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# An ethnopharmacological survey of natural remedies used by the Chinese community in Mauritius

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## PEER REVIEW

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**Comments**

This is a potentially interesting work which have been conducted to collect, preserve and document primary data on common natural remedies used by the Chinese community to treat and/or manage common diseases in Mauritius. Since there has been no previous report on such documentation, this work can provide an opportunity to establish valuable primary information on the different remedies used by the local people and hence open new perspectives for further pharmacological research.

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## ABSTRACT

**Objective:** To collect, preserve and document primary ethnopharmacological information on common natural remedies (NRs) used by the Chinese community to treat and/or manage common diseases in Mauritius, a tropical multicultural island in the Indian Ocean.

**Methods:** Face-to-face interviews were carried out with 52 key Chinese informants using a semi-structured questionnaire. Quantitative ethnobotanical indices, namely, the informant consensus factor ( $F_{ic}$ ), the use value, the fidelity level, the index of agreement on remedies and the relative importance were calculated.

**Results:** Plants (61) and animal species (17), belonging to 43 and 9 families respectively, constituted the exploited flora and fauna by the Chinese community. Based on the  $F_{ic}$  the main categories of plants used were employed against injury and poisons due to external causes ( $F_{ic}=0.97$ ), diseases of the respiratory system ( $F_{ic}=0.96$ ), diseases of the eye and adnexa ( $F_{ic}=0.95$ ), undefined pains or illness ( $F_{ic}=0.95$ ), diseases during the postpartum period, diseases of the digestive system and diseases of the skin and subcutaneous tissue ( $F_{ic}=0.94$  each). For zootherapy, diseases of the circulatory system, diseases of the eye and adnexa, diseases of the skin and subcutaneous tissue and endocrine, nutritional and metabolic diseases had total consensus ( $F_{ic}=1.00$ ).

**Conclusions:** It was found that the Chinese community of Mauritius still relies, to a great extent, on NRs which need to be preserved and used sustainably. Nonetheless, further research is needed to probe the possible active constituents that could be the basis of an evidence-based investigation to discover new drugs.

## KEYWORDS

Traditional Chinese medicine, Natural remedies, Ethnopharmacology, Herbal remedies, Zootherapy, Mauritius

## 1. Introduction

With over 3000 years of experience, traditional Chinese medicine (TCM) has remained one of the many fascinating areas in ancient Chinese culture. First known to be documented in the Yellow Emperor's Canon of Medicine, TCM is believed to have been practiced in as early as 475 to 221 BC<sup>[1]</sup>. Indeed, TCM can be considered as one of the oldest healing systems on the

planet. It has been argued that TCM can be effectively applied to heal anyone and any health issue no matter what year it is, as it is rooted in unchanging natural law, which has its source beyond time<sup>[2]</sup>. Although it has fundamentally different approaches from that of conventional medicine (CM), TCM is well integrated in the Chinese health care system as one of the two mainstream medical practices<sup>[3]</sup>. Presently, millions of patients around the globe make use of TCM. Interestingly,

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TCM has also been recognised as a popular complementary and alternative medicine in Western countries, emphasising on individualised diagnosis and treatment of patients, maximising the body's self-healing capacity and treatment of the person as a "whole" by addressing their physical, mental, and spiritual attributes[4].

TCM includes panoply of interventions such as herbal remedies, zootherapy, dietary therapy, acupuncture, acupressure and massage (Tui Na), and exercise (Qigong) amongst others. However, it has been reported that plants as well as animals are the most commonly used therapies than any other alternative medicine[5]. Plants and their products are used as tinctures, decoctions; the topical parts or extracts of plants are used to treat and/or manage common ailments such as cold and fever to more serious diseases such as diabetes, hypertension and cardiovascular diseases (CVDs). Moreover, several Chinese herbs have already been transformed into commercial products for treatment of CVDs, such as Compound Danshen Dripping Pills[6]. Diet therapy is also a significant part of TCM as foods can be classified in the same way as herbs and used for medicinal purposes[7]. Acupuncture has been used to heal various diseases and physiologic malfunctions in clinical practice for more than 2500 years. Due to its efficacy, it has been recommended by the World Health Organisation as an effective complementary and alternative medicine therapy for 43 different disorders[8].

The number of databases and compilations of herbs, herbal formulations, phytochemical constituents and molecular targets is increasing. This continued popularity worldwide suggests that evidence-based research in this field, as well as information regarding the potential efficacy and safety of phytochemical constituents in herbs and TCM formulations, are essential[9], as they serve as extremely useful natural drugs and provide basic compounds for less toxic and more effective drug molecules. Furthermore, the biologically active prototypes can be explored to discover newer and better synthetic drugs or to transform inactive natural products by suitable biological/chemical means into potent drugs.

Mauritius is a multi-cultural country where the Chinese community represents about 3% of the total population[10]. There are around 32000 Chinese people, who are also called Sino-Mauritians, that come from the Hakka and Cantonese origins predominantly. Most of the Sino-Mauritians live in the capital of the island in a region known as China Town.

Regarding the dearth of updated information on traditional medicine used by the Chinese community from Mauritius, this work has endeavoured to document the primary ethnopharmacological data from the local population concerning natural remedies (NRs) generally used to treat/manage common diseases for the first time.

## 2. Materials and methods

### 2.1. Study area

The survey was performed in several regions of Mauritius from 2012–2013 over 9 districts. Different urban and rural areas were

visited to interview key informants belonging to the Chinese community.

### 2.2. Data collection

Direct interviews were conducted among Sino-Mauritians from 2012–2013. The survey was performed using a semi-structured questionnaire. The questionnaire developed was strictly confidential and non-compulsory, and each participant was interviewed alone where appropriate to maintain confidentiality. Participants were given information on the purpose of the survey, and a prior informed consent form was duly signed by the participants before the interview was conducted. During field visits, when a remedy was mentioned by the participant, if possible, the participant was encouraged to show a sample of the remedy which was collected and/or photographed. The collected sample was then identified by local botanists and experts.

The questionnaire comprised of 4 sections (A to D). Demographic data was collected, which included the age, gender, place of residence, level of education, occupation and religious views. Section A of the questionnaire enquired about the use of NRs in general, the source of NRs, motivations behind NRs use, improvement in health status after using NRs, whether their medical doctor is aware that they use NRs and preference of using NRs over conventional medicine. Section B involved questions about the use of herbal/botanical remedies for different diseases and health complications. Information on the plants such as their common local name, parts of the plant used and the methods of preparation and dosage, related complications or side effects and the effectiveness of the herbal/botanical remedies was noted. Section C was designed to document the use of animals and/or animal's parts for different diseases and health complications. Information on the animals such as their common local name, parts of the animal used and the methods of preparation and dosage, related complications or side effects and the effectiveness of zootherapy was noted. Section D was based on other NRs such as mind-body medicine, Reiki, cultural rituals, and acupuncture amongst others.

Some of the interviews were performed during busy hours of common areas such as the traditional 'bazaars'. Personal visits were also made at homes, herbalists and health centres. During field visits, the characteristics of the NRs were observed and photographed after the interviews. When a remedy was mentioned, the informant was invited to show a sample which was collected, and then the sample was subsequently identified with local botanists and specialists in the field[11,12]. This documentation will fully recognize the contribution of the local people who have been using the indigenous knowledge, protection of community biodiversity and intellectual property rights, and benefits if any comes out of the study; prior informed consent for publication of the work has been obtained.

### 2.3. Classification of diseases

For ease of documentation, reported diseases and health complications were classified in 13 categories based on

the International Classification of Diseases by the World Health Organisation. The categories were diseases during the postpartum period, diseases of the circulatory system, the digestive system, the ear and mastoid process, the eye and adnexa, the genitourinary system, the musculoskeletal system and connective tissue, the respiratory system, the skin and subcutaneous tissue, endocrine, nutritional and metabolic diseases, infectious and parasitic diseases, injury and poisons from external causes and undefined pains or illnesses.

