An Ethnobotanical study: A Record of the Traditional Uses of Common Medicinal Plants on Malapascua Island, the Philippines.

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Abstract: Wild plants have proven medicinal value for various diseases. Conservation of these types of plants is becoming increasingly important due to the recent surge of antibiotic resistance. Information regarding local healing practices using plants must be documented, before such valuable information becomes inaccessible and extinct. Due to limited information regarding plant use by the indigenous people of Malapascua Island, this research aims to investigate and document the traditional local knowledge of edible wild plants commonly used among the community. Data on plant usage was obtained by means of a questionnaire, which was distributed in the northern and southern regions of the island. A total of 55 people were interviewed, they referred to 52 plants species from 34 families, the most commonly used plant species were; A*nnona squamosa, Origanum vulgare,* and *Moringa oleifera*, these species had high use values, diverse use categories, and were abundant on the island. 56% of all informants preferred using medicinal plants, while 44% preferred using synthetic drugs. The north of the island preferred using synthetic drugs, but used medicinal plants more often; while the south preferred using medicinal plants, but used synthetic drugs more often. This study demonstrates that many plant species continue to play a role on the island of Malapascua, but that the availability of modern products such as synthetic drugs are influencing this use, and also contributing to the resistance of drugs on the island.

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1. Introduction

Plants are regularly used as a source of food, as pest control, as narcotics, and also as part of religious rituals; they have been used for medicinal reasons since ancient times. The first piece of medicinal plant evidence exists on a Sumerian clay slab from Nagpur approximately 5000 years ago which contained a list of 12 herbal recipes; this encouraged man to experiment with plants in the following centuries in search for medicinal properties potentially found in the barks, seeds and fruit bodies of plants in order to cure to common illnesses (Petrovska, 2012). Throughout the advancement of civilizations, the benefits of specific plants were identified, noted, and reported to succeeding generations (Kalisdha, 2013) until the advancement of iatrochemistry in the 16th century (Petrovska, 2012).

Scientifically, plants provide us with the basis of a vast amount of biological research; specifically playing a vital role within the pharmaceutical industry. Developing countries use approximately 90% of chemicals derived from plants in their pharmacopoeial, non-pharmacopoeial and synthetic drugs, in contrast to developed countries which only use 25% of material derived from plants in their pharmaceutical products (Sofowora, 2013). Today 50,000 of 422,000 flowering plants are still being used by approximately 80% of the worldwide population in order to fulfil their health needs (Schippman, et al., 2002), with the majority of medicinal plants being traded from India and China.

Recently there has been a growing awareness of the potential nutritional and medicinal value of wild plants; this is the result of a better understanding and interest in personal health, which has increased the usage of supplementation of plant products, which have specifically become more popular in the treatment of minor ailments (Sofowora, 2013).

Conservation of ethnobotanical knowledge is becoming increasingly important due to a surge of synthetic drugs being used globally, resulting in multi-drug resistant bacteria such as *Staphyloccocus aureus*, *Escherichia coli* and *Psuedomonoas aeruginosa,* which are all methicillin resistant. This issue has generated an interest in finding alternative medicinal remedies and utilization of biological resources such as those reported from plants. (Abdulkadir, et al., 2015).

In the Philippines health supplement purchases had grown by 40.35% in only 3 years from 2008-2011; meanwhile food products sourced from medicinal plants had grown 13% in the same year. There are two main categories for plant products, these consist of: natural ingredients e.g. essential oils, and finished products e.g. herbal medicines. Since 2011 there has been a continuous annual increase in the exports of medicinal plants, suggesting increasing demand for these products. The government recognises 10 plant species as containing therapeutic value; they have been approved by the department of health (GOV, 2016). In recent years countries the Philippines have developed economically which has led to an increased usage of western medicine (Abe and Ohtani., 2012), which suggests unrecorded traditional medicinal practices may be lost, hence it is important existing medicinal plants in these countries are surveyed and recorded while still possible.

The objective of this study is to investigate whether plants play a medicinal role in the community of Malapascua Island, as there is no previous research documenting any use. The main focus is to identify plants containing medicinal properties that are used by the local community, how they are currently being used, and what they are used for. Possible associations between the individuals surveyed and their preference of using medicinal plants or synthetic drugs was investigated, in order to further understand the reason behind the use and effectiveness of medicinal plants. This was determined by analysing their occupation, age, gender and residency on the island (North and South); I will also briefly investigate what synthetic drugs are available on the island and whether this plays a part in local medicinal plant use.

The hypotheses were: (1) there will be plants with medicinal properties found on Malapascua Island; (2) medicinal plant use is declining and this will be correlated to a number of factors including; availability of modern medicines, age of individual, and the wealth of locals; (3) there will be a wealth of traditional knowledge of these plants amongst communities; (4) the older generation (51+ years old) will prefer using medicinal plants rather than synthetic drugs; (5) this use will have affected garden cultivation on the island.

2. Methodology

2.1 Study site

Research was conducted on Malapascua Island in the Philippines (figure 1), located close to the north tip of Cebu Island. The area of the island is 600 ha (2.5km by 1km) and has a population of 11,000 people. The island is mainly known for its diving, as one of the only places to observe thresher sharks and manta rays. As observed in figure 1, there are 9 small municipalities (locally known as sitios) on the island known as; Barrio, Tawaigan, Indonacion, Guimbatayan, Kalubi-an, Pasil, Kabatangan, Bakhaw and Bool located in order from the Southern region to the Northern region, with very few residences in the middle region of the island. Many of the locals derive their livelihood from tourism in the South, whilst locals in the North mainly rely on subsistence fishing and farming as their source of income. There is one health clinic on the island; currently there is no pharmacy available, although locals can purchase many synthetic drugs and products from the majority of stalls and shops on the island, the nearest hospital is located on the neighbouring island.

This study was carried out in partnership with a local marine conservation organisation; People and the sea (11°19'48.1 N 124°06'51.2 E). Topography varies considerably throughout the site, with differences in elevation and slopes mainly in the Northern region of the island. The climate during which the research was carried out was a dry savanna climate, the mean temperature during this period was 29^{o}c, and the mean precipitation was 3.5mm. The habitats on the site are mainly occupied by dry savanna and tropical dry shrub land, plant life is majorly abundant in the middle and Northern regions of the island, whilst plants in the Southern region are widely cultivated in residents' gardens.

Fig. 1. Location and aerial photographic map of Malapascua Island, containing labels of sitios.

2.2 Data collection

Fieldwork was carried out over a three week period (29-05-17 to 19-06-17). For the purpose of the research analysis, the island was theoretically split into Northern (Kabatangan and sitios above this) and Southern (sitios below Kabatangan), in order to later investigate associations, frequency and preferences which may have correlated with the location in which the informants' resided in. Interviews were conducted by a team of staff from People and the sea in the local language, i.e. Bisayan, and later translated. Additional information regarding the oldest medicinal plants used and recipes were provided by the local healer (herbalist) known as the 'quack doctor'.

