Sweeter than wine? The use of the grape in early western Asia

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Emotional news for lovers of a dry white wine. The blissful Hippocrene was composed from wild grapes from the sixth millennium BC in the lands of its natural habitat. But, as the author shows, the cultivation, domestication and selective breeding of the grape following in the Late Neolithic to Early Bronze Age was aimed primarily at the enjoyment of its sweetness.

Keywords: western Asia, Neolithic, grape, viticulture, wine

Introduction

Evidence for the origin and spread of the grape (*Vitis vinifera*) in western Asia comes from a variety of sources, on- and off-site: pollen cores, residue analysis, archaeological seeds, stems, and fruit remains as well as charred wood of the vine. This paper is an attempt to explain the observation that despite remarkably early residue evidence for wine in the Neolithic (mid-sixth millennium BC, McGovern *et al*. 1996), other evidence for grapes (pollen from flowers, along with fruits, seeds, stems and wood) does not become common in the archaeological record until 3000 years later, the Early Bronze Age (third millennium BC) (Zohary & Hopf 1994). The goal is to understand the processes behind early exploitation of the vine (Tables 1 and 2).

The area of study is the phytogeographical region classified as the Caspian and Black Sea temperate forest, the Mediterranean coastal woodland and steppe-forest, the Kurdo-Zagrosian oak and pistachio-almond steppe forest, and Syrian steppe (see Zohary 1973) (Figure 1). With the exception of the temperate forest zone, this region coincides with the parts of Syria, Iraq, Turkey and Iran that were home to the Neolithic, Chalcolithic and Early Bronze Age cultures of the ancient Near East. The first evidence for grape wine production in this region dates to the mid-sixth millennium BC; by the mid-fifth millennium the vine had come under cultivation, and the domesticated forms appeared somewhat later.

The present-day distribution of the wild ancestor of the European wine grape (*Vitis vinifera* var. *sylvestris*) was established during the early to mid-Holocene (beginning 11 500 cal BP). It covers a band across western Eurasia from the Mediterranean to the Caspian, in areas characterised by mountain and Mediterranean scrub vegetation. Over most of its range, annual precipitation exceeds 600mm, but in drier regions it also grows in riparian and moister habitats (Zohary, M. 1973; Zohary, D. 1994). The present zone of wild grape is

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Table 1. Overview of archaeobotanical evidence from Israel, Palestine, Jordan, Syria, Iraq, Turkey, Iran and Cyprus: number of sites with reported grape pips, fruit remains or peduncles.[1]

	In present natural habitat	Outside present natural habitat
Neolithic (8th-6th millennium)	4	1
Chalcolithic (4th millennium)	12	1
Early Bronze Age (3rd millennium)	12	28

Table 2. Time line for sites and evidence specifically mentioned in text. *Zeribar date: 5460±120 BP, approx. 4278±147 cal BC (http://www.calpal-online.de/, verified 21 July, 2007).

cal BC	In present natural habitat	Outside present natural habitat (evidence; distance)
>10 000		
	Atlit-Yam (seeds-wild)	
	Lakes Ghab, Van, Urmia (pollen)	
6000		
	Hajji Firuz (residue)	
5000		
		L. Zeribar* (pollen); 175km
4000		
	Kurban Höyük (few seeds-domesticated)	Godin (residue); 400km
		Malyan (few seeds); 600km
3000		
	Kurban Höyük (many seeds-domesticated)	Godin (seeds, wood)
	Eastern Mediterranean sites (seeds)	Malyan (many charred, mineralised seeds; wood)
		Anau (seeds); *c*. 500km, but *c*. 1200km from Hajji Firuz
		Shahr-i Sokhta (seeds); *c*. 1200km, but *c*. 1500km from Hajji Firuz
		Mehrgarh (wood); *c*. 2000km
2000		
	Eastern Mediterranean (pollen indicative of viticulture, wood)	

probably not identical to that of the mid-Holocene, but it should not be that different. It is likely that grape was domesticated in western Asia towards the eastern end of this region (Figure 2).

