



Research note:

Medical therapies for cataracts in Dioscorides' *De Materia Medica*

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Abstract

Dioscorides lived in the 1st century AD in Anazarba in the Cilicia region of the Roman Empire. He gained a thorough medical education during his studies under Areios. He collected all his learning and experience together in a prodigious book, *De Materia Medica*, which encompassed nearly the entire pharmaceutical knowledge of his time and is accepted as one of the most significant pharmaceutical books of ancient times. This work formed a solid systematic basis for later medical authors and remained one of the main reference sources in pharmacy and botany for almost 1500 years.

Cataracts are a common eye disease, and descriptions on cataracts date back to ancient times. Beside surgical treatment, many medical treatments were proposed as possible remedies without any success. The aim of the current investigation was to determine detailed medical treatments recommended for cataracts in *De Materia Medica* to shed light on medical approaches to the common cause of severe visual loss in ancient medicine and the medieval period.

De Materia Medica suggested a total of 26 treatments for cataracts, which can be categorized in three main groups: herbal medicine (18 plants are mentioned), animal medicine (mussels and honey), and minerals (six minerals and metals are suggested for medicine production).

All these treatments were aimed to clear shadows on pupilla but their efficiency against cataract seems to be improbable. Etiological classification of eye diseases was not fully and clearly matured in Dioscorides's time, causing confusion among diagnosis of pathologies related to anterior part of the eye. Hence, shadows on pupilla might refer to cataract or to other eye diseases, mainly corneal opacities.

It may be concluded that all medical therapies written in *De Materia Medica*, although they might have some therapeutic effect on corneal opacities, seems to be ineffective in cataract treatment.

Keywords

Dioscorides, *De Materia Medica*, cataracts.

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Terapias médicas para cataratas en *De Materia Medica* de Dioscórides

Resumen

Dioscórides vivió en el siglo I d.C. en Anazarba, en la región de Cilicia del Imperio Romano. Obtuvo una educación médica completa durante sus estudios bajo Areios. Reunió todos sus conocimientos y experiencias juntos en un libro prodigioso, *De Materia Medica*, que abarcaba casi todo el conocimiento farmacéutico de su tiempo y es aceptado como uno de los libros farmacéuticos más significativos de la antigüedad. Este trabajo formó una sólida base sistemática para autores médicos posteriores y se mantuvo como una de las principales fuentes de referencia en farmacia y botánica durante casi 1500 años.

Las cataratas son una enfermedad ocular común, y las descripciones sobre las cataratas datan de la antigüedad. Además del tratamiento quirúrgico, se propusieron muchos tratamientos médicos como posibles remedios sin ningún éxito. El objetivo de la presente investigación fue mostrar los tratamientos médicos recomendados para cataratas en *De Materia Medica* para iluminar los enfoques médicos antiguos y durante el período medieval frente a la pérdida visual severa.

De Materia Medica sugirió un total de 26 tratamientos para cataratas, que pueden clasificarse en tres grupos principales: medicina herbaria (18 plantas mencionadas), medicina animal (mejillones y miel) y minerales (se sugieren seis minerales y metales para la producción de medicamentos). Todos estos tratamientos estaban dirigidos a despejar las sombras en la pupila, pero su eficacia contra las cataratas parece ser improbable. La clasificación etiológica de las enfermedades de los ojos no fue completa y claramente madura en el tiempo de Dioscórides, causando confusión entre diagnósticos de patologías relacionadas con la parte anterior del ojo. Por lo tanto, las sombras en las pupilas pueden referirse a cataratas o a otras enfermedades oculares, principalmente opacidades corneales.

El trabajo concluye que todas las terapias médicas escritas en *De Materia Medica*, aunque podrían tener algún efecto terapéutico sobre las opacidades corneales, parecerían ser ineficaces en el tratamiento de cataratas.

Palabras clave

Dioscórides, *De Materia Medica*, cataratas.

Introduction

One of the most significant periods in the development of medicine was the medical understanding that started in ancient Greece and reached its peak with Hippocrates. The theory of the four humors became fundamental in understanding health and disease processes, with this tradition maturing into time-molded decision patterns on how treatments should be applied. The theory was used to establish principles for applying medication/pharmacotherapy, which could be named as singular remedy among the medical treatments. Pervading a wide geographical area over long periods, this tradition had surprising variety and richness regarding medicines used for treatment. It became an almost impossible challenge to categorize different medicines within a single book, with their numbers reaching into the hundreds.

De Materia Medica, written by Pedanius Dioscorides (c. 40-90 AD), became a distinguished source in a short time with its richness of content and the rationality of its categorization of treatments. It was translated into many languages and remained until modern times as the main reference source for doctors regarding treatments. It also became a fundamental source for medical treatments described in many later medical studies and works.

