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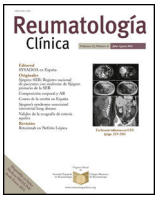

Review Article

Rheumatological therapy in Prehispanic Mesoamerica☆

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ABSTRACT

Nahuatl medicine was remarkably advanced in Prehispanic Mesoamerica. Thoughts on health and disease were different to those prevalent in Europe in the sixteenth century because they included magic, religion and different kinds of animal, mineral and, notably, herbal medicine. These resources were used in a supplementary, not isolated, way by Nahua physicians (*ticitl*) according to patients' needs and beliefs. Most Nahua physicians had similar knowledge but there were some differences between rural and urban areas, and those who were also doctor-priests of a particular deity. After the European colonization of Mesoamerica, great efforts were made by Spaniards and Indians to recover the immense amount of ancient knowledge in Mesoamerica related to medicine. Some of this work, not all, is included in the Cruz-Badiano Codex, the Florentine Codex or *Historia general de las cosas de la Nueva España*, and the Francisco Hernández Codex.

A review of these codices and the recent literature on the practice of Nahua Medicine was performed with particular interest in herbal medicine in rheumatic diseases, or symptoms probably related to rheumatic diseases, during the sixteenth century in the land currently known as Mexico.

Terapéutica reumatológica en la mesoamérica prehispánica

Palabras clave:
Terapéutica prehispánica
Mesoamérica
Herbolaria náhuatl

RESUMEN

La medicina náhuatl tenía un notable desarrollo en la Mesoamérica prehispánica. El concepto de salud y enfermedad era diferente al que en el siglo XVI prevalecía en Europa e incluía conceptos de magia, religión, empleo de recursos físicos, de animales, de minerales y, muy destacadamente, de la herbolaria. El médico nahua (*ticitl*) no utilizaba estos recursos en forma aislada sino de manera complementaria de acuerdo con las características de cada paciente. Los médicos compartían conocimientos generales comunes, pero había diferencias entre los que vivían en las zonas rurales, los de la ciudad y los médicos-sacerdotes.

En los años que siguieron a las guerras de conquista se hicieron esfuerzos para recopilar las características de la medicina en Mesoamérica. Algunos de estos trabajos, no los únicos, son el Códice De la Cruz-Badiano, el Códice Florentino o *Historia general de las cosas de la Nueva España* y el Códice Francisco Hernández. Se llevó a cabo una revisión de estos códices y de la literatura reciente referente a la práctica médica náhuatl con énfasis en la herbolaria como recurso terapéutico para los padecimientos reumatológicos en el siglo XVI, en los territorios que ahora conocemos como México.

Introduction

Before Christopher Columbus arrived on the American continent, the peoples of the territories now known as Mexico were remarkably advanced socially and culturally with a knowledge of various aspects of medicine. The diverse developed cultures in this geographical area known as Mesoamerica, which stretched from the middle region of Mexico to Central America, included the

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Olmec, Teotihuacan, Zapotec, Mayan and Nahuatl, among others. Despite their linguistic and ethnic diversity, they shared factors of cultural unity such as agriculture, the use of civil and ritual calendars, religious aspects, and mathematical and astronomical concepts, as well as hieroglyphic writing.[1]

Several cultures such as those mentioned above developed in this vast area at different times, from 2500 BC until the arrival of the Spanish in the 16th century. We are going to focus on Nahuatl medicine in Mesoamerica in the decades before and after the conquest of these territories in 1521. Although termed pre-Hispanic, the period includes the first years of the colonial period, since this is when the data compilation and cultural syncretism that resulted in the contribution of European medical knowledge to the medical knowledge of the Nahuatl civilisation began.

