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Occidental diffusion of cucumber (*Cucumis sativus*) 500–1300 CE: two routes to Europe

Harry S. Paris[1,*], Marie-Christine Daunay[2] and Jules Janick[3]

[1]*Department of Vegetable Crops & Plant Genetics, Agricultural Research Organization, Newe Ya'ar Research Center, PO Box 1021, Ramat Yishay 30-095, Israel,* [2]*INRA, UR1052 Unité de Génétique et d'Amélioration des Fruits et Legumes, Montfavet, France and* [3]*Department of Horticulture and Landscape Architecture, Purdue University, 625 Agriculture Mall Drive, West Lafayette, IN 47907-2010, USA*

** For correspondence. E-mail hsparis@agri.gov.il*

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• *Background* The cucumber, *Cucumis sativus*, is one of the most widely consumed fruit vegetables the world over. The history of its dispersal to the Occident from its centre of origin, the Indian subcontinent, has been incorrectly understood for some time, due to the confusion of cucumbers with vegetable melons. Iconographic and literary evidence has shown that cucumber was absent in Roman times, up to 500 CE, but present in Europe by late medieval times, 1300. The objective of the present investigation was to determine more accurately when the cucumber arrived in Europe and by what route.

• *Findings and Conclusions* The evidence for the movement of *C. sativus* westward is entirely lexicographical until the 10th century. Syriac, Persian and Byzantine Greek sources suggest the presence of cucumbers, to the east and north-east of the Mediterranean Sea (modern Iran, Iraq and Turkey), by the 6th or 7th century. Arabic medical writings suggest the presence of cucumbers in Spain as early as the mid-9th century and in Tunisia by the early 10th century. Descriptive evidence in Arabic establishes the presence of cucumbers in Andalusia by the second half of the 10th century. Latin translations from Arabic sources indicate the presence of cucumbers in southern Italy by the second half of the 11th century. These writings, together with lexicographical discrepancies in names of cucurbits in late medieval Latin writings, suggest that cucumber was introduced to Europe by two independent diffusions. One diffusion appears to have been overland from Persia into eastern and northern Europe and preceded the Islamic conquests. The other, subsequent diffusion into western and southern Europe, was probably by a mostly maritime route from Persia or the Indian subcontinent into Andalusia.

Key words: Crop diffusion, crop history, cucumber, *Cucumis sativus*.

INTRODUCTION

Cucumbers, *Cucumis sativus* L. (Cucurbitaceae), are among the most widely grown vegetable crops the world over. Like many other cucurbits, they usually are monoecious, bearing staminate and pistillate flowers on the same plant. As cucumbers begin flowering quickly, within 6 or 7 weeks after sowing, and as the fruits are harvested when immature, about 7–10 d past anthesis, they are early-bearing and easy to grow. Moreover, *C. sativus* is better adapted to low temperatures than most cucurbit taxa and it is widely popular in cool temperate regions, where it is more successfully grown than other cucurbits.

Cucumis sativus is native to the Indian subcontinent (de Candolle, 1886; Bisht *et al.*, 2004; Sebastian *et al.*, 2010). Cucumbers were carried eastward and grown in China by 2000 years ago (Li, 1969; Keng, 1974). Until recently, cucumbers were thought to have diffused westward at a very early time, being familiar to the ancient Egyptians, Greeks, Romans and Jews. Closer examination of this view, however, has revealed it to be based on misinterpretations of images and mistranslations of text, and thus devoid of factual basis (Feliks, 1967; Janick *et al.*, 2007). Some melons, *Cucumis melo* L., resemble cucumbers, being elongate and used as vegetables when young, fresh or pickled. However, *C. sativus* and *C. melo* differ from one another in some vegetative traits, plant sexuality and various fruit characteristics.

Images of cylindrical fruits in Egyptian wall paintings have been interpreted as portraying cucumbers but could also portray vegetable melons (Manniche, 1989). Indeed, the more detailed images show the fruits as broader near the stylar end, or as striped or furrowed, traits which are characteristic of vegetable melons, not cucumbers (Janick *et al.*, 2007). Likewise, depictions of *Cucumis* fruits from around the Mediterranean Basin dating to Roman times portray them as somewhat broader toward their stylar ends, and striped or furrowed.

The *sikyos* of ancient Greek has been almost always mistranslated as cucumber. Yet, Theophrastus, in his *Enquiry into Plants* [ca. 300 BCE (before the common era)] (Hort, 1976), described the *sikyos* as an herbaceous plant having a long period of bloom and fruits composed of flesh and fibre, the seeds within them being arranged in rows. The flowers persist for a long time while the fruits are developing. Thus far, the description could fit very well both *C. sativus* and *C. melo*. Plant sexuality differs between the two species, however. Plants of *C. sativus* become increasingly pistillate as they develop (Shifriss, 1961). In sharp contrast, plants of

C. melo bear pistillate or hermaphroditic flowers only on the first one or two nodes of shoots, and all apical nodes are staminate (Rosa, 1924). Theophrastus wrote: *Some flowers are sterile, as in* sikyon*, those which grow at the ends of the shoot, and that is why men pluck them off, for they hinder the growth of the sikyoi*. The sterile flowers, of course, allude to the staminate flowers and, according to the description, these are borne on the shoot ends, which are nipped off. Removal of the shoot apices would encourage the development of new shoots, pistillate flowers and fruits. Hence, the description by Theophrastus fits *C. melo*, not *C. sativus*. Other Greek writings, including the *Regimen* by Hippocrates (ca. 400 BCE), the *On Medical Matters* by Dioscorides (ca. 65 CE), the *On the Properties of Foodstuffs* by Galen (ca. 180 CE) and the *Medical Compilations* by Oribasius (ca. 360 CE), focus on the supposed medical and pharmacological properties of plants and foodstuffs, but have little or no description of the plants themselves (Jones, 1967; Bertelli *et al.*, 1992; Grant, 1997, 2000; Osbaldeston and Wood, 2000; Powell and Wilkins, 2003; Beck, 2005).