[1] *Most data from Simone Riehl's archaeobotanical database, www.cuminum.de/archaeobotany/[verified 12 April 2008], and other reports. #: Four EBA sites with wood, too. Natural habitat. Neolithic: T. Aswad, Ras Shamra, Çayönü, Ilipınar, Dhali Agridhi; Chalcolithic: T. Afis, Jawa, Wadi Fidan, Yarim H., Hacinebi, Korucutepe, Kumtepe, Kurban H., Oylum H., Tilbesar, Kissonerga, Lamba-Lakkous; Early Bronze Age: T. Afis, T. Mozan, T. Nebi Mend, T. es-Sa'idiyeh, Arslantepe, Korucutepe, Kurban H., Tepecik, Titriş, Troy, Kalopsidha, Sotira Kaminoudhia. Outside natural habitat. Neolithic: Jericho; Chalcolithic: T. Yahya; Early Bronze Age: #Arad, T. Gezer, T. Abu al-Kharaz, Bab edh-Dhra', #T. Bderi, En Besor, Hirbet ez-Zeraqon, Jericho, Lachish, Numeira, T. esh-Shuna, T. el-Abd, T. Atij, T. Brak, Hammam et-Turkman, Jerablus Tahtani, Qara Quzaq, T. Raqa'i, T. al-Rawda, Selenkahiye, T. es-Sweyhat, Umm el-Marra, T. Taya, Kaman Kalehöyük, T. Hissar, T. #Malyan, #Shahr-i Sokhta, T. Yahya.*

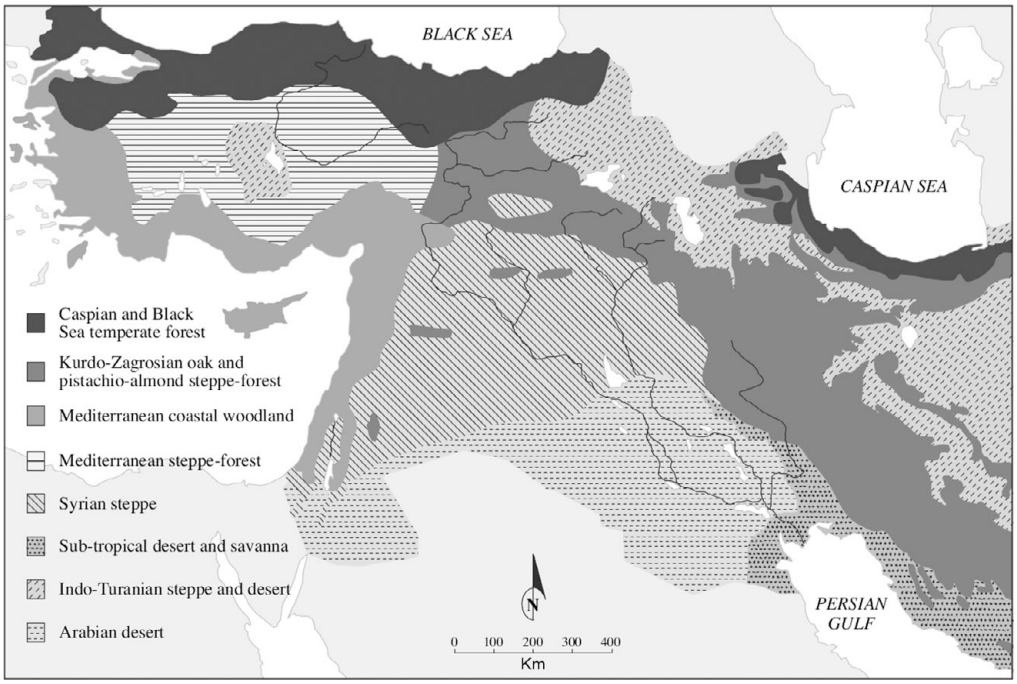

Figure 1. Location map showing the area of study (digital image by L. Shafer, based on Zohary 1973).

The wild ancestor of the grape is distinguished from the domestic variety (*Vitis vinifera* var. *vinifera*) by a relatively simple genetic change. The wild form is dioecious (male and female flowers are produced by male and female plants). The domestic form usually has hermaphroditic flowers (each flower has fertile stamens and pistils). Hermaphroditism permits self-pollination of domestic types, which fixes desirable traits. Once a variety with such traits is recognised, it can be reproduced with cuttings or layering (and in later times, grafting of cuttings onto pre-existing rootstock). Genetic crossing among wild, domestic and feral types makes it difficult to untangle both the early and later history of the many cultivars (see Zohary & Hopf 1994). In the discussion to follow, I use the term *cultivation* to refer to planting the vine for grape production, using cuttings or seed. *Domestication* refers to selecting and propagating hermaphroditic plants with desirable traits. Knowledge of grape cultivation necessarily preceded its domestication (i.e. expanding the population of hermaphroditic vines relative to dioecious ones), because grape seeds are so variable that it would not be possible to produce a new plant by seed with the same characteristics as its parent. At the present time the wild or cultivated status of archaeological remains of grape cannot be distinguished.

