An Archaeobotanical Evaluation of Ibn al Baitar's Herbal Remedies in the Archaeological Record of Near Eastern and Eastern Mediterranean Sites

Mandy Bertram

Archaeobotany today is foremost used to examine dietary practices or changing patterns in exploitation of the environment. For the prehistory of medicine it could give an exclusive insight into the life of our ancestors, coping with their diseases. The collection of over 400 sites at the archaeobotanical database ADEMNES provides an excellent opportunity to combine the knowledge that has survived until today in the ancient medical literature with the existing archaeological record. When it comes to archaeological debris aspects like taphonomy needs to be taken into account attentively. However, several plants, appreciated for their healing properties by well known scholars and physicians of the ancient world, have been found regularly in the archaeobotanical record of these sites.

Keywords: medicinal plants; crops; ancient medicine; ancient pharmacology; archaeobotany; Near East; Mediterranean; ADEMNES database; Ibn al Baitar; herbals

1. Introduction

Due to its crucial role in the development of ancient societies, the Near East has long been a subject of interest for archaeologists. Database-management has gained more importance during the last decades and the compiling of archaeological debris from broader regional scales is giving opportunities to address interesting questions. When it comes to ancient herbal medicine our knowledge about the used plant species is foremost built upon literary sources, mostly descended from ancient Mediterranean or Egyptian scholars. Cuneiform texts provide detailed information from Near Eastern medical systems, but mostly the identification of plant species in use is not possible. With the aid of the archaeobotanical database ADEMNES a comparison can be made between plants from archaeological contexts and the medical lore. Ibn al Baitar, a medieval herbalist, has collected medicinal knowledge from around 150 of the most influential medical entities dating back to c.400 BC. This study compares the archaeological record with Ibn al Baitar's 1637 medicinal substances, derived from plants, animals and minerals to deliver a list of plants which may have been important for a community, because of their medicinal potential. It will discuss some of the taxa observed, give the literary record with ancient uses, the overall abundance of sites, where these species have been found and recent knowledge about pharmacologically relevant constituents. Taphonomy shall be highlighted for a better understanding of the find-category medicinal plants.

1.1 Archaeobotanical Database of Eastern Mediterranean and Near Eastern Sites

As part of the research project "Climate, Agriculture and Society – On the sustainability of Ancient Agricultural Systems" ADEMNES was made by the universities of Freiburg and Tübingen under the supervision of Simone Riehl. It is accessible online as a free, public service (Riehl – Kümmel 2005) and lists archaeobotanically excavated sites with their dated findings, recovery methods and preservation types, from research literature (Fig. 1). ADEMNES covers Greece, Turkey, western Iran, Iraq, Syria, Lebanon, Israel, Jordan and northern Egypt from Epipalaeolithic to Medieval Periods, with an emphasis on Bronze and Iron Age sites (Riehl – Kümmel 2005). Archaeobotanical reports from 363 sites are listed at this day[1], the entering of data is still ongoing.

1.2 Ibn al Baitar's Kitab Al Jami fi Al Adwiya Al Mufrada

As source for remedies in ancient times, the german translation of الجامع لمفردات الأدوية والأغذية (*Kitab Al Jami fi Al Adwiya Al Mufrada)* from Abu Mohammed Abdallah Ibn Ahmed Ibn al Baitar Dhiya Al Din Al Malaqi by Sontheimer has been used. Ibn al Baitar lived from the end of the 12th century to 1248 AD (Gehani – Hammoudeh2003, 1). According to Abulfeda he has travelled through the whole African and nearly the whole Asian continent (Sontheimer 1840, XII). In his Compendium he aimed to summarize all plants mentioned by accepted medical or botanical practitioners and to give an overview about everything written until his times, not without critically assessing and rectifying the knowledge that was recorded (Sontheimer 1840, XIII–XV).

Although his work is younger than most of the archaeobotanical data provided in ADEMNES, we can assume that a good amount of traditional knowledge has survived until his times. Big social and religious upheavals may perform better if new instances incorporate traditional perceptions and reinterpret them, fitting to their purposes. Still Yazid Ibn al-Hakam (c.1030 AD) wrote: "*wal-bagyu yasra`u ahlalu*", meaning: "the wicked deed lets the perpetrator collapse in a heap" (Klein-Franke 1982, 10; translated). The Arabic word '*bagy*' means a misdeed that is done, without

[1] 408 sites altogether, 111 sites with faunal (and often botanical) remains, 363 sites with botanical (and some faunal remains), 66 sites with both, botanical and faunal remains (Riehl – Kümmel 2005).

thinking about the consequences (of physical suffering) (Klein-Franke 1982, 10). These examples reflect aspects of much older medical conceptions that survived up to Islamic times. The extent of ancient ideas retained is difficult to assess, the same applies to changing patterns in medicinal plant usage. Since plants do not have to be linked to specific cultural ideas or concepts of body and health[2], one might think their exploitation does not need to be changed much through cultural upheavals, but without further scientific assessment it is pointless to take it into account too much.

However, it has to be taken in mind that by the time of Ibn al Baitar a tremendous amount of the Greek medical system has been soaked up by the near eastern medicine, which might not have been existent at pre-Islamic sites.

2. Methodology

To avoid information loss, all medicinal substances listed by Ibn al Baitar have been checked against the Taxa found at ADEMNES. One modern and 45 sites with faunal remains have been excluded, overall 362 sites were examined. Every Taxon existent in both of the datasets has been noted with all background information available at ADEMNES. Following this information, every find was grouped according to its age into one of three groups, each spanning an arbitrary set time frame of roughly 1500 years, beginning at around 3000 BC and ending at around 1500 AD (Fig. 2). Older sites were excluded, because of their temporal distance to the literary basis. Due to the variety of sites, resulting in the use of different dating methods, some residues predate this classification (cf. finds from the early EBA phase of Kurban Höyük, dating '3100–2900 BC'), while others are younger (cf. Kaman Kalehöyük, populated until the 'Ottoman period'). In case of an overlap with two of the groups, the remains were categorized according to their cultural association.