The informants were initially asked to fill out their personal details including name, age, occupation and what sitio they resided in. They were then asked a number of questions regarding their knowledge of medicinal plants, which included the following information: (a) whether they currently used any plants to combat disease; (b) if so, to identify these plants and what treatment they were used for; (c) the parts of the plant used (stem, flower, leaves, bark, seed and root); (d) the modes of preparation (boiled, dried, and fresh); (e) if they cultivated any plants in their gardens or sourced plants from the wild; (f) whether they used any synthetic drugs and to identify them; the last section of the questionnaire regarded (g) what form of healthcare (medicinal plants or synthetic drugs) they preferred using and why. All plants that were mentioned by informants were available on the island.

30 questionnaires (sample as seen in appendix 1) were distributed in the North, and 25 questionnaires in the South of the Island, all informants were also informally interviewed to obtain maximum information, the sampling was intentionally random. A total of 55 people were interviewed (49 females and 6 males) aged between 17 and 82, with a median age of 47. Additional information regarding synthetic drugs was mentioned by 2 local shop owners who were informally (without the use of a questionnaire) interviewed, and identified the common types of drugs available of the island.

Plants were identified by locals who provided species vernacular names, plant samples and pictures were also used to help determine common names of species. Undetermined species were researched and checked against references from various cited sources such as; 'the complete updated list of Philippine medicinal plants' on Stuart exchange (Godofredo, 2017), and 'the medicinal plants of the Philippines' on Gutenberg organisation (Pardo De Tavera, 2008). Certain plants were also collected, pressed and stored in ethanol for detailed descriptions of characteristics to be observed and for future work.

20 of the common plant species that were observed from the questionnaires and interviews were identified by locals along the major pathways of the southern region of the island. The plants were then located using a Garmin handheld device (ETrex GPS Birds Eye Select), which produced global positioning system (GPS) coordinates.

2.3. Data analysis

A table (table 1.) was created as a catalogue of all the plants identified by locals using the information provided from the questionnaires. The plants mentioned were further categorised into taxonomic family groups of each species; what part of the plant was used as part of treatment; what use category (symptoms mentioned by informant were grouped with associated diseases) out of a possible 16 groups; and how the plant was prepared and administered during use.

Use value (UV) was calculated for each plant species, in order to provide a quantitative measure for the amount of times each plant was mentioned, and to demonstrate the relative importance of the species known locally. This measurement was calculated with the use of the equation UV = $(\sum Ui)/n$, where U_i signifies the number of use-reports (proportion of plants cited) by the informants; and n signifies the total number of informants surveyed (n=55) (Abe and Ohtani, 2012).

A chi (x^2) squared test was used in order to analyse any significant differences between what preference each of the informants had chosen (medicinal plants or synthetic drugs), this was tested against the age of informants (51 and above, and 50 and below) to observe whether the older generation (51 and above) used medicinal plants more than the younger people of the island (50 and below). The location of the informants (north and south) was also tested, in order to observe whether wealth and availability of modern medicine affected medicinal plant use of these informants.

3. Results

The study reveals that 100% of the total number of informants interviewed (n=55) had knowledge of medicinal plants, and all informants had used or currently still use plants as part of their health regime, the majority of these informants used medicinal plants in combination with synthetic drugs to combat various diseases.

The frequency of the informants' medicinal plant use was not documented. Housewives represented the majority of the informants' occupations at 33%, 4% of informants were fishermen, 3% of informants were housekeepers and chefs, the following represented 2% of total informants; laundrette, fish vendors, therapist and dressmakers. The following represented 1% of total informants; teachers, bodyguards, waitresses and students.

4 of the informants were represented by men; the remaining 51 informants were female. Due to these results no assumptions could be made regarding associations between preference and gender and occupation of the informants.

10 informants in the Northern region cultivated their own medicinal plants in their gardens (18.2%), and 20 people (36.4%) used wild resources. 14 informants (25.4%) in the Southern region cultivated their own medicinal plants while 11 people (20%) used wild resources.

53 plants were mentioned in total, although 1 species (*Theobroma cacao*) was removed from this list as it has never been cultivated on the island, and therefore cannot be identified as a 'commonly used and obtained from Malapascua island'. All 52 species included in the table had medicinal and nutritional value, and 26 species were also used as a common food source for locals.

Two plants (*Rhizophora stylosa* and *Crescentia cujete*) within the table were informally mentioned (without a questionnaire) to myself by some locals, these plants were still input into the table as many people had mentioned the benefits of these plants but, in the case of *Rhizophora stylosa (Mangrove)*, these are only available in the South of the island and were used traditionally to treat snake bites, which are quite rare on the island. In the case of *Crescentia cujete*, there is currently only one species remaining on the island as this was cultivated in the informants' garden.

Table 1. Inventory of local knowledge and uses regarding medicinal plants on Malapascua Island, the Philippines.

Plant No.	Common Name	Scientific Name	Vernacular Name(s)	Family	Parts Used[a]	Use Category[b]	Prep.[c]	Admin.[d]	Use Value[e]
1	Aloe vera	*Aloe barbadensis mill.*	Sabila	Liliaceae	L	BURN, DERM	F	Topical	0.05
2	Asthma plant	*Euphorbia hirta*	Tawa-Tawa/ Mangagaw	Euphorbiaceae	L	RESP, DGF, VIR	B	Oral	0.2
3	Avocado	*Persea americana*	Avocado	Lauraceae	F	BWL, DIA, GAST	F	Oral	0.1
4	Bamboo sprout	*Bambusa spinosa Roxb*	Dabong	Poaceae	R	VIR	F	Oral	0.02
5	Beechwood	*Gmelina arborea*	Gmelina	Lamiaceae	B, F, L, R	GAST, OST, VIR	F	Oral, Topical	0.02
6	Bitter melon	*Momordica charantia*	Ampalaya	Cucurbitaceae	F, L, R	DERM, RESP, VIR	F	Oral	0.2
7	Calabash tree	*Crescentia cujete*	Miracle fruit	Bignoniaceae	F, L	DERM, GAST	F	Oral	0
8	Caricature plant	*Graptophyllum pictum*	Atay-atay	Acanthaceae	L	DERM, VIR	F	Topical	0.02
9	Carrot	*Daucus carota*	Karot	Apiaceae	F	BWL, DERM	F	Oral	0.04
10	Chinese chasetree	*Vitex negundo L.*	Lagundi	Verbenaceae	B, L, R, S	VIR	B, F	Oral	0.1
11	Chinese hibiscus	*Hibiscus rosa-sinensis L.*	Red Gumamila	Malvaceae	F, L, R	DERM, GAST	B, F	Oral	0.02
12	Common barley	*Hordeum vulgare*	Barley	Poaceae	L	DIA	F	Oral	0.02
13	Common indian mulberry	*Morinda umbellata*	Nino	Rubiaceae	L, R	GAST	F	Topical	0.04
14	Cottonfruit	*Sandoricum koetjape*	Santol	Meliaceae	B, L, R	DERM	F	Oral	0.02
15	Drumstick tree	*Moringa oleifera*	Malunggay	Moringaceae	L	BWL, DENT, OST, VIR	B, F	Oral, Topical	0.5
16	Fish poison tree	*Barringtonia asiatica*	Botong	Lecythidaceae	L, S	DERM, VIR	B	Topical	0.02
17	Five fingers	*Schefflera odorata*	Lima-lima	Araliaceae	L	UTI	F	Oral	0.02
18	Fragrant premna	*Premna odorata*	Alagaw	Lamiaceae	F, L	BWL	B, D, F	Oral, Topical	0.04
19	Frangipani	*Plumeria rubra*	Kalachuchi	Cucurbitaceae	B, F, L	DENT, DERM	F	Oral	0.05
20	Garlic	*Allium sativum*	Ajos	Liliaceae	F	DIA	F	Oral	0.04
21	Garuga tree	*Garuga floribunda*	Bogo	Burseraceae	B	DERM, GAST, MEN	F	Oral	0.02
22	Giant pumpkin	*Cucurbita maxima Duchesne*	Kalabasa	Cucurbitaceae	F, R, S	OPT	F	Oral, Topical	0.02
23	Ginger	*Zingiber officinale*	Luya	Roscoe	R	VIR	F	Oral	0.04
24	Guava	*Psidium guajava*	Bayabas	Myrtaceae	L	BWL, DERM, GAST, VIR	F	Oral, Topical	0.3
25	Hauili fig tree	*Ficus septica*	Lagnob	Moraceae	L, R	DERM, GAST	F	Oral, Topical	0.02
26	Indian patchouli	*Pogostemon heyneanus*	Kadlum	Lamiaceae	L, R	GAST, RESP, VIR	F	Oral	0.02

