

How Can Citizen Science in a Botanical Garden Enrich the Discipline of Ethnobotany?

Blaise Mulhauser^{*1} , and Elodie Gaille¹

1 Neuchâtel Botanical Garden, Pertuis-du-Sault 58, 2000 Neuchâtel, Switzerland

*Corresponding author; e-mail: blaise.mulhauser@ne.ch

Abstract: Citizen science is a tool that makes it possible to design large-scale studies while developing dialogues among people. It has developed in many fields, such as ecology, biodiversity studies, climatology, and sociology. Done properly, it can help produce a large amount of data that can later be analyzed using statistical tools. Can ethnobotany also benefit from such investigations? Based on three citizen science projects carried out in a botanical garden, this paper explores the possibility of developing ethnobotanical citizen science research in a context other than that of fieldwork. Examples include a literacy laboratory within a multicultural exhibit (2018), a survey on the uses of medicinal plants during the coronavirus disease 2019 (COVID-19) pandemic (2021), and a call for testimonials about and recipes for medicinal plants from around the world (2020–2023). This approach, enriched by the citizens themselves, is in keeping with the aspirations of the ethnobiologists who have called for a paradigm shift following the COVID-19 pandemic, perceived as a tipping point. Citizen science practices implemented in a museum institution, such as a botanical garden, thus make it possible to carry out multicultural surveys and discuss results with people in an open dialogue.

Keywords: Citizen Science, Medicinal Plants, Literacy, Intangible Heritage, Participation of Communities

Introduction

The term “citizen science,” widely used today to describe studies that require a large amount of data to be gathered in a minimum amount of time, seems to have emerged in the final years of the twentieth century. Mainly implemented in the context of nature observation activities, this method allowed large-scale surveys to be carried out with the help of volunteer observers: the “citizens” (Bonney 1996). Such “goodwill” census activities are an integral part of the concept: “Citizen science refers to the general public engagement in scientific research activities when citizens actively contribute to science either with their intellectual effort or surrounding knowledge or with their tools and resources” (GPCSE 2013: p. 6). We do not enter

into Irwin’s double meaning here, namely that this science is made both for and by citizens (Irwin 1995). But Irwin did insist on an important concept: he wanted “these voices and forms of knowledge, and not only those of scientific experts, to be taken into account in deliberations about technological risks and science policy” (Strasser et al. 2017: p. 54). This concept of the general public participating in scientific activities is often associated with the idea that it is amateurs who are the main contributors to the approach. But in the context of ethnobotanical surveys seeking to highlight the knowledge of local populations, the opposition of amateurs and professionals is nonsensical.

Today, the notion of citizen science is understood as an approach that calls for “public participation in scientific research” (Shirk et al. 2012). However, the public can be involved in a variety of ways, including surveys, computational and statistical analysis, editing, and study design. The most widespread citizen

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science practice in ethnobotany is “community-based research,” in which the information to be analyzed is obtained and submitted by citizens. This practice of relying on citizen knowledge is much older than one might imagine. It may even have been the basis of the first medical compendium, *De Materia Medica*, by the Greek physician and botanist Dioscorides (ca. 30–90; Davis 1995), whose distinctive approach “was to collect information on the many uses of plants from the people themselves, rather than drawing on the writings of his predecessors or contemporaries” (Gaille and Mulhauser 2021: p. 26).

The word “science” refers to a body of knowledge acquired through the application of a strict methodology in accordance with a set of principles that includes the refutability of the hypothesis, the objectivity of the observation, and the reproducibility of the experience (Fortin and Gagnon 2016). However, in the human sciences, it is difficult to standardize methods, as the methodology involves continually refining itself, as in modern anthropology (Ghasarian 2004: p. 12). This issue is all the more difficult to resolve in the field of ethnobotany, where the object of knowledge is itself also subject to constant evolution. This discipline was born from the field practice of various authors in anthropology, such as Hédin and Haudricourt (1943) from the French school and Richard Evans Schultes from the American tradition (Schultes and Hofmann 1979). The latter not only popularized this discipline among the general public but also focused attention on psychotropic plants. Very quickly, this research favored an approach aimed at collecting popular knowledge: for one thing, in order to preserve it, but also in order to estimate its economic potential (Young 2007). In the case of medicinal plants, strong academic, agronomic, and pharmaceutical interests have emerged among researchers and industrialists, often to the detriment of local populations. However, from the 1980s onwards, this “knowledge extraction” approach was counterbalanced by a practice based on reciprocity (Ellen 2000). The concepts of traditional ecological knowledge (TEK) and local ecological knowledge (LEK) have thus emerged, with a collaborative concept (Whyte 2013) that asks for regional knowledge to be recognized within the field (El-Hani et al. 2008; Fortmann 2008).