The Latin word *cucumis* has almost always been mistranslated as cucumbers. Lucius Junius Moderatus Columella, in his *De Re Rustica* (ca. 64 CE) and Pliny the Elder, in his *Historia Naturalis* (ca. 77 CE), described the fruits of the *cucumis* as hairy, long and often coiled like a snake (Rackham, 1950; Jones, 1951; Forster and Heffner, 1955; Janick *et al.*, 2007). As cucumbers are glabrous but young melons are hairy, their descriptions rule out *C. sativus* but fit exactly snake melons, *C. melo* Flexuosus Group. Quintus Gargilius Martialis, in his *De Hortis* (ca. 260 CE), echoed Columella and Pliny by describing how the *cucumeres* could be made to grow straighter and even longer (Condorelli, 1978; Maire, 2007) and Palladius, in his *De Re Rustica* (ca. 400 CE), reiterated this passage (Cabaret-Dupati, 1844). A collection of Roman cookery recipes compiled in the name of Apicius, *De Re Coquinaria* (ca. 400 CE), has recipes which call for the *cucumeres* to be served dressed or stewed (Flower and Rosenbaum, 1974).

The *qishu'im* (sing. *qishut*) of Hebrew has almost always been mistranslated as cucumbers. The *qishu'im* were known in Israel since biblical times, as they were mentioned in *Numbers* 11:5 and a word for a field of them, *miqsha*, appears in *Isaiah* 1:8. They were the most frequently mentioned cucurbit in Hebrew writings of Roman times, particularly in the *Mishna* (ca. 200 CE), a codex of Jewish laws. The *qishut* was described as hairy, so much so that it appears in a pun, the *keshut* of the *qishut* (*Mishna*, '*Oqazin* 2:1), meaning the down of the *qishut*. Moreover, the hairs of the *qishu'im* had to be rubbed off prior to preparing them for eating, a process called *piqqus* (*Mishna*, *Ma'asrot* 1:5; Janick *et al.*, 2007; Paris and Janick, 2008; Paris, 2012).

Overall, the iconography and literature agree that snake melons, not cucumbers, were the cucurbit most enjoyed and esteemed in Mediterranean antiquity. To our knowledge, there is no hard evidence, prior to and including the Roman period and through 500 CE, that indicates the presence of *C. sativus* in Mediterranean lands. From ancient times to the present day, striped or furrowed, young snake melons were and are familiar and widely consumed across much of the tropics and subtropics of the Old World, fresh, pickled or cooked (Chakravarty, 1966; Pandey *et al.*, 2010; Paris, 2012). Cucumbers are much more familiar and widely appreciated in more northerly, cooler regions, and are used for the same purposes. In retrospect, the misinterpretations of iconographic evidence and mistranslations of textual evidence probably reflect on their assessors, who hailed from temperate geographical regions and were unfamiliar with vegetable melons.

There is considerable iconographic evidence for the presence of cucumber, *C. sativus*, in Italy, beginning around the year 1300 (Paris *et al.*, 2011) and therefore this taxon must have arrived in the Occident between 500 and 1300 CE (hereafter dates refer to CE unless otherwise stated). The objective of the present investigation was to establish a narrower time frame for the introduction of cucumber to the Occident and suggest its route of diffusion.

EVALUATION OF EVIDENCE FOR PRESENCE OF FOOD CROPS

An accurate understanding of the history and development of food plants requires critical evaluation and comparison of widely interdisciplinary evidence from botany, horticulture, food preparation, archaeology, medicine and lexicography (Dalby, 2003*b*). This understanding is dependent upon the degree of descriptive detail and accuracy of the original sources as well as the accuracy of the translations of these sources. For an accurate analysis, there is no substitute for critical examination of more than one line of evidence.

Botanical iconography

Accurate, realistic iconography can provide invaluable botanical evidence for the presence of a taxon within a particular time frame and region, particularly for fruit vegetables (Eisendrath, 1961; Paris, 2000; Janick and Paris, 2006; Paris *et al.*, 2006; Daunay *et al.*, 2008; Wang *et al.*, 2008). Most medieval illustrations, though, are poor, often stylized copies of earlier images (Givens, 2006; Sillasoo, 2006), and their lack of accuracy usually precludes taxonomic identification. A change toward imagery drawn directly from living plants began in southern Italy in late medieval times (Pächt, 1950; Collins, 2000). Perhaps the first such illustrated medieval herbal was the *Tractatus de Herbis* (ca. 1300) of southern Italian provenance (Collins and Raphael, 2004). This herbal contains the earliest known depiction of *Cucumis sativus* in the West (Fig. 1). This iconographic evidence allows establishment of the latest possible date for arrival of *C. sativus* in Europe as 1300 (Paris *et al.*, 2011).

Horticulture and culinary usage

Other than the stunning images found in the *Tacuinum Sanitatis* manuscripts of the late 14th century (Paris *et al.*, 2009), there are few medieval depictions or detailed descriptions of vegetables growing in the field or garden. Apparently, food plants were taken for granted by medieval writers, who considered them familiar to everyone and therefore in no need of description (Dalby, 2003*a*, *b*). The culinary

usage of food products, whether they were the fruits, leaves, stems or roots, was seldom described.

Archaeology

Vegetables that are fresh, moist and soft are unlikely to be preserved as archaeological remains. *Cucumis* seeds are dry and hard and have been found at several archaeological sites in eastern, northern and central Europe (Opravil, 1979; Wasylikowa, 1984; Moravec *et al.*, 2004). Seeds of cucumber, however, cannot be reliably distinguished from those of melon (Bates and Robinson, 1995).

Medicine and pharmacology

Human health has been a subject of great interest since time immemorial. Many of the writings alluding to plants from antiquity and the medieval period are focused on their medical and pharmacological properties. The foods themselves were not described but instead discussed in connection to their supposed effects on the body. This commentary on food plants was often dogmatic, incessantly based on 2nd-century Galenic theory, providing little information for understanding crop history.