For each Taxon the number of sites yielding it was recorded and a ranking was made to show frequent and rare Taxa. Here Taxa were sorted loosely into groups for certain characteristics (e.g. exploitation-types, ecological features, domesticated/wild plants or many/few seeded species) to get a better comparability and clearer impression on the most frequent Taxa throughout sites.

[2] Compare for example the high similarity (64%) for medicinal uses of *Lamiaceae* in (Roman-Catholic dominated) eastern Andalusia and (Islamic dominated) eastern Morocco (Gharbaoui et al. 2017, 212) both regions that have been influenced by Ibn al Baitar's lore of herbal medicines.

2.1. Taphonomy

Taphonomic loss is an aspect, which unconditionally needs to be taken into account, when interpreting our results. When we think about the plant parts used for remedies, this becomes quite clear. According to an ethnobotanical study of medicinal plants used today at the Hezar Mountains in South East Iran proportions of plant parts in use differ vastly: in a total of 92 species the leaves of 32% of them are used as medicine. Seeds and roots follow with 13 % each, 11% is counted for aerial parts and fruits (8%), latex (6%), the whole plant (6%), Rhizome (4%), Stem (4%), bark (2%) and tuber (1%) (Rajaei – Mohamadi 2011, 1163) are used in a lesser, though taken together substantial amount as well. Similar, for the survival of botanic remains unfavourable results have been found at North Aegean islands (leaves 22,8%, roots 12,78%, flowers 11,41%, essential oils 7,30%, fruits 6,84% and barks 5% (Axiotis et al. 2018, 2)) The Moroccan Riffians are using leafy parts in a way higher amount, than it was observed from Axiotis et al. or Rajaei and Mohamadi (Chaachouay et al. 2019, 6) when treating metabolic diseases. If we assume the most favourable proportions from the studies listed above for ancient times, only 13 % of the herbals used are more prone to be preserved at all. Moreover, herbs rarely enter the archaeological record, because they are used in carefully husbanded quantities. Such plant products are mostly found in exceptional contexts, like burnt levels or shipwrecks (Nesbitt 1995, 72). Additionally, as a result of the research area, botanical remains are mostly present in a carbonized state. Jacomet has impressively shown the discrimination of preservation chances in dry soils against waterlogged conditions and their effect on species richness. In European LBK sites with well-drained soils, wild plants in carbonized state are often only field weeds, Jacomet counts only 85 taxa from over 30 sites, whereas in waterlogged sites, there are usually over 140 "other" wild plant taxa per well (Jacomet 2013, 507). In Arbon Bleiche3 4 carbonized seeds of wild strawberry (*Fragaria vesca*) were found, in contrast to 5.462 seeds in waterlogged conditions (Jacomet 2013, 508). Furthermore, for the Roman Iron Age, cereals are well represented in both contexts, while oil-containing seeds and condiments, two highly appreciated sources for herbal medicines, are much more numerous in waterlogged environments, compared to dry soils (Jacomet 2013, 509). For construing an adequate interpretation those aspects of taphonomy need to be considered attentively and plants more prone to degradation are in need of a special mindfulness especially in terms of expected quantities.

3. Results

We can expect people to carry their remedies with them, store them in their houses or would know where to find them in the nearer location. But as set out above, some problems need to be considered. Since archaeobotany is a rather young field, a lot of sites are not evaluated in respect of botanical findings yet and older research often focused on agriculture, neglecting the identification of wild species. Furthermore some regions and time periods gained high interest, while others remained unobserved. In ADEMNES the number of Medieval sites (34) is significantly lower, than Bronze (128) and Iron Age sites (133), so this study is not able to show trends for the exploitation of plants through time. Quantities should not be taken as indicator for the importance of a species for a population as well. As it was shown earlier, various factors manipulate the chances of a plant for getting preserved, scientifically evaluated and published, resulting in a highly biased outcome of recorded plants. What these quantities can do, is to deliver a list of plants to the medical archaeologist, where a closer look onto the archaeological record of specific sites, regions or time-periods can be rewarding and to show, where a new set of interpretation for plant residues may be worth considering.

Another aspect needs to be noted for the following quantities: while most taxa listed in the Compendium are determined to species level, some entries are just given as genus (cf. e.g. *Vicia sp.* (Sontheimer 1840, 198–199; idem 1842, 367)). A reason for this can either be disagreement amongst scholars which plant specifically was meant by Ibn al Baitar (cf. e.g. *Vicia sp.* (Sontheimer 1840, 586)) a missing description of the used plant, or the usage of each plant belonging to that genus for healing purposes. The chance of identification through an archaeobotanist needs to be considered as well: Due to fragmentation-rates and the experience-level of a researcher macrorests often can just be determined on genus level, especially when it comes to the morphologically diverse group of wild plants.

186 Taxa on species – and 43 Taxa on genus level were found at archaeological sites in the dedicated timeframe. 337 sites yielded potential medicinal plants (Fig. 3). The plants have been grouped into three classes: field crops, trees & shrubs and herbs & weeds. For each category ten[3] of the most frequent taxa were chosen for illustration (Table 1). Some will be described in detail below; the knowledge from Authors quoted there was not derived from primary sources, but have been cited by Ibn al Baitar itself. For the sake of simplicity this is not termed at each time.

