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Unearthing fruit tree production and dietary practices in the medieval and modern Haouz: an archaeobotanical exploration of Aghmat (Morocco)

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Abstract:

The site of Aghmat in medieval Morocco has attracted attention due to its rich history spanning the High and Late Middle Ages, as well as part of the Modern era. In recent years, the site has seen much-needed archaeological, bioarchaeological, and ethnological research. This study analyzed 30 samples, 11 of which underwent anthracological analysis. The results were compared with historical texts, confirming the site's potential for archaeobotanical research and revealing a variety of fruit trees in the region, including grapevines, olives and figs. The findings suggest a continuity in eaten species alongside significant changes in agricultural practices, particularly a rise in olive-growing after the change of city's status between the 14th and 15th centuries. This study aims to shed light on the evolution of horticultural and agricultural diversity, in relation with socioeconomic changes over time.

Keywords: Archaeology, Agriculture, Archaeobotany, Economy, Landscape.

Introduction:

In Morocco, medieval and modern fruticulture history is mostly grounded in Arabic texts of various nature and origin, among which agronomic and geographic treatises play a major role¹. These have been providing valuable information about plants in terms of past diversity, of agronomic traditions and affiliations and of cultivation methods, as well as of original designation. For example, one of the myriads of authors that have expressed the importance and abundance of fruit trees in medieval Morocco was al-Idrīsī (mid 12th c.). In his book, *Nuzhat al-mushtāq*, he writes that fruit trees production was so abundant in Fez and its surrounding hinterland that fruit stalls sold their products at very low prices². However, the availability of these sources is uneven, and information is lacking

¹ Al-Idrīsī, Description. 111-113.

² Al-Idrīsī. Nuzhat. 232.

for many periods and regions, emphasizing the significance of a complementary approach.

The 1980s and 1990s saw the launch of archaeobotanical³ research on medieval contexts in Morocco, leading to some pioneer publications⁴, although some remained unpublished and challenging to access⁵. Starting with the year 2000, a new generation of programs was developed specifically, thanks to large field operations carried out on several emblematic sites of medieval Morocco⁶. Since the 2010s, some other sites have been included to large-scale archaeobotanical research (carpology, anthracology), within archaeological programs⁷ impulsing paleoenvironmental studies. In the absence of Moroccan archaeobotanist, this type of research was based on collaborations with international teams, as for the large-scale excavations carried out at Îgîlîz⁸.

In the past years, the province of Al Haouz (Marrakech area) has emerged as a focal point for archaeological and bioarchaeological research, thanks to the archaeological settlement of Aghmat and its extensive chronology spanning the High and Late Middle Ages, as well as part of the Modern era⁹. The medieval city of Aghmat, now a 100 hectares area of ruins, lies 30 km south of Marrakech, concealed beneath fields of olive trees and barley, within the location of the present day Ghmat Market (Fig. 1).

³ Archaeobotany is the study of plant remains found in archaeological contexts. This field analyzes plant materials such as seeds, grains, fruits, wood, pollen, and other botanical remains to provide valuable insights into past plant diversity and into the relationship between humans and plants throughout history, shedding light on ancient agriculture, foodways, technology, and cultural practices.

⁴ Pollock, "Progress Report," 355-360.

⁵ Ruas, "Fruits". 161-185.

- Capel, "Sijilmassa"

⁶ Allevato, "Wood Exploitation," 200-217.

- Allevato, "Evidence". 11-17.

- Fuller, "Plant". 349-368.

⁷ Ruas, "Paléoenvironnement". 42-109,

⁸ Ruas, "Archaeobotanical research," 419-433.

- Ruas, "History and archaeology," 114-136.

⁹ Ros, "First archaeobotanical," 12-19.



Figure 1: Location of the archaeological site of Aghmat and aerial view of the site (in the right picture, the white area symbolizes the current village and the dotted line limits the entire archaeological site) (image: Mission Archéologique d’Aghmat).

Located at the foot of the northern slope of the High Atlas Mountain, from which it has drawn its abundant water resources throughout its existence, Aghmat, according to the descriptions of medieval geographers, flourished from the 9th to the 14th century CE as a major agricultural center in the western Maghreb and with a key role in trans-Saharan trade¹⁰. After briefly being the capital of the Almoravid empire, the town flourished until the 14th century CE, when it was abandoned. Later on, in the 16th century CE, Leo Africanus portrayed Aghmat as a ruined city, inhabited by rural dwellers, described as a muslim mystic (Sufi) community, involved in agricultural activities and pottery craftsmanship¹¹.

Since 2005, the Archaeological Mission of Aghmat have been exploring this site, leading to a nuanced understanding of the transitional period between its abandonment and its rural renaissance. This program, which started as a conservation project dedicated to the ruined hammam of the medieval city, prompted the formation of a full archaeological research team under the supervision of Ronald Messier (Middle Tennessee State University) and Abdallah Fili (University Chouaib Doukkali of al-Jedida), joined in 2016 by Chloé Capel (CNRS) and, in 2019, by Mohamed Belatik (INSAP). From 2016 onward,

¹⁰ Ettahiri, “Nouvelles” 259-280.

¹¹ Héritier-Salama, “De la ville”. 195-207.

the archaeological program has developed a paleoenvironmental perspective, leading to the first archaeobotanical publications in this region¹².

The main concern of the palaeoenvironmental studies of the Archaeological Mission of Aghmat is the significant changes that affected the settlement of Aghmat throughout its history, evolving from a large town with strong market and political power, to a small rural locality focused on agriculture and ceramic crafts. These status and demographic changes raise the question of how agricultural and dietary practices also evolved during the different phases of occupation of the site. The existence of various archaeobotanical dataset that documents all these periods allows this article to focus on the specific history of fruit growing at Aghmat, as fruit trees seem to have played an important role for medieval and then modern populations¹³. Our aim is to shed light on the diversity of fruit grown there and on its evolution over time, and to determine whether there was a local terroir dedicated to fruit growing. When possible, available textual sources will be consulted in order to optimize this study.

