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## Research Paper

## Herbal medicine in the Marquesas Islands



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## ABSTRACT

**Ethnopharmacological relevance:** This manuscript reports data on medicinal plants used in Marquesas Islands traditional medicine. The subject is interesting due to the extreme geographical isolation of this archipelago and the scarcity of data on this subject. The hypothesis of the authors was that traditional knowledge in this area should be consequently largely preserved.

The usual ethnobotanical collection of use/symptom was completed by an additional quantitative ethnobotany analysis providing two indices: the relative frequency of plant uses for a given affliction (RF) and the Informant Consensus Factor (ICF).

**Materials and methods:** Our ethnopharmacological study was carried out between 2009 and 2012 in several parts of the archipelago by collecting the accurate names of the medicinal plants, their uses, the methods of preparation of the remedies and the associated traditional nosology. Two methods were applied: *ex situ* focus groups with scientists and local association partners, using fresh plant specimens, dried specimens, and photographs, guided by an outline of simple questions, and *in situ* semi-structured interviews of informants during walk in the woods or homegarden sampling.

**Results:** 96 plant species were pointed out as medicine for which we collected 1774 use reports; 77 of these species cited by more than 1 informant are listed with their frequency of use.

Three species account for one-third of use reports: *Cocos nucifera* (coconut), *Gardenia taitensis* (tiare Tahiti) and *Microsorium grossum*.

Native species (either indigenous or endemic) represent only one quarter of all used species. The Polynesian introductions (plants introduced during Polynesian migrations) represent 42% of the Marquesan medicinal plants. On the other hand, one-third are modern introductions, introduced, for most of them, less than 200 years ago.

Diseases are analyzed according to Marquesan concepts. In the present study, a special attention was focused on the descriptions of the local diseases. Their translation in French was discussed and verified in focus groups involving both scientists and Marquesan language specialists from the "Académie des Marquises".

40 plant species showed a high frequency of citation for a given affliction (RF > 20). Despite the complex nosology the ICF to Marquesan traditional illness categories showed generally high ICF values, suggesting their strong coherence.

**Conclusions:** An overview of the Marquesan pharmacopoeia, linked with ethnomedicinal practices, is presented in this paper. Marquesan traditional medicine survived until now despite the culture shock faced by the Marquesan population switching to numerous introduced plants commonly found in their close environment and easily gathered.

Marquesan herbal medicine appears to draw its inspiration from a common Polynesian root. However further investigations on Marquesan nosologies are necessary to appreciate the originality of the Marquesan pharmacopoeia.

Finally, the crossing of ICF and RF indices shows that 36 species have at least one significant use (frequencies > 20%) with high ICF value (> 0.5). This suggests that some key phytochemical

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ingredients may be present in these plants which require further phytopharmacological studies to a better knowledge of their medicinal properties.

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## 1. Introduction

Despite important economic and cultural changes during the last decades, the practice of Polynesian herbal medicine is still alive in most Polynesian islands. Several ethnobotanical surveys on various archipelagos have been published: Hawaii (Abbott and Shimazu, 1985; 'Ohukani'ohi'a Gon, 2008), Pohnpei–Micronesia (Balick, 2014) Samoa (Cox, 1993), Tonga (Whistler, 1985), Cook (Whistler, 1985, 1991). However there are very few recent ethnobotanical studies on French Polynesia.

The oldest observations regarding the Marquesas Islands are found in the narratives of the first explorers, for example the "Journal of a Voyage to the South Seas", published by James Cook in 1773 after his first Pacific voyage in the company of botanist Joseph Banks. During the French colonial period, Jardin (1858) and Jouan (1858), two naval officers who stayed in the Marquesas Islands for a few years, published some observations on the traditional use of plants. In the 20th century, many species described by Brown (1931, 1935) during his expeditions in several archipelagos of French Polynesia can be found in the Bishop Museum of Hawaii, often accompanied by numerous indications on their uses.

More recent works deal with plant uses in Polynesian traditional medicine (Grépin and Grépin, 1980; Grand, 2007; Lemaître, 1985, 1989). Butaud et al. (2008) supply numerous indications on the uses of Polynesian trees. Pétard (1986) remains the only recent reference for French Polynesian medicinal plants; however this book contains few references to the Marquesas Islands.

Our ethnopharmacological study was carried out between 2009 and 2012 in the Marquesas Islands (Fig. 1) by collecting the Marquesan names of the medicinal plants, their uses, the methods of preparation of the remedies and the associated traditional nosology. The Marquesas archipelago is the most remote archipelago in the world, located more than 5000 km from the nearest continent and lying about 1300 km northeast of Tahiti. Our hypothesis was that traditional knowledge remains largely preserved there due to the extreme remoteness of the islands and isolated valleys.

In order to prioritize plant species for their therapeutic interest or for further pharmacological investigations, we completed the usual ethnobotanical collection of use/symptom by an additional quantitative ethnobotany analysis. This approach reduces researcher subjectivity and intrusiveness by providing indices about the use value and the cultural value of the medicinal plants, the impact of current practices on the resources and the validity of our interpretation of the registered uses.

## 2. Material and methods

### 2.1. Geographic coverage

The Marquesas archipelago is one of the five administrative divisions of French Polynesia.

The ethnopharmacological study was carried out in the six major inhabited volcanic Islands: Nuku Hiva, Ua Huka and Ua Pou (NM: Northern Marquesas), Hiva Oa, Fatu Hiva and Tahuata (SM: Southern Marquesas).

### 2.2. Fields methods

Two methods were applied:

- *In situ* semi-structured interviews of informants during walks in the woods or homegarden sampling. The semi-structured interviews followed the one used for TRAMIL surveys (Boulogne et al., 2011), but were adapted to local conditions.
- Several *ex situ* focus groups were organized with multidisciplinary scientists (botanists, ethnobotanists, pharmacists...) and local associations. Fresh or dried plant specimens, and photographs were showed to local partners to collectively verify or confirm the Marquesan name of plant and use of plants collected during field work, guided by a simple questionnaire highlighting the local name, the therapeutic indication, the mode of application or prevalence as follows: "Do you know this plant?" "What is its Marquesan vernacular name?"; "Do you use this plant? How do you proceed for that use? When did you last use it?"

Translations of disease names in terms of the modern biomedical model were collectively validated during focus groups with scientists and local association partners.

The information obtained from the survey was compared with the already existing literature (Table 1).

### 2.3. Plants collection

The collected plants except common food plants were pressed and dried for the herbaria collection. They were first identified by JF Butaud, a botanist among our group, and for some taxa, by the taxonomist Jacques Florence from MNHN-Paris, by comparison to vouchers taking into account recent taxonomic revisions (Lorence and Wagner 2011). The voucher specimens are deposited in the French Polynesian Herbarium (PAP; <http://www.herbier-tahiti.pf>) located in the "Musée de Tahiti et des îles", Punaauia, Tahiti.

### 2.4. Participants and Prior Informant consent (PIC)

The ethnobotanical surveys in all of the inhabited islands of the archipelago were conducted with 102 informants, selected by peer recommendations. The cohort included 102 informants from 40 to 80 years old, 35 males and 67 females, 62 were from southern Marquesas islands and 40 informants from Northern Marquesas. All interviews were realized in the Marquesan language with the aid of an interpreter from the Académie des Marquises, specialist of the Marquesan language.

There is currently no ABS (Access and Benefit Sharing) practice in Polynesia. So we developed and implemented our own ethical approach. Before beginning the ethnobotanical survey, the legal representatives of the municipalities were contacted and informed of the objectives of the project. A meeting was then held with the representatives of a local cultural association and project partner ("Académie des Marquises") and of local community members to whom we presented the targets of the research project. Each informant was asked if he accepted to participate in the project and consented that the registered data could be published. In case of refusal, the registered data were conserved by the cultural association.