The aim of this review is to provide the reader with an overview of how Nahua physicians treated illness by magic, religion, and different kinds of animal, mineral and, notably, herbal medicine, and how they applied this knowledge to the treatment of joint diseases. We studied herbal therapeutics from 3 principal sources: The Codex De la Cruz-Badiano, the *Historia general de las cosas de la Nueva España* and the Codex Francisco Hernández. I must specify that in this review I am going to refer to Nahuatl medicine, not Mexican or Aztec, which are terms better known in Spain and Latin America for different reasons. The Aztecs arrived and settled in the valley of Mexico in the 14th century; most of their knowledge of medicine was passed down from ancient Mesoamerican cultures, particularly from the Toltec, since similar medical developments took place beyond the borders of the Aztec empire. This suggests that Nahuatl medicine transcended the Aztec empire in time and geographical area, and that the Aztec empire also incorporated knowledge from the cultures of the conquered territories during its expansion.[2]

It is important to clarify that the "Nahua" are the native peoples of Mesoamerica, while "Nahuatl" is an adjective that means belonging to the Nahua. For example, the Nahua are a group of native peoples of Mesoamerica, to which the Mexica or Aztecs belong, whose common language was Nahuatl. A significant amount of this information was collected in the region renamed New Spain.

Concept of health and disease

First of all, it is important to mention that the concept of disease and its treatment among the ancient people of Mesoamerica was a mixture of religion, magic, and science, which cannot be separated except for clarity of presentation, but which were intimately related in the daily activities of Nahua physicians. Religion was a major factor: in most diseases the wide repertory of deities was the cause of or intervened in healing. Magic was also a factor, because in almost all cases a sorcerer was considered to have intervened at the start of the disease and healing was achieved through magic. And there was a mixture of science with the extensive knowledge of herbs, minerals, animals, and physical resources that the Nahuatl physician (ticitl) used to alleviate ailments. Therefore, the physician, male or female, was a sorcerer, but a benevolent one, accepted and approved by society, with knowledge of religion and resources, such as herbal medicine.[3]

Religion and magic

In pre-Hispanic Nahuatl thought, a major role of the gods was to protect their worshippers, but also to demand obedience and worship. The gods caused disease to preserve order. From the general actions of the gods derives their role in health. For example, Quetzalcoatl was a god who protected man, who cured all diseases and ills; however, in his form as Ehecatl, god of the wind, he caused colds, rheumatism and spasms or contractures. Tezcatlipoca, god of the underworld, was the god of punishment, sending great epidemics and madness. Tlaloc, god of rain, was associated with diseases in which liquid appears to play a major role (we could say ascites or oedema nowadays, but he was also associated with drowning).

Bernardino de Sahagún's informants, who we discuss at length below, told him that certain gods "possessed the sick and took away their beauty". This statement might help us understand why they performed "cleansings" and similar ceremonies, a custom that persists to the present day, and why diseases could be transferred to specially made figures to treat "*mal de aire*" (bad air). The appearance of certain diseases at the beginning of spring meant that they were associated with Xipe-Totec, the god who caused the earth to be covered with vegetation. Diseases from certain behaviours were also considered to be associated with a divinity. For example, diseases associated with Tlazolteotl, the goddess of love, were sent to punish those who had indulged in illicit relations. And there are many more examples of the participation of Nahua divinities in the generation of diseases.

The *ticitl* also considered that other people could be the cause of their patient's disease. If gods and supernatural beings could cause disease, so could certain individuals. It was considered that there were individuals who, either by themselves or due to their function, possessed excess "soul energy", as was the case with rulers (*tlatoani*). They were considered able to cause damage through the "evil eye", which they thought an individual with excess energy could give to another weak individual, through a stare. These concepts have persisted in today's indigenous communities, who attribute certain diseases to "*mal de ojo*" (evil eye) or "*mirada pesada*" (heavy stare).

