

The history of pharmacy studies in Croatia

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The first study of pharmacy on Croatian territory was founded in the early 19th century (1806–1813). Vicencio Dandolo (1758–1819), a pharmacist from Venice who was Napoleon's governor of Dalmatia, established a *lyceum* in Zadar in 1806. It included education for pharmacists. The Lyceum (later the Central School) was closed in 1811. The founding of the modern University of Zagreb (1874) and its Department of Mathematics and Natural Sciences (1876) created the conditions for the development of university education for pharmacists. The study of pharmacy was introduced at the University of Zagreb in 1882 through the efforts of the Croatian-Slavonian Pharmaceutical Association and the professors of the Faculty of Philosophy. The study went through a series of reforms. The most significant one came with the introduction of the four-year study of pharmacy and the establishment of the Pharmacy Department of the Faculty of Philosophy (1928). The independent Faculty of Pharmacy (today's Faculty of Pharmacy and Biochemistry) was founded at the University of Zagreb in 1942. Since 1989, it has had two separate studies (Pharmacy and Medical Biochemistry).

1. Introduction

The first pharmacies on Croatian territory appeared shortly after the famous edict of Emperor Frederick II (1240) strictly separated pharmacy from medicine. The direct trade links between the Dalmatian towns and the cities of southern Italy, and the connections with the Medical School of Salerno as the most advanced medical center in the Mediterranean, influenced the opening of the oldest known public and independent pharmacies in Trogir (around 1271), Dubrovnik (1272), Split (1282), Zadar (1289), Zagreb (1355), Šibenik (1420) etc. (Tartalja 1959; Grdinić 1997a). The most famous one is definitely the *Pharmacy of the Friars Minor* in Dubrovnik from 1317, which has been open at the same place for more than 600 years, and the *City Pharmacy at the Black Eagle (Stadt Apotheke zum Schwarzen Adler)* in Zagreb, known for 500 years (Tartalja 1955; Grdinić 1998; Fatović-Ferenčić and Ferber-Bogdan 2004). The long pharmacy tradition on Croatian territory created the need for higher education of pharmacists in Croatia relatively early, at the beginning of the 19th century, along with the need for a scientific basis for pharmacy.

The aim of this study was to present a detailed reconstruction of the evolution process of the education of pharmacists in Croatia, with special emphasis on the foundation of the study of pharmacy at the University of Zagreb. Further on, it aims to show that Croatian pharmaceutical practices as well as educational efforts have always kept pace with Europe.

The research is based on archival sources (Croatian State Archives, Archives of the Division for the History of Medicine of the Croatian Academy of Sciences and Arts, Austrian State Archive). Previously published materials were reviewed and reinterpreted.

2. Investigations, results and discussion

2.1. The education of pharmacists in Croatia before university studies

2.1.1. The education of pharmacists in Croatia from the 13th to the 19th century

In the period before universities emerged, pharmacy was learned in pharmacies. The fact that the pharmacists were teachers is still reflected in their title – Master of Pharmacy. Pharmacy was seen as the art of making medicines from raw materials of herbal origin and less frequently of mineral or animal origin. This art was learned in laboratories and botanical gardens, which could be found in almost every pharmacy. The education included learning natural sciences and related technologies, which mainly relied on the works of Hippocrates, Dioscorides, Theophrastus and Galen, and later on the authors from the Medical School at Salerno, who were significantly influenced by Arabic medicine. The four-year apprenticeship in pharmacies was undertaken by candidates (*garzun*) who had completed four years of comprehensive school and spoke Latin. After the apprenticeship period, they usually continued working in the pharmacy as assistants (*famulus*) for the next 4 to 6 years. At this stage, assistants were allowed to make simpler medications under the supervision of a pharmacist, but they were strictly forbidden from dispensing medicines. After passing an examination in front of an official commission that consisted of experienced physicians, pharmacists and mentors, taking an oath and becoming a member of the pharmacists' guild, candidates became approbated pharmacists. To obtain the degree of Master of Pharmacy, they had to work as pharmacy assistants for a time, which gave them the right to take the master's exam. Later, master's exams were taken at universities. Masters of Pharmacy had the right to operate or buy pharmacies (Tartalja 1977).



Fig. 1: Pharmacist Vicencio Dandolo, Napoleon's *providitore* of Dalmatia. Photo from: Grmek M D (1961) *The Medical-surgical school in Zadar (1806–1811)*. In: *Rad Jugoslavenske akademije znanosti i umjetnosti (JAZU)*, Vol. 323, Section for Medical Sciences, Perović D (ed.), Vol. 7, JAZU, Zagreb, p. 56.