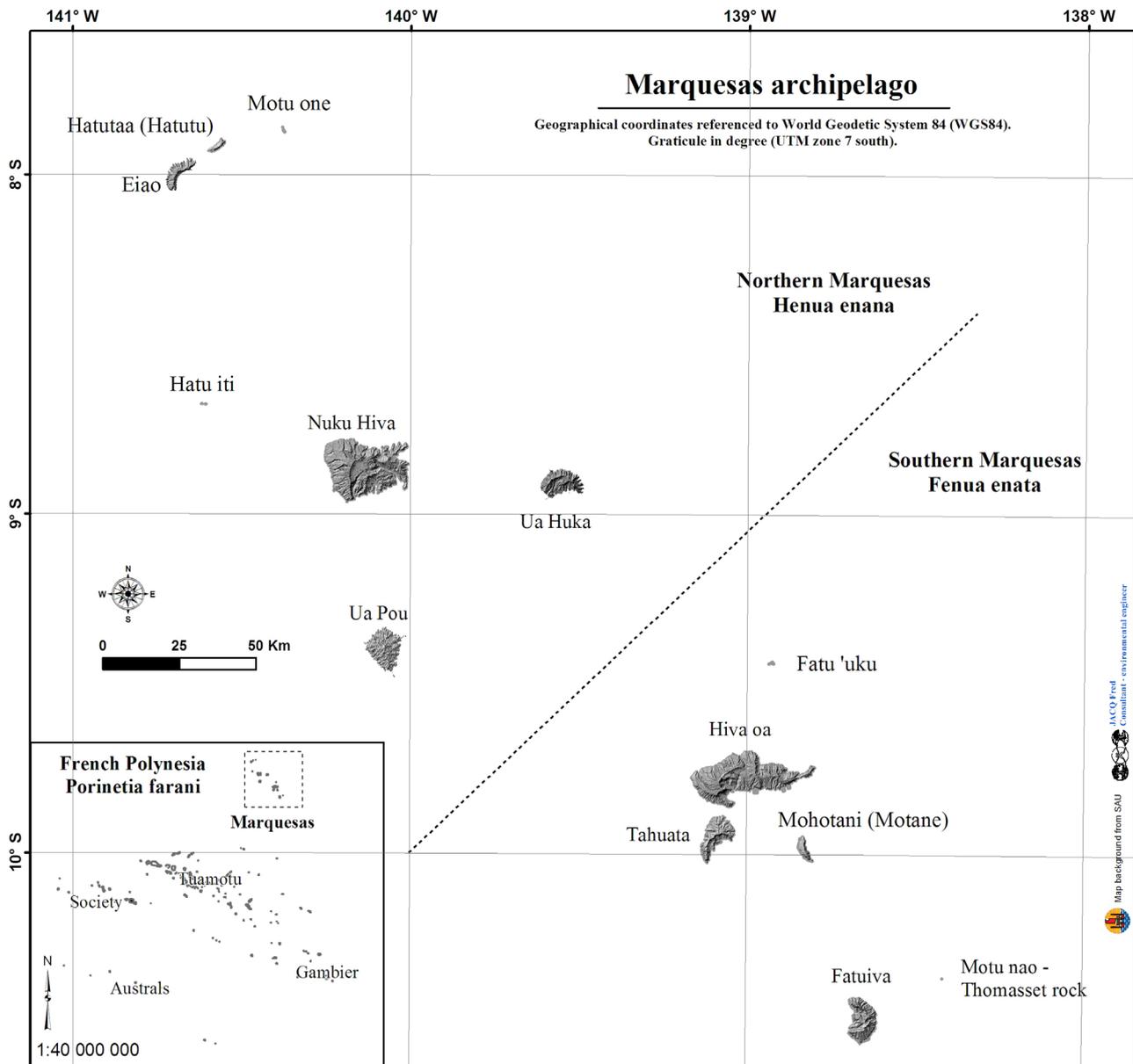


Fig. 1. Map of Marquesas.

Table 1

Questionnaire.

1. Name of health ailments:
2. Traditional description of the diseases or health ailments and associated precautionary measures:
3. When did you last prepare a medicine to treat this disease?
4. How do you prepare the medicine? What is the name of the plant? What organ or part did you use? What is the quantity (posology) and recipe of preparation? What are the dosage and treatment duration?
5. Where did you find the plant?
  - 1=Cultivated around the house
  - 2=Wild but around the house
  - 3=In the neighboring countryside
  - 4=Wood, forest
  - 6=Other places

### 2.5. Application of quantitative analysis

We adapted the previously reported concept of “ethnobotanical event” used by Tardío and Pardo-de-Santayana (2008). The basic structure of the ethnobotanical information was defined as: “*i* informant mentions the use of the *p* part of the considered species *s* to treat the *u* ailment or disease”. The event resulting

from the combination of these four variables has been defined as a *use-report*.

Changes of one variable of this event increment are compiled in the *use-report* table. The same informant can lead to multiple lines in the *use-report* table if several species and/or various parts of the same plant are used, or if he prepares several remedies from the same species.

The use reports table was used to calculate the following indices:

- (i) The frequency of use given by the simplest index, i.e. the number of informants that mention a useful species.
- (ii) The relative frequency of plant uses mentioned by the interviewed groups for a given affliction is calculated with the following formula  $RF (\%) = Ni/Np$  where Ni is the number of informants that used this part of plant species to treat a particular disease; Np is the number of informants that used plants as a medicine to treat this disease (Hoffman and Gallahert, 2007).
- (iii) Informant Consensus Factor (ICF) is one of the most popular indexes, based on the degree of agreement among the various interviewees (Trotter and Logan, 1986; Andrade-Cetto et al., 2006; Neves et al., 2009; Boulogne et al., 2011). ICF is calculated using the following formula:  $ICF = Nur - NEU / Nur - 1$  where Nur is the number of citations of use in each category and NEU the number of species used. This factor indicates the homogeneity level of the informant's knowledge on illnesses and/or their therapy.

### 3. Results

#### 3.1. Medicinal plants

The results of the study showed that 96 species were pointed out as medicinal, for which we collected 1774 lines or quotations of uses. The number of use-reports of a species or informants who cited the species (NI) reflects its cultural importance. The 19 plant species obtained from a single informant are supposed to be of negligible cultural value, they mainly resulted from a confusion between several introduced Citrus or weedy Cyperus; one informant replaced *Paspalum vaginatum* Sw. by the introduced *Paspalum conjugatum* P.J. Bergius to prepare a purge mixture. *Derris malaccensis* (Benth.) Prain was cited by a Marquisan who lived in Tahiti island where this plant was well known as ichthyotoxic plant. *Kalanchoe pinnata* (Lam.) Pers and *Opuntia cochenillifera* (L.) Mill. medicinal uses reflected those reported recently in various newspapers and magazines. All these species have little "cultural values" with one exception: *Fagraea berteriana* var. *marquesensis* F.R. Fosberg & M.-H. Sachet is an endemic tree used by a single informant to cure stomach ulcer, but appreciated by many others only for the fragrance of its flowers used in *pani* or cosmetic-oil preparation.

Table 2 lists and describes the 77 medicinal plants which were cited by more than one informant together with their vernacular names, the islands where these names are used and the relative frequency of plant use for a given affliction.

Three species account for one-third of the citations of uses: *Cocos nucifera* (coconut), *Gardenia taitensis* (tiare Tahiti) and *Microsorium grossum*. Coconut oil and coconut water are the main excipients used to prepare medicines. Coconut and, to a lesser degree, *Gardenia* are also indispensable ingredients used for medicinal preparations called *pani* (*mono'i* in Tahitian, *monoi* in French and *monoi* in English) used as an oily adjuvant in Polynesian medicine.

Like in the TRAMIL program, we selected the threshold of 20% as a significant relative frequency of citations for a given disease (Boulogne et al., 2011): 40 plant species showed an RF value > 20 (species cited by at least two informants).

The high frequencies of uses for *Gardenia taitensis* and *Microsorium grossum* are related to their frequent association in the *fati* remedies, for which we identified a large number of quotations of use (see below).

