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ORIGINAL RESEARCH PAPER

Antimicrobial test of five ethnomedicinal plants in an ancestral forest area

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ABSTRACT: The basic premise of this research was to assess the ethnomedicinal uses of plants in an ancestral forest area at Naawan, Misamis Oriental and determine its inhibition effect against bacterial strains. The assessment of plants was conducted using the transect-plot method. Ethnomedicinal uses and the mode of preparations were obtained using a semi-structured interview questionnaire. Five ethnomedicinal plants: *Crinum asiaticum* L., *Pavetta indica* L., *Bauhinia purpurea* L., *Mollugo pentaphylla* L., and *Cinnamomum mercadoi* S. Vidal were selected for the anti-microbial test against cultured bacterial strains; the *Escherichia coli* and *Staphylococcus aureus* using the disc diffusion method. These species are commonly used by the indigenous people and known to cure stomach disorder and wounds. The mode of preparation of the extracts follows the traditional method of the indigenous people. Chloramphenicol, on the other hand, was used as positive control. Thirty-three out of 61 identified species were locally claimed to have medicinal value and are known to cure stomach disorders, poisoning, bleeding, cough, fever and wounds, among others. Antimicrobial test showed greater inhibitory effect of *Pavetta indica* and *Bauhinia purpurea* against *Staphylococcus aureus* and *Escherichia coli,* correspondingly; however, the synthetic chloramphenicol exhibited greater antibacterial action than any of the plant extracts. In areas where civilization is afar, importance of forest in terms of medicinal uses is highly acknowledged by the local community. Indigenous people, in particular, know the importance of the forest especially in relation to health care system and they believe that there is a need to conserve the resources to sustain the services it provides.

KEYWORDS: *Antimicrobial test; Ethnomedicine; Forest; Pavetta indica; Staphylococcus aureus*

INTRODUCTION

The use of herbal medicines in Asian represents the human interactions to their environment. Their interrelationships in terms of health have been widely acknowledged. Human health depends highly on the quality of the environment in which people live and environmental degradation can have indirect effects on human well-being (Alves *et al.,* 2005). Many rural communities, especially, low income people such as farmers and indigenous people in small villages depend highly on plant resources for food, herbal medicines, shelter, construction materials and other needs for their survival (Ayyanar and Ignacimuthu, 2005; Arances, *et al.,* 2006). And traditional medicine has been widely known to be a possible cure for many diseases (Beaglehole *et al*., 2004). The indigenous system of ethnomedicinal plants and animals has been in existence through time and continues to play a significant role in the health care system of indigenous peoples and in the conservation of biodiversity (Ayinam, 1995). A well-functioning ecosystem, therefore, can help protect human health. The antimicrobial compounds that are found in many plant species may inhibit bacterial growth different