Table 1. (Continued)

27	Jatropha plant	*Jatropha curcas*	Tuba-tuba	Euphorbiaceae	B, L, R, S	DENT, DERM	B	Oral	0.02
28	Latundan bananas	*Musa acuminata × Musa balbisiana*	Saging Tundan	-	F, L, R	BWL, DERM	F	Oral	0.04
29	Lemon	*Citrus limon*	Limon	Rutaceae	F	ANE, DIA	F	Oral	0.04
30	Lemongrass	*Cymbopogon citratus*	Cymbopogon/Tangad	Poaceae	L	DIA	B	Oral	0.2
31	Madagascar periwinkle	*Catharanthus roseus*	Kumintang	Apocynaceae	F	BWL, DERM, MEN, VIR	F	Oral	0.02
32	Mahoganey	*Toona calantas*	Mahugani	Meliaceae	B, S	BWL	F	Oral	0.02
33	Malabar spinach	*Basella alba*	Alugbati	Basellaceae	F, L	BWL, DERM	B, F	Topical	0.1
34	Milayan lilac	*Callicarpa candicans*	Tigau	Lamiaceae	L, R	DERM, VIR	F	Oral, Topical	0.02
35	Molave tree	*Vitex parviflora*	Tugas	Lamiaceae	L	GAST	B	Oral	0.05
36	Moon creeper	*Tinospora crispa*	Panyawan	Menispermaceae	L	DIA	B	Oral	0.04
37	Oregano	*Origanum vulgare L.*	Kalabo	Lamiaceae	L	RESP, VIR	F	Oral	0.5
38	Pignut	*Hyptis suaveolens*	Baboy-baboy	Lamiaceae	L, S	GAST	F	Oral	0.02
39	Pink trumpet tree	*Handroanthus impetiginosus*	Pau d'arco	Bignoniaceae	L	BWL, GAST, KID, VIR	F	Oral	0.04
40	Pipinella	*Sechium edule*	Chayote/Sayote	Cucurbitaceae	L	DIA, VIR	B, F	Oral	0.05
41	Red date	*Ziziphus jujuba Mill.*	Manzanitas	Rhamnaceae	L	BWL, GAST	F	Oral	0.1
42	Sambong	*Blumea balsamifera*	Gabon	Compositae	L	BWL, RESP, VIR	B, F	Oral	0.3
43	Shiny bush	*Peperomia pellucida*	Sinaw-sinaw	Piperaceae	L	DIA	F	Oral	0.02
44	Soursop	*Annona muricata*	Sabana/Goyabano	Annonaceae	L, F	BWL, DIA, GAST	F	Oral	0.1
45	Spanish plum	*Spondias purpurea*	Siniguelas	Anacardiaceae	B, F	BWL, GAST, VIR	F	Oral	0.02
46	Star apple	*Chrysophyllum cainito*	Caimito	Sapotaceae	B, F, L, S	BWL, VIR	F	Oral	0.02
47	Stilted Mangrove	*Rhizophora stylosa*	Mangrove	Rhizophoraceae	B, L	DERM	F	Topical	0
48	Sugar apple	*Annona squamosa*	Ates	Annonaceae	F, L, S	DERM, VIR	B, F	Oral, Topical	0.5
49	Sweet potato	*Ipomoea batatas*	Camote tops/Gay	Convolvulaceae	L	ANE, DIA	F	Oral	0.07
50	Tropical almond	*Terminalia catappa*	Talisay	Combretaceae	B, F, L	BWL, DENT, GAST	F	Oral	0.02
51	White leadtree	*Leucaena leucocephala*	Batelis	Fabaceae	S	MEN, PAR	F	Oral	0.02
52	Wild mint	*Clinopodium douglasii*	Hierbas/Yerba Buena	Lamiaceae	L	GAST	F	Oral	0.04

Table 1. (Continued)

[a] Parts used of the plant: (B) Bark, (F) Flowers, (L) Leaves, (S) Stem, and (R) Root.
[b] Use categories (what type of diseases or ailments informants used plants for): ANE = anaemia, BURN = burns, BWL = bowel related problems such as; irritable bowel syndrome, diarrhea, and constipation. DENT = dental related problems such as; tooth aches and ulcers. DERM = dermatological reasons such as; boils, wounds or general skin health. DGF = to prevent and treat dengue fever (mosquito-borne tropical disease common on island, which causes symptoms such as; high fever and skin irritation). DIA = diabetes and high blood pressure. GAST = gastrointestinal problems such as; indigestion, bloating, stomach aches and vomiting. KID = kidney health. MEN = menstrual cramps. OPT = optical/eye health. OST = osteopathic problems such as; arthritis and joint pain. PAR = removing parasites e.g. worms. RESP = respiratory problems such as; cough, asthma and bronchitis. UTI = urinary tract infection. VIR = treatment of viral symptoms such as; cold, fever, headaches and sore throats.
[c] Preparation of plant as treatment = (B) boil, (D) dried and (F) fresh.
[d] Administration (how to use plant) = orally digesting plant parts or via topical use (using directly onto affected area of skin).
[e] Use value (UV) was calculated by using the sum of use reports by each informant for the given species which was then divided by the total number of informants.