With 58 informant citations, *Premna serratifolia* is one of the most cited medicinal plants (see Table 2). Nevertheless, this species is used for many different purposes or therapeutic categories, among them

only four have significant use frequencies and only one – the treatment of "epa" disease – presents a high consensus among the Marquesan healers (ICF greater than 0.70, see Table 3).

The bark of the trunk and the leaf galls of *Syzygium malaccense* are included in the composition of the main remedies indicated to treat various forms of *vi'ihoa* and *epa*.

Galls of this species are an ingredient of various reported remedies (11 use reports) used to treat oral form of *epa*, corresponding to canker sores, bad breath or thrush.

Most of the species listed in the Table 2 are not used as single-ingredient but are mixed with other species. Marquesans remedies – "haika" in the Northern Marquesan Islands, "apau" in the Southern Islands – are generally constituted by a mixture of plants, the average number of components we noted were 4–5, but the mixtures can contain up to 8 components.

It is interesting to note that high relative frequencies (RF%) are observed for plants with very specific uses. For example, among the 14 inhabitants who treat *tetu'i* disease, which is related to ear pain, ear infections and/or pus in the ear, 12 of them (86%) use exclusively *Phyllanthus amarus*. 75% of the informants treating the "e'omakaa" disease (sublingual cyst) use *Rorippa sarmentosa*, and the species *Microsorium grossum* is always reported for the treatment of *fati* or *hati*.

#### 3.2. Galenical preparations and therapeutic practices: *mono'i* oil, massages and purge

Herbal medicine is handled by healers who could be classified according to Whistler (1985) as semi-specialists because they are not professionals and usually do not require any payment. They are considered as healer by their own family or by the community because they possess the "mana", a supernatural power or efficacy, or perhaps better described as having a force of nature, which is unequally distributed amongst people.

The remedies consist mainly of juices of several fresh plants obtained by expression, usually diluted in a carrier. The main administration mode is oral, frequently accompanied by massages.

Massages are provided to both children and adults using vegetable oils: *mono'i* (Tahitian name) or *pani* (Marquesan name). The *pani* is used in application to the body or hair. Plants are used fresh (except for vetiver – *Chrysopogon zizanioides* whose roots are dried). The floral composition usually includes *mine* (basilic – *Ocimum basilicum*) which reduces the strong odor of locally made coconut oil. This traditional oil can be replaced by refined coconut oil from Tahiti called "coco fine". *Mine* is mixed with other plants like *va'ova'o* (*Premna serratifolia*), *moto'i* (*Cananga odorata*), *taretare* (*Anethum graveolens*), *pitate* (*Jasminum grandiflorum*), *mati* (*Mentha* spp.), *pa'ahei* (*Angiopteris evecta*), *fa'a hoka* (*Ananas comosus*), *puahi* (*Santalum insulare* var. *marchionense*), *mou'u* (*Chrysopogon zizanioides*) 'ena (*Curcuma longa*), *pua ho'ovai* (*Fagraea berteriana*), *tia'e* (*Gardenia taitensis*), *hinano* (*Pandanus tectorius*), *fa'a* (*Pandanus tectorius* fruit) *nio'u* (*Sigesbeckia orientalis*), and *mei'e* (*Ageratum conyzoides*). Locally made coconut oil and the dried kernel of *Calophyllum inophyllum* are ingredients of specific *pani*, like *pani temanu*, which is used in the treatment of certain disorders.

Purges (*tiheke*) are very popular in Marquesan traditional medicine treatment. There are general and specific purges, and in some cases the purge is considered as the treatment itself. For children, *tiheke* are often incorporated in the original recipe. Purges have an important place in the protocols of traditional medicines: If the preparation is dark, it is a sign of prohibitions or transgression by the patient, or a sign that the patient suffers from a serious illness. The frequent practice of purging may be related to the small number of traditional anti-diarrheal medicines.

Table 2

Medicinal plants cited by more than one informant, with their biogeographical status and their vernacular names.

Scientific name	Family	NI (1)	Origin (2)	Part of plant (3)	"Health ailments, correlation between traditional and modern medical systems"	Marquesan name of disease (4)	RF of plant use (5)	Vernacular name	Islands
<i>Achyranthes aspera</i> L. var. <i>aspera</i>	Amaranthaceae	9	Pol.	r	Leucorrhoea, genital disease, girl's intimate hygiene, vaginal discharge	epa (kind of)	35,7	pu'epu, pua pipi'i mokio, mohokio	Hiva Oa, Tahuata Ua Pou, Nuku Hiva
<i>Adenostemma viscosum</i> J.R.Forst. & G. Forst.	Asteraceae	10	Pol.	l, s	Headache, vertigo, sinusitis, migraine	mamae te upoko (NM), mamae te upo'o (SM)	25,0	vaianu	Northern Marquesas
<i>Ageratum conyzoides</i> L.	Asteraceae	15	Mod.	fl, ap fl	Dermocosmetic oil Newborn and baby care	pani	< 20 < 20	tahatahavai putara mei'e rore mei'e	All islands Hiva Oa, Tahuata Nuku Hiva Ua Pou, Ua Huka, Fatuiva
<i>Aleurites moluccana</i> (L.) Willd.	Euphorbiaceae	33	Pol.	l, s	Leucorrhoea, genital disease, girl's intimate hygiene, vaginal discharge	epa	28,6	'ama	All islands
				l, s	Oral abscess, goiter, thyroid abscess, lymph infection	uu'a	27,3		
<i>Alocasia macrorrhizos</i> (L.) G. Don	Araceae	4	Pol.	ap	Abscess, boils	fēfē, pu'u fēfē (MS), puku fēfē (MN)	< 20	kape	Northern Marquesas
<i>Aloe barbadensis</i> Mill.	Aloaceae	5	Mod.	l	Cancer	fe'e (NM), feke (SM)	< 20	aroe, aroeroe, aloe	All islands
	Amaranthaceae	13	Pol.	l, k	Hair care, shampoo Child restlessness with fever and convulsions	ira (sensu lato)	< 20 28,6	upokotiki upo'oti'i	
<i>Amorphophallus paeoniifolius</i> var. <i>campanulatus</i> (Blume ex Decne.) Sivad.	Araceae	5	Pol.	l	Zona, filariasis, elephantiasis	mariri fe'efe'e	21,4	pokotiki teve	Northern Marquesas Southern Marquesas Nuku Hiva All islands
<i>Ananas comosus</i> (L.) Merr.	Bromeliaceae	6	Mod.	fr	Postpartum care, postnatal antisepsis, prevention of puerperal infection	parari	25,0	ha'a ho'a fa'a hoka	Northern Marquesas Southern Marquesas Nuku Hiva All islands except Nuku Hiva
<i>Angiopteris evecta</i> (J.G. Forst.) Hoffm.	Marattiaceae	5	Ind.	l	Dermocosmetic oil	pani	< 20	puhei pa'ahei	All islands
<i>Annona muricata</i> L.	Annonaceae	11	Mod.	l	Child restlessness with fever and convulsions	ira (sensu lato)	20,0	korosoni, manini tota'a, corossol (French)	All islands
				l l	Osteoarthritis, rheumatism, backache Headache	ivi mo'o, ivi hao mamae te upoko (NM), mamae te upo'o (SM)	< 20 < 20		
<i>Artocarpus altilis</i> (Parkinson ex Z) Fosb.	Moraceae	25	Pol.	fermented fr	Bewitchment, taboo transgression, medico-magic	mate tapi'i	< 20	mei me'i	Northern Marquesas Southern Marquesas All islands
<i>Barringtonia asiatica</i> (L.) Kurz	Lecythidaceae	25	Ind.	fermented fr	Hemorrhoids, prolapsed hemorrhoids	vi'ihoa eva, vi'i hoa keo topa	< 20	maiore (Tahitian)	All islands
				s,l	Rheumatism	ivi mo'o	< 20	hutu	
				r	Ciguatera (fish poisoning)	tekeo ika	< 20		
				s l	Ichtyotoxic Dislocations, sprains and strains	mokuki (SM), tohu'i (NM), mokuki (NM), related to kokeka, vaevae kokeka	< 20 < 20		
<i>Calophyllum inophyllum</i> L.	Calophyllaceae	18	Pol.	l, s		pu'ëva	23,7	temanu	All islands

