



Cultivated Plant Collections from Market Places

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Abstract

The study of cultivated plants from markets places can reveal interesting information on the interactions and relationships between people and plants. Despite this, cultivated plants are often overlooked and not vouchered in ethnobotanical studies. This article was written for Ethnobotany Research and Applications to reaffirm and to reach a wider audience of colleagues, via an electronic journal, the importance and proper conventions for the collection, maintenance, and use of voucher specimens, particularly for cultivated plants. A case study with *Colocasia gigantea* (Blume) Hook. f. is presented to help illustrate these points.

Bộ sưu tập các loại rau được trồng thông qua thu thập tại các chợ. Sự nghiên cứu về các loại cây trồng dùng làm rau bán tại chợ có thể cho chúng ta những thông tin thú vị về mối quan hệ và sự tương tác giữa con người và thực vật. Mặc dù vậy, các nhà khoa học thường xem nhẹ việc thu thập những loại cây đã được trồng trọt để làm mẫu vật cho các cuộc nghiên cứu thực vật học dân tộc. Báo cáo này được viết cho tập Ethnobotany Research and Applications (Sự nghiên cứu và ứng dụng thực vật học dân tộc) để khẳng định và thông tin đến được tới nhiều đồng nghiệp và bạn đọc thông qua một tập san điện tử về tầm quan trọng và các bước hợp lý cho thu thập, duy trì, và cách sử dụng những mẫu thực vật, đặc biệt cho các loại cây trồng. Tôi có đưa ra ở đây một nghiên cứu về trường hợp cây *Colocasia gigantea* (Blume) Hook. f. để minh họa cho vấn đề được nêu ở trên.

Les collections de plantes cultivé des marchés. L'étude de plantes cultivé des marchés peut révéler intéressant l'information sur les interactions et les relations entre les gens et les plantes. Malgré ceci, les plantes cultivé sont souvent négligées et pas recueillies dans les études d'ethnobotanique. Cet article a été écrit pour la Recherche et les Applications d'Ethnobotanique pour réaffirmer et atteindre un auditoire plus large de collègues, via un

journal électronique, l'importance et les conventions correctes pour la collecte, l'entretien, et l'usage de spécimens de certificat, particulièrement pour les plantes cultivé. Une étude de cas avec *Colocasia gigantea* (Blume) Hook. f. est présentée pour aider illustre ces points.

Introduction

Marketplaces found in many cities and towns are rich sources of ethnobotanical information. They are places of intensive interaction between people (vendors and consumers) and people and plants. Marketplaces are readily accessible and cost effective places for fieldwork, providing qualitative and quantitative data concerning cultural, social and economic aspects of a plant's usage (Bye & Linares 1983, Cunningham 2001, Martin 1992).

Working in Mexico, Whitaker and Cutler (1966) recognized the value of markets "as vital botanical records of the history of useful plants in a region." Their comparisons of cultivated *Cucurbita* L. from markets with samples excavated from caves demonstrated changes in form and abundance of cultivars. They attributed this to a relationship between the changes in plant cultivars and cultural

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Ethnobotany Research & Applications 3:005-015 (2005)

conditions, including the relationships and movements of human cultures. Observing the early effects of globalization on the area they called on the need for carefully documented collections and records of markets.

Influenced by Whitaker and Cutler (1966), Johnson and Johnson (1976) analyzed data from surveys of two rural markets near Benin, Nigeria. They found that indigenous African food species were absent or had been replaced with introduced 'globally' marketed species. For example, the indigenous West African rice species, *Oryza glaberrima* Steudel, was largely replaced by *O. sativa* L.

More market studies have shown the historical changes in food supply. van den Berg (1984) surveyed and collected vouchers of plants from the Ver-o-Peso market in Belém, Brazil. van den Berg recognized five distinct sections of the market: 1) handicrafts, 2) medicine and magic plants, 3) horticultural and ornamentals, 4) fruits, and 5) vegetable and root crops. Over an 18 year period, van den Berg saw an overall 50% decline of plant species due to cultural migration and modernization. However, there was an increase in variety and quantity in the vegetable and root crop markets reflecting the horticultural and market-gardening practices of recent Japanese immigrants to Northern Brazil.