3.1Plants

3.1.1 *Pisum sativum* – Pea

The knowledge about peas as remedy seems to have been widespread, since Ibn al Baitar was able to collect information from 13 different sources. Mostly they highlight

[3] For the class of field crops only 9 common Taxa have been found at archaeological sites from ADEMNES.

the bloaty and impelling properties, while its virtue for the male genitals is called out from at least seven of them (Sontheimer 1840, 322–324). Some of the authors make distinctions between different kinds of peas and their features, like Galen, who attributes a stronger effect of black peas on urine (Sontheimer 1840, 322), while Rhazes speaks about their good properties for cold diseases, humid joint pain and paralysis (Sontheimer 1840, 323). Al-Israili labels them to be hotter and less humid as white ones, with more bitterness, leading to a better effect on blockage of liver and spleen, helping with oedema, jaundice and abortion or removing worms and stones. In contrast, he ascribes a good impact on the secretion of sperm, milk and urine or beautifying effects on the skin to white peas (Sontheimer 1840, 323). Dioscorides is not dividing between black and white peas and adds, like Galenus, its driving force in menstruation, but is emphasizing another kind of pea, called '*Orobus*', which needs to be cooked and whereof one can make a compress with honey that helps with inflammation of the testes, scaly leprosy, itch, humid ulcers of the head and other ferocious tumours (Sontheimer 1840, 322). Maserdschavia adds the usefulness of pea-meal cooked in milk for patients with lung-ulcerations and to strengthen appetite or sperm (Sontheimer 1840, 322). Ibn Masawayh explains the attribution of peas with male genitals and sexual intercourse insightfully: Three important things are needed for the coitus: heat, which causes passion, humidity, to moisten the body and increase sperm-secretion and bloaty nourishment that fills the vessels of the penis. All these features are united in peas (Sontheimer1840, 322–323). He advises to soak them in water and eat them raw, while the liquid can be drunk with an empty stomach (Sontheimer 1840, 322). Rhazes recommends not drinking water directly after the ingestion of peas because of the wind, but to take a sip of pure wine, some caraway (cf. *Carum carvi*) and other spices – unless one aims to increase the erection (Sontheimer 1840, 324). Ibn al Baitar advices to lay still warm, cooked peas within a pouch onto the testes, to alleviate pain and inflammations on the very spot (Sontheimer 1840, 323).

A rather unusual testimony from Dioscorides shall be added here too, because it may be a relic of an older, magically based practice. Here one should fold a pea into a sheet of linen and place it onto a wart at the beginning of a month. Thereafter, one should throw it away over the shoulder (Sontheimer 1840, 322).

Pisum sativum was found at 28,13% of the early sites with a total amount of 36 sites. Lateron it was documented for 16,54% (22 sites), while 23,53% (8 sites) were reached in the youngest phase. Seeds and pericarp contain starch, albuminoids, alkaloids, galactolipids, trigonelline, piplartine and essential oils, the stems include the phytoestrogens kaempferol-3-triglucoside and p-coumaric esters. In Bangladesh seeds of peas are traditionally used as appetizer, blood purifier, laxative, astringent and in treating wrinkled skin, phlegm and intestinal inflammation (Zilani et al. 2017, 2).

3.1.2 *Hordeum distichum* – Barley

Barley (*Hordeum distichum*) is a common cereal at archaeological sites. Like other cereals, the character of its seeds is said to be of an average admixture in terms of its features, leading to the usage for a whole range of different applications. Galen compares barley with (carrier-) substances like oil and wax (Sontheimer 1842, 97). An Example for this is given by Dioscorides: a mixture of linseeds (cf. *Linum usitatissimum*), seeds of Foenum graecum (cf. *Trigonella foenum graecum*) and rue (cf. *Ruta graveolens*) in barley meal against bloating (cf.Sontheimer 1842, 97). Ibn al Baitar adds its usefulness to reduce bad properties of added substances, without impairing other, desired qualities. He confers to the milk of spurges (*Euphorbia sp.*) whose destructive features are lessened significantly, when mixed together with meal of barley seeds. Usually its meal is used as compress to alleviate pain and to cool down (or warm up) a specific body part (Sontheimer 1842, 98). Dioscorides gives the meal with melilot (cf. *Melilotus officinalis*) and poppy seed capsules (cf. *Papaver sp.*) for soothing side stitch (Sontheimer 1842, 97) According to Ibn al Baitar one should mix it with cooling substances, like vinegar, purslane (cf. *Portulaca oleracea*) or the juice of duscle (cf. *Solanum nigrum*) for headaches or swellings of the eyes. Laid onto the forehead or eye it alleviates pain and inflammations, through the inhibited inflow of heating substances towards the eyes (Sontheimer 1842, 98).

For early times there is an amount of 32,81% and 42 sites yielding *Hordeum distichum* seeds, followed by a time with a lesser amount of only 18,80% and 25 sites. In younger sites percentages increase to 26,47% (9 sites) again.

3.1.3 *Avena sp., Triticum monococcum and Triticum spelta* – Oat, Einkorn and Spelt

Uses of oat (*Avena sp.*), einkorn (*T.monococcum*) and spelt (*T.spelta)* are similar to that of barley (*Hordeum distichum*), according to Dioscorides and Galen (Sontheimer 1840, 362, idem 1842, 206). Dioscorides says for oat it is used as compress and will help with cough (Sontheimer 1840, 362) while spelt, can be cooked with water, mint and cream to alleviate cough and hoarseness (Sontheimer 1840, 335). Galenus explains for oat that, in a compress, it is drying and disaggregating, without causing sting (Sontheimer 1842, 362). While oat and einkorn are common cereals throughout archaeological sites (oat, with percentages of 32,81% (42 sites), 24,81% (33 sites), 17,65 (6 sites) and einkorn with 40,63% (52 sites), 18,80% (25 sites) and 11,76% (4 sites)) spelt is a fairly rare taxon. Its percentages range from 3,91% and 5 sites in early times to 5,97% and 8 sites, followed by 2,94% and 1 site in the youngest time frame.

When used as powder the starch of these crops can bind water that, through the bigger surface, is more prone to evaporation, thus operating desiccative and cooling. Wound secretion and skin fat can be bound (Teuscher et al. 2012, 107). Today corn- as well as pea-starch is used in pharmaceutical applications e.g. as a basis for non-fatty balms (Teuscheret al. 2012, 107).