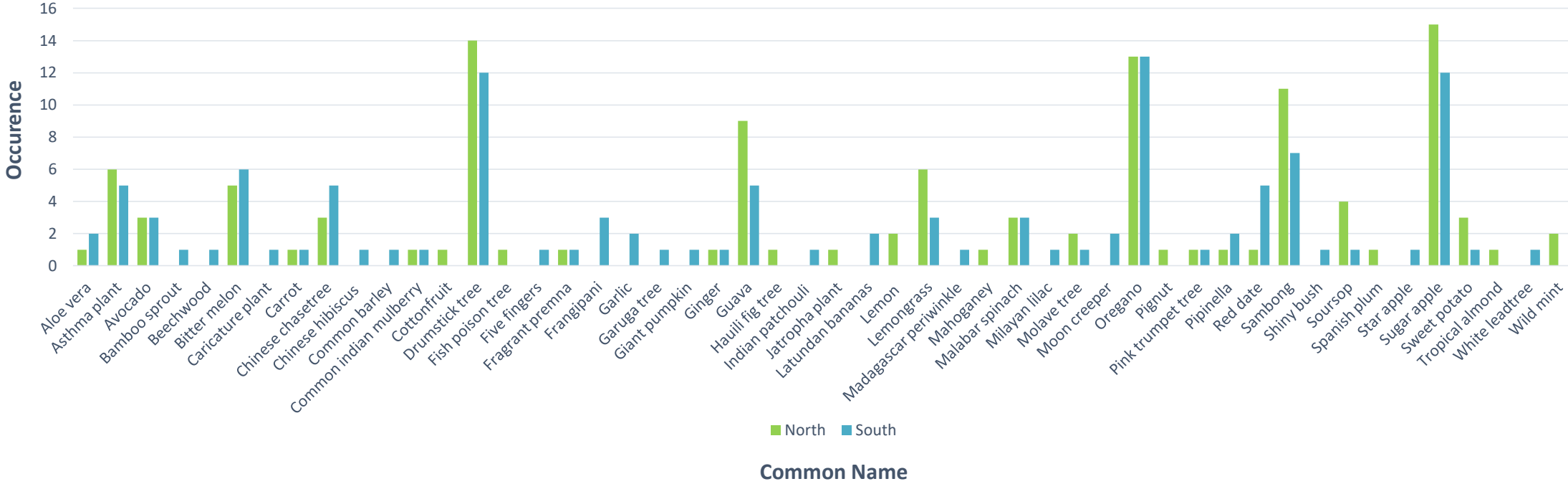

Fig. 2. Graph representing actual use-reports of medicinal plant species, mentioned by informants.

3.1. Map of Plant Occurrence

Fig. 3. Map representing coordinates of some medicinal plants observed in table 1.

Codes (from top to bottom): IMB = India mulberry. ALV = Aloe vera. MLV = Molave tree. ASM = Asthma plant. AMD = Tropical almond. SBG = Sambong. MPR = Madagascar periwinkle. MGV = Stilted mangrove. LMG = Lemongrass. STA = Star apple. CHS = Chinese chasetree. SUP = Sugar apple. GUV = Guava. ORG = Oregano. FGI = Frangipani. CBT = Calabash tree. DST = Drumstick tree. WLD = White leadtree.

Many of the plants observed during the conducting GPS were abundant on the south of the island; this excluded the Calabash tree, and Sambong; although this may differ in the north of the island. All the 'medicinal plants of interest' were observed to be highly abundant across the island.

3.2. Medicinal Plant Diversity

Of the total plants (n=52) mentioned in table 1, 18 species were indigenous to the Philippines (34.6%), while 34 species were endemic to other countries (65.4%), of which the majority of plants were naturalized as weeds or they were cultivated on the island many centuries ago, mainly for ornamental purposes. 45 of these species were dicotyledons (86.5%), while only 7 species were monocotyledons (13.5%). The majority of the growth habits were in the form of trees, as 25 species were part of this group (48.1%), 9 of the species were shrubs, 9 species were vines (17.3% each), 8 of the plants were herbs (15.4%), and the remaining plant (*Hordeum vulgare*) is a weed (1.9%). 34 family groups were observed, the most dominant family containing medicinal plants belonged to Lamiaceae, which had 8 plants in total; followed by Cucurbitaceae which contained 4 medicinal plant species, closely followed by Poaceae which contained 3 species, the following species each had 2 plant species belonging to their family group; Liliaceae, Meliaceae, Euphorbiaceae, Bignoniaceae, and Annonaceae. The remaining families were represented each by one species.

The Lamiaceae family is one of the largest and most diverse of the plant families with regards to plants containing medicinal properties, which are based on the volatile oils concentration within the plant. A study by Venkateshappa and Sreenath (2013) cites the most common plants as containing medicinal properties from the family of Lamiaceae, observed in table 1; *Oreganum vulgare* and *Hyptis suaveolens,* which corresponds with the data collected. In a study by Dhiman, et al (2012), one of the plants reported in table 1; *Mormodica charantia* (of the family Cucurbitaceae) is classed as one of the most important plants due to its diverse medicinal abilities, which corresponds with the data collected.

3.2.1. Plant parts used

Informants mentioned various parts of each plant that provided different benefits, on most occasions informants' used a combination of parts as part of their use. As observed in figure 2, the most frequently used part of the plant was the leaves, of which 40 (43%) species were referred to; followed by flowers which was used by 18 (20%) species; 14 (15%) species used the roots of the plant; 11 (12%) species used the bark; and 9 (10%) species used the stem.

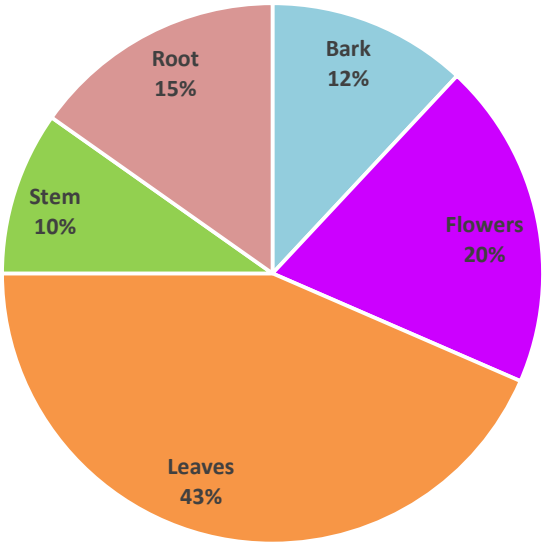

Fig. 3. Pie diagram representing main parts used of the plant during medicinal applications on Malapascua island.

3.2.2. Use Category

Out of the 16 categories, the most dominant category and therefore what many informants used plants for, was for viral problems such as; fever, cold, headaches and sore throats. This was closely followed by the dermatological category which included problems such as; boils, wounds and general skin health. Gastrointestinal, bowel and diabetic related problems also contributed to a large proportion of the informants' main uses of medicinal plants; while respiratory, dental, menstrual, osteopathic, and anaemia were amongst the smaller proportion of diseases which contributed to the overall chart.

Certain diseases were only mentioned once by informants, such as; burns, dengue fever, kidney problems, optical health, urinary tract infections, and parasitic issues (de-worming). These use results were most likely related to frequency and rarity of these types of diseases, in comparison with viral symptoms which are easily spread amongst communities via direct contact with infected persons and objects, therefore creating a higher probable frequency.