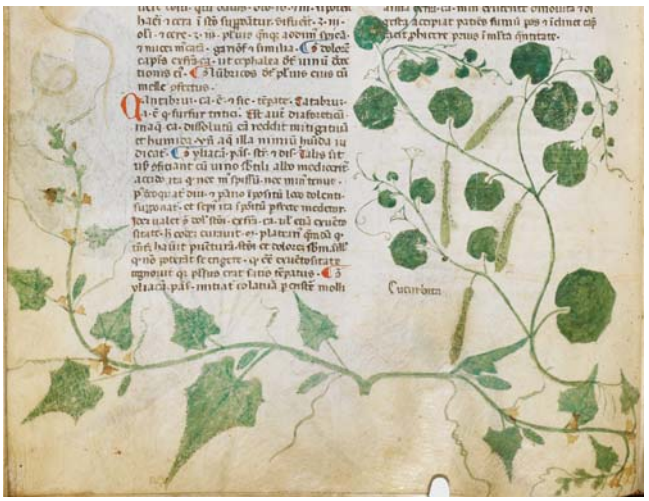

FIG. 1. *Tractatus de Herbis* (southern Italy, ca. 1300), British Library ms. Egerton 747, folio 26v. The plant at the lower left is cucumber, *Cucumis sativus*. The plant at the right, labelled *Cucurbita*, is bottle gourd, *Lagenaria siceraria*. The folio immediately following has the corresponding text, opening with *Cucurbita et Citruli* (Paris *et al.*, 2011).

Lexicography

Arrival of a new food item presents a problem to the local population of what to call it. Sometimes a new name is invented which is descriptive of the new food item in relation to a familiar item. This can provide an important clue concerning the appearance of the new item. Sometimes, the name is adopted from the foreign source and although the name is apt to become distorted to fit local pronunciation abilities, it provides an important clue as to the source of the introduction. Sometimes, a newly introduced food is given an exotic name designating a foreign land. This foreign designation, however, can be mistaken or deliberately misleading for commercial or even political reasons. An exotic name, if shown with corroborating evidence to be accurate and truthful, can be an important clue.

The Cucurbitaceae encompass a number of important polymorphic food crops and exhibit much parallel variation among species and genera (Vavilov, 1951). As a result, there are many cases in which cucurbits of different taxa have the same name and cucurbits of the same taxon have different names, which can even become juxtaposed across regions, languages and time (Table 1). In *The Learned Banqueters* (ca. 200) of the Greek compiler Athenaeus, the *kolokyntas* were said by Diocles to be round, very large and sweet, but were said by Menodorus to be eaten stewed or baked, and long ones were referred to as *sikyai* by the inhabitants of Hellespont (Olson, 2006). In modern English, a few noteworthy examples of misuse of cucurbit names are 'melon' for watermelon, *Citrullus lanatus* (Thunb.) Matsumura & Nakai, and 'cantaloupe' for muskmelon (*Cucumis melo*) and the misnomer 'Armenian Yard Long Cucumber' for a cultivar of snake melon (*Cucumis melo*). Cucurbit lexicography, therefore, would have limitations and must be bolstered with descriptive evidence, particularly of combinations of characteristics that are ubiquitous in one taxon but rare in other, closely related taxa.

TABLE 1. *Names of cucurbit taxa in some western languages*

		Cucumis melo			
	Citrullus lanatus	Long-fruited	Round-fruited	*Cucumis sativus*	*Lagenaria siceraria*
Modern English	Watermelon	Snake melon, snake cucumber	Melon	Cucumber, gherkin	Bottle gourd
French	Pastèque	Concombre serpent	Melon	Concombre, cornichon	Calebasse
Spanish	Sandia	Cohombro	Melon	Pepino, pepinillo	Calabaza
Italian	Cocomeri, Anguria	Tortarello, cogombaro	Melon	Cetriolo, cetriolino	Cocuzza, Zucca
Medieval Latin*	Pepo, Melon	Cucumer	Melopepo, Melon	Citruli	Cucurbita
Classical Latin	Pepo	Cucumis	Melopepo	–	Cucurbita
Medieval Greek	Pepon	Tetrangouron	Melopepon	Angouron	Kolokynthon
Ancient Greek	Pepon	Sikyon	Melopepon	–	Kolokynthon
Classical Hebrew	Avattiah	Qishut	Melafefon	–	Dela'at
Arabic (not all-inclusive)	Battikh	Qitha, faqqous, 'ajjour	Shammam	Khiyar, qathad	Qar'

* Albertus Magnus (Jessen, 1867) used *cucumer* for *Cucumis sativus*, *citrullus* for *Citrullus lanatus* and *pepo* for *Cucumis melo*.

Although cucumbers are most often confused with vegetable melons, they have some obvious differences that allow distinguishing between them, even with meagre descriptions. Cucumbers are glabrous and young melons are hispid. Cucumbers are almost always elongate and warted but the combination of fruit elongation and wartiness in melons is rare. Moreover, the warts of cucumbers, but not melons, are capped with short, hard spines; these spines, however, slough off upon handling and processing. Cucumbers tend to narrow toward the stylar end whereas snake melons tend to broaden and, moreover, can reach lengths far exceeding those of cucumbers (Paris *et al.*, 2011). Melon fruits often have longitudinal stripes or furrows and cucumbers do not. Brief allusions to these differences coupled with lexicography provide here the record for the introduction of cucumbers to the Occident.

EVIDENCE FOR THE ARRIVAL OF *C. SATIVUS* IN THE OCCIDENT

Byzantine Greek

Most early Byzantine writings maintain the classical Greek vocabulary for cucurbits, including *pepon* (watermelon, *Citrullus lanatus*), *melopepon* (round-fruited melon, *Cucumis melo*), *kolokynthis* [bottle gourd, *Lagenaria siceraria* (Mol.) Standl.; usage of *kolokynthis* in Byzantine Greek appears to apply to *L. siceraria* exclusively], and *sikyon* (snake melon, *Cucumis melo*) (Table 1). Aetius of Amida, in his *Tetrabiblion* or *Liber Medicinalis* (ca. 540), vol. 1, book 1, briefly discussed plants in alphabetical order, among them the *sikya* (Aetius Amidenus, 1804). Paul of Aegina, in his seven-book medical compendium *Epitomes Iatrikes* (ca. 685), described the properties of *sikyos* as similar to the *pepon* (Adams, 1834). Another medical compendium, the *Epitome de Curatione Morborum* (ca. 940), mentions the *sikyon*, *peponos* and *kolokynthis* (Martius, 1568). A Greek version of Dioscorides' *On Medical Matters* (ca. 940), preserved at the Pierpont Morgan Library (New York, ms. 652, fol. 167v), has no additional names for cultivated cucurbits but has a crude illustration suggestive of snake melon that is labelled *sikyos*.