<i>Capsicum frutescens</i> L.	Solanaceae	16	Mod.	fl, ap fl	Itches, skin allergy, burns, mild wounds, mange, burns				
					Cancer	feke (SM), fe'e (FI), heke (NM)	33,3	neva	All islands
<i>Carica papaya</i> L.	Caricaceae	9	Mod.	l, s l, s	Ulcers, stomach pain with chest tightness, chest pain, gastric vi'ihoa form ulcers	vi'ihoa moe, vi'ihoa tu	21,1		
					Diabetes, gout	mimi manini, omaha tihota	26,3	kiki'e, vi papai, papaye	All islands
<i>Casuarina equisetifolia</i> L. subsp. <i>equisetifolia</i>	Casuarinaceae	13	Pol.	ap	Tension, hypertension	tosio	42,9	(French)	
<i>Cenchrus echinatus</i> L.	Poaceae	4	Mod.	l	Diabetes, gout	mimi manini, omaha tihota	21,1	toa	All islands
<i>Centotheca lappacea</i> (L.) Desv.	Poaceae	20	Pol.	l, ap	Asthma, shortness of breath, breathing difficulty	aopao, aoko'e (UH), na'eoi (NM)	37,5	piripiri (Tahitian)	All islands
					Shock, fall, fracture, hematoma	kaekae, henei, hekei, fenei fati, hati	29,2	mutie kaipeka kohekohe 'ofe'ofe 'ohe'ohe	Nuku Hiva Hiva Oa, Tahuata All islands Northern Marquesas and Fatu Hiva All islands
<i>Cerbera manghas</i> L.	Apocynaceae	3	Ind.	s, l	Headaches, awareness of its well known toxicity by all Marquesan population		< 20	'eva	All islands
<i>Chamaesyce hirta</i> (L.) Millsp.	Euphorbiaceae	5	Mod.	l	Itchiness, skin allergy, burns, mild wounds, burns	pu'ëva	< 20	fe'efe'eiamata, pu'u fe'efe'e heaheamata, he'ehe'emata, heiheimata eita hi'inoke teita 'epau teita pu'uata'au hitoro	Hiva Oa, Tahuata Northern Marquesas Ua Pou Hiva Oa Fatu Hiva Northern Marquesas
<i>Citrus aurantiifolia</i> (Christm. & Panz.) Swingle	Rutaceae	47	Mod.	l, fr	Post partum care, postnatal antiseptic, prevention of puerperal infection	parari	< 20		
				l	Cold, tuberculosis, influenza, sore throat	hautete, puta kama'i'i (NM), puta metoe (SM)	< 20		
				l, k	Hemorrhoids, prolapsed hemorrhoids,	vi'ihoa eva, vi'i hoa keo topa	< 20	fitoro	Southern Marquesas
<i>Cocos nucifera</i> L.	Arecaceae	84	Pol.	s, fr	Ingredient of numerous preparations as excipient		< 20	ehi e'ehi coco (French) kafe	Northern Marquesas Southern Marquesas All islands All islands Tahuata
<i>Coffea arabica</i> L.	Rubiaceae	4	Mod.	l	Diabetes, gout	mimi manini, mimi patai	< 20	kivakiva, 'au kivakiva	All islands
<i>Colubrina asiatica</i> (L.) Brongn. var. <i>asiatica</i>	Rhamnaceae	19	Ind.	fr	Skin allergy, burns, warts	pu'ëva	< 20		Tahuata
				b fr	Dermocosmetic, shampoo Dislocations, sprains and strains	mokuki (SM), tohu'i (NM), mokuki (NM), related to kokeka, vaevae kokeka	< 20 < 20	tutu	All islands
<i>Cordia subcordata</i> Lam.	Boraginaceae	40	Ind.	b	Leucorrhoea, genital disease, girl's intimate hygiene, vaginal discharge	epa	28,6	tou	All islands
				l, b	Nasal obstruction, chest tightness in young children	epa nanu	44,4		
				fr	Cough, bronchitis, pneumonia, respiratory problems	hapu	30,0		
				b	Purge	tiheke	35,1		
				l, b fr	Hemorrhoids, prolapsed hemorrhoids, hemorrhoidal form of epa	vi'ihoa eva, vi'i hoa keo topa	37,5		
				b	Ulcers, stomach pain with chest tightness, chest pain, gastric vi'ihoa form	vi'ihoa moe, vi'ihoa tu	21,1		
				fr	Ulcers, stomach pain with chest tightness, chest pain, gastric vi'ihoa form	tupito, mate tupito, hu tupito	70,0	'outi, 'outi fio	Southern Marquesas
<i>Cordyline fruticosa</i> (L.) A.Chev.	Asparagaceae	21	Pol.	fr l ( young)	Ulcers, stomach pain with chest tightness, chest pain, gastric vi'ihoa form	vi'ihoa moe, vi'ihoa tu	31,6	ti, 'auti	All islands

Table 2 (continued)

Scientific name	Family	NI (1)	Origin (2)	Part of plant (3)	"Health ailments, correlation between traditional and modern medical systems"	Marquesan name of disease (4)	RF of plant use (5)	Vernacular name	Islands
<i>Curcuma longa</i> L.	Zingiberaceae	19	Pol.	r	Dermocosmetic oil	pani	21,7	'ena jaune, 'ena orange, 'ena moa, 'ena ku'a 'ena  'eka, 'eka mao'i  re'a jaune (Tahitian) 'eka tokatoka fe'e'e'e'iamata	Southern Marquesas Southern Marquesas & Ua Huka Nuku Hiva, Ua Pou Hiva Oa Ua Pou Southern Marquesas
<i>Cyathula prostrata</i> (L.) Blume	Amaranthaceae	4	Pol.	fr, l	Abscess, boil abscess, boils	puku fêfê (MS),	< 20	fe'e'e'e'iamata	Nuku Hiva, Ua Pou
				fr, l	Purge	tiheke	< 20	he'e'e'e'emata	Nuku Hiva, Ua Pou
<i>Cyperus javanicus</i> Houtt.	Cyperaceae	5	Pol.	ap	Shock, fall, fracture, hematoma	fati, hati	< 20	fe'eife'e'iamata mouku, mouku ka'avai	Northern Marquesas
				ap	Purge	tiheke	< 20	mou'u	Southern Marquesas
<i>Emilia fosbergii</i> Nicolson	Asteraceae	4	Mod.	ap	Hemostatic		< 20	mouku tai kaikai rape, kaikai te rape anetae	Nuku Hiva All islands
<i>Erythrina variegata</i> L.	Fabaceae	13	Pol.	l	Post partum care, postnatal antiseptic, prevention of puerperal infection	parari	41,7		Southern Marquesas
				b	Ciguatera (fish poisoning)	tiheke	< 20	kenae aretae ketae aoa, banian (French)	Nuku Hiva Fatu Hiva Ua Pou, Ua Huka All islands
<i>Ficus prolixa</i> G.Forst. var. <i>prolixa</i>	Moraceae	32	Ind.	l, r (young plant)	Leucorrhea, genital disease, girl's intimate hygiene, vaginal discharge	epa	50,0		
				l, r (young plant)	Canker sores, bad breath, thrush, white tongue, oral form of "epa", including colds	kea, epa hahape	27,3		
				r (young plant)	Purge	tiheke	24,3		
<i>Gardenia taitensis</i> DC.	Rubiaceae	72	Pol.	fl (bud)	Shock, fall, fracture, hematoma	fati, hati	66,0	tia'e, tia'e tahiti, tiare tahiti (Tahitian)	All islands
				fl (bud)	Child restlessness with fever and convulsions	ira (sensu lato)	< 20		
				fl (bud)	Canker sores, bad breath, thrush, white tongue, oral form of "epa",	kea, epa hahape	< 20		
<i>Gossypium hirsutum</i> var. <i>taitense</i> (Parl.) Roberty	Malvaceae	3	Ind.	l	Newborn and baby care	pautama	< 20	hahaavai  'uru'uru pupuru vehinehae koute, koute 'enana	Nuku Hiva, Ua Pou Hiva Oa Ua Huka Northern Marquesas
<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	29	Pol.	l, fl (young plant)	Child restlessness with fever and convulsions	ira (sensu lato)	22,9		Northern Marquesas
				l, e	Conjunctivitis	mate mata	55,6	'oute, 'oute 'enata	Southern Marquesas
				fl (bud)	Postpartum care, postnatal antiseptis, prevention of puerperal infection	parari	41,7	hibiscus rouge (French)	All islands
<i>Hibiscus tiliaceus</i> L. subsp. <i>tiliaceus</i>	Malvaceae	14	Ind.	b (young plant)	Hemorrhoids, prolapsed hemorrhoids, hemorrhoidal form of epa	vi'ihoa eva, vi'i hoa keo topa	< 20	hau	Northern Marquesas
				b	Purge	tiheke	< 20	fau	Southern Marquesas
				fl (bud)		parari	< 20	purau (Tahitian)	All islands