Given the normal variability of fruit produced by wild plants and the human ability to observe the natural world, people would have known which specimens in their neighbourhoods had useful traits, and may well have protected them. Initially sweetness may have been appreciated, but was not necessary; even wild grapes can be fermented for wine. Vegetative propagation might have expanded the range of wild vines whose cross-pollinated fruits would be very variable. Once the value of hermaphroditic vines was recognised,

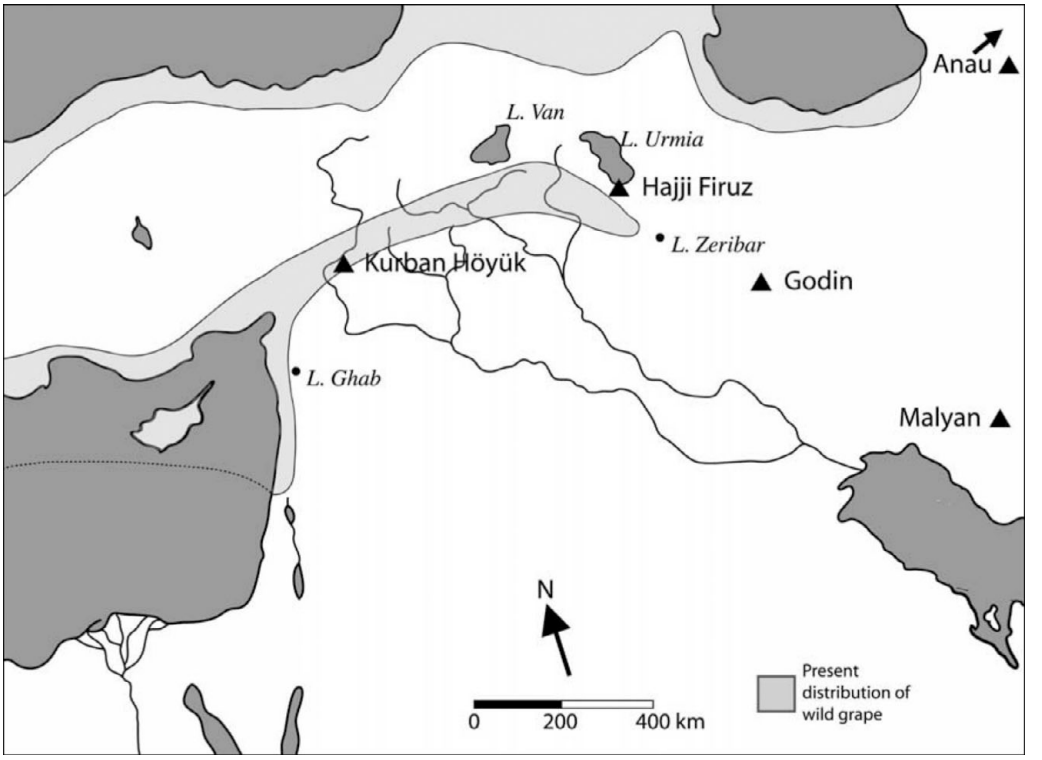

*Figure 2. Present distribution of wild grape (*Vitis vinifera *subsp.* silvestris*) in western Asia (after Zohary & Hopf 1994: Map 16).*

planting would have been of particular value for ensuring a supply of sweet-fruited varieties. It is therefore proposed that a major impetus for growing hermaphroditic clones of the vine across western Asia was to preserve varieties that produced sweet fruits.