The *Geoponika* (ca. 940), a 20-book agricultural and horticultural encyclopaedia, is based on earlier works, notably the 6th or early 7th-century compilation of Cassius Bassus also entitled *Geoponika* which, in turn, was based on a mid-4th century compilation of Vindonius Anatolius, both of which have been lost (for complete ancestry and relationship with other ancient and medieval manuscripts, see Rodgers, 2002). The *Geoponika* echoes the writings of Columella and Pliny for *sikyos*, *kolokynthi* and *melopepones*. For example, the *sikyos* 'can be made to grow long if water is poured into a vessel and set within five or six inches of the fruits, but if the vessel has no water the *sikyos* [translated as cucumbers] grow crooked, and bent backward' (Owen, 1806). The long, crooked shape is, of course, characteristic of snake melons, *C. melo*, not cucumbers, *C. sativus*.

On the other hand, there is an early Byzantine Greek writing which contains new words designating cucurbits. An anonymous author wrote a book on foods, *De Cibis* (ca. 670), the approximate date of which is established by its dedication to Constantine Pogonatum (Constantine IV), emperor of Byzantium from 668 to 685 (Ermerins, 1840; Dalby, 2003*a*). This work contains the earliest appearance, known to us, of two new words for cucurbits, *tetrangoura* and *angouria*. They are mentioned separately in the text. Significantly, the word *sikyos* is absent, but *kolokyntha*, *pepones* and *melopepon* are present. Ermerins (1840) translated both *angouria* and *tetrangoura* into Latin as *cucumeres. Angouri* is the modern Greek word for cucumber (Kykkotis, 1942).

A later compendium on foods, *De Alimentis* (ca. 940), closely follows the 4th-century work of Oribasius (Sonderkamp, 1984). However, it contains the same change in cucurbit vocabulary as *De Cibis* (Ideler, 1842; Dalby, 2003*a*), as *angouron* and *tetrangouron* are substituted for *sikyon*, even though the classical Greek *peponon*, *melopeponon* and *kolokynthis* remain unchanged. The *angouron* and *tetrangouron* are discussed together but separately from the other three cucurbits. Yet later Byzantine writings maintain the newer cucurbit vocabulary. The *Syntagma de Alimentorum Facultatibus* (ca. 1075), of the physician Simeon Seth, has separate sections on *angourion* and *tetrangouron*, as well as *kolokynthon*, *pepon* and *melopepon* (Langkavel, 1868; Brunet, 1939). A poem (ca. 1160) by Theodore Prodromus, also known as Ptochoprodromus, is an appeal to improve the food and mentions the *tetrangoura* of Pegai (Hesseling and Pernot, 1910).

The *Oneirocriticon of Achmet* (ca. 950) is a Byzantine book on dream interpretation. One of the dreams mentions both *angouria* and *tetrangoura* (Drexl, 1925), translated by Oberhelman (1991) as follows:

> *If someone dreams that he was eating sugar, he will have sweet joy that will last for a number of days proportionate to the amount of sugar; if he was eating olives, he will see proportionate bitterness in his life . . . if angouria, he will have wealth that will be at risk; if tetrangoura, the interpretation is greater and more certain.*

Syriac and Persian

The Syriac *Book of Medicine* (ca. 530), attributed to an individual named Sergius (Budge, 1976), has several pharmacological preparations that include *qataya*, the Syriac equivalent of the Hebrew *qishu'im*, snake melon (*C. melo* Flexuosus Group; Table 1). Also included is a preparation using *pragnagh*, translated as 'Indian cucumber'.

The *Bundahishn* (*Primal Creation*) (ca. 800) is the traditional name of an encyclopaedic collection of Zoroastrian cosmogony and cosmology, written in Book Pahlavi. Most of the chapters of the *Bundahishn* date to the 8th and 9th centuries. Among those fruits listed of which the outside and the inside can be eaten is the *wadrang*, *Cucumis sativus* (A'lam, 1993). The same word was also used for the citron, *Citrus medica* L. (Rutaceae), but this fruit is not edible. *Badrang* is a modern Persian word for cucumber (Steingass, 1963).

The *Safarnama* (1048) is a book of travels by Nasiri Khosraw of Marw, Khorasan (now Turkmenistan) (Schefer, 1970). Among the fruits and vegetables seen by this traveller in December 1048 in Cairo were the *khiyar badrang*, the

current name for cucumbers in Pashto and Persian dialects of Shiraz, Yazd, Kerman and Afghanistan (A'lam, 1993).

A translation of the Jewish written law, the *Tora* (*Pentateuch*), from Hebrew into Persian, was made around 1319 (Paper, 1972). In the *Tora*, *Numbers* 11:5, the *qishu'im*, melons, are the first of five vegetables named by the Children of Israel in Sinai that they missed from the Land of Egypt. The Persian translation has *khiyar*, cucumbers (Steingass, 1963; A'lam, 1993).

Arabic

The *qitha* of the *Qur'an* (2:61) (632 CE) is the Arabic equivalent of the Hebrew *qishu'im* (Table 1). *Qitha* are the elongate vegetable melons, *Cucumis melo*, and include the less elongate '*ajjour* (Chate or Adzhur Group, chate melons) but more often allude to the very elongate *faqqous* (Flexuosus Group, snake melons) (Issa Bey, 1930). The Arabic name *faqqous* for these melons is apparently a derivation from the Hebrew *piqqus* (Paris, 2012).

