



Overview on the impact of the Arabic-Islamic scholars on modern ethnobotanical knowledge in Morocco

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Abstract: Morocco is a part of the Arabic world, located in the North-West of Africa. Ethnobotanical studies increasing in this country in the last decade and continue to records novel medicinal plants and new therapeutic practices. However, few studies involve or discuss the historical roots of this traditional knowledge. This work aims to highlight the impact of the ancient Arab-Islamic therapeutic knowledge developed through the Golden Age (7th – 13th C.E) on the current ethnobotanical knowledge in Morocco. Furthermore, we discuss the development of ethnobotanical knowledge in Morocco through time and space. To reveal the relationships and the impact of the Arab-Islamic medical scholars from the golden age on the modern ethnobotanical knowledge developed through time in Morocco, we undertook a bibliographical research based on Published papers recovered from different bibliographical databases such as ScienceDirect, PubMed, and Google Scholar, as well as books and scientific thesis available in Morocco. As a first reflection, few ethnobotanical works conducted in Morocco provide a historical analysis in their study. However, we can note that modern Moroccan ethnobotany is a mixture of different knowledge developed by various ethnicities from different civilizations settled in Morocco through time. Nevertheless, the Arab-Islamic civilization deeply influenced traditional Moroccan practices, principally through Andalusian scholars and medics who lived or traveled across Morocco, such as Ibn al-Baytar. Finally, ancient Arab-Islamic knowledge is considered a solid base for the development of Moroccan ethnobotanical knowledge. Consequently, historical analysis needs more involvement for understanding the cultural sets behind our local traditional practices.

1. The importance of ethnobotany

Ethnobotany is an interdisciplinary science or field of research, incorporates various sciences such as botany, ecology, pharmacology, chemistry, pharmacognosy, archeology, anthropology, linguistics, religion, history, mythology, and sociology. It was defined as the study of the direct interaction between plants and man in his culture (Fuller, 2013; Rodrigues *et al.*, 2020). The term ethnobotany was introduced by the American botanist Dr. John William Hershberger in 1895 to describe plants' use by indigenous people for therapeutic, food, ornamental, firewood, and other purposes (Rahman *et al.*, 2019). Otherwise, ethnobotany is regularly considered to study the interaction between plants and humans in space and time (Prance, 2007). Consequently, ethnobotany is a combination of two terms:

"**Ethno**" refers to people's study, and "**Botany**" refers to the study of plants. Nowadays, the concept of ethnobotany consists of the use of plants by indigenous people for medical purposes, which is historically related at all times in diverse ancient civilizations throughout the world.

Ethnobotany is currently among the most important research fields in the scientific world, precisely on medical and health ones. Despite the significant progress in modern medicine, traditional herbal therapy and co-therapy continue to be practiced worldwide. As a matter of fact, medicinal plants provide a cheap source of medicines for several people throughout the globe and will continue to provide directly bioactive compounds and natural drugs pharmacologically applicable for several diseases, including chronic ones such as cancer (Alami Merrouni and Elachouri, 2021). According to the World Health Organization (WHO), 80% of the African population uses plants traditionally for therapeutic purposes, including Moroccan people. This empirical health care system was deeply rooted in classical Arab-Islamic medicine, further developed and enriched by other knowledge brought in by peoples settled in Morocco.

2. Evolution of traditional knowledge through time and space

Humans have been dependent on mother nature in their basic daily life activities, especially on plants, for a long time. Herbs' use for medical and therapeutic purposes was extensively developed with a succession of cultures through space and time (Ancient Chinese, Indian, Egyptian, Greek, Roman, Arabic, Persian, and other civilizations).