Since the end of the twentieth century, multi-site research has been developing (Marcus 1995) within the combined movements of postcolonial critique (Chakrabarty 1992; Prakash 1994) and reflection on the impact of globalization (Appadurai 1996) and transnationalism (Hanerz 1996). We can also reflect on how museum institutions, which are sometimes symbols of the colonial past, can reinvent themselves. In the field of ethnobotany, botanical gardens are places of memory that require some self-critique: more specifically, current reflections on the colonial history of institutions (Blais 2023) provide the impetus that can inspire the ethnobotanical work. Many ethnobiologists have called for a major change in the practice of their discipline, not only as a part of showing respect for the communities on which they base their research (Fernández-Llamazares et al. 2021) but also as part of the process of complete decolonization (Harrison 2011). The virtuous goals that institutions must achieve are to “work toward institutional transparency surrounding the relationship between the institution’s history and colonialism” and to “reward service to the communities ethnobiologists work with and research outputs like guidebooks and ecocultural restoration projects” (McAlvay et al. 2021). The Neuchâtel Botanical Garden (NBG)’s ethnobotanical approach is one of reconciliation, placing researchers at the service of the population, particularly those from migrant backgrounds. The paradigm shift is that ethnobotanists no longer go into “other people’s fields”; instead, they welcome them into their own.

Despite this reorientation of the discipline, doubts remain as to how ethnobotanical field research can be conducted in the most neutral way possible, and how the ethnologist can successfully take into account his or her own subjective relationship to the object of the research (Bourdieu 1978, p. 68). This is the equation that Geertz (1973) tried to solve by proposing an interpretive anthropology. This inevitable interpretation on the part of the observer is “knowledge that shapes one (or more) version(s) of reality” (Ghasarian 2004, p. 13). But this problem of reflexivity (Clifford and Marcus 1986; Scholte 1969) can be avoided by giving back the floor or the written word to the population group that is not only participating but also contributing significantly to the historiographical construction

of knowledge. This way of working avoids the biases often cited in ethnobotanical research, namely the lack of information about the people who are being interviewed (Silva et al. 2022) as well as the lack of a theoretical framework and clarity in experimental design (Albuquerque and Hanazaki 2009). Thus, the “free testimony” approach (see the “Material and Methods” section) is our proposal for achieving an integrative citizen ethnobotany. This is not about quantitative research but about the qualitative expression of a diversity of knowledge (Albuquerque et al. 2019). We see a botanical garden as the ideal setting for this experiment.

In the world of plants, the anthropologist seeks to assimilate dimensions beyond just human knowledge. While it may be easy to converse with and receive concrete information from human beings, data collection becomes much more complicated when we seek signs of plant learning (Laplante et al. 2023). As Niemeyer et al. (2013) put it, “plants are complex, adaptive, environmentally interactive systems exhibiting synergy and nonlinear healing causality”: plant health must take account of this congruence between “becoming plant” and “becoming human” (Laplante and Kañaá 2023). According to Bergson (cited in Laplante et al. 2023: p. 124), it is a question of letting intuition speak for itself, in order to be able “to bring intelligence to recognize that life is neither multiple nor one, and that neither mechanical causality nor finality provides a sufficient translation of the vital process.” This approach is at the root of a new form of anthropology based on learning through the senses, leading to the co-creation of knowledge not only between different human populations but also between humans and nonhumans (Laplante et al. 2020). This is why ethnobotany is a science of the in-between (Vallès and Garnatje 2016), constantly open to new questions, and in which certain principles of a “hard” scientific approach (such as the reproducibility of experience) no longer make sense or may in fact be impossible.

The development of ethnobotanical research with the support of citizen science is booming. However, the data collection is based on several methods. In the healthcare sector, electronic questionnaires are the preferred method (Afrianto and Diannita 2022; Khadka et al. 2021; Laaribya et al. 2022; Milliken 2023;

Villena-Tejada et al. 2021), but this does not encourage direct dialogue with the people providing the information. Similarly, the synthesis of historical data or second-hand data leads to the same results (Kalle et al. 2022; Köhler et al. 2023). Based on artificial intelligence recognition processes, the data collection by photography, a method borrowed from floristics, can give interesting qualitative results, but remains totally impersonal (Greene et al. 2023). Nevertheless, in research focused on the knowledge generated by citizen science and ethnobotany in the field of sustainable development, transdisciplinary research can be developed with the help of participants, not only in the collection of the data but also in its analysis, which enables the co-creation of knowledge (Prüse 2020). In this sense, Prüse subscribes to the vision of reciprocal exchanges already developed by various anthropologists (Berkes et al. 2000; Ellen 2000; Vandebroek and Balick 2012), as well as to the need to collaborate with communities (Paniagua-Zambrana et al. 2018; Rodrigues et al. 2020; Vandebroek et al. 2011).

In 2019, the education magazine *Roots* devoted a special issue to the subject of citizen science in the world of botanical gardens (Derewnicka 2019). From the dozen or so cases studied, it emerged that the activities were very much focused on data collection through photography and geolocation (e.g., Lainoff and Ralls 2019; Ong et al. 2019) as well as on practical nature conservation and ecosystem regeneration work (e.g., Moreau et al. 2019; Yarger 2019). There was just one example of a citizen-led study, in which the citizens were coached by a scientific team, that went from the development of the working hypothesis to the analysis of results (Schwarz Ballard and Finch 2019). The botanical garden as an ethnobotanical field site seems, therefore, to remain virtually unexplored so far.

This paper focuses on the practice of citizen science in the specific context of a museum institution. To provide some background: we present here three projects carried out as part of citizen activities at the Neuchâtel Botanical Gardens (NBG). The NBG is a museum institution that was established around 1884 by the Second Academy (which became the University of Neuchâtel in 1909) and has been managed by the city of Neuchâtel (a small French-speaking

town of 45,000 inhabitants) since 2014. It is open year round, 24 h a day, and admission is free. Since the 1990s, it has been located in the Vallon de l'Ermitage, a natural valley area between the city and the forest of Chaumont mountain. The park covers some eight hectares, which can be divided into two areas: the botanical collections (around 2.5 hectares) and the natural environments (5.5 hectares), which are maintained using sustainable practices for the development and conservation of biodiversity (Mulhauser and Ruch 2023).