In the Croatian lands under the administration of Venice (until 1797), the education of pharmacists was under the authority of the Board of Physicians and Pharmacists. In mid-17th century (the Law on Pharmacies of Emperor Ferdinand III from 1644), Austria transferred that authority to universities. Pharmacist examinations were taken in front of the dean of a medical school and two reputed pharmacists. They controlled the work of new pharmacists, particularly the application of the regulations of pharmacopoeia when preparing and dispensing medicines. Deans took care of the moral stature of pharmacists and their apprentices, with the authority to punish them for offences. A pharmacist could own only one pharmacy, while physicians could not own pharmacies (Tartalja 1982).

2.1.2. *Lyceum and Central School in Zadar: the first study of pharmacy in Southeast Europe*

Napoleon's reign (1806–1813) brought a rapid development of education and public health in the Illyrian Provinces, which included the Croatian territories under French occupation. This period in Dalmatia saw the creation of seven comprehensive schools, as well as many primary schools, seminaries, vocational schools, and finally, the *lyceum* in Zadar, which had the characteristics of a college or university of the period. The Lyceum, which provided education for physicians, pharmacists, lawyers, engineers and surveyors, was founded in 1806 by the Venetian pharmacist Vicencio Dandolo (1758–1819) (Fig. 1), who was Napoleon's civil governor (*providitore generale*) of Dalmatia. The Lyceum was located in the monastery of St Krševan in Zadar (Fig. 2).

A convent was established for 20 cadets receiving state scholarships. Two of them had to study pharmacy. At first, pharmacy was studied for one year after completing a four-year apprenticeship in a pharmacy and passing the pharmacy practice exam. In the academic year 1808/09, the curriculum was expanded and the study of pharmacy was extended to three years. The new



Fig. 2: Monastery of St Krševan in Zadar, the location of the Lyceum (later the Central School).

Regulations on Discipline and Courses at the Colleges of the Royal Lyceum in Zadar stated that the lyceum had seven courses, including a course for pharmacists. Professors were required to propose a detailed curriculum at the beginning of each year. They were not allowed to leave Zadar during the school year, and they were strictly forbidden from delivering private courses to students or anyone else. Regulations were passed about entrance exams, enrollment, attendance at lectures, exams, discipline and penalties. The first year was about literature and ideology. The second and the third year were about botany, medicines, general chemistry and pharmaceutical chemistry (Grmek 1961a; Grdinić 1997b).

In early 1810, Dandolo left Zadar, which came under French military authority. There was another school reform under the Governor-General, Marshal Auguste de Marmont (1774–1852). Schools were to follow the French model of central schools (*écoles centrales*) with the right to grant academic titles, including the title of pharmacist. The new reform introduced a four-year study of pharmacy with a curriculum modeled on French colleges.

For financial and political reasons (the imminent collapse of Napoleon's empire), the Central School of Zadar was disbanded on 12 December 1811, ending the brief but eventful period of the first study of pharmacy on Croatian territory (Grmek 1961b).

2.1.3. *Croatian pharmacy in the 19th century*

In the Middle Ages, medicine-making was considered a trade. Pharmacists, together with physicians and surgeons, were members of guilds that provided mutual assistance, regulated the profession and educated new generations (Tartalja 1965). As pharmacy developed, the guild system changed. In the 18th century, semi-official organizations called *gremis* appeared in the lands of the Habsburg Monarchy, helping the authorities regulate activities in the field of pharmacy. The first *gremis* in Croatian lands were founded in Rijeka and Poreč in 1819. They were based on a decree with regulations on *gremi* operation, pharmacies, medicine production, education of new pharmacists, duties of pharmacy owners, and relationships with patients. In the territory of Croatia and Slavonia (now the north of Croatia), the *Main Croatian-Slavonian Pharmaceutical Association* was founded in 1858. It was based in Zagreb, with regional associations based in Varaždin, Rijeka, Požega and Osijek. The Pharmaceutical Association exerted considerable influence and independence in conducting the business of pharmacy. Their close cooperation with state authorities greatly advanced pharmacy in Croatia. The Association had a particularly important role in the education of pharmacists. They organized registrations, apprenticeships and exams for pharmacist trainees (*tyros*) and issued trainee certificates that had an official character and