The grape in the archaeological record

Pollen

V. vinifera is generally wind-pollinated, but fruit set can be enhanced with insect-pollination. The pollen of the vine does not disperse widely, so in general, pollen presence in a core supports an interpretation that the vine grew locally (see Turner & Brown 2004). The pollen record from cores in the present range of wild grape shows low but consistent *Vitis* counts at least from the beginning of the Holocene e.g. Lake Ghab (Yasuda *et al.* 2000), Lake Van (van Zeist & Woldring 1978) and Lake Urmia (Bottema 1986). About 175km south and a bit to the east of Lake Urmia, Lake Zeribar lies well outside the range of wild grape; *Vitis* pollen first occurs in the core just before *c*. 5500 BP (≈4300 cal BC; van Zeist & Bottema 1977). The Zeribar evidence implies that grape cultivation had spread to the south-east, but there is no indication of substantial plantings. Noticeable increases in *Vitis* pollen percentages that have been attributed to an expansion of viticulture around the Mediterranean do not occur until relatively late, after around 2000 BC (Bottema &

Woldring 1990). It is not possible to differentiate the pollen of the wild and domestic types. Therefore, *Vitis* pollen from lake cores indicates the presence of vines in an area, but does not say anything directly about its use or cultivation. The *Vitis* pollen found in early samples outside the range of wild grape, however, suggests the spread of its cultivation.

Residues

The presence of grape wine may be inferred from identification of tartaric acid in dried residues on vessels from archaeological sites (Singleton 1994). A hypersceptic might add that the source of the chemical signature could be vinegar, raisins, grape juice, *pekmez* (grape 'molasses'), some other grape product, or one of the few other plants that have tartaric acid. Residues found on the sides of narrow-necked, sealed jars are most likely to be from a liquid. Grape molasses requires substantial fuel (it is boiled down from grape juice), whereas grape juice ferments on its own. So at this early stage in the use of the vine, the residues are most likely to result from the simpler production technology. At present, the earliest evidence for grape used in wine comes from the sixth-millennium BC (Neolithic) site of Hajji Firuz (McGovern *et al.* 1996). The site lies in the Lake Urmia basin, at the edge of the range for wild grape, so it cannot be assumed that the grapes were cultivated. Tartaric acid residue analysed from site was extracted from one of six jars, each with a capacity of about nine litres, found in a domestic context. Investigation of a jar from another find spot yielded additional tartaric acid residue (McGovern *et al.* 1996; McGovern 2003). It is unlikely that a Neolithic household would require over 50 litres of vinegar. The residue extends about halfway up the jars that were examined; a viscous substance like grape syrup would at least partially adhere to the upper part of a jar, too. Patrick McGovern (2003: 54-8) provides these and other arguments for considering the vessel contents as grape wine rather than some other grape product. The discovery raises the question of whether or not the fruits for this early wine were gathered in the wild or from cultivated vines. Although results of chemical assays are not definitive (see Boulton & Heron 2000), the archaeological contexts of the samples support the interpretation of the residues as wine. About 1000 years later than the Lake Zeribar pollen evidence for *Vitis*, expansion of grape cultivation further to the south-east is implied by tartaric residue from a late fourth-millennium jar excavated from Godin Tepe, Iran. That site lies about 400km south-east of Urmia, which suggests that cultivation of the vine (by seed or vegetatively) had spread to this region by that time (McGovern & Michel 1994).

Seeds and fruits

Macrobotanical grape remains come from archaeological sites that were ancient settlements, and so provide direct evidence that the grape was used by people. Evidence for fruit use comes primarily from the charred seeds, peduncles (fruit stems) and fruit tissues. Grape seeds occur on archaeological sites in western Asia in small quantities even during the Pleistocene (Kislev *et al.* 2004), but they do not occur in concentrations until the third millennium (Early Bronze Age) (for many basic references, see Miller 1991; Neef 1997). Grape seeds are sturdy and preserve well through charring. A number of studies have attempted to distinguish wild and domesticated grape by shape, but the results have been ambiguous

Table 3. Vitis remains from Kurban Höyük. Key: III, EB/MB: Early Bronze/Middle Bronze transition; IV, mid-late Early Bronze Age; V, Early Bronze Age; VI: Late Chalcolithic; VII, Middle Chalcolithic; VIII Halaf.