Material and methods

The findings in this paper are based on a thorough carpological analysis of 30 samples, 11 of which underwent anthracological analysis, sieved on fine meshes (0.5 mm) on the spot during the 2016 and 2021 field campaigns. The majority of contexts where plant remains have been preserved are those found in landfills, combustion structure discharges (from domestic homes and furnaces used for household and craft purposes), habitat soils, repurposed containers or silos fillings. The original volume of the samples varied, ranging from 0.2 to 40 L, depending on the context of origin. It is worth noting that 28 of the 30 samples contained fruit tree remains.

At the carpological platform of the UMR5554 (ISEM, Montpellier, France), seed remains were extracted using a Nikon SMZ 645 binocular (magnification $\times 0.8$ to $\times 5$), since sorting the remains by eye is insufficient to view all of them or to notice the diagnostic traits sought at the time of the determination, especially when it comes to the fine

¹² Ros, "First archaeobotanical,"12-19.

- Ros, "Forest and agricultural," .

¹³ Ros, "First archaeobotanical,"12-19.

fractions. We used a reference collection of fresh and archaeological seeds, as well as the following publications: Cappers et al. (2006), and Rameau et al. (2008).¹⁴

For the anthracological analysis, we used an Olympus BH2-UMA reflection microscope with a black/white backdrop and magnifications of x100, x200, and x500, as well as reference atlases¹⁵, along with the reference collection of the "Dynamique de la biodiversité, anthropo-écologie" team (ISEM).

Archaeobotanical results and data criticism

Archaeobotanical results

As part of our analyses, we compiled the archaeobotanical data available from the various studied samples, and assessed 1) the overall fruit diversity on the site, 2) for carpological remains, the frequency of appearance of the various taxa and the type of remains encountered (to detect possible products/by-products), and 3) for anthracological remains, by major phase of occupation of the site, the relative proportions of fruit trees in relation to other non-fruiting woody species, and those of each fruit tree.

In the archaeobotanical samples of the site, fruit trees accounted for the most common type of cultivated plant. Including both carpological and anthracological remains, we identified a total of 12 fruit trees, as follows: strawberry tree (*Arbutus*), argan (*Argania spinosa*), fig (*Ficus carica*), walnut (*Juglans regia*), olive (*Olea europaea*), date palm (*Phoenix dactylifera*), almond (*Prunus dulcis*), peach (*Prunus persica*), pomegranate (*Punica granatum*), blackberry/ raspberry (*Rubus idaeus/ Rubus fruticosus*), grapevine (*Vitis vinifera*), and jujube (*Ziziphus* sp.).

Regarding the carpological samples, the remains mainly correspond to seeds, pips or fleshless pits, entire or fragmented, and, also, in the case of the grapevine, to pedicels. The earliest phases of occupation deliver the widest fruit diversity (Fig. 2), while in the latest phase only three fruit trees are recorded, maybe due to the fewer number of studied

¹⁴ Cappers, Digital.

- Rameau, Flore.

¹⁵ Schweingruber, Anatomy.

- Jacquot, Atlas.

- Jacquot, Atlas.

samples. While most taxa are already present between the 9th and 12th century, *Ziziphus* sp. and *Juglans regia* solely emerge between the 13th and 14th centuries. Within the samples, grapevines, figs and olives are the most common taxa, *Olea europaea* being sparsely represented in the earliest phase and progressively gaining prominence from the 13th-14th century onwards.

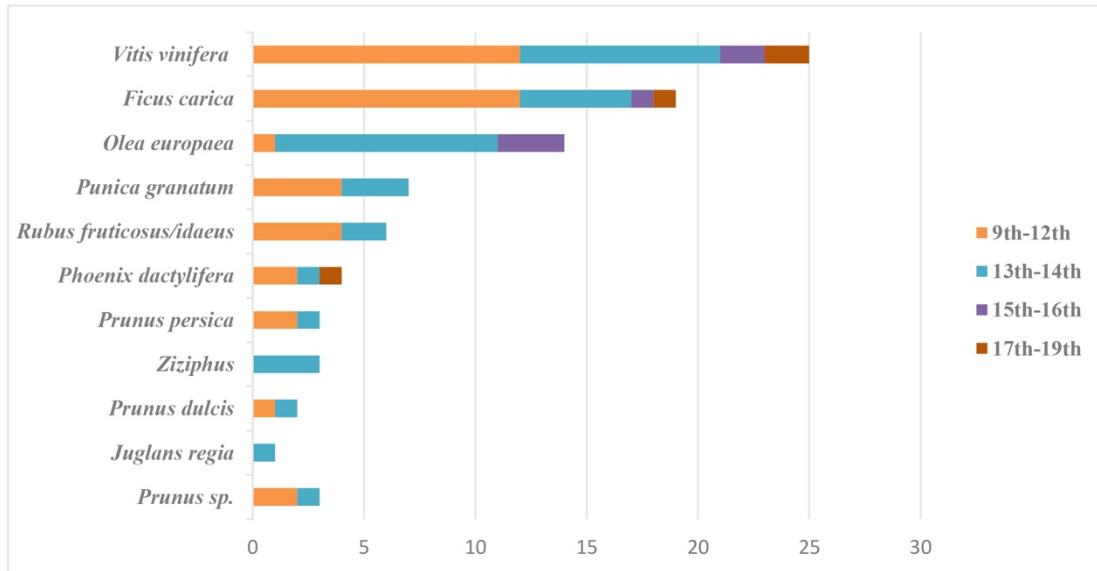


Figure 2: Fruit tree frequencies in carpology: 12 samples for the 9th-12th c., 10 samples for the 13th-14th c., 13 samples for the 14th-15th c., 2 samples for the 17th-19th c.