## 2.4. Quantitative indexes for medicinal plants and animals

### 2.4.1. Informant consensus factor ( $F_{IC}$ )

$F_{IC}$  was used for the general analysis of plants and animals used by the informants.  $F_{IC}$  indicates how homogenous the information obtained, and it is calculated based on the following formula:  $F_{IC} = (N_{ur} - N_i) / (N_{ur} - 1)$  where,  $N_{ur}$  is the number of individual use reports for a particular illness category,  $N_i$  is the total number of species used by all informants for this illness category<sup>[13]</sup>.  $F_{IC}$  values ranged from 0.00 to 1.00. High  $F_{IC}$  values were obtained when only one or a few species are reported to be used by a high number of respondents to treat a particular health complication. Low  $F_{IC}$  values indicated that informants disagree over which plant to employ for the ailment. High  $F_{IC}$  values can thus be used to highlight particularly interesting species for the search of bioactive compounds.

### 2.4.2. The fidelity level (FL)

The FL, is the ratio between the number of informants who independently suggested the use of a species for the same major purpose and the total number of informants who mentioned the species for any use, was calculated for the most frequently reported diseases or ailments for the categories with the highest  $F_{IC}$ <sup>[14]</sup>. It is calculated as follows;  $FL (\%) = N_p / N \times 100$  where  $N_p$  is the number of informants that claimed a use of a species to treat a particular disease, and  $N$  is the number of informants that used the plants or animals as a medicine to treat a particular disease.

### 2.4.3. Use value

The use value shows the relative importance of plants and animals known locally<sup>[15]</sup>. It is calculated as follows; use value =  $\sum U_i / N$ , where  $U_i$  is the total number of citations per species, and  $N$  is the total number of informants.

### 2.4.4. Index of agreement on remedies

The importance of the individual species was estimated by calculating the index of agreement on remedies (IAR) for each species. IAR was calculated using the following formula:  $IAR = nr - na / (nr - 1)$  where,  $nr$  = the total number of citations registered for the species and  $na$  = the number of illness categories that are treated with this species. This value ranges between 0.00 (when the number of illness categories equals to the number of citations) and 1.00 (whereby all the

participants agree upon the exclusive use of the species for the particular illness)<sup>[16]</sup>.

### 2.4.5. Relative importance

Relative importance (RI) is defined by the following formula;  $RI = NUC + NT$  where, regardless of the number of informants citing the species,  $NUC$  is the number of use-categories of a given species divided by the total number of use-categories of the most versatile species, and  $NT$  is the number of types of uses attributed to a given species divided by the total number of types of uses attributed to the most important taxon<sup>[15]</sup>.

## 2.5. Statistical analysis

All data presented in this study were analysed using Microsoft Excel 2007 and IBM statistical package for social sciences (SPSS) version 16.0. Pearson correlations were also performed to evaluate significant associations and relationships between different variables.  $P < 0.05$  was considered as statistically significant.

## 3. Results

### 3.1. Demographic profile of respondents

Out of the 52 key informants interviewed, 47 gave their consent to participate in the survey with a response rate of 90.4%. Age, gender, place of residence, highest level of education achieved and religious level of respondents are illustrated in Table 1.

**Table 1**

Demographic profile of informants.

Indicator	Description	Frequency (%)
Age (y/o)	30–39	9 (19.1)
	40–49	15 (31.9)
	50–59	8 (17.0)
	60–69	6 (12.8)
	70–79	6 (12.8)
	≥80	3 (6.4)
Gender	Male	26 (55.3)
	Female	21 (44.7)
Place of residence	Rural	14 (29.8)
	Urban	33 (70.2)
Highest level of education	None	6 (12.8)
	Primary	28 (59.6)
	Secondary	11 (23.4)
	Tertiary	2 (4.3)
Religious level	Not religious	2 (4.3)
	Quite religious	9 (19.1)
	Religious	11 (23.4)
	Very religious	22 (46.8)
	Extremely religious	3 (6.4)

Significant correlations revealed that age and level of education were closely related to preference for NRs over CM ( $P < 0.05$ ). With increasing age and level of education, the use

of NRs over CM was found to increase.

### 3.2. NRs use

#### 3.2.1. Categories of NRs

As illustrated in Table 2, the use of herbal medicine was the most widely reported (28.5%), followed by meditation (17.0%), Tai Chi (12.7%), zootherapy (12.1%), Reiki (10.9%), massage therapy (7.9%), aromatherapy (6.1%) and acupuncture (4.8%).

**Table 2**

Categories of NRs used by the Chinese community in Mauritius.

NRs	FOC*	Percentage
Herbal	47	28.5
Meditation	28	17.0
Tai-chi	21	12.7
Zootherapy	20	12.1
Reiki	18	10.9
Massage therapy	13	7.9
Aromatherapy	10	6.1
Acupuncture	8	4.8

\*FOC=Frequency of citation.

#### 3.2.2. Ailments for which respondents use herbal/botanical remedies and zootherapy as NRs

Table 3 shows that respondents used herbal/botanical remedies and zootherapy as NRs for a total of 13 different diseases. A total of 20% of the people sought treatment for diseases of the respiratory system, 16% for the digestive system, 13% for the genitourinary system and 13% for undefined pains or illness. The other categories of diseases were less popular among those being treated naturally, with a percentage of only 0.2% for the ear and mastoid process.

#### 3.2.3. Access to and motivations to use NRs

It was observed that 51% of the participants had access to NRs from the wild, 10.6% of which included their private cultivation of medicinal plants and animals and the remaining (40.4%) from other places. About 36.2% reported that they bought the NRs from the market. The remaining

12.8% obtain NRs after being guided by an herbalist/TCM healer.

During this study, it was found that 78.7% of the Sino-Mauritians interviewed were mostly influenced by family traditions when asked about their motivations to use NRs. A total of 12.8% of the interviewees admitted that they have been guided by friends while the remaining 8.5% were influenced by the media.

Following NR's use, 34.0% of respondents reported that they were completely healed, 59.6% claimed much improvement in their health status and 6.4% reported that their health status improved slightly. It was found that 59.6% of the respondents claimed that their medical doctors were aware that they use NRs whereas 40.4% of them did not inform the latter about it. The majority also preferred to use NRs (68.1%) while 8.5% preferred CM, and 23.4% considered both to be equally effective.

### 3.3. Zootherapy

Out of the 47 informants, only 20 informants (42.6%) claimed to have used animals as NRs to treat/manage diseases and/or health complications (Table 4).

As depicted in Table 4, informants quoted 17 animal species distributed in 9 families, namely, mammals (3), insects (3), birds (2), fish (2), reptiles (2), worms (2), amphibians (1), crustaceans (1) and molluscs (1). Zootherapy was used to treat 13 categories of diseases. *Gallus domesticus* was the most highly used species with a use value of 0.23 followed by *Bos taurus* (use value of 0.19) and *Lucanus cervus*, *Capra aegagrus hircus*, *Metanephrops* spp. and *Hippocampus* sp. each with a use value of 0.17. *Scolopendra morsitans* and *Helix pomatia* had a use value of 0.13 each. *Columba livia* and *Serpentes* spp had a use value of 0.11 while *Blatta orientalis* and *Hirudo medicinalis* each had a use value of 0.09. A use value of 0.06 was recorded for *Rana clamitans*, *Carcharhinus amyblirhynchos*, *Pachycondyla verena*, *Lacerta* spp. and *Enchytraeus buchholzi* were the least used species with a use value of

**Table 3**

Ailments for which respondents use herbal/ botanical remedies and zootherapy.

