

## REVIEW

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# Contribution of Arabic Medicine and Pharmacy to the Development of Health Care Protection in Bosnia and Herzegovina - the First Part

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## ABSTRACT

The time interval from the 9<sup>th</sup> to the 13<sup>th</sup> century remained known as the "Golden period of the Arab science", and a significant place among the taught sciences are occupied by Medicine and Pharmacy. In the history of medicine, Islamic medicine, also known as Arabic medicine, refers to the science of medicine developed in the Islamic Golden Age, and written in Arabic. Arabs were able to use their cultural and natural resources and trade links to contribute to the strong development of pharmacy. After the collapse of the Arab rule, the Arab territorial expanses and cultural heritage were taken over by the Turks. Although scientific progress in the Turkish period slowed down due to numerous unfavorable political-economic and other circumstances, thanks to the Turks, Arab culture and useful Islamic principles expanded to the territory of our homeland of Bosnia and Herzegovina. Significant role in the transfer of Arabic medical and pharmaceutical knowledge was also attributed to the Sephardic Jews who, with their arrival, continued to perform their attar activities, which were largely based on Arab achievements. However, insufficiently elaborated, rich funds of oriental medical and pharmaceutical handwriting testify that Oriental science has nurtured in these areas as well, and that the Arab component in a specific way was intertwined with other cultures and traditions of Bosnia and Herzegovina.

**Keywords:** Medicine, Pharmacy, Arabic medicine, great arabic physicians.

## 1. INTRODUCTION

The key to the progress of science is continuity in the comprehension of scientific phenomena, which is enabled by the knowledge of earlier achievements (1). Knowing the achievements of previous civilizations, the mind is preparing for new discoveries and progress (2, 3). Until the early flowering of the human intellect came to the shores of the Mediterranean. Sumerian, Babylonian and Egyptian civilizations have paved the way for Greeks and Romans (1, 4, 5). When they began to collapse, there was a danger of breaking the continuity in understanding natural phenomena, but fortunately for the whole of humanity, the achievements had been collected by the Arabs in the 8<sup>th</sup> century (1-5). Brilliant writings from all fields of science cumulated on the Arab soil and then were translated and adopted by the living, excited and ingenious Arab minds that were adopted and strengthened and enriched with their own wisdom, opaque observa-

tions and experiments and passed on to the West (6-11).

The Muslim Halifax continued to follow the practice of the Holy Prophet Mohammad s.a.v.s. by appreciating and supporting the doctrine, and unlike the common practice of other conquerors, they forbade their armies to destroy the libraries for the objective respect of human search for knowledge (1, 12). First they built a strong and remarkably stable empire on the great expanse of the Middle and Far East, and in the Northern part of Africa and Southwestern Europe. Arabian exhortations, their culture and science have spread to the front of Asia, the Mediterranean and the Arabian Peninsula towards the Far East (1). This has allowed them wherever they come to be conquerors, to propagate the culture and customs of the indigenous population by developing their own culture in newly-established areas. In those countries that are largely part of Alexander the Great's Empire, the Arabs have come to know the traditions

of Hellenism and, with that, Greek medicine. In addition to the Greek as the most important, they inherited the books of Romans, Indians, Chinese, Persians, Syrians and other nations. The Arab rulers, and especially the Khalifa al-Ma'mun in the 9<sup>th</sup> century, gave a special contribution to the development of science through the establishment of translation schools in which these books were translated into Arabic (1). Thus, Arabic language became the language of intellectual progress throughout the Muslim world throughout the Middle Ages. Among the first translated books are also books of great importance for the development of pharmacy. Such are, for example, the Book of Herbs of Greek Theophrastus, and Dioscorides "De Materia Medica", a book that encompasses an overview of ancient pharmacy and medicine (Figure 1). Using these, as well as numerous other books of Greek medicine, the Arabs have taken over the theory of Greek art of treatment, primarily in the forms suggested by Hippocrates and Galen. They then added their own experiences that arose as a result of many years of research and re-examination of what they had accepted from previous civilizations (1, 2).

That is why in the second part of this paper, before the story of Arabic achievements that have given, by the Turks, an invaluable contribution to the development of health and pharmacy in Bosnian and Herzegovina, will be elaborated the translation schools that make the Arabs able to use all available cultural resources (12-23).

## 2. GOLDEN AGE OF ARABIC MEDICINE AND PHARMACY

One of the most important periods in the development of medicine at all, especially medieval medicine, is the so-called "Golden Age of Arabic Medicine". In the history of medicine, Islamic medicine, also known as Arabic medicine, refers to the science of medicine developed in the Islamic Golden Age, and written in Arabic. The books of Arabic science that came about in this period are not only by Muslim authors, but Arab civilization is the result of consecutive, persistent and continuous efforts of various nations, regardless of the religion, race and color of the skin, who lived and produced in the Arab region (1). It is also important to emphasize that Arabic medicine and pharmacy are the pluralist spirit. Arabic, and the Turkish health system was based on several traditions that complement each other. The basic medical tradition was certainly Greek, but it was influenced by Islamic or Prophetic Medicine, and, to a lesser extent, by folk medicine. Islam in the development of Arabic medicine and pharmacy was, above all, a motivating factor. The belief that God creates a cure in nature for every existing disease has led to the development of pharmacognosy (12). The Qur'an as a moral code of the Muslims has evolved the development of professional ethics, and the need for ritual washing has given rise to the cult of water in Islam, thus pointing to the importance of hygiene in preventative medicine (2, 3, 12). The knowledge of medicine spread to the Islamic caliphate between the fall of the Roman Empire in the 5<sup>th</sup> century and the European Renaissance in the 15<sup>th</sup> century. Nevertheless, the true