Before Whitaker and Cutler called attention to market places, Asian immigrants in the U.S. were recognized for introducing new food species. Food plant diversity in the state of Hawai'i has been diversified with the immigration of Asians since 1852. Chung and Ripperton (1929) reported plants locally cultivated and sold in the markets that are indigenous to the "Orient [that] has been gradually accumulated in Hawaii, where they are considered unique botanically and valuable dietetically." Miller (1933) discussed specifically "Japanese" food plants and plant-products, including algal species and soybean (*Glycine max* (L.) Merr.) products not covered by Chung and Ripperton (1929).

Porterfield (1951) described Chinese "vegetable foods" and food plants collected from the Chinatown markets of New York City before World War II. He recognized the lack of information regarding metropolitan Chinatown markets, but noted that their great diversity has "excited the curiosity of those looking for exotic foods." The purpose of these studies was to provide nutritional and use information, including recipes (Chung & Ripperton 1929, Miller 1933), on the plants so that they could be better known and incorporated into local diets. Miller (1933) hoped his bul-

letin would promote *in-situ* conservation of "racial foods" among younger Japanese. Work currently being conducted at the University of Hawai'i and New York Botanical Garden should provide interesting updated information regarding the dynamics of the food plant species and ethnic communities in those markets since these initial surveys.

The market studies discussed above and others (Bye 1986, Mertz *et al.* 2001, Williams *et al.* 2000) have drawn interesting conclusions and new questions regarding the interactions and relationships between people and plants. However, many market studies lack in scientific rigor by not making voucher collections of the plants listed or described. There is an even greater bias against the collection of "common cultivated plants." In such studies, it appears that common cultivated plants are just that, common, their identification known, and therefore, not worthy of a voucher collection.

As reviewed above, cultivated plants do reveal interesting ethnobotanical information. These are often the plants that have been introduced into the culture. It is these plants that are important to collect and record as they document historical patterns of plant introductions and dynamics in cultural foodways (e.g., changes in diet). As an example, my herbarium research on Vietnamese food plants used during the early French colonization of Vietnam has shown that many plants that were probably commonly eaten were not collected, though many were described in the concurrent French-Indochina literature as being newly introduced and incorporated into local agricultural systems (Crevost & Lemarié 1917). Interestingly, the absence, as well as the presence of species represented by vouchers in herbaria and referenced in the literature can suggest motivations of plant collectors and their sponsors at the time. For example, the purpose of French botanists surveying the new colonies was for the exploration for new and better tropical economic plants (Lanesan 1886, Lecomte 1908-42).

Furthermore, not collecting vouchers may be due to the challenges presented by collecting food plants in market places. Plants found as fruits can seem daunting for making vouchers (e.g., gourds [*Cucurbita* sp.] [Figure 1]). More often, food plants are found in juvenile or sterile condition or only the edible portion is available, making their identification difficult (Lee *et al.* 1982, Nguyen n.d., Williams *et al.* 2000). However, voucher specimens are an essential part of market and ethnobotanical studies (see Box 1). In addition to the value of a voucher specimen, the Association of Systematics Collections goes on to say that

Box 1. The value of the voucher specimen. (Lee *et al.* 1982:5)

The Association of Systematics Collections (ASC) states: "A voucher specimen is one which physically and permanently documents data in an archival report by: (i) verifying the identity of the organism(s) used in the study; and, (ii) by so doing, ensures that a study which otherwise could not be repeated can be accurately reviewed or reassessed."



Figure 1. Gourd and other “vegetable” fruits vendor. Biên Hòa Market, Biên Hòa City, Vietnam.

“the extreme importance of voucher specimens has been overlooked far too long,” and that the scientific objectivity and accuracy of a project are seriously compromised when they are necessary for documentation (see Box 2 and 3), yet not collected and appropriately maintained. So critical is the issue, that they called for ALL scientific societies or publishers responsible for scientific journals to publish instructions for the criteria used to decide whether vouchers are necessary, and in those cases where they are necessary, to refuse publication of papers that do not note deposition of voucher material in a suitable repository (Lee *et al.* 1982:11).

There are many books describing ethnobotanical methodology, including conducting market studies and making voucher specimens (Alexiades 1996, Cotton 1996, Cunningham 2001, Martin 1995). I recommend reviewing each one as they individually provide valuable nuances. Martin (1995) provides good descriptions for making voucher collections and includes a copy of a survey form used in an ethnobotanical market study (Martin 1995:194). Cunningham (2001) goes beyond the traditional survey and addresses the analysis of market systems and networks

in Africa. For ethnobotanical work in market places, Bye and Linares (1983) provide detailed methodologies (Box 4) for the collection of voucher specimens in a market survey specifically addressing the inherent challenges associated with market plants. Additionally, Bye's (1986) thorough discourse of voucher specimens in ethnobiological studies provides details not only for collecting but also for citing them in publications.