Category	Ailment	FOC	%
Diseases during the postpartum period	Abdominal pain due to blood stasis, abnormal uterine bleeding, lactation, miscarriage, postpartum hand and feet swelling	54	3.0
Diseases of the circulatory system	Anemia, angina pectoris, CVDs, hypertension, palpitations	120	6.0
Diseases of the digestive system	Constipation, diarrhea, enteritis, flatulence, gastritis, hemorrhoids, indigestion, ulcers, poor appetite, toothache, vomiting	314	16.0
Diseases of the ear and mastoid process	Ear ache, infections	3	0.2
Diseases of the eye and adnexa	Blurred vision, cataract, eye infections, weak eyesight	96	5.0
Diseases of the genitourinary system	Amenorrhea, chronic cystitis, dysmenorrhea, enlarged prostate gland, impotence, infections, infertility, kidney problems, menopausal syndromes, painful urination, premature ejaculation, premenstrual syndrome, renal incontinence/failure, spermatorrhea, vaginal discharge	242	13.0
Diseases of the musculoskeletal system and connective tissue	Arthritis, muscular pain, rheumatism, swollen muscles, edema	99	5.0
Diseases of the respiratory system	Asthma, colds, cough, nasal congestion, phlegm, pneumonia, sore throat, wheezing	390	20.0
Diseases of the skin and subcutaneous tissue	Acne, boils, eczema, skin eruptions	108	6.0
Endocrine, nutritional and metabolic diseases	Diabetes, jaundice, hepatitis, malnutrition	47	2.0
Infectious and parasitic diseases	Chicken pox, influenza, malaria, measles, ringworm, viral infections	123	6.0
Injury and poisons from external causes	Allergy, burns, cuts and wounds, insect bites, sprains	68	4.0
Undefined pains or illness	Body pain, epilepsy, excessive sweating, fatigue, fever, headache, insomnia, nervous disorders, spasms and convulsions	244	13.0

FOC=Frequency of citation.

**Table 4**  
Animal species used by the Chinese community in Mauritius.

Animal/ Scientific name/ Family	Part used	Indication	Preparation and administration	FOC	UV	FL (%)
Ant/ <i>Pachycondyla verena</i> / Formicidae	Whole body	Premature graying hair Cold, chesty cough, lung problems,	Fried and eaten	2	0.04	100
Beef/ <i>Bos taurus</i> / Bovidae	Meat	pulmonary abscess—promotes coughing of thick sputum	Boiled with pumpkin flesh and seeds in soup and added with seasonings	9	0.19	100
Centipede/ <i>Scolopendra morsitans</i> / Scolopendridae	Whole body (Dried)	Painful headaches, spasms and convulsions, seizures	Decoction. About 1–3 g in water.	3	0.13	50
Chicken/ <i>Gallus domesticus</i> / Phasianidae	1. Bones and legs	1. Regaining strength when having fever	1. Cooked in soup with salt, pepper, garlic, tomatoes and carrots.	6	0.23	55
	2. Gizzard	2. Kidney stones	Consumed twice a day until feeling better	5		45
Cockroach/ <i>Blatta orientalis</i> / Blattidae	Whole body (Wingless)	Amenorrhea, postpartum abdominal pain due to blood stasis	Killed by boiling in water and left to dry in sun	3	0.09	75
	1. Horn	1. Painful headaches		1		25
Deer/ <i>Lucanus cervus</i> / Cervidae	2. Musk (navel gland secretion)	2. Facilitates downward passage of stillborns	1. Fatty substance from horn is wrapped around the head using a cloth	4	0.17	50
		1. Pain in joints and bones due to lack of calcium	2. Powdered form. Consumed orally	4		50
Domestic goat/ <i>Capra aegagrus hircus</i> / Bovidae	1. Bones Meat		1. Cooked in soup with salt, pepper, garlic, tomatoes and vegetables.	7	0.17	70
	2. Milk	2. Similar to breast milk; can be given to feeble, malnourished infants fatigue	Consumed frequently	2		20
Frog/ <i>Rana clamitans</i> / Ranidae	Whole body (Dried) Meat	Wounds, bleeding, rheumatism	Boiled in water and applied with washcloth or cooked and eaten	2	0.06	67
			1. Killed by boiling, cut length-wise, dried in the sun, then cooked or ground into powder for oral use	1		33
Leech/ <i>Hirudo medicinalis</i> / Hirudinea	1. Whole body	1. Amenorrhea, constipation		2	0.09	50
	2. Secretion	2. Inflammation of middle ear	2. Secretion is collected from leech and used topically	1		25
Lizard/ <i>Lacerta</i> sp./ Lacertidae	Secretion	Eye inflammation	Secretion is collected and applied topically	2	0.04	100
Lobster/ <i>Metanephrops</i> spp./ Nephropidae	Flesh	Measles	Mix cornstarch with the lobster lightly to coat the pieces. Heat up oil in a frying pan, deep fry for 1 min. Add ginger, salt, sugar and pepper	8	0.17	100
Pigeon/ <i>Columba livia</i> / Columbidae	Whole body	Anaemia	Pigeon is throttled so as not to lose any blood when it is killed. It is then cooked in a soup and consumed frequently	5	0.11	100
				2		25
Sea horse/ <i>Hippocampus</i> sp./ Syngnathidae	Whole body (Dried)	Arthritis, asthma, impotence, renal failure	Cooked in soup with salt, garlic, pepper, tomatoes. Consumed once in 2–3 weeks.	1	0.17	13
				3		37
Shark/ <i>Carcharhinus amblyrhynchos</i> / Carcharhinidae	Fin	Renal failure	Cooked in soup with salt, pepper and garlic. Consumed once a week.	2	0.06	25
				3		100
Snail/ <i>Helix pomatia</i> / Helicidae	1. Saliva	1. Wounds and injuries		4	0.13	67
	2. Slime	2. Pain associated with rheumatism	Slime and saliva are collected from snail and applied topically	2		33
Snake/ <i>Serpentes</i> sp./ Colubridae	1. Meat 2. Skin (Dried)	1. Sore throats, hemorrhoids 2. Skin diseases, aene, boils		1	0.11	40
			1. Cooked in soup with salt, pepper, garlic.	2		40
			2. Powdered form and applied topically	2		40
White earthworms/ <i>Enchytraeus buchholzi</i> / Megascolecidae	Whole body	1. High fever, influenza	1. Washed then made into a decoction to drink	1	0.06	33
		2. Ear infections	2. Ground and made into a paste and applied to infected area	2		67

FOC=Frequency of citation, UV=use value, FL=Fidelity level

0.04 each.

As depicted in Table 5, the most important animal species for different categories of diseases were: *Columba livia* for the diseases of the circulatory system with a FL of 100%; *Lacerta* sp. for diseases of the eye and adnexa with a FL of 100%; *Carcharhinus amblyrhynchos* for diseases of the genitourinary system with a FL of 100%; *Bos taurus* for diseases of the respiratory system with a FL of 100%; *Metanephrops* spp. for infectious diseases with a FL of 100%; *Pachycondyla verena* for undefined pains or illness with a FL of 100%. *Capra aegragus hircus* was the most important species for diseases of the musculoskeletal system and connective tissue (FL=70%).

**Table 5**

Animal species with highest FL values for different categories of diseases.

