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File: ■ Medicinal Plant Investigations
■ Voucher Specimens

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RE: Voucher Specimens Essential in Medicinal Plant Research

Eisenman SW, Tucker AO, Struwe L. Voucher specimens are essential for documenting source material used in medicinal plant investigations. *Journal of Medicinally Active Plants*. January 26, 2012;1(1):30-43.

Using high-throughput screening and genomics, 21st century phytochemical researchers can generate vast amounts of data with relative ease. Yet without one of the basic practices of botanical research – the collection, documentation, and preservation of voucher specimens – much research may not be reproducible, and thus is ultimately worthless.

Of earth's still-uncounted plant species, estimates of the number already described range from 200,000-420,000; this biological diversity has allowed humans to utilize a huge number of botanicals. Variation within species, hybridization, and the difficulty of distinguishing among similar species in some genera can lead to incorrect identification of plant materials. It is therefore essential to document the identity and source of plant materials by preserving voucher specimens. Doing so can ensure reproducibility of research and facilitate consistent quality in botanical products, in which inter-batch variability challenges many manufacturers.

The earliest herbaria (collections of preserved plant specimens) were made up of plants from medicinal (physic) gardens. For example, the Oxford University Herbarium, the oldest in the UK and fourth-oldest in the world, was founded in 1621 to document plants from the Oxford Physic Garden. Institutions worldwide now host herbaria whose collections, in their entirety, may house many different specimens from a particular species, collected at different times and places. Such holdings in total are the best record of morphological and anatomical variation as well as distribution of that species.

A plant voucher kept in an herbarium generally consists of the whole plant dried, pressed, preferably with flowers and/or fruits as well as all accessible vegetative parts, glued to archival paper that bears a label detailing exact location, date, and collector attached to the archival sheet. When researchers collect materials in the wild, they are responsible for proper vouchers being prepared. Whenever possible, field identification should be verified by a trained taxonomist. Vouchers should be preserved in a facility that will make them permanently available to other researchers. Best practice includes preparation of multiple duplicates of the voucher collection, if possible from the same plant, to be deposited in more than one herbarium under conditions that will ensure long-term preservation. Vouchers are equally important in accurately identifying fungal species, which are also preserved in herbaria as dried specimens in paper or waxed paper envelopes.

Where researchers do not collect their own material, but use commercially obtained raw or processed (often powdered) material, the need for proper vouchering is even more critical. After purchased material is identified as rigorously as possible by morphological, chemical, or molecular analysis, a bulk reference voucher should be prepared, with as much precise information as possible on name origin, batch number, date of receipt, and any further details the supplier can provide, such as collection location. Samples of any packaging materials should also be saved.

The authors discuss several research projects affected by vouchering issues. Species misidentification is probably the most common error in plant research. In one study, a bulk sample with a sterile (lacking fruit or flowers) voucher collected in Cameroon was first identified as *Ancistrocladus abbreviatus*. The collected sample showed anti-HIV activity from two novel alkaloids (michellamines) isolated with bioassay-guided fractionation. Follow-up research required more plant matter, and another bulk sample of *A. abbreviatus* was obtained from Gabon; however, it was not bioactive, and contained no michellamines. The existence of the voucher allowed a new collection to be made from the population at the original collection site, and the plant was identified as a new species, *A. korupensis*. In the new material of that species, anti-HIV activity and michellamines were again seen. A voucher specimen that is initially misidentified can be annotated with a new species name when the error is discovered.

Intra-specific variation in plants is at times bewildering. In one striking example, tarragon (*Artemisia dracunculus*), a widespread, diverse, herbaceous perennial, has been used medicinally and as a culinary herb in many parts of its vast range (western North America, Asia, and Eastern Europe). Tarragon contains a wide array of phytochemicals, but also presents an extensive series of polyploid cytotypes (diploid, hexaploid, octoploid, and decaploid), each distinct in phytochemical composition. Studies of samples from many sources found that some cytotypes contain specific antidiabetic compounds while others do not. Vouchering of materials subjected to study made it possible to confirm that varying results were really due to variation within a single species and not to misidentification of samples.

The US Food and Drug Administration's Guidance for Industry: Botanical Drug Products says suitable voucher specimens for each botanical ingredient in a product "should be established, along with a reference standard for the drug substance and drug product." To describe and name a new plant taxon, the International Code of Botanical Nomenclature requires that a "holotype," a specimen that permanently fixes the identity of the new taxon, be prepared or designated from previously collected material, and that the herbarium where it is conserved be named. Voucher specimens can serve as a source of plant tissue for DNA analyses. Most journals require that DNA and amino acid sequences used in publications be submitted to a database such as GenBank, but some still do not require that the identity and location of vouchers be specified for the samples from which sequences are taken, providing an opportunity for error in otherwise valid reports. Voucher specimens, which provide permanent evidence of the exact species used in any study, are fundamental requirements for accurate, reproducible plant-based research and manufacturing.

—Mariann Garner-Wizard

Referenced article can be found at http://scholarworks.umass.edu/jmap/vol1/iss1/8.