

Healing, Health, and Horticulture: Introduction to the Workshop

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The present-day emphasis of horticulture and health is an extension of ancient and medieval traditions. The relationship of healing and the horticultural arts predates written history and relates to ancient wisdom, custom, and folklore. The use of herbs as medicine may be part of animal instinct. Sick animals tend to forage plants rich in secondary metabolites such as tannins and alkaloids. Because these phytochemicals often have antiviral, antibacterial, antifungal, and antihelminthic properties, these wild animals may be self-medicating (Engel, 2002). The uses of herbal medicine may predate the evolutionary development of *Homo sapiens* based on the discovery of pollen of common herbs in Neanderthal graves at Shanidar Caves in Kurdistan, Iraq (Solecki, 1975; Solecki et al., 2004). The prehistoric discovery that certain plants cause harm and others have curative powers is the origin of the healing professions and its practitioners (priest, shaman, physician, and apothecary) as well as the professions devoted to plants (botany, pharmacy, and horticulture). The Iceman, a Bronze Age man from ≈5300 years ago murdered in the Italian Alps, carried a birch fungus attached to a leather thong probably for medicinal use.

HEALTH AND HORTICULTURE

The relationships between plants and health have been and continue to be of great concern for humankind considering both diet and medicinal uses.

Antiquity. Plant cures as well as nutrition became part of ancient medicine based on the philosophical concepts in ancient civilizations, including those of Sumer, Babylonia, Greece, China, and India (Galambos, 1996; Hsu et al., 1986; Janick, 2003). Each of these medical systems developed a strong nexus with nutrition and medicinal plants. Health was found to be promoted by the consumption of vegetables, fruits, and herbs; well-being was rationally based on nutrition.

The earliest medicobotanical treatises of the West date to antiquity (Janick, 2003). In the

Middle East, a Sumerian tablet from ≈2100 BCE contains a dozen prescriptions and prescribes plant sources from the ancient Nile Valley. Historical fragments of documents from ancient Egyptians such as the *Ebers Papyrus* and the *Edwin Smith Papyrus* contain descriptions of the use of herbs as medicine (Scholl, 2002). The *Ebers Papyrus* (1550 BCE), a 110-page scroll ≈20 m long, lists more than 700 formulae and remedies, although it is primarily a medical treatise on the heart. Herbal remedies for asthma and bowel problems are included. The *Edwin Smith Papyrus*, a fragment of a textbook on trauma surgery from ≈1800 BCE, includes the prevention and curing of infection with honey and bread mold.

Greek medicine. Asklepios, the Greek god of medicine and healing [his daughters were named Hygieia (health), Laso (medicine), Aceso (healing), Egle (healthy glow), and Panaceae (universal remedy)], became associated with healing temples that incorporated medicinal herbs (Arikha, 2007). Knowledge of plants that cured was practiced by root diggers (rhizotomoi), which led to the ancient Greek tradition of herbal medicine. Drug merchants (pharmacopuloi), derived from the Greek word for remedy or drug, gave rise to the word pharmacy. The great botanical treatise *Enquiry into Plants* of Theophrastus, written in the fifth century BCE, devotes Book IX to the medicinal value of herbs. The school of the Greek philosopher Hippocrates (460 to 377 BCE), now considered the Father of Medicine, mentions almost 400 medicinal herbs (Collins, 2000).

Hippocrates proposed that health was based on a balance of humors—three observable entities, phlegm, blood, and yellow bile, and a theoretic entity, black bile (Arikha, 2007). The concept of the humors was based on observational experience related to observation of symptoms (Bates, 1995; Collins, 2000). For example, phlegm was a general term for bodily fluids such as cerebrospinal fluid, saliva, nasal mucus, gastric juices, semen, and menstrual blood. The concept of humoralism was that their disequilibrium resulted in pain or disease. The Greeks associated significance to the number four. Thus, each of the four humors was associated with four temperaments or *complexion*: the phlegmatic, the sanguine, the choleric, and the melancholic. The humors also correlated to four qualities (hot, dry, cold, wet), each varying in four degrees of intensity as well as to the four seasons and the four ages

of man—infancy, youth, adulthood, and old age (Fig. 1).

The medical concepts of Hippocrates were further developed by Galen (129 to 200 CE) who proposed six causes (called “non-naturals” in the Latin translations) that influence health: food and drink, ambient air, movement and rest, sleep and wakefulness, elimination and retention, and psychological states. These concepts, adopted, elaborated on, and further developed by Byzantine and Arab physicians, dominated medicine until the 18th century. For a sick patient, the physician’s role was to diagnose the elements responsible for the loss of balance and design a treatment with elements having opposite characteristics to those of the defecting humor according to the compensation principle *contraria contrariis* (Ullmann, 1978).

The school of Hippocrates stressed that diet influenced health and recommended moderation. Food was incorporated into the humoral tradition and each item was associated with one of the four humors as well as with the four qualities (hot, cold, wet, and dry). Remnants of this classification persist as we consider hot peppers, cool cucumbers, and dry wines. Foods associated with one given humor were assumed to balance the defecting humor responsible for sickness.

Eastern medicine. The amount of ancient medical scholarship was greater in the East than in the West. In the East, there are two dominant traditions, Chinese medicine and Indian medicine, known as Ayurveda, “the science of life.” In prehistoric China, people of the Hsia and Shang dynasties used prayer in treating the sick (Hsu et al., 1996). Of 180,000 separate oracle bones (chia-ku-wen), 36 pieces recorded the names of diseases but mention only prayers for healing with no reference to herbal cures.

The Chinese developed a legendary history and dates are suppositions (Galambos, 1996). The founder of Chinese agriculture and medical botany is the mythical emperor Shen-Nung (traditional dates 2737 to 2697 BCE). Cited in the first millennium, he is known as the “Divine Cultivator” of the five grains, inventor of the plow and soil testing for suitable crops, the originator of ceremonies associated with sowing vegetables and grains, and the supposed author of the renowned pharmacopoeia, Pen T’sao Ching (The Classic Herbal), compiled in the first century.

In traditional Chinese teaching, the beginning of the healing arts was associated

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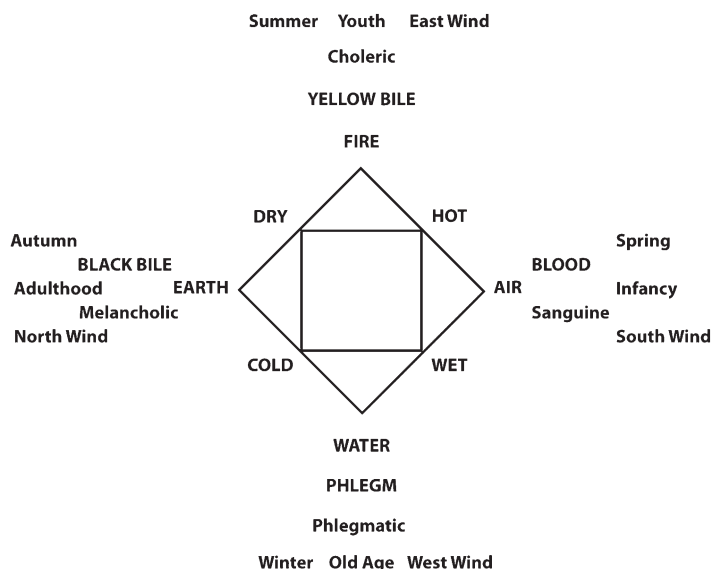