The scientific, educational, and cultural missions of the institution are fully in line with the new definition of a museum as recognized by the Extraordinary General Assembly of the International Council of Museums (ICOM) in Prague in August, 2022: "A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing" (ICOM 2022). The last sentence of this definition brings us back to the question of how ethnobotany can explore new avenues of knowledge in a museum institution rather than in field surveys.

Through its sampling practices and its survey methodology, based on individual or community knowledge, the discipline of ethnobotany is de facto founded on citizen science. In order to clarify the inputs in this paper, we focus our discussion on the act of donation and the use of medicinal plants, a central theme in the NBG's ethnobotanical research. This discussion is based on three citizen science activities carried out between 2018 and 2023, a period that encompassed the arrival of a new pandemic.

Using these examples, we will seek to answer the following questions: Is there an advantage to practicing citizen science in a museum institution? Can this approach be a way of renewing ethnobotanical practices? And finally, does it highlight certain shortcomings of the discipline or does it, on the contrary, reveal certain positive characteristics?

Material and Methods

For more than a decade, our own personal knowledge, the knowledge of the community we serve, and in particular the knowledge of our migrant communities have been an integral part of the NBG institution's research and public activities (Fig. 1). In this paper, we offer three examples of citizen science projects undertaken by the NBG, all with a common theme, namely the use of plants for health: "Objects of Culture: These Plants that Are Part of Us" (2018); "Plants and the Coronavirus disease 2019 (COVID-19) pandemic" (2021); and the *Recipe Book*, started in the fall of 2019 but still in progress.

In our first example, the 2018 exhibit "Objects of Culture: These Plants that Are Part of Us," we gave free rein to citizens to create the entire exhibit. A citizen exhibit can be defined as "an exhibit prepared by museum professionals with the help of citizens" (Mulhauser and Gaille 2019, p. 3). This practice, however, is generally limited to the showcasing of creations or testimonials that have been collected in advance by those responsible for the event. The curators thus retain control over the content presented to the public. With "Objects of Culture: These Plants that Are Part of Us," on the other hand, we wanted to encourage our visitors to put their knowledge into perspective more fully (Fig. 2). Our aim was to involve the public in the construction and every aspect of the exhibit, from its opening on January 14, 2018, to its closing on December 2, 2018. Every willing participant donated an object related to the plant world, accompanied by either a written or spoken testimonial in their mother tongue. We call this research method "free testimony." Participants then chose where to place their object and how it would be displayed in the exhibit. The exhibit was divided into eight living spaces (Fig. 3): the fireplace, the community space, the meditation room, the courtyard, the workshop, the path of dreams, the caring space, and the restrooms. The material that was collected was first-hand evidence directly linked to an object.

For "Plants and the Coronavirus disease 2019 (COVID-19) pandemic," we wanted to find out how plants were being used during the specific period of COVID-19. We found the answer to this question using a community-minded approach, turning to the



Fig. 1. Chuseok, associated with the full moon, is one of Korea's most important traditional festivals. It is celebrated on the 15th day of the 8th lunar month, which falls in either September or October, depending on the year. It is a harvest festival, during which people give thanks to the earth for its generosity. Organizing this festival in Neuchâtel with the help of the Korean community was an opportunity to present the importance of family and solidarity, a principle that guides Korean society. In the middle of the day, children collect the food and bring it to their elders. Photo taken on September 23, 2018

public that visited the NBG between June and August of 2021. The survey method we used focused on the use of plants in general (acquired knowledge) and on the use of plants during COVID-19 in specific and, if plants were indeed used, which plants, and in what forms. This work was supplemented by interviews with pharmacological researchers and retail druggists. The latter are a specific group of Swiss preparators in the field of phytotherapeutic product sales, who were able to shed light on their customers' expectations and compare them with the results

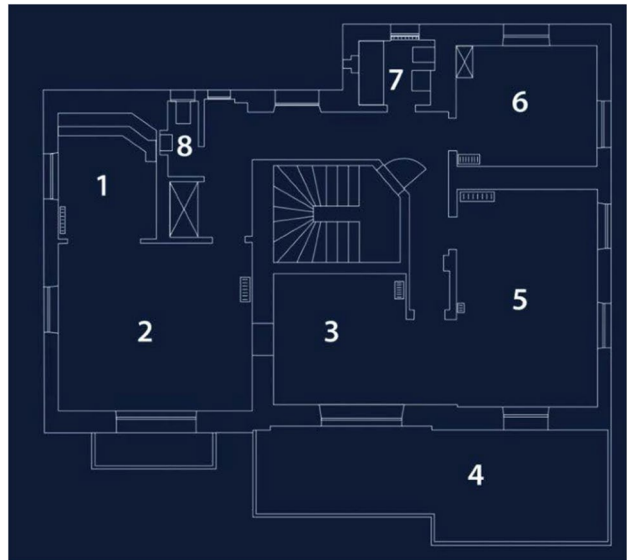
we had obtained from the questionnaires. Seven closed-ended questions on the use of plants in health prevention were evaluated on a scale from 1 to 10 (1 = strongly disagree / 10 = strongly agree). Two closed-ended multiple-choice questions on how to find information about the pandemic were also included. Finally, there were a number of open-ended questions about the choices of plants used and their transformation process (for the sample form, see Gaille and Monnier 2023).

