

## Notes on Economic Plants

# Maya Medicinal Fruit Trees: Q'eqchi' Homegarden Remedies

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### Introduction

Five cultivated fruit trees are among the most popular medical plant species that Q'eqchi' Maya horticultural villagers of Alta Verapaz, Guatemala, grow in their dooryards. Participant–observation with informal interviews and 31 semi-structured interviews amidst walking homegarden tours inform findings. Beyond their apparent nutritional, ornamental, and shade values, Q'eqchi' use bitter orange, *Citrus x aurantium*, for headaches, gastrointestinal problems, high blood pressure, cough, and fever. Prevalent home garden tree *Citrus x latifolia* treats fever, throat, cough, and heart problems; *Mangifera indica* treats fever and kidney pain; *Persea americana* helps gastrointestinal and skin problems, body pain, evil eye, and has abortive properties; and *Psidium guajava* remedies gastrointestinal problems, amoebas, and bites. In this paper, we review the regional ethnomedical use and pharmacology of these species. Outside pharmacological research supports Q'eqchi' villagers' cultural reasons for these phytotherapies.

Guatemala is a hotspot of biological and cultural diversity; ecological zones range from coastal, to highland, to lowland tropical, and over 20 Maya—among other—ethnic groups live throughout the small country (McKillop 2004). Maya homegardens have a long history of use and provide biocultural resources with overlapping uses: food and medicine are two common functions (Kumar and Nair 2006; Mariaca Mendez 2012). Home remedies—often homegarden medicinal plants—are the first choice for health care, especially in rural, impoverished areas (Quinlan 2004; Vandebroek 2013; Weller et al. 1997). Guatemalans regularly use medicinal plants in home health care, as they are readily available, have

longstanding traditions of use, and are virtually free (Adams and Hawkins 2007; Cosminsky 2016). Many Guatemalan medicinals show pharmacological efficacy (Caceres 1996; Michel et al. 2007).

### METHODS AND SETTING

This research took place in a village of Alta Verapaz, Guatemala, which is home to approximately 700 people, of mostly Q'eqchi' ethnicity. Abundant rain falls (2000–3000 mm annually) in this lowland village. Evergreen rainforest grows from limestone soil and temperatures range from 25 to 38 °C (McKillop 2004). Native palms, orchids, and bromeliads predominate (Standley and Steyermark 1945).

Villagers simply call their homegarden (or dooryard garden) area their *lote*, or “lot.” All gardened and wild plants indeed grow around a household's lot, the rectangular parcel of land (usually 30 × 60 m) where villagers build their house and live. They own or rent additional plots for *milpa* maize-based horticultural subsistence or small-scale commercial production. Homegardens are outdoor living spaces with work and social gathering areas. Plants of all sizes provide food, medicine, ornament, and shade.

### METHODS

We conducted fieldwork here between June and August 2016, and July 2018. This research builds on village-wide participant–observation and informal interviewing (Bernard 2017). We sampled 26% of the 100 village households for focused participation, and interviewed 31 consenting adult members of those households (see Table 1 for details). Five dyads participated, two of which were interviewed

TABLE 1. DESCRIPTIVE STATISTICS OF THE SAMPLE ( $N = 31$  INDIVIDUALS IN 26 HOUSEHOLDS)

Variable	Mean	Median	Minimum	Maximum	SD
Participant ages	35.1	31.5	19	70	12.5
IDs per species	1.64	1	1	7	1.19
Plants per participant	4.03	3	0	11	3.21
	Proportion	1	0		
Sex	0.74	♀ (23)	♂ (8)		
Interview language	0.935	Spanish (29)	Q'eqchi' (2)		
Household near road	0.5	Yes (13)	No (13)		
Interviewed individually	0.774	Yes (24)	No (7)		
Household member	0.677 ♀heads	♀Head (21)	♂Head (7)	Adult ♀ (2)	Adult ♂ (1)

separately (two husband/wife pairs). In three dyads (two mother/adult daughter pairs and one husband/wife pair), the interviewees clearly indicated personal knowledge of local plants independent from their family member. Households were selected by stratified convenience sampling according to the distance and direction (north or south) from the central road.