Most Arabic writings of the early medieval period are from the eastern half of the Islamic Empire, modern Iran and Iraq. The word *khiyar*, which in modern Arabic and Persian is cucumbers, *Cucumis sativus* (Table 1), appears in a chapter heading of the medical encyclopaedia *Paradise of Wisdom* (850) by 'Ali ibn-Sahl of Tabaristan (north-central Iran, near the Caspian Sea) (Meyerhof, 1931). A pharmacological work (ca. 865) by Sabur ibn Sahl has several recipes calling for *khiyar* (Kahl, 2003). Abu Hanifa Ahmad ad-Dinawari, in his *Book of Plants* (ca. 890), wrote that the *qitha* is also called *sha'arir* because it is hairy but the *qathad* differs and is synonymous with *khiyar* (Hamidullah, 1993). Abi Bakr Muhammad ibn Zakariya ar-Razi, a prolific writer on medical subjects, devoted chapter 16 of his *Book of Foods and Correctives* (ca. 920) to moist fruits (Ar-Razi, 1982), among them the *khiyar*, *qitha* and *faqqous*. In the *Nabatean Agriculture* (ca. 930) of Ibn Wahshiyya, a controversial compendium of agriculture-related subjects (Hämeen-Anttila, 2006), the *qitha* and *khiyar* are mentioned together as being preserved for out-of-season use. The *Cookbook* (ca. 950), written in Baghdad by one Ibn Sayyar al-Warraq (Nasrallah, 2007), mentions the *khiyar* and the *qitha* as being used in cold, summer dishes, as garnish, and pickled. In the *Best Divisions for Knowledge of the Regions* (986) by Shams ad-Din Abu Abdallah al-Muqaddasi (De Goeje, 1991; Collins and Al-Tai, 1994), the *khiyar* of Shiraz (southern Iran) are described as spiny, like porcupines. Ibn Sina (Avicenna) mentioned the *qathad* in his massive *Qanun* (*Canon of Medicine*) (Kirsten, 1609). In the *Rectifying Health by Six Causes* (ca. 1060), Ibn Butlan presented the *qitha* and *khiyar* together (Elkhadem, 1990); this work was translated into Latin and inspired the production of the finely illuminated *Tacuinum Sanitatis* manuscripts in the late 14th century, which contain an illustration of cucumber (Paris *et al.*, 2009).

Perhaps the first report of the *khiyar* in the western part of the Islamic Empire is in the *Compendium of Medicine* (ca. 850) of the Andalusian author 'Abd al-Malik Ibn Habib (Alvarez and Giron, 1992). Is-haq ibn Sulayman al-Isra'ili or Ysaac Judaeus of Qayrawan, Tunisia, in his *Book of Particulars in Diet* (ca. 920), devoted one paragraph to *khiyar*, immediately after the one on *qitha* (Sabbah, 1992).

Abu Dawud Sulayman ibn Hassan al-Andalusi ibn Juljul (944–994), a historian from Cordoba, wrote a *Maqala* (*Supplement*) (983) to the drugs not mentioned in the *On Medical Matters* of Dioscorides (Dietrich, 1993; Amar and Lev, 2011; Amar *et al.*, in press). This *Supplement* contains descriptions and Galenic properties of 60 items, among which is the *khiyar*. The *khiyar* is given a telling description: its leaves are similar to those of the *qitha* but its fruits are shorter and have warty execresences.

In the *Cordoban Calendar* (ca. 965), an agricultural almanac written in Judeo-Arabic (Pellat, 1961) by one 'Arib ibn Sa'd al-Katib, the *khiyar* is listed for sowing in April. The twelfth chapter of the Andalusian *Book of Agriculture* (ca. 1080) by Ibn Bassal (Millas and Aziman, 1955) has separate sections devoted to each of six cucurbits but the *khiyar* is not one of them. Instead, *khiyar* are mentioned as differing from *battikh* (round melons, watermelons) by requiring supplemental irrigation. In a later Andalusian *Book of Agriculture* (ca. 1180), by Ibn al-'Awwam (Clément-Mullet, 1866), the *khiyar* is given a separate section, albeit shorter than that of the *qitha* and other cucurbits. The text has this description: 'According to Abu al-Khayr and others, the *khiyar* is the *qitha al-Sham* (*qitha* of the Levant). It is cultivated on irrigated land, where it does well but is not as good on non-irrigated land. There are two kinds: the small, which is white and has firm flesh, and the other is orange, with soft flesh.' Apparently, Ibn al-'Awwam was describing the colour of the ripe fruits, even though cucumbers are eaten when green and unripe.

The *Book of Simples* (1106) by Yusuf ibn Is-haq ibn Biklarish al-Isra'ili of Andalusia is a lexicography presented in tabular form (Serri and Lev, 2010), listing the synonyms for *khiyar* as *khiyar badrang*, *qitha al-shammi* (Levantine *qitha*) and *jalmatha* (Amar, 2000). The *Glossary of Drug Names* (ca. 1200) by Moshe Ben-Maymon (Maimonides) lists the *khiyar* as synonymous with *qathadh* and *julmatha* (Rosner, 1995). The *Description of Egypt* compiled by 'Abd al-Latif of Baghdad also mentions that the *qathad* is the *khiyar* (De Sacy, 1810). The *Treatise of Simples* (ca. 1240) by 'Abdullah ibn al-Baytar of Malaga (Leclerc, 1883) lists *jalmatha* and *qathad* as synonymous with *khiyar*, which are refreshing when pickled in vinegar and best when small, with thin, numerous, dry seeds, the flesh being the best part for eating and the most digestible. Modern Arabic words for cucumber, *C. sativus*, are still *khiyar*, *qathad*, *jalmatha* and *qitha shammi* (Issa Bey, 1930).

Hebrew and Aramaic

The *Babylonian Talmud*, written mostly in Babylonian Jewish Aramaic, is a commentary and expansion of the Hebrew-language *Mishna*. Redacted in Sasanid Iraq mostly during the 5th and 6th centuries (Rubinstein, 2003), it includes discussions of the *qishu'im* and other cucurbits of the *Mishna* but also has Aramaic words pertaining to cucurbits (Sokoloff, 2002). The *qattuta* is easily equated with the Syriac *qataya*, Hebrew *qishu'im* and Arabic *qitha* (Table 1). The identity of the *bozina* is unclear but it was considered to be superior to

the *qara* (bottle gourd). The *qishu'im*, snake melons, were esteemed more than bottle gourds by Jews and other Mediterranean peoples (Janick *et al.*, 2007). On the other hand, the word *bozina*, thought to be derived from Persian, has some resemblance to *badrang*.

In the *Commentary on the Mishna* (1168), Maimonides equated the *melafefonot* of the *Mishna* with the Arabic *khiyar* (Haverman, 1970). The word *melafefonot* is the Hebrew plural version of the Latin *melopepo*, which Pliny described as detaching from the vine when it turned ripe, and therefore could only have been *Cucumis melo* (Janick *et al.*, 2007; Table 1). In the Hebrew-language *Book of Commandments* (ca. 1490), written in Turkey by Eliyyahu Besaychi, the *khiyar* were said to be common locally, shorter than the *qishu'im*, but broader, and rougher (Anqori, 1966).