Information about the life of Dioscorides is scarce. He was born in Anazarba, an ancient city near Adana in Turkey. It is thought that he was born between 40 and 49 AD. He studied with Areios, famous at the time for his knowledge of herbal treatments. He kept Dioscorides at his side over a long period and taught him all facets of intricate herbal treatments. Dioscorides, as a mark of gratitude, dedicated his book to Areios, because of his significant contribution to Dioscorides' education and his extensive knowledge of herbal treatments. As well as this strong educational background, Dioscorides gained further opportunities to excel in his knowledge of medical treatments by serving in a Roman military legion during the time of Roman Emperor Nero, which allowed him to travel to different countries with military expeditions.

De Materia Medica contains descriptions regarding the treatment of many diseases (Eadie, 2004; Tortora, 1994), with treatments related to eye diseases important among these (Lopez de Letona, 2006a; 2006b; 2006c; 2006d). Treatment suggestions for cataracts are covered under many topics. This condition, which can cause considerable loss of vision, has been known since ancient times, and various surgical methods have been described for its treatment (Feigenbaum, 1960). However, the difficulty in performing surgical operations, the need for special surgical instruments and experience in these procedures, as well as the high failure rate due to complications, led to the prioritization of the use of medical treatments in the first instance.

Many different medicines were used or suggested for cataracts, showing the lack of a single efficient medical treatment (Toh, Morton, Coxon & Elder, 2007). Some clinical studies with experimental drug treatments, such as carnosine, reported encouraging results that warrant further investigation. Employing an effective medical treatment for cataract is likely to make a colossal effect on global eye health, giving rise to a cure for one of the most important cause of blindness. Both traditional treatments and pharmacopoeia are currently the main source of new drug search and exploration, which renews the interest in the study of archaic pharmacopoeia books, including *De Materia Medica*.

In this work, our aim was to investigate the treatments suggested for cataracts in *De Materia Medica*. Such research will contribute to an understanding of the approaches for treating this disease before modern medicine and its potential for the development of therapies against cataract formation, based on herbal medicines.

Material and method

De Materia Medica was written in Greek and later translated into Arabic, Syriac, Latin, French, and English (Colon, 1998; Riddle, 1985). While there is a substantial number of Arabic translations (Sadek, 1983), significant differences can be noticed between various Arabic copies, leading to serious uncertainty about the original manuscript. Conversely, the uncertainties that remained for a long time were reduced to a certain extent with the ancient Greek text published by Max Wellman as three volumes between 1906 and 1914 (Dioscorides Pedanius & Wellmann, 1914). Lily Beck's 2005 English translation is based on Greek text published by Max Wellman (Dioscorides Pedanius, 2005). This text is used as the main source when investigating proposed medical treatments against cataract formation.

De Materia Medica has a distinctive organization. It was divided into five "books": the first on medicinal plants affecting the senses of olfaction and taste; the second on animals or animal parts used for their medicinal value; the third on roots, juices, and seeds; the fourth containing more roots and herbs; and the fifth on various kinds of medicinal wines and minerals. Dioscorides did not use an alphabetical order when he listed the plants. Interestingly, as a new method, he grouped together plants having similar pharmacological action. Over 550 plants, 80 animals or animal parts, and about 90 minerals are described. In the translation, each plant is listed by its Greek name followed by the English equivalent and the scientific name. This is

followed by the translation of Dioscorides' text containing a brief description of the plant (habit of growth; description of leaves, roots, flowers, and seeds; and geographic location of those sources that offered the best pharmacologic activity). Then the part used, its properties, and the method of preparation and medical uses are given. Various types of adulteration of the product, especially for plants not grown locally, are often mentioned.

After the translation, two important indices to the book are appended: an index of plants, animals, and minerals, and an index of the medical conditions for which the agents were recommended by Dioscorides.

Human crystalline lens focuses light rays coming from observed objects on the fovea, a small region containing most of the photoreceptor cells which convert light energy into electrical signals leading to visual perception of outside world. In healthy individuals human crystalline lens is clear and transparent. However cataract causes human lens to lose its transparency and become a white opaque mass behind pupilla. Therefore when a cataracteous eye is examined by a physician under poor conditions by simple examination tools, a pathology resembling a white shadow on pupilla could be observed. For determining which medicines were used in cataract treatment, we included those recommended for the treatment of conditions that caused shadows on pupils. This approach was also suggested by Beck.

