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Review / Revisión

A review of ethnobotanical abortifacients in Mexico

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Abstract
This review synthesizes 70 years of ethnobotanical, clinical, community-circulated, and archival sources (1950-2023) to document abortifacient plants used in Mexico and to evaluate their taxonomic, cultural, and historical patterns of use. We identified 119 species across 45 families, with 11 families cited four or more times in the literature. Among these, Rutaceae, Verbenaceae, Apiaceae, Aristolochiaceae, and Commelinaceae appeared disproportionately frequently relative to their species richness, while Fabaceae was markedly underrepresented. Across species, two ethnospecies groups, *Ruta* spp. ("ruda") and *Montanoa* spp. ("zoapatle") accounted for 44 % of all citations and exhibited continuity in use from the 1950s through 2021. We also summarize available information on modes of action, preparation forms, cultural roles, and gaps in phytochemical knowledge. By integrating quantitative taxonomic patterns with socio-cultural context, this review clarifies longstanding plant-based reproductive practices in Mexico and underscores their relevance within contemporary reproductive justice and community health landscapes.
Keywords: Cultural practices, emmenagogues, ethnobotany, medicinal plants, reproductive justice, traditional knowledge.

Resumen
Esta revisión sintetiza 70 años de fuentes etnobotánicas, clínicas, de circulación comunitaria y archivos (1950-2023) para documentar las plantas abortivas utilizadas en México y evaluar sus patrones taxonómicos, culturales e históricos de uso. Identificamos 119 especies pertenecientes a 45 familias, de las cuales 11 fueron citadas cuatro o más veces en la literatura. Entre estas, Rutaceae, Verbenaceae, Apiaceae, Aristolochiaceae y Commelinaceae aparecieron con una frecuencia desproporcionadamente alta en relación con su riqueza de especies, mientras que Fabaceae estuvo notablemente subrepresentada. A nivel de especies, dos grupos de etnoespecies, Ruta spp. ("ruda") y Montanoa spp. ("zoapatle") concentraron el 44 % de todas las citas y mostraron continuidad en su uso desde la década de 1950 hasta 2021. También resumimos la información disponible sobre modos de acción, formas de preparación, roles culturales y vacíos en el conocimiento fitoquímico. Al integrar patrones taxonómicos cuantitativos con su contexto sociocultural, esta revisión aclara prácticas reproductivas a base de plantas con larga trayectoria en México y subraya su relevancia en los actuales esfuerzos de justicia reproductiva y salud comunitaria.
Palabras Clave: Conocimiento tradicional, emenagogos, etnobotánica, interrupción del embarazo, justicia reproductiva, plantas medicinales.

Across societies and historical periods, women have faced the need or decision to terminate a pregnancy –or a potential pregnancy– for a variety of personal, social, and health-related reasons. Pharmacological methods of terminating a pregnancy by or before twelve weeks -a period that falls well within international public health definitions of pregnancy termination- especially those using plant-based or medicinal substances, tend to be less physically invasive and often more socially acceptable than procedural interventions. Ethnobotanical, historical, and clinical sources indicate that plant-based methods have been used in diverse cultural contexts to regulate menstruation and terminate pregnancies under specific social, health, and personal circumstances. In communities where medicinal plants are central to healthcare, these practices occur as context-specific reproductive decisions, rather than as prescribed or universal customs. Identifying and synthesizing these practices presents challenges, in part due to the persistent social stigma surrounding termination of pregnancy in many cultural contexts. This stigma extends into academic literature, where avoidance and censorship have historically shaped how abortion-related plant knowledge is recorded and interpreted. Within this context, plant-based methods constitute forms of traditional termination of pregnancy, situated in long-standing systems of reproductive care that predate and coexist with formal biomedical approaches.

Ethnobotany and abortifacients. Ethnobotany investigates the interaction humans have with plants; especially how Indigenous and local communities incorporate plants within traditional medicine and broader cultural practices. (Balick & Cox 2020). Most publications directed toward plant use focus on interviewing and consulting with Indigenous community members of the area (Conway & Slocumb 1979, Ortiz de Montellano & Browner 1985). Studies of ethnobotany include plant uses that extend beyond medicinal purposes into all aspects of human culture, such as food, including spiritual and cultural uses (Balick & Cox 2020). Within traditional medicine systems, reproductive care is understood as part of holistic health rather than a discrete biomedical intervention.

A case of a plant that is close to the subject of reproductive health is the multitude of uses of *huitlacoche* or corn smut (*Mycosarcoma maydis*) growing on corn ears and named *cuitlacochin* in Náhuatl. In modern agriculture this fungus is seen as a plant disease that needs to be eradicated but, historically, it was used for its antibiotic properties in ancient Mesoamerica (Carmona Rosales 2021). It has also been known to induce the termination of pregnancy (Dahl 2009) and has been known to be an aid in childbirth like ergot alkaloids while having a lower toxicity (Dahl 2009). Ergot alkaloids, also derived from a fungal crop pathogen, stimulate uterine contractions, and extracts taken orally have been known to facilitate births and pregnancy terminations (Liu 2018). Aside from medicinal use, huitlacoche has also been and still is currently used in Central America and Mexico for food purposes (Kealey *et al.* 1981, Valverde *et al*. 2012). Lastly, corn including the huitlacoche growing on it played an important spiritual and cultural role in Indigenous North American groups (Adamson 2012).