Phase	VIII	VII	VI	V	IV	III
Millennium BC	Late 6th - early 5th	Mid 5th-early 4th	Late 4th	Early 3rd	Mid-late 3rd	Late 3rd - early 2nd
No. of flotation samples	38	4	46	37	70	21
No. of samples w/*Vitis* seeds	0	0	6	7	32	15
No. of samples w/*Vitis* peduncles	0	0	2	2	16	3
No. of samples w/*Vitis* fruit remains	0	0	0	0	12	2
No. of samples w/undeveloped *Vitis* seeds	0	0	0	4	8	0
% of samples with any charred *Vitis* (seed, fruit, peduncle)	0	0	15	24	46	76
Seed wt. (sum, gm)	4.66	1.20	24.31	49.37	36.76	8.30
Vitis seed wt. (gm)	0	0	0.03	1.33	2.36	1.98
Vitis/Seed sum (gm/gm)	0	0	+	0.03	0.06	0.24
No. of whole developed *Vitis* seeds	0	0	4	2	120	2
No. of whole undeveloped *Vitis* seeds	0	0	2	3	210	0
% undeveloped	n/a	n/a	33	60	64	0

because charring can distort the shape, and the seed variation among cultivars obscures any possible regularities. Helmut Kroll (1999) observed that it is only the domesticated type that produces underdeveloped seeds even when ripe, so the presence of these small, narrow seeds along with otherwise ordinary-looking plumper seeds is good evidence for the presence of domesticates. Kroll's criterion for domestication status, the presence of undeveloped seeds, is not well known or reported. Also, it cannot be assumed that absence of undeveloped seeds signifies absence of domesticated or cultivated plants.

The first examples of fruit remains date to the Early Bronze Age at Tell es-Sa'idiyeh (Cartwright 2003), Arad and Bab edh-Dhra (see Riehl n.d.) in the Levant, and Kurban Höyük in south-eastern Turkey (Miller 1984), all of which are in or very close to the range of wild grape. At Kurban Höyük charred fruit skin fragments (shiny bits, recognised initially because some had grape seeds embedded in them) or tiny shrivelled 'fruits' are preserved in many samples (Table 3). In contrast to the raisins reported by Cartwright, the Kurban fruit remains seem to be from pressings (the skins tend to be flattened; see Valamoti *et al.* 2007). At Kurban, grape seeds, including undeveloped ones, occur in very small numbers as early as the Late Chalcolithic (late fourth millennium). The seeds increase in frequency over the third millennium (Miller 1984: 120), as do the remains of charred fruit skins and stems.

Unlike olive pressings, which have great fuel value and little fodder value, grape pressings are unlikely to be charred, and the remains might even be fed to animals. This could account for the relative scarcity of archaeological grape remains.

Macrobotanical evidence for the expansion of grape cultivation down the Zagros mountain chain during the fourth millennium can be seen at Malyan, about 600km south-east of Lake Urmia and well outside the range of wild grape. As at Kurban Höyük, grape seeds are present in late fourth millennium deposits, and become more common in the third millennium. Mineralised pips, presumably from cess deposits, are the most direct evidence of fruit consumption in two late third-millennium latrines at the site (Miller 1982). Even further away, in Iranian Baluchistan, grape seeds were recovered from the site of Shahr-i Sokhta (Costantini 1977). At Anau, Turkmenistan, grape seeds are absent from the Chalcolithic mound, with deposits dating as late as 3100 BC (Miller 2003), but do occur in the Bronze Age mound, Namazga V levels (*c*. 2500 BC) (Harrison 1995).

Charred wood

Grape vine wood is occasionally encountered on archaeological sites, but the wood of wild and domesticated types cannot be distinguished on anatomical grounds. One would not expect *Vitis* wood to have been heavily utilised for fuel in antiquity. The wild vine would not be that common in the environment relative to wood that is easier to cut and harvest. On the other hand, pruning cultivated vines to shape them and improve fruit set would produce waste wood that might be burned in small amounts. For that reason, the presence of *Vitis* wood on a site suggests that the vine was cultivated. *Vitis* wood is at best a minor component of western Asian charcoal assemblages. Willcox (1991) reports no grape in his survey of wood remains from Neolithic sites, many of which lie in its natural habitat zone. At Godin, the evidence for wine appears in the Chalcolithic (fourth millennium), but small quantities of grape seeds and wood do not appear until the third millennium (Miller 2007). At Malyan, well outside the range of wild grape, late fourth/early third-millennium deposits have a few grape seeds and no grape wood; the late third/early second-millennium deposits have higher concentrations of charred seeds, a small amount of grape wood, and the two excavated latrines have concentrations of mineralised grape seeds (Miller 1982). At Mehrgarh, Pakistan, Thiebault (1989) attributes the earliest presence of *Vitis* wood to its first cultivation in the mid-third millennium; the earlier deposits do not have it. For three sites in southern Syria (Early Bronze Age to Islamic period), the earliest grape wood dates to the Roman period (Willcox 1999).