Category of disease	Most important animal species	FL (%)
Diseases during the postpartum period	<i>Lucanus cervus</i>	50
Diseases of the circulatory system	<i>Columba livia</i>	100
Diseases of the digestive system	<i>Serpentes</i> spp.	40
Diseases of the ear and mastoid process	<i>Enchytraeus buchholzi</i>	67
Diseases of the eye and adnexa	<i>Lacerta</i> spp.	100
Diseases of the genitourinary system	<i>Carcharhinus amblyrhynchos</i>	100
Diseases of the musculoskeletal system and connective tissue	<i>Capra aegragus hircus</i>	70
Diseases of the respiratory system	<i>Bos Taurus</i>	100
Diseases of the skin and subcutaneous tissue	<i>Serpentes</i> spp.	40
Endocrine, nutritional and metabolic diseases	<i>Capra aegragus hircus</i>	20
Infectious and parasitic diseases	<i>Metanephrops</i> spp.	100
Injury and poisons from external causes	<i>Helix pomatia</i>	67
Undefined pains or illness	<i>Pachycondyla verena</i>	100

As shown in Table 6, a total of 13 disease categories were treated by zootherapy. F<sub>IC</sub> values for all the different categories of diseases recorded are high, ranging from 0.50

to 1.00.

**Table 6**

FIC for different categories of diseases (zootherapy).

C <sup>A</sup>	C <sup>B</sup>	C <sup>C</sup>	F <sub>IC</sub>
Diseases during the postpartum period	2	3	0.50
Diseases of the circulatory system	1	5	1.00
Diseases of the digestive system	2	3	0.50
Diseases of the ear and mastoid process	2	3	0.50
Diseases of the eye and adnexa	1	2	1.00
Diseases of the genitourinary system	7	19	0.67
Diseases of the musculoskeletal system and connective tissue	9	12	0.73
Diseases of the respiratory system	3	11	0.80
Diseases of the skin and subcutaneous tissue	1	2	1.00
Endocrine, nutritional and metabolic diseases	1	2	1.00
Infectious and parasitic diseases	2	9	0.88
Injury and poisons from external causes	3	7	0.67
Undefined pains or illness	7	25	0.75

C<sup>A</sup>=Category of disease; C<sup>B</sup>=Number of species for the disease category; C<sup>C</sup>=Number of citations for the disease category; F<sub>IC</sub>= Informant consensus factor= (CC-CB)/(CC-1)

Four categories attained total agreement among respondents (F<sub>IC</sub>=1.00), namely, diseases of the circulatory system, diseases of the eye and adnexa, diseases of the skin and subcutaneous tissue and endocrine, nutritional and metabolic diseases. The category for infectious and parasitic diseases (F<sub>IC</sub>=0.88) and diseases of the respiratory system (F<sub>IC</sub>=0.80) also showed high agreement followed by the undefined pains or illness category (F<sub>IC</sub>=0.75) and diseases of the musculoskeletal system and connective tissue (F<sub>IC</sub>=0.73).

**Table 7**

Plant species used by the Chinese community in Mauritius.

Family/ Scientific name	Local/ common name	Indication	Part used <sup>a</sup>	Preparation <sup>b</sup>	Administration <sup>c</sup>	FOC	UV	IAR	RI	FL (%)		
Amaranthaceae/ <i>Celosia cristata</i>	Coqueliocot	Hemorrhoidal bleeding	Flo	Dec	Ora	8	0.17	1.00	0.38	100		
		CVDS, hypertension				5				21		
Amaryllidaceae/ <i>Allium sativum</i>	<i>L'ail</i> Garlic	Cold, flu	Bul	Cru	Ora	8	0.51	0.89	2.00	33		
		Arthritis, rheumatism				6				25		
		Cuts, insect bites				5				21		
Apiaceae/ <i>Coriandrum sativum</i>	Cotomili Coriander	Measles	Who	DB	Loc	11	0.23	1.00	0.38	100		
Araliaceae/ <i>Panax ginseng</i>	Ginseng	1. Improving blood circulation	1. Roo	Inf	Ora	29	0.94	0.98	0.75	66		
		2. Boosting sexual performance	2. Flo			15				34		
		1. Blood cleanser				19				51		
Asphodelaceae/ <i>Aloe barbadensis</i>	Aloe vera	Roundworms, ringworms	Lea	1. Dec 2. Ext	1. Ora	3	0.79	0.94	1.38	8		
		2. Burns, eczema			2. Loc	15				41		
Asteraceae/ <i>Taraxacum officinalis</i>	Pissenlit Dandelion	Increasing lactation in nursing mothers	Her	Dec	Ora	14	0.36	0.94	0.75	82		
		Pulmonary abscess				3				18		
Asteraceae / <i>Cirsium segetum</i>	Small thistle	Painful urination	Aer	Inf	Ora	7	0.28	1.00	0.50	54		
		Bloody urine	Roo			6				46		
Asteraceae/ <i>Artemisia annua</i>	Sweet wormwood	Malaria	Lea	Dec	Ora	8	0.17	1.00	0.38	100		
Asteraceae/ <i>Artemisia capillaries</i>	Oriental wormwood	Jaundice, hepatitis	Ste	Dec	Ora	8	0.17	1.00	0.50	100		
			Lea									
Asteraceae / <i>Ayapana triplinervis</i>	Ayapana	Indigestion	Lea	Dec	Ora	16	0.45	0.95	0.75	76		
		Expel worms				5				24		
		Easing cold symptoms				16				41		
Asteraceae/ <i>Matricaria chamomilla</i>	Chamomile	Easing headache, insomnia	Flo	Inf	Ora	23	0.83	0.97	0.88	59		
		Sore swollen throats, red eyes, can reduce										
		fever, prevent cold and sunstroke, for									42	
Asteraceae/ <i>Chrysanthemum indicum</i>	Chrysanthemum Chrysanthemum	pneumonia	Flo	Inf	Ora		1.00	0.98	1.50			
		Enteritis				5				11		

Diseases of the genitourinary system and injury and poisons from external causes were the two categories with an F<sub>IC</sub> of 0.67 each. The least agreement among the informants was observed in three categories with an F<sub>IC</sub> of 0.50, namely, diseases of the postpartum period, diseases of the digestive system and diseases of the ear and mastoid process.

In relation to views of users on safety of zootherapy, 75% of the zootherapy users agreed that it was safe to use animals to treat ailments, 10% reported that it was a quite safe practice and 15% stated that it was indeed very safe. When the respondents were queried whether they found zootherapy effective as a natural remedy, 65% of the users agreed, 25% strongly agreed and 10% said that they quite agreed.

### 3.4. Herbal/botanical remedies

As summarized in Table 7, 61 medicinal plants were found to be commonly used by the Chinese community in Mauritius. Primary ethnobotanical information (local/ vernacular name(s), parts used, source, number of citations, use value and the dosage) for all the different herbal remedies were collected from the informants and summarized in Table 7.

The highest use value for plant species was 1.00 and the lowest was 0.15. The IAR values for the 61 plant species ranged from 0.78 to 1.00. A total of 22 species had an IAR of 1.00. The two lowest IAR values recorded were 0.89 (*Allium sativum*) and 0.78 (*Trigonella foenum-graecum*). The RI of the plant species cited by 47 respondents ranged from 0.38 to 1.75. Out of the 61 plant species recorded, a total of 16