Fig. 1. Cosmology of ancient medicine based on Hippocrates and Galen (Source: Bovey, 2005).

with the legendary Huangdi, the Yellow Emperor, ≈ 2698 BCE. His name is associated with the technology of raising silkworms, origination of boats and carriages, and the invention of writing, music, and medicine. The *Huangdi neijing*, or the Yellow Emperor's Inner Classic, is the fundamental text for Chinese medicine. In 1973, 14 medicinal classics were excavated from Tomb III of the Mawangdui site in Changsha, Hunan Province (Galambos, 1996; Hsu et al., 1996). These documents, written on silk and bamboo slips, describe 52 diseases, 283 prescriptions, and 247 drugs including licorice, scute, atracylodes, achyranthes, and cnidium (Hsu et al., 1996). From the evidence in these documents, at the time of Qin (221 to 206 BCE) most of the typical features of the Chinese healing arts had not yet been formed but become systematized at the beginning of Western Han (206 BCE to 23 CE). Whenever it was written, the *Huangdi neijing* is undoubtedly the most important classic in the history of Chinese medicine and had an enormous influence on medical thought in later centuries. The book records the dialogues between the Yellow Emperor and some of his sage physicians on medical issues; the emperor's questions encompass every possible aspect of diagnostics, pathology, acupuncture, and moxibustion, including both theory and practice, whereas the sage teachers give detailed explanations on each topic. Humoralism was not a part of Chinese medicine, indicating that it developed independently of both Greek and Indian influences (Bates, 1995).

The Indian medical tradition known as Ayurveda is based on Sanskrit texts dated between 200 and 200 CE that link prevention and healing to spirituality and interpret health as the result of external influences such as lifestyle and diet and internal influences such as the bodily humors (Trawick, 1995). Disease is seen as disequilibrium and the use of herbs contributes to the restoration of the patient's balance. Ancient Greek medicine

may have influenced Ayurvedic medicine, or vice versa, because of the striking similarities of both systems based on related humoral traditions. However, Ayurveda considered five rather than four basic elements [*aakash* (ether or vacuum), *vayu* (air or wind), *aapa* (water), *pita* (fire), and *prithvi* (earth)] and three humors (*doshas*): *vata* (corresponding to breath, the Greek *pneuma*), *pitta* (corresponding to bile), and *kapha* (corresponding to phlegm). Clearly, the concepts of Greek and Indian medicine are strikingly similar. The familiarity of the Greeks during the Hippocratic era with black pepper, native to India, indicates an early interchange between these two ancient cultures (Arikha, 2007).

The herbal tradition. The Greek herbal *Peri Ylis Iatrikis* (*De Materia Medica* in Latin; *Of Medical Matters* in English) written by Pedanius Dioscorides of Anazarba, a Roman army physician, in the Year 65, listed health-giving properties of over 500 plants, many of which were to become horticultural crops (Beck, 2005). This medical treatise, one of the most famous ever written, was slavishly referred to, copied, and commented on for 1500 years. Compendia focused on plants, their properties and virtues, based on the Dioscoridean tradition, were referred to as herbals in medieval and Renaissance times, and were invaluable resources for the physician and apothecary (Collins, 2000; Janick, 2003). The great epoch of printed herbals started in the late 15th century, principally by German, Flemish, Italian, French, and English authors. The most notable herbals include: *Das Buch zu Distillieren*, 1500, by Hieronymus Brunschwig; *Herbarum Vivae Eicones*, 1530, 1532, and 1536, by Otto Brunfels; *Kreüter Buch*, 1546, by Hieronymus Bock; *De Historia Stirpium*, 1542, of Leonhart Fuchs; *New Herbal*, 1551, 1562, and 1568, by William Turner; *Commentarii*, 1544, by Pier Andrea Matthioli; *Crôydeboeck*, 1554, by Rembert Dodoens; and the *Herball*, 1597, by John Gerard. It culminated in the great compendia of Bauhin, 1651, and

Chabrey, 1666. In these Renaissance herbals, vegetables, fruits, and herbs were principally considered for their medicinal properties.

Botany and medicine were essentially in step until the 18th century, when both arts turned scientific and, from this juncture, botanical works would essentially ignore medicinal uses while medical works were devoid of plant lore, yet the medicinal use of plants continues as an alternate form of medicine and remains popular to the present day despite the questionable efficacy of many popular herbs and the reliance of many herbal recommendations on superstition and astrology. The fact that most drugs were originally plant-based has encouraged a new look at the medicinal properties of plants from traditional medicine.

Horticulture and nutrition. The modern system of horticulture and nutrition based on modern science is a relatively new science. Its beginnings date to the ancient discovery that fresh plant food could counteract the dreadful consequences of scurvy, a disease not known to be the result of a lack of L-ascorbic acid (Vitamin C) in the diet. As early as 1617, citrus was recommended for the British navy and by the end of the 18th century, limes and sauerkraut were shown to be antiscorbutic. In the 20th century, scientific research demonstrated the occurrence of various vitamins (a word derived from vital amines) or substances required in tiny amounts by various organisms, including humans (Desjardins, 2008; Finley, 2005; Goldman, 2003). Subsequently, fruits and vegetables were shown to be good sources of various vitamins. Recently, various substances in vegetables, including antioxidants, carotenoids, flavonoids, glucosinolates, polyphenols, polysaccharides, organic acids, and lipids, have been associated as protective agents against certain diseases. The concept of functional foods has been established and the benefits are under intense study but still not clearly understood or established.

THE WORKSHOP

This workshop, organized by the History of Horticultural Science Working Group of the American Society for Horticultural Science, included three presentations with the goal of drawing attention to the historical connection between horticulture and health. Articles from two of these presentations are presented here. The first article, by Kim Hummer (*Rubus* Pharmacology: Antiquity to the Present), discusses the changing relationship of brambles to health from antiquity to the present based on ancient manuscripts (Hummer and Janick, 2007). The second article, coauthored by Jules Janick, Marie-Christine Daunay, and Harry S. Paris (*Tacuinum Sanitatis*; Medieval Horticulture and Health), discusses an illustrated manuscript from the late Middle Ages, now located in the Austrian National Library (Daunay et al., 2009; Janick et al., 2009; Paris et al., 2009), that provides information on the interrelationship of horticulture, medicine, and health and makes it possible to compare and

contrast medieval and modern concerns about this relationship. The third presentation, by Douglas Holland (The Library Collection of the Missouri Botanical Garden; A Resource for Historical Literature on Health and Horticulture), provided information on the early resources of great botanical literature on the subject of health, horticulture, and medicine.