We used two semi-structured interview techniques. Interviews were in Spanish except with two monolingual participants interviewed with a Q'eqchi' translator. Initial open-ended interviews assessed life course, cultural, and ethnobotanical topics. Next, Thiel conducted walking homegarden tours (Martin 2014) to elicit names and uses of plants. She asked for the Spanish, Q'eqchi', and other names for each plant, then asked for the plant's local uses and probed for details regarding parts, amounts, and preparations. She interviewed 31 informants between the ages of 19 and 70; 8 men and 23 women. Availability skewed the sample's sex ratio: men spend daylight hours working outside the home, while women remain near home.

#### VOUCHER SPECIMENS

The Guatemalan National Council for Protected Areas granted permission for voucher collection. We deposited vouchers at the University of San Carlos Herbarium in Guatemala City.

## Results and Discussion

Medicinal plant home remedies are often the first choice for health care in rural, impoverished areas (Quinlan 2004; Weller et al. 1997) and homegardens are uniquely situated to provide these resources (Kumar and Nair 2006; Mariaca Mendez 2012). In this Q'eqchi' village, women generally spend waking hours around home, and men spend

more time away from home in subsistence production or wage labor. Women may generate income with at-hand resources by selling their trees' fruit to neighbors, grinding corn or making tortillas or tamales, or making fruit popsicles or sliced fruit to sell to neighbors and school children. Village women list more fruit tree uses than men do, plus more medicinal plants—presumably the plants they maintain in homegardens. Men list more non-fruiting tree species than women, reflecting Q'eqchi' labor division in which men regularly gather fire and construction wood, while women prepare food. This research does not draw conclusive evidence about gender differences regarding Alta Verapaz medicinal plant cultivation and use, although ethnobotanical domains appear gendered elsewhere (Mariaca Méndez 2012; Quinlan et al. 2016; Voeks 2007; Wayland 2001). Our observations warrant further research.

Five fruit trees were among these Alta Verapaz villagers' most frequently mentioned homegarden medicines (Table 2). While variation in medicinal plant cultivation and use is a village norm, there are several species that villagers identify easily, species of common knowledge. Each plant herein—listed in order of prevalence—is reported in at least three (12%) sampled village homegardens.

#### *CITRUS X AURANTIUM* L.

Seven interviews (27%) indicated a tea of infused *Citrus x aurantium* (bitter orange) leaves to cool and treat stomachache, colic, vomiting, diarrhea, cough, fever, and high blood pressure. Stomach complaints and fever are the most common uses, and informants may add other plants (especially *Citrus x latifolia* Tanaka ex Q. Jiménez and *Cymbopogon citratus* [DC.] Stapf, Poaceae) to improve the effect. One informant applies the leaves directly to the forehead to treat headaches.

TABLE 2. THE FIVE MOST FREQUENTLY MENTIONED GUATEMALAN Q'EQCHI' HOMEGARDEN FRUIT TREES AND THEIR MEDICINAL USES.

Latin name and family	Spanish name	Q'eqchi' name	English name	Medicinal plant part	Illnesses treated locally	Homegardens reporting as medicinal	Homegardens in which present	Voucher ID
<i>Citrus x aurantium</i> L., Rutaceae	Naranja	Chiin	Bitter	orange	Leaves	Headache, stomachache, intestinal cramps, high blood pressure, vomiting, diarrhea, cough, fever	7	14
AT024 <i>Citrus x latifolia</i> Yu. Tanaka, Rutaceae	Limón/Limón persa	Lamux, lamux q'en	Persian lime	Leaves	Fever, sore throat, cough, heart problems	4	8	AT017
<i>Mangifera indica</i> L., Anacardiaceae	Mango	Mank	Mango	Leaves, bark	Fever, kidney pain, unknown	4	13	AT013
<i>Persea americana</i> Mill., Lauraceae	Aguacate	o	Avocado	Leaves, bark, pit	Diarrhea, ulcers, skin problems, evil eye, stomachache, abortive	4	20	AT001
<i>Psidium guajava</i> L., Myrtaceae	Guayaba	Para	Guava	Leaves, bark	Bites, stomachache, amoebas	3	9	AT025