In the anthracological remains, we identified 5 taxa already recorded by carpological remains (*Vitis vinifera*, *Olea europaea*, *Ficus carica*, *Punica granatum*, *Prunus armeniaca/dulcis/persica*), and several others who might have or not been exploited for their fruits: argan (*Argania spinosa*), strawberry tree (*Arbutus*), oak (*Quercus coccifera/ilex*) and pistachio (*Pistacia lentiscus*, *P. terebinthus*). In the non-fruit category, we identified *Populus/Salix*, *Cistus*, *Daphne*, juniper, arar, filaria/buckthorn and pine. As for the carpological remains, the widest fruit diversity is identified in the earlier phase of occupation. Some species, *Ficus carica* and *Argania spinosa*, are only marginally represented during the 9th to 12th century, while others, such as *Vitis vinifera*, *Pistacia lentiscus*, *P. terebinthus* and *Punica granatum*, are present since the 9th-10th century with very minimal representation from the 13th onwards. *Olea europaea*, present since the earliest phase of occupation, experienced exponential growth, becoming the main wood species represented by the 16th-17th century.

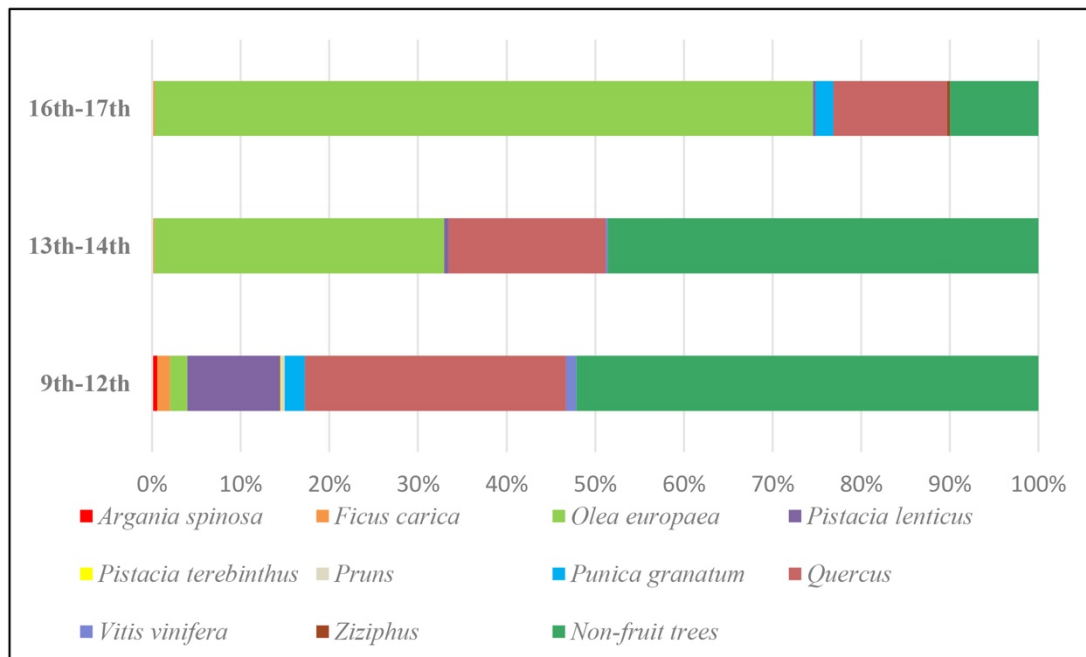


Figure 3: Relative proportions and diversity of fruit taxa in the anthracological samples. Number of wood charcoal fragments studied per period: 1028 for the 9th-12th c., 813 for the 13th-14th c., 350 for the 16th-17th c.

Limitations of the data

Before these results can be interpreted, it is necessary to understand the contributions and limitations of each approach. The carpological approach offers several advantages, notably the direct documentation of ancient agricultural practices, since carpological remains often constitute the products or by-products of various operational chains implemented by past populations. However, these botanical remains, often fragile, may eventually disappear or become difficult to identify depending on the method of preservation encountered (carbonization, mineralization). For instance, in assemblages preserved through carbonization, there is a scarcity of delicate seeds, like those from strawberries or figs. Conversely, large stones are well-represented, such as those from olives or plums.

Anthracology may face some challenges due to the resemblance in charcoal appearance across various plant species, making precise identification sometimes difficult. Additionally, within a single plant species, factors like plant part, growth conditions, and fire type, contribute to morphological variability, complicating the task of accurate identification. It is also worth noting that not all fruit-bearing plants contribute to

anthracological assemblages, some of them (e.g. strawberries) producing few or no wood at all. This inherent bias in the preservation potential of different plant parts adds complexity to interpreting anthracological data and understanding past plant exploitation. Additionally, the reliance on wood as fuel for the preservation of plant remains introduces a selective process. Only the species used for combustion will be represented in the archaeological record. This selection excludes some plants, preventing a uniform, linear view of the plants used in the past.

In this regard, a cross-disciplinary approach using both archaeobotanical data and historical texts, provided they are chronologically and geographically comparable, offer complementary insights into past agrohorticultural practices. For this reason, we conducted a reading of available historical texts that mention Aghmat's agriculture, and subsequently translated the Arabic terms used by the authors to describe the exploited/present plant species, attempting to find their English counterparts.

Beyond the inherent limitations of each corpus and analysis methods, the process of cross-reading written and carpological data sometimes faces the difficulty of comparing plant lists established from often precise botanical identifications at the species or even variety level with ancient written sources that do not provide information on the cultivated variety. Additionally, identifying the plant, product, or dish from these two sources is confronted with the problem of correspondence between the botanical name attributed to a vegetal remains and the word used to describe a product or dish in medieval texts, which employ a scientific or vernacular language that may have evolved over time. This difficulty has also been raised by various researchers working on the medieval Western world¹⁶.

Discussion

Economic pillars: olive, vine and fig trees

This new archaeobotanical synthesis highlights the essential role played by three fruit trees in the site's economy: the olive, the grapevine and the fig. The central role of these

¹⁶ Ruas, "Fruits". 161-185.

three fruit trees is not original to the site, since they are generally the most common fruit trees in Moroccan assemblages, since at least the ancient period¹⁷.

