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Ethnobotany / Etnobotánica

Beyond ornamentals: Ethnobotany of Mexican *Dahlia* (Asteraceae), the national flower of Mexico

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Abstract
Background: The genus *Dahlia* is native to Mexico and has 41 described species. Globally, it is notable for its diversity and ornamental relevance. In Mexico, its use is widespread, being employed for ornamental purposes, food, and medicine. Despite its historical and cultural significance, detailed knowledge about the uses of *Dahlia* mostly comes from scattered gray literature.
Questions: What are the documented traditional uses, geographic distribution of knowledge, and conservation challenges for the genus *Dahlia* in its center of origin?
Studied species: The study focused on the genus *Dahlia* (Asteraceae).
Study site: Mexico, the center of origin and diversification for the genus.
Methods: Information was compiled from scientific databases, theses, and herbarium specimens. A systematic search was conducted to identify all available sources reporting traditional uses of *Dahlia* within Mexico.
Results: Our research documented ethnobotanical uses in 19 states and for 11 *Dahlia* species. Ornamental use is the most extensive and widely documented. Other uses include food and medicine, though these are less recorded.
Conclusions: We highlight the need for further studies on regional ethnobotany, conservation, and sustainable management to preserve this valuable genetic and cultural resource. The over reliance on gray literature emphasizes the urgency of concentrated and formalizing this knowledge before it is lost. The geographic patterns shown in this work are a fragment of the total knowledge. Future studies should prioritize filling these geographic and taxonomic gaps to fully appreciate and safeguard this invaluable biocultural heritage.
Keywords: biocultural knowledge, cosmogony, dalia, traditional medicine, natural products.

Resumen
Antecedentes: El género *Dahlia* es nativo de México y cuenta con 41 especies descritas. A nivel mundial, es notable por su diversidad y relevancia ornamental. En México, su uso está ampliamente distribuido, empleándose con fines ornamentales, alimenticios y medicinales. A pesar de su importancia histórica y cultural, el conocimiento detallado sobre los usos de *Dahlia* proviene principalmente de literatura gris dispersa.
Pregunta: ¿Cuáles son los usos tradicionales documentados, la distribución geográfica del conocimiento y los desafíos de conservación para el género *Dahlia* en su centro de origen?
Especies estudiadas: El estudio se centró en el género *Dahlia* (Asteraceae).
Sitio de estudio: México, centro de origen y diversificación del género.
Métodos: Se recopiló información de bases de datos científicas, tesis y especímenes de herbario. Se realizó una búsqueda sistemática para identificar todas las fuentes disponibles que reportaran usos tradicionales de *Dahlia* dentro de México.
Resultados: Identificamos usos etnobotánicos en 19 estados con 11 especies de *Dahlia*. El uso ornamental es el más extenso y ampliamente documentado. Otros usos incluyen el alimenticio y medicinal, aunque estos están menos registrados.
Conclusiones: Destacamos la necesidad de realizar más estudios sobre etnobotánica regional, conservación y manejo sostenible para preservar este valioso recurso genético y cultural. La excesiva dependencia de literatura gris enfatiza la urgencia de formalizar este conocimiento antes de que se pierda. Los patrones geográficos mostrados en este trabajo probablemente son solo una fracción del conocimiento total. Estudios futuros deberían priorizar estas lagunas geográficas y taxonómicas para apreciar y salvaguardar plenamente este invaluable patrimonio biocultural.
Palabras clave: conocimiento biocultural, cosmogonía, dalia, medicina tradicional, productos naturales.

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Humans have used plants since before recorded history, resulting in diverse knowledge about plant resources. This explains why some species have become fundamental for the global economy. However, many wild plants of economic importance lack sufficient information on their distribution, habitat conservation status, population dynamics, ecological requirements, and traditional use practices (Gómez-Pompa 1993, Caballero *et al.* 1998, Schmidt & Cheng 2017).

Asteraceae is a botanical family with over 25,000 described species and is one of the most diverse angiosperm family (Anderberg *et al.* 2007). It is of great economic and ecological importance, but its high species diversity does not necessarily translate into a proportional number of species directly useful to humans (Simpson 2009, Rolnik & Olas 2021, Palazzesi *et al.* 2022). Approximately one in five genera of Asteraceae have documented plant species used (Molina-Venegas *et al.* 2021, Palazzesi *et al.* 2022). The FAO (2024) lists only six globally significant crops within Asteraceae: i) *Cynara scolymus* (artichoke), ii) *Lactuca sativa* (lettuce), iii) *Cichorium intybus* (chicory root), iv) *Carthamus tinctorius* (safflower), v) *Helianthus annuus* (sunflower seed), and vi) *Tanacetum cinerariifolium* (pyrethrum), the latter being widely used as an insecticide.

The family is best known for its ornamental plants, such as edelweiss (*Leontopodium nivale*), *Senecio* spp., daisies (*Leucanthemum*, *Arctotis* and other genera), marigolds (*Tagetes*, *Calendula*, and others), and chrysanthemums (*Chrysanthemum indicum*). It also includes notorious weeds like thistles (*Cirsium* spp. and *Sphagneticola* spp.), dandelions (*Taraxacum campylodes* and *T. erythrospermum*), and ragweed (primarily *Ambrosia* spp.) (Schmidt & Cheng 2017, Palazzesi *et al.* 2022). Nevertheless, at a local level, hundreds of Asteraceae species are used as herbal medicines, dyes, ornamental plants, flavorings, and more (e.g., Heinrich *et al.* 1998, Narváez-Elizondo *et al.* 2020, Cilia-López *et al.* 2021, Imtiyaz-Ali & Venkatesalu 2022, Kachura & Harris 2022, Bouteche *et al.* 2024, Mehrzadeh *et al.* 2024, Rajlaxmi 2024).

The genus *Dahlia* (Asteraceae) comprises 41 species and is native to the Americas. Mexico represents the center of diversification with 38 species endemics (Carrasco-Ortiz *et al.* 2019, Sánchez-Chávez *et al.* 2019, Reyes-Santiago *et al.* 2024). This genus includes herbs, subshrubs, and epiphytic lianas, usually with fistulous internodes or when woody variously chambered (Figure 1A), with tuberous, fascicled roots developing from a short rhizome (Figure 1B). Their inflorescence is a heterogamous capitulum (Figure 1C) composed of two series of dimorphic phyllaries, eight ray florets (white, yellow, orange, red, or purple; Figure 1D), and 15-150 disc florets (yellow, red, or purple; Figure 1E-F) (Castro-Castro *et al.* 2012).