Despite the available literature citing the value, acquisition, and use of voucher specimens, they remain overlooked in many ethnobiological studies, particularly where cultivated plants are involved. Part of building the strength and rigor of ethnobiological sciences is to establish, and to follow established conventions for our work. This is a pivotal time to reaffirm foundational elements for biological studies. With a focus on cultivated plants from market places, I highlight here some important methods for the collection, management, use, and citation of voucher specimens. I provide a case study from my research to help illustrate these points. It is hoped this article in *Ethnobotany Research and Applications* may be more accessible to our colleagues as an electronic journal than per-

Box 2. Voucher specimen requirements in order to fulfill their function. (Lee *et al.* 1982:7)

1. Have recognized diagnostic characteristics that are appropriate to the level of identification in the report (see Box 3).
2. Be preserved in good condition and according to acceptable practice.
3. Be thoroughly documented with field and/or other relevant reports.
4. Be maintained in good condition and be readily accessible in a suitable repository institution(s).

Box 3. Forms of voucher specimens. (Lee *et al.* 1982:6-7)

1. The actual organism (part or whole) of research.
2. A sample of one or more individuals from a population being studied, observed, or treated.
3. A representation of the organism(s) or its characteristics (e.g., sound recordings, photographs, fossils, etc.) in the research. However, these are usually not adequate as a substitute for voucher specimens and should be used only when the organism themselves are impractical or illegal to collect.
4. An associated specimen that is biologically or functionally related (e.g., seeds, pollen preparations, stomach contents, etc.) to the study organism. The basic evidence studied by the ethnobiologist may not be the standard materials used by taxonomists (e.g., flowers). In these cases a voucher specimen of the organism should be prepared, in addition to an appropriate preparation for the associated specimen. These are deposited and cross referenced between the voucher and the associated specimen (see Bye 1986).
5. A corroborative specimen. A collection of a previously collected voucher specimen that is at a different time or stage of life cycle that provides additional data. For example, Bye and Linares (1983) collected plants from the farms or fields of the same population where the original market specimen originated. They also collected additional material when the specimens were fragments or parts (e.g., seeds, stems, and roots), using them as “propagation specimens” to produce more taxonomically important parts that then served as corroborative specimens.

Box 4. Market survey methodology used by Bye and Linares (1983). For greater detail see that article and also Alexiades (1996) and Martin (1995).

1. Go to the market early in the morning and on a regular schedule. Arriving early enables you to make collections and access vendors before the market becomes very busy with shoppers. Regular visits enable you to observe changes in offerings (e.g., seasonal fruits).
2. Interview and record the vendor about the plant, including:
 - a) plant name(s),
 - b) purpose(s) and use(s),
 - c) preparation(s),
 - d) qualities (e.g., "hot", "cold", flavor, etc.),
 - e) source area,
 - f) gathered or cultivated,
 - g) plant community and habitat or origin,
 - h) price of the unit sold, and
 - i) type of vendor (e.g., resale vendor, collector-vendor, etc.).
3. Plant documentation and collection.
 - a) Plants are purchased.
 - b) Original vouchers prepared.
 1. Herbarium specimens: material that can be pressed in a standard plant press.
 2. Case specimens: bulky material that is dried or placed in liquid preservative[†].
 - c) Propagation specimens: for specimens that are seeds, stems, and roots, additional material is purchased to propagate specimens for the collection of important identification characteristics (e.g., flowers).
 - d) Photographs taken of the specimens.
4. Field visits to places where products are derived to collect corroborative specimens and record additional ethnobotanical and ecological data.
5. Identification of specimens using flora literature, comparison with identified voucher specimens in herbaria, or with the assistance of an expert.
6. Labeling of voucher specimens.
7. Deposition of vouchers, photographs and notes in the appropriate herbaria.

[†] I recommend thinly slicing bulky material and sun or air drying to remove excess water followed by pressing in a standard plant press (Figure 2). In this way herbarium specimens can be prepared rather than making case specimens that require additional maintenance.

haps the earlier printed articles by which this article was inspired (cf. Bye 1986).

The Case Study: *Colocasia gigantea* (Blume) Hook. f. (Araceae) in the market.