Summary of evidence

To summarise the kinds of evidence that can be used to address the human exploitation of the vine in ancient western Asia: pollen, fruit, and wood remains all suggest grape was growing in the area. Wine residues could come from imports, but for the earliest periods considered here, the residues are presumably from local production. Residues on ceramic vessels are good evidence for the use of the grape in drink. The occurrence of charred fruit, seeds and stems strongly suggest that grapes were consumed, and mineralised seeds from

cess deposits virtually prove that grapes were eaten by people. Wood remains are evidence for cultivation of the vine (i.e. planting it), as is grape pollen from cores if the lake is situated outside the range of the wild vine. Domestication (i.e. genetic modification of the wild type by cloning hermaphroditic mutations) can be inferred if some seeds are undeveloped.

Discussion

Sweetness is a highly valued taste. Aside from honey, there are few sweeteners that can be extracted simply from nature. In eastern North America, native peoples produced syrup from sap of the sugar maple. Iltis (2000) proposed that wild *Zea* (teosinte) may have been cultivated initially for its sweet pith, and Smalley and Blake (2003) have suggested that sugars in the stalks might have motivated the spread of *Zea* (corn and teosinte) cultivation beyond Mesoamerica. In western Asia, sugar cane was introduced from the east in the Hellenistic era and beet sugar was first produced in Europe in the eighteenth century. As Marvin Powell (1995) has observed, sweeteners were much rarer in antiquity than they are today. Ancient Mesopotamians consumed alcohol in the form of beer; the ancient Mesopotamian texts of the third and second millennia support the view that their vineyards produced grapes for fruit, not wine (Powell 1995). Although they favour wine production as an explanation for pressed grape skins at a fifth-millennium BC Neolithic site in Greece, Valamoti *et al.* (2007) also suggest the possibility of syrup or juice production.

In western Asia, people's initial interest in the vine appears to have been for alcohol. In any vine-growing region, local production and consumption of wine could reach all levels of society. In regions climatically suited to the vine, the most efficient way to obtain wine would be to produce it locally. The Godin wine would be representative of this early expansion of grape production through cultivation (by seed or vegetatively). In coastal or riverine regions, transport by boat would be reasonably economical. Transferring wine produced in clay vessels over even short distances was difficult. From the third millennium onwards, long-distance transport of wine is attested in texts and through archaeology, but it appears to have been a luxury or high-status item. An early example of wine travelling well outside the zone of known grape production comes from Abydos, Egypt, where a royal tomb yielded many wine jars brought over land and sea from the Levant (McGovern 2001).

The archaeological evidence for the exploitation of the vine in its natural habitat predates the Neolithic. Grape wine is attested in the sixth millennium, soon after the invention of pottery vessels in which it could be fermented. Yet the best evidence for first use of the *domesticated* grapevine, with its reproduction dependent on people through vegetative propagation rather than by seeds, dates to the fourth millennium, and the *widespread* adoption of the domesticated vine outside its natural habitat did not occur until the third millennium. Based on the timing and spatial distribution of the evidence for grape pollen, wine residues, wood charcoal, seeds and fruit remains, I propose that an appreciation for sweetness may account for the distribution of archaeological grape remains in western Asia from the Neolithic to the Early Bronze Age. Though the exact time and place of domestication cannot be specified, this survey suggests that people learned how sweet fruits

could be produced consistently by some hermaphroditic vines during the Chalcolithic period at the earliest, and had certainly developed that knowledge by the mid-third millennium BC.

Wine can render sour wild grapes potable. With the domestication of sweet varieties, different culinary (and nutritional) uses become possible. Sweet grapes could be rendered into syrup or dried into raisins. Compared to wine, the concentrated sweetness is easily stored, and the reduction in water content would make both syrup and raisins valued overland trade commodities. Such concentrated food energy would have been particularly appreciated by the early urban civilisations.

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