Latin

Latin writings to 1000 show no new vocabulary or descriptive material concerning cucurbits. *De Observantia Ciborum* (ca. 510), probably compiled near Ravenna, northern Italy, and attributed to a Pseudo-Hippocrates, is derived from the *Regimen* of Hippocrates (ca. 400 BCE) and the work of Gargilius Martialis of the mid-3rd century CE (Riddle, 1992). Among the plant foods, the grains and legumes are listed first (Mazzini, 1984), probably as an indicator of their importance. The *cucumere*, snake melon (Table 1), is the first one listed that is not a grain or legume, and must have continued to be an esteemed food. The *cucumeres* are also mentioned in *De Observatione Ciborum* (516), a letter written by Anthimus (Grant, 2007). The *cucumeres* must have been seasonally available as Anthimus wrote that they 'cannot be procured here at present'. In his *Etymologiarum sive Originum* (ca. 636), Isidore of Seville wrote that the *cucumis*, *cucumeris* are so-called because they are sometimes bitter (*amarus*) (Lindsay, 1966; Barney *et al.*, 2006). In the *Capitulare de Villis* (ca. 800), a charter enacted by Charlemagne (Fleischmann, 1919), there is a list of 90 plants recommended for cultivation in the gardens of the empire, probably near the Mediterranean. Among these plants are *cucumeres*. The *Hortulus* of Walahfrid Strabo (ca. 845) has *cucurbita* and *pepones*, but no *cucumeres* or any new cucurbit vocabulary (Payne and Blunt, 1966).

After 1000, there appeared a new Latin word for a cucurbit, *citruli* (Table 1). This word appeared first in translations from Arabic texts. The *Liber Dietarum Particularium* (ca. 1070), a translation by Constantine the African of the Arabic medical work on diet by Ysaac Judaeus (Friedenwald, 1944), has the Latin translation *citrulis* (Hispani, 1515) for the Arabic *khiyar* (Sabbah, 1992). The *Liber Totius Medicine Necessaria Continens* (ca. 1127), a translation by Stephen of Pisa = Stephen of Antioch (De Capella, 1523) of a medical work in Arabic by 'Ali ibn al-'Abbas al-Majusi, has a phrase equating the Arabic *khiyar* with the Latin *citroli*: *Attame chaiar i citrolus*. The *Liber Nonus ad Almansorem* (ca. 1175), a translation by Gerard of Cremona of a book that Ar-Razi dedicated to the Governor of Rayy (northern Persia) (Conrad *et al.*, 2003), has a paragraph entitled *cucumeres et citroli* (Manfredi, 1500). The *Cordoban Calendar* was translated in the 13th century as *Liber anoe* (Pellat, 1961), which has *citroli* as a translation for the Arabic *khiyar*.

The *Circa Instans* (ca. 1150), a medical book written by Matthaeus Platearius, mentions two edible cucurbits, *cucurbita* and *citruli* (Platearius, 1200). This work inspired the production, beginning a century and a half later, of the first realistically illustrated herbals in over 500 years (Pächt, 1950; Collins, 2000). Subsequently, the *Liber Ruralium Commodorum* (1306), an agricultural compendium by Piero de' Crescenzi, book 6, has a paragraph opening with *De cucumeribus et citrullus* (Crescenzi, 1495); in the Italian version, chapter 21 opens with *Cocomeri & cedriuoli* (Crescenzi, 1504). The *citruli* are described as better when small, tender, green and crisp and are not good when they turn yellow (Sturtevant, 1891). The *Carrara Herbal* (ca. 1400) contains the finest medieval image of *Cucumis sativus* (Baumann, 1974; Paris *et al.*, 2011), which is captioned *citron piçolo*, *citrollo*, clearly indicating the diminuitive derivation of the word *citrollo* from *citron*. The *Naturalis Historiae, Historia Mundi* (Barbaro, 1529; first printing was in 1490) mentions the *citreolu* as the diminutive form of the *citrinus* and of orange–yellow colour at full maturity.

Strikingly different from the lexicography of the Italian translators and authors is that of Albertus Magnus of Germany in his *De Vegetabilibus* (ca. 1260) (Jessen, 1867). Albert described the *cucumer* as having yellow flowers and a fruit that is initially green then turns yellow. Moreover, he described it as having a lumpy skin and a columnar shape, a description certainly fitting *C. sativus*. He described the *citrulus* as having a smooth green rind, but otherwise like the *pepo*, which is commonly yellow with an uneven surface, composed of regular semicircles in relief, hence he was comparing watermelons, *Citrullus lanatus*, and round melons, *Cucumis melo*.

DISCUSSION

No iconographic or descriptive evidence of *Cucumis sativus* has been found in the Occident dating from antiquity through 500 CE (Janick *et al.*, 2007). Abundant iconographic evidence has been found beginning in 1300 and lexicographical evidence associated with this iconography, specifically the *Circa Instans* of Platearius, places this taxon in Mediterranean Europe by no later than the mid-12th century (Paris *et al.*, 2011). We have searched extensively for medieval writings that might provide clues for an improved understanding of cucumber history in the Occident, but found relatively few that contain any pertinent information. Our conclusions are necessarily biased by the meagre literary output from the Dark Ages and the relative amounts from different cultures during that time.

The description by Ibn Juljul of Andalusia of the *khiyar* as having foliage like the *qitha* (snake melon) but with shorter, warty fruits, leaves no doubt that *C. sativus* must have arrived in the Occident by no later than the second half of the 10th century (Dietrich, 1993; Amar and Lev, 2011; Amar *et al.*, in press). There is no prior iconographic or descriptive evidence, from the 6th through the 10th centuries, leaving only lexicographical evidence to establish a possible earlier time for the introduction of cucumber.