Results

In total, 26 treatments were suggested for cataracts. These can be categorized in three main groups: herbal medicines with 18 plants mentioned; animal medicines, specifically mussels and honey; and minerals, with six minerals and metals suggested for medicine production. The information in *De Materia Medica* about each of these treatments is as follows:

1. Yellow Flag (ἄκοπον, *Iris pseudacorus*): The juice extracted from the roots of this plant cleans away the materials that cause shadows on pupils.
2. Cinnamon (κινάμωμον, *Cinnamomum cassia*): When taken together with myrrh, this pulls down menstrual blood and the fetus, becomes a suitable antidote for animal poisons and other poisons, and cleans away materials that cause shadows on pupils.

3. Mecca Balsam (βάλασμον, *Commiphora opobalsamum*): This juice is the most efficient medicine that cleans away the materials that cause shadows on pupils by significantly heating them. It stops uterus spasms when used together with golden liniment.
4. Saffron (κροκόμαγμα, *Saffron residuum*): Saffron has diuretic, emollient, peptic, and excofactive features and cleans away the materials that cause shadows on pupils.
5. Oil-honey (έλσιόμελι, *Olei mellis*): Olive-honey derived from olive trees in Palmyra increases motion, and it can be efficient in cleaning away the materials that cause shadows on pupils particularly when applied above the eyes.
6. Myrrh (σμήρυμα, *Commiphora myrrha*): This closes eye ulcers and cleans away the materials that cause shadows on pupils. With corneal leucomas, it heals trachoma lesions.
7. Pitys Pine (πίτυς, *Pinus*): This cleans away the materials that cause shadows on pupils.
8. Ebony (έβενος, *Diospyros ebenum* Koenig and *D. melanoxylon* Roxb.): This cleans away the materials that cause shadows on pupils and is a powerful medicine against arthralgia and boils on thighs. It becomes more effective when pulverized and transformed into a powdered ointment. It can be added to eye medicines. Scraps and the bark of the tree steeped in Chian wine for one day and one night are pestled and formed into an eye ointment. Alternatively, some people first powder the ebony pieces by grinding them and filter out the powder, and then complete the process in the same way. Some use water instead of wine. Ebony pieces are burnt in a brand new stewpot until they are reduced to ashes and can be washed like burned lead. The last recipe in particular is more suitable for blepharitis.
9. Dyer's Buckthorn (λύκιον, *Rhamnus petiolaris*, *Rh. lycioides*, *Rh. punctata* Boiss): This has firming and drying qualities. It cleans away the materials that cause shadows on pupils. It is beneficial for blepharitis rashes, irritations, and long-term inflammation.
10. Willow (Ιτέα, *Salix*): The bark of the willow is peeled off, and the juice of the tree extracted during blooming. This juice cleans away the materials that cause shadows on pupils.
11. Sea Mussels (μύακες Ποντικοί, *Ponticum mussel*): Black Sea mussels are the best. When fried, they produce the same result as snail shells. After frying, they are washed in the same way as lead, mixed with honey, and used to prepare eye medicine. This softens the indurations on eyelids, cleans away leucomas, and cleans away the materials that cause shadows on pupils.

12. Honey (μέλι, *Mel*): When boiled and applied to the eye, this cleans away the materials that cause shadows on pupils.
13. Sugar: A sugar similar to crystallized honey extracted from the reeds in Arabia and India may be used as a lotion to clean away the materials that cause shadows on pupils.
14. Pepper (πέτρι, *Piper nigrum*): This usually has a calefacient feature; it is a peptic plant that increases urine, induces sweat, and cleans away the materials that cause shadows on pupils.
15. Ginger (ζιγγίβερι, *Zinziber officinale*): This has effects similar to pepper, and it cleans away the materials that cause shadows on pupils.
16. Othonna (όθάννα, *Othonna*): Eye medicines produced from its juice clean away the materials that cause shadows on pupils.
17. Feverfew (κενταύριον τό λεπτόν ή μικρόν, *Erythraea centaurium*): Medicines produced from its juice clean away the materials that cause shadows on pupils.
18. Giant Fennel (σαγάτηνον, *Ferula persica*, *Sagapenon*): When put into vinegar and smelled, this cures uterus asphyxiation, cleans away lesions on the eye, cures night blindness (nyctotophlosis), and cleans away the materials that cause shadows on pupils.
19. Italian Melilot (λωτός ό έν τοίς παραδείσοις φυόμενος, *Melilotus*): When its juice is extracted and mixed with honey, this cleans away opacities on the eye and leucomas and also cleans away the materials that cause shadows on pupils.
20. White Hellebore (έλλέβορος λευκός, *Veratrum album*): This can be mixed with medicines that clean away the materials that cause shadows on pupils.
21. Flower of Copper (χαλκού & νθος, *Flos Aeries*): After copper glance is melted in the oven, it is molded, the dirt accumulated over the mold is cleaned, and cold water is poured on to cool it. When squeezed suddenly, copper foil appears on the metal like leaves coming out of a tree. This material reduces warts and even though it stings, it cleans away the materials that cause shadows on pupils.
22. Alum (στυπηρία, *Aluminis*): Alum has heating and firming qualities. It makes the eyelid muscles tighter and minimizes tumors growing on eyelids. It cleans away the materials that cause shadows on pupils. Two halves are more effective than one round piece of alum.
23. Pumice Stone (κσηρις, *Pumice*): This has a firming quality and cleans gums. It cleans away the materials that cause shadows on pupils and cicatrizes and fills tumors.