During the 11th-12th century phase, the fig tree and the grapevine are the most frequent fruit remains at Aghmat, while olive stones remain scarce. The three taxa are also present in the charcoal remains of this phase, confirming their presence in the local landscape. During the next phase (13th-14th), corresponding to the final phase before the town was abandoned, we note a gradual increase in the frequency of olives in the samples, also observed in the anthracological samples, with olive trees representing over 30% of the total of identified charcoal fragments. These observations are consistent with the earliest textual sources. For instance, in their accounts, Ibn Ḥawḳal and Al-Idrīsī highlighted the importance of the olive tree as well as the grapevine, one of them describing the olive tree as a common tree in the Aghmat region in the 12th and even 14th centuries¹⁸, while the other mentioned that grapes were consumed fresh or dried (as raisins), not to mention their use in making must, syrup, and an alcoholic drink called *Anziz*¹⁹. Carpology does not necessarily allow us to specify the form in which the grapes were consumed, fresh or dried, but it does allow us to detect the presence of by-products of crushing/pressing of the grapes²⁰. At Aghmat, the sample QUB4510, dated in the 12th century level of the Qubba, corresponds to a pressing by-product, characterized by the presence of thousands of pips, whole and fragmented, and pedicels (Fig. 4). The presence of this assemblage attests to the earliest practice of crushing/pressing on the site, and the charring of these remains suggests that they were opportunistically reused as fuel. The obtained product (juice, vinegar, wine) cannot, however, be determined, and only a chemical study of the ceramic from this phase would tell us more²¹.

¹⁷ Ruas, “Fruits”. 161-185.

¹⁸ Al-Idrīsī, *Nuzhat*. 233.

- Ibn Ḥawḳal, *Ṣūrat*. 99.

¹⁹ Al-Idrīsī, *Nuzhat*. 233.

²⁰ Ros, “Identifier” 259-280.

²¹ Pecci, “Identifying” 4491-4498.

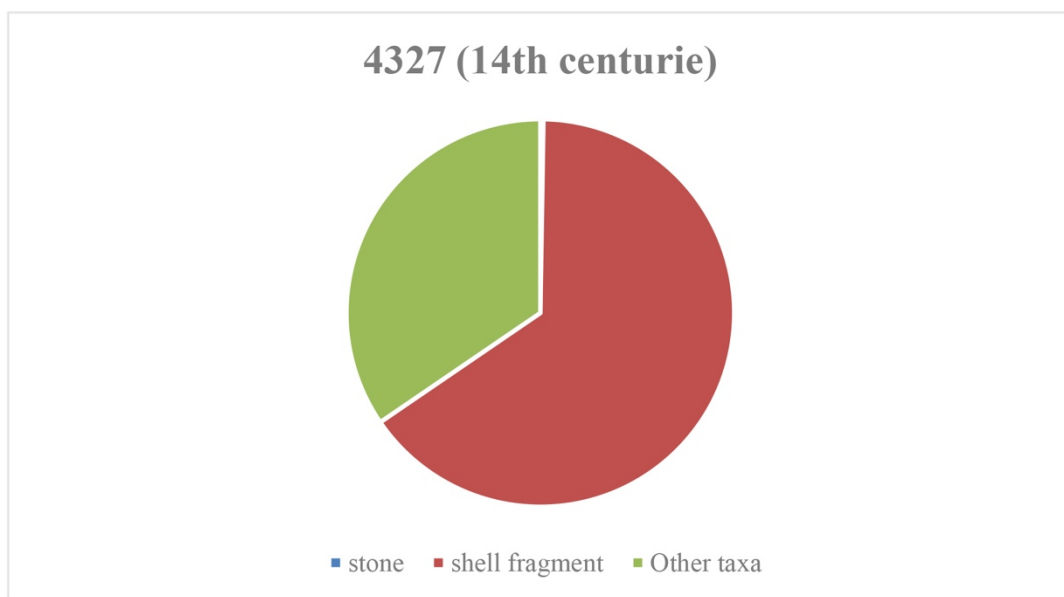
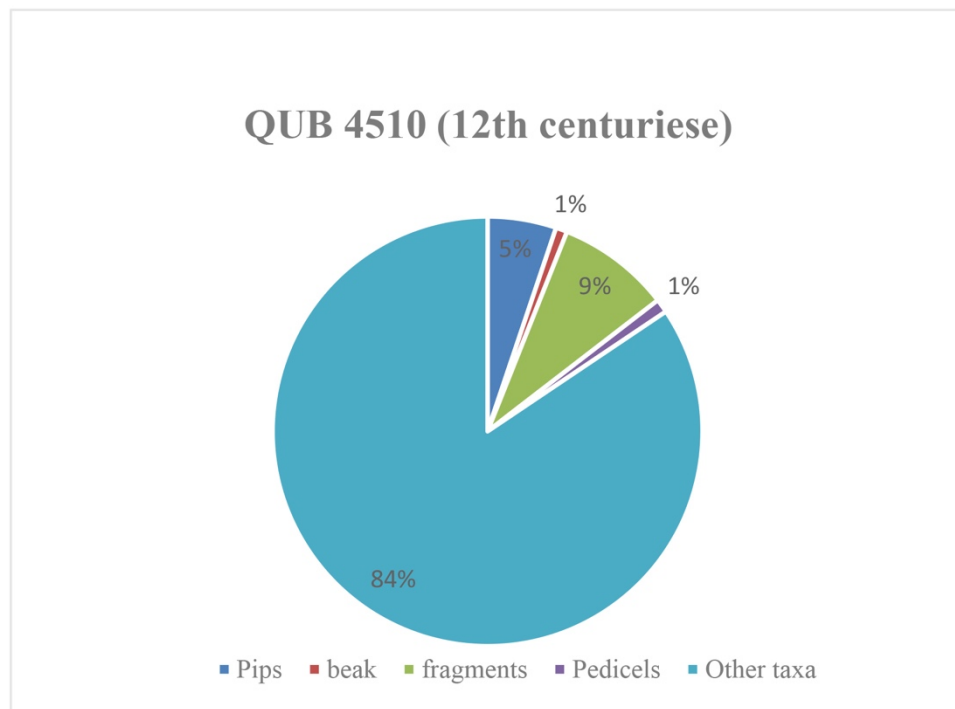