In ornamental horticulture, dahlias are globally recognized for their diverse inflorescence forms, sizes, and colors. Since their initial description in 1791, genetic modifications in these plants have produced over 63,000 cultivated varieties (TRHS 2023). The cultivars originate from the nothospecies *Dahlia* × *hortensis* (Hansen & Hjerting 1996, Puente Miranda 2024) derived from crosses among *D. coccinea*, *D. sorensenii*, *D. merckii*, and *D. imperialis* (Hansen & Hjerting 1996, Gatt *et al*. 2000a, b).

Dahlia species are also currently used in the food industry. Their tuberous roots yield inulin, which serves as a thickener, emulsifier, and gelling agent, as well as a substitute for fats and added sugars (Santana *et al.* 2016). In the pharmaceutical sector, inulin derived from *Dahlia* is employed as an excipient in medications (Hauly & Moscatto 2002, Madrigal & Sangronis 2007).

Dahlia species, commonly known as "dalias" or "jícamas" (in Spanish), hold a distinguished position as one of the most culturally important plants in Mexico. They were officially designated as the National Flower in 1963 by presidential decree of Adolfo López Mateos, and this honor encompasses all *Dahlia* species and varieties (Secretaría de Agricultura y Ganadería 1963, Mera-Ovando & Bye 2006). Their usage dates back to pre-Hispanic Mesoamerica, where the Aztec Empire called them "acocoxóchitl" or "acocotli" (hollow stems containing water). Historical records indicate different applications, such as ornamental, culinary, and medicinal uses, particularly as remedies for chronic cough and colic, and as diuretic or diaphoretics (substances that induce sweating) (Hernández 1945, Mera-Ovando & Bye 2006, Mejía Muñoz *et al.* 2010).

Given the longstanding utility of dahlia since pre-Hispanic times, it is likely that these uses have persisted through generations. However, despite its multifaceted historical uses, a comprehensive record of this traditional knowle-

dge does not exist today. This study aims to characterize the uses and geographic distribution of the knowledge of *Dahlia* species in Mexico through a literature review. Therefore, the evaluation primarily adopts a genus-level approach; the species-specific information is included but not exhaustive.

Materials and methods

This analysis incorporates all ethnobotanical studies published between 1930 to December 2024 on *Dahlia* via electronic search using Scopus, Web of Science, Science Direct, Google Scholar and publications in peer-reviewed scientific journals, ethnobotanical textbooks and further scientific data network SEINet (Gilbert *et al.* 2019), including the ancient writings of the Florentine Codex (1540) and Francisco Hernández (1571-1576). The search keywords included: botany, dahlia, dalia, ethnobotany, medicinal use, conservation, phytochemistry, acocoxochitl and pharmacology of *Dahlia.* Unpublished studies have been excluded from this analysis. However, our sources included bachelor, master, and doctoral theses and were classified as gray literature (Frandsen 2009, Campos *et al.* 2016). The criteria used to select these studies following aspects like inclusion of field work, clear methodology, indication of sources used, herbarium specimens or photographs of the specimens. All studies via electronic search, textbooks and theses that mention the ethnobotanical use of any *Dahlia* species in Mexico were included. Studies that only mentioned the genus without data on use were excluded. Additionally, we examined usage records and collection locations of specimens housed in two major herbaria: IBUG (Herbario Luz María Villarreal de Puga, Universidad de Guadalajara) and MEXU (Herbario Nacional, Universidad Nacional Autónoma de México) (acronyms according to Index Herbariorum, Thiers 2025). The final data collected were then evaluated and compared, and conclusions were drawn accordingly.