<i>Inocarpus fagifer</i> (Parkinson ex Z) Fosberg	Fabaceae	4	Pol.	b (adult and young plant)	Postpartum care, postnatal antisepsis, prevention of puerperal infection	ira (sensu lato)	< 20	ihi, mape (Tahitian)	All islands
<i>Ipomoea batatas</i> (L.) Lam.	Convolvulaceae	3	Pol.	(young plant)	Ulcers, stomach pain	vi'ihoa moe, vi'ihoa tu	< 20	kuma'a 'uma'a	Northern Marquesas Southern Marquesas
<i>Kyllinga nemoralis</i> (J.R.Forst. & G. Forst.) Dandy ex Hutch. & Dalziel	Cyperaceae	29	Pol.	ap	Asthma, shortness of breath, breathing difficulty	aopao	37,5	mutie upoko maita	Northern Marquesas
				ap	Shock, fall, fracture, hematoma		< 20	punie pokotavarire	Nuku Hiva
				ap	Leucorrhoea, genital disease, girl's intimate hygiene, vaginal discharge	epa	35,7	upo'o maita	Fatu Hiva
				ap	Canker sores, bad breath, thrush, white tongue, oral form of epa, including colds	kea, epa hahape	27,3	mutie upo'o, mutie upo'o maita, teita upo'o maita	Southern Marquesas
<i>Mangifera indica</i> L.	Anacardiaceae	4	Mod.	fr	Ciguatera (fish poisoning)	tekeo ika	< 20	mako	All islands
<i>Mentha spicata</i> L.	Lamiaceae	3	Mod.	ap, l	Dermocosmetic oil	pani	< 20	mati, menthe (French)	All islands
<i>Microsorium grossum</i> (Langsd. & Fisch.) S.B.Andrews	Polypodiaceae	61	Ind.	rh, l	Shock, fall, fracture, hematoma	fati, hati	81,3	mati keka'a papamo'o	Fatu Hiva Southern Marquesas
				l	Headache, vertigo, sinusitis, migraine	mamae te upoko (NM), mamae te upo'o (SM)	25,0		
				rh, l	Dislocations, sprains and strains	mokuki (SM), tohu'i (NM), mokuki (NM), related to kokeka, vaevae kokeka	38,5	papamoko	Northern Marquesas
<i>Morinda citrifolia</i> L.	Rubiaceae	33	Pol.	l, r	Purge	tiheke	21,6		
				l, fr	Osteoarthritis, rheumatism, backache, joint problem	ivi mo'o , ivi hao, related topo'o'o, pororo	21,4	noni, nono (Tahitian)	All islands
				l	Ulcers, stomach pain with chest tightness, chest pain, gastric vi'ihoa form	vi'ihoa moe, vi'ihoa tu	21,1		
				fl (bud), fr (young)	Hemorrhoids, prolapsed hemorrhoids, hemorrhoidal form of epa	vi'ihoa eva, vi'i hoa keo topa	< 20		
<i>Mucuna sloanei</i> Fawc. & Rendle var. <i>sloanei</i>	Fabaceae	2	Ind.	l	Taboo transgression	bewitchment, taboo transgression,	< 20	papaniahoe, papanuiaohoe 'auto'u	Southern Marquesas Nuku Hiva, Ua Huka
<i>Musa troglodytarum</i> L.	Musaceae	9	Pol.	l, (young plant)	Zona, filariasis, elephantiasis	mariri fe'efe'e	64,3	huetu, fe'i (Tahitian)	All islands
<i>Musa x paradisiaca</i> L.	Musaceae	5	Pol.	l, (young plant)	Zona, filariasis, elephantiasis	mariri fe'efe'e	21,4	meika mei'a	Northern Marquesas Southern Marquesas
<i>Ocimum basilicum</i> L.	Lamiaceae	20	Mod.	l	Cold, tuberculosis, influenza, sore throat	hautete, puta kama'i'i (NM), puta metoe (SM)	30,4	mine, miri (Tahitian)	All islands
				l, ap	Dermo-cosmetic oil	pani	86,0	mine 'enata	Southern Marquesas
				l	Same use as <i>Ocimum basilicum</i>		< 20	mine kaka'a	Nuku Hiva, Ua Pou
<i>Pandanus tectorius</i> Parkinson ex Z. var. <i>tectorius</i>	Pandanaceae	17	Ind.	fl (male)	Dermo-cosmetic oil	pani	21,7	mine keka'a	Southern Marquesas & Ua Huka
<i>Paspalum conjugatum</i> P.J. Bergius	Poaceae	3	Mod.	r ( areal part)	Oral abscesses, goiter, lymph infection, thyroid goiter	uu'a	36,4	fa'a, fa'a ku'a	Southern Marquesas
				ap	White spots on children's skin		< 20	mutie taravao	Tahuata

Table 2 (continued)