The above shown percentages do illustrate the reliability of quantities as indicator for the importance of a Taxon for medicinal purposes pretty well. This high amount of sites yielding medicinal usable Taxa certainly were not reached because of the importance of these species as remedy, but because of their extensive exploitation as common foodstuff. As a consequence higher quantities for dietary crops can obviously be expected, without implying a higher medicinal significance. For species with a narrow utilisation-range (e.g. poisonous plants) chances for their deposition in archaeological contexts are more limited, without implying lesser medicinal significance of this plant for an ancient population.

3.1.4 *Vitis vinifera* and *Vitis sylvestris* – Wine

Vitis vinifera and its wild form *V. sylvestris* may have belonged to the most important plants for medicinal purposes. In Ibn al Baitar's Compendium 681 recipes are listed with wine as ingredient and his chapter regarding *Vinum* spans 10 pages for itself (Sontheimer 1840, 383–393). He cites Dioscorides, specifying the effects of different varieties, places of origin or production methods of wines onto its medical characteristics. However some features do they all have in common if they are pure. They are astringent and warm, spread swiftly through the body, strengthen appetite and stomach, nourish and strengthen the body, provide a better look and induce sleep (Sontheimer 1840, 385). Drunken with olive oil they stimulate vomit, helping with poisoning through Meconium, Conium, Pharicum[4], Toxicum[5], and clotted Milk in the stomach as well as sting and ulcers in the urinary tract or kidneys (Sontheimer 1840, 384). It shall help with negative forces of coriander (cf. *Coriandrum sativum*) mercury, poisonous sponges and with all remedies, killing through coldness, as well as coldness inducing animal-poisons (Sontheimer 1840, 385). Dioscorides describes white wine as softening the body (Sontheimer 1840, 384) and most fitting for healthy or sick people (Sontheimer 1840, 383) while sweet wine is thick, bloating and good for urinary bladder and kidneys (Sontheimer 1840, 383). Astringent wine is strongly diuretic compared to other sorts, but causes headache and drunkenness as well. In contrast, mild wine is less intoxicating and diuretic, while rough wine is said to be more fitting when consumed with food, because it suppresses fluxes

4 Berendes was not able to find out, exactly which poison Pharicum might be. According to him Dioscorides is characterizing its taste to be similar to *Nardus sylvestris* (Berendes 1891, 276).

5 In his translation of Dioscorides *De Materia Medica* Berendes interprets this word as „*Pfeilgift*“ (arrow poison) (Berendes 1902, 482).

from the body (Sontheimer 1840, 383). Adding different ingredients into the wine changes its qualities too (Sontheimer 1840, 384). Furthermore he is not sparing with information about bad qualities and effects of extensive consume (Sontheimer 1840, 383–392).

But not only was the use of wine described in detail. The leaves of *V. vinifera* are recommended alone or with paste of barley as compress for the burning of hot swellings in the stomach (Sontheimer 1842, 356) and the ash of its branches shall heal the anus after a condylomata was destroyed (Sontheimer 1842, 357). Its resin used as a balm is recommended for healing flaky leprosy and ulcerous or non-ulcerous scab (Sontheimer 1842, 356) and warts (Sontheimer 1842, 357) but can also be drunk with wine, to carry off urinary calculi (Sontheimer 1842, 356). The juice of fresh leaves or vines soaked in water helps with dysentery, haemoptysis, afflictions of the stomach and in pregnancy. Crushed leaves and vines in a compress alleviate headache (Sontheimer 1842, 356). The ash of branches can be used to help with a pulled tendon or snakebites (Sontheimer 1842, 357). Some cautionary indications from Dioscorides are given for the resin of the plant: if one uses it together with olive oil as balm consistently, it promotes shedding of hair. He suggests washing the body with nitrum prior to the usage of resin on the skin (Sontheimer 1842, 356). Galen ascribes the same characteristics of the cultivated wine to the wild species (*V. sylvestris*), but with the restriction that domesticated wine is of a weaker quality as the wild one (Sontheimer 1842, 357). Dioscorides gives a recipe with the root of wild wine, cooked within two cups of wine and seawater, which is given to hydropic patients, because of its water purging features (Sontheimer 1842, 357). Both suggest using wild grapes to remove spots, blood and everything else appearing on the surface of the body (Sontheimer 1842, 357). In the archaeobotanical record *Vitis sp.* is exceptional frequent. Most of these finds consists of *V. vinifera*, only at two EBA sites, namely Arslantepe and Yenibademli Höyük *V. sylvestris* has been identified. At early sites *Vitis sp.* shows up in 60,16%, with a total of 68 sites, later on there is an abundance of 57,89% and 77 sites. In the youngest time frame there still is an amount of 55,88% and 19 sites. Next to the high amount of remnants left through activities of wine production, this increased numbers may partly be a result of the easy recognizable, sturdy seeds with its pyriform shape and the small beak, which are quite durable and often survive as charred specimen, but in mineralized form as well (White – Miller 2018, 211). Grape stem attachments, whole grapes and even fragments of its skin can be preserved (White – Miller 2018, 211). Through the interest in wine production and morphological and experimental studies (cf. e.g. Margaritis – Jones 2006) archaeobotanical remains of *V. vinifera* are relatively well understood and may be recognized in a sample, while other taxa have to be left unidentified.