It was common belief that disease was caused by one or more coinciding factors: by a foreign substance entering the patient's body through magic; by damage inflicted on the sick person's ẗotem̆(their animal double or *nahualli*); by loss of *tonalli* (the vital breath and g̈ood star,̇ in the sense of pre-determined fortune); and, finally, by äirs of disease,̇ nefarious influences that hover around human beings. Even now people are said to fall ill from ä bad air.̇ These äirsẅere attributed to the *tlatoques*, mountain gods. The Indians believed that diseases associated with cold came from the mountains and that from these same mountains came the power to heal them. Therefore, those affected by these diseases made offerings to this or that mountain. Sahagún[4] described through his informants that ẗhe diseases for which they made these vows were gout of the hands or feet, or of any other part of the body; and also, the crippling of any limb or of the whole body and stiffness of the neck or any other part of the body.̇ Throughout his *Historia general*, Bernardino de Sahagún[4] frequently describes joint disorders as gout. It could be that this word was used to indicate joint disease in general, and not to define gout as the disease we know today. These seem to be descriptions of generalised osteoarthrosis or rheumatoid arthritis, although some may think of chronic gouty polyarthropathy as they read them. In short, these diagnostic conjectures cannot, for the moment, be more than mere speculation.

Nahua physicians described diseases as the result of dynamic changes in the patient's organism because they considered health the result of equilibrium, and when this equilibrium is lost, the result is disease. Thus, diseases were considered a dynamic process in which the conditions of the individual, the aggressiveness of external agents and the patient's environment intervened. They individualised each case by emphasising both natural and supernatural causes. In general terms, they divided diseases into those in which a foreign being or object has entered the patient's body and those in which the patient has lost or had their mental capacities diminished. It was important for a prognosis of life in children to establish whether their *tonalli* was inside their bodies; there

were those who fell ill with ¨*espanto*¨(fright).[5] The stars also had an influence on the development of disease and in predicting an individual's good or bad fortune.

The *ticitl* knew about magic as applied to medicine, but in practice they did not use it alone, as the following presciption illustrates: to assist a woman in labour, after commending herself to the corresponding deity, the woman was given a medicine made from *cihuapatli*, which has oxytocic properties; *cuauhalábuac*, ślippery tree,, to facilitate the exit of the product through the birth canal, and the tail of the *tlacuache*, an animal that gives birth easily, and, finally, they used *éztetl*, which worked to stop bleeding.[6] In other words, herbal remedies, sympathetic magic and religion were used simultaneously.

Rheumatic diseases

Viesca Treviño and Aranda Cruzalta[7] give many examples of osteoarthritic bones throughout central Mexico, as well as rheumatoid arthritis. They go on to describe what is noted as wind sickness, weakness of the hands, pain in the knees, contraction of the knees, and gout or podagra, without identifying the underlying disease as we now know it. Studies conducted by Mexican rheumatologists demonstrated the presence of erosions in 21 skeletal remains stored at the National Institute of Anthropology and History from the Preclassical (Tlatilco) in 8 cases, 5 from the Classical (Teotihuacan) and 8 from the Postclassical period; Fraga[8] believes that these symmetrical erosive lesions suggest a diagnosis of rheumatoid arthritis. Rheumatoid arthritis is not considered a recent disease, although bone remains are difficult to analyse and interpret.[9,10] Martínez-Lavin et al.[11] showed the presence in old bone remains of data compatible with hypertrophic osteoarthropathy. This same group reported the presence in a skeleton from the post-classical period of data suggestive of ankylosing spondylitis,[12] and in the north of the country, bone remains have been collected with lesions indicating treponematosis.[13] Alarcón Segovia[14] reported data suggestive of rheumatological diseases, particularly osteoarthritis and vertebral tuberculosis.

Viesca[15] notes that Quetzalcoatl, in his form as Ehecatl, god of the wind, was involved in cases of rheumatological problems. He describes what is noted in some codices in relation to a large number of sick c̈rippled and lameṗeople gathering to pray to the god for health in the temple of Quetzalcoatl in Cholula, in present-day Puebla. It was noted that many of those who attended the temple at Cholula were rheumatic patients. Sahagún refers to the risk in spending the night in the mountains where there might be winds (*ehecame*) that could cause diseases such as colds, crippling and lameness.[16]

There are many examples of descriptions of diseases that we now consider rheumatological, although they are encompassed under terms such as gout, stiffness, numbness. Remedies are described ägainst weakness of the hands, against pain in the knees, against incipient contraction of the knees, against gout, against pain in the neck,, and several others.