Another example historically and culturally relevant to Mexican ethnobotany and directly related to reproductive health is *zoapatle (Montanoa tomentosa).* Indigenous to Mexico, *zoapatle* has been documented since pre-Hispanic and early colonial periods as a plant used in childbirth, menstrual regulation, and pregnancy termination (Hernández 1946). Ethnobotanical sources describe its uses to induce uterine contractions, facilitate labor, and expel retained products of conception (Martínez 1969). Pharmacological studies corroborate its strong uterotonic properties, situating *zoapatle* as one of the most culturally and historically significant abortifacient plants in Mexico (Gallegos 1983). Within the general landscape of ethnobotany are plants, like huitlacoche and zoapatle, that have built and continue to enrich culturally relevant at-home practices of reproductive health.

Terminating pregnancies through abortifacient use is a living, changing, and evolving practice. These practices align with ethnomedical frameworks, where healthcare knowledge is transmitted through community experience, cultural dimensions, and embodied practice rather than standardized clinical protocols. Knowledge surrounding these processes is often maintained and transmitted within Indigenous and local communities, where plants are understood for their taxonomic and cultural significance. These plant-based processes include preparatory care, inducing with abortifacients, and post-termination care.

Abortifacients & emmenagogues. Plants used to influence reproductive processes are often described as abortifacients, or more specifically emmenagogues. Emmenagogues are substances that stimulate or regulate menstrual flow, whereas abortifacients are used with the intention of terminating an established pregnancy through an unknown mode of action. In practice, these categories frequently overlap, particularly in cases where menstrual regulation and pregnancy termination may be physiologically indistinguishable. Clarifying this distinction is essential for accurately interpreting ethnobotanical records and understanding how reproductive plant knowledge is documented and transmitted through generations.

Embodied, cultural process of abortion care. For many pregnant individuals, the use of plants to terminate a pregnancy is not strictly transactional but has deep cultural and spiritual value (Olmos 2022). Preparatory care can include reducing anxiety, softening the cervix, opening the cervix, and warming up the body. In addition to physical preparation, there are instances of prayer. For example, an abortion support guide from Chile and Argentina depicts a prayer and invocation of *Santa Dora Sanadora* when beginning the termination process (Ballena 2016).

The termination process is not limited to the expulsion of material in the womb and consists of a cycle of physical, mental, emotional, and often spiritual care. Preparing for the process can include taking supplemental medication or plant products to prepare or minimize side effects such as nausea or pain. Terminating pregnancies includes specific processes that induce contractions, inhibit implantation of the embryo, induce menstruation, and empty out womb contents. Post-termination care can be a culturally and spiritually significant part of the overall abortion journey. Care after a pregnancy is terminated is aimed at closing the cycle spiritually and physically. This often consists of herbal baths aimed to heat up and tighten the body after all contents in the womb have been removed. The aftercare process can also consist of prayers and/or rituals (Olmos 2022). Overall, it is crucial to consider all dimensions related to abortifacient plants in Mexico. Abortifacient plants in this review are not standalone tools for purely transactional uses. They have deep socio-cultural roots that shape their uses and safety.

Study area. The focus of this literature review is on Mexico, during a time of great activity specifically for reproductive justice. During the 2020 pandemic, there was a noticeable increase of social activism in Mexico and Latin America regarding unwanted pregnancies and gender violence (Espino & Morales 2020) that pushed reproductive health to the forefront of public attention, including terminations of pregnancies through use of abortifacients. According to prior literature and current interviews, there is a long history of stigma and shame regarding abortion in Mexico (Ona Singer 2020, Wollum *et al*. 2022). The persistent stigma, criminalization, and violence directed at those who seek to terminate a pregnancy have fueled the emergence of the "Green Tide" (*La Marea Verde*), a social movement originating in Argentina in the late 2010s that demands justice in the face of gender violence, reproductive inequality, and femicides, and which has since spread throughout South and Central America, including Mexico (Palmeiro 2018). Recently in 2020, the movement in Argentina succeeded in legalizing abortion (Lopreite 2023). More recently, in 2021 Mexico's Supreme Court ruled the criminalization of abortion to be unconstitutional (Medina Ávila & Mecalco López 2023). Amidst this landmark decision, the stigma and criminalization of abortion continue. Weeks after the court decision, at least one person in Michoacán, Mexico was being tried for homicide for a voluntary termination of a pregnancy (García López *et al*. 2021). Two years later the Supreme Court moved to demand that Congress remove federal criminal penalties in place (Tamés & Quijano Carasco 2023) building a pathway for federal health facilities to provide services to end a pregnancy.

Plant-based abortions exist as a culturally relevant option to many in Mexico. The existing rich cultural practice derives from Indigenous populations of Mexico. Mexico is home to a large number of Indigenous peoples, with populations concentrated across roughly a third of the country's states (Fox 2010). Some Indigenous groups, such as the Totonaca & Nahuatl utilize plants before, during, and after a pregnancy termination. For some, the termination process has strong spiritual and cultural components. The Totonaca & Nahuatl believe that the ancestral tree Puchat or Chichihuacuauhco, respectively, nourishes and cares for the spirit of babies until they are called to be with their parents (Olmos 2022). In this tradition, after an abortion, the spirit is believed to return to the ancestral milk-giving tree. Some of these Indigenous groups in Mexico hold plant-based postpartum traditions and altars for the spirit of their babies (Olmos 2022).