Hippocrates (460–377 B.C.) started Western traditional medicine, named the subject's father (Edriss *et al.*, 2017). Afterward, many other Occidental physicians, such as Rufus of Ephesus, Dioscorides, Soranus, Celsus, and Galen, contribute toiled by teaching Hippocrates' works and doing their significant work (Elachouri, 2018). By the end of the 5th century, the Roman empire was fallen, and their medical knowledge and texts were transferred to the Near-East, where the Arabic and Islamic civilization come to rise, by the 7th century, which is called: The Arabic-Islamic Golden Age, Meanwhile Europe, and the western world went through its dark period (Edriss *et al.*, 2017; Elachouri, 2018).

The Arabic-Islamic Golden Age (7th - 13th C.E.) is a period characterized by the renaissance of the Islamic empire, which was started from the Arabic peninsula in the Middle-East, and spread to the extreme West (Nowadays Morocco) and Al-Andalus (Islamic Spain) (Figure 1). During this period, the Arabic-Islamic culture, economy, and science flourished and made extensive progress in several disciplines, notably medical and health sciences. The Prophet Muhammad (Peace Be Upon Him) himself is believed to have been the founder of Arabic-Islamic medicine (Elachouri, 2018). His statement that "*There is no disease that Allah has created, except that He also has created its treatment*" inspired Islamic and Arabic scholars to involve in medical research and try out a cure for every disease known to them (Bashar and Omar, 2011). During the Prophet's life (PBUH), he states many "*Hadiths*" about medication, including prevention and treating ailments inspired by his wisdom and the Holy Quran's verses. These statements and recommendations narrated by the Prophet (PBUH) were eventually regrouped by the Prophet's companions "*Al-Sahaba*" and establish the prophetic medicine "*Al-Tibb Al-Nabawi*," in which several medicinal plants were mentioned to be useful against various diseases (El-Seedi *et al.*, 2019).

Afterward, Arab-Islamic medics translate, analyses, and criticize the ancient western medical texts and approve them through their new theories, discoveries, and original works.

The Arab-Islamic civilization is one of the most remarkable cultures that have primarily contributed to the development and make extreme progress of various sciences include botany, pharmacology, and

medicine -between the 7th and the 13th centuries- through the greatest works of several famous botanists, physicians, and scholars such as:

- **Al-Dinawari (828–896 C.E.)**

Abu Hanifah Ahmad ibn Dawud Al-Dinawari, author of “*Kitab al-Nabat*” Book of Plants, in which he described about 640 plants and described the phases of plant growth and the production of flowers and fruits, as well as he devoted a chapter to the classification of plants “*Tajnis al-Nabat*”. Therefore, He is considered to be the founder of Arabic botany (Bashar and Omar, 2011).