Herbal medicine

Bernal Díaz del Castillo[17] described the impact of the Tlatelolco market on the Spaniards, due to its size and the order and diversity of products found there, including a great variety of vegetable products: ". . .since we arrived at the great plaza, which is called Tlatelulco, as we had not seen such a thing, we were amazed at the multitude of people and merchandise there and the great harmony and regimentation that they had in everything. . . There were many herbalists and merchants of other kinds". And the opinion of Hernán Cortés in his second letter of report to Charles V: "It has another square twice the size of the city of Salamanca, all surrounded by gates, where there are all kinds of merchandise that can be found in all lands. . . There are streets of herbalists, where there are all the roots and medicinal herbs that can be found in the land. There are houses like apothecaries, where they sell ready-made medicines, potables, ointments and poultices".

The therapeutic use of herbal medicine in Nahuatl medicine is remarkable. I give as an example descriptions from 3 main sources: The Codex De la Cruz-Badiano, published in 1552, the Florentine Codex, or *Historia general de las cosas de Nueva España*, which Sahagún started in 1557, and the Codex of Francisco Hernández, who started his works of analysis of herbal medicine in these lands in 1570. For this review, I provide a general outline of these works and examples of herbal medicine as applied to rheumatic diseases.

The Codex De la Cruz-Badiano

The first book written by indigenous people and produced in New Spain is the *Libellus de Medicinalibus Indorum Herbis* (Treatise on Indigenous Medicinal Herbs), which, as its name suggests, refers to with healing plants in the territory now known as Mexico. The book was written at the Colegio de la Santa Cruz in Tlatelolco, then on the outskirts of present-day Mexico City. This college was attended by the sons of the Mexica nobility and was directed by friar Jacobo de Grado, who sought funding from the Spanish crown with local data on herbal medicine. Martín de la Cruz was a prestigious *ticitl* due to his experience and extensive knowledge, even without formal education, based in Santiago Tlatelolco. He worked at the school attending sick students. He was commissioned to write a text on local remedies; the manuscript was most likely written in Nahuatl. Juan Badiano, a native of Xochimilco in southern Mexico City, also had knowledge of traditional indigenous medicine and formal education in Latin and Spanish, and therefore collaborated with De la Cruz in translating the document into Latin and probably modified it to make it understandable to Spanish readers. Native artists, *tlacuilos*, drew the plants that illustrate the work, and students of the college, educated in Spanish, Greek and Latin, probably participated in drawing up the *Libellus*. It was in the royal library at El Escorial and it seems that it was transferred to Italy by Cardinal Barberini in around 1625. It was later moved to the Vatican and from there to Mexico, where it has been since 1990.

The Codex De la Cruz-Badiano[18] describes 224 plants with 185 illustrations. The taxonomic identification of about half of the plants described in the Codex has been proposed, as well as their indigenous name, and their probable medical application. Bye and Linares[19] of the Institute of Biology of the Universidad Nacional Autónoma de México (UNAM) confirm that approximately 60% of the plants identified in the codex grow spontaneously in the Basin of Mexico.

The Codex consists of 13 chapters, each generally in an anatomical sequence. Thus, the first chapter covers diseases of the head, the second diseases of the eyes, the third diseases of the ears, the fourth diseases of the nose, and so on. The eighth chapter includes, among other diseases, p̈odagra, popliteal pain and incipient contraction of the kneesänd the ninth chapter, d̈iseases of the joints,. Many of the plants initially listed, under what we can infer to be rheumatic diseases, have not been identified or are no longer in use as indicated in the Codex. I will only mention a few that are still used as treatment for rheumatic diseases. However, it seems appropriate to start, as an example of the descriptions in the Codex, with cocoa, a plant that is well known and used today, although not specifically for rheumatic diseases. The scientific name is *Theobroma cacao*,[20] from the botanical family Malvaceae. The Nahua name is *tlapalcacahuatl* and the current common name is cocoa. It is described as a small tree with oblong leaves and flowers with pink petals. The use stated in the Codex ägainst the fatigue of those who administer

the republic and hold public offices has obviously changed, although cocoa is still used as a stimulant and as a beverage drunk for pleasure almost everywhere in the world. At that time, it was restricted to the nobility.