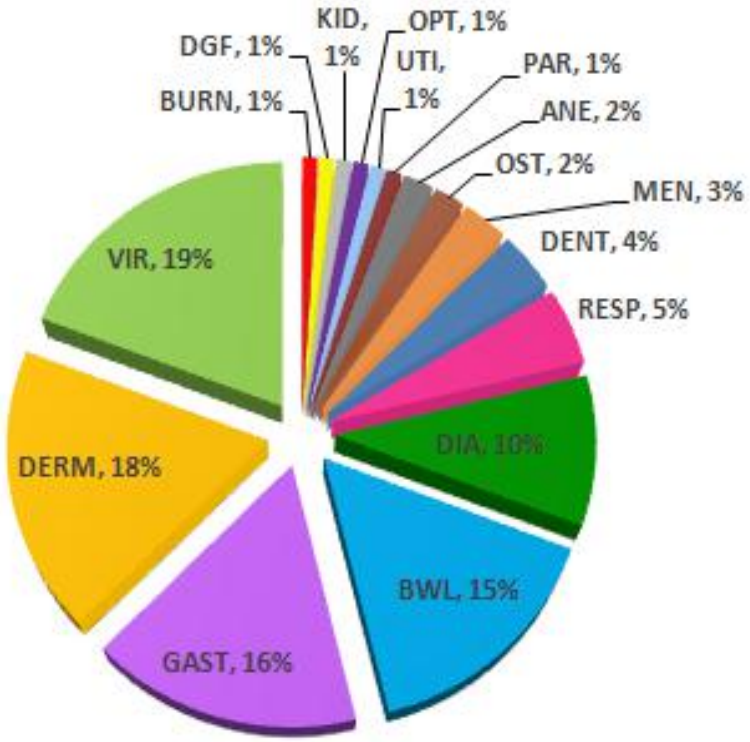

Fig. 4. Pie diagram showing percentage values of each use category.

3.2.3. Preparation and Administration

45 species were used fresh, 14 species were able to be boiled, and only 1 species was able to be used dried. 8 plants within the total had various methods of preparation (a combination of 2 or 3 of the preparation methods). This corresponds with information regarding boiling food which has been known to remove nutritional significance from that food, in contrast to fresh forms of the same food; this may also be indicative of using medicinal plants, which are likely to lose their medicinal value after the initial extraction from the root. The main route of administration was orally (internally) with 38 species (73.1%) solely using this method. Only 6 (11.5%) plants were used directly onto the skin (topically/externally), and 8 (15.4%) species were able to taken both ways. Both routes of administration are equally beneficial, the explanation for the oral method to be preferred, is probably due to the ease of this process; many informants claimed they infuse the leaves of the specific plant in hot water, which is much easier than using the plant topically. This is also dependant on what disease the plant is used for, internal problems will correlate with oral transmission in contrast to dermatological problems which can be healed rapidly with the application of a thick substance e.g. a latex property of a plant such as *Aloe barbadensis mill.* Which is easy to apply directly onto the skin.

3.2.4. Use Value

Use values were rounded up to the nearest significant figure. The plant containing the highest use value, as observed in table 1 was the sugar apple (*Annona squamosa*) (0.49) which had 27 use reports, specifically by 15 and 12 informants in the North and South, respectively. This was closely followed by Oregano (*Origanum vulgare*) (0.47) and the Drumstick tree (*Moringa oleifera*) (0.47) which both had 26 reports, Oregano specifically had use reports by 13 informants in both the North and South, while the Drumstick tree had 14 and 12 use reports in the North and South, respectively. The lowest use values were calculated at 0.02 by 22 species which were each only mentioned by 1 informant.

These high use values were due to a number of factors such as;

- High abundance of all plants over the island, in both North and South regions and therefore easily accessible.
- High diversity of category ailment treatment of *Moringa oleifera*, which allows informants to use the plant as treatment for many different diseases.
- Ability to use two of the species; *Annona squamosa and Moringa oleifera* internally and externally, this is beneficial for diseases that have dermatological side effects, which provide combined treatment methods for the individual.
- Traditional use by older generations provides reliable knowledge and experience, and therefore locals are more likely to use these species of plants.

3.3. Preference and Associations

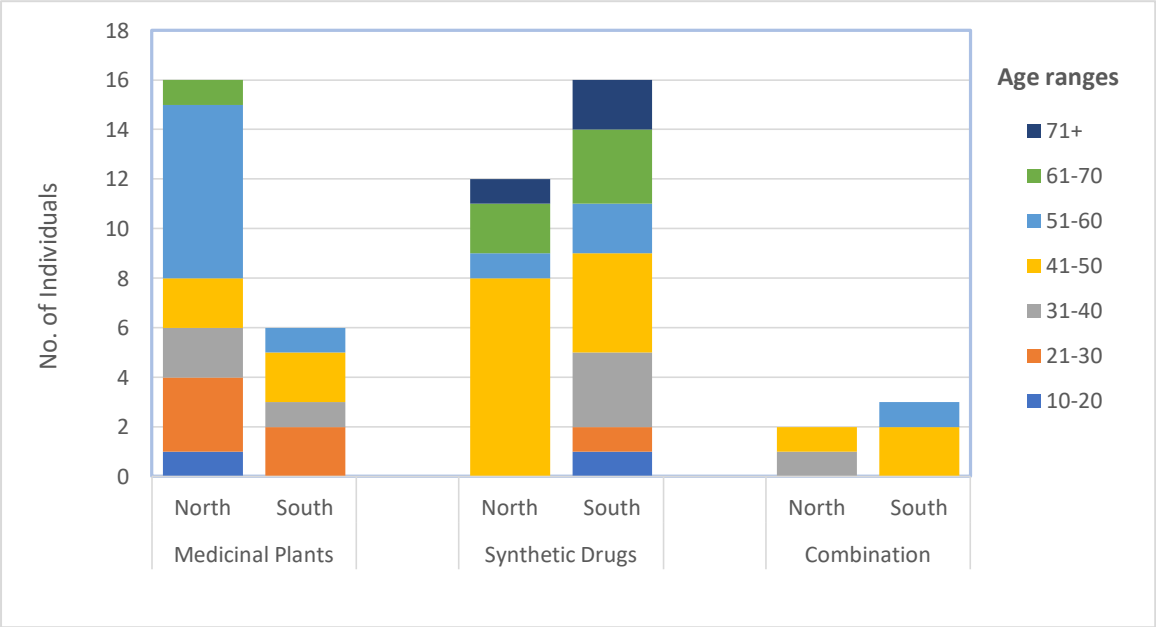

Fig. 5. Graph representing the number of individuals in each age group (coloured) and how many people preferred medicinal plants, synthetic drugs or a combination of both as part of their health regime.

The chi squared (X^2) test results showed no significant difference between preferences and the 50+ and below 50 age groups, the observed and expected values represented the same values.

The results represent the following number of informants and what age group they were in, to prefer using medicinal plants in the North of the island: 1 (10-20), 3 (21-30), 2 (31-40), 2 (41-50), 7 (51-60) and 1 (61-70). The following number of informants preferred using medicinal plants in the South of the island: 2 (21-30), 1 (31-40), 2 (41-50), and 1 (51-60). The following number of informants preferred using synthetic drugs in the North of the island: 8 (41-50), 1 (51-60), 2 (61-70) and 1 (71+). The following number of informants preferred using synthetic drugs in the South of the island: 1 (10-20), 1 (21-30), 3 (31-40), 4 (41-50), 2 (51-60), 3 (61-70) and 2 (71+). 1 person of the age group 31-40, and 1 person of the age group 41-50 preferred using both of these methods as part of their health regime in the North. 2 people of the age group 41-50 and 1 person of the age group 51-60 in the South also preferred using a combination of these methods.