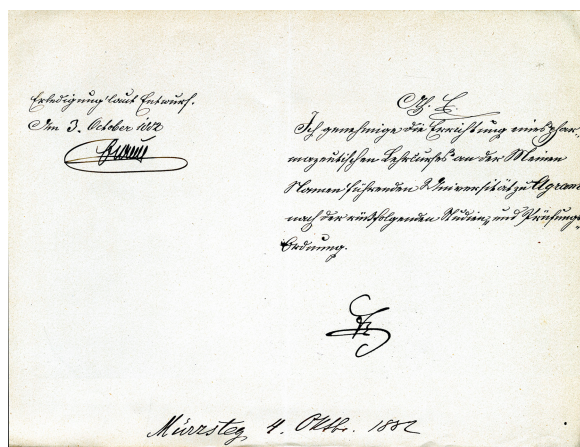


Fig. 3: The decision of Emperor and King Franz Joseph I, introducing the study of pharmacy at the University of Zagreb, from 4 October 1882, courtesy of the Österreichisches Staatsarchiv, Vienna.

were a prerequisite for the study of pharmacy. With that degree, one could study pharmacy at European universities (Vienna, Graz, Budapest and Prague) (Tartalja 1958).

2.2. The establishment of university education in Croatia

2.2.1. The establishment of the modern University of Zagreb in 1874

It is generally accepted that university education in Croatia began with the privilege conferred by Emperor and King Leopold I on 23 September 1669, proclaiming that *the establishment of Neoacademia Zagradiensis, for all time and for all people of any class and standing, is to be deemed approved, accepted and confirmed* (Šidak 1969). However, more than two hundred years were to pass until the establishment of the modern university.

The rapid development of natural sciences and the notions of democracy following the industrial revolution swept across Europe in mid-19th century. The Austro-Hungarian Monarchy was slowly becoming a more liberal society. Under the influence of Western progress and the powerful ideas of the *Croatian revival* (a national, political and cultural movement in the first half of the 19th century), local resistance to Austrian and Hungarian hegemony was reflected in the creation of the most important national cultural and scientific institutions. In 1861, the Croatian bishop, politician and cultural patron Josip Juraj Strossmayer (1815–1905) founded the Yugoslavian (now Croatian) Academy of Sciences and Arts (CASA). The modern university was founded in 1874 as the *Royal University of Franz Joseph I in Zagreb*. The law of 1874 stipulated the creation of four faculties: Philosophy, Law, Theology, and Medicine including a course in pharmacy. However, the opening of the Faculty of Medicine was delayed for financial and political reasons (it started operating only in 1917). Since pharmacy-related subjects were planned for the second and third years of the Faculty of Medicine, the study of pharmacy was postponed too (Kujundžić and Inić 2013).

2.2.2. The study of pharmacy at the University of Zagreb

A milestone for Croatian pharmacy, largely determining its future till our time, was this one-sentence decision by Emperor and King Franz Joseph I from 4 October 1882 (Österreichisches Staatsarchiv 1882a): *“I approve the introduction of the course in pharmacy at the University of Zagreb, named after me, under the valid study and exam regulations”* (Fig. 3). It was the final

act of the long struggle of the Croatian-Slavonian Pharmaceutical Association and the professors of natural sciences at the Faculty of Philosophy of the University of Zagreb to realize the centuries-old dream of Croatian pharmacists to be educated in their native language in their homeland (Kujundžić 2012a).

A key role in the establishment of the study of pharmacy was played by the Department of Mathematics and Natural Sciences of the Faculty of Philosophy, which started teaching mathematics, chemistry, botany and physics in 1876.

The lack of highly educated pharmacists, the costs of studying abroad and the struggle for national emancipation were the reasons why the well-organized Main Croatian-Slavonian Pharmaceutical Association encouraged the establishment of the study of pharmacy at the University of Zagreb as early as 1877. *The Proposal for the creation and establishment of the 1st Pharmaceutical Teaching Course in Zagreb before the legally determined date for the opening of a faculty of medicine at the Royal University of Zagreb* was sent by the Association to the Croatian ruler (*ban*), the poet, linguist and politician Ivan Mažuranić (1814–1890), on 8 October 1877. The proposal was forwarded to the State Health Council, which decided, however, that the course should be established only after the foundation of the faculty of medicine. The new proposal, written by Bohuslav Jiruš (1841–1901), professor of botany and dean of the Faculty of Philosophy, was unanimously adopted at the Faculty Council on 11 July 1878 and forwarded to the Croatian-Slavonian-Dalmatian government on 13 September of the same year. This proposal was also rejected. The third proposal for a course in pharmacy, accompanied by a detailed study plan, written by Gustav Janeček (1848–1929), professor of chemistry, Bohuslav Jiruš and Vinko Dvořák (1848–1922), professor of physics, and supported by the Council of the Faculty of Philosophy, was sent to the government in mid-1881 (Grđinić et al. 2002). On the basis of that proposal and the approval of the *ban* Ladislav Pejačević (1824–1901), Minister Koloman Bedeković sent the proposal to the Emperor on 29 September 1882 (Österreichisches Staatsarchiv 1882b) (Fig. 4).