Fragmented knowledge. Despite the long-standing presence of plant-based methods for regulating menstruation and terminating early pregnancies, knowledge about abortifacient plants in Mexico remains fragmented across ethnobotanical studies, clinical reports, archival texts, and community-circulated sources. Much of this information is obscured by inconsistent terminology, and the historical criminalization and moral stigmatization of abortion. As a result, abortifacient plant knowledge is often excluded from formal pharmacological or public health syntheses, even as these practices continue to be used in contemporary contexts. Addressing this gap requires an approach that integrates ethnobotanical, historical, and taxonomic perspectives while acknowledging the social conditions under which reproductive knowledge is transmitted.

Materiales and methods

Our data collection was conducted for over two years and focused on a range of sources from printed books published in Mexico not available online, search engines such as Google Scholar, Clarivate and JSTOR, and the University of California, Riverside's online library. Databases and search engines were utilized to collect any articles that included plants that facilitate the termination of a pregnancy or cause symptoms that may lead to it, such as by inducing menstruation, preventing successful implantation of embryos, or inducing contractions (Figure 1). Books and peer-reviewed sources ranged from 1904 to 2022 at the most current. Some books in print have been circulated among local community members for generations and are particularly well known, such as Manual para el uso de plantas medicinales: Región de Lago de Pátzcuaro (Suárez 1997). Articles varied in terms of the journal, some articles were derived from journals focusing on clinical toxicology, ethnopharmacology, pharmacy, and ethnobotany. We used keywords including 'detenido flujo,' *emenagogo*,' '*provoca contracciones*,' 'abortifacient,' '*aborto*,' '*abortion + plants*,' '*emmenagogue*,' '*oxytocic*,' '*abortivo*,' and '*herbal abortion*.' Within these keywords, we narrowed down research that focused on Mexico. Plants indicated to primarily cause harm by being generally poisonous were excluded. We focused on collecting information, if known, that included the plant's taxonomy, Indigenous names, geographic origin (endemic, invasive, exotic, or native), mode of action, preparation, and active principle.

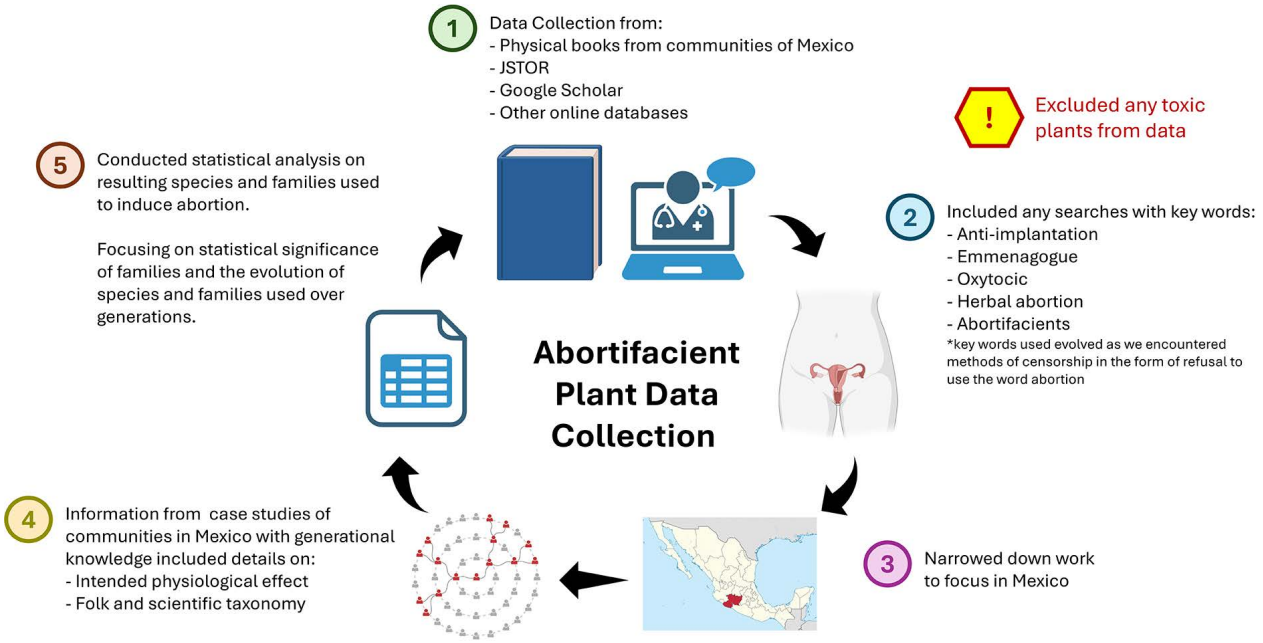

Figure 1. Steps in the literature review and statistical analysis of abortifacient plants in Mexico.

Analysis of family-level representation. To explore broad taxonomic patterns in the published record, we compared the observed frequency of abortifacient species in each plant family with the expected frequency based on national species richness in Mexico. For each plant family that had been cited four or more times as having abortifacient properties, we counted in the published literature both (a) the number of species cited as being pharmacologically active within each family, and (b) the number of citations in the literature reporting pharmacologically active species within each family (the number of citations is normally higher than the number of active species, as some species are repeatedly cited). With this information, we organized a table with the families in the rows and their frequency of citation as well as the number of cited species in the columns (Table 1). For comparison purposes, we also added the total number of species cited as present in Mexico for each family, taken from Villaseñor (2016). We also added a fourth column with the ratio between the number of citations to the number of pharmacologically active species, a measure of citation intensity: the larger the ratio, the more times some species in the family have been cited as being used for pregnancy termination purposes.

Table 1. Chi-square results for the 11 most frequently cited plant families with abortifacient use in Mexico.