continued Table 7

Brassicaceae/ <i>Raphanus sativus</i>	Radis	Reducing phlegm, chronic cough with phlegm	See	Dec	Ora	3	0.30	0.92	1.13	21
	Radish	Indigestion, abdominal pain, acid reflux with belching				11				79
Campanulaceae/ <i>Lobelia chinensis</i>	Lobelia	Diuretic	Her (D) <sup>+</sup>	Dec	Ora	9	0.36	0.94	0.75	53
		Edema				8				47
Caprifoliaceae/ <i>Lonicera japonica</i>	Chèvrefeuille	Fever, headache, excessive thirst	Flo	Inf	Ora	26	1.00	0.98	1.00	55
	Honeysuckle	Viral infections	Her			21				45
Caricaceae/ <i>Carica papaya</i>	Papaya	Pain in joints and muscles	Roo	Cru	Loc	8	0.43	1.00	0.50	40
		Arthritis				12				60
Caryophyllaceae/ <i>Saponaria officinalis</i>	Saponaire	Skin problems, itches, acne	Who	Dec	Ora	18	0.57	0.96	1.00	67
		Rheumatism				9				33
Convolvulaceae/ <i>Ipomoea batatas</i>	Patate	Eye problems, poor eyesight, cataract	Roo	Inf	Loc	29	0.62	1.00	0.63	100
	Sweet potato									
Cucurbitaceae/ <i>Cucurbita argyrosperma</i>	Giraumon	1. Expulsion of parasitic worms	1. See	1. Emu	Ora	13	0.87	0.95	1.00	32
	Pumpkin	Increases of lactation in nursing mothers, postpartum hand and feet swelling	2. Fle & See	2. Cooked with beef		18				44
		2. Pulmonary abscess-coughing of thick sputum				10				24
Ephedraceae/ <i>Ephedra sinica</i>	Ephedra	Asthma	Ste	Dec	Ora	11	0.43	1.00	0.50	55
		Bronchitis				9				45
Fabaceae / <i>Myroxylon balsamum</i>	Baume du Perou	Cough	Ext	Cru	Ora	47	1.00	1.00	0.38	100
Fabaceae/ <i>Trigonella foenum-graecum</i>	Fenugrec	Lowering blood sugar level	See	Dec	Ora	3	0.23	0.78	1.25	30
	Fenugreek	Erectile dysfunction caused by kidney deficiency, lack of libido stomach pain				3				30
						4				40
Ginkgoaceae/ <i>Ginkgo biloba</i>	Ginkgo	Allergies	Lea	Dec	Ora	6	0.87	0.95	1.38	15
		Phlegm, wheezing	Nut			23				56
		Vaginal discharge in yeast infections, urinary tract diseases				12				29
Hydrangeaceae/ <i>Hydrangea</i> spp.	Hydrangea	Urethritis, cystitis	Roo	Dec	Ora	18	0.53	1.00	0.63	72
		Enlarged prostate gland				7				28
Lamiaceae/ <i>Mentha x piperita</i>	La menthe	Indigestion, colic, bloating	Lea	Raw	Ora	38	0.81	1.00	0.63	100
	Peppermint									
Lauraceae/ <i>Cassythia filiformis</i>	Liane sans fin	Diarrhea, toothache	Who	Dec	Ora	9	0.47	0.95	1.00	41
		Cholera, dysentery				13				59
Lauraceae/ <i>Cinnamomum cassia</i>	Cannelle	Anaemia, angina pectoris	Bar (D) <sup>+</sup>	Dec	Ora	4	0.94	0.95	1.63	9
	Cinnamon	Cold phlegm, common cold				25				57
		Headaches, fever and chills, sweating				15				34
Linaceae/ <i>Linum usitatissimum</i>	L'orge	1. Laxative	See	1. Dec	1. Ora	18	0.89	0.98	0.75	43
	Grain de lin	2. To relax the eyes for inflammation		2. Pou	2. Loc	24				57
Longaniaceae/ <i>Strychnos nux-vomica</i>	Nux vomica	Gastrointestinal tract diseases	See	Dec	Ora	10	0.34	0.93	0.88	63
		Impotence, menopausal syndromes				6				38
Malvaceae/ <i>Hibiscus genevii</i>	Hibiscus	Effective in digestive system	Flo	Dec	Ora	12	0.66	0.93	1.13	39
		Diuretic				12				39
		Inflammation of lymph nodes				7				22
Meliaceae/ <i>Melia azedarach</i>	Lilas de Perse	1. Blood cleanser-expel worms	1. Bar	Dec	1. Ora	28	0.79	0.97	0.75	76
	Chinaberry	2. Eczema	2. Lea		2. Loc	9				24
Meliaceae/ <i>Azadirachta indica</i>	Lilas	Allergies	Lea	DB	Loc	18	0.96	0.98	0.88	40
	'Neem'	Chicken pox, measles				27				60
Moraceae/ <i>Morus alba</i>	Mulberry	1. Fever, headaches	1. Bar	Inf	Ora	12	0.87	0.93	1.75	29
		Dry cough	2. Fru	Jui		12				29
		2. Anaemia, palpitations	3. Lea			7				17
		3. Blurred vision				10				25
Moringaceae/ <i>Moringa oleifera</i>	Brède mouroum	1. Pain in joints and muscles	1. Dru	Sou	Ora	8	0.66	0.93	1.13	26
		Diabetes	2. Lea			12				39
		2. Increasing lactation in nursing mothers				11				35
Myristacaceae/ <i>Myristica fragrans</i>	Noix de muscade	1. Stops diarrhea, nausea, vomiting, flatulence, poor appetite	See	1. Dec	1. Ora	20	0.81	0.95	1.50	53
	Nutmeg	2. Rheumatism, sprains, bruises		2. Cru	2. Loc	8				21
						10				26
Myrtaceae/ <i>Syzigium aromaticum</i>	Giroffle	Tooth ache, abdominal pain, impotence, vaginal yeast infections	Flo (B)	Raw	Ora	31	0.94	0.98	1.00	70
	Clove					13				30
Nelumbonaceae/ <i>Nelumbinis nuciferae</i>	Lotus	1. Stabilize kidneys, stops bleeding, enuresis, vaginal discharge, premature ejaculation, spermatorrhea	1. Sta	Dec	Ora	19	0.96	0.98	1.50	42
		2. Excessive sweating, fever	2. Lea			26				58
Pedaliaceae/ <i>Sesamum indicum</i>	Sesame	Blurred vision	See	Dec	Ora	14	0.55	0.96	0.75	54
		Dizziness				12				46
		Hypertension				21				47
Plantaginaceae/ <i>Plantago asiatica</i>	Plantain	Infections, swelling of the prostate gland	Her	Dec	Ora	13	0.96	0.98	1.00	29
		Painful urination				11				24