blossoming of Arabic medicine and pharmacy begins in the 9<sup>th</sup> century and coincides with the Golden Age of the Abbasid Caliphate in the East (749-1258) (1, 2). By establishing Abbasid Caliphate, centers of all activities, and also scientific, are moving from Syria to Iraq. The newly founded city of Baghdad becomes the capital and the center of culture and science of the empire (1, 4). Significant centers of learning were also cities like the previous capitals - Damascus, Cairo, and Cordoba and Granada in Spain. In these cities, scientific institutions, schools, libraries and hospitals have been built, and soon the first pharmacies, whereby doctors or wise men from all over the world come to these cities. They were dedicated to collecting data and orchestrating scientific development (5).

## 3. TRANSLATION SCHOOLS

Undoubtedly, the translation schools established in the big medieval Arab cities played an important role in collecting the treasures of biomedical doctrines of previous civilizations. Physicians translators translated the books from Greek, Persian, Syriac, Indian, Hebrew, and other languages to Arabic and this was the first stage of the Arabic science development (1, 3, 5). One of the key reasons why Arabs translated the scientific sources is the desire to give the Hellenistic teachings a rational dimension to Islamic faith and thereby strengthen it. Therefore, this period of translation is called "Medressetu-Surrah el-Igrikijjini", or "School of Greek Books" (1, 2).

Hellenistic teachings become available to Arabs mostly thanks to Christian sects, such as the Nestorians and Jacobites, who were repeatedly expelled by Byzantine emperors who proclaimed their teachings heretical. In these sects, there were many scientists who, by expulsion, carried their books and wisdom into the places they migrated. They went to Persia, Syria, India, and other oriental countries where they opened famous schools like those in Edessa, Nisibis and Gondeshapur. When the Arabs came to this political-cultural scene, this special Greek-Oriental synthesis of science was offered to them. The second time that medical-philosophical discoveries reached the Arabs, went through Alexandria. From this school, also originated a Christian physician, Ahron, who wrote the book "Compendium of Medicine", translated into Arabic and containing, apart from Greek medicine, many drugs that were not known to Dioscorides and Galen (6, 7).

In Gondeshapur, in western Persia, long before the founding of Baghdad and its famous translation school, there was a large hospital and medical school. Greek medical science was taught in this school, and the famous Greek and Roman books were translated into Aramaic, and later into Arabic (1-3). Greek books came along with the professors from the Academy of Athens who were expelled by Byzantine emperor Justinian by closing the Academy in 529. When, after the unusually rapid spread of the Arab state, the need for education of medical science experts has been felt, the advanced rulers of the Abbasid dynasty invite scientists from various sides to the newly-created capital Baghdad. Translating books

into Arabic language experiences its culmination during al-Ma'mun's rule as one of the halifas who contributed most to the founding of translation schools. Towards the end of the 8<sup>th</sup> century, in Baghdad, he founded a special translation school entitled "Bayti al-hikmah", or "House of Wisdom", which later became the Academy of Sciences. The most significant representative of this translating school was Hunayn Ibn Ishaq Al-'Ibadi (809-873), who translated most of his books of Dioskorides, Hippocrates and Galen (1, 2). For medicine, the translation of Dioskorides' book on drugs "De Materia Medica" in 1229 is of crucial importance. The book is divided into five pockets describing about 500 drugs of herbal and animal origin, ways of collecting, storing and therapeutic applications. This is the first pharmacopeia to be supplemented by Arabs to the number of about 2000 substances (1).

So the world that spoke and wrote the Arabic had already had, around year 900, almost all the Greek scientific literature, which was well-translated. Arab countries have been better off than European countries, which after three or four years had much worse translated Arabic-Latin texts in their hands (1, 3).

#### 4. CONTRIBUTION OF MEDICINE BIOHEMIC SCIENCES IN DEVELOPMENT OF PHARMACY

Arabic medicine has made a major contribution to the development of pharmacy. It is logical that doctors who are looking for ways to treat their patients to discover new drugs. They wrote about them in booklets about the history of the disease called "al-Mujarrabat". Subsequently, good and lesser known drugs were extracted from it. Physicians have tried to use simple medicines to determine the exact effect of the entered component into the disease. Still, some doctors have prescribed and combined the medications that they themselves formulated. This is why polypharmacy and the use of combined recipes in practice have played a decisive role in therapy (1).

Early pharmacological development was partly triggered by the use of poison and antidote. This job was mostly performed by alchemists who played the role of toxinologist. Alchemists were a common in the 9<sup>th</sup> century. Although they did not succeed in transforming nonprecious metals into precious metals, their work has greatly contributed to the development of pharmacy because they have been using a number of chemical methods, techniques and laboratory equipment, and they knew a wide range of organic and inorganic substances. Among the useful chemical techniques used were: distillation, sublimation, condensation, evaporation, pulverization and boiling (Figure 2) (1).

The most significant books from alchemy in the early Abasid period were written by ar-Razi and his contemporaries Ibn Wahshiyah. Due to the great tendency of Arabic chemistry and abundance of precious drugs arriving in Arab cities from the Middle East and the Orient, it is said that pharmacy has started its professional existence with the Arabs (1, 4, 9).