Figure 4: Carpological composition of two samples with *Vitis vinifera* and *Olea europaea* by-products (in QUB 4510, pips, beak, fragments and pedicels belong to *Vitis*, in HAM 4327, stone and shell fragment belong to *Olea*)

Regarding olive consumption, we suppose that the fruits were mainly consumed for their flesh in the earliest phase of occupation. The first evidence of local olive oil production is identified in the hypocaust of the hammam in a 14th century level, by the presence of

hundreds of crushed carbonized olive pits²² (Fig. 4), which were probably used as fuel in the hammam. In the absence of significant production infrastructure (olive presses), we assume it corresponds to small-scale production, meant for domestic/familial use.

When it comes to the fig tree, it holds a notable presence in archaeobotanical findings, ranking only behind the olive and grapevine in abundance. However, its historical significance tends to be understated, primarily because references to it in historical texts are often casual and lack explicit details regarding its consumption methods (fresh, dried figs).

After the town was abandoned and became a rural locality, olive trees, grapevines and fig trees were the only fruit trees still identified by carpology, but this may be a source effect, as fewer samples are studied so far for these phases. Anthracology, on the other hand, reveals a singular dynamic, with a very significant increase in olive trees, which account for more than 70% of the identified charcoal, the other fruit trees present being pomegranates and figs, albeit in smaller numbers. The reason for the supremacy of olive trees in the late samples is debatable: is it a source effect, or is it the result of an agrarian specialization geared towards oil or olive production? In the 16th century, the price of Spanish olive oil increased due to strong Spanish and European demand²³, undoubtedly encouraging the expansion of olive groves in Morocco and potentially in Aghmat. The absence of other anthracological studies in Morocco for this late chronology means that we cannot say whether Aghmat is an isolated case, or whether it is representative of a new dynamic that may have affected other areas of Morocco at this time.

Fruit species of lesser economic importance: a remarkable diversity

While olive, vine and fig dominate the archaeobotanical assemblages, both in terms of frequency and sometimes abundance, our analyses reveal a relatively high diversity of fruit species, with some changes depending on the chronology studied. The earliest textual sources²⁴ describe a wealth of gardens both inside and outside of the city,

²² Salavert, “Olive” 53-61.

²³ Thirsk, “L’agriculture”. 5-24.

²⁴ Al-Bakrī, al-Masālik. 843.

- Al-Idrīsī, Nuzhat. 233.

highlighting the importance of regional horticulture and arboriculture. The same sources mention the presence of numerous fruit trees, and, apart from the olive, vine and fig mentioned above, there are references to pomegranate, pear, carob, apple, quince, apricot, bitter orange, citron and mulberry, used for silk production²⁵. Archaeological seed remains also provide a great diversity of fruit species, especially for the earliest phases of occupation, with, ranging from more to less frequent: pomegranate, blackberry, peach and almond. Also, during that same period, fruit tree woods make up half of the fuel. The fuel comes from a variety of fruit trees, including, beside grapevine, olive and fig, pomegranate, Rosaceae prunoideae (the *Prunus* genus, and, in this case, probably apricot, almond or peach trees) and Rosaceae maloideae (that might correspond to apple and/or pear tree). We may assume that, because urban arboriculture produces a large amount of pruning debris, this wood is readily available and frequently used for domestic fuel. During the following phases of occupation, the archaeobotanical remains indicate a certain continuity in terms of eaten species, with the emergence of two new fruit trees: walnut and jujube. While jujube can be locally grown, walnut remains, identified in a late 14th-15th century context, suggest exploitation or trade with a mountainous terroir, walnuts currently growing in the mountainous areas of Ourika, beyond 1200 m, along watercourses. During the reoccupation of the city by rural populations, fruit diversity appears to be limited, and, apart from the olive, grapevine and fig, only pomegranate seems to continue to be exploited, as proven by the presence of charcoal fragments in the studied samples.

At Aghmat, this research, which combines archaeobotanical and textual sources, gives us a broader view of the spectrum of consumed and cultivated fruit, with some fruit trees falling outside the scope of either discipline. For example, pears, carobs, apples, quinces, bitter oranges, citron and mulberries often escape archaeobotanical analysis when it concerns assemblages preserved by carbonization, because their fragile seeds are not fire-resistant. They are more likely to be found in contexts preserved by water (wells) or mineralization (latrines). On the other hand, the presence of blackberry is more common thanks to archaeobotany than through the study of textual sources, which rarely mention

²⁵Al-Bakrī, al-Masālik. 843.

- Al-Idrīsī, Nuzhat. 233.

fruit trees of little economic importance (gathered fruits) or which do not occupy a special place in the local landscape.

A little-known local history: the argan tree and the date palm

Two fruit species raise questions, namely the argan tree, identified only by a few anthracological remains, and the date palm, attested by few carpological remains.