The explanation of the proposal stated that a course in pharmacy in Croatia would be of great national and economic interest, since a significant number of Croatian pharmacists had to go to foreign universities each year, and many pharmacies were owned by foreigners. It pointed out that the issue of whether the study of pharmacy should be independent and separate from the faculty of medicine had become moot, since such a study had been recently introduced at the University of Chernivtsi (Ukraine), which was organized in the same way as the University of Zagreb and which also did not have a faculty of medicine.

Furthermore, a course in pharmacy would not require considerable financial resources, because most of the obligatory equipment needed for the course was already there. It was only necessary to approve the lectures of pharmacognosy and pharmaceutical chemistry, which would be gladly undertaken by the professors of botany and general chemistry. The leading pharmacies of Zagreb offered an almost complete pharmacognostic collection for the purposes of lectures, asking only for an annual grant of 50 to 100 florins for its completion and maintenance. Five days after the proposal was submitted, the Emperor issued the above-mentioned ruling, graciously allowing the establishment of a course in pharmacy at the University of Zagreb.

The study plan was similar to that of other universities in the Monarchy. To be admitted, the candidate had to complete a minimum of four years of an Austro-Hungarian comprehensive school, apprenticeship in pharmacy according to the state gremial regulations, to pass the trainee exam, and to spend at least another two years in a public pharmacy as a pharmaceutical assistant. It was a two-year course with three exams. The first covered the theory of fundamental sciences (physics, gen-

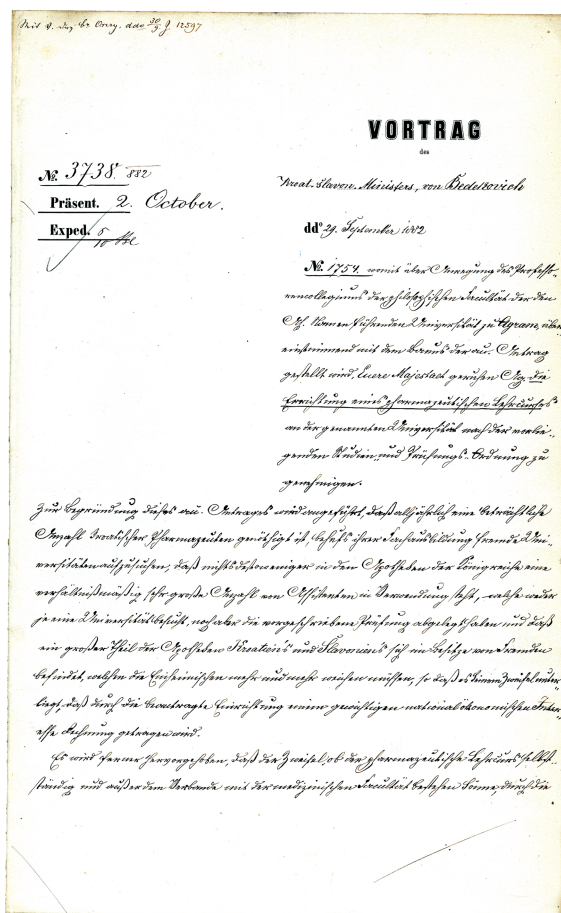


Fig. 4: The first page of the proposal of Minister Koloman Bedeković for the establishment of the Pharmaceutical Teaching Course in Zagreb, addressed to Emperor and King Franz Joseph I, from 29 September 1882, courtesy of the Österreichisches Staatsarchiv, Vienna.

eral chemistry, botany, zoology and mineralogy); the second was practical, about analytical chemistry; the third was about pharmacognosy, pharmaceutical chemistry, and the knowledge of laws and rules governing pharmacy. After passing the exams, the student obtained a master's degree in pharmacy.

The study plan included a PhD in Pharmacy, which required a baccalaureate, a degree of master of pharmacy, and another year of studies at the Faculty of Philosophy. All the other regulations were the same as for the PhD in Philosophy (Croatian Archives 1882).

Pharmacy lectures at the University of Zagreb officially started in the winter semester of the academic year 1882/83, fulfilling the wish of Croatian pharmacists to study in Croatian in their homeland.

As the establishment of the study of pharmacy was followed by a rapid increase in the number of students, the premises became too small. It was necessary to build an appropriate building as soon as possible. Under the guidance of Prof. Gustav Janeček, who was head of the Department of Chemistry from 1879 to 1924, the famous Austrian architect Hermann Bollé (1845–1926) developed the project for the new building of the Chemistry Institute. The construction started in spring 1883; the Institute was officially opened a year later (Fig. 5).