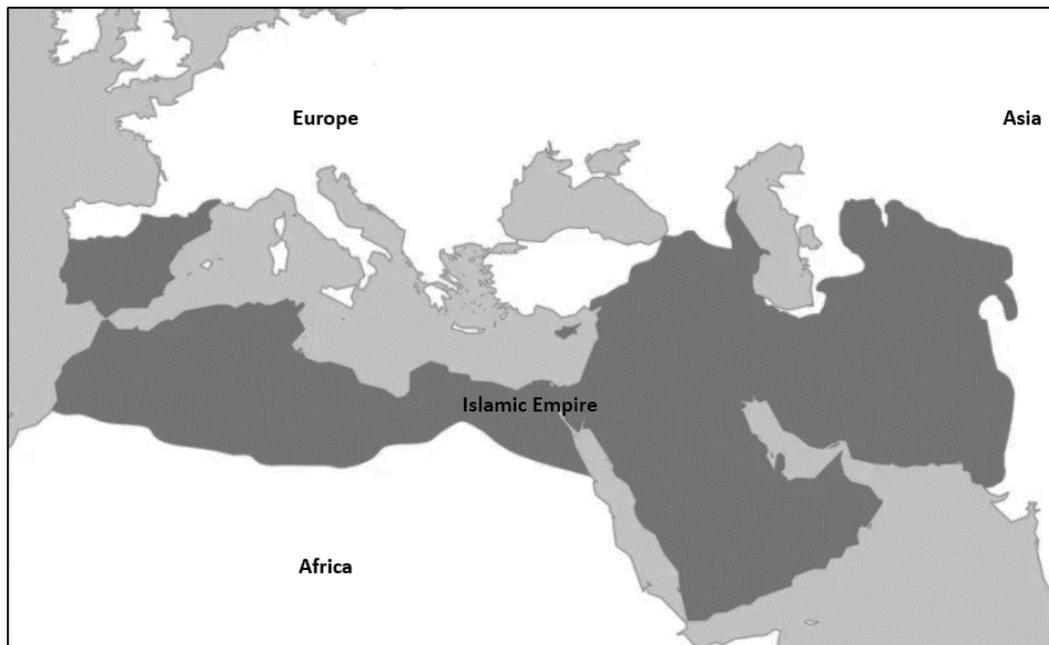


Figure 1: The Arabic-Islamic Empire in the Golden Age (7th - 13th C.E.)

- **Al-Razi (865-925 C.E.)**

Muhammad ibn Zakariya al-Razi is known in Latin world by Rhazes. He is considered the greatest physician of the Golden Age of the Islamic world (Ligon, 2001), authored “*Kitab al-Hawi fi al-Tibb*” The Comprehensive Book on Medicine. About 23 volumes encompass different diseases with separate sections of pharmacology. Furthermore, in the same book, Al-Razi criticized the Greek philosophers Aristotle, Galen, Plato and developed innovative ideas on many medical subjects (Edriss *et al.*, 2017).

- **Al-Zahrawi (936-1013 C.E.)**

Abu al-Qasim Khalaf ibn al-'Abbas al-Zahrawi al-Ansar (Figure 2), is known by Albucasis in Western Literature. Al-Zahrawi was one of the most outstanding surgeons and chemists between the 10th and 11th centuries. His principal work is “*Kitab al-Tasrif*” The method of Medicine (Figure 4), a great encyclopedia of surgery and medical practices (Al-Rodhan and Fox, 1986; Zarrintan *et al.*, 2020).

- **Ibn Juljul (944-994 C.E.)**

Abu Dawud Sulayman ibn Hassan ibn Juljul, an Andalusian physician and pharmacologist, author of “*Tabaqat al-atibba w'al-hukama*” Generations of physicians and Wise, an important work using both Eastern and Western source (Calvo, 2008). Another notable work of Ibn Juljul is “*Tafsir asma al-adwiya al-mufrada min kitab Diyusquridus*” Explanation of the Names of the Simple Drugs from

Dioscorides' Book. Furthermore, Ibn Juljul is appreciated for his knowledge, and ability to locate the geographic origin of plants (Alqethami *et al.*, 2020).



Figure 2: (a): Portrait of Al-Zahrawi (936-1013 CE), (b): Original Arabic text of “*Kitab al-Tasrif*” The method of Medicine (Zarrintan *et al.*, 2020)

- **Ibn Sina (980-1037 C.E.)**

Abu Ali al-Husayn ibn Abd Allah ibn Al-Hasan ibn Ali ibn Sina (Figure 3), is known in the western world by Avicenna, is one of the famous Islamic scientists and the most influential one (Elachouri, 2018). His greatest works are the “*Kitab Al-Shifa*” Book of Healing and “*Kitab al-Qanun fi al-Tibb*” The Canon of Medicine. Ibn Sina’s works were translated into Latin and continued to influence medical science for many centuries (Aciduman *et al.*, 2008; Edriss *et al.*, 2017).



Figure 3: (a): Portrait of Ibn Sina “Avicenna” (980-1037 CE), (b): *Kitab al-Qanun fi al-Tibb*” The Canon of Medicine (Source: Muslim heritage Website)

- **Ibn Al-Wafid (994- 1074 C.E.)**

Ali Ibn al-Husain Ibn al-Wafid, known in Latin World as Abenguefit, his main work is “*Kitab al-adwiya al-mufrada*” The Single Drugs (De Frutos and Guerrero, 2011).