Regarding the argan tree, while its anthracological evidence remains limited, it is noteworthy that it is the first archaeobotanical mention of the species in medieval Morocco outside of Îgîlîz²⁶, where the species prevail in both carpological and anthracological remains. According to textual sources, the argan tree was also a plant resource exploited by the Aghmati populations, notably for its fruits, named "berber almonds"²⁷ by Ibn al-Bayṭār. The method of extracting argan oil, still used in the Souss region, involves collecting fruits, using them as fodder for livestock, specifically goats, then gathering the nuts rejected by these animals, which are then roasted and ground using a hand mill to make a paste. Said paste is then pressed to extract a large quantity of pure oil. This oil, with its benefits, is considered an essential element in the lives of the inhabitant of Aghmat; it is used in cooking, lighting, and even in Masmoudi women's pharmacopoeia and cosmetics. In the case of argan, oil production generates waste, whose remnants can be identified in archaeological structures, as in Îgîlîz. At Aghmat, the identified argan remains are charcoal and not a by-product of oil production (crushed kernels), meaning that wood was very occasionally used as fuel. However, this discovery remains exceptional, with the argan tree appearing in only one sample dating from the earliest phase of occupation. Since the area surrounding Aghmat is not included in the species' natural distribution range, its presence in the archaeobotanical sample of the site could indicate an extremely extensive area for harvesting fuel, or the presence of a wooden object/architectural element on the site that was ultimately used as fuel.

As for the date palm, the interpretation of its scarce carpological remains poses a challenge. While the consumption of date palm in medieval northern Morocco appears to be minimal, which might be expected, an odd aspect can be observed in the south.

²⁶ Ruas, "History and archaeology," 114-136.

²⁷ Ibn al-Bayṭār al-Jāmi', 112.

Medieval textual sources describe the presence of extensive palm groves²⁸, yet, archaeobotanical evidence contradicts this. At Îgîlîz²⁹, only a few fragmented seeds and charcoal fragments have been identified so far and the same scarcity is observed at Aghmat, where only a handful of carpological remains of date palm have been documented. In southern medieval Morocco, Sijilmasa seems to be the only exception, an abundance of both anthracological and carpological remains being documented in the site³⁰. If date palm is really as common as the historians suggest, why don't we find more date palm remains in the archaeological settlements? One of the reasons explaining its scarcity in archaeological deposits could be that at the time, waste management practices did not favor the carbonization of its products/by-products.

Conclusion

Cross-referencing archaeobotanical and textual sources has enabled us to draw up a list of the fruit trees grown in Aghmat over the course of its long history, and to note that the early phases, when the town was most dynamic economically, also corresponded to a period of great fruit diversity. In the urban phase of the site, people had access to a wide variety of fruit, and used both the fruits and the wood from fruit trees that were certainly grown on the outskirts of the town or in the town itself. Local production of juice/wine/vinegar was also detected in the earliest phase, followed by the production of olive oil during the 14th century. This is the first evidence of these practices, which are not mentioned in the textual sources, probably because at the time they did not play a key role in the local economy. The late phases seem to see a decline in fruit diversity, with olive trees, grapevines, figs and pomegranates taking center stage. At this stage of our study, we cannot say whether this is a dynamic driven by the rural Sufi populations settled on the site, or a source effect, as the study of new samples could contradict this trend. In the near future, the remaining archaeobotanical samples will be examined in depth. The acquired archaeobotanical data will allow for a more thorough record of the plants, practices, and terroirs exploited, depending on the status of the Aghmat residents, in

²⁸ Al-Bakrî, *al-Masālik*. 843.

²⁹ Ruas, "Archaeobotanical research," 419-433.

³⁰ see Mahoney unpublished report 1994, 1995, 1996.

regard to the chronological and social context within each sector of the site. The application of experimental frameworks will also be helpful for future work to complete this approach, especially for the grapevine and olive fruit and wood remains: geometric morphometrics³¹ to record the processes of varietal diversification of these fruit trees, and quantitative eco-anatomy³² of charcoals to understand the evolution of their management (cultivation, irrigation). Comparing Aghmat's agricultural system with those recorded in medieval Morocco and more globally in the Western Mediterranean region would confirm the originality of the settlement, particularly regarding the late medieval olive boom.

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References

- Al-Bakrī. *Al-Masālik wa al-mamālik*. Tahqīq Adiran Van Luvan et André Feri. Dar al-rarabya li-nachr: 1992.
- Al-Idrīsī. *Nuzhat al-mushtāq fī ikhtirāq al-āfāq*. Maktabat al-thaqafa al-dīnya, 1990.
- Al-Idrīsī. *Description de l'Afrique et de l'Espagne*. Translation of Reinhart Pieter Anne Dozy and Michael Jan De Goeje. Brill: 1866.
- Allevato, Emilia, Mauro Paolo Buonincontri, Alessandra Pecci, and Alessia D'Auria. "Wood Exploitation and Food Supply at the Border of the Roman Empire: The Case

³¹ Terral, "Evolution" 443-455.

³² Terral, "Les apports" 229-245.

of the Vicus of Thamusida, Sidi Ali Ben Ahmed (Morocco).” *Environmental Archaeology, The Journal of Human Palaeoecology* (2017): 200-217.

Allevato, Emilia, Mauro Paolo Buoniconti, Alessandra Pecci, Alessia D’Auria, Emanuele Papi, Antonio Saracino and Gaetano Di Pasquale. “Evidence from charcoal analysis for the extensive exploitation of cork-oak (*Quercus suber*) forest in the roman imperial period: the vicus of Thamusida (north west Morocco)”. In *Proceedings of The Fourth International Meeting Of Anthracology*. Brussels, 8-13 September 2008. Editor F. Damblon, BAR International Series n° 2486, 11-17. Oxford: Royal Belgian Institute of Natural Sciences, 2013.

Al-Zuhrī. *Kitāb al-jughrāfiyā*. Bulletin d’Etudes Orientales, XXI. Institut Français de Damas, 1968.

Capel Chloé. *Sijilmassa, porte du Sahara : histoire et archéologie d’une ville oasisienne médiévale du sud marocain*. Rennes : Presses Universitaires de Rennes, à paraître.

Cappers, Reinier Theodorus Jozephus, Renée Marlies Bekker, and Judith E. A. Jans. *Digital Seed Atlas of the Netherlands*. Barkhuis Publishing and Groningen University Library, 2006. Ibn al-Bayṭār. *Al-Jāmi‘ Li Mufradāt al-Adwiya*, v.4. Beyrouth, 1990.