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Rubus Pharmacology: Antiquity to the Present

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Abstract. The genus *Rubus* L., indigenous to six continents, includes blackberries, raspberries, and their hybrids and is commonly referred to as brambles or briars. *Rubus* species were a food and medicinal source for native peoples soon after the Ice Age. This short article presents only a sample of the wealth of historical reports of medicinal uses for *Rubus*. Brambles were documented in the writings of the ancient Greeks: Aeschylus, Hippocrates, Krataeus, Dioscorides, and Galen; Romans: Cato, Ovid, and Pliny the Elder; Asian medicinal traditions; traditional Chinese medicine; and the Ayurvedic tradition of India. Folk traditions of native peoples throughout the world have also applied *Rubus* for multiple medicinal uses. Although in modern times *Rubus* is grown for its delicious and vitamin-rich fruit for fresh and processed product consumption, the ancients used the whole plant and its parts. Stems, branches, roots, leaves, and flowers were used in decoctions, infusions, plasters, oil or wine extractions, and condensates. Decoctions of branches were applied to stop diarrhea, dye hair, prevent vaginal discharge, and as an antivenom for snakebites. Leaves were chewed to strengthen gums and plastered to constrain shingles, head scurf, prolapsed eyes, and hemorrhoids. Flowers triturated with oil reduced eye inflammations and cooled skin rashes; infusions with water or wine aided stomach ailments. Greeks and Romans recorded female applications, whereas the Chinese described uses in male disorders. The fruits of *R. chingii* are combined in a yang tonic called *fu pen zi*, “overturned fruit bowl,” and prescribed for infertility, impotence, low backache, poor eyesight, and bedwetting or frequent urination. The *Leechbook of Bald* described the use of brambles against dysentery, combining ancient medicinal knowledge with pagan superstition and herb lore. Medicinal properties of *Rubus* continue in Renaissance and modern herbals, sanctioning leaf infusions as a gargle for sore mouth, throat cankers, and as a wash for wounds; the bark, containing tannin, was a tonic for diarrhea; and root extract, a cathartic and emetic. Recent research has measured high ellagic acid, anthocyanin, total phenolics, and total antioxidant content in *Rubus* fruits. Fruit extracts have been used as colorants and are now being tested as anticarcinogenic, antiviral, antiallergenic, and cosmetic moisturizing compounds. From ancient traditions through conventional folk medicines to the scientific confirmation of health-promoting compounds, *Rubus* is associated with health-inducing properties.

Raspberry cultivation for fruit only became widespread in European countries by the 16th century (Jennings, 1988). Modern uses of *Rubus*, the blackberries and raspberries, include consumption as delicious fresh fruits and processed in jams, jellies, pastries, dairy products, and juices (Daubeny, 1996). Many breeders throughout the United States and Canada have developed plants with large succulent fruits having delicate sugar–acid ratios and complex flavors. These small or soft fruits have high antioxidant capacity, high anthocyanins, high vitamins, simple sugars, and high mineral content (Määttä-Riihinen et al., 2004; Moyer et al., 2002). Ancient references of *Rubus* in Western and Eastern traditions do not refer to berries as food; rather the stems, leaves, and other plant parts were prized for their medicinal properties (Beck, 2005). The object of this review is to summarize the uses of *Rubus* for health from antiquity to the present from a sampling of the wealth of historical data on this subject. Although the recent use of the fruits as fresh and processed foods represents a global mul-

timillion dollar industry annually, interest in the medicinal qualities continues to expand.

The genus *Rubus*

Distribution. The genus *Rubus*, one of the most diverse in the plant kingdom, contains ≈740 species that have been divided into 12 or 15 subgenera, depending on the botanist (Daubeny, 1996; Jennings, 1988). These diverse species are native on six continents and have been found from the tops of mountains to coastal locations at sea level (Thompson, 1995). Although the raspberries and blackberries are common in cool temperate regions of the northern hemisphere, the majority of *Rubus* species are native to South Pacific Islands.

Taxonomy. Blackberries are botanically classified in the genus *Rubus* subgenus *Rubus* (formerly *Eubatus*). European blackberries (*Rubus fruticosus* L. agg.) have a center of origin in the Caucasus, are well distributed throughout Europe, and have been introduced into Asia, Oceania, and North and South America. Subgenus *Idaeobatus* includes the European raspberries (*Rubus idaeus* L.) and the cloudberry (*R. chamaemorus* L.) native to southern European mountains (Tutin et al., 1980) and were named by Linnaeus for Mount Ida, Turkey; North American raspberries (*R. strigosus* Michx., *R. spectabilis* Pursh, *R. parviflorus* Nutt.) and black raspberries (eastern, *R. occidentalis* L. and western, *R. leucodermis* Douglas ex Torr. & A. Gray); and Asian species such as *R. chingii* Hu, *R. coreanus* Miq., *R. crataegifolius* Bunge, and *R. parvifolius* L. This species is mainly distributed in Zhejiang, Fujian, Hubei, and Guizhou provinces of China. *Rubus hawaiiensis* A. Gray

from Hawaii as well as species in East and South Africa are among many used by native peoples.

Rubus medicinal uses

Plants synthesize a variety of medically active phytochemicals, but most are derivatives of alkaloids, phenolics, terpenoids, and glycosides. The phenolics are the biochemical motif most active in *Rubus* plants for ethnomedicinal applications. *Rubus* phenolics include the flavonoids, potent in vitro antioxidants, including compounds such as flavones, isoflavones, flavonones, catechins, and the red, blue, and purple pigments known as anthocyanins (Määttä-Riihinen et al., 2004; Moyer et al., 2002). Tannins, present in *Rubus* stems and leaves, have astringent properties. Many cultures, without knowledge of the particular chemical agents, have observed medicinal properties in *Rubus* and applied them in different ways (Gunther, 1934; Rohde, 1922).

Prehistory. The use of herbs in the western hemisphere stretches back into antiquity, well into the Paleolithic or Old Stone Age era, ≈40,000 BCE. *Rubus* species were a food source and medicinal plant for native peoples soon after the Ice Age (Connolly, 1999). In the New World, archeologists found evidence of *Rubus* as a food source in Newberry Crater near Bend, OR. Radiocarbon dating puts the artifacts and food remnants at ≈8000 BCE (Connolly, 1999).

Antiquity. Brambles were documented in the writings of Aeschylus (Hendrickson, 1981) and Hippocrates, between 500 to ≈370 BCE. Hippocrates recommended blackberry (*batos*) stems and leaves soaked in white wine as an astringent poultice on wounds and in difficulties

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of childbirth (Litre, 1979). Raspberries were harvested by the ancient Greeks as early as 370 BCE (Handley and Pritts, 1989). Pompey introduced raspberries from southeast of Troy in what is now Turkey to Rome ≈65 BCE (Trager, 1995). Ancient Egyptians knew of the blackberry but did not document uses for it. Egyptian words for blackberry were “*aimoios*” or “*ametros*” approximately the second century CE (Manniche, 1989).

The earliest published blackberry descriptions and image (Fig. 1) can be found on fol. 82v–83r of the *Juliana Anicia Codex* or *Vindobonensis Codex* (Hummer and Janick, 2007). This image is very similar to fol. 32 of another Dioscoridean manuscript called *Codex Neapolitanus*, which, despite its crudeness, is more botanically precise, suggesting the possibility of a lost common archetypic illustration (Hummer and Janick, 2007). The *Juliana Anicia Codex* is a magnificently illustrated manuscript with written information based on the *Peri Ylis Iatrikis* (*De Materia Medica* in Latin; *Of Medical Matters* of Dioscorides). This book, one of the earliest that now survives, was originally presented to the imperial Princess Juliana Anicia in Constantinople ≈512 CE (Collins, 2000). In the 15th century it was purchased by the Emperor Maximilian for the Imperial Library and it was moved to Vienna, where it now resides. The translation of the Byzantine Greek written around the margins of the blackberry image on fol. 83r inspired the search for medicinal uses of *Rubus*, presented in this manuscript.