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from the presently used antimicrobials or synthetic medicine and may have a significant clinical value in treatment of resistant microbial strains (Eloff, 1988; Sarac and Ugur, 2007). Bacteria such as *Escherichia coli, Proteus sp., Pseudomonas aeruginosa, Shigella dysenteriae, Salmonella enteritidis, Salmonella typhi* and *Staphylococcus aureus* are some of the microorganisms that are resistant to antimicrobial compounds of plants (Barbour *et al*., 2004; Tambekar and Dahikar, 2011). Antimicrobial properties such as tannins, terpenoids, alkaloids and many others are known to help cure bacterial infections and diseases (Cowan, 1999; Dahanukar *et al*., 2000). World Health Organization estimates that the active constituents of plants are used in traditional therapies. Eighty percent (80%) of the world's population used plants as their alternative way of curing diseases and other ailments (WHO, 1993; Shaikh *et al*., 1994; Owolabi *et al*., 2007). Many plants extracts were tested to test their antimicrobial properties. *Cassia fistula* Linn was proven to have remarkable inhibition of the bacterial growth against *Staphylococcus aureus, Streptococcus pyogenes* and two Gram-negative-*E-coli* (*Escherichia coli) and Pseudomonas aeruginosa (Bhalodia and Shukla, 2011). Plant species such as Osmium sanctum, Azadirectha indica , Pcidium gujava* and *Aegle marmilos* were also tested and found to have potential medicinal activity against *E. coli* (Prasuna and Chandel, 2015). Some plants were used to treat urinary tract infections such as Bearberry (*Arctostaphylos uva-ursi*) and cranberry juice (*Vaccinium macrocarpon*) (Rios and Recio, 2005; Geetha *et al*., 2011). Lemon balm (*Melissa officinalis*), garlic (*Allium sativum*) and tee tree (*Melaleuca alternifolia*) are described as broad-spectrum antimicrobial agents (Heinrich *et al*., 2004). *Ocinum gratissimum* and *Eugenia uniflora* which are rich in volatile oils and contain up to 75% thymol are effective against diarrhea and ear infections (Fadeyi *et al*., 1989). In the study of Selvamohan *et al* (2012), the zone of inhibition of the methanol extract of *Phyllanthus neurri* is much higher than the available commercial antibiotic Ciproflaxacin against *S. aureus* having a value of 30 mm zone of inhibition. The continued discovery of new medicinal drugs has shown that plants represent potential sources of antibiotic prototypes (Afolayan, 2003). However, economic progress and rapid urbanization has spread to rural communities, creating a change in lifestyle and health system. The loss of traditional medicine culture due to advancement of lifestyle had a significant effect on the self- sufficiency, health status of many indigenous peoples (IP's), and on forest conservation and management. Indigenous peoples living a traditional lifestyle maintain both physical and spiritual ties to the land. Every aspect of their existence, from biodiversity conservation to the accessibility of medicinal plants and animals, is dependent on careful stewardship of local resources. The IPs have an unparalleled knowledge about these resources and how best to manage them (Balick and Cox, 2003). According to Bletter (2007) and Jeruto *et al*., (2008), the study on local knowledge of natural resources is becoming increasingly important in defining conservation and management strategies and actions for residual forest. The mountainous areas of Barangay Lubilan in Naawan, Misamis Oriental (Fig. 1) are inhabited mostly by the Higaonon tribe. Part of the barangay is Lake Danao which is surrounded by a relatively thick forest and is a shared watershed with Bgy. Tula in Alubijid, Misamis Oriental. The Higaonon culture is strong and thriving and the group's claim on the land is locally recognized. But like in many other parts of the country, the forested area is threatened by various forces such as illegal logging. The strongest threat is the reported proliferation of mining activities that are already known to devastate forest ecosystems and the surrounding ecosystems therein.

This study was focused on the forest community in Lubilan with the general objective of generating baseline information on the forest plant community and its ethnomedicinal value. Specifically, plant community structure and conservation status of the species were determined. Antimicrobial tests were done for selected species to validate its medicinal value. Results of this study are very important in advocacy work for protection and conservation. Presence of endemic and endangered species should compel both the scientific and the non-scientific community to initiate efforts that will protect them. Ethnomedicinal values of plants, validated through laboratory tests, should drive the local community to protect the forest that serves as their "pharmacy". The study has been carried out in the forest area of Misamis Oriental in Philippines in 2009.

MATERIALS AND METHODS

Study site

This study was conducted in the vicinity of Lake Danao situated at the boundary between Barangay Lubilan, Naawan and Bgy. Tula, Alubijid, both

