |
| VII                            | Alkoholi, fenoli, tio derivati ugljovodonika<br>Proizvod rastvorljivosti, hidroliza   | 3           | Hemijska kinetika<br>Teorije kiselina i baza, neutralizacija, hidroliza<br>Test III (koligativne osobine rastvora, oksidoredukcije)         | mol/l NaCl   |
|                                |   | 2           |   |  |
| VIII                           | Glicidi, monosaharidi<br>Derivati monosaharida  | 6           | Stehiometrijski zadaci  | Pregled predjenog gradiva  |
| IX                             | Holozidi, oligo i polisaharidi  | 6           | Puferi, acido-bazna ravnoteža<br>Test IV (hidroliza, puferi, oksidoredukcije)   | Pravljenje rastvora pufera odredjene pH vrednosti  |
| X                              | Amini, karboksilni derivati ugljovodonika<br>Derivati kiselina<br>Derivati ugljene kiseline   | 5           | Hemijske reakcije u organskoj hemiji<br>Diskusija testa IV  | Reakcije alkohola i fenola, aldehida i ketona  |
| XI                             | Supstituisane kiseline, halogenske, hidroksi, aldehydne i ketonske.<br>Amino kiseline   | 5           | Test I (organska hemija)  | Reakcije ugljenih hidrata  |
| XII                            |   |             | N a d o k n a d e v e ž b i   |  |
| XIII                           | Medicinski značajni elementi i njihova jedinjenja   | 6           | Karbonske kiseline; derivati kiselina; lipidi<br>Test II (organska hemija)  | Reakcije organskih kiselina i lipida   |
| XIV                            | Heterociklusi<br>Proteini<br>Nukleinske kiseline  | 6           | Supstituisane kiseline i belančevine  | Reakcije amino kiselina i belančevina  |

Figure 1. The syllabus of Medical Chemistry from 1986

modified by temperature and aging, comparison of methods of electrophoretic separation of serum proteins on various gels and application in solving clinical problems.

As part of the professional work at the Institute, various chemical analyses of clinical samples were performed (at that time current analyses in blood: urea, glucose, amino acids, creatinine, cholesterol, etc.). Also, chemical analyses of mineral water were performed. Chemical analyses of drugs were carried out for the Commission for Drugs under the Ministry of Health.

Since the 1980s, scientific research work has included the isolation, purification and characterization of biomolecules from different sources: human, animal, microbial, and plant. The research is based on preparative biochemistry, fundamental enzymology, structural and functional protein tests, identification and analysis of metabolites, using spectrophotometry, electrophoretic and related techniques and methods.

Nowadays, an important turn of scientific research has been made towards new methods and techniques in the study of genomes, proteomes, and metabolomes. Scientific





Figure 2. Prof. Dr. Petar Matavulj

research is conducted at the Institute in five research laboratories: the Laboratory for Protein Biochemistry, the Laboratory for Protein Mass Spectrometry, the Laboratory for Biomolecule Analytics, the Laboratory for Fundamental Enzymology and *In Vitro* Toxicology, and the Laboratory for Bioinorganic and Bioorganic Chemistry in Medicine. The research includes areas such as protein biochemistry, toxicology, microbial and human enzymology, biomolecule analytics, and bioinorganic chemistry. This research is carried out through national research projects as well as international research projects and collaborations.

### DISTINGUISHED PROFESSORS

Prof. P. Matavulj, founder of the Institute, the Dean of the Faculty of Pharmacy and Acting Dean of the Faculty of Medicine (Figure 2), was born in 1892 in Šibenik, in a merchant family. He studied six grades of high school in Zadar and matriculated in Zagreb in 1908. He graduated from the Faculty of Medicine in Vienna in 1914. In 1915 he was an assistant at the Department of Chemistry at the Technical Faculty of Aachen, and from late 1915 to 1923 he was an assistant at the Institute of Chemistry and Physics at the



Figure 3. Prof. Dr. Pavle Trpinac with his colleagues and medical chemistry demonstrators in front of the Institute



University of Lausanne. At that time, he graduated from the Faculty of Philosophy and passed the doctoral exam in physical chemistry. Professor Matavulj was the founder of the Institute of Chemistry at the Faculty of Medicine in Belgrade in 1923 and its first director from its founding to 1948 when he passed away. Until 1930, he was a part-time chemistry teacher when he was elected as an associate professor and in 1940 as a full professor at the Faculty of Medicine (7).