3.1.5 *Fumaria sp.* – Fumewort

Fumaria officinalis is found in arable land as a character species of the Fumario-Euphorbion organisation (Oberdorfer 2001, 430), other sorts of fumewort are sprouting at the wayside or in wastelands, growing up to 30 cm high (Teuscher et al. 2012, 485). In Ibn al Baitars Compendium authors like al-Ghafiqi, Dioscorides, Rhazes or Ibn al Baitar itself does not seem to refer to just one species of fumewort, although Sontheimer (Sontheimer1842, 75) is specifying the expression *Schâhtarradsch* to be *F. officinalis*. In a later chapter Ibn al Baitar is clearing up confusions regarding the term *Kammunbarri* (Sontheimer 1842, 396–397), which was – according to Ibn al Baitar wrongly – determined by Rhazes through the word *Kapnos* as "wilder Kümmel" (Sontheimer 1842, 396) probably meaning cumin (*Cuminum cyminum*) or perhaps wild caraway (*Carum carvi*) (Sontheimer 1842, 394), although he concedes that it is the species *Fumaria* for most of the splendid penmen (Sontheimer 1842, 396). Following Ibn al Baitar, it is clear in the description of Dioscorides, who as a side note, never connected the term *Kapnos* with the plant Rhazes meant (Sontheimer 1842, 396) that a sort of fumewort with a crimson red flower, a known remedy for every scholar, is described (Sontheimer 1842, 397).

Galenus describes the plant to be hot, bitter and somewhat astringent, leading to the urging of biliary urine (Sontheimer 1842, 75). He refers to a man, who was using the plant, to strengthen the stomach and open up the body. For this he dried and stored it, strewing it into honey water, if he wanted to purge a patient. When strengthening of the stomach was aimed, he strewed the powder into undiluted wine (Sontheimer 1842, 75–76). Al-Israili, Ibn Imran, and Elscherif recommend it for similar areas. According to al-Israili fumewort strengthens the stomach, stimulates appetite, purges burned bile and opens obstipations of the liver (Sontheimer 1842, 76). For this he recommends drinking its fresh juice uncooked, which will also help with pruritus and itchiness, coming from tainted blood, phlegm or burned bile (Sontheimer 1842, 76). Ibn Imran endorses this characterization, adding its usefulness to staunch vomit caused by phlegm, when dissolved in vinegar (Sontheimer 1842, 76). Elscherif gives, next to the strengthening of the stomach and the opening of liver obstipations, a different set of applications though. If the leaves of fumewort were soaked in water for a day, and afterwards head and beard are washed with this solution, it will help with lice and dandruff. The juice drunken with tamarind soaked in it helps with the itch. A decoction of the plant gargled in the mouth strengthens the gums and alleviates heat of mouth and tongue (Sontheimer 1842, 76). Galen and Dioscorides are both indicating its qualities for sharpening the sight when moving the eyes to tears through fume, leading to its Greek name *Kapnos* (Sontheimer 1842, 75–76). For a wild herb *Fumaria sp.* is quite common in archaeological deposits. Its percentages are ranging from 21,88% and 28 sites, to 19,55% with 26 sites and later on to 17,65% with a total number of 6 sites. *F. officinalis* was found at early and middle Bronze Age Troy, Demircihöyük and Tell Mishrifeh or in LBA and IA phases of Troy, Ayios Dhemetrios, Emar and Samos Heraion. Through its habitat it often might have entered sites as a field weed that has to be painstakingly sorted out from dietary crops, because of its toxicity. Nevertheless, drying and storing of this herb would not be much of an effort, but instead of simply throwing it away, it would indeed provide people with a strongly effective remedy. The herb contains 0,4–1,2% Isochinolinalkaloids, prime-alkaloid is Protopin and para-alkaloids are among others Cryptopin and Stylopin, as well as Indenobenzazepin derivates (Teuscher et al. 2012, 485). Protopin operates spasmolitic on muscles (Teuscher et al.2012, 483) and today the leaves are used for spasmodic afflictions of the gallbladder, the biliary tract, the gastro-intestinal system or for nausea and vomit (Teuscher et al. 2012, 485).

3.1.6 *Heliotropium sp.* – Heliotrope

Heliotrope was known in Egypt as scorpion herb or *Scorpiurus,* referring to its rolled up inflorescence, similar to the tail of a scorpion. Dioscorides labels the plant *Heliotropium magnum* (Sontheimer 1842, 118), according to Berendes and Sontheimer *H. europaeum* is meant (Berendes 1902, 475; Sontheimer 1842, 118) a possible alternative candidate could also be *H. villosum* (Berendes 1902, 475) (syn. *H. hirsutissimum*). Following Dioscorides the seeds were said to help with fevers, four seeds of the plants in wine, an hour before the attack of the quartan fever, and three seeds, for the tertian fever (Sontheimer 1842, 199). The leaves of Heliotrope in a compress will help with inflammations of a child's brain, the gout or a distortion of the tendons. A handful of them cooked in water and drunken, purges phlegm and bile (Sontheimer 1842, 118) carried powdered (as a suppository (Berendes 1902, 475)) they further menstruation and abortion (Sontheimer 1842, 119). Some people are tying the roots to themselves to alleviate pain, coming from a scorpion-sting (Sontheimer 1842, 119). Likewise, it is useful to drink its leaves with wine, or make a compress for the sting (Sontheimer 1842, 118), which should also work for drying out warts (Sontheimer 1842, 119). The small Heliotrope has been interpreted as *Croton tinctorius* from early authors (cf. e.g. Sontheimer 1842, 119). Berendes however follows Fraas more fitting interpretation of *H. supinum* (Berendes 1902,476). Dioscorides is recommending the fruit and leaves of the small Heliotrope mixed with nitrum, *Hyssopus* (cf. *Hyssopus officinalis*) and *Nasturtium* (cf. *Nasturtium officinale*) added into water, to cope with tape- or roundworms. Compresses with salt disperse corns and warts (Sontheimer 1842, 119). *Heliotropium sp.* was found at 14,84% (19 in total) of early dating archaeological sites. Later its presence was found at 9,77% (13 in total) and afterwards at 14,71% (5 in total) of the sites. *H. europaeum* was found at the EBA to MBA sites Hirbetez-Zeraqon, Tell Aphek, Tell Mishrifeh and Troy and at LBA to IA Jarma, Kinet Höyük, Tell Atchana, Troy and Ulu Burun, lateron at Yassi Ada and Serce Limani as well. Interestingly seeds of *H. europaeum* have been found at the LBA shipwreck of Ulu Burun, the early Byzantine wreck of Yassi Ada, as well as the wreck of Serce Limani, dating 1025 A.D (cf. www.ademnes.de/db/sites.php). All were carrying trade goods through the Mediterranean. To have those finds in even three such exceptional contexts gives rise to the assumption that *Heliotropium*, perhaps coming from a specific region, may have been appreciated for its medical purposes. Today *H.subulatum* is used for the treatment of wounds caused by scorpion stings on the Deccan Peninsula, the leaves of the plant are used as stimulant and bitter tonic in Africa (Sing – Ram 2020, 545). *H. supinum* is rich in lupeol and ß-sitosterol (Ramanpreet et al. 2019, 1). *H. indicum* contains the pyrrolizidine alkaloids heliotrine and lasiocarpine, its main alkaloid indicine shows effects against tumours (DeFillips et al. 2004, 59). In Guyana the boiled plant is drunk against heat rash, thrush, diarrhoea and frequent excretion of urine, the juice of the leaves is used to alleviate conjunctivitis pain (DeFillips et al. 2004, 59). In Tamil Nadu the juice mixed with hot water is used to treat snake bites or scorpion sting (Reza et al. 2018, 38). Other applications are known from Mali, Ghana, Senegal, Bangladesh, Taiwan, Indonesia, Jamaica and many other regions (cf. e.g. Reza et al. 2018, 38–39).