Family	Citations	Species	Total richness	Citations /species
Asteraceae	47	23	3,057	2.04
Lamiaceae	18	15	601	1.20
Apiaceae	18	10	208	1.80
Rutaceae	16	3	93	5.33
Verbenaceae	9	4	169	2.25
Fabaceae	9	10	1,903	0.90
Amaranthaceae	9	2	211	4.50
Malvaceae	6	6	527	1.00
Commelinaceae	5	3	126	1.67
Aristolochiaceae	5	4	75	1.25
Lauraceae	4	3	141	1.33
Total	**146**	**83**	**7,111**	
Mexican Flora			**23,314**	

We also tested two hypotheses with respect to the distribution of species and citations in the table. Firstly, we tested whether some families had more species reported as pharmacologically active than could be expected from the size of the family in Mexico. That is, assuming that each taxonomic family represents a distinct evolutionary lineage, we tested whether some lineages had a higher proportion of species with secondary compounds that are pharmacologically active for the early termination of pregnancy. Secondly, we tested whether the distribution of citations in the literature for each family -a measure of research intensity- differed significantly from the number of species recognized as having pharmacologically active properties. That is, we tested whether the number of citations each family received was proportional to the number of active species identified within that family or if, alternatively, there were some families that were cited as having abortifacient species more frequently than other families. This second hypothesis is conceptually similar to the citations/species coefficient described above, with an added probability value for the null hypothesis of no-effect. Both hypotheses were tested using a χ^2 distribution test; the statistical procedures and detailed results are provided in the Supporting Information (Tables S1-S2).

We also analyzed several patterns within our compiled data table including the evolution of plants cited across time with consideration to their geographical origin and ethno-species (i.e., grouping of species or genera with similar ethnobotanical use). Following a review of our compiled data and the statistical review of the families, we also

considered how our results correspond with existing phytochemical studies. According to phytochemical studies, isoquinoline alkaloids, particularly prevalent in the Ranunculaceae, Papaveraceae, and Berberidaceae families, are frequently reported in plants used as abortifacients, and some have been shown to influence uterine activity or pregnancy outcomes (Gupta *et al*. 1990). Accordingly, we expected these families to appear frequently in the literature.

Limitations of informant-based indices and rationale for analytical approach. Because our dataset synthesizes information from heterogeneous published and community-circulated sources rather than from structured informant interviews, additional clarification of our analytical choices is warranted. Ethnobotanical indices such as Relative Frequency of Citation (RFC), Use Value (UV), and the Cultural Importance Index (CI) are widely used to assess species importance and cultural salience; however, these methods require primary field data, including a defined sample of informants, counts of how many informants cite each species, and standardized documentation of multiple use categories. Because our review synthesizes literature-based data spanning more than 70 years of published and community-circulated sources, informant-level details are not uniformly available, and methodologies vary substantially across studies. As a result, the assumptions required to calculate RFC, UV, and CI cannot be met in this dataset. In lieu of informant-based indices, we used analytical strategies appropriate for literature-derived data, including (1) citation frequency across sources, (2) taxonomic over- and underrepresentation relative to national species richness, and (3) temporal persistence of species in the literature. These approaches allow us to assess broad ethnobotanical patterns while remaining aligned with the structure and limitations of archival and published data.

Results

The following sections describe (1) patterns of family-level representation, (2) ethnospecies groupings, and (3) temporal persistence of cited species. Narrative summaries have been added to accompany each figure for clarity.
Taxonomic dimension of abortifacients. The 11 most commonly cited families included: Asteraceae, Lamiaceae, Apiaceae, Rutaceae, Verbanaceae, Fabaceae, Amaranthaceae, Malvaceae, Commelinaceae, Aristolochiaceae, and Lauraceae. These families were cited four or more times during the timeframe from 1950 to 2021. With respect to the taxonomic component at the family level, three families (Lamiaceae, Apiaceae, and Aristolochiaceae) showed a significantly higher number of pharmacologically active species cited in relation to their family size ($P < 0.0001$), while two large families (Asteraceae and Fabaceae) showed a relatively small number of active species in relation to their family sizes (Appendix 1). Research intensity (the number of citations in the literature for each family) also differed significantly from the number of species recognized as having pharmacologically active properties. Two families (Rutaceae and Amaranthaceae) showed a significantly ($P < 0.0001$) higher number of citations in relation to their number of pharmacologically active species, while one family (Fabaceae) showed a relatively small frequency of citations in relation to its known number of active species. That is, past research has concentrated disproportionately on species in the rue and amaranth families (Appendix 1). This pattern is also clearly visible in citations/species ratio, shown in the fourth column of Table 1. Abortifacients in the Rutaceae and Amarathaceae have, respectively, 5.33 and 4.50 citations/species, significantly higher than the average for the whole group of species (2.12 ± 0.44 citations per species; $P < 0.0001$). Despite being the most frequently cited family, the Asteraceae appear in the literature at rates consistent with their overall species richness and therefore do not deviate significantly from expected values. In contrast, Fabaceae displayed the largest underrepresentation across the families cited as having abortifacient properties. In contrast, the Rutaceae were highly overrepresented in the literature, with the highest significance out of the 11 families (Tables S1 and S2).