Food plants identified by Vietnamese participants in a survey conducted in Hawai'i were collected from the Chinatown markets in Honolulu, Hawai'i. *Colocasia gigantea* was included in the market collection. *Colocasia gigantea* is cultivated for the use of its petioles as an essential, traditional ingredient in making a Vietnamese soup called **canh chua** (Nguyen n.d.). In the Chinatown markets of Hawai'i, and other Asian markets internationally, the aroid petiole is sold whole or cut into smaller sections with the leaf blade completely removed (Figure 3).

Identification of specimens

The identification of the aroid is complicated by the lack of fertile specimens in cultivation, fragmentary condition in market settings, reference by different regional vernacular names, and reference by different scientific names.

While dictionaries or checklists can be useful resource materials, they should not be used to simply match folk names to a scientific name for identification (Mead 1970). Regional differences in local names can make this a frustrating exercise. Incorrect or questionable determinations may be perpetuated through authors employing this method and publishing the names in their works. Specimens should be identified using available floristic literature, comparison with specimens already determined and deposited in herbaria, or by a taxonomic specialist (Bye & Linares 1983).



Figure 2. Bulky specimens sliced and being sun dried to remove excess water prior to pressing in a standard plant press.



Figure 3. *Colocasia gigantea* petioles for sale in Asian grocery store located in Chinatown, Paris, France.

Colocasia gigantea is referred to as *bac hà*, in southern Vietnam and by Vietnamese speakers in the U.S. In northern Vietnam, it is called *độc mùng*, while *bac hà* refers to a culinary mint herb: *Mentha arvensis* L. or *Mentha x pandiperita* L. Many plant species have multiple regional names resulting from Vietnam's geographic and political northern, central, and southern divisions. Folk names, however, included on voucher specimens are important for, and should be included in, ethnobiological collections

(Bye 1986). In many cases while examining *C. gigantea* vouchers, the combination of a physical specimen that included the folk names and uses provided data for cross-referencing with cultural representatives and literature sources and the opportunity to learn historical information not found in printed literature (Figure 4) (also see Nguyen n.d.).



Figure 4. Voucher specimen of *Colocasia gigantea* collected in Hawai'i in 1935 (original citation: *Colocasia esculenta* (L.) Schott G.P. Wilder s.n. BISH! sheet 666211). The original label includes the Japanese folk name and information on food usage. This specimen has been re-evaluated and re-determined from *C. esculenta* to *C. gigantea*, an important scientific work that may not have been possible if it was recorded with a photograph only.

Beyond the Market

Identification of sterile plants or plant parts may require tracing their path to the market back to the area of production (i.e., commercial farm, home garden, 'wild' collection sites). This usually requires that the researcher has established a rapport with the vendor, delivery person, farmer or gardener in order to ask to see the plants at the farm or in the person's garden.

From my research, only the petiole of *C. gigantea* was reported and observed as being used for food and sold in Honolulu's Chinatown markets. All of the specimens I examined in home gardens in Hawai'i were sterile (Figure 5). The identification of this aroid in many literature sources

(Hodel *et al.* 1999, Matthews 2004, Nguyen 2000, Phạm 2000) is divided between *Alocasia odora* (Roxb.) K. Koch and *C. gigantea*. Working through a network that included a vendor of *C. gigantea* and a restaurateur, I was introduced to a Vietnamese farmer from whom I collected flowering specimens of *C. gigantea* for identification during a visit to his commercial farm.

Photographing Specimens

With digital photography and the Internet, now, more than ever, the method of photographing voucher specimens and having them accessible should be encouraged for any work where they are included (Flaster 2004). It is a cost effective method for research and education, via



Figure 5. *Colocasia gigantea* in Mai Thị Huệ's home garden in Hawai'i. Note its usual sterile condition in cultivation.

sharing information for comparative work with colleagues, checking identifications or learning the plants. In the study of *C. gigantea*, I was able to send my digital images of the plant habit and gynoecium to experts in the U.S. and Asia for identification. The carefully prepared images were sufficient for a quick identification and response. Although a photograph cannot entirely replace the physical specimen in the herbarium, it was a satisfactory alternative to the traditional mailing of the herbarium sheets that would have required a much greater output of resources for the experts and me.

Using photographs as vouchers, in addition to collecting specimens, and depositing them in herbaria is common (Nguyen 2003, Pemberton & Lee 1996, Porterfield Jr. 1951). Others have used digital photography exclusively to record species in a study (Hodel *et al.* 1999). This is not recommended because a photograph, while convenient for sharing information, does not provide the level of information available from the real plant. Information that can be used to verify the identity of the plant, review or reassess a study, or provide material for additional studies (e.g., anatomical, chemical, molecular).