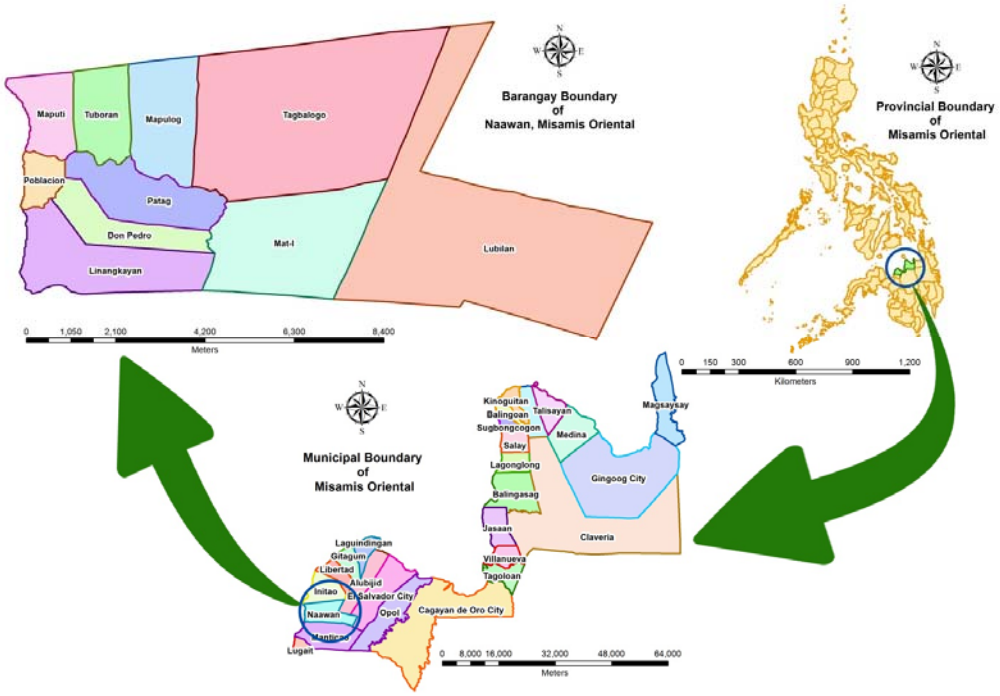

Fig. 1: Location of study area showing Bgy, Lubilan in the municipality of Naawan, Misamis Oriental

in the province of Misamis Oriental (Fig. 1). The municipality of Naawan lies on the western part of the province; situated 60 km from Cagayan de Oro City and 24 km from Iligan City. Forestlands occupy a larger area relative to the agricultural lands of the municipality. Majority of its landscape consists of steep mountains and rolling hills. Lubilan is the innermost upland barangay of Naawan and has perhaps the last remaining thick forest in the municipality. Within the upland area are settlements of many Higaonons and other *lumads*.

Establishment of sampling plots and Determination of ethnomedicinal uses

The rapid assessment of forest community was carried out using a Transect-Plot method. A one-hectare plot (200m x 500m) was established in the study site, within which three 100m transect lines were positioned at an interval of 100m from the reference point. Along each transect, two 100m^2 quadrats were established at an interval of 50 m for the inventory of tree species. Within each 100m^2 plot a 5m x 5m (area = 25m^2) subquadrat was delineated for the inventory of saplings and shrubs. Further, inside the 25m^2 area, 1m x 1m subquadrats were marked for the inventory of the smaller plant forms (e.g., herbs, vines, pteridophytes, bryophytes, and seedlings) (Arances, *et al*. 2006). Plants inside the quadrats and subquadrats were surveyed with the help of two Higaonon leaders. Plants were identified up to species level as possible using a guidebook by Madulid (2001). The conservation status of the identified plants was determined from the IUCN Red List database (IUCN, 2016). The determination of the ethnomedicinal uses of plants within the forest was obtained using a semi-structured interview questionnaires and the guidance from the Higaonon tribe.

Antimicrobial test of plant crude extracts

Medicinal plants. Five ethnomedicinal plants were tested for antimicrobial property in the laboratory, namely: *Crinum asiaticum* L. (*Liryo*), *Pavetta indica* L. (*Galawan*), *Bauhinia purpurea* (Linn) (*Alibangbang*), *Cinnamomum mercadoi* S. Vidal (*Kalingag*) and *Mollugo pentaphylla* L. (*Salukot*). The number of plants verified was limited only to five species due to funding limitations. The test substances were prepared in the traditional way of the Higaonons. The plants were sorted, washed, and chopped into smaller pieces. In the case of tree species *B. purpurea*, *M. pentaphylla* and *C.*

mercadoi, a decoction was prepared by boiling leaves in tap water. For *P. indica* and *C. asiaticum*, leaves were grounded until the juice was extracted.

Bacterial strains. Two clinical bacterial strains, namely: *Staphylococcus aureus* and *Escherichia coli* were used in the study. *E. coli* is gram-negative, facultative anaerobic and non-sporulating (Andrews, 1992) which can be obtained from eating unwashed vegetables, unhygienic food preparation, and farm contamination. It can also be found in the humans and other warm-blooded animals feces. *Staphylococcus aureus* is gram-positive, a facultative anaerobic coccus, which may occur as a commensal on human skin where its infections can spread through contact from an infected wound, or skin-to-skin contact with an infected person by producing hyaluronidase that destroys tissues.