Aside from the occurrence of citations in literature, we also analyzed the temporal distribution of these families in literature. Asteraceae, Rutaceae, Apiaceae, Verbanaceae, and Lamiaceae were all first reported as potential abortifacients in the 1950s, while Amaranthaceae first appeared in 1964. All families have persisted and been documented for abortifacient use throughout 2020-2021. However, some families have experienced gaps in documentation when observing the timeline from 1950 to 2021. Most notably, Lamiaceae had a large gap between publication years,

although it was one of the most commonly cited families there was a period of absence for this family in literature after 1950 up until 1997 (Figure 2).

Aside from the most cited families, we focused on the top ten cited species in our review. We will discuss four species in terms of ethno-species groupings. *Ruta graveolens* and *Ruta chalepensis* belong to the same ethnospecies group, just as *Montanoa tomentosa* and *Montanoa frutescens* form an ethnospecies group (Table 2). Both of these groups (*M. tomentosa* with *M. frutescens* and *R. graveolens* with *R. chalepensis*) represent species within the same genus that, share the same medicinal uses, and the same common name in Spanish (Table 2). Through healers' consensus, including traditional midwives (parteras), *R. graveolens* and *R. chalepensis* have been named the same way; both are known as "*ruda*" (Zamora-Martínez & de Pascual Pola 1992, Fonseca-Chávez *et al*. 2020). Likewise, *M. tomentosa* and *M. frutescens* are both identified by healers as "*zoapatle*." In interviews and fieldwork, healers' consensus is used to verify a plant for anthropological uses. Overall, these two ethno-species make up 44% of citations in the abortifacient literature of Mexico.

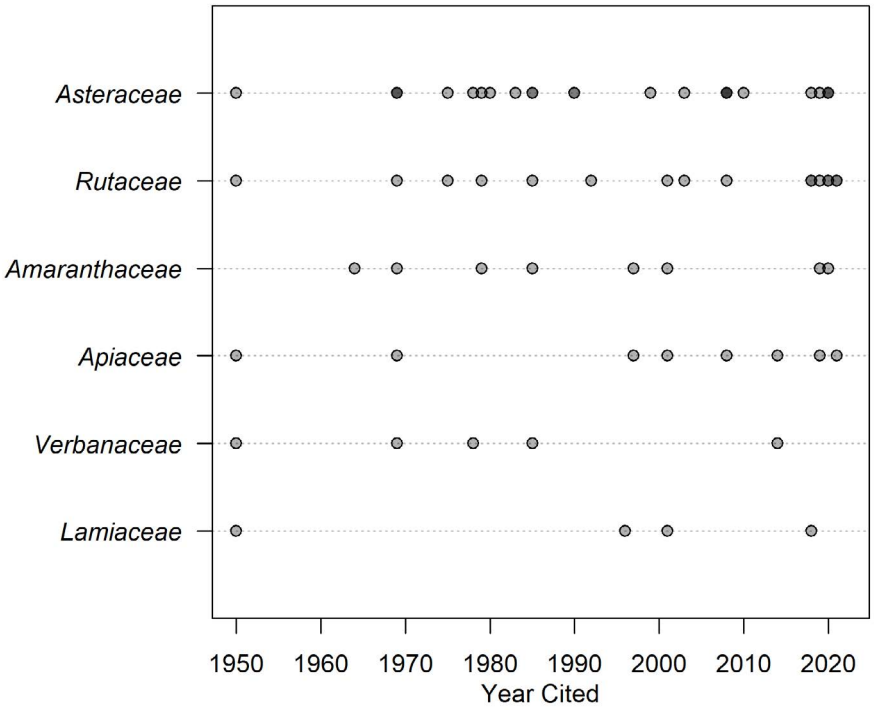

Figure 2. Timeline of plant families cited as abortifacients in Mexico (1950–2021).

Similar to the temporal analysis of families in our review, we also looked into how often species persisted throughout time. In addition to the counts for each species mentioned in the literature (Figure 3), we also took note of which years each species was cited to observe the frequency of their appearance through time (Figure 4). This temporal analysis revealed that several frequently cited abortifacient species show discontinuous documentation across the 1950-2021 period. While species such as *Ruta graveolens* and *Montanoa tomentosa* appear repeatedly across multiple decades, other commonly cited species exhibit extended gaps between citation periods despite high overall citation counts (Figure 4).

The potential mode of action for the majority of our species of interest, specifically in Mexico, is obtained from a combination of healers' consensus and laboratory studies. For example, *Ruta chalepensis* is known to terminate pregnancies, induce menstrual flow, and facilitate uterine contractions. This is according to healers' consensus as well as a study that tested extracts on pregnant mice that found there are embryotoxic effects after its application (Gonzales *et*

al. 2007). For example, two studies investigated the chemical composition of Mexican oregano (*Lippia origanoides*) and its use for abortive effects (Lin *et al.* 2007, Martínez-Rocha *et al*. 2018, Cortés-Chitala *et al*. 2021). *Preparation Forms and Care Contexts Associated with Abortifacient Plants.* Across the reviewed literature, abortifacient plants are most often described in terms of preparation forms and care contexts rather than standardized dosing. For the most frequently cited species in this review (*Ruta* spp., *Montanoa* spp., *Dysphania ambrosioides*, *Lippia* spp., *Calendula officinalis*), sources consistently reference preparation as infusions, decoctions, or baths. These preparations are typically described qualitatively ("strong tea" or "warm baths") and vary by region and context.

Table 2. Top ten plant species used as abortifacients in Mexico, with physiological effects.