- **Ibn Rushd (1126-1198 C.E.)**

Abu l-Walid Muhammad ibn Aḥmad ibn Rushd (Figure 4), is largely known in the Western world as Averroes, authored over 20 books on medicine. Unfortunately, his philosophical, religious, and legal works have been studied more thoroughly than his medical books (Tbakhi and Amr, 2008).



Figure 4: Ibn Rushd “Averroes” (1126-1198 CE) (Tbakhi and Amr, 2008)

- **Ibn al-Baytar (1197-1248 C.E.)**

Diya al-Din Abu Muhammad Abdullah Ibn Ahmed Ibn al-Baytar (Figure 5), is one of the most notable Islam-Andalusian physicians, pharmacists, and botanists. He authored the excellent book "*Aljami li-mufradat al-adwiya wa'l-aghdhhiya*" The Compendium of Simple Drugs and Food, during his travel across the Arab world (Edriss *et al.*, 2017). Considered a pharmaceutical encyclopedia that detailed around 1400 plants, minerals, and foods (El-gharbaoui *et al.*, 2017), his works and knowledge influenced the medical and pharmacological sciences for many centuries (Edriss *et al.*, 2017).

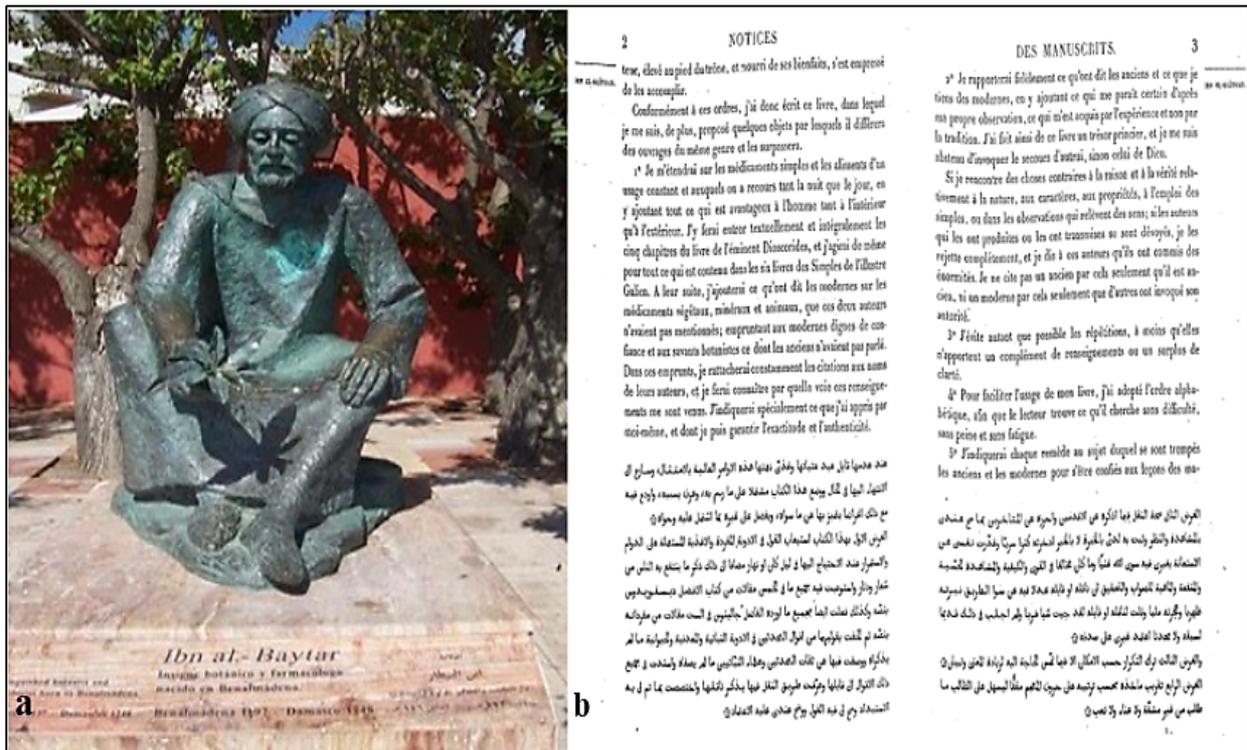


Figure 5: (a) Statue of Ibn al-Baytar (1197-1248 C.E.) in Spain, (b) French edition of “The Compendium of Simple Drugs and Food” (Leclerc, 1877)

Overall, several medieval Islamic medicines works, especially Ibn al-Baytra's, Ibn Sina's, and al-Razi's manuscripts, were later translated into Latin language starting from the 12th and 13th centuries, to become a primary reference and continued to impact medical sciences and practices in the Western world for many years, until the 19th century (Edriss *et al.*, 2017; El-gharbaoui *et al.*, 2017; Elachouri, 2018). Nowadays, there is no doubt that Arab-Islamic medical knowledge is considered the base of modern western medicine, including Pharmacology, Anatomy, Surgery, and Pathology...

These great works and contributions of the ancient Arabic-Islamic physicians and scholars during the Golden Age are now recognized by several foundations and libraries worldwide, such as:

- The National Library of Medicine in Bethesda, MD: More than 300 Islamic-Arabic manuscripts were collected and presented through a numeric database called: Islamic Medical Manuscripts at the National Library of Medicine, available online: (<https://www.nlm.nih.gov/hmd/arabic/welcome.html>).