Culture medium and antibacterial activity test. Typtone Soy Broth (TSB) medium and MacFarland Standard were used to culture the microorganisms in agar plates following standard protocols in bacterial preparation and analysis (Andrews, 1992). The disc diffusion method by Drew, *et al.* (1972) was used to screen the antimicrobial activity of the crude extracts. Sterile paper discs (8mm diameter) were soaked in the leaf extract for 2 hours. Broth culture of bacteria (106 CFU/ml) was spread on the surface of gelled sterile TSB agar plates. The paper discs soaked in the plant preparation were placed at different areas on the surface of each plate. The discs were lightly pressed to ensure surface contact with the agar medium, then were incubated at 37°C for 24 h. Chloramphenicol was used as positive control in the test. Antibacterial activity of the extract is indicated by the growth-free zone of inhibition. Diameter of inhibition zones was measured in millimeter using a transparent ruler. The microbial index was calculated as Eq. 1.

$$\text{Microbial Index (MI)} = \frac{\text{diameter of zone of inhibition - diameter of the disc}}{\text{diameter of the disc}} \quad (1)$$

A larger zone of inhibition indicates greater antibacterial action, hence, as the value of microbial index increases; the more effective the extracts are against the pathogens (McGregor *et al*., 1997).

RESULTS AND DISCUSSION

Ethnomedicinal plants and its uses

A total of 61 plant species belonging to 29 families were identified around Lake Danao comprising of trees, shrubs, herbs and vines. Fifteen species were trees, 39 species were saplings, and 19 species of herbaceous plants were recorded in the area. Thirty-two of the 61 plant species are known to have medicinal values and are used as immediate and an alternative solution to curing illnesses (Table 1) (Guerrero, 1921; Quisimbing, 1978). Some 13 species of plants are used in treating stomach disorder, 8 species for curing cuts and wounds, and two species for curing animal bite poisoning. Higaonon tribe declared that some of the ethnomedicinal plants they use were obtained in the forest while some were grown in their home gardens. *Lagundi* and *helbas* are the most commonly identified herbal cure for various illnesses and diseases such as fever, cough and colds. Other common ethnomedicinal plants utilized by the community are *Graptophyllum pictum* (Linn) Griff, *Blumea balsamifera* (Linn) DC., *C. mercadoi* and*Chromolaena odorata*. *G. pictum* and *C. odorata* are used for curing wounds while *C. mercadoi* and *B. balsamifera* are used for stomach disorders and flatulence or gripes. Different parts of the plants are used depending on the traditional mode of preparation, including flowers, leaves, root, stem, whole plant, fruits, seeds, bark, latex, and cones. Each medicinal plant is used either raw or in dried form.

The conservation status of plant species found within the study area (Table 2) was identified based on the IUCN database (2016) and the Lexicon of Philippine Trees (Rojo, 1999). Two species of trees are critically endangered, namely: *Shorea guiso, Shorea negrosensis* and *Shorea contorta.* Logging (for construction and furniture making) and slash-and-burn agriculture in the area threaten these species. *Vatica mangachapoi* Blanco which is recorded also around the area is listed as endangered species. *Dillenia philippinensis* and *C. mercadoi* are vulnerable species. These species are under threat from adverse factors throughout their range and are likely to move to the endangered category in the future. At least six plant species in the forest are endemic to the Philippines, two of which are critically endangered and one is vulnerable. Based on the 2015 draft updated national list of threated Philippine Plants and their categories, one species, *Gymnostoma rumphianum,* is listed as threatened species in the country. While conservation status of some species in the area could not be ascertained for lack of available references, the conservation status of some plants based on the IUCN conservation status in the forest of Lubilan sends a