General and pharmaceutical chemistry were taught in this building, which became the seat of the university Institute of Pharmacognosy in 1896. In 1921, the Institute moved to the building at No. 20 of Marulić Square, where it has remained until today. The Institute of Pharmacognosy was organized according to the ideas of Julije Domac (1853–1928), professor of pharma-



Fig. 5: The former building of the Chemistry Institute at No. 14 of Strossmayer Square in Zagreb. Today it houses the CASA Library.

cognosy from 1896 to 1924, as the first independent institute of its kind in the world (Inić and Kujundžić 2011). In 1920, the building became the seat of the university Institute of Botany, where pharmacy students were taught pharmaceutical botany until the establishment of the separate Institute for Pharmaceutical Botany in 1942.

The development of natural and biomedical sciences which are the basis of pharmacy studies has been tumultuous since the late 19th century up to our time, so it is no wonder that the university studies of pharmacy were reformed many times (Malnar and Grdinić 1983).

The first change, introduced in 1888, applied to admission requirements. Since then, the requirements for the study of pharmacy were six years of comprehensive school or a secondary school that taught Latin and three years of practice in a pharmacy. The candidates with a school-leaving certificate needed only two years of practice.

In 1896, mineralogy and zoology were dropped as less important subjects, while there was an increase in chemistry and botany classes. Practical exercises in pharmaceutical chemistry and pharmacognosy were introduced. The two-year practice in pharmacies was abolished as a condition for admission after the trainee exam.

Women were barred from university studies until the 20th century. The law of 1901 opened the university to women, but the first female student of pharmacy appeared in 1906 (Croatian Archives 1901).

In 1914, a matriculation examination and Latin became prerequisites for the study. The practice period was reduced to two years.

A reform in 1923 introduced new subjects in the curriculum: biochemistry, the basics of physical chemistry, exercises in botany, experimental physics, hygiene with bacteriology, and pharmaceutical technology as an important specialized subject.

The Royal Decree of 6 April 1928 (NN 1928) established the Pharmaceutical Department at the Faculty of Philosophy and introduced the four-year study of pharmacy. After passing the exams, the graduate student received the title of *Graduate Pharmacist*. Then, after two years of practice in a public pharmacy and passing the state exam, the candidate would obtain the degree of *Master of Pharmacy*.

The Faculty of Pharmacy was finally established in 1942 (NN 1942), pursuant to Article 121 of the Legal Order on the Croatian University in Zagreb of 23 October 1941 (NN 1941). Antun Vrgoč (1881–1949), a university professor of pharmacognosy, was elected the first dean of the new Faculty, which was housed in the building at No. 2 of Domagoj Street. During the Second World War (1939–1945), the number of pharmacy students was sharply reduced, and the educational and scientific activities slowed down. In 1945, the new Yugoslav government abolished



Fig. 6: The central building of the Faculty of Pharmacy and Biochemistry of the University of Zagreb, situated at No. 1 of Kovačić Street.

the entire legislation of the former state (laws, decrees, regulations etc.), including the Order on Establishing the Faculty of Pharmacy. The decision of the Pharmacy Department of the Ministry of Public Health of the Federal State of Croatia of 8 June 1945 re-established the independent Faculty of Pharmacy (Archives 1945).

After an adaptation, the former eye clinic at No. 1. of Kovačić Street received three departments in 1947: the Department of General, Inorganic and Analytical Chemistry, the Department of Organic Chemistry, and the Department of Pharmaceutical Chemistry. It also became the seat of the dean. Now it is the central building of the Faculty of Pharmacy and Biochemistry of the University of Zagreb (Fig. 6).

Since 1947, the Department of Botany with the Pharmaceutical Botanical Garden "Fran Kušan" has been located at No. 39 of Schrott Street. The garden was named after its founder, the botany professor Fran Kušan (1902–1972) (Kremer 2013).

After the Second World War, the role of pharmacists in health services began to change. In 1961, three specialized courses emerged: the course in pharmacy and technology with its optional specializations (pharmaceutical and technological), the course in medical biochemistry, and the course in food and sanitation (abolished in 1974). All three courses ended with a degree thesis and a final exam.

With time, the curricula of the two courses gradually separated. Finally, in 1989, they became two separate studies (Pharmacy and Medical Biochemistry). In the academic year 2005/06, the curriculum of these studies was extended to five years as an integrated undergraduate and graduate study, coordinated with the Bologna process. Medical biochemists are given the title of *Master of Medical Biochemistry* (Kujundžić and Inić 2013).