Overall, 22% of 51+ ages (older generation), and 34% of the below 50 age groups preferred to use medicinal plants. 18% of 51+ ages (older generation), and 26% of the below 50 age groups preferred using synthetic drugs. These results exclude the 'combination' preference. This shows that in general, the younger generation (50 and below) preferred using medicinal plants.

Location results: The chi squared (X^2) test results for the northern informants showed (3, N = 80) = 0.982, $p < 0.05$. This suggests a significant difference for the synthetic drug preference of the informants in the north. Results for the southern informants showed (9, N = 80) = 5.38, $p < 0.05$. This suggests a significant difference for the medicinal plant preference of the informants in the south.

North results: overall 24.4% preferred using medicinal plants, while 32.7% preferred using synthetic drugs.

South results: overall 32.7% preferred using medicinal plants, while 10.2% preferred using synthetic drugs.

Overall informants displayed a number of reasons for the preference for using plants such as; effective relief, natural, traditional, easily accessible, no/less side effects than that of drugs, and inexpensive. While informants that preferred using synthetic drugs expressed that they were; easier to consume, fast and effective, fights bacterial infections, and widely available.

3.4. Local Synthetic Drug Use

As with many developing countries, health care facilities within the island of Malapascua are very limited due to the increasing cost of general health care; the island contains one health clinic, which only had access to drugs since the 1980's. A variety of modern synthetic drugs are available at stalls located across the island, but mainly occupying the south region, where tourism is high.

Out of the 16 categories, the most dominant category and therefore what many informants used plants for, was for viral problems such as; fever, cold, headaches and sore throats, 17 informants mentioned this (40.5%); this was followed by 5 informants mentioning bowel related issues (11.9%); 4 informants for dermatology related issues (9.5%); 3 informants each for hay-fever, osteopathy, respiratory and gastrointestinal related issues; the lowest use reports for synthetic drugs was 2 people each for high blood pressure and dental problems (4.8%).

The highest use reports were for the drug carbostine, which was mentioned by 12 informants in the treatment for viral symptoms. This was closely followed by the use of paracetamol, which was mentioned by 10 informants. The subsequent high-use drugs were; loperamide which was mentioned by 9 informants for treating diarrhea, neozep was mentioned by 7 informants to treat viral symptoms, and also amoxicillin which was mentioned by 7 informants to treat viral symptoms.

Drug	Type	Use Category	Use Reports
Advil	Anti-inflammatory	VIR	0
Aihdephine	-	DIA	1
Alaxan	Anti-inflammatory	HFV, VIR	1
Ambroxol	Mucolytic	RESP	2
Amoxicillin	Antibiotic	DERM, VIR	7
Bioflu	Antihistamine	HFV	1
Biogesic	Analgesic	VIR	3
Bonamine	Antihistamine	HFV	0
Buscopan	Anticholinergic	BWL, GAST	0
Calmiox	Corticosteroid	RESP	0
Carbostine	Mucolytic	VIR	12
Cefalexin	Antibiotic	DERM, VIR	3
Clotrimazole	Anti-fungal	VIR	5
Detoplenax	-	OST	1
Diatab	Anti-diarrheal	BWL	1
Dicyclomine	Antispasmodic	GAST	2
Disudrin	Decongestant	VIR	1
Dolcolax	Laxative	BWL	0
Dolfenal	Anti-inflammatory	OST	0
Gardan	Anti-inflammatory	OST	0
Heltonic	-	DENT, VIR	1
Kremil-s	Antacid	DENT, GAST	3
Loperamide	Anti-diarrheal	BWL	9
Mefenamic	Anti-inflammatory	DERM, VIR	1
Metoprolol	Blocking agent	DIA	1
Metronidazole	Antibacterial	BWL	1
Neozep	Analgesic	VIR	7
Oitwent	-	DERM	1
Paracetamol	Analgesic	VIR	10
Rexidol	Analgesic	VIR	0
Salbutamol	Bronchodilator	RESP, VIR	5
Saridam	-	VIR	0
Solmux	Mucolytic	VIR	2
Tuseran Forte	Cough suppressant	VIR	1

Table 2. Inventory of synthetic drug use in Malapascua.

(-) used where drug name was not globally recognised.
Use category (what type of diseases or ailments informants used plants for): BWL = bowel related problems such as; irritable bowel syndrome, diarrhea, and constipation. DENT = dental related problems such as; tooth aches and ulcers. DERM = dermatological reasons such as; boils, wounds or general skin health. DIA = diabetes and high blood pressure. GAST = gastrointestinal problems such as; indigestion, bloating, stomach aches and vomiting. HFV= hay fever. OST = osteopathic problems such as; arthritis and joint pain. RESP = respiratory problems such as; cough, asthma and bronchitis. VIR = treatment of viral symptoms such as; cold, fever, headaches and sore throats.

4. Discussion

Medicinal potency was significantly higher in trees; this may be due to the abundance of trees and shrubs in the area, mainly located towards the north of the island, but also spread around the southern region. Shrubs and vines were widely cultivated in locals' gardens, this may suggest that the medicinal potency of vines and shrubs are either not as high as that in trees, or that trees are more accessible on the island.

The results observed from the 'plant parts used' (3.1.2.) section correspond with similar studies in the region, specifically a study by Abe and Ohtani (2012) conducted on an island in the Philippines, showed the leaves were also the most commonly used part of the plant reported by informants. This frequent use of leaves indicates that these parts of the plants are easily accessible to the informants or suggesting there may be a sufficiency of medicinal properties found in the leaves of plants in general (Singh and Lal, 2008); this may be explained due to the leaves and other aerial organs e.g. the flowers, being the first point of contact from sunlight during the process of photosynthesis, energising the leaves and therefore leaving residues of additional nutrients (Abe and Ohtani, 2012) that may be of value to humans. In a study by Aziz, et al (2015) it was observed that the leaves of *Catharanthus roseus* showed higher concentrations of elements such as; sodium, calcium, magnesium, chromium, iron, aluminium, copper, lead, and manganese; while the flowers had high concentrations of potassium and zinc. This suggests that leaves may have various properties that are beneficial for different ailments, rather than other organs of the plant which may have limited healing properties. These results are not representative of all plants, as types of parts used from the plant may differ in species, such as *Zingiber officinale* where the roots have been scientifically confirmed to contain medicinal properties.

Although all plant species were used for a number of ailments and diseases, this use was specific to the plants of Malapascua; in the case of *Catharanthus roseus* it was used for many different purposes globally, in India the juice from the leaves was used to treat wasp stings, while in the Carribean the extract from the flowers was used to treat eye irritation and infections (Aziz, et al., 2016). This suggests that medicinal value of the species mentioned in table 1 has not been thoroughly researched by users and therefore medicinal potency may be different elsewhere.