Common Name (Spanish)	Species	Physiological Effect	Citation
Ruda	*Ruta graveolens* L.	Emmenagogue	(Cabrera 1950, Parker 1975, Conway & Slocumb 1979, Zamora-Martínez & de Pascual Pola 1992, Pick *et al*. 2003, É Ibiza 2008, Pineros Ospina *et al*. 2018, Aguirre 2019, Souza *et al*. 2020, O'Brien 2021)
Ruda	*Ruta chalepensis* L.	Oxytocic, emmenagogue	(Ortiz de Montellano & Browner 1985, Pineros Ospina *et al*. 2018, Fonseca-Chávez *et al.* 2020, O'Brien 2021)
Epazote	*Dysphania ambrosioides* (L.) Mosyakin & Clemants	Abortifacient, emmenagogue, oxytocic	(Luna 1964, Martínez 1969, Conway & Slocumb 1979, Ortiz de Montellano & Browner 1985, Suárez 1997, Montes de Oca 2001, Aguirre 2019, Fonseca-Chávez *et al.* 2020)
Perejil	*Petroselinum crispum (Mill.) Fuss*	Abortifacient, emmenagogue	(Cabrera 1950, Martínez 1969, Suárez 1997, Montes de Oca 2001, É Ibiza 2008, Tisserand & Young 2014, Aguirre 2019, O'Brien 2021)
Zoapatle	*Montanoa frutescens* Brandegee	Oxytocic	(Villacis 1978, Sanchez 1980, Gallegos 1983, Ortiz de Montellano & Browner 1985, Lozoya 1998, Lozoya 1990, Aguirre 2019)
Zoapatle	*Montanoa tomentosa* Cerv. ex Lag.	Abortifacient, emmenagogue, oxytocic	(Cabrera 1950, Martínez 1969, Lozoya 1990, Pick *et al*. 2003, Castañeda *et al.* 2008, Fonseca-Chávez *et al.* 2020)
Altamisa	*Tanacetum parthenium* (L.) Sch.Bip.	Abortifacient, emmenagogue, oxytocic	(Martínez 1969, Ortiz de Montellano & Browner 1985, É Ibiza 2008, Wink 2010, Fonseca-Chávez *et al.* 2020)
Caléndula	*Calendula officinalis* L.	Abortifacient, emmenagogue	(Martínez 1969, Parker 1975, É Ibiza 2008, Pineros Ospina *et al*. 2018, Souza *et al*. 2020)
Orégano	*Lippia origanoides* Kunth (syn. Lippia graveolens Kunth)	Abortifacient, emmenagogue	(Cabrera 1950, Martínez 1969, Villacis 1978, Ortiz de Montellano & Browner 1985, Tisserand & Young 2014)
Romero	*Salvia rosmarinus Spenn.*	Abortifacient, emmenagogue	(Cabrera 1950, Lemonica *et al.* 1996, Montes de Oca 2001, Pineros Ospina *et al*. 2018)

The literature also distinguishes between plants used directly to induce uterine contractions or menstrual flow and those used as part of pre-abortion or post-abortion care (Piñeros Ospina *et al*. 2018). Preparatory practices are commonly described as measures intended to reduce anxiety, warm the body, or prepare the uterus prior to induction. Post-abortion care often focuses on rest, warming the body through herbal baths and supportive infusions (Piñeros Ospina *et al*. 2018). This care is aimed at aiding physical and emotional closure. In addition, community-circulated care manuals produced in other Latin American contexts, particularly Argentina, describe the use of herbal baths as part of pre-, during-, and post-abortion care (Ballena 2016). These materials circulate through abortion accompaniment networks in Mexico, including regions such as Michoacán, where locally available or native plants are available. For example, species such as *Ruta* spp. and *Dysphania ambrosioides* are repeatedly referenced in these materials as part of pre- during-, and post-abortion care processes (Ballena 2016). This pattern reflects both ethnobotanical convergence and the exchange of reproductive care knowledge across regional boundaries. These care practices are presented as crucial components of the abortion process rather than extra steps. Explicit quantitative dosing information is rarely reported across ethnobotanical, historical, and community-circulated sources. This highly reflects both the embodied transmission of knowledge and the longstanding reluctance to document abortive practices in precise terms.

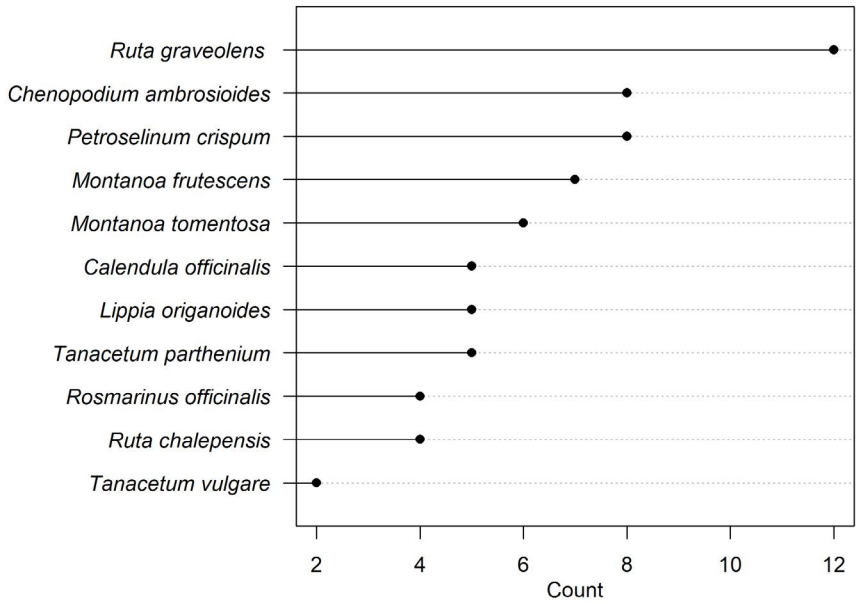

Figure 3. Number of citations for the most frequently reported abortifacient species in Mexico.