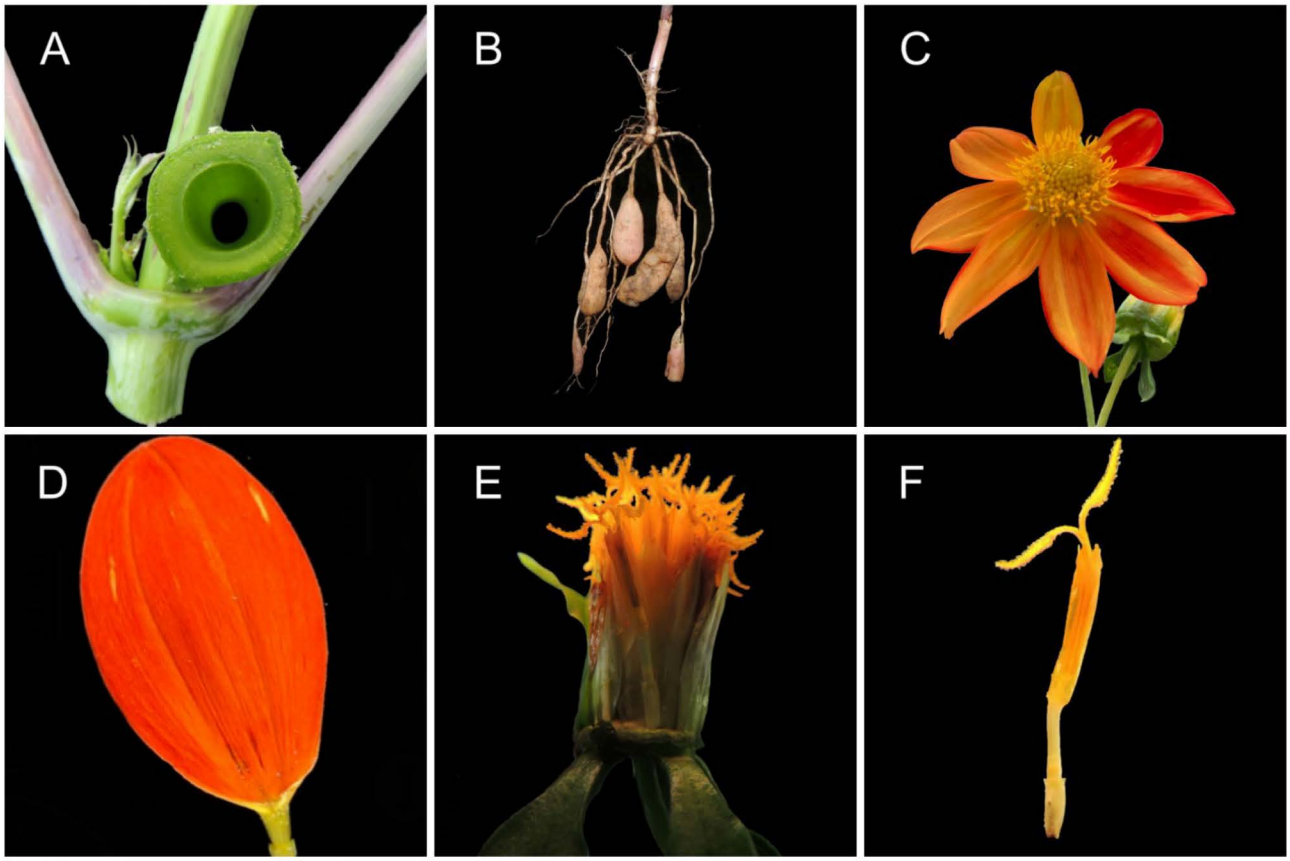

Figure 1. Morphology of *Dahlia* with particular emphasis on the parts used. A, fistulose internodes of *Dahlia imperialis*. B, tuberous root of *Dahlia pugana*. C, inflorescence of *Dahlia coccinea*. D, ray floret. E, Capitulum with disc florets. F, disc floret.

Results

A total of 132 studies were evaluated, of which 58 met the inclusion criteria for this research. The final compilation comprised 24 peer-reviewed articles, 23 academic theses, eight ethnobotanical reference books, and three traditional Mexican cookbooks. Additionally, we included information from 62 herbarium specimens (IBUG and MEXU), incorporating data from SEINet.

The records document traditional uses of at less 11 *Dahlia* species (*Dahlia australis*, *D. coccinea*, *D. imperialis*, *D. merckii*, *D. pteropoda*, *D. pugana*, *D. sherffii*, *D. sorensenii*, *D. tamaulipana*, *D. tenuicaulis*, *D. wixarika*; Figure 2) and the hybrid *D. pinnata* across 19 Mexican states. Figure 3 shows the proportion of literature sources documented per state. *Dahlia coccinea* was the species with the most reported uses: ornamental, food uses, natural dye applications, medicinal uses, and cultural uses. The states of Durango and Oaxaca recorded the most *Dahlia* species, and Oaxaca recorded also the highest number of distinct use reports (Table 1, for more detail see Appendix 1). The ornamental category was the most frequently documented. Notably, the hybrid derived specie *D. pinnata*, identified by their multiple series of ray florets, was reported almost solely for ornamental use. Six other uses were listed: food, natural dye applications, medicinal, ceremonial practices, forage, and cultural (Figure 4). Roots comprised the most consumed plant structure, with both medicinal and nutritional applications reported in eight states (Figure 1B).

Figure 2. *Dahlia* species with ethnobotanical uses. A, *Dahlia pugana*. B, *Dahlia sherffii*. C, *Dahlia australis*. D, *Dahlia coccinea*. E, *Dahlia imperialis*. F, *Dahlia merckii*. G, *Dahlia sorensenii*. H, *Dahlia pinnata*.

Food uses. In Mexico, traditional culinary applications of *Dahlia* have been documented in the states of Chihuahua, Durango, Jalisco, Oaxaca, San Luis Potosí, and Tamaulipas. The tuberous roots are consumed both raw and cooked, serving as a carbohydrate source. More recently, contemporary culinary applications have emerged, featuring innovative preparations using both vegetative and reproductive plant structures. Notable modern uses include: incorporating ray florets fresh into salads or using them for herbal infusions, and processing the roots into purees or milling them into specialty flour.

Natural dye applications. The ray florets of *Dahlia* are used to extract natural dyes for coloring textiles and other materials. In the municipality of Soledad Atzompa, Veracruz, yellow and orange dyes are extracted from both cul-

tivated and wild plants for textile dyeing. In the State of Mexico, the Mazahua community of Santa Rosa de Lima obtains yellow, orange, and bronze dyes exclusively from wild plants, and they have no formal cultivation practices. The residents of San Andrés Chicahuaxtla (Putla municipality), Oaxaca, refer to dahlias as flor de gallo ("rooster flower"), and children use them as coloring material. In Chihuahua, the Rarámuri community of Cuiteco (Urique municipality) extract dyes from these plants, although their specific uses remain undocumented. In the locality of Santa Rita Tlahuapan, Puebla, the extraction of red, orange, and yellow dyes has been recorded by literature and herbarium specimens. The herbarium records confirmed the existence of this practice in Durango, although the exact details are not documented. In Chiapas, this practice has been recorded by ethnobotanical books, but specific details of the extraction are not documented.

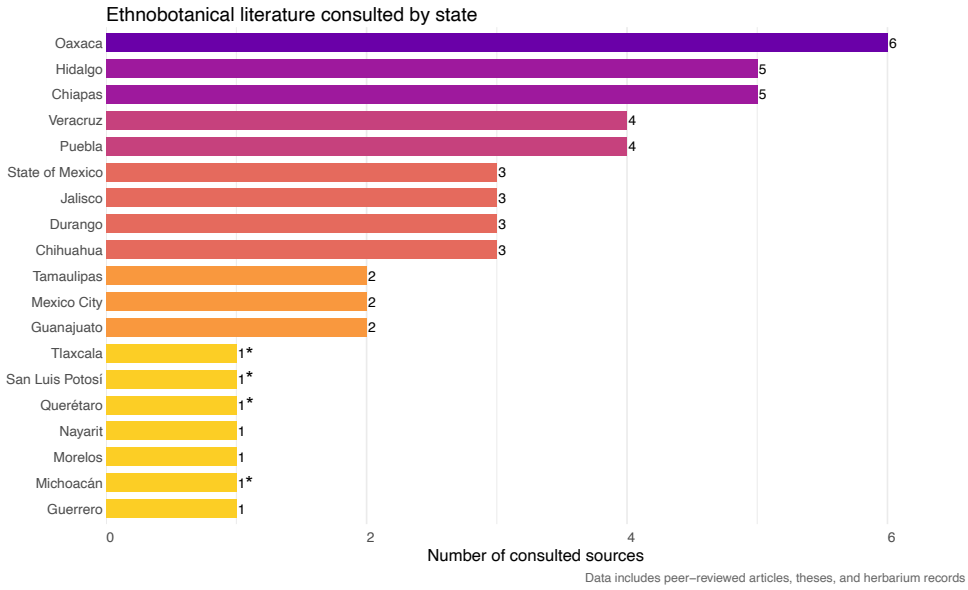

Figure 3. Literature consulted by state in Mexico. * Data from Herbarium specimens.