continued Table 7

Poaceae/ <i>Cymbopogon citratus</i>	Citronelle	Citronella Cough	Ste Lea	Inf	Ora	47	1.00	1.00	0.38	100
Portulacaceae/ <i>Portulaca oleracea</i>	Pourpier Purslane	1. Hemorrhoidal bleeding	Lea	1. Dec	1. Ora	8				19
		2. Boils, sores, eczema	See	2. Cru	2. Loc	11	0.91	0.95	1.38	26
Primulaceae/ <i>Lysimachia Christina</i>	–	Urinary infections	Who	Inf	Ora	24				55
Ranunculaceae/ <i>Rhisoma coptidis</i>	Huang lian	Liver detoxification	Her	Inf	Ora	7	0.15	1.00	0.38	100
		Malaria				7	0.30	0.92	0.75	50
Rhamnaceae/ <i>Ziziphus zizyphus</i>	Jujube	Anorexia				7				16
		Asthma in children	Fru	Raw	Ora	13	0.96	0.93	1.63	29
		Hemorrhoids, ulcers				9				20
		Weakness				16				35
Rosaceae/ <i>Prunus mume</i>	Prune	Ulcers	Fru	Raw	Ora	12	0.26	1.00	0.38	100
Rosaceae/ <i>Pruni armaniaca</i>	Chinese plum									
Rosaceae/ <i>Rosa chinensis</i>	Apricot	Constipation	See	Dec	Ora	28	0.85	0.97	0.75	70
		Eye inflammation				12				30
Rosaceae/ <i>Rosa chinensis</i>	Rose	Blood cleanser	Flo (B)	Inf	Ora	20	0.79	0.97	1.13	54
		Amenorrhea, irregular menses, menstrual pain, premenstrual breast tenderness	Flo			17				46
Rosaceae/ <i>Crateagus pinnatifida</i>	Hawthorn	Indigestion	Fru	Jui	Ora	9	0.19	1.00	0.38	100
Rosaceae/ <i>Eriobotrya japonica</i>	Bibasse	Sore throat, common cold	Fru Lea	Raw	Ora	20	0.43	1.00	0.38	100
Rutaceae/ <i>Dictamnus dasycarpus</i>	Dittany	Acute rheumatic arthritis	Roo (Bar)	Ora	Loc	18	0.91	0.95	1.50	42
		Eczema, rashes, boils	Dec			7				16
		Jaundice, eliminate toxins								
Sapindaceae/ <i>Cardiospermum halicacabum</i>	Poquepoque	Skin problems	Lea	DB	Loc	22	0.47	1.00	0.38	100
Sapindaceae/ <i>Dimocarpus longan</i>	Longane	Insomnia	Fru	Ton	Ora	8	0.17	1.00	0.38	100
Schisandraceae/ <i>Illicium verum</i>	Anis etoile Star anise	Aids digestion	Fru	Dec	Ora	23	0.60	0.96	0.75	82
		Rheumatism				5				18
		Arthritis		Raw		7				30
Solanaceae/ <i>Lycium barbarum</i>	Goji Wolfberry	Diabetes	Fru	Sou	Ora	11	0.49	0.91	1.13	37
		Improves eyesight				5				33
Solanaceae/ <i>Capsicum</i> sp.	Piment	Skin problems, lesions, rashes, boils, pimples	Lea	Cru	Loc	8	0.17	1.00	0.88	100
Tiliaceae/ <i>Tilia cordata</i>	Tilleul	Insomnia, nervous disorders, epilepsy, migraines, fatigue	Flo	Inf	Ora	29	0.62	1.00	0.88	100
Verbeneaceae/ <i>Verbena officinalis</i>	Verveine	Cough and throat inflammation				12				26
		Helps digestion	Who	Inf	Ora	12	0.98	0.93	1.63	26
		Insomnia				17				37
		Malaria				5				11
Zingiberaceae/ <i>Alpinia oxyphylla</i>	Bitter cardamom	Diarrhea	Fru (D) <sup>a</sup>	Inf	Ora	9	0.40	0.94	0.75	47
		Frequent urination due to inflammation				10				53
Zingiberaceae/ <i>Anomum kravanh</i>	Round cardamom	Diarrhea	Fru (D) <sup>a</sup>	Inf	Ora	9	0.38	1.00	0.88	50
		Nausea, vomiting, morning sickness	See			9				50
		1. Arthritis				9				19
Zingiberaceae/ <i>Zingiber officinalis</i>	Gingembre Ginger	Nasal congestion, common cold, cough, sore throat	1.Rhi (D) <sup>a</sup> 2.Rhi (F) <sup>a</sup>	Inf	Ora	29	1.00	0.96	1.75	62
		2. Diarrhea, vomiting, nausea				9				9
Zingiberaceae/ <i>Curcuma</i> sp.	Safran vert	Cough, common cold	Roo	BM	Ora	42	0.89	1.00	0.50	100

<sup>a</sup> Part used: Aer, aerial parts; Bar, bark; Bul, bulb; Dru, drumstick; Fle, flesh; Flo, flower; Flo(B), flower bud; Fru, fruit; Her, herb; Lea, leaf; Nut, nuts; Sta, stamen; Ste, stem; See, seeds; Rhi, rhizome; Roo, root; Roo (Bar), root bark; Who, whole plant.

<sup>b</sup> Preparation: BM, boiled with milk; Cru, crushed; Dec, decoction; DB, decocted and used to bath; Emu, emulsion; Ext, extract; Inf, infusion; Jui, juice; Raw, raw; Sou, soup; Ton, tonic.

<sup>c</sup> Administration: Loc, local; Ora, oral.

<sup>\*</sup> (D): Dried; (F): Fresh. FOC=Frequency of citation. UV=use value.

species had RI ≤ 0.50; 26 species had RI from 0.51 to 1.00, 13 species had RI from 1.01 to 1.50, and 6 species with RI from 1.51 to 2.00.

As shown in Table 8, the most important plant species for different categories of diseases were: *Celosia cristata*, *Mentha x piperita*, *Prunus mume* and *Crateagus pinnatifidata* for diseases of the digestive system each with a FL of 100%; *Ipomoea batatas* for diseases of the eye and adnexa with a FL of 100%; *Lysimachia christina* for diseases

of the genitourinary system with a FL of 100%; *Myroxylon balsamum*, *Cymbopogon citratus*, *Eriobotrya japonica* and *Curcuma* spp. for diseases of the respiratory system each with a FL of 100%; *Cardiospermum halicacabum* and *Capsicum* spp., for diseases of the skin and subcutaneous tissue each with a FL of 100%; *Artemisia capillaris* for endocrine, nutritional and metabolic diseases (FL=100%); *Coriandrum sativum* and *Artemisia annua* for infectious and parasitic diseases each with a FL of 100%; *Dimocarpus*

*longan* and *Tilia cordata* for undefined pains or illness with a FL of 100%; *Taraxacum officinalis* for diseases of the postpartum period (FL=82%); *Panax ginseng* for diseases of the circulatory system (FL=66%); *Carica papaya* for diseases of the musculoskeletal system and connective tissue (FL=60%); *Myristica fragrans* for injury and poisons from external causes (FL=26%).

**Table 8**

Plant species with highest FL values for different categories of diseases.

Category of disease	Most important plants	FL %
Diseases during the postpartum period	<i>Taraxacum officinalis</i>	82
	<i>Cucurbita argyrosperma</i>	44
Diseases of the circulatory system	<i>Moringa oleifera</i>	35
	<i>Panax ginseng</i>	66
	<i>Rosa chinensis</i>	54
	<i>Aloe barbadensis</i>	51
	<i>Plantago asiatica</i>	47
Diseases of the digestive system	<i>Celosia cristata</i>	100
	<i>Mentha x piperita</i>	100
	<i>Prunus mume</i>	100
	<i>Crateagus pinnatifidata</i>	100
Diseases of the eye and adnexa	<i>Ipomoea batatas</i>	100
	<i>Linum usitatissimum</i>	57
	<i>Sesamum indicum</i>	54
Diseases of the genitourinary system	<i>Lysimachia Christina</i>	100
	<i>Hydrangea spp.</i>	76
	<i>Cirsium segetum</i>	54
	<i>Lobelia chinensis</i>	53
Diseases of the musculoskeletal system and connective tissue	<i>Carica papaya</i>	60
	<i>Dictamnus dasycarpus</i>	42
Diseases of the respiratory system	<i>Myroxylon balsamum</i>	100
	<i>Cymbopogon citratus</i>	100
	<i>Eriobotrya japonica</i>	100
	<i>Curcuma sp.</i>	100
Diseases of the skin and subcutaneous tissue	<i>Cardiospermum halicacabum</i>	100
	<i>Capsicum sp.</i>	100
	<i>Saponaria officinalis</i>	67
	<i>Portulaca oleracea</i>	55
Endocrine, nutritional and metabolic diseases	<i>Artemisia capillaries</i>	100
	<i>Moringa oleifera</i>	39
	<i>Lycium barbarum</i>	37
Undefined pains or illness	<i>Dimocarpus longan</i>	100
	<i>Tilia cordata</i>	100
	<i>Matricaria chamomilla</i>	59
	<i>Nelumbinis nuciferae</i>	58
	<i>Lonicera japonica</i>	55

As shown in Table 9, a total of 12 disease categories were treated/managed by herbal/botanical remedies. The  $F_{IC}$  results showed that the values for all the different categories of diseases stated by the informants are high, ranging from 0.89 to 0.97. Following  $F_{IC}$  calculations, the category attaining highest agreement among respondents ( $F_{IC}=0.97$ ) was injury and poisons due to external causes followed by diseases of the respiratory system ( $F_{IC}=0.96$ ), diseases of the eye and adnexa ( $F_{IC}=0.95$ ) and undefined pains or illness ( $F_{IC}=0.95$ ). Diseases during the postpartum period, diseases of the digestive system and diseases of the skin and subcutaneous tissue also had a high  $F_{IC}$  of 0.94 each, while both the diseases of the circulatory system and diseases of the genitourinary system had an  $F_{IC}$  of 0.93. The high  $F_{IC}$  values of the different categories indicate the agreement among the informants concerning the plants appropriate for the treatment of each particular category.