These are the kind of descriptions used throughout the *Libellus*, albeit more extensive and with several of the indigenous words that defined them. For this review I will only mention some of the characteristics described in the Codex with the above-mentioned criteria: they were used for rheumatic diseases (or for pains that nowadays could be attributed to rheumatic diseases), they are identified, and they are still used with similar indications.

Texochitl yamanqui has the scientific name *Selaginella lepidophylla*,[21] of the family Selaginellaceae; its current name is "*flor de peña*" or "*doradilla*". The use in the Codex is for contraction of the knees, but its current use is for rheumatism".

Tzitzicton, scientific name *Gymnosperma glutinosum*,[22] of the botanical family Asteraceae. Its current common name is *tatalencho* or *escobilla*. The use recorded in the Codex is also for incipient contraction of the kneesänd has been maintained to some extent, as today a decoction of the herb is taken and rubbed in to relieve joint pain.

Quauhtzitzicaztli, scientific name *Urera martiniana*,[23] of the botanical family Urticaceae. The current common name is chichicaztli. Its use in joint disease as designated in the Codex has continued.

Tetzitzicaztli, scientific name *Cnidoscolus* sp.,[24] botanical family Euphorbiaceae. Current common name is *chichicaztli*, "*mala mujer*" or nettle. The use as recorded in the Codex is for patients with joint disease has continued.

Tetzitzicaztli, scientific name *Cnidoscolus* sp.,[25] of the botanical family Rosaceae. The current common name is capulin. In the Codex it is indicated for joint disease. Nowadays it is used more generally used for the myoarticular system by massaging the whole body, including the joints, in the temazcal bath (traditional steam bath used at that time and still in use today).

Florentine Codex or Historia general de las cosas de la Nueva España

The Codex was also produced at the Colegio de la Santa Cruz de Santiago Tlatelolco, which, as we note above, was the most important centre for the sciences and arts during the early colonial period in New Spain. Fray Bernardino de Sahagún was the main promoter of the activities of the college, where the natural sciences, including Nahuatl medicine, were studied. It also taught Greek, Latin, and Spanish and what we would now call political science to indigenous people who came from the nobility. Fray Bernardino was born in the village of Sahagún, kingdom of León, in around 1500. He studied at the University of Salamanca between 1523 and 1528. He embarked from Cadiz for the so-called West Indies in 1529 and in 1536 he settled in Santiago Tlatelolco, where he was the main promoter of the college's activities. He wrote sermons in the Nahuatl language and collected prayers and exhortations used by the indigenous people. In the wake of the plague that struck New Spain, he began his research into what the indigenous people did to treat such diseases. He travelled to various parts of the country and during these journeys he continued his work gathering information, primarily through questionnaires that he presented to the most knowledgeable of the local indigenous people. After returning to Tlatelolco in 1565, he was sent to the convent of San Francisco in Mexico, where he spent three years revising and organising his documents into the form they are known today. These manuscripts make up the *Historia general de las cosas de la Nueva España*, which is the Spanish text of the Florentine Codex, as the king's representative ordered Sahagún to translate the Nahua texts in 1575. Thus, the work we know today as the Florentine Codex was produced in Tlatelolco. Fray Bernardino died on 5 February 1590.