- Muslim Heritage: Discover the golden age of Muslim civilization: About 90,000 references covering many aspects of Muslim Heritage in science, medicine, technology, culture, and social sciences. By the Foundation for Science, Technology, and Civilization, United Kingdom. Available online: (<https://muslimheritage.com>).

The exceptional Arabic-Islamic medical knowledge, especially plants-based traditional therapy, was transferred and developed from one generation to another through the Arabic world until it became a part of many peoples' daily lives, including Moroccan people.

3. Ethnobotanical knowledge in Morocco

Morocco is located in the North-West of Africa and is a part of the Arabic world, characterized by a Mediterranean climate that promotes the propagation of about 4800 plant species of vascular flora

(Fennane and Rejdali, 2018), among which 905 were qualified as medicinal (Fakchich and Elachouri, 2021). Besides the biodiversity richness, Morocco is recognized as one of the wheatless cultural countries. Moroccan people have developed a traditional therapy knowledge with medicinal plants by the accumulation and homogeneity of culture that originates from various ethnicities settled in Morocco through the time (Figure 6), mixing the traditional knowledge of Amazigh, Arabs, Andalusians, as well as Africans (Alami Merrouni and Elachouri, 2021; Bellakhdar, 2006; El-Hilaly *et al.*, 2003). It was reported that the frequency of use of medicinal plants among the population of Morocco varies between 60% and 90% in several regions of the country (Eddouks *et al.*, 2002; Fakchich and Elachouri, 2014; Jouad *et al.*, 2001; Tahraoui *et al.*, 2007; Ziyayat *et al.*, 1997). Moroccan people are still attached to herbal-based therapy and co-therapy due to several socio-economic factors, spiritual and religious beliefs, limited access to modern medical services, and poverty, especially in rural areas (Alami Merrouni and Elachouri, 2021; Elachouri, 2018).