Medicinal uses. Plants play a significant role in traditional Mexican medicine, and dahlia roots are a prime example. They are used to treat various illnesses, including kidney discomfort, skin conditions, and cough. For example, in Jalisco, fresh roots are used by La Manzanilla de la Paz people to alleviate kidney problems, and in Mezquitic, boiled roots are used for similar purposes. They are also believed to reduce inflammation by applying poultice on affected areas. In Zacapu, Michoacán, the roots are consumed to quench thirst. In Oaxaca, tuberous root poultices are applied to treat skin conditions. In Chiapas, inflorescence infusions are prepared to relieve coughs, and the sap extracted from hollow stems is used to treat kidney complaints. Although *Dahlia* is also described as having medicinal applications in Durango, Tlaxcala, and Veracruz the specific parts of the plant used and their associated illnesses remain undocumented.

Ornamental uses. The most popular use of dahlias is as ornamentals. This category was documented in 15 Mexican states. Ornamental varieties are widely cultivated in gardens for their vibrant and diverse flowers. However, they are less frequently used in floral arrangements.

Religious uses. In Guerrero, *Dahlia coccinea* decorate graves during Día de Muertos festivities, in October and November.

Forage use. *Dahlia merckii* is used in Guanajuato as forage for bovine, equine, caprine, and ovine livestock.

Table 1. Main uses of *Dahlia* species. * Information obtained from herbarium specimens labels.

State	Specie	Common name	Uses	Used part	Source
Mexico City*	*Dahlia* sp.	Dalia	Ornamental		Azcarraga Rosette 2004
Chiapas*	*Dahlia coccinea*, *D. imperialis*, *D. pinnata*	Dalia	Ornamental, medicinal, dye	Inflorescence, stem	Gutiérrez Miranda 2003, Cancino Escobar 2020, Farrera Sarmiento *et al.* 2020, López Flores 2020
Chihuahua*	*D. coccinea*, *D. sherffii*	Amájui	Food, dye	Root	Camou Guerrero 2008, Král 2014
Durango*	*D. coccinea*, *D. pugana*, *D. sherffii*, *D. wixarika*	Jícama silvestre, flor de cabeza de guacamaya	Food, dye, medicinal	Root	Král 2014, Narváez-Elizondo *et al*. 2020
State of Mexico *	*D. coccinea*	Dalia, catarina	Ornamental, dye	Inflorescence	Gaytán-Ávila *et al*. 2001, Franco-Maass *et al*. 2019
Morelos	*Dahlia* sp.	Dalia	Ornamental		Gutiérrez García 2020
Guanajuato*	*D. coccinea*, *D. merckii*, *D. pinnata*	Mirasol	Ornamental, forage	Stem, leaf, inflorescence	Monroy Vázquez 2005
Guerrero	*D. coccinea*	Dalia	Ornamental, religion	Inflorescence	González Guinea 2008
Hidalgo*	*D. coccinea*, *D. merckii*, *D. pinnata*	Dalia, girasol, ninfa	Ornamental		Nava Hernández 2009, Reyes Cobarrubias 2012, Carrasco Hernández 2011, Pérez Escandón *et al.* 2022
Jalisco*	*D. coccinea*, *D. tenuicaulis*, *Dahlia* sp.	Dalia, jícama de rosa, charahuasca	Ornamental, food, medicinal	Root	Gamboa Ruiz 1999, Camberos Sánchez 2002
Michoacán*	*D. coccinea*, *D. sorensenii*	Chalihuesca o xicamoxochitl	Medicinal, cultural	Inflorescence, root	Carmona Romaní 2005
Nayarit	*D. coccinea*		Ornamental		Ibarra Sánchez 1996
Oaxaca*	*D. australis*, *D. coccinea*, *D. pteropoda*, *D. pinnata*, *D. tenuicaulis*	Dalia, flor de gallo, hiaj de'lo, yarg yurshe	Ornamental, food, dye, medicinal	Inflorescence, leaf, root	Cedano González 1989, Reyes-Santiago *et al*. 2004, Naranjo Cruz 2012, Lara-Cortés 2014, Aparicio Aparicio *et al.* 2021
Puebla*	*Dahlia* sp.	Juarigo, mira-sol cimarrón	Ornamental, dye	Inflorescence	Paredes-Flores *et al.* 2007, Arroyo Ortiz 2014
Querétaro*	*D. coccinea*, *D. pinnata*	Dalia	Ornamental		
San Luis Potosí*	*D. coccinea*, *D. merckii*	Jícama	Ornamental, food	Inflorescence, root	
Tamaulipas*	*D. coccinea*, *D. tamaulipana*, *D. pinnata*	Dalia, dalia sencilla, dalia silvestre	Ornamental, food	Root	Medellín-Morales *et al*. 2017
Tlaxcala*	*D. coccinea*		Medicinal		
Veracruz*	*D. coccinea*, *D. tenuicaulis*, *D. imperialis*, *D. pinnata*	Xicamitli, xicamaxochitl, camili, mirasol, flor de noche-buena	Ornamental, medicinal, dye	Inflorescence, root	Trueba Sánchez 2009, Navarro Perez & Avendaño 2002, Saavedra Ramírez 2021

Other uses in Mexican culture. The Mazahua ethnicity of Michoacán features a distinctive eight-petaled floral motif known as the Rosachi in their embroideries. Carmona Romaní (2005), in her work on traditional Mazahua embroidery, interprets this Rosachi as a representation of the wild dahlias that grow in the region during the summer. This design is commonly embroidered on traditional cotton skirts (enaguas de manta), as well as on ceremonial bags or satchel handmade (morrales), wool coats (gabanes), and quilts (colchas).

Discussion

The Florentine Codex (1540), compiled by Franciscan friar Bernardino de Sahagún, and the work of the Spanish physician Francisco Hernández (1945) are the most significant sources on the pre-Hispanic use plants in Mexico (Heinrich *et al.* 1998). These texts contain the earliest records of dahlias, detailing ornamental and medicinal uses mainly in central Mexico. However, the genus *Dahlia* has a broader distribution, occurring wild in 26 Mexican states (Carrasco-Ortiz *et al.* 2019), of which 19 currently report diverse uses. Our analysis systematically classified seven distinct ethnobotanical uses in these 19 Mexican states.