Finally, in the *Recipe Book*, a collection of recipes related to medicinal plants to which anyone



Fig. 2. Persian calligraphy class in Room 5, designated as the “workshop” space, of the citizen exhibit “Objects of Culture: These Plants that Are Part of Us.” March 28, 2018

Fig. 3. Map of the citizen exhibit “Objects of Culture. These Plants that Are Part of Us,” with the following show-rooms: 1. fireplace, 2. community space, 3. meditation room, 4. courtyard, 5. workshop, 6. path of dreams, 7. caring space, and 8. restrooms



could add information according to their own experience, we present a citizens’ approach and a way to think about how to provide feedback to the population. From 2020 to 2021, the NBG staged an exhibit on medicinal plants entitled “Medicinal Plants: Infusions of Knowledge.” This exhibit developed out of the *Recipe Book* project, which

had begun in the fall of 2019, a few months before the COVID-19 pandemic began. The aim was to create a large *Recipe Book for the 21st Century* (its large size, 54 × 36 cm, is visible in Fig. 6) to give an account of an intangible heritage that is still alive throughout the world. As with the exhibit on “Objects of Culture: These

Plants that Are Part of Us,” we called on the goodwill of individuals to offer their testimonials about the history of an important health plant in their lives. Each author wrote a recipe in their mother tongue for the *Recipe Book* (Fig. 5). Here again, the knowledge obtained by this “free testimony method” is first-hand knowledge. Important differences emerged depending on the age, gender, and origin of each contributor.

The application of this citizen research requires a significant investment of time. For each testimonial or donation received, three sessions of one hour with the contributor are required. Added to this is the translation effort required to enable a global analysis of the material obtained. Thus, the main constraint of the “free testimony method” is that it relies on people (donators and translators) who are motivated to devote their time to the project. In order to obtain a sufficient quantity of data, the study can extend over a period of several years. We also note a bias with regard to the range of people taking part, as the working population is underrepresented.

Data collection using a simple questionnaire, by contrast, is quick, but it can only accommodate citizens who understand the languages being used (for instance, for our COVID-19 survey, French and German). With the questionnaire, the bias stems mostly from the fact that we only reached a small portion of the population, namely, those who are interested in the subject proposed by the NBG. In the survey, the biggest problem lies in the contributors’ descriptions of the plants in the open-ended questions. Most citizens are not botanists, and the data analysis must take this into account. The results are therefore less precise than for the “free testimony method” method, where dialogues between the contributors and botanists enabled us to determine the identity of the species that were being described. This aspect is the main problem for any citizen science based on the identification of organisms.

Results

THE CITIZEN EXHIBIT “OBJECTS OF CULTURE: THESE PLANTS THAT ARE PART OF US”

In this study topic and citizen exhibit, a total of 134 objects from 60 countries, representing six continents, were included; 32 languages were

used. The most popular areas of the exhibit were the community space (28 objects), the workshop (27 objects), and the fireplace (24 objects), three important places of exchange in all societies (see Fig. 2). This distribution of popularity also most likely indicates that most donors had unconsciously assimilated the idea that this exhibit was a space for social cohesion. Moreover, the plants most associated with these gifts were those based on the principles of dietary attachment and communal eating and drinking: coffee (*Coffea arabica* L.), tea (*Camellia sinensis* (L.) Kuntze), and tobacco (*Nicotiana tabacum* L.).

The more intimate spaces—the path of dreams (19 objects), the meditation room (18 objects), the caring space (13 objects), and the restrooms (1 object)—were less used, although some fifty objects found their way there. This relatively smaller number of objects shows that people might be more hesitant to talk about their more intimate experiences. As an example, among the healing plants, we mention paramao oil (the local name in Bali), which is made from the roots of the *Cinnamomum culilawan* Blume tree and had been used by a Swiss woman who had traveled to Bali in 2004. She wished to testify to the efficacy of this lotion for muscular pain. This kind of chance discovery is one of the forms of knowledge transmission most frequently invoked in the world of transcontinental European travelers. In contrast, people with a migrant background all suggested a healing plant from their region of origin, even if the prescription for its use sometimes became imprecise. In the face of supply difficulties, they looked to their networks for a way to fulfill their wish to testify (although many of them admitted to us that they had given up on presenting a plant that was representative of their country because it was impossible to find it in Switzerland). The testimony of a young Indonesian woman is a good illustration of this wish to present a healing plant from home: “I, Siau Mie, have chosen to introduce you to the candlenut tree [*Aleurites moluccanus* Willd.], found only in tropical countries. The nut is useful for cooking, as it has 60% fat and has a distinctive taste. It is also used to stimulate hair growth. I chose this object because it reminds me of my childhood. My mom often used candlenut oil to make her hair grow. Every morning, she would put some oil on my hair and massage it for thirty minutes. Now I live in Neuchâtel,

and every time I cook with candlenut, it reminds me of my childhood memories, as well as Indonesia” (testimony in Indonesian: Fig. 4). Herbal remedies are often used in childhood and subsequently used again. Even if this knowledge evolves, it still has an empirical basis shared by the collective (see Fig. 2).