Thanks to the basic knowledge of medicine and biochemical science, Arabs have become experts in the preparation of numerous pharmaceutical preparations

such as concentrated herbal juices, called Roob and Julap, syrups, electories, purgatives, sweetened and silver pills, distilled aromatic waters, essences, and aldehydes and alcohols as solvents, but also for other purposes (2, 6).

#### 5. PHARMACY AS A SEPARATE PROFESSION AND FIRST PHARMACIES

The birth of pharmacy as an independent, well-defined profession was established in the early ninth century by Muslim scholars. For the history of pharmacy, it is very important that in Arabic countries are found the first beginnings of pharmacy as an independent profession (12, 14). They set up the first hospitals with permanent pharmacy and hospital apothecary. The early distinction between medicine and pharmacy begins in the 7<sup>th</sup> century. One of the most influential Arab scientists, Al-Biruni states that "pharmacy became independent from medicine as language and syntax are separate from composition, the knowledge of prosody from poetry, and logic from philosophy, for pharmacy is an aid to medicine, rather than a servant" (1). Another Arab scientist Sabur (d. 869) wrote the first text on pharmacy - it was the first Arab collection of formulas (1, 12).

Any distinction means reported progress and training, which can only happen when all conditions are met. That is why the emergence of pharmacy, as an autonomous science and profession, means that social forces and developments have reached such a degree of development that they have made it possible to distinguish it. Some of the main causes for the emergence and development of professional Arabic pharmacy were increased drug demand for the growing population and the availability of the same on the market, a singular intellectual curiosity and the rapid translation of medical books (2, 7, 9).

About the opening of the first private pharmacy, which marks the ultimate independence of pharmacy on medicine, many historians have written. Many of them note that the first apothecary was opened by the khalifa al-Mensur in Baghdad in April 754 (1, 4). But the fact is that Baghdad itself was founded and completed ten years after the mentioned year. It is therefore claimed that the first pharmacies in Baghdad were open at the time of the reign of al-Mensur son, and that it was not possible to determine whether they were owned by non-educated pharmacists, or by pharmacists who had certain academic training. It is therefore claimed that the status of a recognized profession reaches in the early 9<sup>th</sup> century when practiced by trained and educated specialists and pharmacists who were fully aware of the ethical and technical responsibilities of their vocation (1, 4).

Thanks to the circulation of the aforementioned information on the contribution of medical and biochemical science to pharmacy, it is no surprise that Arabic pharmacists presented a great opus of new techniques and substances as well as having established a monopoly in the distribution of pharmaceuticals. The role of a professional educated pharmacist in society was not ignored, but was, on the contrary, welcomed. Profession and the role of pharmacist was first defined by al-Biruni in his



Figure 1. Page from the book “De Materia Medica” written by Dioscorides (Arabic translation)

book “Saydanah fit-tibb”, as follows: “A professional who specializes in collecting all medications, choosing only the best from simple and complex, and in preparing good medicines, follows the most accurate methods and techniques that are recommended by the treatment experts” (1). This pharmacist’s description differs slightly from the modern one. Al-Biruni promoted the idea of academic training for pharmacy students, and emphasized that pharmacology, knowledge of how medicines book on the organism is more important than mere preparation. In his book, Al-Biruni also performs the Arabic name for pharmacist “as-saydanani” or “as-saydani”, which would mean “the one who sells sandalwood” because the trained pharmacists used this aromatic plant from the 8<sup>th</sup> century. On the other hand, herbalists did not use sandalwood so much (12).

### 6. LEGAL REGULATION

The early development of a professional pharmacy has hampered the legal regulation regulating the work of pharmacists and doctors. To pharmacists must be forbidden to set the diagnosis and medical treatment for patients without a physician, and physicians should have limited the preparation and distribution of medicines. It is true that physicians feared that their recipes would not go to the hands of some charlatan pharmacists or attracts who did not have a professional training for pharmaceutical practice. But they still could not prepare everything, but some of the famous pharmaceutical preparations were only sought in pharmacies. During the al-Mu’tas rule, it is noted that educated and morally-minded pharmacists have been granted licenses to run their private apothecaries. It should be emphasized that during the entire period of Arab and Turkish rule, both educated pharmacists and attarists (druggist) existed and worked side by side, only the attarists in some aspects of their business were limited (18, 22, 27, 30).

It should be stressed that with Islam, there has been a revival in the domain of public health. Islamic religious regulations on hygiene have led to the creation of special control services. At the time of Abasid there was a surveillance service subordinated to a single authority

called ihtisab or hizaba. As head of ihtisab was muhtesib or president. The scope of work of each muhtesib was precisely defined in some manuals. The most significant and even the most ancient book of this kind is “Nihajjet-ur-rutbe” by Abdullah bin Nasr bin Abdullah bin Muhammad Ash-Shizeria. This book, among other things, explains the way of evoking and recognizing the proper from falsified drugs, spices and foods. It deals in detail with the method of controlling the pharmacist in Chapter 17. Medications which are prescribed for the disease, they must have a specific composition and dose. The author, therefore, recommends that every week control the pharmacies, medicines and work of the herbalists (1, 12).