Elsewhere in Guatemala, Q'eqchi' in Izabal infuse *C. x aurantium* leaves to drink and apply directly for night sweats and insomnia (Michel et al. 2006). Guatemalan Caribs drink a leaf decoction for flatulence, the pericarp for vomiting and diarrhea, the bud for “cardiac weakness” and nervousness, and eat the fruit for fever (Girón et al. 1991:184). Countrywide, Guatemalans use bitter orange leaves, flowers, peel, and bark for many digestive, respiratory, nervous, and cardiac symptoms (Caceres 1996). Belizean Maya use *C. x aurantium* leaf infusions topically for fever, and as tea for gastrointestinal problems, colds, influenza, fever, and blood clots, and with other plants for various digestive, circulatory, and nervous system ailments (Balick and Arvigo 2015).

Yucatec Maya drink the leaf infusion for various forms of upset stomach, apply the infusion for rheumatism, and decoct bark tea for diarrhea (Anderson 2003). Haitians treat fever, flu, irregular heartbeat, and emotional shock with *C. x aurantium* leaf tea, use leaves topically for headaches, and fruit topically to promote circulation, e.g., for bruises (Paul and Cox 1995).

Knowledge of *C. aurantium*'s pharmacology remains limited; however, biological assays find gastroprotective and antiulcer properties (Karthikeyan and Karthikeyan 2014), supporting *C. aurantium*'s traditional use for gastrointestinal problems, especially gastritis and ulcers. The whole plant contains volatile oils and alkaloids including synephrine, which shows activity against depression, and flavonoids with antianxiety, sedative, and tranquilizing effects. The essential oil is anti-fungal against *Candida albicans*, *Lentinius lepideus*, *Lenzites trabea*, *Polyporus versicolor*, *P. cyclopium*, and *Trichoderma viride*; antibacterial against *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Streptococcus pyogenes* (Carvalho-Freitas and Costa 2002); and an effective smooth muscle relaxant (Karthikeyan and Karthikeyan 2014).

#### CITRUS X LATIFOLIA TANAKA EX Q. JIMÉNEZ

In four homegarden interviews (15%), villagers report that *Citrus x latifolia* (*limón*, lime) leaf tea and fruit juice are useful for fever, sore throat, and cough. One informant mentioned the leaf tea for heart issues. Villagers often combine the leaves with other plants, including *C. x aurantium*, *Mangifera indica* L., *Psidium guajava* L., and *Cymbopogon citratus*. *C. x latifolia* has had multiple names (e.g., formerly *C. latifolia* Yu Tanaka, *C. aurantiifolia*

Swingle, synonym *C. x aurantiifolia* subsp. *Latifolia* [Yu.Tanaka] S.Ríos, D.Rivera and Obón). We include *C. aurantiifolia* (etc.) reports here if authors identify it by *C. x latifolia*'s common names; *limón* (Spanish), *lamunx* (Q'eqchi'), or Persian lime (English).

Highland Maya use *limón* (or *limón persa*) fruit for fevers, stomachache, appetite loss, ear infections, and rheumatism (Orellana 1997). Indigenous and Ladino Guatemalans use *limón* juice and dried pulverized fruit for respiratory and digestive problems, fevers, hepatitis, rheumatism, and pain (Caceres 1996). Local Caribs use the leaf infusion for fever (Girón et al. 1991).

Among Belizean Q'eqchi', Zarger (2002) lists *C. x aurantiifolia* leaves as a tea but does not specify medicinal applications. Balick and Arvigo (2015) report Belizean Maya medicinal use of *C. x aurantiifolia* for cough, colds, “congested blood,” and high blood pressure (Balick and Arvigo 2015). Yucatec Maya consider *C. x aurantiifolia* to be cooling and use the leaf tea for stomach upset and the fruit with honey for catarrh (Anderson 2003). Dominicans use the leaves and roots for fevers (Quinlan 2004).