Discussion

From our data compilation and analysis, it seems clear that plants with abortive properties have been used for generations, and in all likelihood will continue to be used. We can also see that several plants have persisted through generations going back to 1950 and are still being used. Beyond these frequently mentioned plants, there are an additional 122 species that have historically been reported as abortifacients. Abortifacients, although sparse within the larger realm of medicinal plant use research, have deep social and cultural ties that provide a strong foundation for the continuation of their dissemination. This review of abortifacients used in Mexico has not only shown us the species and plant families used over time but has uncovered the degree of accessibility of abortifacients in peer-reviewed literature. Our findings also expand on recent literature reviews of plant-based reproductive care in Mexico that have

relied largely on database-driven searches (Cabada-Aguirre *et al*. 2023). Comparable plant-based abortifacient and emmenagogic practices have been documented in diverse regions of the world, often involving similar taxa or functional plant groups, even in the absence of direct cultural contact. These patterns suggest convergent ethnobotanical knowledge systems, while underscoring the importance of region-specific analyses grounded in local cultural and historical contexts (Garnatje *et al*. 2017). Practices parallel to abortifacient and emmenagogic uses of Mexico have been documented in other regions, including the use of *Ruta* spp. in Chinese and Mediterranean medicine (Pollio *et al*. 2008, Luo *et al*. 2024). While contributions in abortifacients are important in consolidating accessible information, their limited source base sometimes led to inconsistencies in species identification. For example, oregano was noted as being used to induce abortion, but the species was identified as Italian oregano (*Origanum vulgare*, family Lamiaceae) rather than Mexican oregano (*Lippia origanoides*, family Verbenaceae) (Cabada-Aguirre *et al*. 2023). This distinction is significant, as the two belong to entirely different plant families and only the latter is consistently cited in community and ethnobotanical sources as an abortifacient. By incorporating community-circulated texts and ethnographic records, our review helps to clarify such misidentifications and highlights the importance of local knowledge in complementing database-based reviews.

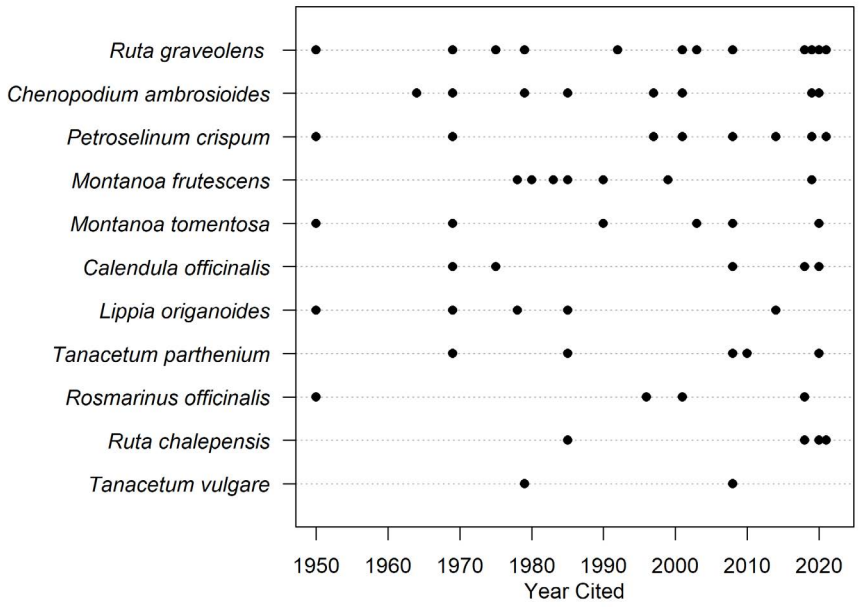

Figure 4. Timeline of citations for the top plant species in Mexico cited as abortifacients (1950–2021).

Socio-cultural dimension of abortifacients. Plants used for reproductive health care in Mexico have been researched not only regarding what plants are used but also how this information is shared and guarded (Browner & Perdue 1988). In some cases, plants used for reproductive care are guarded from men as a way for women to exercise reproductive autonomy (Browner & Perdue 1988). Despite being riddled with social stigma and criminal penalties, abortifacients are part of a generations-long practice that has been passed down orally albeit with some hesitation (Browner & Perdue 1988). Under certain circumstances, the process to terminate a pregnancy has been even noted to be acceptable by midwives to help an individual induce or regulate their menstruation (Castañeda *et al*. 2008). However, in the grand sense, a terminated pregnancy is viewed by many midwives as an "unforgivable sin" for whoever attempts one (Castañeda *et al.* 2008). Even miscarriages were often equated to provoked terminations, claiming a miscarriage is a woman failing her duty to carry out a pregnancy (Castañeda *et al*. 2008). A study focusing on birth workers that include women who have terminated their pregnancy demonstrated that individuals in this study area (Morelos, Mexico) felt that terminating their pregnancy was justified for specified reasons while still disapproving of

other individuals who decide to abort (Castañeda *et al*. 2008). The reasoning and justification for terminating a pregnancy, at the end of the day, is made at the individual level, despite the continuous reinforcement of stigma related to voluntarily ending a pregnancy.