### 7. PHARMACEUTICAL LITERATURE DEVELOPMENT

Intensive development of the pharmaceutical literature begins in the 9<sup>th</sup> century. Scientists who wrote books on the history of pharmacy sought to group pharmacy books into basic categories. Thus historian Sami K. Hamameh categorized into a variety of pharmacological literature into several basic categories (1, 12, 16, 18):

**Forms and compediums.** Which offered collections of formula and prescription medications, systematically arranged (e.g., alphabetically by the names of medicines). They contained instructions on formulation and preparation of medications as well as instructions for use. The first form in Arabic was Sabur b. Sahl in the 9<sup>th</sup> century and was called “al-Aqrabadhin al-Kabir”, translated by the “Great Book of Medicines”. After this book in the eastern caliphate, in the western caliphate, doctor Ibn ‘Abd Rabbih writes “al-Dukkan”. In the next few centuries, compositions of drug formulas have continued to be written, either as independent books or as sections within the encyclopaedias.

**Books about plants and about Materia Medica.** These were under the influence of the Greek-Roman authority of Dioskorides. The Arabs have gradually written their additions to natural medicines from their own soil or from enterprising expeditions (Figure 1). Medicinal herbs were of extraordinary economic importance, so it was at the fingertips of doctors and pharmacists. Among the most important Arabic books in this area is the “as-Saydanah fit-Tibb” of al-Biruni, physician in the



Figure 2. Jabir bin Hayyan described distillation using “alembic” in 8th century



Figure 3. Ibn al-Baitar



Figure 4. Abu ar-Rayhan al-Biruni



Figure 5. A-Hussain Ibn al-Haytham



Figure 6. Hunayn bin Ishaq



Figure 7. Rabbi Moses bin Maimon



Figure 8. Yuhann ibn Masawah



Figure 9. Ali ibn Sahl at-Taberi



Figure 10. Abu Kasim al-Zahrawi

11<sup>th</sup> century. Even more extensive medicine is written in the 13<sup>th</sup> century by famous botanist Ibn al-Baytar, citing about 150 other authors, and describes around 2000 medicinal substances of plant, animal and mineral origin.

**Books of Toxicology.** They were in response to the risk of accidental or deliberate poisoning, because poisoning was one of the popular personal and political weapons. These special manuals describe toxic substances and their effects, symptoms of poisoning, and often very complex and wonderful antidotes. Some of this knowledge came from India thanks to commercial and cultural relations. Especially the many forms of tertiaki, the universal antidote of complex content that originate from the Greek-Roman antiquity. The Arabs contributed to the toxicology since Hunayn bin Ishaq in the 9<sup>th</sup> century to Ibn al-Suri in the 13<sup>th</sup> century.

**Books on Diet and Drug Therapy.** Arabs have paid attention to the importance of combination of diet and drug therapy more than the predecessors. The central concept of these books is that a sick person needs a different diet and way of life than healthy persons. The inspiration for creating this literature was given by Hunayn ibn Ishaq in the 9<sup>th</sup> century by translating relevant Hippocrates and Galen's books, but also by writing their original about this subject.

**Pharmaceutical books as parts of the encyclopaedia.** The Arabic encyclopedists sought to consolidate all the medical knowledge of their time into their encyclopaedia

books. They usually devoted two books (parts) to pharmacy, in their multidimensional medical encyclopaedias. The thrill of successful encyclopaedists began by al-Razi, and continued by 'Ali ibn' Abas with an even more systematic and conclusive book and a great interest in ethics of medical care. Among the most brilliant names is Ibn Sina, who dedicates two parts of his famous Canon of medicine to drugs, describing about 760 of them. His contemporaries in the western caliphate of the Empire was the encyclopedist Abu-l-Kasim al-Zahrawi (6).

## 8. GREAT NAMES OF ARABIC MEDICINE AND PHARMACY

The pleiad of distinguished doctors, botanists, alchemists and philosophers has played a key role in the development of pharmacy. There are many prominent names of Arabic scientists, and we will try to summarize, in a chronological order, a brief overview of the names of some of the scientists who have contributed most to the pharmacology with a brief overview of these contributions. The greatest glory in the history of medicine, however, had the doctors encyclopaedists, whose rich encyclopaedia books, in which all the medical experiences of previous ages and civilizations are collected, will be the basis of research and development of modern medicine. Therefore, in this review, the most significant encyclopaedists are intentionally omitted, as they will be given special attention later (Figures 3-13) (1-5, 12).

**Yuhann ibn Masawayh (777-857)**, in the West known as Mesue Elder, was a Nestorian physician and translator. His most famous translations are on hygiene, fever and diets. He wrote about combining drugs and diets, arguing that the most successful physician was able to cure the disease only with a change of diet. He recommended using medicinal herbs to improve the body's natural resistance. He led the first private medical school in Baghdad, and his pupil was also a scholar Hunayn b. Ishaq.

**Hunayn bin Ishaq (809-873)** in the West known as Johanus, as mentioned above, is the most significant translator of the first translating school in Baghdad. He personally corrected the translation of Dioskorides Pharmacopeia, which is of crucial importance to pharmacy. He also wrote about 100 original books, including the book on complex drugs for ocular illnesses. Especially the terminology in identifying drugs and plants, which will, thanks to Latin translations, enter European dictionaries.

**Sabur bin Sahl (died 869)**, as mentioned earlier, is the author of the first Arabic collection of formulas. The collection contained methods and techniques of drug composition, pharmacological activity and dosage. The originality of this book lies in classifying the drugs according to their forms and is written with the intention of being a guide to pharmacists.