The Codex, now in the Biblioteca Medicea Laurenziana in Florence (Italy) (hence the name Florentine Codex) is a work written in 2 languages by Nahua co-authors (*tlamatinime*) and illustrated by skilled indigenous painters (*tlacuiloque*). Its complex manuscript and illustrations make the Codex as whole a work of art. It depicts a world about to disappear after the war of conquest and epidemics. The authors and artists who decided to finish the work locked up in the college of Tlatelolco fought with brushes and nibs like warriors for life and against death. . . they made the world they inherited materialise, they created images to communicate what they saw in all its splendour through colour.[26] The importance of the colour pigments in the manufacturing process of the Codex, the influence of the painters on the work, as well as the methods they used to prepare these pigments, have recently been highlighted, and these data have been related to the historical context.[27]

Sahagún's work consists of 12 books covering not only medicine but all aspects of the life and culture of the ancient peoples of central Mexico.[28] However, in several of the books that comprise this work there are references to diseases and how to treat them. For example, the first book, which does not cover medicine or herbalism but rather the gods worshipped by the natives, describes the belief that certain illnesses derived from the cold, mainly in the mountains, referring to gout of the hands or feet. Sick people with these ailments made vows to the gods of air, water, and rain, as described above in relation to Ehecatl and his cult in Cholula.[16]

Chapter VIII of the tenth book[28] describes the medical activity of women or men: "the good physician is learned, a knower of the properties of herbs, stones, trees and roots, experienced in cures, his craft is to know how to set bones, to purge, to bleed, to cut, and to stitch, and finally to deliver from the gates of death". In this same tenth book, a chapter "diseases of the human body and of the medicines against them"[29] is described with 72 entries. One entry notes joint puncture[30] "for swellings or bulges of the knees it will be necessary to lance them, and thus the blood or *aguadija* will come out, and then a poultice made from the ground leaf of a certain herb called *toloa* will be applied". Remedies for "swellings and humours of the feet" are also described.

In line with the aim of this review, we shall focus on the eleventh book, which refers in clause 5 to the properties of medicinal herbs.[31] There are 98 clauses referring to such herbs, their general characteristics and their indications. Of these, only 4 refer to rheumatic diseases. One herb is called *cocotzauhqui xíhuitl*, with the indication that drinking it "makes rheumatism run away".[32] Another herb was called *cococxíhuitl*, which "purifies the throat from rheumatism and the chest". These 2 plants were also used for the management of coughs and to facilitate expectoration. There is another plant called *quauhxoxoxouhqui*: "the leaves and seeds ground all together and mixed with water and resin, washing the body with it combats gout; and when the gout has spread throughout the body and causes great pain, and the whole body is drying up, if it is washed with it or it is put all over the body mixed with resin, and feathered, with this it tames the pain; and also drinking the ground seed on an empty stomach and mixed with water tames the pain".[33] They also used the maguey,[34] *tlacámetl*, a drink known as pulque, still very common today, especially in rural areas. It was used as a poultice mixed with resin for gout pain or mixed with other herbs drunk for various types of pain.

The following is an example of how herbal medicine was used with other resources in cases of rheumatic disease of the hand: *xoxouhcapahtli* seed was used with *quetzalxoxoxouhqui* leaves and *yztauhyatl* herb, crushed and boiled in water.[35] In addition to the likely soothing effect of these plants, the patient was led to a hole where ants lived and instructed to "patiently tolerate your hands being bitten by ants". Therefore, in addition to herbal medicine,

ant bite is described, whose venom contains formic acid and piperidine, which are substances with some antioxidant and anti-inflammatory effect.

Both the Codex De la Cruz-Badiano and Sahagún's Codex describe other non-herbal remedies for the treatment of rheumatic diseases, such as that mentioned in the above paragraph, and others in which herbs were ground and mixed with animal substances (from scorpions or snakes), or with minerals. They also used physical remedies, such as massages in the steam bath called *temazcalli*.[36,37]

Francisco Hernández Codex

As we have already mentioned, many Spaniards who came to colonise New Spain were impressed by the efficacy of some indigenous medical resources, which came to the attention of the Spanish crown. For this reason, in 1570, Philip II, King of Spain, sent his personal physician, Francisco Hernández, to Mexico, who for 7 years gathered considerable knowledge about the country's medicinal plants and collected a magnificent herbal collection.[38] In 2015 in Mexico, the UNAM prepared and published the complete works of Francisco Hernández, in electronic and printed versions, gathering all the writings of the "*protomédico* general of all the Indies, islands and mainland of the Ocean Sea", on the occasion of the 500th anniversary of his birth.