Scientific name	Family	NI (1)	Origin (2)	Part of plant (3)	"Health ailments, correlation between traditional and modern medical systems"	Marquesan name of disease (4)	RF of plant use (5)	Vernacular name	Islands
<i>Passiflora foetida</i> L.	Passifloraceae	6	Mod.	l, fl	Dermocosmetic oil	pani	< 20	mo'ina koko'u	Southern Marquesas Nuku Hiva, Ua Pou
<i>Peperomia blanda</i> var. <i>floribunda</i> (Miq.) H.Hüber	Piperaceae	4	Ind.	ap	Itchiness, burns, mild wounds, warts, ciguatera (fish poisoning)	pu'ëva	< 20	kava'i'i	Southern Marquesas
<i>Phyllanthus amarus</i> . Schumach. & Thonn.	Phyllanthaceae	12	Mod.	ap	Ear pain, ear infections, ear's pus	tetu'i	85,7	'au'iki teita kavi'ipua'ina moemoe (Tahitian) konini	Hiva Oa, Tahuata Fatu Hiva All islands Northern Marquesas Southern Marquesas
<i>Physalis angulata</i> L.	Solanaceae	32	Pol. ?	l, ap l, ap l, ap l, ap l, ap	Osteoarthritis, rheumatism, backache, joint problems Back pain, herniated disc, low back pain Diabetes, gout Postpartum care, postnatal antiseptic, prevention of puerperal infection Unbalanced arterial tension, hypertension	ivi mo'o, ivi hao, related to po'o'o, pororo ivi mo'o, ivi hao mimi manini, omaha tihota parari tosio	21,4 60,0 26,3 33,3 42,9	'au taioha'e	Tahuata
<i>Pisonia grandis</i> R.Br.	Nyctaginaceae	3	Ind.	b b	Skin allergy, warts Dislocation, sprain, hemorrhoids	pu'ëva mokuki (SM), tohu'i (NM), mokuki (NM)	< 20 < 20	pu'atea pukatea	All islands except Ua Pou Ua Pou
<i>Plectranthus amboinicus</i> (Lour). Spreng.	Lamiaceae	3	Mod.	l	Dislocation, sprain, hemorrhoids	mokuki (SM), tohu'i (NM), mokuki (NM)	< 20	wiki kira	Ua Pou
<i>Premna serratifolia</i> L.	Lamiaceae	58	Ind.	l, t ap ap l l, b	Leucorrhea, genital disease, girl's intimate hygiene, vaginal discharge Canker sores, bad breath, thrush, white tongue, oral form of epa, including colds Bewitchment, taboo transgression, medico magic Diabetes, gout Painful periods, breast cancer, prolapsed hemorrhoids	epa kea, epa hahape mate tapi'i mimi manini, omaha tihota	31,6 27,3 42,9 26,3 < 20	va'ova'o	All islands
<i>Psidium guajava</i> L.	Myrtaceae	12	Mod.	fr fr	Hemorrhoids, prolapsed hemorrhoids Ciguatera (fish poisoning)	vi'ihoa eva, vi'i hoa keo topa tekeo ika	< 20 20,7	tuava, goyavier (French)	All islands
<i>Punica granatum</i> L.	Punicaceae	6	Mod.	b	Leucorrhea, genital disease, girl's intimate hygiene, vaginal discharge	epa (kind of)	50,0	remuna (Tahitian) tu'eiao	All islands Nuku Hiva
<i>Rauvolfia nukuhiensis</i> (Fosberg & Sacht) Lorence & Butaud	Apocynaceae	7	End. Marq.	ap	Leucorrhea, genital disease, girl's intimate hygiene, vaginal discharge	epa (kind of)	75,0	mahi	Nuku Hiva
<i>Rorippa sarmetosa</i> (Sol. ex G. Forst. ex DC.) J.F.Macbr.	Brassicaceae	36	Pol.	ap ap ap ap ap	Oral mucocele, sublingual cyst Leucorrhea, genital disease, girl's intimate hygiene, vaginal discharge Nasal obstruction, chest tightness in young children Child restlessness with fever and convulsions osteoarthritis, rheumatism, backache, joint problems	e'omaka (NM), 'e'omana (SM) areroma'a (Tahitian) epa (kind of) epa nanu ira (sensu lato) ivi mo'o, ivi hao	21,4 21,4 33,3 45,7 21,4	mahimahi	All islands
<i>Saccharum officinarum</i> L.	Poaceae	31	Pol.	juce, l	Leucorrhea, genital disease, girl's intimate hygiene, vaginal discharge	epa	28,6	to	All islands
<i>Santalum insulare</i> var. <i>marchionense</i> (Skotts.) Skotts.	Santalaceae	19	End. Marq.	w (powder)	Dermocosmetic oil	pani	52,2	puahi	All islands
<i>Sapindus saponaria</i> L.	Sapindaceae	13	Ind.	s, fr	Newborn and baby care, cradle cap	pautama	50,0	koku'u	All islands

<i>Senna occidentalis</i> (L.) Link	Caesalpinaceae	2	Mod.	l, s l, r	Hair care, shampoo, soap Abscess, boils		38,9 < 20	pa'o'o tani  pakoko  'au pirika, eita tuhia	Northern Marquesas Southern Marquesas Nuku Hiva
<i>Sigesbeckia orientalis</i> L.	Asteraceae	4	Pol.	l, ap, fl	Dermocosmetic oil	pani	< 20	ino'u rio'u nio'u	Hiva Oa, Tahuata Fatu Hiva Northern Marquesas & Fatu Hiva All islands
<i>Spondias cytherea</i> Sonn.	Anacardiaceae	17	Mod. (Pol. in Tahiti)	l, b	Ciguatera (fish poisoning)		< 20	vi tahiti  vi farani	Ua Pou
<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	Verbenaceae	3	Mod.	l, b l	Cold, pharyngitis Dislocations, sprains and strains		< 20 < 20	pua viore	Hiva Oa, Tahuata
<i>Syzygium malaccense</i> (L.) Merr. & L. M.Perry	Myrtaceae	27	Pol.	l, (Galls )  l, (Galls )  l, (Galls )  l, (Galls )	Leucorrhea, genital disease, girl's intimate hygiene, vaginal discharge  Nasal obstruction, chest tightness in young children  Canker sores, bad breath, thrush, white tongue, oral form of epa, including colds  Hemorrhoids, prolapsed hemorrhoids, hemorrhoidal form of epa  Ulcers, stomach pain with chest tightness, chest pain, gastric vi'ihoa form	epa (kind of)  epa nanu  kea, epa hahape  vi'ihoa eva, vi'i hoa keo topa  vi'ihoa moe, vi'ihoa tu	42,9  33,3  45,5  34,4  21,1	kehi'a  'ahi'a (Tahitian), pomme rouge (French)	Southern Marquesas & Ua Huka  All islands  Nuku Hiva, Ua Pou Tahuata
<i>Tephrosia purpurea</i> (L.) Pers. var. <i>purpurea</i>	Fabaceae	2	Pol.	l, r	Ichtyotoxic		< 20	kohuhu i'a	Southern Marquesas All islands
<i>Terminalia glabrata</i> var. <i>brownii</i> Fosberg & Sacht	Combretaceae	3	End. Marq.	l,fr  l,fr	Measles  Breast cancer		< 20  < 20	kohuhu ma'i'i  koua'i'i  koua'iki	Northern Marquesas Southern Marquesas Nuku Hiva, Ua Pou Tahuata All islands
<i>Thespesia populnea</i> (L.) Sol. ex Corrêa	Malvaceae	34	Ind.	fr (young), l  b b fr (young), l b b b	Eczema, fungus, ringworm, dermatophytosis  Cancer  Venereal sores  Itching, skin allergies, burns, minor wounds, scabies, warts  Purge  Umbilical hernia, stomach cramps, flatulence	ceka ceka, punā kina  feke (SM), fe'e (FI), heke (NM) hea paatita pu'ëva  tiheke tupito, mate tupito, hu tupito	75,0  25,0 75,0 26,3  43,2 40,0	tai'e mi'o	All islands
<i>Vigna adenantha</i> (G.Mey.) Maréchal, Mascherpa & Stainier	Fabaceae	15	Pol.	l, ap  l, ap	Hemorrhoids, prolapsed hemorrhoids, hemorrhoidal form of epa  Ulcers, stomach pain with chest tightness, chest pain, gastric vi'ihoa form	vi'ihoa eva, vi'i hoa keo topa  vi'ihoa moe, vi'ihoa tu	28,1  21,1	papa, papa 'enata  papa vehine	Southern Marquesas All islands
<i>Wikstroemia coriacea</i> Seem.	Thymelaeaceae	3	Ind.	b	Ichtyotoxic, purge (tiheke)		< 20	akatea ka'apihi hihea haukatea 'ena kina	Nuku Hiva Hiva Oa, Tahuata Fatu Hiva Ua Pou Southern Marquesas & Ua Huka
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	2	Mod.	r	Ulcers, stomach pain with chest tightness		< 20		

Table 2 (continued)

Scientific name	Family	NI (1)	Origin (2)	Part of plant (3)	"Health ailments, correlation between traditional and modern medical systems"	Marquesan name of disease (4)	RF of plant use (5)	Vernacular name	Islands
<i>Zingiber zerumbet</i> (L.) Sm.	Zingiberaceae	8	Pol.	r r	Ciguatera (fish poisoning) Hair care, shampoo, soap		<20 22,2	re'a ma'a (Tahitian) 'ena 'eka vao 'ena vao	All islands Hiva Oa, Tahuata Ua Pou Southern Marquesas Nuku Hiva, Hiva Oa

(1): NI: Number of informants who cited the species (with NI > 1).

(2): End. Marg.: endemic to the Marquesas archipelago; Ind.: indigenous/native species, also known outside the archipelago; Pol.: polynesian introduction; Mod.: modern introduction

(3): ap: all the plant, l: leaf, b: bark, r: root, fl: flower, fr: fruit, w- wood.