**Ali Ibn Sahl at-Taberi (808-861)** wrote a Compendium of Medicine "Firdaws ul-Hikma", which has 25 chapters on drug properties. The book was remarkably enriched with Indian medical texts by well-known doctors Sushru and Chanaky, directly translated for this purpose from Sanskrit to Arabic.

**Muhammad ibn Zakarya al-Razi (865-925)**, "Arab Galen" is one of the most brilliant middle-aged geniuses. He was a Persian alchemist, chemist, physician, physicist, philosopher, scholar. In medicine, its contribution is so significant that it can only be compared to that of Ibn Sina. The most prominent medical works of ar-Razi are "Kitab al-Hawi", "Kitab al-Mensuri", "Kitab al-Muluk" and "Kitab al-Judari". The first book of the listed had its glory in Latin as "Continens liber". This array is the latest and greatest book that includes all the medical knowledge of that time and includes parts dedicated to pharmacy, complex drugs, pharmaceutical doses and toxicology. With its use of mineral drugs as a medicine for external and internal use, ar-Razi was the founder of chemotherapy in Islamic medicine. For "Kitab al-Mensuri" it was worth dedicating four out of ten parts of the book of drugs and diets, cosmetics, toxicology and antidote use, laxatives, and complex medicines that are of pharmaceutical interest. It is interesting that he first used opium as an anesthetic, and



Figure 11. Zakarya al-Razi

that drug, prior to being administered to humans, had been tested on animals in order to estimate their effects and side effects. He was also the first in the Arab world to write a book that was devoted to the general public to find advice on treatment if a doctor was unavailable. He called it "Man la yahduruhu al-tibb" and this book had a particularly important role in the history of pharmacy (1).

**Ali Ibn 'Abbas al-Majusi (925-994)** was considered one of the greatest doctors of the 10<sup>th</sup> century. He wrote the medical encyclopaedia "Kamil as-Sina'ah at Tibbiyyah", which was used not only in the Islamic world but also in Europe after being translated into the Latin language entitled "Liber regius".

**Abu-I-Kasim al-Zahrawi (936-1013)** was a practitioner, physician, pharmacist and surgeon of Islamic Spain. He is the author of a medical encyclopaedia whose translation of chapter 28, "Liber servitoris", was used as a highly regarded medical chemistry manual in Europe.

**Abu ar-Rayhan al-Biruni (975-1048)** was originally Persian. From the field of medicine he made a series of books of historiographic and encyclopaedic character. He wrote a text on pharmacy and materia medica "as-Saydanah fit-tibb". As mentioned earlier, he gave the most definitive definition of pharmacy, and a statement on the duties of pharmacology, arguing that knowledge of how the drug work within the organism is more important than mere preparation.

**Abu-Ali ibn Husayn ibn Abdullah ibn Sina (980-1037)** is named "the prince of physicians", almost exclusively known in the West as **Avicenna**.

For centuries he has been named for the greatest philosopher and doctor. Ibn Sinna wrote over 450 manuscripts. Aproximatel-ly 240 have survived (40 are devoted to medicine, 150 are on philosophy, the two fields to which he contributed the most). His passion for medicine resulted in development of the most complete, magnificent and effective treatments for stomach and skin cancer, depression, immune disorders, psychiatric disorders, skeletal disorders. Ibn Sina, also, was extremely advanced in chiropractics. The medical experience of Hippocrates and Galen was enriched by his own clinical observations and experiments. He did not consider medicine one of the toughest sciences, and he was absolved at the age of 16. Mainly Ibn Sina's book on medicine is "Al-Qanun fit-tibb", which was already translated into Latin in the 13<sup>th</sup> century and until the 17<sup>th</sup> century was a major medical textbook at almost all European medical universities. The Encyclopaedia is made up of five parts, the second and the fifth being the most important for pharmacy because they sum up all the ancient knowledge of the materia medica and men-



Figure 12. Hasan ibn Ali ibn Sina

tion many drugs unknown to the Greeks. The other one is called "Simple Medicines". It explains the rules that need to know every one who deals with medicine and the power of action of certain established drugs. In the fifth part, the "Drug Formulas" discusses pharmaceutical compositions and pharmacology (1, 12). He described about 760 new medicinal substances, but his most intense book in the field of pharmacy was setting rules for testing the effectiveness of new drugs. These principles remained the basis of modern clinical drug testing: a) The drug must be clean of all foreign accidental agents; b) The drug must be tested on two different diseases because sometimes the drug treats one disease with its essential qualities and the other with the accidental quality; c) The quality of the drug must correspond to the severity of the disease; d) Careful monitoring of drug action time; e) The effect of the drug has to occur constantly or in different cases, because if that does not happen, the effect it causes is considered to be random; f) The experiment must be carried out on man, because if it is carried on animals, they can not prove the effect they cause on humans (3, 4, 5, 9). He created a system of medicine that is now called holistic, and implies that physical and mental factors, a diet and medication are combined in treating the patient (1).

**Ibn Jazlah (died 1100)** writes about poisons and antibodies, and in the compendium "al-Minhay al-Bayan" discusses simple and combined medications and diets used in various diseases. The author claims that book fill the gaps left by previous medical writers. Describes each of these medications and states substitutions when

the originally mentioned medications are unavailable.

**Ibn al-Tilmidh (1073-1165)** founded one of the most famous medical schools in Baghdad and wrote books on medicine and therapeutics. He wrote "al-Aqrabadhin", a pharmaceutical text on the preparation and prescribing of a large number of medications. The text become the reference for pharmacist practitioners in private and hospital institutions.