Within Mexico, there is a substantial presence of accompaniment that tends to the emotional and mental support aspect of terminating a pregnancy and further speaks to the social and cultural support provided by certain groups within the local community. A particular study on accompaniments has found that this available support can help increase the positive emotions pregnant individuals feel when undergoing the process to terminate while lessening negative emotions (Wollum *et al*. 2022). Accompaniment is a part of all pregnancy termination processes be it at home through pharmaceuticals, procedural, or plant-based (Broussard 2024). More specifically, accompaniment is provided by feminist activists and trained volunteers (Veldhuis *et al*. 2022). Overall, the process to terminate a pregnancy has complex social and cultural dimensions tied to long-standing stigmas, feminist movements, gender roles, and religion.

Plant-based abortion practices are also shaped by gendered expectations and roles within traditional and contemporary communities, where reproductive responsibility and its social consequences are disproportionately on the shoulders of women. Factors such as stigma, moral judgment, limited access to formal healthcare, economic inequities, and exposure to gender-based violence can influence when and how plant-based abortion practices are used. Within these contexts, abortion-related knowledge and care are often managed through informal networks, secrecy, and accompaniment, reflecting structural constraints and the ways individuals navigate reproductive decisions.

What do we know about abortifacient plants in Mexico? Across the literature reviewed, healers' consensus emerges as a central framework through which abortifacient plants are named, grouped, and understood, particularly regarding shared uses and ethnospecies groupings. As mentioned before, we utilize the term ethnospecies to refer to species that contain the same common name in Spanish, have the same intended use, and share the same genus. These ethnospecies are considered the same plant by healers regarding uses. Just as mentioned previously, ruda and zoapatle are used for two sets of different species (Table 2).

Unknowns of abortifacient plants. Regarding the limitations of what we know regarding abortifacients, the mode of action is often missing but so is the mechanism of action and the active principle. For a majority of plants that serve as abortifacients in literature, their role is often reduced to "abortive" or "abortifacient" which gives us little information on what the plant extract does. Of all the plants cited in the literature to facilitate pregnancy terminations, 21 % of plants were cited as "abortifacient" with no further clarification on how exactly the process is triggered. Although healers' consensus often gives us the intended effects of these species within plant based processes, there is sparse literature regarding what and how specific compounds are responsible for inducing pregnancy termination.

Side effects & secondary metabolites. Side effects associated with abortifacient plants are closely linked to the secondary metabolites responsible for their intended physiological activity. Several of the most frequently cited species contain compounds with known emmenagogic or oxytocic properties. For example, *Ruta* spp., an abortifacient and emmenagogue contains alkaloids, flavonoids, phenols, and coumarins many of which exhibit biologically potent activity (Gonzales *et al.* 2007). Experimental studies demonstrate that extracts of *Ruta graveolens* exert dose-dependent uterine contractile effects, with some fractions producing responses comparable to oxytocin (Luo *et al*. 2024). Furthermore, investigations indicate that different classes of compounds within *Ruta* spp. are associated with distinct reproductive and toxicological effects. While coumarin analogs have been implicated in antifertility mechanisms related to sperm motility, the specific compounds responsible for uterine contractile activity have not been definitively identified (Luo *et al.* 2024). Toxicological reports describe adverse effects such as uterine bleeding, gastrointestinal irritation, photosensitivity, and potential toxicity in a variety of organs (Luo *et al.* 2024). This knowledge suggests that both the intended physiological effects and the connected side effects of *Ruta* spp. develop from the combined action of multiple bioactive constituents. The absence of standardized dosing and preparation methods

further underscores the importance of culturally grounded knowledge systems and highlights the need for continued interdisciplinary research into both efficacy and safety.

Our sources, be they peer-reviewed articles or print books circulated locally in Mexico, often presented abortifacients within the lens of "do not use if pregnant" or "avoid during pregnancy" as opposed to outright labeling the plant use as "emmenagogue" or "abortive." In this case, the very manner in which information is documented displays a form of censorship and perhaps even stigma. As we began our literature review process, we began searching for literature that discussed plants as "abortive," "herbal abortion," and "abortifacient," specifically filtering for literature focused on Mexico that discusses these plants through the lens of choosing to use them for the early termination of pregnancies. However, we began to find that literature discussed these plants through the perspective of avoiding them for pregnancy to avoid the elective termination of a pregnancy. The keywords we utilized then were changed to include "emmenagogue," "oxytocic," "induce contractions," and "induce menstrual flow." We approached our literature review with a focus on precise terminology, acknowledging that much of the existing literature discusses abortifacients avoiding direct use of the term 'abortion'.

Ethnobotanical abortions in Mexico are a living, changing, and continuing practice. This knowledge is traditionally held by Mexican, Indigenous, and Mexican migrant women, and includes the taxonomic and social-cultural value of these plants. Aside from their application to their practical use for abortion, there is much to be investigated regarding their role in social mobility as tools for bodily autonomy and by managing whether a pregnancy is carried out.

In addition to further researching this practice and these plants within the social and cultural realm, researching through a biochemical lens the species used in the continuing practice of ethnobotanical abortions is crucial to addressing the knowledge gap of abortifacients (Ciganda & Laborde 2003, Gonzales *et al*. 2007, Shah *et al*. 2009) and fueling the current reproductive justice movement in Mexico (Acevedo & Bosio 2019) that has accomplished so much towards the nationwide decriminalization of abortion in the country (Medina Ávila & Mecalco López 2023).

Supplementary material

Supplemental material for this article can be accessed here: https://doi.org/10.17129/botsci.3816

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