As anticipated, the ornamental use was predominant, reflecting the global horticultural significance since their introduction to Europe in 1791 (Sorensen 1969, Janick 2013). In Mexico, the ornamental use of dahlias has persisted since pre-Hispanic times to the present day, although their cultivation remains largely limited to private gardens, with less large-scale expertise compared with Europe or the U.S.A. (Ciobanu *et al.* 2021). However, beyond this well documented role, medicinal and dye applications emerged as the second most frequently reported categories, revealing a deeper layer of traditional knowledge.

Plants play an essential role in traditional Mexican medicine. The use of *Dahlia* appears to form a potential corridor of traditional knowledge along western Mexico, with reports ranging from Durango to Chiapas through Jalisco, Michoacán, and Oaxaca. The conspicuous absence of data from Guerrero likely reflects a critical gap in documentation rather than a genuine lack of use of the plant, suggesting a potential area for future ethnographic fieldwork. In contrast, this medicinal application is notably less documented in eastern regions, with Veracruz being a singular

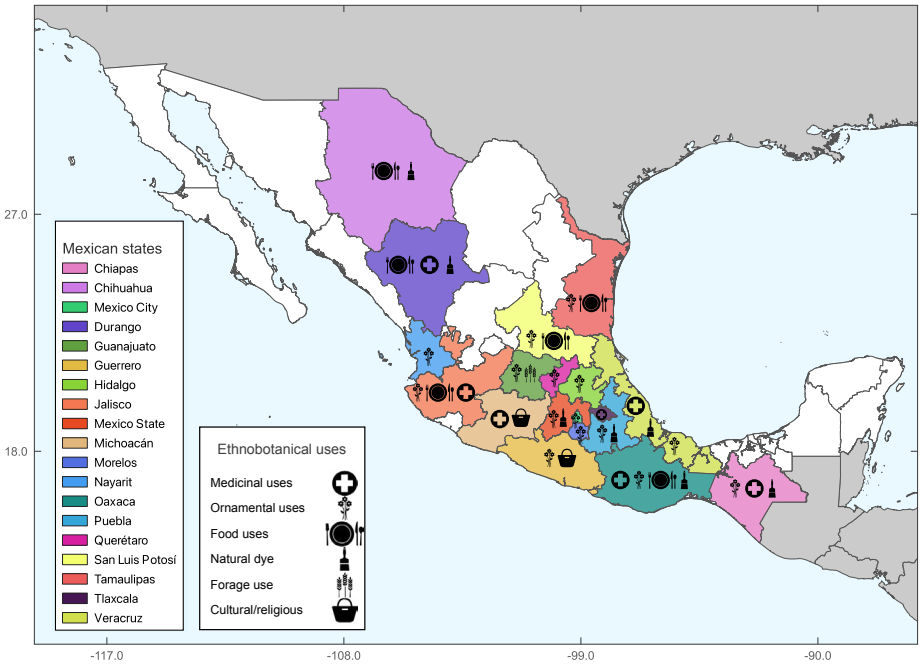

Figure 4. Geographical distribution of ethnobotanical uses of *Dahlia* across Mexican states.

exception. The tuberous roots of dahlias have been documented as possessing both nutritional and medicinal properties (Whitley 1985, Laguna-Cerda *et al.* 2004). The roots and leaves are used to treat skin conditions (herbarium specimens Chávez *et al.* s/n, and Solano *et al.* 438, IBUG). This is not surprising, since several other species in Asteraceae, such as *Artemisia ludoviciana*, *Calea zacatechichi*, *Polymnia maculata*, and *Tithonia diversifolia*, are traditionally used to treat topical inflammations, infected wounds, and bruises (Rungeler *et al.* 1998, Heinrich 2000, Chagas-Paula *et al.* 2012). Another traditional use of *Dahlia* is as an antitussive, a property documented from the 16th century to the present (Hernández 1945, Whitley 1985, Marzouk *et al.* 2016, Rodríguez-Chávez *et al*. 2017, Ruiz-Vásquez *et al.* 2018, López Flores 2020, Olennikov & Chirikova 2024). *Dahlia* also attributes diuretic, sudorific (sweat-inducing), and antispasmodic properties (Hernández 1945, Mera-Ovando & Bye 2006, Mejía Muñoz *et al.* 2010). However, these uses remain underreported and lack extensive verification in modern scientific literature.

A similarly heterogeneous pattern characterizes the use of *Dahlia* as a natural dye. Its scattered distribution across the country is more plausibly explained by irregular ethnographic recording than by the actual absence of the practice, though variations in local dye-extraction techniques may also influence its visibility and persistence. The ray flowers are used to produce dyes for coloring textiles and other materials (Camou Guerrero 2008, Gaytán-Ávila *et al.* 2001, Trueba Sánchez 2009, Mishra *et al.* 2012, Král 2014, Lira *et al.* 2016, Franco-Maass *et al.* 2019, Aparicio *et al.* 2021). However, the collection of flowers for dye production is becoming less common. Nevertheless, Franco-Maass *et al.* (2019) report that this practice has led to a reduction in the size of some wild populations in the State of Mexico.

The food use of *Dahlia* demonstrates intriguing regional specialization. In the northern and western parts of its range (e.g., Chihuahua, Durango, Jalisco), the tuberous root is the primary part consumed. In contrast, Oaxaca showcases a more diverse culinary tradition, utilizing both the roots and the ray florets (Lara-Cortés *et al.* 2014). This geographical variation in edibility underscores how cultural preferences can shape the utilization of a different plant structure. In recent years, the use of edible flowers in Mexican cuisine has increased due to their aesthetic appeal and their ability to improve the visual presentation of dishes (Mulík & Ozuna 2020, Hernández-Epigmenio *et al.* 2022). The most popular species reported are *Dahlia brevis*, *D. campanulata*, *D. coccinea*, *D. merckii*, and *D.* × *hortorum* (Mulík & Ozuna 2020). Their flowers may be consumed fresh in salads, soups, and beverages, or dried for use in infusions, desserts, and seasonings (Kaisoon *et al.* 2012, Kumar *et al.* 2024). Recent studies have highlighted potential health benefits, including the presence of bioactive compounds such as anthocyanins, which have antioxidant, anti-inflammatory, and antiproliferative properties (Rivera Espejel *et al.* 2019, Pires *et al.* 2019).