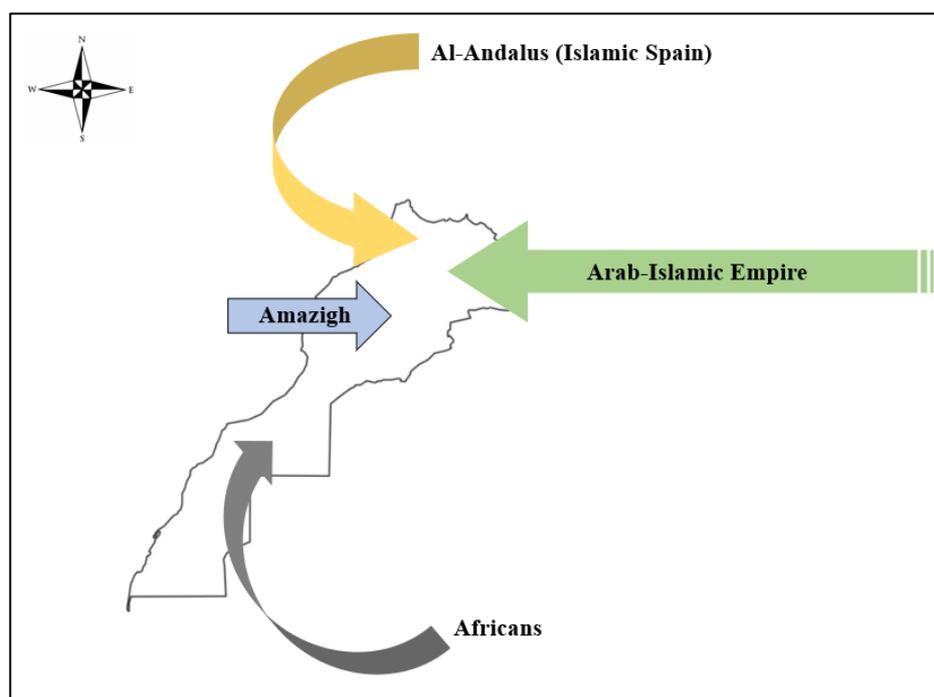


Figure 6: Civilizations impacted ethnobotanical knowledge in Morocco

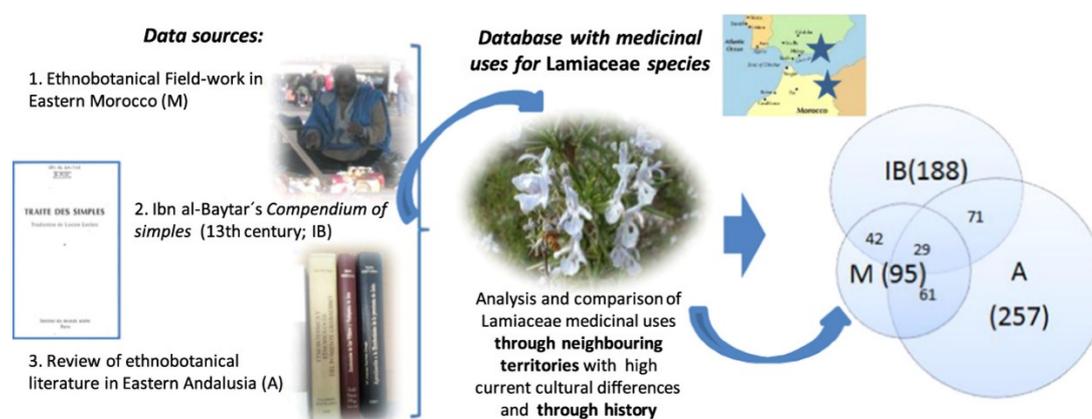
Ethnobotanical studies are currently increasing in Morocco using qualitative and quantitative methods and continuing to record new medicinal plant species as well as new therapeutic uses. Unfortunately, most of these studies are interested only in the compilation of lists of plant species with their therapeutic effects and neglect discussing or understanding the rationale and cultural sets behind these uses.