Deposition of Voucher Specimens

Voucher specimens need to be deposited, maintained properly, and available to researchers. Often collections of cultivated plants do not fit the criteria for acceptable specimens by curators because they are sterile or consist of fragments. For the best assurance that your collections are adequate and will be accepted, or at least some of the specimens will be acceptable, it is best to establish contact with the primary repository before you begin your work to understand their current curatorial practices (Bye 1986). If you will be working in a location for several years, you could concentrate on finding better specimens after the initial collection (Martin 1995). If no institutions will accept your vouchers, you can share them with interested colleagues.

Due to the importance of vouchers in biological studies, it is essential to:

1. deposit your original or corroborative voucher specimens in a proper repository,
2. link them with your associated specimens, and
3. have duplicates of the specimens available to share with others.

Citation of voucher specimens

The proper citation (Box 5a) of voucher specimens (see Box 5b for examples) links the physical evidence of the organism with the research publication. The citation of the voucher includes the scientific name of the specimen at the most accurate taxonomic level possible. Intraspecific taxa (e.g., subspecies, variety, cultivar, etc.) are included if known. Refer to the International Code of Botanical Nomenclature (Greuter *et al.* 2000) and the International Code of Nomenclature for Cultivated Plants (Brickell *et al.* 2004) for more information on the citation for plant names.

Conclusions

Market places are important areas to study the interactions and relationships between people and plants. Cultivated plants from markets can be used in studies to better understand the food history of a community(ies) or region. The collection of voucher specimens, including those of cultivated plants, is an essential element of ethnobiological studies.

Even with the challenges and biases against market collections and those of cultivated plants, it is essential that the scientific community of ethnobiologists, authors, and publishers of scientific literature understand the importance and proper conventions for the collection, maintenance, and use of voucher specimens.

My experience with the collection of cultivated plants in market places, and in particular to the food plant, *Colocasia gigantea*, underscored for me the need to document floristic and ethnobotanical work with good voucher

Box 5a. Items in a voucher citation. (Council of Biology Editors Style Manual Committee 1994)

1. Scientific name of the specimen (*Genus species* Authority).
2. Collector name(s) and number(s). Like the generic name, specific and subspecific epithets, are *italicized* or underlined.
3. Herbarium identifier (full name, or if available for major institutions, the code designation cited according to the abbreviation system of Index Herbariorum (Holmgren *et al.* 1990).
4. If the author of the study examined the specimen, an exclamation mark (!) after the herbarium identifier. This designation (!) also gives the study more credibility because the researcher actually saw the physical specimen!

Box 5b. Voucher citation examples.1. *Colocasia gigantea* (Blume) Hook. f. *M.T. Nguyen 114 HAW*

The herbarium specimen of taro (*Colocasia gigantea* (Blume) Hook. f.), was collected by M.T. Nguyen, this is the collector's 114th voucher and is deposited at the herbarium of the University of Hawai'i at Mānoa that is officially recognized as HAW.

2. *Colocasia antiquorum* Schott var. *esculentum* (L.) Schott *F.R. Fosberg 11243 BISH!*

This was F.R. Fosberg's 11243rd voucher specimen and is deposited at the herbarium of the Bishop Museum in Honolulu, Hawai'i officially recognized as BISH. The example ends with the exclamation point (!) designating that it was examined by the author of the study.

3. *Colocasia antiquorum* Schott var. *esculentum* (L.) Schott *F.R. Fosberg s.n. BISH!* sheet 115605

This was also collected by F.R. Fosberg but was not assigned a voucher number (*s.n.* = *sans nombre*, without number). The herbarium of the Bishop Museum, the repository institution, however, has given it an institutional number identifying the sheet as 115605. This number is usually entered into a database or other information retrieval system at the institution.

specimens that include the vernacular names and cultural uses.

Acknowledgements

In addition to acknowledging their explorative spirits and unwavering support, I thank: Dr. Sovanmoly Hul, curator of the Asian Collection of Paris Herbarium, Laboratoire de Phanérogamie, Muséum National d'Histoire Naturelle in Paris, for providing the get-a-way car to Chinatown; Bác Hai (Mrs. Nguyễn Thị Gai) for her patience of my specimens and my camera; Cô Huệ (Mrs. Mai Thị Huệ) for cultivating both **bạc hà** and her Vietnamese-American niece; and Dr. Will McClatchey for his encouragement of my writing this article. Funding was provided by a Graduate Degree Fellowship and research grant from the East-West Center Education Program.

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