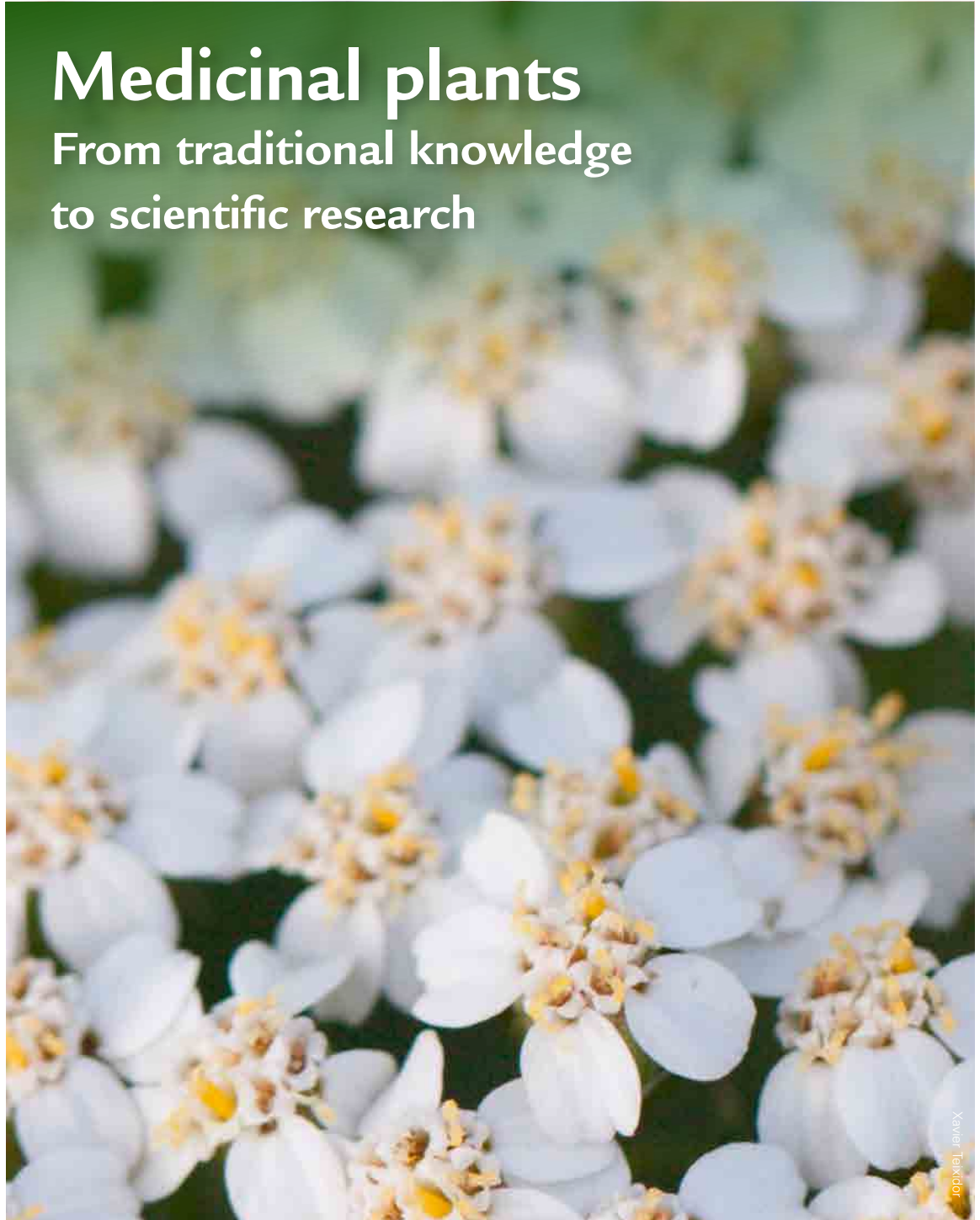


Medicinal plants

From traditional knowledge to scientific research

Yarrow is used
medicinally across
the globe as a tonic,
astringent, diaphoretic
and stimulant remedy.

Key words
medicinal plants
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DNA



Botanists estimate that there are more than 350 000 different plant species on Earth and many of these are used medicinally. There is evidence that plants have been used as medicines since prehistoric times. The pollen of yarrow (*Achillea millefolium*) was found in a Neanderthal burial site and archaeologists believe that the plant might have been used ritually and medicinally. In the 1st century CE, the Greek author Dioscorides wrote the most detailed guide to medicinal remedies of the time, which included 600 different plant remedies and greatly influenced the development of European medicine.

Plants are not commonly used in European medicine any more, but many chemical compounds in pharmaceutical products are extracted from plants. Importantly, many people around the world, especially in developing countries, rely on

herbal remedies. These may be the only source of medicine available.

What makes a plant medicinal?

Only a portion of plant diversity is used medicinally. Many human cultures have selected some of the plants available because of their perceived healing effects. Local herbal remedies are part of a culture's Traditional Ecological Knowledge (*see box below*).

Medicinal plants often have particular tastes and smells, and these organoleptic properties have guided the identification of effective medicinal plants. These properties can be clues to the plant's chemical makeup, and often confer its effectiveness on the plant. Plants produce these molecules mostly as defence mechanisms against insects, fungi and herbivorous mammals.