The Dioscorides text was first translated into English by John Goodyer in 1655 (Gunter, 1934), but a recent translation by Beck (2005), based on a more authoritative German translation by Wellman (1906–1914), is provided (Table 1). The first uses of *Rubus* (*batos*) state that a decoction of the branches contracts, binds, and dyes hair. Interestingly, although the ancient Greeks and Romans had numerous physical maladies to contend with, a top desire in health was to keep up an appearance of looking younger; dying hair would be a priority. Other uses included preventing stomachaches, stopping excess fluxes of bodily fluids particularly in the female plus far-ranging assistance for a multitude of symptoms, including droopy eyes, mouth sores, hemorrhoids, and snakebites. These uses described in the *Juliana Anicia Codex* were reiterated in many recensions of Dioscorides works for the next several millennia (Collins, 2000; Hummer and Janick, 2007).

Medieval. The image of the Leyden *Apuleius* is dissimilar and much inferior (Fig. 2) to that of the *Juliana Anicia Codex* (Fig. 1). In Medieval times, the basic information for the medicinal uses was similar to that of the ancient Greek and Latin texts, but the writings were imbued with pagan superstition and Christian ritual during the medieval period.

The *Leechbook of Bald* is an Anglo-Saxon herbal from Winchester prepared in 920 CE. “*Lece*” in Old English means healer; a leechbook was a physician’s desk reference (Rohde, 1922). Leechbooks were consulted to determine what kind of blood letting was



Fig. 1. Blackberry, *Batos* image *Juliana Anicia Codex* Vienna, Österreichische Nationalbibliothek, Cod. Med.gr.1. fol. 83r. 512 CE. Vienna. The text on the side gives medicinal uses for blackberry and raspberry plant tissues in Byzantine Greek.

Table 1. English translation of reference to *Rubus* spp. in *De Materia Medica* of Dioscorides (Beck, 2005).

Book, section	Translation
IV, 37	[Βάτος (<i>batos</i>), <i>Rubus ulmifolius</i> Schott, Bramble]
	The bramble is a familiar plant. The decoction of its branches contracts, desiccates, dyes hair, and stops diarrhea when drunk, keeps in control, leucorrhea, and is suitable for the bite of the <i>prester</i> [A kind of serpent whose bite is poisonous].
	When chewed, the leaves strengthen the gums and heal the thrush; plastered on, they keep in control shingles, treat head scurf, prolapses of the eyes, callous lumps, and hemorrhoids, and they are suitable to apply ground up on those with stomach and heart ailments. But its juice, extracted from the stems and leaves and condensed in the sun, will accomplish everything better. The juice of its fully ripened fruit is suitable for mouth ailments, its half-ripe fruit stops diarrhea when eaten, and its flower checks diarrhea when drunk with wine.
IV, 38	[ΒάτοςἸδαία (<i>batos idaia</i>), <i>Rubus ideaus</i> L., Idaian bramble, Raspberry]
	The raspberry (Idaian bramble): it was named so because a great deal of it grows on mount Ida [in Turkey]. It is much softer than the previous one, having small thorns. But it is also found without thorns. It can treat the same conditions as the one before it, but its flower helps far more for eye inflammations when triturated with oil and smeared over them; it also cools erysipelas and it is given in a drink with water to those with stomach problems.

necessary, if any, whether the patient should rest more or exercise more, if a change of diet were in order, or what medication or herbal remedies were needed. This book was scribed by a monk named Cild under the direction of another monk named Cyril Bald, who most probably was a personal friend of King Alfred (Rohde, 1922). The *Læchbook of Bald* contained 109 leaves and was written in a large bold hand with one or two of the initial letters faintly illuminated. A Saxon image of blackberry at the time of the *Læchbook of Bald*, ≈920 CE, is diagrammatic (Fig. 3).

The *Læchbook of Bald* was written in the vernacular by men who were not Latin scholars. The medical knowledge originally

based on pagan superstition combined with herb lore was absorbed into Christian tradition: “Against dysentery, a bramble of which both ends are in the earth [tip layer!] take the newer root, delve it up, cut up nine chips with the left hand and sing three times the Miserere mei Deus and nine times the Mater Noster, then take mugwort and everlasting, boil these three worts and the chips in milk till they get red, then let the man sip at night fasting a pound dish full...let him rest himself soft and wrap himself up warm; if more need be let him do so again, if thou still need do it a third time thou wilt not need oftener,” *Leechbook II* 65 (Rohde, 1922).

The image of the blackberry in *Bodley 130 Apuleius Platonicus* suggests blackberries



Fig. 2. Image of blackberry from the Leyden Apuleius 600 CE (Singer, 1958; Fig. 80).

without botanical precision (Fig. 4). The medicinal use is similar to that written in Dioscorides recensions.

Although raspberry (framboise in French) and blackberry (ronce in French) are illustrated in Manuscript Latin 9474 (Les Grandes Heures d'Anne de Bretagne, 1503 to 1508), respectively, on folio 20 (<http://visualiseur.bnf.fr/Visualiseur?Destination=Mandragore&O=7833778&E=1&I=68538&M=imageseule>) and folio 206 (<http://visualiseur.bnf.fr/Visualiseur?Destination=Mandragore&O=7834164&E=1&I=68849&M=imageseule>), no medicinal use is mentioned in this prayer book.

Renaissance. Although records indicate that Henry III's clerk bought raspberries for the king's drinks (Jennings, 1988), nothing much was written of them until almost the 16th century when Matthioli wrote about raspberries being collected from the woods and brought into the gardens in Bohemia. According to Jennings (1988), yellow forms were recorded by Canerarius in 1588 and by Clusius in 1601. Heresbach (1570) indicated that raspberries were not very popular.

Turner (1548) mentioned the "soure" taste of red raspberries (English raspes or hyndberries) and that they "grow most plentifully in the wooddes in east Friesland" and "grow in certayne gardines in Englande."

Gerard's Herbal, a famous English herbal published in 1597, contains realistic images of red raspberries using wood cuts and sum-

marizes medicinal and horticultural information (Woodward, 1927). Gerard starts out with a description of the plant and then goes into the uses and qualities. His uses include healing the eyes that hang out; leaves of bramble boiled in water with honey, alum, and a little white wine make an excellent lotion and washing water; and the same decoction fastens the teeth. John Parkinson (1629) wrote of red, white, and thornless "raspberries" that grow in the English climate.

By Culpeper's (1652) time brambles were so well known that this plant "needeth no description." By his determination, astrological connections were an important facet of herbal use. The virtues of these tasty fruits indicate that "Venus in the house of Aries," although the pricklers (an un-Venus-like trait) occur because, for this plant, "Venus is in the house of Mars." Besides adding the astrological references, Culpeper regurgitated the teachings of the ancient Greek and Roman traditions. Brambles continued to be used for dyeing hair, binding the belly, and soothing the mouth. Other uses included a decoction of the leaves as a gargle for throat cankers and as a wash for wounds. The bark, containing tannin, was a tonic for diarrhea. Extracts of the roots were a cathartic and emetic.

Traditional Indian medicine (Ayurveda). The Indian medical tradition of the Ayurveda is based on Sanskrit texts from ≈200 CE, which link health to spirituality. Health is the

result of external influences such as lifestyle and diet combined with internal influences (Trawick, 1995). Disease is disequilibrium, and the use of herbs contributes to the restoration of balance. Ancient Greek medicine has striking similarities to Ayurvedic medicine because both systems are based on "humors."