Asteraceae include numerous plant species with significant pharmacological properties (e.g., Heinrich *et al.* 1998, Chagas-Paula *et al.* 2012, White *et al.* 2015, Ajao & Moteetee 2017, Cilia-López *et al.* 2021, Imtiyaz-Ali & Venkatesalu 2022, Cicio *et al.* 2023, Bouteche *et al.* 2024, Mehrzadeh *et al.* 2024). The tuberous roots of dahlias store carbohydrates such as inulin and other fructans (Whitley 1985, Santana *et al.* 2016, Jiménez Ruiz 2017, Puente Miranda 2024). These compounds are present in other species within Asteraceae, such as yacón (*Smallanthus sonchifolius*), chicory (*Cichorium intybus*), and Jerusalem artichoke (*Helianthus tuberosus*) (Bosscher 2009). Inulin is a prebiotic fiber known for its digestive benefits (Santana *et al.* 2016, Ciobanu *et al.* 2021). In addition, dahlia flowers contain butein, a polyphenol that inhibits enzyme protein tyrosine kinase, potentially offering protection against certain cancers and inflammatory diseases (Yang *et al.* 1998, Samoszuk *et al.* 2005, Semwal *et al.* 2015, Pires *et al.* 2018).

At the species level, *Dahlia coccinea* was identified as having the most reported uses. This finding aligns directly with its status as one of the most widely distributed wild species (Carrasco-Ortiz *et al.* 2019), supporting the ecological principle that widely available species often accumulate a greater diversity of cultural applications (Levis *et al.* 2024, Bolcato & Aplin 2025). A significant limitation encountered in this synthesis was the frequency of use reports identified only to the genus level (*Dahlia* sp.). This taxonomic imprecision obscures species-specific relationships and highlights a critical need for future research to delineate the exact roles of individual species within this culturally rich genus.

Compared to their ornamental, medicinal, and food uses, the use of dahlias as forage has been less documented. However, there is evidence that certain species may be used as livestock feed in some regions, such as Guanajuato (Monroy Vázquez 2005). This underexplored application presents potential for diversifying animal feed resources, particularly within sustainable agroecological systems.

While this study detailed the culturally significant representation of *Dahlia* in Mazahua embroidery (Carmona Romaní 2005), this is almost certainly not an isolated case. It serves as a compelling example of the plant role as a cultural motif, and it is highly probable that other Indigenous communities incorporate dahlias into their material culture and cosmovision. The documentation of these cultural uses remains a vast and largely untapped field of inquiry.

In conclusion, the ethnobotanical panorama of *Dahlia* in Mexico extends far beyond its ornamental value, encompassing a rich diversity of medicinal, alimentary, and artisanal uses (Figure 5). The geographic patterns revealed in this analysis, while insightful, are likely just a fragment of the total knowledge, greatly influenced by disparities in research effort. Future studies should prioritize filling these geographic and taxonomic gaps to fully appreciate and safeguard this invaluable biocultural heritage.

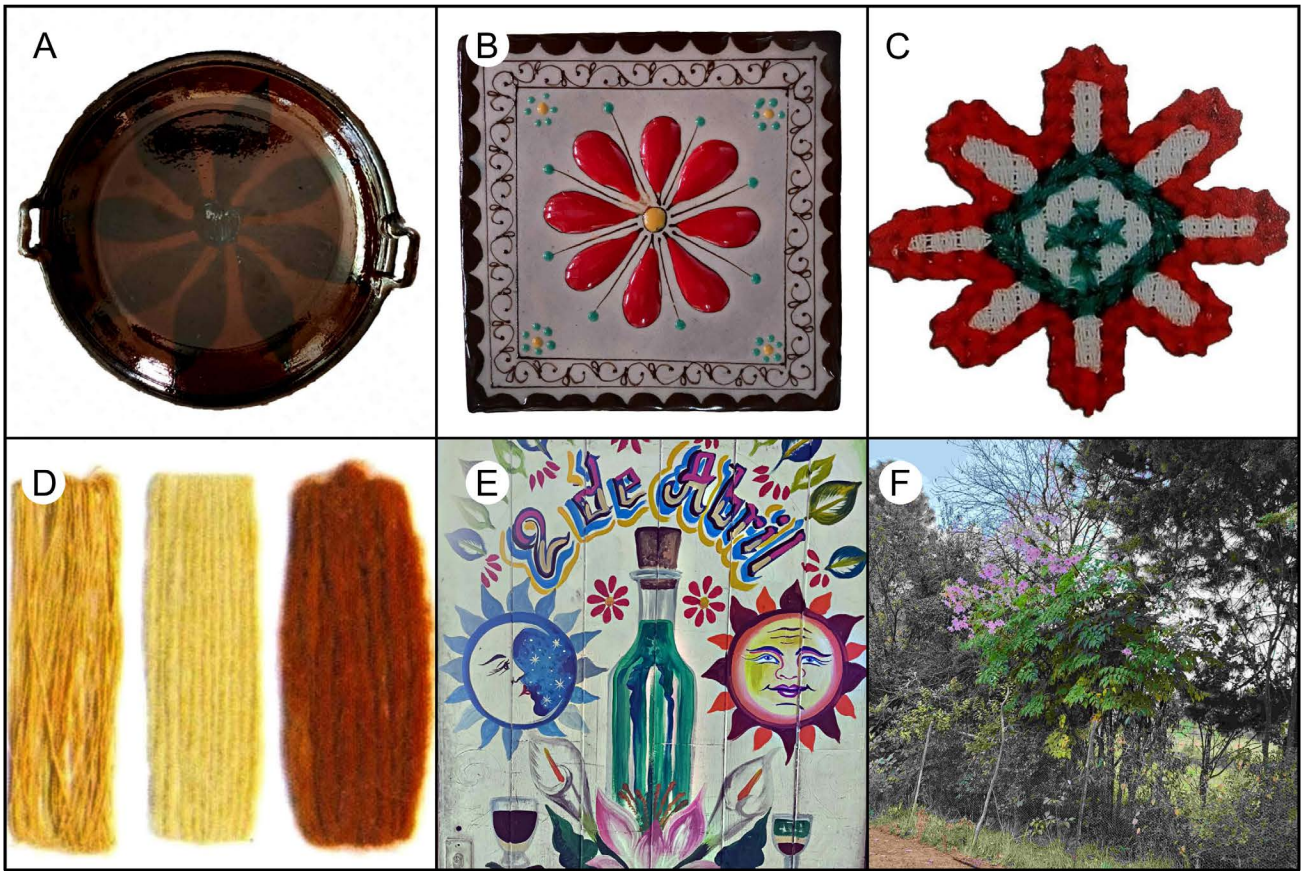

Figure 5. Ethnobotanical uses of *Dahlia* species. A, ceramic vessel paintings featuring designs resembling *Dahlia* flowers. B, production of ceramic tiles featuring *Dahlia* representations. C, embroidery of Mazahua ethnicity. D, natural dye applications (Arroyo Ortiz 2014). E, painting in a business depicting an eight-petaled flower. F, ornamental uses.