(4): SM: Southern Marquesas; NM: Northern Marquesas; UH: Ua Huka; FH: Fatu Hiva.

(5): Frequency of plant uses mentioned by the interviewed informants for a given affliction: RF = Ni/Np, with Ni = number of informants that used this plant species to treat a particular disease; and Np = number of informants that used plants as a medicine to treat this disease. RF > 20%: species' citation by at least two informants.

The traditional Marquesan medicine is also surrounded by many *tapu* or, "taboo". These restrictions or prohibitions can last from 3 days to 3 months, and apply to food and sexual matters. Raw fruits or vegetables, offshore fishes, alcohol, fried meat and sweet drinks are prohibited during the treatment, and so are sexual intercourses. However *tapu* (taboo or temporary interdiction during the treatment) are particularly difficult to respect, so several informants consider that it is not necessary to comply with certain *tapu*, particularly those related with sexual intercourses, more than two weeks after taking the medicine.

Some variability of medicinal uses may exist depending on the healers, but in general the healing process follows a specific protocol: 3 days of herbal medicine followed by a purge. The sequence is repeated if necessary at the new moon period following the 6th day of the first administration of the medicine.

### 3.3. Traditional medical concepts and their ICF values

The Informant Consensus Factor (ICF) values are calculated for each ailment or health problem. The ICF values reflect the consistency of the Marquesan informants in the selection of plants to treat a specific illness category (see Table 3). A value close to 0 means that the informants do not agree in the choice of the used medicinal plant species attributed to an illness category. On the contrary, a value of 0.98 reflects a general agreement between the chosen species and the treated disease.

The highest ICF levels are observed for *ira ki'iti* or *ira patu* (0.98), related to restlessness in children with seizures and fever, *tetu'i* (0.85) related to ear infections, most of the time treated with *Phyllanthus amarus*, and *hati* or *fati* (0.80), related to shocks, fractures or hematoma, mainly treated with *Microsorium grossum*. *Ira ki'iti* and *ira patu* are two different names of the same illness used in Northern and Southern Marquesas, respectively, and so are *hati* and *fati*.

Some remedies were found to treat ailments or health problems which can be described as "cultural diseases".

Women's vaginal secretions are subject to special care. Even if this physiological function is not considered as a disease itself, we did not record any name to designate it. The Marquesans consider that it is necessary to treat these secretions and associated odors preventively in early childhood. It is common to apply herbal preparations directly to girls' vulva, from an early age, the mode of preparation depending on the island and/or on the plant used. In Ua Pou, they mostly use *mohokio* (*Achyranthes aspera* var. *aspera*), whole plant, in Nuku Hiva, they use the trunk bark of the endemic *tueiao* (*Rauvolfia nukuhivensis*), while green and immature coconuts, locally called *koi'e*, are used all over the different islands. These applications of plant preparations, which can take several months or years, can also be applied again in adulthood if necessary. This traditional practice is still widespread in the Marquesas Islands and shows one of the highest ICF values (0.80). It is likely that the applied herbal preparations inhibit the glandular secretion responsible of the lubrication of the vagina. In the long run, it is also possible that the process leads to the atrophy of the glands responsible for secretion, but this point remains to be demonstrated.

### 3.4. Biogeographical status of medicinal plants

Native species (either indigenous or endemic) constitute a minority fraction of the Marquesan medicinal plants as they only represent one quarter of all used species (20 species out of 77), all the others being introduced ones. More striking is the very low number of Marquesan endemic species used as medicinal plant with only 3 taxa listed from which 2 of them are just botanical varieties of endemic species from Eastern Polynesia.

Regarding the introduced plants, it is possible to distinguish between Polynesian introductions (plants introduced during

**Table 3**

Informants consensus factor (ICF) of the plants to be used in treatment of illness category by Marquesan healers.

Marquesan name of disease (1)	Health ailments, correlation between traditional and modern medical systems	NUr (2)	NEU (2)	ICF (2)
ivi mo'o, ivi hao	Osteoarthritis, rheumatism, backache, joint problem	33	16	0.53
tupito, mate tupito, hu tupito	Umbilical hernia, stomach cramps, flatulence	29	14	0.54
hapu	Cough, bronchitis, pneumonia, respiratory ailments	41	19	0.55
mate mata	Conjunctivitis	10	5	0.56
epa, hea, epa hahape, kekea	Canker sores, bad breath, thrush, white tongue, oral form of epa, including colds	22	16	0.57
mimi manini, omaha tioha	Diabetes, gout	41	18	0.58
pautama	Care of newborns, cradle cap	13	6	0.58
vi'ihoa eva, vi'i hoa keo topa	Hemorrhoids, hemorrhoidal prolapse (hemorrhoidal form of epa)	44	19	0.58
ira niho	Restlessness in children with fever, teething, loss of appetite, diarrhea	6	3	0.60
vi'ihoa moe, vi'ihoa tu	Ulcers, stomach pain with chest tightness, chest pain (gastric form of vi'ihoa)	78	31	0.61
hautete, puta kama'i'i	Colds, tuberculosis, flu, sore throat	50	20	0.61
e'omaka (NM), 'e'omana (SM), areroma'a (Tahitian)	Oral mucocele, sublingual cyst	14	6	0.62
mokuki (SM), tohu'i (NM), mokuki (NM), related to kokeka, vaevae kokeka	Dislocations, sprains and strains	34	13	0.64
tekeo ika	Ciguatera	50	17	0.67
mariri fe'efe'e	Shingles, filariasis, elephantiasis	23	8	0.68
pu'eva	Itching, skin allergies, burns, minor wounds, scabies, warts	92	29	0.69
epa, epa toiki, epa tae ko'a	Leucorrhoea, genital disease, unpleasant smell, intimate hygiene	42	18	0.72
epa (related to epa)	Leucorrhoea, genital disease, girl's intimate hygiene, vaginal discharge	19	5	0.77
ira ( <i>sensu lato</i> )	Restlessness in children with seizures and fever	107	23	0.79
fati, hati	Shock, fall, fracture, hematoma	97	20	0.80
tiheke	Purge	155	30	0.81
tetu'i	Ear pain, ear infections, pus in the ear	14	3	0.85
ira ki'iti (NM), ira patu (SM)	Restlessness in children with seizures and fever, breath holding spells without fever	4	1	0.98

(1) SM: Southern Marquesas; NM: Northern Marquesas.

(2) Informant Consensus Factor:  $ICF = (NUR - NEU) / (NUR - 1)$ ; NUr=number of citations of use for each disease; NEU=the number of species used for each disease.

Polynesian migrations) and modern introduction (plants introduced more recently with the arrival of Europeans by the end of the 18th century). The Polynesian introductions represent 42% (i.e. 32 species) of the Marquesan medicinal plants. Many of them were intentional introductions (as food plants or for other useful species), others were unintentional. The significant presence of Polynesian weeds in the current Marquesan pharmacopoeia suggests that many of the species of this category are not unintentional introductions, but were truly brought for medicinal purposes. This is the case for major local medicinal plants like *Achyranthes aspera* var. *aspera*, *Centotheca lappacea*, *Cyathula prostrata*, *Kyllinga nemoralis*, *Sigesbeckia orientalis* and *Vigna adenantha*, and also for *Laportea interrupta* and *Oxalis corniculata*, which are of minor medicinal importance today. These latter species introduced by the first Marquesans probably more than 1000 years ago, are considered today as "local" species, belonging to the biological patrimony of the archipelago similar to the endemic species.

On the other hand, one-third (i.e. 25 species) of the Marquesan medicinal plants are modern introductions, introduced, for most of them, less than 200 years ago. Their integration in the Marquesan traditional medicine shows the innovative and adaptive capabilities of the Marquesan healers to face new diseases and to use new plants.