Today, scientific and educational activities take place in 15 departments: the Department of Analytical Chemistry; the Department of General and Inorganic Chemistry; the Department of Physical Chemistry; the Department of Organic Chemistry; the Department of Biophysics; the Department of Biochemistry and Molecular Biology; the Department of Microbiology; the Department of Pharmaceutical Botany; the Department of Pharmacognosy; the Department of Pharmaceutical Technology; the Department of Pharmacology; the Department of Medical Biochemistry and Hematology; the Department of Food Chemistry; the Department of Pharmaceutical Chemistry; the Department of Drug Analysis and Control; and two centers: the Center for Applied Pharmacy and the Center for Applied Medical Biochemistry. Apart from the two graduate studies, the faculty has 8 specialist postgraduate studies and a doctoral degree (Kujundžić 2012b).

2.3. Professors

The establishment of the study of pharmacy at the University of Zagreb and the great success of academic and practical pharmacy in the late 19th and early 20th century can be attributed to a few outstanding personalities that left an indelible mark on the history of Croatian science. Two of them, both professors and pharmacists, are particularly notable: Gustav Janeček and Julije Domac. Their names are related to almost everything that happened in Croatian pharmacy in the first 40 years after the establishment of the study. Janeček was one of the founders of the study of pharmacy, the founder of the Croatian pharmaceutical industry (in 1918, he founded the wholesaler ISIS; in 1921, he founded the drug factory *Kaštel*, which is today's pharmaceutical company PLIVA), Dean of the Faculty of Philosophy (1885/86, 1895/96, 1906/97), Rector of the University (1908/09), member of the Academy and its president (1921–1924) (Grđinić 2002; Kovačević 2002). Domac founded the first independent Institute of Pharmacognosy in the world (1896). He was also Dean of the Faculty of Philosophy (1901/02) and Rector of the University (1911/12) (Inić and Kujundžić 2012a). The two of them wrote the extremely valuable original Croatian pharmacopoeia (1901) (Inić and Kujundžić 2012b). The professors at the study of pharmacy included 7 university rectors and 21 CASA members. Eleven streets in Zagreb are named after them.

2.4. Nobel Prize winners and their impact on the study of pharmacy in Zagreb

Just as students tend to follow their professors, the professors themselves are an image of their teachers. Quite a few professors at the study of pharmacy at the University of Zagreb were taught by the greatest scientists in the history of science – the Nobel Prize winners. Krešimir Balenović (1914–2003), a professor of organic chemistry at the Faculty of Pharmacy, specialized at the Hungarian university of Szeged in 1949–1950 under Albert Szent-Györgyi (1893–1986, Nobel Prize in Medicine in 1937). Fran Bubanović (1883–1956), a professor of inorganic and organic chemistry at the study of pharmacy, had a postdoc at the Nobel Institute for Physical Chemistry in Stockholm in 1913 under Svante Arrhenius (1859–1927, Nobel Prize in Chemistry in 1903). Zlatko Janković (1916–1987), a professor of mathematics at the Faculty of Pharmacy, specialized at the Institute of Theoretical Physics in Copenhagen, Denmark, in 1953/54 under Niels Henrik David Bohr (1885–1962, Nobel Prize in Physics in 1922). Emil Prašek (1881–1934), a professor of bacteriology and hygiene at the study of pharmacy, was an assistant of Karl Landsteiner (1868–1943, Nobel Prize in Medicine in 1901). Stanko Miholić (1891–1960), a professor of pharmaceutical chemistry, specialized in 1928 under Frederick Gowland Hopkins (1861–1947, Nobel Prize in Medicine in 1929). Marija Fišer-Herman (1897–1994), a professor of medical biochemistry, wrote her PhD thesis in Vienna under Hans Fischer (1881–1945, Nobel Prize in Chemistry in 1930). Fisher also worked and published together with Mladen Deželić (1900–1989), a professor of physical chemistry. Ivan Butula (1932–2012), a professor of pharmaceutical chemistry, worked at Max Plack Institute in Heidelberg, Germany, from 1961 to 1965, as a postdoc and assistant of Richard Kuhn (1900–1967, Nobel Prize in Chemistry in 1937).