Pharmacological research finds *C. x latifolia* as antimicrobial against various microbes that produce fever, cough, and sore throat. Leaf extracts attack Gram-positive and Gram-negative bacteria comparably to standard antibiotics tobramycin, gentamicin sulphate, ofloxacin, and ciprofloxacin screened under similar conditions. Palmitic acid in the essential oil is active against *Mycobacterium tuberculosis*, including multi-drug-resistant *M. tuberculosis* strains. The fruit extract is fungicidal against pneumonia-causing *Aspergillus niger* and *Candida albicans*, causing mouth and throat thrush infections (Al-Snafi 2016). Lime's high antioxidant flavones protect cell damage, particularly from oxidation associated with respiratory and digestive problems, hepatitis, and rheumatism (Urbando-Rivera et al. 2005); and *Citrus* flavonoids, which are anti-inflammatory—especially in the circulatory system (Benavente-Garcia et al. 1997)—thus should reduce fever and improve cardiovascular health. Consistent with Q'eqchi' *C. x latifolia* leaf tea for heart issues, experiments with ingested fruit extract significantly decreases blood pressure and heart rate in rodents, reduces systolic, diastolic, and mean blood pressures, heart rate, triglycerides associated with strokes, and LDL cholesterol associated with coronary artery disease (Al-Snafi 2016).

*MANGIFERA INDICA* L.

*Mangifera indica* (mango) grows in 13 (50%) of the sampled homegardens. Villagers eat the mango fruit or sell it to local shops. One woman sells sliced mango with condiments to schoolchildren during breaks. Four participants (15%) mentioned the leaves and bark as medicinal. Two informants use the leaves for fever; one also said the bark is useful for kidney pain. The other two informants that mentioned *Mangifera* as a medicine did not know what conditions it could treat.

The Ch'orti' Maya and Ladinos in Eastern Guatemala use *M. indica* seed, bark, and "tender shoots" for digestive problems, and the seed, tender shoots, and leaves for respiratory illnesses (Kufer et al. 2005:1133). Guatemalan Caribs and Panamanians use the leaf and bud tea as a tonic and for coughs and bronchitis (Girón et al. 1991; Lewis and Elvin-Lewis 2003). Yucatec Maya make *M. indica* leaf infusions to wash and to drink for scorpion stings (Anderson 2003). In Belize, *M. indica* leaves treat bruises, cough, mucus, and menstrual cramps (Balick and Arvigo 2015). In Dominica, *M. indica* leaf tea is a remedy for loose bowels (Quinlan 2004).

Mango bark and leaves are pharmacologically active. The bark extract has anti-inflammatory and analgesic effects in rodent tests (Ojewole 2005), consistent with its Alta Verapaz fever use. Mangiferin—a major constituent responsible for *Mangifera*'s medicinal effect—has proved effective for its antioxidant, antitumor, antiallergic, antibacterial, antiparasitic, antifungal, antidiabetic, and antiviral properties in multiple trials (Shah et al. 2010; Wauthoz et al. 2007).

*PERSEA AMERICANA* MILL

Four village residents (15%) report *Persea americana* (avocado) as a medicinal homegarden plant, although it is present in 20 (77%) homegardens sampled in this research. The remaining 16 informants mention it only for food. Villagers use *P. americana* leaves for body pain, diarrhea, ulcers, *granos* (skin bumps/pimples), and evil eye. They use *P. americana* bark for stomachaches and the pit as an abortive.

Literature from Guatemala, and elsewhere, indicates similar *P. americana* medicinal uses. Eastern Guatemalan Q'eqchi' use the seed as an abortive (Michel et al. 2006). Guatemalan Caribs use the leaf tea for urinary and bronchial infection, to detoxify,

and for cardiac weakness (Girón et al. 1991). Guatemalans nationwide use *P. americana* seed, bark, and leaf tea for skin bumps, bruises, rheumatism, malaria, tumors, gastrointestinal trouble, and parasites (Caceres 1996), headaches (Caceres 1996; Orellana 1997), and the leaves and pit for wounds (Orellana 1997). *P. americana* leaf tea is a treatment for cough and colds and an external application for bruises in Belize (Balick and Arvigo 2015). Dominicans infuse the leaves to treat loose bowels and indigestion (Quinlan 2004).