The Indian medicinal uses of *Rubus* include application of the astringent diuretic action of the leaves and bark. Raspberry leaves are combined with many other herbs to produce kasaya. The action of a decoction of this herb mixture produces clarity, causes stiffening of the mouth, contracts the tongue, provides a feeling of heaviness, and diminishes saliva. The infusion of *Rubus* leaves is alleged to aid in stomach problems, childbirth, and menopause.

The native *Rubus* species of Europe such as the blackberry, *Rubus fruticosus*, and the red raspberry, *Rubus idaeus*, are not endemic in India but were brought there through human exchange from east to west along the Silk Roads. Many web-related nutraceutical applications of Ayurvedic medicine promote the use of accessible European *Rubus* species such as the red raspberries rather than Asian ones, e.g., *Rubus coreanus*, *R. crataegifolius*, or *R. parvifolius*.

Traditional Chinese medicine. The Shen Nung Ben Tsao (25 to 220 CE), the Herbal Classic, is considered to be the oldest book on oriental herbal medicine (Hsu et al., 1986). It classifies 365 species of roots, grasses, woods, furs, animals, and stones into three categories of herbal medicine. Among the herbal remedies described is Fu pen zi, (覆盆子), Fructus Rubi, which is commonly composed of fruits of *R. chingii*, one of the Chinese raspberry species. Fu pen zi means "upside-down bowl." This may refer to the shape of an overturned raspberry fruit, or an overturned chamber pot, because of the plant's enuretic effects. In traditional Chinese medicine, Chinese raspberries are considered to have sweet and warm properties and are associated with the liver and kidney meridians. They function to tonify and stabilize the kidneys to preserve vital energy and treat cases of liver and kidney deficiency. The uses of Chinese raspberry are alleged to include: preventing frequent urination, enuresis, premature ejaculation, impotence; reducing sore lower back; improving eyesight or blurry vision; and preventing uterine, cervical, and colon cancer.

Folk medicine. Ethnomedicinal uses of *Rubus* can be found in many cultures. Indigenous folk medicine from native peoples of Oceania, Africa, and America include *Rubus*, which is naturally distributed on six of the seven continents. These include strengthening pregnant women, relieving morning sickness, aiding in childbirth, stimulating the uterus at the beginning of labor, and relieving menstrual cramps.

In Australia, aboriginal people used a decoction of raspberry leaves as a traditional treatment for diarrhea (Symons and Symons, 1994). Leaves were made into tea, which was considered helpful for painful menstruation, childbirth, flu, and morning sickness. The fruit

is considered a mild laxative if eaten in large quantities.

In Hawaii, the Hawaiian term for their native raspberry species (*R. hawaiiensis*) is “akala.” The ash of dried akala stem and naupaka (*Scaevola* spp.) was used for kepia (dandruff) (Chock, 1968). Ashes of akala stem and ripe he’i (papaya, *Carica papaya*) are ingested as a treatment for umauma naha (burning effect in the chest) and hoaoa lua’i (stomach ailment with vomiting).

In the Pacific Northwest, native peoples used *R. leucodermis*, *R. parviflorus*, and *R. spectabilis* (Gunther, 1973) for medicinal uses. The Quileutes from western Washington State chewed the leaves or bark and spit them to clean infected wounds, especially burns. They also boiled the bark in seawater, and the brew was drunk to lessen labor pains. The Makah pounded the bark and laid it on aching teeth or festering wounds.

Recent research. Current investigations have identified *Rubus* fruit as a source of bioactive phenolic antioxidants. These compounds have a strong capacity to scavenge oxygen radicals. They inhibit oxidation and the growth of pathogenic bacteria and inhibit growth of certain cancer cell lines in vitro.

Moyer et al. (2002) analyzed dark-pigmented fruit from *Rubus*, *Vaccinium*, and *Ribes*. The black raspberry (*R. occidentalis*) cultivars had the highest total anthocyanins observed of genotypes of *Ribes*, *Rubus*, and *Vaccinium* (Table 2). Black raspberry extract was used in the early 20th century as a dye stamp for meat inspection in the United States and as a food colorant (Moyer et al., 2002). Määttä-Riihinen et al. (2004) analyzed fruits of three *Rubus* species and observed Quercetin 3-glucuronide typical flavonol glycoside. The cyanidin glycosylation forms could separate species of *Rubus* through chemotaxonomic analysis. Ellagic acid was present as free and glycosylated forms and ellagitannins; other reportedly anticarcinogenic compounds were also present.

Evidence suggests that *Rubus* and other berry fruits may have beneficial effects against several types of human cancers (Seeram, 2008). Studies show that the anticancer effects of berry bioactives are partially mediated through their abilities to counteract, reduce, and also repair damage resulting from oxidative stress and inflammation. In addition, berry bioactive chemicals also regulate carcinogen and xenobiotic metabolizing enzymes, various transcription and growth factors, inflammatory cytokines, and subcellular signaling pathways of cancer cell proliferation, apoptosis, and tumor angiogenesis. Berry phytochemicals may also potentially sensitize tumor cells to chemotherapeutic agents by inhibiting pathways that lead to treatment resistance, and berry fruit consumption may provide protection from therapy-associated toxicities (Seeram, 2008).

CONCLUSION

Just as diverse *Rubus* species are found throughout the world, diverse uses for *Rubus*



Fig. 3. Saxon image of blackberry at the time of the *Læchbook* of Bald, about 920 CE. Sloane 1975, folio 37a, in Rhone, 1922.

Table 2. Total anthocyanin (ACY), berry count, and total phenolics (TPH) of blueberries, black currants, blackberries and black raspberries (Moyer et al., 2002).

Genotype	ACY	Berries	TPH
	mg/100 g	per 100 g	mg/100 g
<i>Vaccinium corymbosum</i> L., blueberries			
Bluecrop	84 ± 1.0	91	304 ± 15
Brigitta Blue	103 ± 1.7	56	246 ± 5.4
Duke	173 ± 8.1	64	274 ± 18
<i>Ribes nigrum</i> L., black currant			
Ben Conan	162 ± 4.2	66	498 ± 15
Ben Lomond	261 ± 5.2	91	933 ± 36
Ben Nevis	252 ± 6.2	60	815 ± 25
Blackdown	216 ± 1.0	128	812 ± 33
Boskoop	240 ± 2.7	125	796 ± 3.6
Consort	411 ± 12	176	1342 ± 28
<i>Rubus</i> section <i>Rubus</i> , blackberries			
Cherokee (erect)	123 ± 4.5	13	407 ± 20
Chester (semierect)	164 ± 1.1	15	361 ± 8.1
Marion (trailing)	230 ± 2.1	21	560 ± 5.3
Navaho (erect)	126 ± 2.5	17	304 ± 6.2
Siskiyou (trailing)	133 ± 3.7	11	543 ± 10
Triple Crown (semierect)	113 ± 3.9	10	275 ± 0.3
<i>Rubus occidentalis</i> L., black raspberries			
Earlysweet	464 ± 7.8	74	897 ± 32
Jewel	607 ± 2.5	52	1079 ± 34
Munger	627 ± 8.3	71	890 ± 30

appear in each of the traditions of ancient medicine as well as in the folklore from the cultures of indigenous people on each continent. *Rubus* plants have played a low but

consistent role in the pharmacology of herbal medicines throughout the history of the world.