PLANTS, KNOWLEDGE, AND COVID-19

So, what happens when a disease is unknown? This is the question that we address with the second example, taken from a survey about the plants mobilized by citizens during the COVID-19 pandemic, in which we attempted to understand how knowledge emerges and circulates during a health crisis. More than 500 people took part in the survey. Although we are aware of the bias represented by the location of the survey (a site featuring an exhibit on medicinal plants), the results

enabled us to observe that a significant proportion of the population was seeking to manage their health with the help of plants during this health emergency. Indeed, 55% of those surveyed had used plants, in various forms, either as a preventive measure or to reduce the symptoms of illness. How did people find out about which plants to use to avoid becoming ill? Of the respondents, 43% had found out from the press, 42% from a relative, 36% from purveyors of alternative or official medicines, 24% from specialized magazines, and 24% from social networks (multiple answers were possible).

More than 50 genera of plants were cited, including *Echinacea* sp., *Cinnamomum* sp., *Zingiber officinale* Roscoe, *Eucalyptus* sp., *Thymus* sp., *Citrus* sp., and *Salvia* sp. In terms of galenic formulations (i.e., medicinal preparations and compounds), essential oils, herbal teas, capsules, and mother tinctures were favored. Most

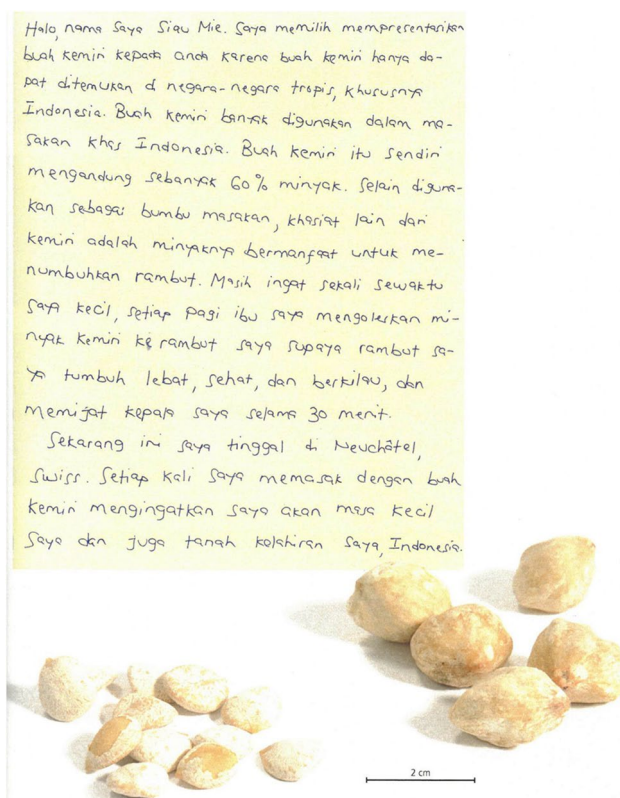


Fig. 4. Testimonial by Siau Mie, in Indonesian, on the use of candlenut (*Aleurites moluccanus* Willd.). Neuchâtel, January 2018

of the time, these products had been ordered from local pharmacies or drugstores. However, some preparations had been brought back from trips and then distributed to family and friends. A few people, highly motivated to take an active role in their own health, made their own ointments, macerates, and herbal teas at home.

A number of druggists confirmed an increase in the number of customers, and even a certain panic at the start of the pandemic among some people who were searching for miracle cures. Two plants were especially sought after in this context: annual mugwort (*Artemisia annua* L.), which is not authorized by Swissmedic, the authority responsible for monitoring and authorizing the marketing of medicinal products in Switzerland; and echinacea (*Echinacea purpurea* L.) Moench). Their popularity forced the authorities to take a position on their use and to call on the population to exercise caution. It is interesting to note that, at the time of COVID-19, the transmission of information was especially rapid, more so as the sources themselves were multiple (social networks, various media, healthcare professionals, etc.), in keeping with the diversity of age groups.

These data relate to several aspects of ethnobotanical science. Citizens are taking charge of their own health; in particular, they are willing to seek out information on their own, even or especially in times of crisis. A body of experience is thus built up through individual or collective experiences in times of emergency, over and above the official recommendations. This example shows how practices circulate and evolve, never being fixed in time or space.

THE RECIPE BOOK: BUILDING AN INTANGIBLE CULTURAL HERITAGE

Over the course of four years (2020 through 2023), 50 people took part in the development of the *Recipe Book*. More than 20 languages and 30 countries were represented (see Fig. 5 for an example). With each new entry, the idea was to describe the history of a medicinal plant species that had not yet been chosen. The botanical diversity was great: from a Polynesian fern to an alpine plant, via spices from the Eastern world and specialties from South America, 52 different plant species from six continents were listed.

As in the exhibit “Objects of Culture. These Plants that Are Part of Us,” the diversity of

languages included here directly conveys the image of a common project, produced by people from all over the world, without distinction of any kind except for the age and gender of the authors. No single language dominates; the number of different texts written in any given language was a matter of chance. Logically enough, since the project began in the French-speaking part of Switzerland, French is somewhat overrepresented, but this in no way detracts from the cultural mix of plant usage: a woman from Quebec writes about the Asian plant camphor (*Cinnamomum camphora* (L.) J. Presl); a French-speaking Swiss man about lemon verbena (*Aloysia citrodora* Paláu), originally from the Andes; and a Frenchman about Metuapua’a (*Phymatosorus scolopendria* (Burm.f.) Pic.Serm.), a fern from Polynesia.