Most of the medicinal plants are collected around the villages or in homegardens, and are accordingly not threatened or vulnerable to extinction. But three endemic medicinal plants are considered rare or very rare species: *Santalum insulare* var. *marchionense* (sandalwood or *puahi*), *Terminalia glabrata* var. *brownii* (Polynesian tree almond or *koua'i'i*) and *Rauvolfia nukuhivensis* (*tu'eiao*), all restricted to the islands of Nuku Hiva and Ua Huka. The latter taxon result from a recent taxonomic combination (Lorence and Butaud, 2011) of this threatened species whose bark is a component of a still popular remedy for feminine intimate care (see below).

The other rare species are Polynesian introductions: *Sigesbeckia orientalis* and *Tephrosia purpurea* var. *purpurea*. Besides that, we observed that the Marquesan name *kohuhu* which refers to *T. purpurea*, a plant used as an ichthyotoxic in almost all the Pacific

area, is now frequently transferred to the common and similar weedy species *Indigofera suffruticosa*.

#### 4. Discussion

The cumulative number of healers who reported a medicinal use for each plant is a reasonable indice for their biological and/or cultural importance; "cultural" is used here in the sense of shared knowledge. However medicinal plant knowledge often belongs to the specialty domain of a limited number of individuals in the community and may be kept secretive for these purposes. Vandebroek (2010) distinguishes between cultural and idiosyncratic knowledge that is more or less restricted to an individual or a few individuals and has not (yet) been widely distributed. In our study some medicinal plants cited only by 2-3 informants seem to have disappeared from the collective memory of Marquesan people with the exception of some individuals who still know their use: it is the case for the shrublet *Tephrosia purpurea* (L.) Pers. var. *purpurea* which became very rare according to our own observations, *Wikstroemia coriacea* Seem, these two species formerly used as ichthyotoxic. The toxicity of *Cerbera manghas* L. is still well known but its medicinal use is now restricted to some traditional practitioners. Some recently introduced species with a number of use-reports  $NI \leq 3$  (see Table 2) could be also interpreted as an idiosyncratic knowledge implemented by some traditional healers.

Like in other places of the world, the loss of traditional knowledge is a reality in the Marquesas Islands, and the cultural and demographic trauma that the Marquesan people have experienced in recent history, mixed with the loss of economic and social functions of medicinal practices, have accelerated this process.

However, despite economic and cultural changes, the practice of herbal medicine continues today throughout French Polynesia. Indeed, the therapeutical approach of the healers, *tuhuka haika* (NM) or *tuhuna apau* (SM), and their social functions, survived

until now despite the culture shock faced by the Marquesan population. They have pursued their healing activities by switching to numerous introduced plants commonly found in their close environment and easily gathered. The predilection given to modern introductions may be interpreted as an innovative process implemented by traditional healers. Moreover, several native or introduced Tahitian medicinal plants have been recently introduced in the Marquesas Islands for their healing reputation. It is the case of the native fern *Davallia solida* var. *solida* and the Polynesian herbs *Leucas decemdentata* and *Lindernia crustacea*. These facts demonstrate the innovative ability of Marquesan healers and their capacity to integrate new plants species in the Marquesan pharmacopoeia.

The high proportion of modern introductions could strengthen the hypothesis which considers the pre-European Polynesian phytotherapy as relatively poor, linked with healing conceptions that are not built on empirical observations of the human body functions, with the exception of traumatic accidents (Nina and Brien 1993). Whistler (1985) noted that in the Cook Islands, the widespread use of herbs to heal ailments is mostly a result of contact with the Western world.

However, as mentioned above, several plants were intentionally introduced for their medicinal virtues, suggesting the existence of a corpus of medicinal plants with sufficient efficacy to be transported during the lengthy travels of migrations throughout the Pacific Ocean. To support this idea, a bibliographic review written by Zepernick (1972) shows that 66% of the 427 plants used in the Polynesian medicine are considered medicinal only in Polynesia.

The complexity of the Marquesan nosologies and the large number of synonyms collected for the same diseases are also contradictory to the assumptions on the relative poverty of the pre-European Polynesian phytomedicine.

The Marquesan traditional medicine as practiced today may result from successive contributions since the time of first contact. Remedies showing a weak consensus among the Marquesan healers were probably recently introduced in the Marquesas Islands medicine, as it is the case of some remedies indicated to treat cancers, which showed low ICF values ( $< 0.5$ ). The word *fe'e* from Fatu Hiva and Tahiti, *feko* in the other islands of the Southern Marquesas and *heke* in the Northern Marquesas which mean “octopus or squid”, refer to a symbolic representation of an invisible illness “as the tentacles of an octopus invading the body.” The term *kavekave*, name of the peduncle of the inflorescence of the coconut which looks like an octopus tentacle, is also used for the same purpose.

Until now, the Polynesian nosologies or conceptions of sickness did not receive much attention. Whistler (1985, 1991) gathered at the end of its papers a short list of ailments he translated himself from Tongan and Cook herbal medicine. In the present study, a special attention was focused on the descriptions of the local diseases. They were obtained from interviews of several informants, and their translation in French was discussed and verified in focus groups involving both scientists and Marquesan language specialists from the “Académie des Marquises” (see Section 2)

Despite the complex nosology, the ICF related to the medicinal plants used to treat the Marquesan diseases could be calculated and it showed generally high ICF values, suggesting a strong coherence in the Marquesan ailments. Moreover, in the Marquesan medicinal system, diseases are linked to complex etiologies based on the observation of sharp clinical signs associated with gestures and behavior. During the interviews, they were frequently associated with the influence of the *tupapa'u – vehinehae*, the pagan ancestors, considered as “bad dead”, and excluded from the current lineage of the patients (Gérard 1986). The Maori concept of illness has a much broader basis than the Western concept (Nina and Brien 1993). It encompasses not just physical health care, but all social interactions as well.

## 5. Conclusion

Marquesan herbal medicine appears to draw its inspiration from a common Polynesian root. Most of the medicinal plants used in Marquesas islands are also commonly used in many of the Polynesian and Pacific region, and correspond to plants brought by Polynesian along with their migrations through the Pacific.

The use of a combination of numerous plants as ingredients (at least two components) for each medicinal recipe is also common in Pacific region, as well as the use of fresh plants and purges.

However further investigations on Marquesan nosologies are necessary to appreciate the originality of the Marquesan pharmacopoeia by comparison of ethnobotanical data from available literature. Not enough attention was carried on in these studies on the ailment translation process and some misunderstandings between healers, interpreters and investigators might have led to errors when it was asked to translate in English or French the names of the ailments, with their associated symptoms. In that way, we tried to reduce researchers' subjectivity during focus group with Marquesan academicians specialists of the language.

As previously observed in other Polynesian societies, Marquesan traditional diseases are associated with complex symptoms (Lemaître, 1989). However it remains difficult to identify a design that could encompass the Polynesian diseases categories in a consistent corpus of concept. As previously observed by Cox and Banack (1991), we can only assume the existence of a proto-classification of diseases, which disappeared from the collective memory.

The same authors noted that if correspondence between Polynesian and botanical taxonomy can be easily established, it is however more difficult to translate the Polynesian disease categories in terms of Western medicine. In consequence, it appeared difficult for the ethnopharmacologist to correlate the traditional use of plants with their therapeutic or chemical properties. In the Marquesan Islands, this difficulty is compounded by the complexity of remedies, which often contain several plants, generally between 4 and 7 different ones, and sometimes even more. The same species are found in several remedies, treating several diseases. The healers cannot give any specific effects that can be attributed to the numerous components of the *haika*, except to some herbs or plant substances used as purges. Despite this difficulty, it was possible to identify 41 plant species with a significant high relative frequency of citations using statistical data for a given disease (RF  $> 20$ , Table 2). Finally, the crossing of ICF and RF indices shows that 36 species have at least one significant use (frequencies  $> 20\%$ ) with high ICF value ( $> 0.5$ ). This suggests that some key phytochemical ingredients may be present in these plants which require further phytopharmacological studies for a better knowledge of their medicinal properties.

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