The earliest evidence for the likely arrival of *Cucumis sativus* in the Occident is an obvious change in the cucurbit vocabulary of Byzantine Greek. All of the Byzantine writings antedating the 7th century use the same names for cucurbits as those in classical Greek, *sikyos*, *pepones*, *melopepones* and *kolokynthi*. These, in most cases, were used for long-fruited *Cucumis melo*, *Citrullus lanatus*, round-fruited *Cucumis melo* and *Lagenaria siceraria*, respectively (Table 1). The herbalists Jean Ruel (1537) and Leonhardt Fuchs (1549) cited Aetius (fl. 6th century) as being the first to name *angouria*; however we could not verify this, neither in a Greek edition of his *Tetrabiblion* (Aetius Amidenus, 1804) nor in a Latin edition (Cornarius, 1542).

Of the Byzantine works, *De Cibis*, which was written perhaps as early as 668, is the earliest known to us to exhibit a marked change in cucurbit vocabulary. In *De Cibis*, *De Alimentis* (mid-10th century) and *Syntagma* (latter half of 11th century), the words *tetrangoura* and *angouria* appear instead of *sikyos* (Ermerins, 1840; Ideler, 1842; Langkavel, 1868; Brunet, 1939; Dalby, 2003*a*). As for the identity of the *tetrangoura*, the great Greek thesaurus, *Suda* (974), was definitive: the *sikya* is the *tetrangoura* (Du Cange, 1688; Gaisford and Bernhardy, 1853). However, there are no descriptions of the *tetrangoura* and *angouria* except in relationship to one another, as described in the *Oneirocriticon of Achmet* (ca. 920) (Drexl, 1925; Oberhelman, 1991). The *tetrangoura* is a larger version of the *angouria* (Sophocles, 1888) and although the former was desired by a mid-12th century writer (Hesseling and Pernot, 1910), it would seem that only the latter is in common use today among Greek-speaking people.

Snake melons, *Cucumis melo* Flexuosus Group, are much larger than cucumbers, *C. sativus*. Still, the taxonomic identity of the *angouria* of early medieval times is not entirely certain if based only on the difference in size. Sophocles (1888) noted the similarity between *angouria* and the Egyptian Arabic '*aggur* (classical Arabic '*ajjour*), for *C. melo* Chate (Adzhur) Group, which are used in the same fashion as snake melons but are shorter, like cucumbers. Even though modern Greek *angouri* is cucumbers (Kykkotis, 1942), *C. sativus*, it is possible that, initially, it was used for '*ajjour* melons. Another possibility is that the Egyptians adopted the term from Greek but used it for chate melons, which have been much more widely grown in Egypt than cucumbers (Ascherson and Schweinfurth, 1887). As a medieval Greek variant of *angoura* was *ankoura* (Du Cange, 1688; Langkavel, 1866), a more likely possibility would be derivation from the Persian–Arabic *khiyar*. Indeed, Latin translations of two Arabic works, the *Antidotarium* of Yohanna Mesue (Masawaiyh) (777–857), a physician from Gundishapur (south-western Iran) and, later, Baghdad and the other, based on a manuscript by Serapion the Younger (fl. 12th century), have *kura* as a transcription of *khiyar* (Serapion, 1497; Civitavecchia and Paglia, 1546).

A change in medieval cucurbit vocabulary also occurred in Latin, albeit later than in Greek. Sturtevant (1891) observed that the Latin epithet *citrullus* and its variants were absent from writings on Roman agriculture as well as from early medieval Latin writings, including those of Macer Floridus and Walahfrid Strabo. We can add that *cucumeres* are mentioned but *citruli* are absent from the writings of Pseudo-Hippocrates (ca. 510), Anthimus (516), Isidore of Seville (636) and Charlemagne (800) (Fleischmann, 1919; Mazzini, 1984; Barney *et al.*, 2006; Grant, 2007). *Citruli* does appear in several 11th- to 13th-century Latin translations of Arabic works, first by Constantine, then Stephen of Pisa, Gerard of Cremona and/or Gerard of Sabloneta (Manfredi, 1500; Hispani, 1515; De Capella, 1523; Pellat, 1961). These translators used *citruli* for the Arabic *khiyar*. The Arabic *qitha* was translated as *cucumeres* and when *qitha* and *khiyar* appeared together, as in the work of Ibn Butlan (Elkhadem, 1990), the two were translated into Latin as *cucumeres et citruli* (Paris *et al.*, 2009). Given the several translators and the mid-12th century use of *citruli* by Platearius (1200), it would appear likely that the word *citruli* was familiar to Latin-speaking populations of the 11th and 12th centuries. Late medieval herbals from Italy provide imagery that clearly establishes the *citruli* as *C. sativus* (Paris *et al.*, 2011). One of these herbals, British Library ms. Sloane 4016 (1440), even allows iconographic and lexicographical identification of *C. sativus* with the Latin *citruli* and *chache*, *circea*, distortions of the Arabic *khiyar* (Paris *et al.*, 2011). In his herbal, Peter Schöffer (1485) gave, for the Latin *citrullus*, the vernacular *kychern*, forerunner of the English word 'gherkin'.

Other late medieval productions, notably the Paduan *Carrara Herbal* (Baumann, 1974) and the *Historia Mundi* (Barbaro, 1529 but first printed in 1490), provide the derivation of *citruli* as the diminuitive of *citri* (citron, *Citrus medica*) (Paris *et al.*, 2011). The citron had long been familiar in the Mediterranean Basin (Nicolosi *et al.*, 2005) and thus the word *citruli* would have been all-too-obvious to invent for a new, albeit smaller but similar-appearing fruit. Curiously, this is a parallel to the medieval Persian *wadrang*, which meant both cucumber and citron (A'lam, 1993) and modern Persian *badrang* can be a cucumber or another citrus fruit, an orange (Steingass, 1963).

Sturtevant (1891) indicated that while the Latin *citruli* initially designated *Cucumis sativus*, it was in later times applied to the watermelon, *Citrullus lanatus*. The discrepancy in use of *citrul* and *cucumer* is evident as early as 1260 in the *De Vegetabilibus* of Albertus Magnus (Jessen, 1867). By comparing the work of Albertus Magnus (ca. 1260) with the herbal of Rufinus (ca. 1290), Thorndike (1945) concluded that there was a lack of exchange between the writers of northern Europe and those of Mediterranean Europe, especially Italy. Possibly, the discrepancy in terminology is attributable to separate introductions of cucumber to the Occident, one into the cooler climates of central, northern and eastern Europe, where vegetable melons, *cucumeres*, and citrons, *citri*, were not familiar, and one into warm southern and western Europe, where they were common.