The studies of organic chemistry at the Faculty of Pharmacy were particularly influenced by Vladimir Prelog (1906–1998, Nobel Prize in Chemistry in 1975). Mihovil Proštenik (1916–1994) and Dragutin Kolbach (1912–1990), professors of organic chemistry, were postdocs fellows at the Swiss Federal Institute of Technology Zurich (Eidgenössische Tech-

nische Hochschule – ETH) under Vladimir Prelog and Lavoslav Ružička (1887–1976, Nobel Prize in Chemistry in 1939). Stanko Borčić (1931–1994), a professor of organic chemistry and dean, wrote his PhD thesis under the mentorship of those two Nobel Prize winners at ETH. Eugen Cerkvencik (1904–1985), a professor of organic chemistry, wrote his PhD thesis under V. Prelog and published articles together with him. Prelog also cooperated with two pharmacology professors, Pavao Štern (1913–1976) and Zlatko Supek (1914–2004). Postdocs under Prelog at ETH included Krešimir Balenović (1914–2003), a professor of organic chemistry, and Mladen Žinić (1947–), an assistant. Mirko Ternbah (1920–?), an assistant of organic chemistry, wrote his PhD thesis under Prelog at ETH. Two of the mentioned Nobel Prize winners, N. Bohr and V. Prelog, visited the Faculty of Pharmacy in Zagreb and made lectures (Kujundžić and Inić 2013).

All the mentioned professors deserve the most credit for the foundation, strength and persistence of the course in pharmacy despite three wars of four years each and five different states and legal frameworks in which it operated. In 130 academic years of its continuous existence, the course in pharmacy at the University of Zagreb has achieved a high scientific and educational level.

2.5. Conclusion

The need for higher education of pharmacists in Croatia arose relatively early because of its seven centuries of tradition. The first course in pharmacy was established in Zadar in 1806 by Vicencio Dandolo, a pharmacist from Venice who was Napoleon's governor of Dalmatia, and lasted until 1811. The founding of the modern University of Zagreb (1874) and its Department of Mathematics and Natural Sciences (1876) created the conditions for the establishing of university education for pharmacists. The study of pharmacy was established by the decision of Emperor and King Franz Joseph I from 4 October 1882. In 130 years of its continuous existence, the study went through many reforms to adapt to the tumultuous development of natural and biomedical sciences in the European context.

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References

- Archives of the Division for the History of Medicine, CASA (1945) Decision of the Pharmacy Department of the Ministry of Public Health of the Federal State of Croatia No. 1517 of 8 June, re-establishing the independent Faculty of Pharmacy.
- Croatian State Archives (1882) Order of the Government Department for Religion and Education No. 10.882 of 11 October, proclaiming the supreme decision of 4 October 1882 about the establishment of the pharmaceutical study at the university of Franz Joseph I in Zagreb: the organization and examination system for the master's degree and the doctor's degree in pharmacy at the royal university of Franz Joseph I in Zagreb.
- Croatian State Archives (1901) Order of the Government Department for Religion and Education No. 14.290 of 9. September whereby the Government approved enrollment of female students at the university studies.