Carrato, Charlotte, Abdelfattah Ichkhakh, Mohamed Kbiri Alaoui, Elsa Rocca, Marie-Pierre Ruas et al. “Recent Discovery of an Urban Winery in Rirha (Sidi Slimane, Morocco), 2nd–3rd Century CE”. In *Making Wine in Western-Mediterranean / Production and the Trade of Amphorae: Some New Data from Italy*, Panel 3.5, 9. Heidelberg: Propylaeum, 2020 (*Archaeology and Economy in the Ancient World: Proceedings of the 19th International Congress of Classical Archaeology, Cologne/Bonn 2018, Volume 9*), 167-175. 2020.

Ettahiri, Ahmed Saleh, Abdallah Fili, and Jean-Pierre Van Staëvel. “Nouvelles recherches archéologiques sur la période islamique au Maroc : Fès, Aghmat et Igîlîz”. In *Villa*

4. Histoire et archéologie de l'occident musulman (viie-xve siècle): Al-Andalus, Maghreb, Sicile. Toulouse, 259-280. Presses universitaires du Midi, 2012.

Fuller, Dorian Q and Ruth Pelling. "Plant Economy: Archaeobotanical Studies". In *Volubilis après Rome: Les fouilles UCL/INSAP, 2000-2005 (Arts and Archaeology of the Islamic World)*, 349–368. Brill, 2018.

Héritier-Salama, Violaine, Chloé Capel, Abdallah Fili and Ronald Messier. "De la ville aux champs. La transformation d'Aghmat (Maroc) entre les XIVE et XVIe siècles". In *Transitions historiques, 195-207*. Paris : Editions de Boccard, 2016.

Ibn Al-Khatīb. *Mi'yār al-ikhtiyār fī dhikr al-ma'āhid wa al-diyār*. Maktabat thaqafa diniya, 2002.

Ibn Ḥawqal. *Ṣūrat al-arḍ*. Bibliotheca Geographorum Arabicorum, Leiden, 1938.

Jacquot, Clément, Yvonne Trenard, and Danièle Dirol. *Atlas d'anatomie des bois des Angiospermes (Essences feuillues)*. Centre technique du bois, 1973.

Jacquot, Clément. *Atlas d'anatomie des bois des Conifères*. 2 vol. Centre technique du bois, 1955.

Moukhli, Abdelmajid, Hicham Haouane, Cherkaoui El Modafar and Bouchaib Khadari. "Histoire de l'introduction et de la diffusion de l'oléiculture au Maroc". In *Indications Géographiques, dynamiques socio-économiques et patrimoine bio-culturel en Turquie et dans les pays méditerranéens*. Montpellier : CIHEAM. 169-196, *Options Méditerranéennes : Série A. Séminaires Méditerranéens*, n. 104, 2, Séminaire International d'Antalya, 2010, Antalya, Turquie, 2013.

Nouaim, Rachida. *L'arganier au Maroc entre mythes et réalités : une civilisation née d'un arbre*. Paris, 2005.

Pecci, Alessandra, Cau Ontiveros, Miguel Angel, and Garnier, Nicolas. "Identifying wine and oil production: analysis of residues from Roman and Late Antique plastered vats". *Journal of Archaeological Science* 40 (2013): 4491-4498.

Pollock, Susan. "Progress Report on the Plant Remains from Badis, Al-Basra, Nakur and Qsar es-Seghir." *Bulletin d'archéologie marocaine* 15 (1984): 355-360.

Rameau, Jean-Claude, Dominique Mansion, Gérard Dume, and Christian Gauberville. *Flore forestière française, guide écologique illustrée. Tome 3: région méditerranéenne. Le journal botanique*, 42. Institut pour le Développement Forestier, CNPPF, Forêt Privée Française, 2008.

Ros, Jérôme, Fatima-Ezzahra Badri, Amandine Cartier, Benoit Marie, Abdallah Fili, Leïa Mion, Sandrine Canal, François Fourel, Violaine Héritier-Salama, Chloé Capel, Laurent Bouby, and Ilham Bentaleb. "Forest and agricultural dynamics in the Haouz plain over the last millennium: archaeobotanical and isotopic research at Aghmat (Morocco)." *Journal of human ecology* (2024).

Ros, Jérôme, Fatima-Ezzahra Badri, Violaine Héritier-Salama, Chloé Capel, Abdallah Fili, and Ronald Messier. "First archaeobotanical contribution to the history of food production and agriculture at Aghmat (Morocco) between the 11th and the 17th c." *Journal of Archaeological Science: reports*, Volume 38 (2021).

Ros, Jérôme, Marie-Pierre Ruas, and Michel Lemoine. "Identifier les résidus vitivinicoles carbonisés : référentiels expérimentaux et application au site romain du Petit Clos I (Perpignan, Pyrénées-Orientales)". In *Actes des 10e rencontres d'Archéobotanique, Les Eyzies-de-tayac*, 2016. Supplément à la revue *Aquitania* (36), 259-280. 2016.

Ruas, Marie-Pierre. "Fruits et légumes consommés au Maroc antique et médiéval : témoignages archéobotaniques". In *Manger au Maghreb-Partie IV : Par les mots, les fruits et les légumes*, 161-185. Toulouse: Presses Universitaires du Midi, Horizons Maghrébins, 2018.

Ruas, Marie-Pierre, Isabel Figueiral, Christine Heinz and Sarah Ivorra. “Paléoenvironnement et paléoéconomie d’après l’anthracologie et la carpologie”. In *Le site antique et médiéval de Rirha (Sidi Slimane, Maroc). Campagnes de fouilles 2005-2009*, 42-109. Rabat: Casa Velázquez et INSAP, 2016.

Ruas, Marie-Pierre, Jérôme Ros, Jean-Frédéric Terral, Sarah Ivorra, Hélène Andrianarinosy, Ahmed S. Ettahiri, Abdallah Fili, and Jean-Pierre Van Staëvel. “History and archaeology of the emblematic argan tree in the medieval Anti-Atlas Mountains (Morocco).” *Quaternary International*, Volume 404, Part A (2016) : 114-136.