Furthermore, writing in native languages is another way of promoting local knowledges. Where a foreign botanist might see only one species, a local herbalist would be able to distinguish and assign different names to dozens of individual plants with complementary healing properties, as in the case of ginger (*Zingiber officinale* Roscoe), a plant from the Indian sub-continent widely used in Amazonia (Gaille and Mulhauser 2021, pp. 252–253).

Accompanying the meteoric emergence of the COVID-19 pandemic, it was also possible to witness the speed with which populations throughout the world attempted, by simple means, to curb the severity of the disease’s symptoms. In the *Recipe Book* project, two testimonials (one from Syria, the other from Afghanistan) specifically mention ways of combating COVID-19. A third person told us orally (not documented in her written testimony) that in Japan, people focus their diet on fermented food to guard against the disease.

The testimonial on cultivated black cumin seeds (*Nigella sativa* L.) is very enlightening in this respect. It was reported by a person of Syrian origin who had settled in Switzerland in June 2020, just three months after COVID-19 was declared a pandemic: “In March 2020, the virus began to spread in Switzerland, affecting more people with weakened immunity, such as the elderly and those with chronic illnesses. I met a friend who had started using black cumin, a plant native to Syria and the Orient. When I asked him how he had learned about the immune-boosting benefits of this plant, he replied that he had met an elderly Swiss woman who had obtained a recipe prepared

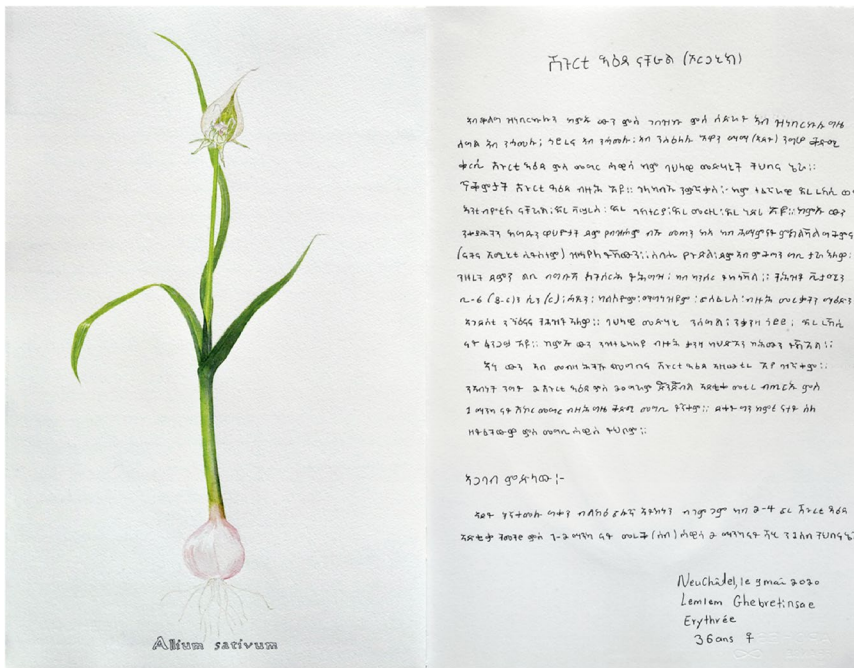


Fig. 5. Garlic (*Allium sativum* L.), a testimonial written in Tigrinya in the *Recipe Book*: “When I was a child and during my adolescence, my mother gave us raw garlic mixed with honey to eat in the morning before breakfast, especially when we had an illness such as the flu, a cold, or a sore throat. Garlic has many beneficial effects. It is used as a natural antibiotic, antiviral, antibacterial, antioxidant, and anti-inflammatory; it fights infections and high blood pressure, is good for the immune system, lowers cholesterol, is good for the heart, and protects against cancer. It contains vitamins B6 and C, iron, calcium, manganese, phosphorus, numerous enzymes, and other minerals essential for good health and for curing the flu, colds, sore throats, and fungal infections. It can also cure many other ailments. I too use it in many different ways, as my mother taught me. For my family, I mix it with soups, sauces, and so on. Recipe: peel between 2 and 4 cloves of garlic and cut into small pieces. Mix the garlic with one or two tablespoons of honey.” Neuchâtel, May 9, 2020. Lemlem Ghebretinsae, Eritrea, 36 years old

by a Syrian herbalist during a previous visit to Syria. This woman had used the mixture every morning for thirty years and is in good health now at the age of eighty, rarely falling ill with the seasonal flu” (testimony of Hadi Aljundi, June 22, 2020, born in Syria in 1983; lives in Neuchâtel, Switzerland. English translation by the authors).

Discussion

One might well ask: What does the practice of citizen science in a botanical garden add to the field of ethnobotany? The three approaches we have presented demonstrate the value of making room for citizens’ experiences, of transcribing

discourses, of hosting forums for debate, and of providing the opportunity for plant-related demonstrations (drinking, cooking, crafts, festivities, etc.) in an institutional setting. With their open approach to exchanges and discussions, these civic activities have enabled the people involved to forge links between generations and communities. They have also helped the participants to develop tolerance and respect for others. Finally, they have strengthened the feeling of belonging to a larger community than one’s own.