- Fatović-Ferenčić S, Ferber-Bogdan J (2004) Medieval roots and chronology: on the occasion of the 650th anniversary of Zagreb's upper town pharmacy. *Medicus* 13: 139–149.
- Grđinić V (1997a) An illustrated history of Croatian pharmacy. Pharmacy on Croatian soil: the evidence, Hrvatsko farmaceutsko društvo i Nakladni zavod Matice hrvatske, Zagreb, p. 101.
- Grđinić V (1997b) An illustrated history of Croatian pharmacy. Pharmacy on Croatian soil: the evidence, Hrvatsko farmaceutsko društvo i Nakladni zavod Matice hrvatske, Zagreb, pp. 332–343.
- Grđinić V (1998) Tracing the identity of pharmacy in Zagreb. *Medika* 10(52): 19–25.
- Grđinić V (2002) Gustav Janeček founder of the modern Croatian pharmacy. In: Grđenić D (ed.) *Gustav Janeček (1848–1929): Life and Achievements*, Hrvatska akademija znanosti i umjetnosti, Zagreb, pp. 49–133.
- Grđinić V et al. (2002) Faculty of Pharmacy and Biochemistry: 120 Years of Experience and Progress, Farmaceutsko-biokemijski fakultet Sveučilišta u Zagrebu, Zagreb, pp. 17–19.
- Grmek M D (1961a) The Medical-surgical school in Zadar (1806–1811). In: *Rad Jugoslavenske akademije znanosti i umjetnosti (JAZU)*, Vol. 323, Section for Medical Sciences, Perović D (ed.), Vol. 7, JAZU, Zagreb, pp. 5–64.
- Grmek M D (1961b) Pharmaceutical courses in Zadar during the French rule. *Farmaceutski glasnik* 17: 402–410.
- Inić S, Kujundžić N (2011) The first independent pharmacognosy institute in the world and its founder Julije Domac (1853–1928). *Pharmazie* 66: 720–726.
- Inić S, Kujundžić N (2012a) *Julije Domac: Life and Achievements 1853–1928*, Hrvatsko farmaceutsko društvo i Farmaceutsko-biokemijski fakultet Sveučilišta u Zagrebu, Zagreb.
- Inić S, Kujundžić N (2012b) The original Croatian pharmacopoeia from 1901. *Pharmazie* 67: 652–657.
- Kovačević K (2002) Gustav Janeček one of the founders of the Croatian pharmaceutical industry. In: Grđenić D (ed.) *Gustav Janeček (1848–1929): Life and Achievements*, Hrvatska akademija znanosti i umjetnosti, Zagreb, pp. 151–161.
- Kremer D (2013) Presentation of the renewed Herbarium “Fran Kušan”. *Farmaceutski Glasnik* 69: 30–33.
- Kujundžić N (2012a) Memorial book on the occasion of the celebration of 130 anniversary of pharmacy studies at the University of Zagreb 1882–2012, Farmaceutsko-biokemijski fakultet Sveučilišta u Zagrebu, Zagreb, pp. 12–13.
- Kujundžić N (2012b) Memorial book on the occasion of the celebration of 130 anniversary of pharmacy studies at the University of Zagreb 1882–2012, Farmaceutsko-biokemijski fakultet Sveučilišta u Zagrebu, Zagreb, pp. 62–162.
- Kujundžić N, Inić S (2013) Historical overview of pharmacy studies in Croatia. *Farmaceutski Glasnik* 69: 1–12.
- Malnar M, Grđinić V (1983), A century of pharmacy studies in Zagreb (1882–1982). *Saopćenja* 29: 111 – 132.
- Narodne novine (NN) (1928) Decree establishing the Pharmaceutical Department of the Faculty of Philosophy, No. 102 of 3 May, p. 1.
- Narodne novine (NN) (1941) Legal Order on the Croatian University of establishing the independent Faculty of Pharmacy at the Croatian University in Zagreb, No. 162 of 25 October, pp. 1–5.
- Narodne novine (NN) (1942) Order on the Faculty of Pharmacy at the Croatian University in Zagreb, No. 155 of 14 July, pp. 1–2.
- Österreichisches Staatsarchiv (1882a) Kroatische Akademie der Wissenschaften und Künste. ÖSTA-2011846/0002-HHSTA/2012. Decision No. 1754 of 4 October whereby the Emperor Franz Joseph I introducing the study of pharmacy at the University of Zagreb.
- Österreichisches Staatsarchiv (1882b) Kroatische Akademie der Wissenschaften und Künste. ÖSTA-2011846/0002-HHSTA/2012. Document No. 3738 of 29 September; the proposal for the establishment of the Pharmaceutical Teaching Course in Zagreb of Koloman pl. Bedeković to Emperor and King Franz Joseph I.
- Šidak J (1969) Overview on the three hundred-years development of the university education in Zagreb. In: Šidak J (ed.), *Memorial book on the occasion of the celebration of 300 anniversary of the University of Zagreb*, Vol. 1, Sveučilište u Zagrebu, Zagreb, pp. 17–20.
- Tartalja H (1955) A historical overview of development of pharmacy in Zagreb. In: Tartalja H (ed.), *600 years of pharmacy in Zagreb*, Vol. 2, Farmaceutsko društvo Hrvatske i Institut za povijest farmacije, Zagreb, pp. 30–46.
- Tartalja H (1958) The share of pharmaceutical corporations in the organization of teaching at the Zagreb Faculty of Pharmacy. *Farmaceutski glasnik* 14: 251–256.

Tartalja H (1959) L'histoire de la pharmacie en Yougoslavie et sa situation actuelle. Thèse présentée à la Faculté de pharmacie de l'Université de Paris pour l'obtention du grade de docteur de l'Université de Paris. Mention: Pharmacie, Société pharmaceutique de Croatie. Institut d'histoire de la pharmacie, Livre 4, Zagreb, pp. 24–33.

Tartalja H (1965) Die Apothekergremien in Kroatien und Slovenien. In: Iveković H and Glesinger L (ed.), The Discussions and materials regarding the history of science, Vol. 2, JAZU, Zagreb, pp. 145–159.

Tartalja H (1977) The beginnings of chemistry and pharmacy in Croatia. *Croat Chem Acta* 50: S39-S43.

Tartalja H (1982) The education of pharmacists in Croatia and Slovenia from the 13th to the 19th century. In: Franković D (ed.), *Annals for the history of education*, No. 15, Hrvatski školski muzej u Zagrebu, Pedagoški muzej u Beogradu i Slovenski školski muzej v Ljubljani, Ljubljana, pp. 49–63.