Ruas, Marie-Pierre, Margareta Tengberg, Ahmed Saleh Ettahiri, Abdallah Fili, and Jean-Pierre Van Staëvel. “Archaeobotanical research at the medieval fortified site of Îgîlîz (Anti-Atlas, Morocco) with particular reference to the exploitation of the argan tree.” *Vegetation History Archaeobotany* 20(5) (2011): 419-433.

Salavert, Aurélie. “Olive Cultivation and Oil Production in Palestine during the Early Bronze Age (3500–2000 BC): The Case of Tel Yarmouth, Israel”. *Vegetation History and Archaeobotany* 17 (2008): 53-61.

Schweingruber, Fritz Hans. *Anatomy of European woods: an atlas for the identification of European trees*. Verlag Paul Haupt, 1990.

Terral, Jean-Fre'de'ric, Tabard, Elidie, Bouby, Laurent, Ivorra, Sarah, Pastor, Thierry, Figueiral, Isabel, Picq, Sandrine, Chevance, Jean-Baptiste, Jung, Ce'cile, Fabre, Laurent, Tardy, Christophe, Compan, Michel, Bacilieri, Roberto, Lacombe, Thierry, and This, Patrice. “Evolution and history of grapevine (*Vitis vinifera*) under domestication: new morphometric perspectives to understand seed domestication syndrome and reveal origins of ancient European cultivars”. *Annals of botany* 105 (2010): 443-455.

Terral, Jean-Frédéric, Catherine Marie Breton, Claire Newton, Sarah Ivorra, and André Jean Bervillé. “Les apports décisifs de la morphométrie (écoanatomie et morphométrie géométrique) et de la génétique (marqueurs moléculaires microsattellites) In la reconstruction de l’histoire de la culture et de la domestication de l’olivier”. In *Eleiva Oleum Olio. Le origini dell’olivicoltura in Toscana: nuovi percorsi di ricerca tra archeologia, botanica e biologia molecular*, 229-245. DonChisciotte - San Quirico d’Oria ed., 2010.

Thirsk, Joan and Maïca Sanconie. “L’agriculture en Angleterre et en France de 1600 à 1800 : contacts, coïncidences et comparaisons”. In *Histoire, économie et société*, 1999, 18^e année, n°1. *Terre et paysans*, sous la direction de Olivier Chaline et François-Joseph Ruggiu, 5-24.

Mots-clés :

Archéologie ; Agriculture ; Archéobotanique ; Économie ; Paysage

Résumé

Le site d'Aghmat est devenu un centre d'attention pour le Maroc médiéval en raison de son histoire couvrant une longue chronologie, allant du Moyen Âge à la fin de la période moderne. Des recherches archéologiques, bioarchéologiques et ethnologiques récentes ont été menées sur une partie du site. Cette étude a analysé 30 échantillons, dont 11 ont été soumis à une analyse anthracologique, confirme son potentiel pour la recherche archéobotanique. Elle révèle une variété d'arbres fruitiers dans la région, les plus importants étant la vigne, l'olivier et le figuier, et suggère une continuité dans les espèces consommées malgré des changements agricoles notables, comme la montée de la culture de l'olivier alors que la ville change de status, entre le XIV^{ème} et le XV^{ème} siècle. L'objectif est d'éclairer l'histoire des pratiques liées aux fruitiers en relation avec les changements socio-économiques dans la longue durée.

Palabras clave:

Arqueología; Agricultura; Arqueobotánica; Economía; Paisaje

Resumen

El yacimiento de Aghmat en Marruecos ha sido clave para la investigación histórica, debido a su larga ocupación desde la Edad Media hasta la era moderna. Un estudio reciente analizó 30 muestras de restos vegetales, de los cuales 11 fueron estudiados para los carbones. Los resultados confirman la presencia de una variedad de árboles frutales en la región, como uvas, aceitunas e higos, y señalan cambios significativos en las prácticas agrícolas, incluido un aumento en el cultivo de olivos entre los siglos XIV y XV, cuando la ciudad cambia de estatus. Este estudio proporciona información sobre la evolución agrícola y sus implicaciones socioeconómicas a lo largo del tiempo.

الكلمات المفتاحية

علم الآثار، الزراعة، علم النباتات الأثرية، الاقتصاد، المنظر الطبيعي والتاريخي.

ملخص

يعتبر موقع أغمات نقطة محورية في تاريخ المغرب بفضل تاريخه الطويل الذي يمتد من العصر الوسيط إلى العصر الحديث. استدعت أهميته إلى إرساء برامج للبحث الأثري والبيوأنثري والإثنولوجي في السنوات الأخيرة. يستند هذا البحث على دراسة 55 عينة نباتية، حيث خضعت 30 منها لتحليل أولي (تحديدات أولية وتقدير الوفرة)، بالإضافة إلى 11 عينة من أجل الفحم. تم مقارنة نتائج التحليل مع نصوص التاريخ المقابلة. تؤكد النتائج الموجودة في هذا البحث غنى الموقع للبحث النباتي الأثري، حيث تظهر وجود مجموعة متنوعة من أشجار الفاكهة في المنطقة. كما يمكن أن تشير استغلال أنواع البقايا المختلفة الموجودة (مثل العنب والتين) إلى استمرارية نسبية فيما يتعلق بالأنواع التي تم استهلاكها، في حين خضعت الممارسات الزراعية لتغيير ملحوظ، ولا سيما زيادة في زراعة الزيتون بعد تغيير وضع المدينة بين القرنين الرابع عشر والخامس عشر. يهدف هذا البحث إلى تقديم رؤى حول تطورات محتملة في الإنتاج والممارسات البستانية والزراعية، فيما يتعلق بالتغيرات الاقتصادية والاجتماعية.