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Pharmacological properties of citrus and their ancient and medieval uses in the Mediterranean region

Beatriz Álvarez Arias[a], Luis Ramón-Laca[b,*]

[a] *Real Jardín Botánico de Madrid, Spain*
[b] *Instituto Madrileño de Investigación, Agraria y Alimentaria, Finca El Encín, Apartado 127, 28800 Alcalá de Henares, Spain*

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Abstract

This paper reviews the pharmacological properties of Mediterranean-grown citrus species (*Citrus* L., Rutaceae), including citron (*Citrus medica* L.), lime (*Citrus* × *auantiifolia* [Christm.] Swingle), lemon (*Citrus* × *limon* [L.] Osbeck), bitter orange (*Citrus* × *aurantium* L.) and pomelo (*Citrus maxima* [Burm.] Merr.), as referred to in ancient, medieval and 16th century sources. The virtues of the species reported in these texts were compared to those known to modern science. A much broader spectrum of pharmacological properties was recorded by these early writers than one might expect. The use of the citron and lemon as antidotes for 'poison and venom' is recorded in the very earliest material. According to modern scientific literature the citron and the bitter orange may possess anti-cancer activity, lime may have an immunomodulatory effect in humans, and the pomelo may be useful for treating circulatory problems. Lemons might even ease hangover symptoms. Research is required to confirm these properties.

Keywords: *Citrus* fruits; Pharmacological properties; Remedies

1. Introduction

Eight taxa belonging to the genus *Citrus* (Rutaceae) have been traditionally cultivated in the Mediterranean region. The citron (*Citrus medica* L.) was probably the only citrus fruit known in ancient times in Europe since the lemon (*Citrus limon* [L.] Osbeck), lime (*Citrus* × *auantiifolia* [Christm.] Swingle), pomelo (*Citrus maxima* [Burm.] Merr.) and bitter orange (*Citrus* × *aurantium* L.) were all introduced into Europe by the Muslims via the Iberian Peninsula and Sicily. The sweet orange (*Citrus* × *aurantium* L.), mandarin (*Citrus reticulata* Blanco) and grapefruit (*Citrus* × *aurantium* Macfad.) arrived in the West between the 15th and 19th centuries as a result of trade with British and Portuguese colonies.

This paper presents ethnobotanical information discovered in ancient and medieval manuscripts during research into the history and origin of Mediterranean-grown citrus fruits. The obvious edible uses of these fruits are not included. The information presented comes from the 5th century B.C. up to the 16th century A.D., meaning these treatises were published well before the advent of modern pharmacology. Current chemical, medical, and pharmacological literature confirms some of the uses reported by these early authors. This work may shed light on the reliability of ancient and medieval, i.e., empirical–pharmacological knowledge.

2. Materials and methods

The citrus taxa studied were taxonomically treated using the synthetic proposal of Mabberley (1997), in which the subgenus *Citrus* comprises four allopatric species: two tropical, *Citrus halimii* B.C. Stone and *Citrus maxima* (pomelo), and two subtropical, *Citrus medica* L. (citron) and *Citrus reticulata* Blanco (mandarin). According to Barrett and Rhodes (1976), the last three species have given rise to all the edible citrus fruits (i.e. to *Citrus* × *auantiifolia* [Christm.]

* Corresponding author. Tel.: +34 918879457; fax: +34 918879494.
E-mail address: luislaca@hotmail.com (L. Ramón-Laca).

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Swingle [lime], *Citrus* × *limon* [L.] Osbeck [lemon], and *Citrus* × *aurantium* L. [orange]) via natural and deliberate hybridisation.

The search for the historic pharmacological uses of cultivated citrus plants involved the review of agricultural, botanical and medical works by Greek, Roman, Muslim and Medieval European authors. The Greek texts in which information was found included a story by Democritus (5th–4th century B.C.) told in the *Deipnosophists* by Athenaeus (3rd century A.D.), *Enquiry Into Plants* by Theophrastus (4th century B.C.) probably written about 310 B.C. in Babylon, and *De Materia Medica* written between 60 and 79 A.D. by Dioscorides. The Roman texts that provided data were *The Georgics* by Virgil (70–19 B.C.), and *Natural History* by Pliny (23–72 A.D.). Useful works from the Muslim world were by authors who lived from Syria to al-Andalus (i.e., the Iberian Peninsula), including *A Treatise on Foodstuffs* by Abu Marwan (died in 1162), *Umda* recently attributed to Abu l-Khayr (12th century), and *A Treatise of the Dietetic Properties of the Lemon* by a Hebrew physician (Egypt, 12th century). The latter was later translated from the Arabic into Latin by the philosopher Andrea Alpago (1450–1520). The Medieval European source that provided information was *A Description of Palestine* written about 1219–1221 by Jacques de Vitry. The works examined from the 16th century were *Work of Agriculture* by Gabriel Alonso de Herrera (1470–1539), published in 1513, *A Treatise on Citrus* by the Sevillian physician Nicolás Monardes (1508–1588), published in 1540, and The Spanish edition of Dioscorides' *De Materia Medica*, by Andrés de Laguna, published in 1555. The uses of the fruits referred to in the above works were compared to current knowledge on citrus pharmacology. The results are offered in the following paragraphs and summarised in Table 1. The medical terms used are mostly those of Sayre (1917).