24. Copper Pyrites (νυρίτης λίθος, *Calchitis*): Both fried and not fried, this has firming and cleaning qualities and cleans away the materials that cause shadows on pupils. It resolves and softens indurations when used together with pine resin.
25. Turquoise (θυίτης, *Thyites*): This cleans away the materials that cause shadows on pupils.
26. Earth-like Stone (λίθος γεώδης, *Terra quasi lapis*): This ties, dries, and cleans away the materials that cause shadows on pupils.

Discussion

The study of medical history has shown that medical textbooks that left their mark on their eras and served as the basis of subsequent works for centuries are exceptional. *De Materia Medica* by Dioscorides has a prominent and distinguished place among these works. *De Materia Medica* was not the first book on herbal medicine. The first book on medical plants was written by Crateus, the doctor of King Mithridates (Sadek, 1983). This contained many figures depicting plants and their characteristics, and it is apparent that it had an effect on Dioscorides. In the preface of his book, Dioscorides states that, before him, Lollas of Bithynia and Heraclides of Tarentum wrote about medical treatments but did not mention minerals or treatments applied with various spices and that they included only a small part of the subject in their books.

Another distinctive aspect of Dioscorides' book is the categorization of similar plants and materials under different topics in a way that they could easily be found when searching through the book. Furthermore, the information given about each plant starts with a description of that plant and where it grows and continues with descriptions of the parts of the plant that will be used to produce the medicine, when such parts should be collected, and how they are processed to produce the medicine. As he also stated in the preface of his book, unlike the previous authors, he wrote his book by personally seeing and experiencing all the plants he described rather than by quoting from the books of others and writing about treatments he had not seen or experienced. In addition, Dioscorides used clear and sometimes rustic words instead of complex and literary language, with the purpose of making the book more beneficial for its readers; this made his book more suitable for practical use than the previous works (Dioscorides Pedanius, 2005).

De Materia Medica had an explicit effect on Islamic medicine. According to Sadek, it served as a resource for ibn Juljul's "*Tafsir asma' al-Adwya al-Mufrada min kitab Dioscorides*", ali

ibn radwan's "*al-Adwiya al-Mufrada*", ibn 'Abd al-aziz al-andalusi's "*Kitab al-Adwiya al-Mufrada*", Muhammad ibn Abdullah ibn Idris' "*Jami' Ashtat al-Nabat*", 'abd-al-latif al-Baghdadi's "*Intiziat min Kitab Dioscorides fi sifat al-Hasha'ish*", Abu al-Abas ibn al-Rumiya's "*Tafsir Asma' al-Adwiyah al-Mufrada min Kitab Dioscorides*" as well (Sadek, 1983).

Different Arabic translations of *De Materia Medica* have been made at various times. The translations of Istefan-Hunayn, Behnam bin Musa, Mihran bin Mansur, Natili, and el-Malti have survived to the present day (Çoşkun A., 2012). In the Ottoman period, an Italian translation by P.A. Matthioli was translated into Turkish by Osman bin Abdurrahman with the title *Kitabü'n-Nebat* (Ataç A., 2004).

A medieval latin version of *De Materia Medica* by Peter of Abano was printed in 1478, causing a heave of new editions, translations and commentaries by many authors, which was studied in great detail in John Riddle's detailed survey, "*Catalogus Translationem et Commentariorum: Medieval and Renaissance Latin Translations and Commentaries, IV, 1980*" (Reeds, 2008; Riddle, 1980).