In medieval times, Hebrew was not widely spoken, impeding adoption of new vocabulary. Maimonides, the scholar, doctor and lexicographer, mistakenly equated the Mishnaic *melafefonot*, a melon which detached from the vine when ripe, with the Arabic *khiyar* (Haverman, 1970); this error has persisted in modern Hebrew. Several centuries after him, Besaychi simply transcribed the Arabic word for cucumber, *khiyar*, in his Hebrew-language *Book of Commandments* (Anqori, 1966).

Of the Arabic works known to us, the earliest, the 7th-century *Qur'an*, has *qitha*, *C. melo*. Subsequent Arabic

works, dating from the mid-9th century, also have *khiyar* as well as other names for *C. sativus*, indicating introduction by that date to lands under Islamic conquest, including modern Iran and Spain. However, it would seem that cucumbers were appreciated earlier in the eastern lands, as suggested by the appearance of *khiyar* in a chapter heading of the *Paradise of Wisdom* (northern Iran, ca. 850) (Meyerhof, 1931) and its familiar culinary use ca. 950 (Nasrallah, 2007). Although the *khiyar* was mentioned in Andalusia at an early date by Ibn Habib (ca. 850) (Alvarez and Giron, 1992) and in the mid-10th century Cordoban calendar (Pellat, 1961), the *khiyar* must have been a minor crop initially. That cucumbers were a crop secondary to vegetable melons and relatively new in the Occident is evident from the writings of Ibn Juljul (Dietrich, 1993), who described the *khiyar* in comparison with the locally well-known *qitha*. In the *Book of Agriculture* (ca. 1080) by Ibn Bassal, the *khiyar* does not have its own section (Millas and Aziman, 1955), suggestive of lesser importance or novelty. A century later, however, in Ibn al-'Awwam's *Book of Agriculture* (ca. 1180) (Clément-Mullet, 1866), the *khiyar* has its own section and two distinct cultivars are mentioned. Thus, the cucumber attained greater importance and diversified in Andalusia during the 12th century. Nonetheless, it was still of secondary importance to the snake melon, given the shorter commentary, comparison with the *qitha*, and its local name *qitha al-Sham* (*qitha* of the Levant).

Qitha can be used generically in Arabic to include the long-fruited *faqqous* as well as the '*ajjour* and other short-fruited vegetable (chate) melons (Issa Bey, 1930). *Qitha al-himar* is the squirting cucumber, *Ecballium elaterium* (L.) A. Rich., and *qitha shammi* or *qitha al-Sham*, as recorded by the Andalusian writers Ibn Biklarish (Amar, 2000), Ibn al-'Awwam (Clément-Mullet, 1866) and Ibn al-Baytar (Leclerc, 1883), was synonymous with *khiyar*. On the other hand, *khiyar* in Persian can be generic, for *Cucumis*, as *khiyar chanbar* can refer to the snake melon (A'lam, 1993) (as well as the golden shower tree, *Cassia fistula* L., Fabaceae), *khiyarza'i sipand* is a wild cucumber, and *khiyar-ayin* means both *Cucumis*, cucumber and melon, together; there are also special compound words, for gherkin, *khiyar-riza*, and a small cucumber, *khiyarza* (Steingass, 1963). Generic use of *khiyar* in Persian is also evident in the early 14th-century translation of the Hebrew *qishu'im* from *Numbers* 11:5 as Persian *khiyar* (Paper, 1972). The generic use of the words *qitha* in Arabic and *khiyar* in Persian suggests that each, respectively, was the one initially familiar to native speakers of those languages.

The earliest-known Persian manuscript to mention plants, the 8th- or 9th-century *Bundahishn*, has a word for cucumber, *wadrang*, similar to the modern Persian *badrang* (A'lam, 1993). *Khiyar badrang*, for cucumber, is still current in some dialects of Iran and central Asia. The *pragnagh*, 'Indian cucumber', of the ca. 530 Syriac *Book of Medicine* (Budge, 1976) is suspiciously similar to *badrang* and the nearly contemporary Aramaic *bozina* (Sokoloff, 2002) is perhaps related. *Badrang* is also a Hindustani word for cucumber (Forbes, 1857).

The Persian–Arabic word *khiyar* is much like the Hindustani *khira*, also *k-hira* (Forbes, 1857; Platts, 1960; Chakravarty, 1982) for cucumber, *Cucumis sativus* (Platts, 1960). Hindustani is spoken across much of the Indian subcontinent, the native range of *C. sativus*, from northern India westward to modern Pakistan. Cucumber probably diffused westward to Persia at an early date, where its common name became altered, from *khira* to *khiyar*. From there, *C. sativus* could have been introduced to lands closer to and east and north of the Mediterranean Sea, inclusive of modern Iraq and then Turkey, through overland contacts across the Sasanid Persian and Byzantine Empires (O'Leary, 1964; Frye, 1972) prior to the Islamic conquests. By this overland route, cucumber could have been introduced to central, northern and eastern Europe. Seeds identified as *C. sativus* dating to early medieval times have been found at archaeological sites in Slavic, Polish and Czech lands (Opravil, 1979; Wasylikowa, 1984; Moravec *et al.*, 2004). However, cucumber seeds cannot be consistently distinguished from melon seeds (Bates and Robinson, 1995). Analysis of ancient DNA (Gyulai *et al.*, 2006) from these seeds might reveal their taxonomic identity. If indeed of *C. sativus*, these seeds would provide corroborative evidence for an early overland introduction of cucumber into Europe. The Islamic conquest of the Sasanid Empire in the mid-7th century could have facilitated early adoption of the word *khiyar* into Arabic. By a familiar, mostly maritime route from the north-western Indian subcontinent via the Red Sea to northern Africa and Spain (O'Leary, 1964), *C. sativus* seeds could easily have been taken across the Islamic Empire, reaching Andalusia before the writing of Ibn Habib (ca. 850) (Alvarez and Giron, 1992). Given the translations and transcriptions of Arabic into Latin in 14th- and 15th-century manuscripts, diffusion of cucumber to Latin Europe appears to have been later and from Islamic lands.

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