Although traditional medicinal uses of *Rubus* consider the applications of astringent

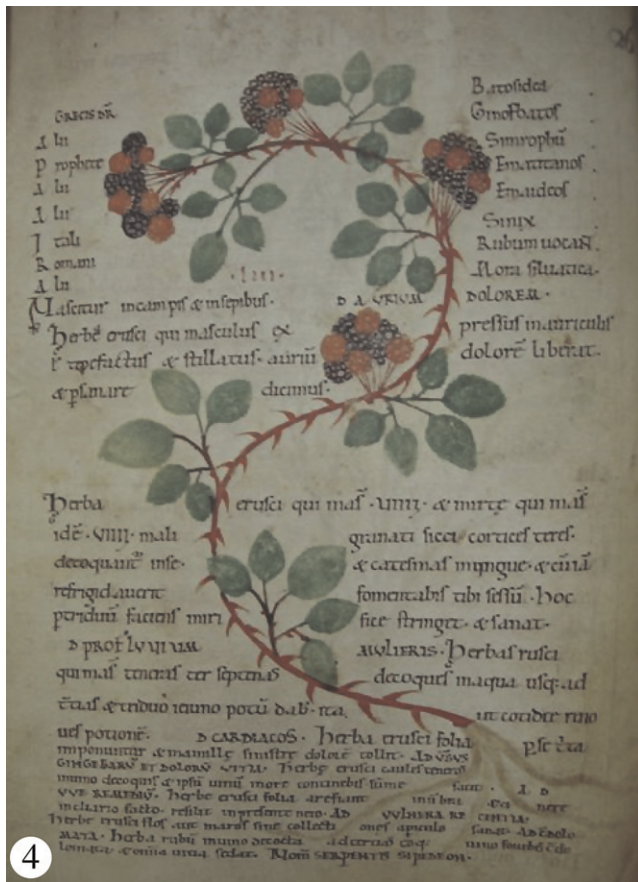


Fig. 4. Bramble, *Rubus fruticosus* with Latin text from *Bodley 130 Apuleius Platonius Codex*, fol. 26r. Abbey of Bury St. Edmunds. ca. 1120 CE. Bodleian Library, Oxford, UK.

action of plants, stems, and leaves, modern focus resides in the phytochemical action of the ingested berries at the cellular and molecular levels. Research on the effects of berry nutrients on human health, the interaction between diet and disease, and metabolomics of berry phenolics are active areas of discovery. *Rubus* berry phytochemicals may act as “prodrugs” within target tissue sites or to promote colonic microflora to contribute to health benefits (Seeram, 2008). The consumption of *Rubus* fruits demonstrates a contribution in the prevention of chronic human diseases, improvement of quality of life, and promotion of healthy aging. The pharmacology of *Rubus* presents not only a textbook study of ancient wisdom, but suggests a potential health benefit in humanity’s future.

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Horticulture and Health in the Middle Ages: Images from the *Tacuinum Sanitatis*

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Abstract. Lavishly illustrated late 14th century manuscripts known as the *Tacuinum Sanitatis*, a guide for healthy living, were based on an 11th century Arabic manuscript known as the *Taqwim al-Sihha bi al-Ashab al-Sitta* (*Rectifying Health by Six Causes*) written by the physician and philosopher Ibn Butlan (d. 1063). The expensive, illustrated *Tacuinum Sanitatis* tomes portray a utopian feudal society in which nobles are engaged in play and romance while feudal laborers work the estate. Rich in horticultural imagery, they include vivid scenes of the harvest of vegetables, fruits, flowers, and culinary and medicinal herbs. Each scene is accompanied by a brief summary of the health aspects of the subject. Although medieval medicine was based on ancient philosophical concepts of Greek sciences, particularly Hippocrates and Galen, these documents connect vegetables and fruits with human health and well-being, similar to modern medicine. Hence, the present-day focus on the connection between horticulture and health can be seen as an extension of ancient and medieval regimens for a healthy lifestyle.

The relationship between plants and human health has been and continues to be of great concern for humankind based on both diet and medicinal uses. In this article, we present and analyze images and associated text of an illustrated manuscript from the late Middle Ages, known as the *Tacuinum Sanitatis*, that provides information on the interrelationship of horticulture and health (Daunay et al., 2009; Janick et al., 2009; Paris et al., 2009). We further compare modern and medieval feelings about the role of horticultural plants and health.

IBN BUTLAN AND MEDIEVAL MEDICINE

The course of medieval medicine as it relates to horticulture can be followed in the career of a Baghdad-born Nestorian Christian physician and philosopher who died in 1068 (Fig. 1). Ibn Butlan, full name Abu al-Hasan al-Mukhtar ibn al-Hasan ibn 'Abdun Ibn Sa'dun ibn Butlan, was born and educated in Baghdad but traveled widely to localities that are today in Iraq, Syria, Egypt, Israel, and Turkey (Elkhadem, 1990). In a fascinating footnote in the history of medieval medicine, Ibn Butlan is remembered for a famous dispute with Ibn Ridwan, chief physician to the Caliph of Cairo, that delved around the question posed whether

a chicken is of a warmer nature than the chick. The issue concerned the philosophic question of warmth and movement often discussed in Aristotelian science as an exercise for experts and a conundrum for students (Braziller and Conrad, 1995). The controversy between the young, ambitious, and disputatious Ibn Butlan and the elder, temperamental, and mean-spirited Ibn Ridwan ended up as a bitter polemic. Ibn Ridwan took offense at anyone who was not an Egyptian or did not strictly adhere to classical orthodoxy. Ibn Butlan's strivings to make a name for himself in a new city where egg production was an important activity turned into a disaster, resulting in a professional boycott. He left Cairo for Constantinople and ended his days in a cloister in Antioch.

Ibn Butlan, however, is best known for his work entitled the *Taqwim al-Sihha bi al-Ashab al-Sitta* (*Rectifying Health by Six Causes*), which became an influential treatise on hygiene and dietetics. The *Taqwim* was a synthesis of the long tradition of ancient Greek medicine and was essentially a guide for healthy living. It summarized in tabular form information on some 280 health-related items, in particular food and especially vegetables and fruits. Widely popular in the Arabic world, it stressed preventive medicine. A French translation (Elkhadem, 1990) exists of the original Arabic text.

The *Taqwim* summarized information concerning food, and especially vegetables and fruits, in a tabular form that was easy to understand and use. It emphasized that a balanced lifestyle was the prerequisite to prevent disorders and diseases. Ibn Butlan coordinated the doctrine of the six "non-naturals" of Galen by detailing 280 health-related items, their names, their natures according to the four

elements, the degree, the best variety, the usefulness, the noxious effects and contraindications, the remedies to the noxiousness, the humors produced, the proper temperaments, the season, the age, the country, the authorities cited, and additional notes.

A Latin translation of the *Taqwim* commissioned by the Court of Sicily, and completed in 1266, was to become known as the *Tacuinum Sanitatis* (*Tables of Health*). It was essentially a medieval handbook on health and wellness. One hundred years later the first illuminated copies of the *Tacuinum Sanitatis* were commissioned by Giangaleazzo Visconti, the Count of Milan in the Po Valley in northern Italy (Hoeniger, 2006), as expensive gift volumes. The lavishly illustrated volumes portray a utopian feudal society in which nobles are engaged in play and romance while feudal laborers work the estate (Bertiz, 2003; Bovey, 2005; Cogliati Arano, 1976; Hoeniger, 2006; Mane, 2006; Opsomer-Halleux, 1991; Segre Rutz, 2002; Witthoft, 1978). Rich in horticultural imagery, they include vivid scenes of the harvest of vegetables, fruits, flowers, and culinary and medicinal herbs. Each scene is accompanied by a brief summary of the health aspects of the subject that derives from the *Taqwim* of Ibn Butlan. These documents connect vegetables and fruits as well as the garden itself with human health (Bertiz, 2003). Their advice was intended for the elite and intelligentsia of their epoch.