3.1.7 *Papaver sp.* – Poppy

The genus Papaver incorporates highly appreciated plants, nowadays and in ancient times, and the supplier for "one of the most important and powerful drugs for which we have evidence" (Arnott 1996, 268), the opium. Al Tamimi reportes the real opium is neither known in the eastern nor in the western world, but only in Egypt, especially in upper Egypt, at a place called Asiut. Ibn al Baitar specifies opium to be the latex of black poppy (Sontheimer 1840, 64). Theophrastus reports people calling a variety of plants 'poppy', e.g. the black, horned, or herakleian poppy, or a poppy called rhoias (Megaloudi 2005, 77). Ibn al Baitar lists several of them too (Sontheimer 1840, 28, 64–65,367–369, idem 1842, 546–547). Galen relates every sort of poppy to be cooling; garden-poppy has a gentle virtue to induce sleep, a second sort belongs to the strong remedies. The third kind should only be used in an admixture of drugs, because of its fierce, cooling strength, leading to numbness and death (Sontheimer 1840, 368). *P. argemone*, a plant described by Dioscorides to be similar to a poppy called *Rhoeas*, acts against ulcers, when its leaves are used as a compress and alleviates diseases of the eye, known as obscuration or cloudlet (Sontheimer 1840, 28). For the *Rhoeas* called Poppy, Galenus reports the name *Elmanthur,* because of its easily falling off leaves. The seeds are acting cooling to a high degree and Dioscorides gives a recipe with 5 or 6 poppy heads given into three cups of wine and boiled down to two cups, which will induce sleep when drunken (Sontheimer 1840, 369). For the gum of opium poppy (*P. somniferum*) he states to take an amount of a pea to alleviate pain, a long-lasting cough or to induce sleep.

More will cause deep, frightening sleep, similar to a sleep called *Lethargus* (Sontheimer 1840, 64). Mixed with rose oil rubbed onto the head, it will alleviate headache, with almond oil, saffron and myrtle given into the ear earaches were treated, roasted until it is soft and reddish brown it was used for diseases of the eye and with roasted egg yolk and saffron it was used for wounds and erysipelas (Sontheimer 1840, 64). From Diagoras it is chronicled that Erasistratos does not use opium for diseases of the eyes or ears, as it weakens the face and causes anaesthesia; and that Andreas claims falsified opium leads to blindness, if used to heal illnesses of the eye. Ibn al Baitar rejects both of these statements (Sontheimer 1840, 64). Additionally he cites Dioscorides advices to identify falsified opium. These quotations support the assumption of a highly demanded and traded remedy as well as the respect with which it was treated. *P.somniferum* was found at EBA Kastanas and at LBA/IA Assiros Toumba, Jarma, Kalapodi, Kastanas, Tiryns and Samos Heraion. In the early archaeological samples *Papaver sp.* was present at 12,5 % of the sites with a total amount of 16 sites, thereafter the numbers lowered to 8,27 % with 11 sites and afterwards to 5,88% with 2 sites. These numbers may seem to be relatively low, to the high reputation assumed for this plant. However there is a diverging chance for seeds to get carbonized in an archaeological context. According to Märkle and Rösch for *P. somniferum* the temperature range in which carbonization appears is pretty small, resulting in a very limited chance to be preserved at all (Märkle – Rösch 2008, 257). Other, additional lines of evidence are highly needed to account for this problem and to get an adequate picture of the ancient situation. A pretty interesting study was conducted by Smith et al. for the detection of opium alkaloids in a Cypriot base-ring juglet in 2018. This, in the eastern Mediterranean during the LBA (1650–1350 BC) widely traded ceramic ware, have already been suggested to be linked with opium in 1962 by Merilles, because of its significant form, looking much alike poppy-capsules (Smith et al. 2018, 5127). Artificial ageing experiments have shown that morphine, the most abundant alkaloid of *P. Somniferum* does not survive well through time, but papaverine, thebaine and the breakdown products of noscapin are relatively resistant to degradation (Smith et al. 2018, 5127) with papaverine being the most stable alkaloid (Smith et al. 2018, 5134). In the examined juglet residues of papaverine and thebaine have been detected with concentrations of 0.4–2.6 pg mg^{-1} and 2–12 pg mg^{-1} (Smith et al. 2018, 5135) hence giving a positive result for opium alkaloids. Another interesting line of evidence was followed by Saul et al. in search for spices of prehistoric European cuisine. They tested carbonised food deposits on pottery from the western Baltic for phytoliths, finding *P. somniferum* at seven sites, dating from c. 5650 BP to c.3950 BP, in France, Germany, Poland, Spain and Switzerland (Saul et al. 2013, 2). Approaches like these are able to concrete our evidence and should be taken into account not only for taxa whose seeds are more prone to degradation, but also for plants, where the nature of its use (e.g. preparations of leaves) is problematic for archaeological survival.