Figure 13. Alauddin ibn al-Nafis

**Rabbi Moses bin Maimon (1135-1204)**, known as Maimonides, wrote a poison book and a manual for medicinal herbs containing synonyms for the drug name.

**Ibn al-Baitar (1197-1248)**, a famous botanist, herbalist and author of the most prominent and most popular books of medicine. It contributes to pharmacy by its book "Choice of Ordinary Medicines".

**Kohen al-Attar** was a Jewish doctor and pharmacist, and in 1259 he wrote the most important pharmacy code of that time entitled "Apothecary Laboratory Handbook", which even today uses pharmacists in the East. It deals with the duties of pharmacists, receipts, instructions on measuring medicines, purchasing and prescribing skills,

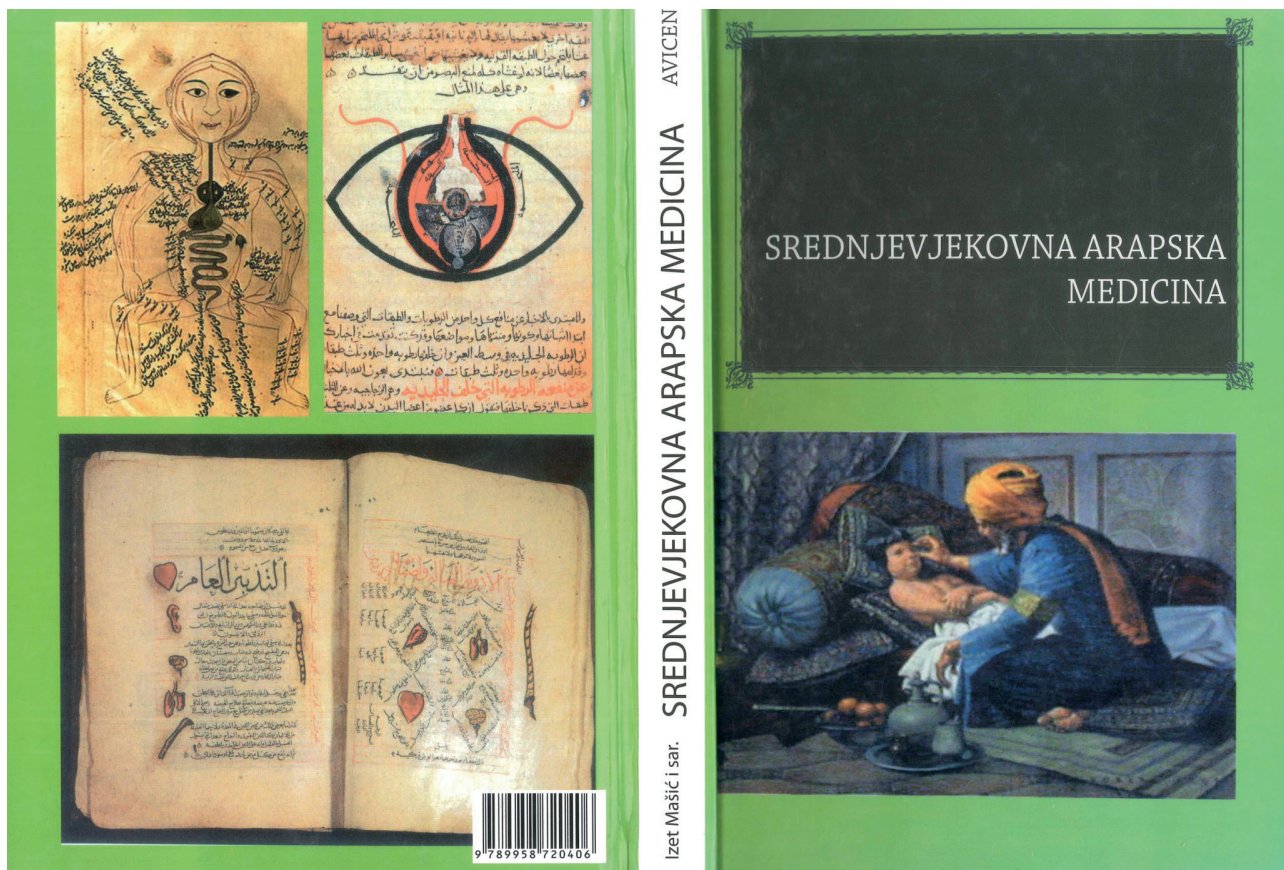


Figure 14. Cover pages of the book "Medieval Arabic Medicine" written by Izet Masic et al.

recognizing falsification and many other topics (1, 4, 7, 8).

**Alauddin ibn al-Nafis (1210-1277)** was a great physician of the 13<sup>th</sup> century. “Mu’giz al-Qanun” and “Sharh al-Qanun” are the most important of the books he has written. The first book was the excerpt of Ibn Sina’s “Canon of Medicine” and was a favorite medical manual for several centuries. It is divided into four parts, and for the pharmacy is a fascinating second part of the book that discusses the simple and complex medicines. In that part of the book, taking into account the quality of the drugs, it classifies them on the degrees of strength of their activity. Compound medicines are defined as those made up of several substances for which the mixture has received a completely different quality (7-10).