THE ILLUSTRATED TACUINUM SANITATIS MANUSCRIPTS

A dozen *Tacuinum Sanitatis* manuscripts have survived, of which six have full-page illustrations (Table 1) and are considered archetypical (Paris et al., 2009). They are

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Fig. 1. Ibn Butlan from the Vienna *Tacuinum Sanitatis* folio 4r.

located in libraries in Austria, Belgium, France, Italy, and Spain. Four of them can be viewed online (<http://mandragore.bnf.fr/html/accueil.html>; <http://bibliotheque.rouen.fr> and <http://www.casanatense.it>) and a number of facsimile editions have been published. These six copies provide a rich source of information on agriculture and horticulture of the late medieval period containing vivid images of plants being harvested in fields and gardens.

The images of the *Tacuinum Sanitatis* recensions include some plants of the *Taqwim* supplemented with those grown in northern Italy during the late 14th century. The plant images depict harvest, emphasizing when the horticultural product has reached the proper stage for consumption. One manuscript (Cod. Ser. N. 2644) in the Osterreichische Nationalbibliothek contains the most accurate depictions and will be the source of most of the plant images presented here. It includes 26 vegetables, 33 fruits, three flowers, 21 culinary and medicinal herbs, and one mushroom (truffles) in addition to nine cereals. Although botanical inaccuracies and lack of detail obscure precise identification in some cases, the images—although in many cases idealized—are, overall, of far better quality than those of most medieval manuscripts. In this article, we present illustrations of four vegetables, four fruits, and four culinary herbs along with the associated health information provided in the Latin text that is derived from the *Taqwim*.

Vegetables

Cucumber. Native to India, the first cucumber reached Europe in the medieval period (Paris et al., 2009). In Figure 2A, a well-dressed couple examines yellow cylindrical fruit from a viney plant. Identification of the plant is based on the tuberculate (warty) surface of the fruit, a diagnostic feature of cucumber. The bipartite label *Cucumeres et citruli* can be traced back to Table 10, Line 66 of the *Taqwim*, the Arabic being *al-qitha* (chate melon) *wa* (and) *al-khiyar* (cucumber),

Table 1. The six archetypical manuscripts of the *Tacuinum Sanitatis*.

Text reference	Catalog no.	Depository	Date ^z
Paris 1673	Nouv. Acq. Lat. 1673	Bibliothèque Nationale de France, Paris	1380–1390
Liège 1041	Ms. 1041	Bibliothèque de l'Université de Liège	1380–1400
Vienna 2644	Cod. Ser. N. 2644	Osterreichische Nationalbibliothek, Vienna	1390–1400
Rome 4182	Ms. 4182	Biblioteca Casanatense, Rome	1390–1400
Paris 9333	Latin 9333	Bibliothèque Nationale de France, Paris	1445–1451
Rouen 3054 and Liechtenstein ^y	Ms. 3054 (Leber 1088)	Bibliothèque municipale, Rouen, and private collection	1450

^zDates are according to Bovey (2005), Cogliati Arano (1976), Hoeniger (2006), Opsomer-Halleux (1991), and/or Segre Rutz (2002), and/or respective depository catalogs.

^yThe Rouen 3054 and Liechtenstein manuscripts are actually two parts of the same *Tacuinum* manuscript separated from one another in the 19th century (Bertiz, 2003; Bovey, 2005).



Fig. 2. Vegetables from the Vienna *Tacuinum Sanitatis*: (A) cucumber (*Cucumis sativus*) folio 23v; (B) eggplant/aubergine (*Solanum melongena*) folio 31v; (C) onion (*Allium cepa*) folio 25v; (D) chickpea (*Cicer arietinum*) folio 49r.

indicating similarity of culinary use of these two cucurbits. Although the illustration shows mature fruits that have turned yellow, the text advises green ones as best to consume. The text indicates that these fruits reduce burning fevers as a result of their cold, moist nature, are diuretic, and produce watery blood but cause stomachaches.

Eggplant. Domesticated in the Indo-Burma area, eggplant has been an important crop in India as early as the third century BCE and has also an important place in Ayurvedic medicine (Daunay and Janick, 2007). It was

domesticated in China by the first century BCE (Wang et al., 2008) and reached Europe in the medieval period (Daunay and Janick, 2007). In Figure 2B, a dramatic scene labeled *Melongiana* displays a fondling, amorous couple embracing in front of a row of eggplants while being severely admonished by an elegantly gowned lady. The illustration clearly suggests that eggplant had aphrodisiac properties. The plants bear a prolific crop of globular, purple fruits that appear similar to the present-day 'Black Beauty' market type. The undulate leaf laminae are depicted accurately,

but the attractive purple flowers are absent. Ibn Butlan wrote that the young, non-bitter, medium-sized Persian fruits are best and are beneficial to blood vessels and for stomach weakness (Elkhadem, 1990).

Onion. Native to western Asia, onions were known in Egypt as early as 3200 BCE and were considered medicinal plants in India in the sixth century BCE (Simmonds, 1976). In Figure 2C, a laborer standing in a field of onions with one hand outstretched expecting payment offers a bunch of white bulbs to a middle-aged lady whose head is covered, suggesting she is married, and who already holds a bunch of purple bulbs. The illustration is labeled *Cepe*. The onions are neatly planted in rows in a garden that also contains two trees, one of which is a cherry. The text informs that onions were considered to be a diuretic, sharpen eyesight, promote coitus, generate milk in nursing mothers and semen in men, but cause headaches.

Chickpea. Native to western Asia, progenitors of the present-day chickpea have been known in India from 2000 BCE (Simmonds, 1976). Chickpea is now a traditional dryland crop in the Mideast. In Figure 2D a well-dressed woman in a red gown protected by an apron is sampling pods in preparation for harvesting to a basket in the foreground. The crop appears spaced and planted. The text indicates that chickpeas are warm and humid to the first degree and the best are large-seeded. Chickpeas were supposed to increase sperm but to be noxious for the kidney and bladder.

Fruits

Grape. Old World species of *Vitis* are indigenous to the south Caspian belt, Turkey, and the Balkans and were widely distributed to the Mediterranean basin (Janick, 2005) and were very early used to make wine. Grape is illustrated three times in this *Tacuinum* manuscript either listed as *Uve*, or for the production of verjuice (juice of immature grapes used in ancient and medieval cuisine), or as a symbol of fall, the time of wine-making. Depending on the images, the vines grow on trees or are trellised and bear black, purple, light red, or gold grapes. In Figure 3A, a man in red tights is getting ready to cut a cluster of purple grapes with a knife while a young woman in an aproned blue dress has just handed a basket of harvested grapes to a third man in a large barrel who is stomping them to extract their juice being collected in a wooden container below that will be used to prepare wine. Grapes were considered to cause thirst and cleanse the intestine.