The most dominant use category for both medicinal plants and synthetic drug use was for viral symptoms, WHO quotes "infectious diseases are the sixth leading cause of premature deaths in the world" (WHO, 2017), drugs treating highly prevalent diseases are in high demand (Bennadi, 2014). This fact, in addition with the small area (m^2) of the island may result in high probability of catching viruses due to the close living proximity of locals which will increase the likelihood of physical contact and therefore transmission. Due to the complex life cycle of viruses, modern drugs are unable to treat viruses; herbal remedies are therefore re-explored as an alternative treatment in order to gain a more rapid recovery, Ganjhu, et al. (2015) cites many herbal recipes and specific plant species used in the treatment of various infectious diseases (viruses) (Ganjhu, et al., 2015).

As observed from table 2, there is slight misuse of available drugs, specifically for the antibiotics such as amoxicillin and cefalexin. The self–medication on the island may contribute to high antibiotic resistance, specifically in the south region, where there is more availability of synthetic drugs and therefore probably a higher intake of these individuals. Drug purchases should be monitored, as

misuse of these medicines may result in large scale resistance, as observed in the Solomon Islands, where the government have implemented a system where basic training is given to sellers of synthetic drugs, which will allow advice to be given to patients on which antibiotics are required for specific diseases, and how long they should take them for; this system will reduce further antibiotic resistance, restrict unnecessary use of drugs, and maximise cost effectiveness of the health system (WHO, 2015).

When comparing the two tables (table 1 and 2) listing the medicinal plants and synthetic drugs used on the island, all synthetic drugs have a medicinal counterpart (plant that is able to be used as similar treatment), certain diseases such as dengue fever and de-worming have not been mentioned by informants as having a synthetic drug treatment. This could suggest that these plants are effective to prevent and treat these specific diseases, or it could suggest there are no accessible drugs on the island to cure the mentioned diseases.

Overall, 56% of all informants surveyed (n=55) preferred using medicinal plants rather than drugs as part of their health regime, while 44% preferred to use synthetic drugs. There was higher usage of medicinal plants in the North, although the results show they preferred using synthetic drugs. The main age group preferring to use medicinal plants were 51-60 years old, a large proportion of the 41+ (excluding 51-60) age group preferred using synthetic drugs, mainly in the south but also in the north, and 5 individuals preferred using a combination of these methods. Nevertheless there was no direct correlation between the older generation (51+) and plant use preference.

This could have been due to a number of reasons including; the north have better access to wild plants, while the South have access to many stalls that sell synthetic drugs due to the tourism in this region. This may also relate to the wealth, as tourism is probably the main income type in the south, which will therefore facilitate the funding for more synthetic drugs than the locals in the north whose main income is from the fishing industry.

As observed in figure 2, informants in the north generally (excluding bitter melon) had higher use occurrences of the 6 species mentioned in the 'plant species of interest' more than informants in the south. This correlates with the results regarding the source of the informants' plants, with the majority of the people from the north using wild resources, while the majority of the south cultivated their own medicinal plants; this suggests informants in the north were more likely to use plants as they have better access to a wider variety of plants, and therefore use the most common plant species often. It is unknown why the north generally preferred using synthetic drugs, as they clearly have access to the most common plants, this could potentially be an indication of:

1. Plants are ineffective in treating diseases.

2. Plants are potentially being used as a preventative, or to treat lesser symptoms.

3. Plants have slight effects, but are mainly used because they are inexpensive.

5. Medicinal Plants of Interest

6 plants species chosen based on 5 of which had the highest (0.3+) use values (UV) in table 1; two of these species were listed by the Philippine department of health (DOH, 2007) in the 'Philippines Field Health Service Information System (FHSIS) 2007 Annual Report', which was signed into the law known as the Traditional and Alternative Medicine Act (TAMA). This act recognised ten plants to have medicinal properties; *Allium sativum*, *Blumea balsamifera*, *Cassia alata*, *Clinopodium douglasii*, *Ehretia microphylla Lam*., *Mormodica charantina*, *Peperomia pellucida*, *Psidium guajava*, *Vitex negundo,* and *Quisqualis indica L*. The plant *Mormodica charantina* from these 10 was also included as a plant of interest due to high use-reports, broad geographical range, and a wealth of social interest (many published papers citing medicinal value).

***Annona squamosa* (Sugar apple)**

The sugar apple originates from the West Indies and South America; it is commonly cultivated in Asia as a food product. The fruit has been reported to contain various chemical constitutes such as glycoside, alkaloids, saponins, flavonoids, phytosterols and amino acids which are known to have medicinal value. In a study by Pandey and Barve (2011) the essential oil of the fruit was removed via a steam distillation process, the oil was found to exhibit antimicrobial activity against *Bacillus subtills* and *Staphylococcus aureas.* The study also tested the leaves of the fruit, which were administered to diabetic rats, after 2-6 hours the insulin levels of the rats significantly decreased and balanced, confirming anti-diabetic (type 2) properties. A series of other tests conducted in the study concluded that the sugar apple also possesses properties such as; anti-genotoxic, anti-head lice, antiviral, anti-HIV, anti-fertility, anti-tumour (against AD-5 tumor), and antioxidants (Pandey and Barve, 2011). This corresponds with the local use in Malapascua, as all reports were used for dermatological health and viral infection which need properties contain antioxidant which are known to protect the skin by decreasing the production of free radical skin cells. The antimicrobial properties in the fruit work against common viral bacteria.

***Blumea balsamifera* (Sambong)**

Indigenous to Southeast Asia, Sambong leaves have been used as an important traditional Chinese medicinal (TCM) herb for centuries and presumably treat dermatology related issues; specifically eczema, dermatitis, and beriberi, as well as treatment for general body pain. The biological activities of Sambong were reviewed in a study by Pang, et al. (2014) who cited numerous other laboratory studies; concluding the plant contains properties including; antitumor, hepatoprotective, superoxide radical scavenging, antioxidant, anti-diarrheal antityrosinase, and anti-obesity activities (Pang, et al., 2014). The established medicinal properties correspond with the local use of the plant reported in table 1, which was used as treatment for bowel related issues; although there is a lack of laboratory work supporting these uses. This plant was also locally used to treat viral symptoms; in a study by Pang, et al (2014) extracts from the plant showed no significant antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*, there is potential for the leaves to work against certain toxin producing microorganisms, although this has not yet been proven. This does not disprove that it may have antiviral properties, but it may be an indication of what the plant is better equipped to treat.

***Moringa oleifera* (Drumstick tree)**

Classed as 'miraculous', the Drumstick tree is indigenous to tropical and subtropical areas of Asia, Africa and the Middle East; it is widely cultivated in China. Antimicrobial activity of the Drumstick tree has been extensively researched, confirming these properties in various tissues of the plant such as; leaf, flower, bark, root, seed in the treatment bacteria, specifically; *Staphylococcus aureus, Escherichia coli* at concentrations of 100ml (Abdulkadir, et al., 2015) and also, *Bacillus subtilis, Mycobacterium phlei, Bacillus cereus, and Sarcina lutea* (Pal et al, 1995). Apart from this the essential oil of the seeds and leaves contain antifungal properties in vitro against *Trichophyton mentagrophytes, Trichophyton rubrum, Epidermophyton floccosum,* and *Microsporum canis* (Chuang, et al., 2007). A study by Mittal et al (2017) confirms the anti-inflammatory properties of the leaves of this species.