Setting up a real citizen science exhibit involved taking a certain amount of risk. In contrast to previous exhibits where we, as curators, had constructed a dialogue over which we had full control, we were now confronted with the challenge of dealing with life stories and experiences

that we were discovering on a day-to-day basis. Furthermore, we were making our institutional space available to people who had no idea about the constraints of museography. Nevertheless, as curators, we assumed responsibility for ensuring the coherence of the project (Baracchini et al. 2022). The stakes here were twofold: to take responsibility for highlighting the significance of each donor's experience, and to maintain professional standards of museography for our public. The project thus modified the concept of classic museography. To succeed in this challenge, we had to develop a new relationship with our public that involved placing them at the center of the event. We put ourselves at the service of our donors (citizens), whom we saw as the true repositories of knowledge. In the end, we found ourselves faced with a blend of knowledge and the richness of the vocabulary used in the original languages (Gaille and Mulhauser 2019), a veritable laboratory of literacy (see Mulhauser and Gaille (2019) and Fig. 2). An interesting fact corroborates the success of the experiment: many gifts went to the heart of such community principles as food attachment, communal meals, and eventfulness (Otye Elom 2023).

In ethnobotany, knowledge is defined as know-how (Rescher 2003) that is passed down, sometimes modified, over generations, or as a result of individual discoveries or chance events (Prüse 2020). But what about when it comes to mobilizing implicit knowledge in a new situation (Nonaka and Takeuchi 1995) that the community has little or no hindsight about or experience of? The example of the COVID-19 pandemic of 2020 is a powerful illustration. Although the coronavirus family was already known, the rapid emergence of the SARS-CoV-2 virus and the resulting symptoms in carriers were new to everyone, including the medical and pharmaceutical professions. No one could claim to be an expert, not even the most seasoned virologist. In such a context, we could not pass up the opportunity to try and answer the question: how does therapeutic knowledge emerge?

The starting point was a simple hypothesis: "in an emergency, the spoken word always circulates faster than the written word." Many authors have already noted that knowledge transfer emerges rapidly. For example, in the case of the blending of Eastern and Western medicines, the therapeutic knowledge from both sides mutually influence

each other, making the emergence of new knowledge highly dynamic (Leslie and Young 1992, Niemeyer et al. 2013, Pordié 2011). Faced with the meteoric emergence of a new disease, then, we asked ourselves how medicinal plants had been mobilized in Switzerland, whether for preventive or curative purposes, just as others had asked in other parts of the world (Aljowaie et al. 2023; Palero et al. 2023; Pieroni et al. 2020). In many cases, the data from elsewhere was based on questionnaires that were comparatively close to the one we had drawn up ourselves; these included questionnaires from Indonesia (Afrianto and Diannita 2022), Morocco (Laaribya et al. 2022), Nepal (Khadka et al. 2021), and Peru (Villena-Tejada et al. 2021).

In Switzerland, the first thing we noticed was that, in official government recommendations and in the public health and political discourse, as well as in the media, the subject seemed taboo. As luck would have it, the Swiss Confederation ordered the closure of cultural institutions three weeks before what would have been the opening of our exhibit "Medicinal Plants. Infusions of Knowledge" so we were right at the heart of the matter. The exhibit stayed closed for three months. At the opening, the journalists were very cautious in their own statements and also asked us not to talk explicitly about plants that could potentially be of interest in the fight against the disease. This expectation was even more surprising given that a large part of the discussion could have focused on prevention.

The medicinal recipes contained in the *Recipe Book* are a good example of the dynamics of popular knowledge that come into play when a particularly dramatic event occurs in society, as was the case with the COVID-19 pandemic. Solutions emerge within a few months, tested by the public and then analyzed by science. Such was the case for the black cumin (*Nigella sativa*) recipe proposed by one of the participants. The prescription given—one tablespoon of black cumin seeds mixed with one tablespoon of honey, to be swallowed on an empty stomach every morning—was identical to that subsequently proposed by doctors (Graz 2023: p. 196) after conducting randomized studies (Ashraf et al. 2023; Koshak et al. 2021; Tania et al. 2021).

The conclusions of these two citizen approaches carried out in the NBG during the

COVID-19 period are ultimately quite similar to those drawn by other authors, who have found in their medicinal plant surveys that these plants play a key role in human health and well-being (Ahmed and Hughes 2022). Thus, the pandemic is expected to bring about a paradigm shift in the human relationship with nature, in which the importance of ethnobiology and ethnobiologists will become much more pertinent. One of the fundamental criticisms made by anthropologists about the political management of the crisis has been the claim that it “prioritized the voices of ‘experts,’ who impose hegemonic scientific systems as if they were the only option” (Ladio 2020). What ethnobiologists call for, instead, is more exchanges between researchers and communities, as well as a renewed methodology: “this implies, for example, re-thinking nature and culture as a unit (not as separate pathways), or re-considering interviews as communication systems that generate meaning (not as mere information exchange)” (Vandebroek et al. 2020). Offering space in a botanical garden to people from a migrant background, a space in which they can freely express themselves, is a part of this effort.