Apple. The large, sweet-smelling domestic apple originated in Kazakhstan, migrated to Europe in antiquity, and was widely planted in the Roman era (Janick, 2005). In Figure 3B, labeled *mala acetosa* (sour apple), a courtier brings down large apples with a stick while an elegant lady carrying a basket watches in amazement. The best sour apples are very juicy, alleviate fainting and hepatitis but adversely affect joint articulation. Sweet apple (*mala dulcis*), shown in another illustration, strengthens the heart.



Fig. 3. Fruits from the Vienna *Tacuinum Sanitatis*: (A) grape (*Vitis vinifera*) folio 85r; (B) apple (*Malus domestica*) folio 9r; (C) tart cherry (*Prunus cerasus*) folio 12r; (D) fig (*Ficus carica*) folio 4v.

Cherry. The origin of sweet and tart cherries is central Europe and areas surrounding the Black Sea with sweet cherries occurring as far east as central Russia (Janick, 2005). In Figure 3C, tart cherries, labeled *cerosa acetosa*, are being harvested by a child who has climbed into the tree. A well-dressed lady opens her gown to catch fallen fruits and another elegant lady carries off two full baskets balanced on a pole. The very sour ones were considered best. The fruits were considered to cure bilious attack and dry out and settle upset stomachs. *Cerosa dulcia*, sweet cherry, which softens the stomach, is displayed in a separate image.

Fig. The common fig is a classic fruit of Mediterranean climates, and signs of cultivation are found in Neolithic sites (Zohary and Spiegel-Roy, 1975). Native to western Asia, figs were early introduced to India, where they have become a major fruit. In Figure 3D, a couple harvest figs; the young man in the tree throws down fruit to a lady companion in a red gown who catches the fruit in her skirt as she daringly shows her white-stockinged legs.

The text indicates that figs are warm and humid in the second degree and that white-peeled kinds are optimum; figs cleanse the kidneys but inflate and fatten.

Herbs

Sage. This aromatic spice is found originating in southern Europe and Asia Minor (Simon et al., 1984). In Figure 4A, two well-dressed ladies are shown picking a plant labeled *Salvia* growing in an enormous basket. Domestic sage was considered best and was good for paralysis and for the nerves, although slow to be digested.

Marjoram. This is a spice originating in northern Africa and southwestern Asia (Simon et al., 1984). Two elegantly gowned women tend marjoram (*Marjorana*) growing in a vase resting on a bench (Fig. 4B). Very small, aromatic marjoram was considered optimum, good for cold and moist stomachs, and to purify the blood. No noxious effects are described.

Dill. Native to southwestern Asia and India (Brickell and Cathey, 2008), this herb is well known in Ayurvedic medicine. The



Fig. 4. Culinary herbs from the Vienna *Tacuinum Sanitatis*: (A) sage (*Salvia officinalis*) folio 37v; (B) marjoram (*Origanum marjorana*) folio 33v; (C) dill (*Anethum graveolens*) folio 32r; (D) saffron (*Crocus sativus*) folio 40v.

image in Figure 4C, labeled *Aneti*, shows a woman and a child harvesting dill in a weedy setting. The herb was considered best when green, fresh, and tender and was recommended for cold and flatulent stomachs, but was harmful to the kidneys and nausea-provoking.

Saffron. The saffron crocus, an ancient perennial herb, is known only in cultivation (Simon et al., 1984). Originating in southwestern Asia and perhaps native to Crete, the saffron crocus has long been cultivated in India. It is one of the most expensive spices on a weight basis; it takes 210,000 stigmas from 70,000 flowers to make 1 lb of true saffron. The dried red three-branched stigmas are used in cooking as a colorant and seasoning. In Figure 4D a blue-gowned woman carrying a basket harvests flowers from saffron crocus (*Crocus*) neatly planted in rows. The text advises that saffron is hot in the second degree and dry in the first degree. The best is freshly cut, strong in color, and with a delicate scent. Saffron helps hearing but may induce vomiting.

DISCUSSION AND CONCLUSION

The familiar 16 horticultural crops illustrated in the *Tacuinum* manuscripts have little changed in their appearance over the centuries. The garden scenes resemble traditional horticulture practiced today in many parts of the world. Vegetables are shown harvested in gardens and fields from dense plantings, whereas fruit trees are pictured alone, suggesting that large orchards were uncommon. Aromatics such as sage and marjoram are generally depicted as growing in tended conditions (beds or pots), indicating that these plants were prized, whereas dill and saffron are shown in plantings. Peasants and feudal laborers are frequently pictured with the root and leafy vegetables, which were their basic food (Mane, 2006). Conversely, courtiers and nobles are more frequently found next to fruit vegetables such as cucurbits and eggplant, of relatively recent introduction in Europe (Daunay et al., 2008; Paris et al., 2009), which were probably

considered fit for the elite. The upper class is also pictured next to fruit trees, produce reserved for the privileged (Mane, 2006). The medieval idea that the garden was a place for healing, relaxing, and physical and mental well-being was a premonition of modern horticultural therapy. Interestingly, all of the horticultural crops presented in the illustrated *Tacuinum* manuscripts were allocated physiological effects on the body and were fully part of the Western medieval pharmacopeia. Clearly, then as now, the population was concerned with general health and bodily functions, including flatulence, incontinence, and kidney stones, ill health, and sexuality. The brief text that accompanies each illustration in the *Tacuinum* provides information for balancing the beneficial and noxious effects of each plant.

Although the basis of modern medicine has completely changed from the ancient European and Asian philosophical concepts that date to antiquity, our attitudes toward our common horticultural crops are amazingly the same. All cultures, ancient, medieval, and modern, have come to the conclusion that horticulture is basic to a healthy life. However, modern knowledge of medicine and nutrition has changed our understanding of food through advances in biology, chemistry, and genetics and we now view foods in terms of calories, vitamins, antioxidants, polyphenols, anthocyanins, polysaccharides, proteins, and lipids (Goldman, 2003). However, it does appear as if all the analyses, ancient and modern, come to the same result: the horticultural crops we eat are sustaining, nutritious, healthy, and delicious. Although we no longer evaluate them on the basis of hot, cold, wet, or dry, or the effect on the “humors,” some of the ancient feelings still persist. We still say colloquially “cool as a cucumber,” we refer to pungent chili peppers as “hot,” we associate spicy foods with passionate temperaments, and consider aroma and fragrance to affect our well-being. The classic cures of bloodletting and induced vomiting have been discarded, but purging is still being promoted by some under the guise of “clean colon.” At times it may seem, as we investigate the healthful attributes of our food through chemistry, that we merely seek accreditation for our preferences. Although we smile indulgently at some extravagant claims of the ancients, it appears that in a number of cases their experience was prescient. For example, it turns out that horseradish does have a factor that affects urinary health (Shehata et al., 2008), and we have confirmed the health-giving properties of the alliums (Desjardins, 2008) and crucifers (Monteiro and Rosa, 2008). Although not generally stated, some horticultural crops need to be considered carefully for detrimental effects as in the case of allergies (5% of the population is allergic to apples), excessive soluble fibers (such as persimmon), and toxic substances such as solanine in potato.

It is clear that the present-day emphasis on the connection between horticulture and health is an extension of ancient and medieval

concerns. We suggest that our present understanding of nutrition will probably be considered naïve in the coming centuries and it may be that the approach for attributing health benefits to horticultural crops will likely be different from the present one. We predict, however, that the conclusions will be similar: horticultural crops are important for good health!

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