## 9. INFLUENCE OF ARABIC TO EUROPEAN MEDICINE AND PHARMACY

At the beginning of the middle ages, European science was at a very low level of development. The reason for this was also the Barbarian tribes who destroyed the libraries and valuable manuscripts that had been collected for centuries on several occasions. Due to these devastation, Europe lost, and then forgot its cultural heritage. Meanwhile, the Arabs have collected the famous books of previous civilizations and on these grounds continued scientific progress. They taught the way of Europe with their doctrine that in the dark middle ages their period of Renaissance began (9). By the 17<sup>th</sup> century, Western European medicine was the result of Latin translations of Arabic-based medical books. That Arabism begins with Constantine the African who translated the books for the medical school in Salerno. He did not only translate Arabic translations of Greek books, but also the original books of Arab doctors. These translation activities were particularly pronounced in Spain in the 12<sup>th</sup> and 13<sup>th</sup> centuries (1). In the Latin translations of these books, and in particular Ibn Sina’s Canon, many medical courses were based on the universities of Europe. Translated by Kremon in Toledo, and as soon as a Latin copy appeared, the book had a great glory. The first university that accepted Canon was in Poland in the 13<sup>th</sup> century, and remained on the throne of the university until the 17<sup>th</sup> century when science-based medicine was born. In Montepelleier, a large center of medical studies, parts of Canon were included in official literature from 1340 to 1657, and at the Universities of Leipzig and Tibingen from 1481. The medicine courses of the University of Vienna in 1592 and the University of Frankfurt am Oder in 1598 were also based on Canon. The Arabic texts of Canon of Medicine were also available in Bosnia and Herzegovina at the beginning of the 20<sup>th</sup> century, and were used by some folk doctors (24-30). From the point of view of science as a method of research and analysis, today’s scientists are direct heirs to Ibn Sina and his predecessors: Ar-Razi, Galen and Aristotle, because their mode of presentation gives the impression of a concept that is true for all times (1, 12, 14).

Apart from Canon, many other encyclopedias such as ar-Razi’ “al-Mansuri” and texts of unofficial Arabic phar-

macopeia have been included in European pharmaceutical texts, thus encompassing books describing grass and formulas all the way to modern times. The common practice of Arabs was to give specific names to medications based on their pharmacological activities, as we know that today is a common practice followed by modern medical patents in the West. So they came to the modified Arabian teriaki, the universal antidote, the combined medicine found by ancient Greeks, and perfected Galen (1). Tertius and other antidotes were adopted in several Arab formulas, some of which contained over 60 ingredients. The West was fascinated by the marvelous effects of such combined drugs and were sold there by astronomical prices until the 18<sup>th</sup> century (1).

Also, the differentiation of pharmacy and medicine that took place in the Arab world for the West has played a significant role. Their teachings and arrangements were established by the Arabs in Sicily during the occupation from the 9<sup>th</sup> to the 11<sup>th</sup> century. The Arabian regime served the Roman Emperor Friedrich II in 1240 that he adopted the constitutions governing the health system, which included the part related to sanitary legislation on the separation of medicine and pharmacy. That part of the Friedrich’s constitution was called the Sicilian edict, but as it was set up by the medical school of Salerno, it was known as the Salerno edict. Thanks to the great contribution of Arabia, pharmacy and medicine were legally separated, and this model will be familiar with Sicily via the rest of Europe (1-5).

## 10. CONCLUSION

Arabic civilization has played an invaluable role in preserving the continuity of scientific progress. Its greatest contribution was that it was collected in critical moments for humanity, when the numerous cultural barbarians have destroyed the world’s cultural heritage. Rescuing the supreme books of ancient civilizations, Arabs, unlike many conquerors, have shown an objective respect for the human search for knowledge. These books have accumulated on the Arab soil, translated and built on their foundations. Some facts about it is described in the book written by the first author of this article (Figure 14) (1).

The Arabs from the primitive disbanded tribes in the recorded time have yielded the brightest culture known to the world of the Dark Middle Ages. Thanks to Arabs and European cultural renaissance, the scientific revolution was possible. Thus, the time interval from the 9<sup>th</sup> to the 13<sup>th</sup> century remained known as the “golden period of the Arabic science”, and a significant place among the taught sciences are occupied by medicine and pharmacy. Arabs were able to use their cultural and natural resources and trade links to contribute to the strong development of pharmacy. After the collapse of the Arab rule, the Arabic territorial expanses and cultural heritage were taken over by the Turks. Although scientific progress in the Turkish period slowed down due to numerous unfavorable political-economic and other circumstances, thanks to the Turks, Arabic culture and useful Islamic principles expanded to the territory of our homeland of Bosnia and Herzegovina. Significant role in the transfer



of Arabic pharmaceutical knowledge was also attributed to the Sephardic Jews who, with their arrival, continued to perform their attar activities, which were largely based on Arab achievements (25-31). However, insufficiently elaborated, rich funds of oriental medical and pharmaceutical handwriting testify that Oriental science has nurtured in these areas as well, and that the Arabic component in a specific way was intertwined with other cultures and traditions of Bosnia and Herzegovina.