Francisco Hernández was born in Puebla de Montalbán (Toledo) around 1517, studied medicine in Alcalá de Henares and undertook his professional work at the Spanish court and university. In January 1570, King Philip II proclaimed him "*protomédico*" of all the Indies and gave him detailed instructions on what he was to investigate in the New World. At that time, Spain and all Europe were closely watching what was new in America and its riches. There were new men, new customs, unknown plants, animals, and minerals; immense mountains, vast plains; seas, islands, and rivers of remarkable width, and soon the land offered gold, silver, precious stones, food, and medicine. The American pharmacopoeia spread rapidly across Europe. Many of the herbs and roots used by indigenous healers proved valuable in the European pharmacopoeia, so much so that they were praised by writers and poets of the time.

In Mexico, Spain was building a state organisation in its new territories on its own model. Military conquest gave way to civilian presence and gradually left the field open to physicians, pharmacists and naturalists, whose reports clearly showed the essential need to learn about indigenous herbal medicine. Therefore, the instructions issued by the king to Francisco Hernandez read[39] "It is hereby ordered that you, Doctor Francisco Hernández, our physician. . . First, that with the first fleet to leave these realms for New Spain you shall embark. . ., you shall consult, wheresoever you go, all the doctors, medicine men, herbalists, and Indians. . . and thus gather information generally about herbs, trees and medicinal plants in whichever province you are at the time".

During years of constant work, not only in the capital of New Spain but also in several of its provinces, Hernández completed a remarkable compilation work with his medical informants in these regions, who even 50 years after the conquest were still practising the medicine inherited from their ancestors. It is likely that such information was richer and more authentic in the Mexican province, as it is conceivable that medical ideas and practices from Spain had initially permeated the capital.

Doctor Hernández returned to Spain with extensive writings detailing many of his findings, which were handed over to the Spanish crown. Fortunately, he kept several originals and drafts. He died on 28 January 1587, having won over the newly discovered world with his medical and scientific vision.[40,41]

The works that remained in Hernández' home are preserved to this day and allow us to learn about his work, as Philip II commissioned the Neapolitan physician Nardi Antonio Recchi to produce an abridged version. This work was deposited in the library of El Escorial, where it remained until it was consumed by fire during the fire of 1671. The manuscript material that Hernández kept in his home was dispersed over time; most of it ending up in the Jesuit convent in Madrid; other works ended up in private libraries, thanks to which they have been preserved.

This great work describes 3076 plants; 3000 of them are listed in Nahua names, the rest in other native languages. They were found in 1858 localities; their medical use, dosage and in many cases form of preparation is indicated in the work.[42] One hundred and fifty-two chapters form the first book of the *Historia de las plantas de Nueva España*. The following paragraphs describe the order in which Hernández records in his *Historia* the data he obtained from his informants, from his travels around the country, often growing the plants himself and sometimes testing their effect on the natives and even on himself[43]:

a Name of the plant; the indigenous name is noted by Hernández, with a second name that translates the plant's meaning into Spanish, its medical action and similarity with another foreign plant.
b The description of the specimen, which usually begins by specifying whether it is a herb or a tree.
c On the "temperament" or "nature" of the specimen, heat, coldness, dryness, and humidity are referred to in different degrees.
d Form of action. In the *Historia* about a thousand plants are described as cold; there are slightly fewer hot plants and fewer than a hundred warm plants. Both the nature and form of action were concluded from the theory of humours, then prevalent in European medicine, and not what we now understand as the mechanism of action.
e Reference to the health problems that the plant is recommended to resolve.
f Place where the plant grows. Characteristics of the soil and climate.
g Special observations. Hernández' observations about certain plants show discrepancies between his ideology, principally the theory of humours, and that of the indigenous peoples. The most frequent differences lie in the treatment of fever.