How, then, does the citizen ethnobotany approach practiced in a museum institution enrich the discipline? First, unlike in conventional

anthropological research, the anthropologist does not invest time in a process of total immersion (Ghasarian 2004: p. 9). In this case, the anthropologist’s field work takes place in the workplace, a place nearly as familiar as home. The quality of the exchanges with participants in citizen research depends on the creation of a space that facilitates the development of confidence and trust. From this point of view, testimonials prepared in the mother tongue of each participant represent an added value, even though, in rare cases, people preferred to use the language of the host country in order to demonstrate their ability to integrate into the host society. The considerable amount of translation work, usually carried out in collaboration with a teacher of the host language, is also an advantage, as it allows words to be accurately chosen in both languages.

Secondly, there is the enrichment that comes from multiculturalism (Fig. 6), which enables us to embrace the richness of practices from a universal heritage perspective. Rather than seeking to generalize facts, the contribution of a multicultural citizen approach reveals what we might compare to a mapping of the diversity of a “total social fact” (Mauss 1973 [1923–1924]). This is obviously the case for the human approach to health.



Fig. 6. Day of the *Recipe Book* (September 12, 2021) at the Neuchâtel Botanical Garden. People of all ages and backgrounds got together to talk about healing plants. For some, it was also an opportunity to write their testimonials in the book

Thirdly, a dimension that was unexpected at the beginning of the first citizen exhibit project was the propensity to share: to receive as much as to give. Since Marcel Mauss's "Essai sur le don" (1973 [1923–1924]), which emphasized the importance of acts of giving to strengthen social bonds, several authors have been interested in the basis of this act. For Maurice Godelier (1996), exchange and transmission are the underlying foundational elements of our societies, presiding over the affirmation of our social ties, from simple gifts of love to bribes, sometimes leading to corruption. Annette Weiner (1992) adds that the act of giving has always had a reflexive extension in the choice of what to keep. In the example of the "Objects of Culture. These Plants that Are Part of Us" exhibit, we might have imagined that the rules of the game, established in advance, would have enabled us to escape the classic pattern of museography sketched briefly above. In fact, donating a very small part of one's history, in full view of the public (i.e., in a public exhibit), is a powerful social act and requires a great deal of work on the part of the person involved. In the NBG's citizen experiences, many donors could be described as "storytellers," as they often acted as intermediaries between the person who had given them the object and the institution in which it was then deposited. These people avoided telling their own story, preferring instead to give a tribute to loved ones or to their culture.

Citizen science, applied to ethnobotany, reinvents the traditional ecological knowledge (TEK) movement developed in the 1980s (Crosnier 2003: p. 60) by transforming the balance of power. It is no longer the researchers who are the bearers of discourse on the practices observed, but the actors in the world who are the producers. In this way, it seems possible to "shatter the mirror of the self," to borrow the title of an article by Maurice Godelier (2004). In the active citizen science approach, the anthropologist, who is both observer and observed, puts him- or herself at the service of the dialogue of the "inter" (intercultural, intergenerational, intergender, etc.). In ethnobotany, this means adding the dimension of the plant world, through which "entities are as much surrounding as surrounded, constructing an immeasurable relational diversity of the living continuum" (Mulhauser 2023: p. 9). This

leads to a reconsideration of the position of the meaning-maker: "Reflecting on the personal and institutional research modalities and constraints leads us to consider the moment of ethnography as just one phase in a wider process, also including the phase of textual production and textual reception. The question arises as to what is accomplished in this writing of texts. For, after having conducted fieldwork and theoretically analyzed the facts observed and the data gathered, one must communicate, one must pass on one's experience, one's knowledge, one's conclusions; one must share them" (Godelier 2004: p. 194, translation by the authors).

Conclusion

Beyond giving everyone a voice through the written word, ethnobotany as practiced in a botanical garden works hard to open up debates and set up discussion forums, but also to leave room for events from different communities. Plants are always at the heart of festivities, demonstrating their use and transformation and, above all, sharing knowledge and know-how about plants that comes not from ethnobotanists, nor from the managers of the institution, but from the citizens of the world themselves.

Citizen science practices implemented in a botanical garden thus make it possible to carry out multicultural surveys in collaboration with participants. But one of the prerequisites, in line with the new ICOM museum definition, is to have an institution that is freely accessible to all sections of the population. Compared with field research, setting up a citizen science space in a botanical garden opens up new possibilities in the field of ethnobotany. It facilitates studies of multiculturalism and removes the issue of immersion for the researcher. The "free testimony" approach, which invites people to express themselves in their mother tongue, is inclusive, but can complicate the ethnobotanist's work. Nevertheless, this method also has the advantage of allowing the ethnobotanist to be in direct contact with the people contributing to the study, not only during the data collection phase but also when the results are presented, thus prolonging an open dialogue.

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BM conceived and designed the study of “*Recipe Book*”. Both wrote, modified, and approved the final manuscript.

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Data availability Data from the three citizen studies cited in this article are available on request, with the exception of personal information that falls within the private sphere of citizen science participants.

Declarations

Ethics Approval In all of our citizen activities, we certify that we have requested prior authorization to use the information transmitted from each person and community who has participated. As the events are often public (exhibits, writing workshops, etc.), we also obtain oral agreement from each person for image rights and respect for others, in accordance with the code of ethics of the International Society of Ethnobiology. We declare that we have no competing interest in the field of this subject.

Competing Interests We declare that we have no competing interest in the field of this subject.

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