**Table 9**

$F_{IC}$  for different categories of diseases (herbal/botanical remedies).

C <sup>A</sup>	C <sup>B</sup>	C <sup>C</sup>	F <sub>IC</sub>
Diseases during the postpartum period	4	51	0.94
Diseases of the circulatory system	9	115	0.93
Diseases of the digestive system	21	311	0.94
Diseases of the eye and adnexa	6	94	0.95
Diseases of the genitourinary system	16	223	0.93
Diseases of the musculoskeletal system and connective tissue	8	87	0.92
Diseases of the respiratory system	16	379	0.96
Diseases of the skin and subcutaneous tissue	7	106	0.94
Endocrine, nutritional and metabolic diseases	6	45	0.89
Infectious and parasitic diseases	11	114	0.91
Injury and poisons from external causes	3	61	0.97
Undefined pains or illness	11	219	0.95

C<sup>A</sup>=Category of disease.

C<sup>B</sup>=Number of species for the disease category.

C<sup>C</sup>=Number of citations for the disease category.

F<sub>IC</sub>=Informant consensus factor= (C<sup>C</sup>-C<sup>B</sup>) / (C<sup>C</sup>-1).

The categories of diseases were then analysed in order to determine the most important plants species in each category. Some popular species had 100% FL values, which were: *Myroxylon balsamum* and *Cymbopogon citrates* for diseases of the respiratory system, *Dimocarpus longan* and *Tilia cordata* for undefined pains or illness, *Ipomoea batatas* for diseases of the eye and adnexa. The high RI values calculated [*Allium sativum* (RI=2.00); *Morus alba* and *Zingiberis officinalis* (RI=1.75 each); *Cinnamomum cassia*, *Ziziphus zizyphus* and *Verbena officinalis* (RI=1.63 each)] lead us to conclude that that these plants were easily available and affordable by the most of the informants. The high IAR values (1.00) documented for 22 plant species in the present study suggest that all the informants agreed upon the exclusive use of the medicinal plants for a particular disease/health complication.

### 3.6. Effectiveness of herbal/ botanical remedies

Views of informants on effectiveness of herbal/ botanical remedies were also sought in the present survey. It was found that 55.3% of the users agreed that herbal/botanical remedies were effective, 38.3% strongly agreed and 6.4% reported that they quite agree. None of the informants was found to disagree with the effectiveness of using plants as part of NRs.

## 4. Discussion

During the last few years, promising advances have been achieved among scientists to explore traditional medicines of Mauritius in an endeavour to evaluate the chemical composition and pharmacological action of various local plant species. While the pharmacological properties of many Chinese herbs have been documented in many countries, there is currently a dearth of information on how

TCM are actually used in practice outside China<sup>[17]</sup>. This study is the first of its kind to document and understand the TCM practices integrated as NRs by the Chinese community of Mauritius, also known as Sino-Mauritians. Mauritius is a developing country where the use of NRs is deeply rooted in all the cultural groups, especially in the Chinese community.

It was found from the present investigation that Sino-Mauritians used various NRs for diseases/health complications and a total of 8 distinct categories of NRs were used to treat/manage 13 different categories of diseases, suggesting that knowledge of TCM among respondents passed on from ancestors to the current generation has been valued and preserved. Moreover, many users of NRs from the Chinese community claimed that the use of NRs was a mean of promoting health, preventing diseases as well as providing effective treatment for their ailments. Herbal/botanical remedies were the most common NRs used by the Sino-Mauritians which tend to show that plants were easily accessed and/or available. Despite the rich floral diversity of Mauritius, some herbalists reported that many of the plants and herbs that they sold to consumers were imported from China. Additionally, they also claimed that many plant species obtained locally have now become less easily accessible.

The use of herbal medicine and zotherapy for the treatment of diseases, meditation for stress, depression and anxiety, and Tai-chi and Reiki were also common in the Sino-Mauritian population. On the other hand, it was found that the use of acupuncture and aromatherapy were the least common practices. This may be attributed to a weak incorporation of these two TCM practices as NRs in Mauritius. Furthermore, the fact that these practices are unpopular can be ascribed to their cost while herbal/botanical remedies are fairly low-priced. This study also showed that the Chinese community had an unwavering stand on the use of natural products for their health complications. Many of the respondents simply relied on nature to find cures for their ailments as they were easily accessible and cheap. It was also observed that the NR users' had their own small-scale private cultivations of medicinal plants and/or animals, in their gardens or yards, with which they had experienced positive health outcomes.

Based on the results of this survey, it was found that gender had no influence on the use of NRs to alleviate diseases amongst the Sino-Mauritian population. Male participants were more responsive during the interviews. This could be due to the fact that the Chinese community is patriarchal and long ago men were more active in handling their families, particularly concerning health issues. This observation is supported by the study carried by Hasan *et al*<sup>[18]</sup>, which showed that gender does not influence use of NRs. Conversely, other studies demonstrated that more

women compared to men reported the use of NRs which was explained by a high interest of a subjective sense of well-being<sup>[19,20]</sup>.

Some female's informants mentioned that herbalists were very careful about the possible negative effects that some herbs/plants could have on the foetus or expecting mothers, and advised them which species to use during pregnancy. In addition, it was observed that pregnant women preferred to employ TCM that have been used by their ancestors for decades. Some females participants also quoted that they were guaranteed to be cured with the TCM. Such practices were also common for diseases during the postpartum period.

Sino-Mauritians were observed to have profound knowledge on the mode of preparation and administration of herbal remedies. The most suggested methods of preparation of herbals/botanicals were decoctions and infusions, while the most frequent route of administration was oral. This suggests that traditional know-how on the identification of medicinal herbs, its method of preparation and administration was transmitted from generation to generation and this wisdom and awareness has been well preserved by the Chinese community throughout the years.

Interestingly, place of residence of informants was found to have no significant bearing on the use of NRs. Chinese communities from both rural and urban areas were well acquainted to the use of NRs. This may be linked with the fact that similar health facilities are provided in both rural and urban areas by the government. Therefore, the decision of using NRs as an alternative to CM is entirely based upon the users' personal choices and preferences as reported previously<sup>[20]</sup>.

It was reported that the use of NRs by Sino-Mauritians were mostly influenced by family traditions although many claimed that they had started using NRs following advice from friends and peers. Some reported to have been influenced by media such as health magazines and documentaries. Besides, a positive correlation was found between both age and level of education and preference of NRs over CM. This is in line with previous data which showed that as level of education increases, use of alternative medicine also increase<sup>[18]</sup>. It can also be proposed that respondents who had a preference for NRs over CM found it to be more effective than CM.

Animal-based remedies were found to be an important part of TCM practiced in Mauritius. According to Alves *et al.*, there are varying opinions and documentation on the effectiveness of such remedies<sup>[21-25]</sup>. The categories of diseases with the greatest  $F_{IC}$  values were diseases of the circulatory system, diseases of the skin and subcutaneous layer and endocrine, nutritional and metabolic diseases. Six different animal species scored high FL values which tend to show that most animal species in each category

were important. The two most highly used species were *Gallus domesticus* and *Bos taurus*. This may be attributed to the easy availability of these two species in Mauritius. None of the informants reported that zootherapy was safe to use and the only reason that other people ignoring to use animals as therapies was due to the dearth of information about it. Given a low exposure, people therefore tend to rely more on CM.