Indeed, the most frequent problem lies in the indigenous treatment of fevers, which used to be with remedies that Hernández described as hot. According to his thinking, fever should be treated with medicines he described as cold, which did not always coincide with the indigenous treatments. Francisco Hernández knew and applied the theory of humours, inherited from Greek and Roman medical culture. The humours are referred to 13 times in the 152 chapters that make up the first book of the *Historia de las plantas de Nueva España*. In this review we mention this theory of humours because of the importance attached to them by Hernández, but we indicate the relationship with the therapeutic resources used in pre-Hispanic Mesoamerica, which shows the cultural and medical syncretism in this work.

Examples of what we describe can be found in several texts, such as that which states that "the joints loaded with humours are joints that are hindered, which are relieved with the decoction of *tzonpotónic*,"[44] or that *chichicahoazton* "thins and makes the humours accumulated in the joints disappear."[45] The "protomédico" explains the action of a *cihuapatli* "born in the warm lands of Yacapichtla - today's Yecapixtla de Morelos – which admirably resolves the humours that have penetrated the joints or the nerves ."[46] In other words, the causal role according to the theory of humours and the therapeutic resource according to indigenous herbalism,

as we mentioned, show the cultural and medical syncretism in Mesoamerica at that time.

The physicians

The vision and hard work of many of those who arrived from Spain with a scientific spirit and humanist vision is remarkable. As soon as the wars of conquest were over, they began to analyse the prevailing culture in the newly discovered lands, and in other situations, in relation to medical knowledge. For this purpose, the most commonly employed mechanism was the interview with indigenous doctors, the *ticiti* (plural of *ticitl*), who knew and used between 100 and 200 medicinal plants. Nahua doctors were not a homogeneous group.[47] Outside the big cities, healers with empirical training handed down from generation to generation prevailed. Another group comprised Nahua physicians who lived in the larger population centres and therefore had the advantage of an exchange of opinions and some institutionalisation of medical practice. Both groups of physicians shared their knowledge of beliefs, rituals, causes and manifestations of ailments, and knowledge of plants and other medicinal resources. However, being a member of the latter group required belonging to a few families in which knowledge was passed down from parent to daughter or son. The parent's profession was decisive for their offspring's activity as a *ticitl* and teaching was tutorial and at home, at least during the first years. As skilled artisans, they lived in special quarters for themselves.

The physician-priests were a third group. These underwent a rigorous apprenticeship in centres called *calmecac*, generally reserved for the nobility. We do not know for sure whether medicine was taught in these centres. However, we can assume that they learned the relationship between certain gods and particular ailments associated with them, including the preparation of certain medicines that were not accessible to other physicians. The priests had to know how to diagnose and treat the ailments caused by the particular deity they served. For example, the priests of Ehecatl were responsible for treating those suffering from rheumatic diseases, colds, and torticollis. Other gods caused other types of illnesses, and priests dedicated to that deity had to know the diseases specifically associated with them. Their training and knowledge were therefore more specialised and more closely related to their role as priests.

Conclusion

Our review of Nahuatl medicine from the perspective of rheumatological diseases and their treatment in pre-Hispanic Mesoamerica is biased towards our speciality. However, it provides an insight into the knowledge of the cultures prevailing in Mesoamerica in the 16th century and the mechanisms of cultural syncretism with the Europeans. Several of these therapeutic resources are used in Mexico to this day and merit further description and analysis by those of us who, not being historians or anthropologists, can contribute to the subject through our knowledge of rheumatology. In our review we acknowledge Nahuatl medicine as a major cultural phenomenon and, therefore, a source for future studies.

Conflict of interests

The author has no conflict of interests to declare.

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