Untapped resources for medical research

A therapeutic solution to the current coronavirus (COVID-19) pandemic is urgently needed, but new drug discovery and development is a lengthy process. Pharmaceuticals derived from plants and fungi remain important in our armory against numerous diseases (*1*, *2*), yet much of plant and fungal biodiversity remains unexplored for drug discovery (*3*). Of about 390,000 known plant species, 7% have medicinal uses (*4*), and the wider potential of the world's flora to yield new medicines has been discussed by conservation biologists for decades (*5*). We urgently need a comprehensive scientific study of biodiversity to inspire, accelerate, and innovate medicinal discovery.

Acquiring usable plant and fungal material is resource-consuming, but a partial solution lies in specimens already housed in herbaria, botanic gardens (*6*), and fungal biological resource centers. Herbaria host about 380 million specimens from all described plant species, and botanic gardens maintain about one-third of all known land plant species (*7*). Fungal collections currently host about 860,000 strains worldwide (*8*). These collections are invaluable resources representing unparalleled chemical diversity.

Evolutionary relationships inferred from DNA could be used to guide selection of species with medicinal potential. Just a few milligrams from specimens enable comprehensive chemical profiling, uncovering new chemical entities that share chemical or physical characteristics to drug molecules, potentially with novel modes of action (*1, 2*). Artificial intelligence and emerging technologies could reveal compounds with mechanistic effects relevant to diseases threatening humanity (*2*, *9*). Furthermore, collections are increasingly used to generate genomic data, which could be used to identify members of gene families known to be involved in the synthesis of useful compounds (*10*).

Investing in a new era of large-scale exploration of therapeutic candidates from nature could help humanity prepare for future health challenges. Scientists, stakeholders and governments must establish functional and equitable agreements to ensure that this work complies with the Nagoya Protocol, Access and Benefit Sharing legislation and reflects the value and origins of specimens collected during the colonial era (*11*). It is also critical that benefits revert to the nations and ethnic groups from where these resources derive (*12*).

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