After reviewing more than 90 Moroccan ethnobotanical articles, books, and thesis published between 1991 and 2021, only four works (Bellakhdar, 1997; El-gharbaoui *et al.*, 2017; Fakchich and Elachouri, 2021; Redouan, 2019) highlighting the historical roots of their local plants recorded by comparing the current traditional uses within the Arabic-Islamic historical texts, principally with Ibn al-Baytar's manuscript (13 century): The Compendium of Simple Drugs and Food (Leclerc, 1877), otherwise, by checking their citation in this historical document. Additionally, a similar ethnobotanical study was conducted recently by our team in North-Eastern Morocco including a historical part adopting the same method (Alami Merrouni *et al.*, 2021). The table 1 provides the significant outcomes of these historical studies:

Table 1: Moroccan ethnobotanical studies include historical analysis:

Study	Region	Type of work	Number of plants recorded	Analysis	Principal outcomes	References
1	All Morocco	Book	More than 500	Citation	77.7% of plants were cited by Ibn al-Baytar.	(Bellakhdar, 1997)
2	Eastern Morocco	Review Article	14 (Lamiaceae)	Citation & Uses Comparison	43% of plant uses may have acquired straight from Ibn al-Baytar text.	(El-gharbaoui <i>et al.</i> , 2017)
3	Northern Morocco	Thesis	152	Citation & Uses Comparison	76.97% of plants were cited by Ibn al-Baytar and have 96 common uses.	(Redouan, 2019)
4	All Morocco	Review Article	25 (Most important)	Citation	92% of plants were cited by Ibn al-Baytar.	(Fakchich and Elachouri, 2021)
5	North-Eastern Morocco	Research Article	283	Citation	73.5% of plants were cited by Ibn al-Baytar.	(Alami Merrouni <i>et al.</i> , 2021)

These results revealed that a large part of modern traditional knowledge in herbal-based therapy originated from ancient Arabic-Islamic medieval medicine (Figure 7), especially from Andalusian texts such as Ibn al-Baytar compendium. Therefore, we can conclude that a considerable part of ancient knowledge was preserved and transferred from one generation to another in Morocco. Undoubtedly, many medicinal plants and therapeutic uses mentioned by Ibn al-Baytar are still not revealed in the modern Moroccan ethnobotanical studies. Consequently, increasing the historical-comparative approach in ethnobotanical investigations is now necessary. The historical analysis of the ancient Arabic-Islamic texts may help develop new theories about the current traditional uses of plant species and denote the loss and modification of knowledge (El-gharbaoui *et al.*, 2017). Furthermore, it could serve as an alternative way for drug discovery in modern medicine through which we can call a Historical ethnopharmacological approach.



Scheme 1 : Historical ethnopharmacological summarize (El-gharbaoui *et al.*, 2017)