The use of this plant has been applied in various manners, from additives in the food industry to a replacement for synthetic antibiotics (Mangundayao and Yasurin, 2016). Interestingly, the seeds of the plant are able to soften hard water using the adsorption process, which requires high dosage concentrations in order to lower PH and alkaline levels of the water; therefore this can be used as a water clarification agent which would be beneficial in the treatment of tropical waters, potentially in developing countries such as the Philippines (Muyibi and Evison, 1995).

This information corresponds with the local use in Malapascua, which were mainly for dermatological and viral-symptoms which have the associated properties in order to combat such diseases. The anti inflammatory properties may explain the use for pain related problems such as; dental and osteopathic related issues.

***Mormodica charantia* (Bitter melon)**

Bitter melon originates from tropical areas of Asia, east Africa, and the Caribbean. It is widely cultivated in India and China (Kumar, et al., 2010). Traditionally, the fruit and leaves were used for bilious disorders as an emetic and purgative; externally they are generally used to treat irritation on the skin as the fruit inhibits the enzyme guanylate cyclise which heals skin (Kumar, et al., 2010), while internally they have been used for worms (Pardo De Tavera, 2008). Apart from this various studies have cited that the fruit can be used to treat various ailments and used as; carminative, anaemia, jaundice, antiobesity, malaria, and cholera. The plant also contains alpha-momorcharin, beta momorcharin, and MAP-30 which are anti-HIV proteins (Kumar, et al., 2010).

A study by Dhiman, et al (2012) reported that extracts of this plant showed significant antihyperglycemic effects upon oral administration in diabetic rats, the water extracts of the plant increased glucose uptake and adiponectin secretion in adipose cells, while extracts from the seed balanced antioxidant status in streptozotocin induced diabetes (Virdi et al., 2003). In a study by Kumar, et al (2010) reported that the plant contained anti-fertility properties, after it induced abortions in mice and rats. This information corresponds with the uses mentioned by informants, which cited dermatological and anti viral symptoms.

***Origanum vulgare L.* (Oregano)**

Oregano is used globally, mainly as a food spice in Western diets, but also as a traditional medicine for the treatment of various diseases, such as colds, coughs, and digestive disorders. Although there little evidence to support extensive medicinal properties, a review by Zhang, et al. (2014) states the medicinal properties of this herb include; antioxidant, anti-ulcer, anti-inflammatory, ant diabetic, antiviral, cytotoxic, antitumor, and antimicrobial activities. This corresponds with the healing properties mentioned by informants; this suggests the plant is most likely to be effective to treat viral symptoms due to the high use value of this species.

***Psidium guajava* (Guava)**

The Guava is indigenous to Mexico; the main traditional use is as an anti-diarrhoeal. There is a lack of evidence supporting the following properties. It has been reported that uses include gastroenteritis, dysentery, and antibacterial (Gutierrez, et al., 2008). According to Chaudhary and Tripathi (2014) the leaves of the plant may have potential properties including anti-hypertensive, antioxidant, antimicrobial, hypoglycaemic and anti- mutagenic. This corresponds with the healing properties mentioned by informants, as discussed this plant has traditional been used for bowel related issues, as the plant contains antibacterial properties, this may be an indication of what the plant is better suited to treat.

6. Conclusion

The study reveals that medicinal plant use is very much still active in Malapascua; the informants cited use from many species of plants, suggesting high plant biodiversity on this island. It is unclear whether medicinal plant use is declining as the frequency of plant use was not reported in this study. Plant use did not seem to correlate with wealth or age, and therefore these hypotheses can be rejected; however location of informants did affect preference of using plants in their health regimes, as observed in the results people from the north region of the island preferred using synthetic drugs, while people in the south preferred using medicinal plants, which may have been affected by the availability of modern medicine, these drugs were more accessible in the south of the island. Plant use also affected garden cultivation, as many informants in the south cultivated their own plants, while people in the north had better access to wild resources.

In the case of the medicinal plants of interest, it is evident that these plants have been researched, and some medicinal value is linked to each of the plants which correspond with the data from the informants. As observed in section 3.2 there are various reasons for preferences of medicinal plants, although there is a lack of strong evidence supporting the effectiveness as treatment of the majority of the plants listed in table 1. Continued use of these plants is probably a result of habit use over generations, therefore these plants should be investigated further.

Modern health care facilities are currently not sufficient which has led to the misuse of available synthetic drugs by locals, they are widely available across the southern part of the island, which has resulted in the majority of people preferring to use medicinal plants rather than synthetic drugs. Guidelines and restrictions of these drugs, specifically antibiotics must be considered in order to prevent increased resistance on the island, and also to encourage the use of medicinal plants.

This report may represent one of the first botanical studies conducted on Malapascua Island, which will hopefully contribute to preserving current knowledge on the use of medicinal plants on this island; but also stimulate further research in this study area.

7. Limitations

Although the aims in this research have been successfully completed, there were some unavoidable limitations. We must first point out that the language barrier in this case may have skewed the authenticity of the results, as the survey results, such as plant species identification, were completely dependent upon translation. The time restriction of three weeks proved to be an insufficient amount of time to complete certain initial aims of the study such as field plant surveys in gardens, and also restricted the sample size, which would have been larger if more time was allocated.

One other possible bias to consider with the reported survey results was the tendency of participants to second-guess the desired survey outcome; although all participants were aware that the survey was designed to investigate the traditional uses of plants on the island, Filipino locals on the island had a tendency to potentially misinterpret the questions asked on the survey.

8. Implications

As a preliminary study, there are certain implications for succeeding research. Firstly guidelines should be implemented to monitor the use of drugs on the island, and to maximise the effect of these drugs. Similar research study should be conducted on the island to report the frequency of use of medicinal plants on the island, which will be able to detect whether the plants are declining in use.

Furthermore, the plants of importance should be extensively researched in laboratory facilities by means of phytochemical analysis, which will be able to confirm or dismiss the medicinal potency of each species. Specifically, *Moringa oleifera* should be tested on pure water samples from the island; as discussed previously, a study by Muyibi and Evison (1995) has cited that the seeds of this species are able to soften hard water which is important research to conduct as water purification methods on the island are required due to the hardness of the water.

Lastly, all common plants mentioned in table 1 must be preserved, and should then be DNA barcoded which is important to identify certain species correctly and conserve the rarer plants that may be under threat of extinction.

Appendix 1. Sample questionnaire used during field work.

Name Gender: M OR F

Citio: Occupation: Age:

1. What medicinal plants do you use, and what symptoms do you use them for?

I use Malunggay for wounds

I use Aloe vera for wounds and burns

I use Ampalaya for coughs

2. Do you use synthetic drugs?

Yes

3. If yes, what do you use them for?

I use Paracetamol for Viral

I use Solmux for Viral

I use Alaxan for Hayfever

4. Do you prefer to use herbal remedies or synthetic drugs? Why?

Synthetic – effective

5. Source of medicinal plants (circle)

I grow it myself I find it in the wild

6. Part of plant/tree used (circle)

Root Stem Bark Flower Seed Leaves

7. How is the plant prepared (circle)

Fresh Boiled Dried

8. Additional comments

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