Traditional Ecological Knowledge

Traditional Ecological Knowledge (TEK) is the body of knowledge about the natural environment, held by a community and transmitted orally. TEK includes a system of classification of nature, empirical observations of the local environment, a system of community governance, and the skills necessary to carry out traditional practices such as agriculture, healing or manufacturing items (such as baskets and tools). TEK can also be expressed in stories and songs, it is encoded in cultural values, and embodied in everyday practice. It develops from the experience of a community in a particular landscape over centuries, each generation building upon the knowledge of earlier generations, adapting to technological and socioeconomic changes.



The bark of walnut tree (*Juglans regia*) is used as a mouth antiseptic in the High Atlas mountains (Morocco). An Ashelhi man is preparing this herbal remedy.

Why study medicinal plants?

There are many scientific disciplines engaged with medicinal plant research, from pharmacology to anthropology, genetics and evolutionary biology, as well as sociology and, of course, botany. Research on medicinal plants aims to document their diversity, to ensure its sustainability and safe

use, to promote biocultural conservation and to find chemical compounds that could inspire new pharmaceuticals.



Collection of medicinal plant samples. Herbarium specimens are pressed plants that botanists use to identify species.

The documentation of medicinal plants has been an ongoing effort for decades if not centuries, but much is still unknown. Communities that rely on the use of medicinal plants, would often stop using them when modern medicines become available. Then, Traditional Ecological Knowledge about plant medicines is not transmitted to younger generations, and when elders die, this knowledge is lost forever. Community associations and ethnobotanists (scientists who study the use of plants by different cultures) work together in initiatives aimed at writing this knowledge down.

The loss of medicinal plant knowledge is one aspect of biocultural diversity loss. Biocultural diversity refers to the diversity of life in all its manifestations. Biological, cultural and linguistic diversity are interrelated; areas with a high richness of species are inhabited by many different societies, each with its culture and language. Indigenous peoples often developed livelihoods that have low environmental impact and use natural resources in a sustainable way. These traditional lifestyles not only maintain biodiversity, but sometimes even enhance it by managing and protecting animal and plant species.



An Amazigh elder in the High Atlas (Morocco) collecting fennel, a locally managed species used as a medicinal plant (*Foeniculum vulgare*).

Amadou Hampate-Ba, a Malian writer, is credited with saying: “When an old man dies, a library burns to the ground.”

Barcoding for sustainable and safe medicines

Medicinal plants are not only used in rural communities, but also in urban areas where they are sold in shops and markets. Many of these plants are harvested from the wild, and whilst an increased demand can help develop the rural communities that collect them, it can also promote unsustainable collection. Some plant species that were abundant are becoming scarce, threatened with extinction. Thus, it is important to identify plants being sold and ensure that threatened species are not traded.



Tiguendizt is the vernacular name for Anacyclus pyrethrum, a medicinal plant that could soon be extinct. Photo by Vincent Manzanilla.

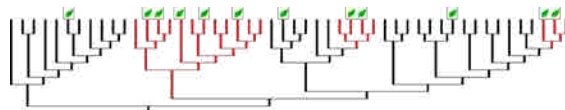
Botanists identify plants by looking at their morphological characteristics such as leaves, flowers, fruits and seeds. However, this is challenging when plants are traded; they are often sold dry and even as powders. New DNA barcoding methods are being developed to identify species based on their particular DNA sequences. DNA is extracted from biological material, then sequencing reveals the individual combination of nucleotides. Specific regions in the genome are used to differentiate species. This allows identification of an herbal remedy, even if there are no morphological traits to be observed.

DNA barcoding is not only useful to track endangered species' trade, but also to find out when a product is contaminated or adulterated. Contamination happens when other plants are mixed unintentionally, and adulteration refers to the

purposeful substitution of one species by another. Traders may adulterate herbal medicines to increase the quantities sold. The regulation of medicinal plant trade is critical, since ineffective and even toxic plants may be sold under the wrong name.

New medicines

Medicine is still unable to cure many of the world's most widespread diseases. Finding and developing new chemical compounds as pharmaceuticals is one of the ways in which scientists look for cures, but this is a time-consuming and expensive endeavor. Pharmacologists and evolutionary biologists have developed new methods to explore plant diversity in order to find effective medicines. Plants are evolutionarily related, which means that some species are more similar to each other because they come from a common ancestor. If many plants in a clade (group of organisms that comprise the evolutionary descendants of a common ancestor) are used medicinally, it is likely that other non-used species in the same clade have similar medicinal properties.



Phylogenetic tree where plants used traditionally as medicines are highlighted by a green leaf. Clades in red are rich with medicinal plants; some of the non-used species could harbor new cures. Graphic provided by Estevão Fernandes de Souza.

Good health is one of the 17 Sustainable Development Goals, a United Nations' initiative to ensure the human rights of living in a healthy and productive environment. Promoting Traditional Ecological Knowledge, understanding medicinal plant diversity and protecting it are central to guarantee safe and effective medicines for all.

Irene Teixidor-Toneu is a PhD student at the University of Reading who researches medicinal plant use in Morocco. She has done extensive fieldwork among Amazigh communities in the High Atlas mountains.

Look here!

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PHYLOGENETIC EXPLORATION OF MEDICINAL PLANT DIVERSITY