4. Conclusion

337 of the 362 investigated sites yielded potential medicinal Taxa (in total 186 Taxa on species – and 43 Taxa on genus level). As expected, dietary crops were present at a higher frequency of sites than it was observed for wild plants. Some of the reasons for this will be a more regular or a broader utilisation plant and taphonomic agents. Although taphonomy is exclusively unfavourable when it comes to medicinal herbs, a notable amount of them is present at archaeological sites. Especially the frequencies of *Fumaria sp.* and *Heliotropium sp.* are noteworthy. Since a remedy should be easy accessible when it's needed, crops should not be ruled out as a possible source for pharmaceuticals. The collection of 13 different authors describing the medical qualities of peas does illustrate this pretty well. However abundances of medical plants in an archaeological context do not necessarily indicate their importance for a population and the above given percentages should not be interpreted as such. Additional lines of evidences are highly needed, on the one hand, to be able to find even those plants with a rather unfavourable fossil record (the family of *Lamiaceae* for instance is highly esteemed in modern ethnopharmacology, but severely underrepresented in the archaeological record) but on the other hand, to be able to verify the actual use of a plant as a remedy, since a lot of healing plants belong to spices, oil and fibre sources or dietary crops. Interesting approaches were made by Chaves and Reinhard (2003) who linked pollenfinds in coprolites with diseases that affected the studied population or by Berihuete-Azorin (2015) who proposed a form for the systematization of ethnobotanical information for archaeobotanical interpretation that could help to find markers on residues coming from specialized preparation procedures. Interdisciplinary research will be the key for an in-depth understanding of our medicinal prehistory.

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Correspondence
B.A. Mandy Bertram
Eberhard Karls Universität Tübingen
Institut für Naturwissenschaftliche Archäologie
Rümelinstr. 23
72070 Tübingen
mandy.bertram@fu-berlin.de
mandy.bertram@student.uni-tuebingen.de

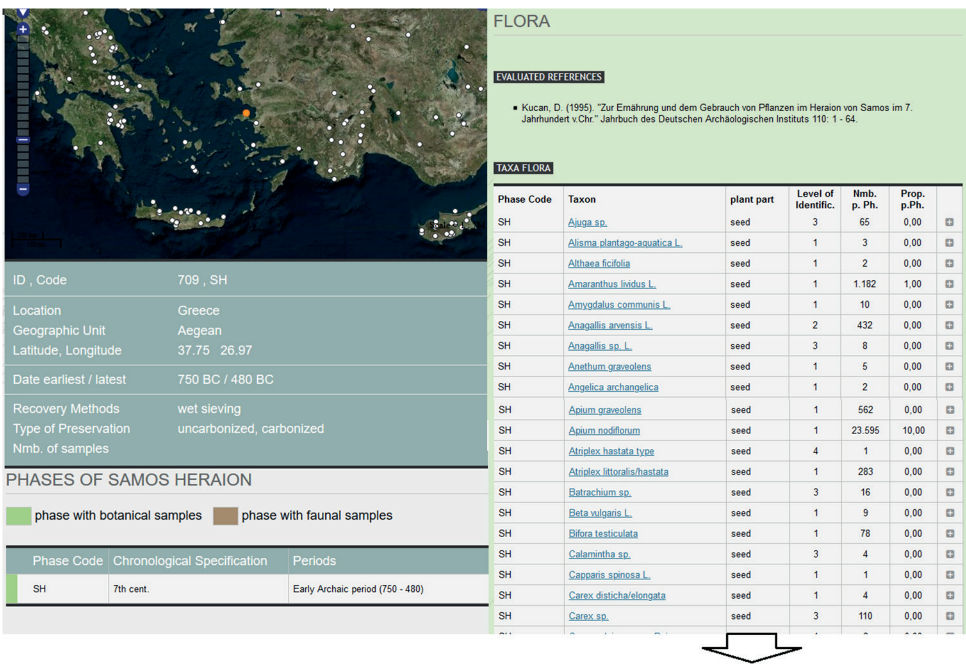

Fig. 1: ADEMNES webpage for the site Samos Heraion (cf. Riehl and Kümmel 2005: http://www.ademnes.de/db/site.php?s=709). Copyright: ADEMNES webpage (screenshot created by the author).