The limited accessibility of some literature, like academic theses, which are confined to institutional repositories with minimal global visibility, poses a major challenge for comprehensive ethnobotanical reviews. In this study, theses accounted for ca. 20 % of the sources consulted (23 works), almost matching the number of peer-reviewed articles (24 works). This aligns with Campos *et al.* (2016) assertion that gray literature (Frandsen 2009) repositories are vital primary sources for ethnobiology studies, particularly in biodiverse regions where traditional knowledge often exists only in these gray literature repositories. Although these sources can preserve valuable local knowledge unreported in indexed literature (e.g., dye techniques in Chihuahua), they vary widely in quality, methodological inconsistencies and lack of formal peer-review. This inherent variability underscores the necessity of applying rigorous inclusion and

exclusion criteria to grey literature sources, as was done in this analysis. Our criteria prioritized works that provided verifiable ethnographic details, cited voucher specimens, and clearly described their data collection methods.

Finally, the information attached on herbarium specimens is valuable for studies of plant distribution, morphology, phenology, and genetics. In ethnobotanical research, data serve as irreplaceable chronological records, capturing precise moments in humanity's relationship with plants. Herbarium specimens are essential for understanding traditional plant uses. These pressed vouchers document more than morphology. Their labels often preserve vanishing practices, biocultural shifts, and geographic specificity (Nesbitt 2014, Swain & Chakraborty 2024). For dahlias, specimens provide tangible evidence of pre-industrial medicinal knowledge (e.g., skin treatments). This evidentiary gap becomes particularly critical for culturally significant taxa like *Dahlia*, where 97.5 % (n = 2,484) lack ethnobotanical annotations. The remaining 2.5 % of annotated specimens (n = 64) predominantly derive from three states (Oaxaca, Michoacán, and State of Mexico), reflecting geographic biases in ethnobotanical documentation.

Our findings highlight the ethnobotanical importance of *Dahlia* species as a multifunctional resource for ornamentation, gastronomy, traditional medicine, rituals, clothes, outfits, and crafts. However, unsustainable harvesting and lack of management practices threaten some applications. Further ethnobotanical research and documentation are crucial to promote sustainable use and preserve this traditional knowledge. The geographic patterns shown in this work are a fragment of the total knowledge. Future studies should prioritize filling these geographic and taxonomic gaps to fully appreciate and safeguard this invaluable biocultural heritage.

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Appendix 1

Specie	Use category	Common name	Specific use	Plant part used	State	Reference	Literature
Dahlia australis	Medicinal		Buried grains		Oaxaca	Solano S.C. 438 (IBUG)	Herbarium
Dahlia coccinea	Food	Flor de cabeza de guacamaya, jícama	Raw or cooked	Root	Durango	Narváez-Elizondo *et al.* 2020	Article
Dahlia coccinea	Food	Jícama		Root	Durango	Benítez Paredes A. 844 (IBUG)	Herbarium
Dahlia coccinea	Ornamental	Dalia silvestre			Tamaulipas	Medellín-Morales *et al.* 2017	Article
Dahlia coccinea	Cultural	Dalia	Decoration of graves for Día de Muertos		Guerrero	González Guinea 2008	Thesis
Dahlia coccinea	Natural dye	Dalia	Dye (yields yellow, orange, and bronze pigments)	Ray floret	State of Mexico	Franco-Maass *et al.* 2018	Article
Dahlia coccinea	Ornamental				Jalisco	F. Colin-Nolasco 269 (IBUG)	Herbarium
Dahlia coccinea	Food	Dalia	Fresh roots	Root	Jalisco	D. Bojórquez 2 (IBUG)	Herbarium
Dahlia coccinea	Food			Root	Jalisco	M. Anaya C. 30 (IBUG)	Herbarium
Dahlia coccinea	Food			Root	Jalisco	Vázquez García, José Antonio 492 (IBUG)	Herbarium
Dahlia coccinea	Medicinal	Jícama de rosa, Tzicuri-Tzitzituame-olariiyari in huichol	Kidney ailments: consumed as a boiled decoction. Swelling/inflammation: applied as a crushed poultice	Root	Jalisco	Carlos Chávez s/n (IBUG)	Herbarium
Dahlia coccinea	Food	Chaliguesca	To quench thirst	Root	Michoacán	A. Grimaldo-Nuñez 1777 (IBUG)	Herbarium
Dahlia coccinea	Food	Jícama		Root	Zacatecas	Provance 5158B (UCR)	SEINet
Dahlia coccinea	Food	corneta in spanish, xiketön kuichi (arma de conejo) in chatino			Oaxaca	Weiss 368 (UCR)	SEINet
Dahlia coccinea	Ornamental				Oaxaca	Weiss 435 (TEX)	SEINet
Dahlia coccinea	Ornamental				Querétaro	Orozco H. 10672 (QMEX)	SEINet
Dahlia coccinea	Ornamental				Querétaro	Hernandez-Magaña 11383 (QMEX)	SEINet
Dahlia coccinea	Food	Girasol	Source of nectar for honey production		Veracruz	Pérez G. 970 (MEXU)	Herbarium