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## REFERENCES

1. Mašić I. Srednjovjekovna arapska medicina/Medieval Arabic Medicine. Avicena. Sarajevo, 2010: 296 pages. ISBN: 978-9958-720-40-6.
2. Mašić I. Arapska medicina. Avicena. Sarajevo, 1994: 58 pp.
3. Mašić I, Riđanović Z, Kujundžić E. Ibn Sina - Avicena život i djelo. Avicena. Sarajevo, 1995: 148 pp.
4. Muminagić S, Masić I. The classics of Arabic medicine. *Med Arh.* 2010; 64(4): 254-6.
5. Mašić I. Klasici Arapsko-islamske medicine. Avicena. Sarajevo, 1995: 96 pp.
6. Masic I. Thousand year anniversary of the historical book "Kitab al-Qanun fit-tibb" - the Canon of medicine, written by Abdulah ibn Sina. *Journal of Research in Medical Sciences.* 2012; 17(11): 993-1000.
7. Masic I, Dilic M, Solakovic E, Rustempasic N, Ridjanovic Z. Why historians of medicine called ibn al-Nafis second Avicenna? *Med Arh.* 2007; 62(4): 244-9.
8. Masic I. On occasion of 800th anniversary of birth of ibn al-Nafis - discoverer of cardiac and pulmonary circulation. *Med Arh.* 2010; 64(5): 309-13.
9. Mašić I. i sar. Doprinos islamske tradicije razvitku medicinske znanosti. Avicena. Sarajevo, 1999: 212 pp.
10. Masic I. Who Really First Described the Pulmonary Blood Circulation? *Circulation.* 2007 Sep4: 159-60.
11. Mašić I. Avicenska medicina. U: Hadžović S, Mašić I. i saradnici. Attari i njihov doprinos razvoju farmacije u BiH. Sarajevo: Avicena. 1999: 117-34.
12. Mašić I, Škrbo A, Mulić I. Farmacija u islamu. Avicena. Sarajevo: 2010: 7-24.
13. Shefer-Mossensohn M. Ottoman medicine: healing and medical institutions 1500-1700. Albany: State University of New York Press. 2009: 22-23.
14. Hamarneh S. The rise of professional pharmacy in islam. *Med Hist.* 1962; 6(1). 59-66. Retrieved: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1034673/?page=1>. Accessed: September 9th, 2016.
15. Hajar R. The air of history part III: The golden age in Arab islamic medicine an introduction. *Heart views.* 2013; 14(1): 43-6. Retrieved: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3621228/>. Accessed: September 9th, 2016.
16. Masic I. Korijeni medicine i zdravstva u Bosni i Hercegovini. Avicena. Sarajevo, 2004: 228 pp.
17. Đuričić A, Elazar S. Pregled istorije farmacije Bosne i Hercegovine. Sarajevo. 1958: 44-62.
18. Hadžović S. Farmacija i veliki doprinos arapske islamske znanosti njenom razvitku. *Med arh.* 1997; 51(1-2): 47-50.
19. Tschanz D.W. A short history of islamic pharmacy. *JISHIM.* 2003. Retrieved: <http://www.ishim.net/ishimj/3/03.pdf>. Accessed: September 9th 2016.
20. Al-Hassan AY. Factors behind the decline of islamic science after the sixteenth century. Retrieved: <http://www.history-science-technology.com/articles/articles%208.html>. Accessed: September 9th, 2016.
21. Majeed A. How islam changed medicine. *BMJ.* 2005; 331(7531): 1486-7.
22. Mašić I. Zdravstvo u Bosni i Hercegovini tokom osmanskog perioda. Avicena. Sarajevo, 1994: 3-20.
23. Gušić S. Uređenje attarske djelatnosti u osmanskome periodu u Bosni i Hercegovini. U: Hadžović S, Mašić I. i saradnici. Attari i njihov doprinos razvoju farmacije u BiH. Sarajevo: Avicena. 1999: 23-33.
24. Devetak Z. Ljekaruše iz osmanskog perioda. U: Hadžović S, Mašić I. i saradnici. Attari i njihov doprinos razvoju farmacije u BiH. Sarajevo: Avicena. 1999: 67-73.
25. Latal-Danon Lj. Jevrejska komponenta u attarskoj djelatnosti. U: Hadžović S, Mašić I. i saradnici. Attari i njihov doprinos razvoju farmacije u BiH. Sarajevo: Avicena. 1999: 35-8.
26. Fabijanić R. Pojava attara i njihova djelatnost u Sarajevu u turskom periodu. U: Hadžović S, Mašić I. i saradnici. Attari i njihov doprinos razvoju farmacije u BiH. Sarajevo: Avicena. 1999: 7-20.
27. Mašić I. Pregled orijentalnih medicinskih rukopisa o liječenju prirodnim lijekovima na području BiH. U: Hadžović S, Mašić I. i saradnici. Attari i njihov doprinos razvoju farmacije u BiH. Sarajevo: Avicena. 1999: 85-91.
28. Skrbo A, Masic I, Skrbo S, Ramakic E, Zunic L. Bosnian Franciscans and the Monasteries in Kresevo and Fojnica as Source of Scientific Bibliography. *Mater Sociomed.* 2017 Jun; 29(2): 149-54. doi: 10.5455/msm.2017.29.149-154.
29. Masic I. Historija zdravstvene i socijalne kulture u BiH. Avicena. Sarajevo, 1993: 48 pp.
30. Zunic L, Masic I. Roots of Pharmacy Practice in Bosnia and Herzegovina from Ottoman and Austro-Hungarian period: Attars Mission for Pharmaceuticsl Care. *Mater Sociomed.* 2015 Feb; 27(1): 56-8. doi: 10.5455/msm.2015.27.56-58.
31. Skrbo A, Masic I. Influence of Arabian Pharmacy on Diseases Treatment During Ottomans Period in Bosnia and Herzegovina. *Med Arch.* 2017 Jun; 71(3): 219-25. doi: 10.5455/medarh.2017.71.219-225.