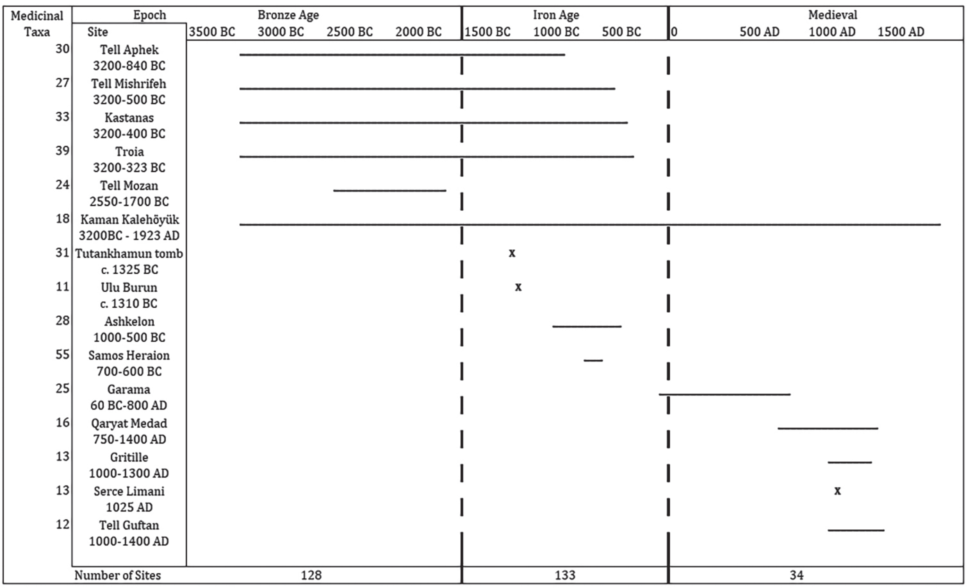

Fig. 2: An exemplary selection of sites used for this analysis. Finds were grouped according to their age. For display five sites per group have been chosen for their richness in medicinal taxa or their exceptional contexts. At the bottom you can see the total number of medicinal taxa yielding sites in the related timeframe. Note the small amount of sites in the latest group. Created by the author.

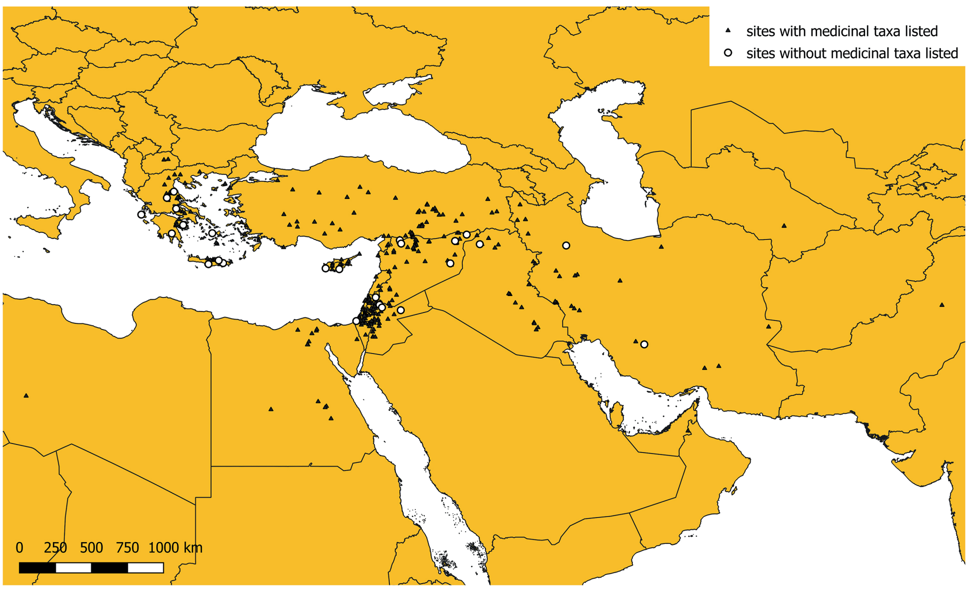

Table 1: Representation of medicinal taxa in the literature listed in Ademnes. 362 Sites were included in the analysis. 25 of them didn't yielded any medicinal taxa. These sites are (from west to east): Kephallenia, Tsani, Menelaion, Marmariani, Drachmani, Synoro, Liliana, Saliagos, Mallia, Gournia, Lemba-Lakkous, Kalavasos village, Kissufim road, Beth Saida, Tell Miqne, Tell el Fukhar, Dhuweila, Tell Ilbol, Tell Qaramel, Shheil 5, Tell Hwes, Tell Leilan, Yarim Tepe I, Susa and Tall e Mushki

Fig. 3: Medicinal Taxa yielding sites (337). Map made with QGIS by the author.

Field Crops						
	c.3000–1500 BC		c.1500–1 BC		c.1–1500 AD	
Taxon	%	sites	%	sites	%	sites
Vicia sp.	60,16	77	58,65	78	38,24	13
Lens culinaris	51,56	66	44,36	59	44,12	15
Avena sp.	32,81	42	24,81	33	17,65	6
Triticum monococcum	40,63	52	18,8	25	11,76	4
Hordeum distichum	32,81	42	18,8	25	26,47	9
Pisum sativum	28,13	36	16,54	22	23,53	8
Linum usitatissimum	23,44	30	15,04	20	11,76	4
Panicum sp.	7,81	10	10,53	14	35,29	12
Triticum spelta	3,91	5	5,97	8	2,94	1
Trees and Shrubs						
Vitis sp.	60,16	68	57,89	77	55,88	19
Olea europaea	35,94	46	46,62	62	20,59	7
Ficus carica/sycomorus	26,56	34	35,34	47	20,59	7
Quercus sp.	21,88	28	19,55	26	14,71	5
Punica granatum	7,03	9	19,55	26	14,71	5
Phoenix dactylifera	7,81	10	17,29	23	17,65	6
Tamarix sp.	11,72	15	15,79	21	0	0
Amygdalus communis	5,47	7	12,78	17	11,76	4
Capparis spinosa	5,47	7	6,02	8	0	0
Cedrus sp.	4,69	6	8,27	11	0	0
Herbs and Weeds						
Fumaria sp.	21,88	28	19,55	26	17,65	6
Heliotropium sp.	14,84	19	9,77	13	14,71	5
Papaver sp.	12,5	16	8,27	11	5,88	2
Coriandrum sativum	2,34	3	7,52	10	14,71	5
Euphorbia sp.	10,16	13	7,52	10	5,88	2
Verbena sp.	5,47	7	6,02	8	2,94	1
Portulaca oleracea	4,69	6	6,02	8	0	0
Hyosciamus sp.	8,59	11	5,26	7	2,94	1
Lepidium sp.	5,47	7	2,26	3	0	0
Carthamus tinctorius	7,81	10	1,5	2	0	0

Tab. 1: Most common medicinal plants. Created by the author.