The knowledge and use of herbal/botanical remedies was more popular in the Chinese community in Mauritius as compared to knowledge and use of zootherapy. It was observed that the Sino–Mauritian males of 50 years and above had an impressive awareness of the plants and herbs used in TCM of Mauritius. Data collected from them reflected that traditional knowledge had been cautiously preserved throughout the years. The main reason of not using herbal/botanical remedies was cited as being a lack of knowledge on the subject, which was mostly agreed upon by the users of NRs. They believed that more people would definitely use NRs if they were more aware of its benefits. This is supported by the work of Picking *et al.*, illustrating that lack of knowledge was the main reason cited by non–users of herbal medicine[26].

In the present study, various parts of plants were found to be used for the herbal formulations, with leaves being the most frequently used plant parts. The reason for this is possibly the higher concentration of active agents in this part of the plant. This may arise from the fact that leaves act as reservoirs for photosynthesis or exudates that are thought to contain toxins for plant protection and survival, which consequently be of medicinal values in human health. Interestingly, the work of Nadembega *et al.* also showed that leaves were used in highest proportion[27]. Most people preferred to use fresh plants for concocting remedies, while others incorporated these into their meals so as to promote good health.

A total of 61 plant species used to treat 13 different categories of diseases were recorded in this study. Based on the importance of species known locally (*i.e.* use values), *Chrysanthemum indicum*, *Cymbopogon citratus*, *Lonicera japonica*, *Myroxylon balsamum* and *Zingiber officinalis* were found to be the most used species by the informants. Other important species used by the informants were *Verbena officinalis*, *Azadirachta indica*, *Nelumbinis nuciferae*, *Cinnamomum cassia*, *Panax ginseng* and *Syzygium aromaticum*. All these plant species were well–recognised by people of the Chinese community in Mauritius and use of these species was widespread.

One of the species widely quoted by the informants is *Cymbopogon citratus* (lemongrass) used against respiratory diseases, and interestingly Bahtiar *et al.* has recently showed that the solvent fraction possessed good antiviral activity and is used against fever[28]. Also *Cymbopogon*

*citratus* is a well studied medicinal plant and the essential oil (includes mircene, neral, geranial, and other unidentified compounds) has been documented to be used for fighting colds, dysentery, headaches, and also as a tranquilizer and antispasmodic, besides its antimicrobial activity[29]. Recently, oils of *Cymbopogon citratus* and *Syzygium aromaticum* (clove) have been reported to be used in traditional practices of many ancient cultures. In Ayurveda, the traditional system of healing in India, lemongrass oil is used to treat hypertension, fever, stomach disorders, and to reduce pain and inflammation associated with rheumatism, cold and flu, and bacterial and fungal infections of throat, urinary and vaginal tract. Similarly clove oil has been used in treatment of toothache and as a carminative, anaesthetic, and it is also used as an antimicrobial for oral and skin infections. Studies have reported the presence of citral, geraniol and myrcene as major active constituents in lemongrass oil and eugenol predominates in clove oil. These essential oils have been recommended as home remedies for treatment of oral and vaginal fungal infections by numerous publications. Scientific literature has also shown that these oils and its active constituents (citral, geraniol and eugenol) possess antifungal activities[30]. Additionally, the effect of essential oils of *Cymbopogon citratus* and *Syzygium aromaticum* has been recently reported to have anti–biofilm activity against strong biofilm forming strains of *Candida albicans*. Most of the *Candida albicans* strains tested displayed formation of moderate to strong biofilms and the essential oils of *Cymbopogon citratus* and *Syzygium aromaticum* were more active against preformed biofilms compared to amphotericin B and fluconazole[30].

Another plant quoted by informants from the present study is *Zingiber officinale* which was used mostly against respiratory ailments. Reported data also showed strong anti–candida activity of *Zingiber officinale*, which may be used for infectious diseases. However, in the present study the plant was solely used for respiratory infections which might be due to the presence of gingerol which has good scavenging activity[31].

*Chrysanthemum indicum* L. is an important medicinal plant spreading widely in Korea, native of China and Japan, and occasionally grows in Indian gardens for its ornamental multi–colored flowers. It has also been reported to possess inhibitory activity against bacteria and viruses, and it has been used in oriental traditional medicine to treat several infectious. Traditionally, *Chrysanthemum indicum* has been reported for treatment of pneumonia, colitis, stomatitis, cancer, fever, vertigo, pertussis, hypertensive symptoms, inflammation and parkinson’s diseases, and has also been used as antibacterial (oral bacteria) agent[32,33].

Flowers and buds of *Lonicera japonica*, commonly known as ‘Jinyinhua’ in Chinese traditional medicines,

are used for treatment of affection by exopathogenic wind–heat or epidemic febrile diseases at the early stage, sores, carbuncles, furuncles and swellings. The plant has been reported to possess properties of clearing heat and detoxicating, removing heat from the blood and arresting dysentery. Several pharmacologically active secondary metabolites have been isolated from *Lonicera japonica*, namely, essential oil, saponins, terpenoids, flavones and phenolics<sup>[34]</sup>.

The present study has endeavoured to collect, preserve and document primary ethnopharmacological information on common NRs used by the Chinese community to treat and/or manage common diseases in Mauritius. It was found that the Chinese community of Mauritius still relies to a great extent on NRs which need to be preserved and used sustainably. Medicinal plants from the tropical island of Mauritius were found to be of particular importance for the Sino–Mauritians as it provides primary health care to them. Among the plant species, Asteraceae is the most used family probably because of the presence of terpenoid essential oils, alkaloids and tannins. However, many of the species recorded lack phytotherapeutic evidence. Further pharmacological evaluations of *Chrysanthemum indicum*, *Cymbopogon citratus*, *Lonicera japonica* and *Myroxylon balsamum* deserve considerable attention.

### Conflict of interest statement

We declare that we have no conflict of interest.

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### Comments

#### Background

TCM is one of the world's oldest documented medical systems mainly based on herbal and animal medicines. It has spread all over the world and it is recognized as a popular complementary and alternative medicine. Plant secondary metabolites include an array of bioactive constituents which are able to improve human health. The results of ethnobotanical studies can be an important source to start further research to discover new drugs.

#### Research frontiers

This piece of research can be considered to be of great

importance as alternative medicines are gaining much popularity.

#### Related reports

This is the first report from the island of Mauritius to document alternative medicines used by the Chinese community. The authors have used important and up-to-date quantitative ethnobotanical indices to interpret primary data collected. Also, for ease of documentation, reported diseases and health complications were classified in 13 categories based on the International Classification of Diseases.

#### Innovations and breakthroughs

This is the first documentation from Mauritius. The pharmacological activity of many plant species used in TCM have been evaluated. Authors have discussed the phytopharmacological properties of important medicinal plants used by the Chinese community.

#### Applications

The documentation of the uses of alternative and indigenous systems of medicine can provide information on new or scarcely reported properties of medicinal plants, which deserve further pharmacological studies. Results have established baseline data on native remedies used in Mauritius, and it can open avenues for further pharmacological assays.

#### Peer review

This is a potentially interesting work which have been conducted to collect, preserve and document primary data on common natural remedies used by the Chinese community to treat and/or manage common diseases in Mauritius. Since there has been no previous report on such documentation, this work can provide an opportunity to establish valuable primary information on the different remedies used by the local people and hence open new perspectives for further pharmacological research.

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