Curtius Sprengel edited Latin translation of *De Materia Medica* in 1829-1830 with the title "*Pedanii Dioscoridis Anazarbei De materia medica libri quinque*". In 1902, Julius Berendes translated the book into German from Sprengel's Latin text (Dioscorides & Berendes, 1988). Max Wellmann published a new critical version of the Greek text between 1906 and 1914 (Dioscorides Pedanius & Wellmann, 1914). In later periods, academic studies by Vivian Nutton (Nutton, 1970; 1976), John Scarborough, John Riddle (Riddle, 1985), and Max Aufmesser (Dioscorides Pedanius & Aufmesser, 2002) have made contributions to the study by Dioscorides. Lily Beck's English translation of Max Wellmann's version has helped the work reach a wider audience. In the present study, medical treatments suggested for cataract treatment were reviewed using Beck's book as the reference.

It is possible to categorize the suggestions for cataract treatment in three main groups: herbal medicines, animal medicines, and minerals. Medicines derived from plants constituted the majority. Among these, cinnamon, Mecca balsam, myrrh, ginger, saffron, sugar cane, and pepper were the most commonly used and suggested for the treatment of many diseases. Mecca balsam was accepted to be the most efficient agent for cataract treatment. Also among the suggested medicines were othanna, willow tree, and feverfew, which were used for the treatment of other eye diseases and mentioned as effective for cataract treatment. As yellow flag, giant fennel, and Dyer's buckthorn were thought to treat corneal opacities and other leucomas on the eye through their astringent effects, it was suggested that these medicines would be effective in cataract

treatment as well. Medicines that might be considered as specific only to cataract treatment were made with ebony and the juice extracted from the roots of yellow iris.

Mussels, particularly Black Sea mussels, were one of the suggested animal medicines. It was written that a mixture prepared from mussels and honey reduces indurations and inflammations on eyelids, treats leucomas, and cleans away cataracts. It was also argued that the application of boiled honey to the eyes would also clean away cataracts. As the treatment of cataracts was not easy and most herbal treatments did not offer an effective treatment option, this resulted in the production of agents that were stronger but at the same time may have had more toxic effects. Metallic dusts and minerals used for this purpose had been suggested by various authors; Dioscorides included six of these treatments in his work. Among these, wine, earth-like stone, turquoise, and pumice stone had less toxic and astringent effects. Dioscorides also suggested two compounds including copper: flower of copper and copper pyrites. Common to these two treatments was that when applied to areas of induration, they cleaned away the induration, and when applied above the eye, they treated cataracts.

When considering all these treatments together, it may be that in the first instance, the initial treatments would be those with mild effects and fewer side effects and that in conditions where such treatments were unable to obtain a result, mineral treatments including copper, which were considered to be more effective but had the possibility of causing toxic effects, were applied.

Current medical knowledge accepts that any external treatment applied to the eye would treat cataracts is not possible. Cataract is formed by disruption in the human lens physiology, disarrangement of lens proteins and clumping of those lens proteins to form opacities within human lens. Therefore it is highly probable that these treatments could not have been effective in advanced cataract cases, having a white hardened human lens with a totally disrupted anatomic structure. Again, according to current medical knowledge, cataract formation is irreversible, and any medical treatment is ineffective to restore a damaged human lens anatomy, rendering surgical treatment as the one and only option.

One possible explanation for these suggested treatments' effectivity is that cataracts can be confused with corneal leucomas that cause whitening of the cornea. Since these treatments could be used for corneal opacities and leucomas, it may have been wrongly concluded that the same treatments could also be effective in cataract treatment.

Another mechanism of action may be the indirect effect of those substances applied on eye. When the effects of simple herbal drugs explained, Dioscorides frequently writes "It cleans away the materials that cause shadows on pupils". These explanations supports the notion of effects of applied drugs not on the application site, ocular surface and cornea, but on the target

site, cataracteonus human lens. Suggested treatments could be believed to have such effects, at least stopping advancement in cataract formation and at last restoring normal anatomy by nullifying effects of substances causing cataract.

Comparing Dioscorides' *De Materia Medica* to the works written during the Islamic medicine period, and later works with regard to the medicines suggested for the treatment of cataracts and other eye diseases, will help elucidate the influence of *De Materia Medica* over such works as well as help gain a more comprehensive understanding of the place of ophthalmology in Islamic medicine within the discipline of the history of medicine.

In conclusion, effectivity of medical treatments suggested against cataract formation in *De Materia Medica* are questionable. Some treatments among them, especially mineral treatments, might decrease corneal opacities and might help to clear "shadow on pupils", with possible severe complications. Confusion related to "shadow on pupils" term, referring to many eye diseases, ranging a wide spectrum of ocular pathologies from corneal opacities to cataract, leaves an important question unanswered: which "shadows on pupils" were indeed considered "cataracts". Without a clear answer to this question, it will be more logical to conclude that there were not any effective medical treatment of cataract in *De Materia Medica*.

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