3. Results

According to Theophrastus, (1968 pp. 310–313) if the fruit of the citron tree was placed among clothes, it kept them from being eaten by moths. It was also useful when one had drunk 'deadly poison'; administered in wine it acted as an emetic, expelling the toxin. Theophrastus also records citrons being used as breath fresheners; the inner part of the fruit was boiled to form a sauce or the juice of the fruit was squeezed into the mouth. The juice could also be prepared in other media, and then inhaled.

Democritus wrote that this fruit should be stored like some precious heirloom in chests containing one's clothes to keep them from being eaten by moths (Athenaeus, 1969, pp. 357–367). Democritus believed, as did Theophrastus, that the citron, either in solid or liquid form, was an effective antidote against all poisonous agents when taken before food. In his work *Deipnosophists*, Athenaeus included the story of a number of convicted criminals in Egypt whose punishment was to be thrown into a pit of asps. After eating some of a citron belonging to a woman in the street, they remained unharmed by the animals' venom. This story seems to have inspired similar accounts by Dioscorides (1555, p. 102), Pliny (1968, pp. 484–485) Virgil (1986, pp. 124–125) and several 16th century authors, such as Laguna (Dioscorides, 1555, p. 106) and Monardes (Fernández and Ramón-Laca, 2002, pp. 159–160). According to Democritus, the citron was a proven antidote to every kind of poison (if eaten beforehand) since its protectant properties had been recorded on many occasions, even once when someone had taken aconite (*Aconitum* L., Ranunculaceae). Like Theophrastus, Pliny (1968, pp. 12–13) said the fruit had an exceptionally strong scent (also a property of the leaves), which on penetrating stored garments warded off insects. The Parthian grandees cooked the seeds of the fruit with their meat in order to freshen the breath, and both the fruit and the pips were taken in wine to counteract poison (Pliny, 1969, pp. 484–485). The pips were also prescribed for nausea during pregnancy, and the fruit was eaten for 'weakness of the stomach' –although apparently not very easily without the aid of vinegar (Pliny, 1968, pp. 160–161).

Dioscorides (1555, p. 102) wrote that citron pips counteracted poison and relaxed the stomach. When boiled, they improved one's breath, as did the juice. The fruit was useful for bouts of fainting after childbirth. And again, if put in chests with stored garments, it warded off moths.

According to Abu Marwan (1992, p. 76) people sometimes prepared a marmalade with the peel of the citron, mixing it with a pinch of sugar to ensure better preservation. This marmalade, which comforted the stomach, was also made from the leaves. Abu Marwan (1992, p. 76, 121) also believed the peel of the citron to act as a mild antidote for poison, that it perfumed the breath, and that its scent 'comforted the spirit'. The pulp, he wrote, quenched one's thirst, the pips cleaned the stomach, and when applied in a poultice they cleansed and lightened the skin. The syrup made from the peel was thought to be a diuretic and a mild antidote for poison. The oil obtained from the flowers and peel was used as a stomach tonic.

Herrera (1970, p. 76) believed if the leaves of the citron were placed among clothes, they gave off a pleasant odour and kept moths away. He also wrote that the fruit was a remedy against the plague, invigorated the stomach and prevented vomiting. It was also useful as an antidote for poison, especially that of the scorpion or viper, either when drunk or applied externally to the wound.

Laguna wrote that all citrus fruits could be used as antidotes against poison, especially the juice and seeds of the citron and lemon (Dioscorides, 1555, pp. 105–106).

Abu Marwan (1992, p. 91) believed lime pickle improved the appetite, invigorated the stomach and acted as an antidote against poison.

According to a Hebrew physician living in Egypt in the 12th century (Ebenbitar, 1583, pp. 6–11), the peel, pulp and seed of the lemon had different virtues and uses. The peel invigorated the stomach, whetted the appetite, helped one to digest food, provided better breath, improved the smell