Specie	Use category	Common name	Specific use	Plant part used	State	Reference	Literature
Dahlia coccinea	Medicinal	Mirasol			Tlaxcala	A. Ruiz 283 (MEXU)	Herbarium
Dahlia coccinea	Food			Ray floret, root	San Luis Potosí	Hernández-Sandoval 8750 (QMEX)	SEINet
Dahlia coccinea	Food			Root	Tamaulipas	Hernández-Sandoval 8845 (QMEX)	SEINet
Dahlia coccinea	Natural dye	Xicamitli o xicamaxochitl	Yields yellow and orange pigments	Ray floret	Veracruz	Trueba Sanchez 2009	Book
Dahlia coccinea	Ornamental	Dalia			Jalisco	Gamboa Ruiz 1999	Thesis
Dahlia coccinea	Ornamental	Dalia, girasol			Hidalgo	Nava Hernández 2009	Thesis
Dahlia coccinea	Medicinal		Fresh roots for kidney remedy	Root	Jalisco	Morales-Ramirez 24 (IBUG)	Herbarium
Dahlia coccinea	Ornamental	Dalia			Nayarit	Ibarra Sánchez 1996	Thesis
Dahlia coccinea	Ornamental	Dalia			Hidalgo	Carrasco Hernández 2011	Thesis
Dahlia coccinea	Ornamental				Chiapas	Cancino Escobar 2020	Thesis
Dahlia coccinea	Food	Amájui			Chihuahua	Camou Guerrero 2008	Thesis
Dahlia coccinea	Natural dye	Amájui			Chihuahua	Camou Guerrero 2008	Thesis
Dahlia coccinea	Food			Root	Jalisco	J.A. Machuca N. 8454 (IBUG)	Herbarium
Dahlia coccinea	Food	Jícama			Durango	A. Benítez Paredes 844 (IBUG)	Herbarium
Dahlia coccinea	Food				State of Mexico	Mulík & Ozuna 2020	Article
Dahlia coccinea	Ornamental				Veracruz	Navarro & Avendaño 2002	Article
Dahlia imperialis	Ornamental				Veracruz	F. Ventura 9640 (MEXU), Calzada 2087 (IBUG)	Herbarium
Dahlia imperialis	Medicinal	Soló in Mamé	Kidney remedy (sap from hollow stems)	Stems	Chiapas	Sánchez-Chávez 148(IBUG)	Herbarium
Dahlia merckii	Food			Ray floret	State of Mexico	Mulík & Ozuna 2020	Article
Dahlia merckii	Ornamental	Mirasol			Guanajuato	Monroy Vázquez 2005	Thesis
Dahlia merckii	Forage	Mirasol		Stems, leaves and ray floret	Guanajuato	Monroy Vázquez 2005	Thesis
Dahlia merckii	Ornamental				Hidalgo	L. Zamora 467 (CIIDIR)	Herbarium

Specie	Use category	Common name	Specific use	Plant part used	State	Reference	Literature
Dahlia merckii	Ornamental	Jícama			San Luis Potosí	A. Rodríguez 6375 (IBUG)	Herbarium
Dahlia pinnata	Ornamental	Dalia			Mexico City	R. Vélez (IBUG)	Herbarium
Dahlia pinnata	Ornamental				Veracruz	Martínez A. 316 (MEXU)	Herbarium
Dahlia pinnata	Ornamental				Veracruz	Martínez A. 317 (MEXU)	Herbarium
Dahlia pinnata	Ornamental	Flor de noche buena			Veracruz	Rosas M. 897 (MEXU)	Herbarium
Dahlia pinnata	Ornamental	Mirasol			Guana-juato	Monroy Vázquez 2005	Thesis
Dahlia pinnata	Ornamental		Floral arrange-ments at the market and street market		Chiapas	Farrera Sarmiento *et al.* 2020	Article
Dahlia pinnata	Ornamental				Chiapas	Gutiérrez Miranda 2003	Thesis
Dahlia pinnata	Ornamental				Chiapas	Cancino Escobar 2020	Thesis
Dahlia pinnata	Ornamental	Dalia			Oaxaca	Cedano González 1989	Thesis
Dahlia pinnata	Ornamental				Oaxaca	Aparicio Aparicio *et al.* 2021	Article
Dahlia pinnata	Ornamental				Querétaro	Aguilar-Glavan 35 (QMEX)	SEINet
Dahlia pinnata	Ornamental	Dalia			Hidalgo	Carrazco Hernan-dez 2011	Thesis
Dahlia pinnata	Ornamental	Dalia			Chiapas	Farrera Sarmiento *et al.* 2020	Article
Dahlia pinnata	Medicinal	Dalia	Cough remedy (as an herbal infusion)	Ray floret	Chiapas	López Flores 2020	Thesis
Dahlia pinnata	Ornamental				Querétaro	Sandoval A. 10 (QMEX)	Herbarium
Dahlia pinnata	Ornamental	Mirasol			Veracruz	Rosas M. 795 (MEXU)	Herbarium
Dahlia pinnata	Natural dye	Dalia, camili		Ray floret	Veracruz	Saavedra Ramírez 2021	Thesis
Dahlia pteropoda	Ornamental				Oaxaca	E. Hunn 1933 (MEXU)	Herbarium
Dahlia pugana	Food	Jícama silvestre	Raw	Root	Durango	Narváez-Elizondo *et al.* 2020	Article
Dahlia sherffii	Food	Jícama silvestre	Raw	Root	Durango	Narváez-Elizondo *et al.* 2020	Article
Dahlia sherffii	Food	Jícama			Durango	A. Benítez Paredes 777 (IBUG)	Herbarium
Dahlia sherffii	Food		Seasonal food source (sweet roots eaten raw in autumn)	Root	Chihuahua	Bye 6385 (ASU)	SEINet

Specie	Use category	Common name	Specific use	Plant part used	State	Reference	Literature
Dahlia sorensenii	Ornamental				Michoacán	A. Rodríguez Contreras 8200 (IBUG)	Herbarium
Dahlia sp.	Ornamental	Mirasol cimarrón			Puebla	Duarte A. 63 (HUAP)	SEINet
Dahlia sp.	Natural dye				Puebla	Arroyo Ortiz 2014	Book
Dahlia sp.	Food	Dalia			Jalisco	Camberos Sánchez 2002	Thesis
Dahlia sp.	Ornamental				Mexico City	Azcarraga Rosette 2004	Thesis
Dahlia sp.	Ornamental				Morelos	Gutiérrez García 2020	Thesis
Dahlia sp.	Ornamental	Juarigo			Puebla	Paredes-Flores *et al.* 2007	Article
Dahlia sp.	Ornamental	Ninfa			Hidalgo	Pérez Escandón *et al.* 2022	Book
Dahlia tamaulipana	Ornamental	Dalia sencilla			Tamaulipas	Medellín Morales *et al* 2017	Article
Dahlia tenuicaulis	Ornamental	Dalia, hiaj de'lo			Oaxaca	Naranjo Cruz 2012	Thesis
Dahlia tenuicaulis	Natural dye	Flor de gallo	Natural coloring for children's drawings	Ray floret	Oaxaca	Naranjo Cruz 2012	Thesis
Dahlia tenuicaulis	Food	Jícama			Jalisco	O. Bravo-Bolaños 712 (IBUG)	Herbarium
Dahlia tenuicaulis	Ornamental	Jícama			Veracruz	Calzada 2087 (MEXU)	Herbarium
Dahlia wixarika	Medicinal		Antidiarrheal remedy		Durango	J. Medina 31 (CII-DIR)	Herbarium