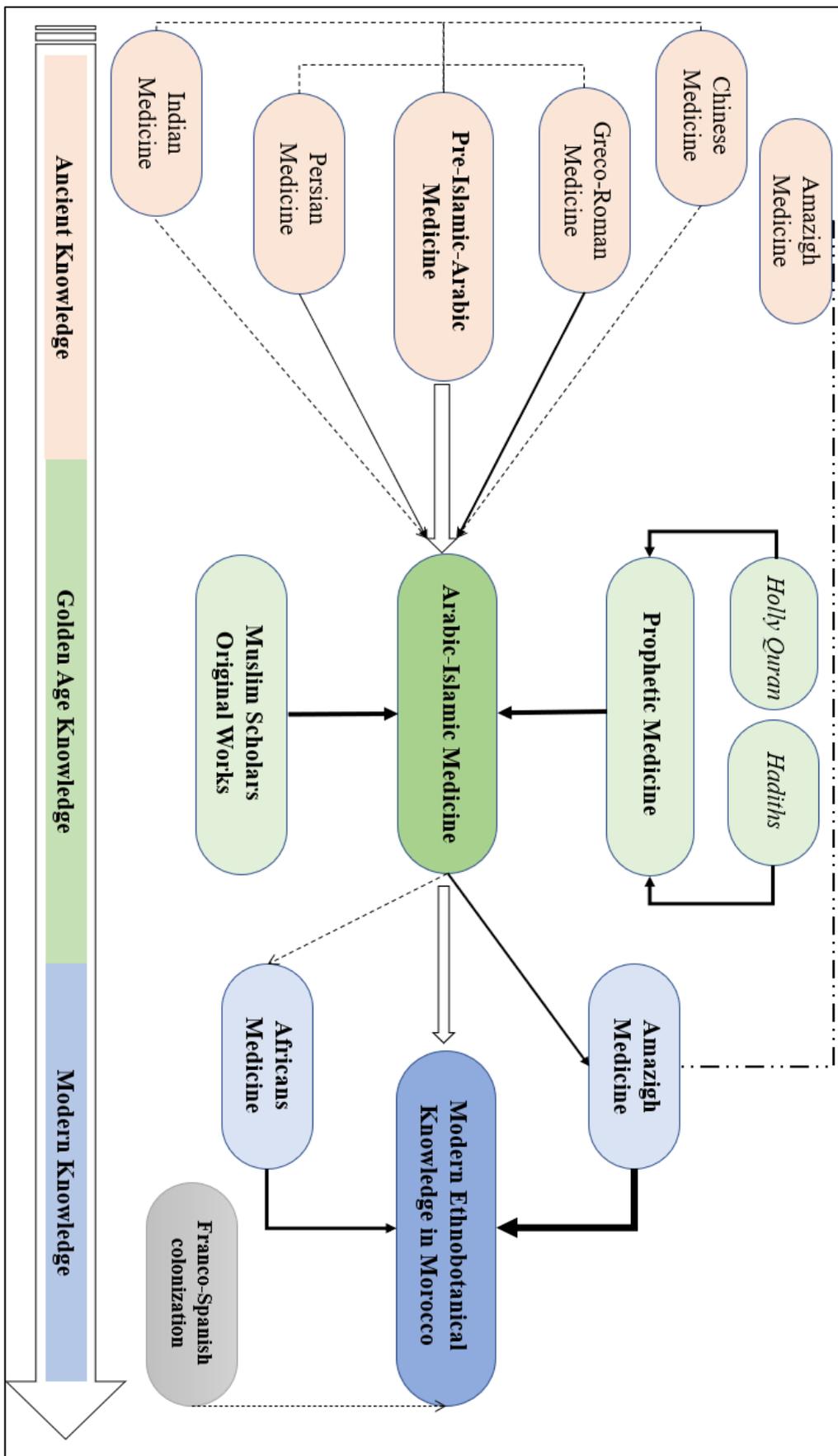


Figure 7: Shema proposed to recapitulate the historical roots of modern ethnobotanical knowledge in Morocco.

Conclusion

Nowadays, Morocco's modern ethnobotanical profile is a rich wealth of indigenous knowledge and practices on medicinal plants' traditional uses. Despite the increasing number of ethnobotanical studies in Morocco, very few works were interested in the historical roots and the impact of the ancient Arabic-Islamic civilization developed during the Golden Age (7th-13th C.E) on the current knowledge. Undoubtedly, the Arabic-Islamic scholars, especially those who lived or traveled across Morocco, directly influenced our traditional practices, particularly in plants-based therapy. Unfortunately, a significant part of this ancient knowledge was lost since that many ancient texts were destroyed or not transmit. Because Arab-Islamic knowledge is considered a solid base for the development of current sciences, the historical analysis approach in ethnobotanical studies in Morocco needs more involvement for understanding the rational and cultural sets behind our local traditional knowledge. This approach may help also develop new theories about the current traditional practices. Furthermore, it can serve as an additional strategy in modern drug discovery, getting started with plant selection based on historical knowledge, followed by pharmacological assessments, phytochemical characterization, toxicological evaluation, and finishing by clinical trials.

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Declaration of Competing Interests

The authors declare that they have no competing interests.

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