Pharmacologically, aqueous extract of *P. americana* leaves causes significant, dose dependent analgesic and anti-inflammatory activity (Ngbolua et al. 2019). It is antibacterial against several diseases including diarrhea-producing *Escherichia coli* and *Staphylococcus aureus* bacteria, and antiviral against Herpes simplex virus-1 and human adenovirus type 3 acute respiratory disease. The aqueous leaf extract produces significant anti-ulcer activity in rats. Avocados are among the world's most potent antioxidant fruit, and tests on the seed show similar antioxidant, free radical scavenging activity (Ngbolua et al. 2019). Biochemical findings match local applications for pain, gastrointestinal and dermatological healing, plus the generalized illness of evil eye.

*PSIDIUM GUAJAVA* L.

Villagers report using *Psidium guajava* (guava) leaves and bark for medicine in three homegarden interviews (12%). Two informants indicate the infused leaves as medicinal for dabbing on insect bites, and in an unspecified tonic ingredient with the leaves of three other plants. A third informant indicates a cooled bark decoction to treat stomachache and amoebas. Nine homegarden interviewees mention *P. guajava*'s edible fruit while three identified the plant as medicinal.

One Belizean Q'eqchi' community's only *P. guajava* use is fruit-eating (Zarger 2002), while Balick and Arvigo (2015) found Belizean Q'eqchi' and Mopan Maya use *P. guajava* internally and externally. They apply guava leaf infusion externally for pain, to prevent measles and chickenpox scabs, and for sores and itching, and decoct the *P. guajava* bark tea for an external wash to treat skin wounds and athlete's foot. Internally, they drink the bark tea for all manner of stomach upset: dysentery, diarrhea, vomiting, stomach discomfort, and pain.

Guatemalan Caribs use *P. guajava* leaf tea for diarrhea (Girón et al. 1991). Guatemalan

highlanders drink *P. guajava* leaf and bark infusion for diarrhea, dysentery, and intestinal cramps; gargle the infusion for oral health; and apply or wash with it for men's and women's genital discomfort and itching and to disinfect wounds and treat sores on the skin (Orellana 1997). Caceres (1996) cites the above uses across Guatemala, adding that the leaf and bark tea treat intestinal parasites and amoebas. The Yucatec Maya similarly use *P. guajava* leaves for wash to treat measles and *granos* (skin problems/sores), and the bark for diarrhea (Anderson 2003). In Dominica, *P. guajava* leaf tea is a treatment for upset stomach, diarrhea, vomiting, and nausea (Quinlan 2004).

Pharmacological literature on *P. guajava* supports Q'eqchi' therapeutic applications, especially to treat diarrhea and dysentery due to its significant antispasmodic and antibacterial properties. *P. guajava* leaf aqueous extract is an effective antioxidant, antibiotic, and has anti-allergic agents that attenuate T cell responses in mice. Experiments find that, applied topically, guava-leaf-infusion reduces infection, speeds wound healing, and reduces pain and swelling. It similarly heals acne through its antibiotic effect on *Propionibacterium acnes* and anti-inflammatory effect on the sores (Gutierrez et al. 2008).

## Conclusions

We presented five trees that Guatemalan Q'eqchi' Maya villagers use for their edible fruits and as home remedies. The regional cross-cultural ethnobotanical literature reports similar uses of these plants, and pharmacological literature points to the efficacy of these treatments for a variety of ailments. Our hope is that documenting this information contributes to preserving useful ethnobotanical knowledge for Alta Verapaz Q'eqchi'.

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permission for research, a process Medinaceli (2018) discusses further. We obtained free, prior, and informed consent for each interview.

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