Prof. P. Trpinac (Figure 3.), Director and Head of the Department in 1948-1975, was born in 1905 in Novi Sad. He graduated from the Faculty of Medicine in 1934. During his studies, from 1927 to 1934, he worked as a student assistant at the Institute of Chemistry of the Faculty of Medicine. In 1934, he was elected to the position of a teaching assistant. He studied chemistry from 1935 to 1938. He finished the first four semesters at the Technological Department of the Technical Faculty in Belgrade and a two-year training in Paris (1937-1938), in physical chemistry and radioactivity with Professor Irene Joliot-Curie. In 1939, he was elected to the position of assistant professor for medical chemistry at the Faculty of Medicine in Belgrade. More than forty generations of medical students listened to the chemistry lessons of this outstanding lecturer. He trained medical chemistry demonstrators to conduct practical laboratory classes (8).

Prof. Dr. Božica Rotović (Figure 4.), was elected the dean of the Faculty of Medicine in 1973. She served as a dean for two terms. She graduated in Chemistry at the Faculty of Philosophy in Belgrade in 1938. She completed her doctoral dissertation in 1955, in Strasbourg (9).



Figure 4. Prof. Dr. Božica Rotović

Prof. Dr. Miloš Mladenović was a member of the Serbian Academy of Sciences and Arts. Miloš Mladenović completed three years at the Seminary in Sremski Karlovci, after which he attended the group of natural sciences - chemistry group at the Faculty of Philosophy in Belgrade. Finally, in 1921, he went to Graz to study chemistry (9).

#### DIRECTORS OF THE INSTITUTE SINCE ITS ESTABLISHMENT TO THE PRESENT DAY (10):

- 1923-1948 Prof. Petar Matavulj, Ph.D.
- 1948-1975 Prof. Pavle Trpinac, Ph.D.
- 1975-1980 Prof. Olga Bugarski, Ph.D.
- 1980-1984 Prof. Ružica Vljajnić, Ph.D.
- 1984-1989 Prof. Nevena Dimitrijevic, Ph.D.
- 1989-1995 Prof. Anka Dražić, Ph.D.
- 1995-2000 Prof. Zorana Vujovic, Ph.D.
- 2000-2004 Assist. Prof. Kristina Gopčević, Ph.D.
- 2004-2009 Assoc. Prof. Vesna Vujić, Ph.D.
- 2009-2015 Assoc. Prof. Danijela Krstić, Ph.D.
- 2015-2021 Prof. Kristina Gopčević, Ph.D.
- 2021- Assoc. Professor Lidija Izrael Živković, Ph.D.

#### HEADS OF THE DEPARTMENT FROM ITS ESTABLISHMENT TO THE PRESENT DAY (10):

- 1923-1948 Prof. Petar Matavulj, Ph.D.
- 1948-1975 Prof. Pavle Trpinac, Ph.D.
- 1975-1981 Prof. Milanka Čorbić, Ph.D.
- 1981-1985 Prof. Olga Bugarski, Ph.D.
- 1985-1989 Prof. Ružica Vljajnić, Ph.D.
- 1989-2000 Prof. Nevena Dimitrijević, Ph.D.
- 2000-2002 Prof. Ivanka Karadžić, Ph.D.
- 2002-2004 Prof. Anka Dražić, Ph.D.
- 2004-2012 Prof. Zorana Vujović, Ph.D.
- 2012-2015 Prof. Ivanka Karadžić, Ph.D.
- 2015-2021 Prof. Vesna Vujić, Ph.D.
- 2021- Prof. Danijela Krstić, Ph.D.

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The first textbook used by medical students:

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## 100 GODINA INSTITUTA ZA HEMIJU U MEDICINI MEDICINSKOG FAKULTETA UNIVERZITETA U BEOGRADU

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### Sažetak

Institut za hemiju u medicini, jedan od najstarijih instituta Medicinskog fakulteta Univerziteta u Beogradu, osnovan je 1923. godine. Sagledavajući ulogu hemije u razumevanju medicinskih nauka, osnivači Medicinskog fakulteta angažovali su vodeće autoritete toga doba u oblasti hemije: Simu Lozanića, Milivoja Lozanića i Petra

Matavulja, postavivši čvrste temelje za kvalitetnu edukaciju budućih lekara. Tokom više od jednog veka, nastavnici i saradnici instituta uspešno odgovaraju na specifične izazove u medicinskoj edukaciji, prilagođavajući se savremenim trendovima u nauci i obrazovanju.

**Ključne reči:** Institut za hemiju u medicini “Prof. dr Petar Matavulj”, Medicinski fakultet Univerziteta u Beogradu, istorijat

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