Table 1: List of Ethnomedicinal plants, its uses and mode of preparation

Family name	Scientific name	Botanical name	Parts used	Mode of preparation	Administration	Diseases Treated
Anacardiaceae	*Mangifera indica* Linn.	manga	Leaves	Decoction (boiled in water together with the leaves of coffee)	Oral intake	Stomach disorder
			Sap	Sap is directly applied into the infected wound		Wounds
Arecaceae	*Daemonorops* sp.	Uway	Roots	Decoction	Oral intake	Relapse
					Extracts applied directly to the wounds	
Asterraceae	*Wedelia biflora* Linn	Hagonoy	Leaves	Leaves will be extracted by grinding into smaller pieces until it will produce a juice		Wounds and cuts
Clusiaceae	*Calophyllum* sp.	Palo-maria	Leaves	Decoction	Oral intake	Relapse
Commelinaceae	*Costus igneus* N.E. Br.	Mantawasi	Sap		Apply directly on eyes	infected eyes
Cyperaceae	*Scleria lithosperma* (L) Sw.	Talaid	Roots	Decoction	Oral intake	Stomach disorder
Dilleniaceae	*Dillenia philippinensis* Rolfe	Kulambog	Stem bark	Decoction	Oral intake	Cough
			Fruits	The fruits will be eaten directly	Oral intake	Cough
Dipterocarpaceae	*Mollugo pentaphylla* Linn	Salukot	Stem Bark	Decoction	Oral intake	Stomach disorder
	Shorea negrosensis Foxw.	Lanagon	Roots	Decoction	Oral intake	Stomach pain
Fabaceae	*Bauhinia purpurea* Linn	Alibangbang	Leaves	Decoction	Oral intake	Stomach disorder
Fagaceae	*Lithocarpus* sp.	Ulayan	Bark	Decoction	Oral intake	stomach disorder
Lauraceae	*Cinnamomum mercadoi* S. Vidal	Kalingag	Stem Bark	Decoction	Oral intake	Stomach disorder
			Roots	Soaked into fighter wine	Oral intake	Stomach disorder
Longaniaceae	*Fagraea blumei* G. Don	Kalainig	Leaves	Extraction	Extracts applied directly to the wounds	Wounds
			Shoot	Cut into pieces	Rub directly into the stomach	Stomach disorder
Melastomataceae	*Malastoma sp.*	Tungaw	Roots	Decoction	Oral intake	Bleeding and Stomach disorder
Moraceae	*Artocarpus heterophylus* Lam.	Nangka	Roots	Decoction	Oral intake	Poisoning
	Ficus sp.	Baliti	Skin bark	Directly apply on the area of bone fracture		Bone fracture
	Ficus heteropleura Bl.	Kalapat	leaves	Decoction	Oral intake	Flatulence or gripes
Poaceae	*Imperata* sp.	Kogon	Shoot (mimis)	Decoction	Oral intake	Children that are about to have teeth
Rosaceae	*Rubus moluccanus* Linn.	Sapinit	Roots	Decoction	Oral intake	Relapse
Rubiaceae	*Pavetta indica* Linn	Galawan	Leaves	Leaves will be powdered to produced extracts	Extracts applied directly to the wounds	Wounds and cuts
Urticaceae	*Leucosyke capitellata* (Poir.) Wedd.	Manumbila	Roots	Decoction	Oral intake	gastrointestinal Disorder
			Bark	Decoction	Oral intake	Stomach disorder
						Cough
		Kaulod	Leaves	Decoction	Oral intake	diabetes
				Extraction	Extracts applied directly to the wounds	Wounds
		Salungan	leaves	The leaves will be boiled in the water together with the chili leaves	Oral intake	Stomach disorder
		Kanding-kanding	Leaves	Decoction	Oral intake	stomach disorder
			Leaves	Extraction	Extracts applied directly to the wounds	Wounds
		Mangon-Bangon	Leaves	Stem bark		Bone fracture
Around the area:						
Amaryllidaceae	*Crinum asiaticum* Linn.	Liryo	Rhizome	Extraction	Extracts applied directly to the wounds	wounds
Annonaceae	*Annona muricata* Linn.	Rabana	Leaves	Decoction	Oral intake	Stomach disorder
Lauraceae	*Cinnamomum zeylanicum* Nees.	kanila	Stem bark	Decoction	Oral intake	Stomach disorder
Moringaceae	*Moringa oleifera* Lam.	Kalamunggay	Leaves	Extraction	Extracts applied directly to the wounds	Wound
			Seeds		Oral Intake	Stomach disorder
			Stem		Extracts applied directly to the wounds	Dog bite, Bee bite poisoning
Myrtaceae	*Psidium guajava* Linn.	Bayabas	Leaves	the leaves is crushed to get the extracts	Extracts applied directly to the wounds	Wounds
				Decoction	Oral intake	Stomach disorder
	Vatica mangachapoi Blanco	salong-salong		Extract the sap	Extracts applied directly to the wounds	wounds and cuts
	Capsicum frutescens Linn.	Sili	Seeds/Fruits		The fruit is directly applied into the bite area of the body	dog, bee, and snake bite poisoning

strong message to step up conservation efforts in the area. Biodiversity is the nation's natural capital: a highly diverse forest provides, among others, diverse habitats to many plant and animal organisms.

The type of ailment (e.g. stomach disorder, wounds, stomach pain, cough, among others) also determines the type of herbal preparations such as powder, crushed, paste, decoction (liquid obtained from boiling or the medicinal plants in the solvent), and infusion/homogenization (plant powder/paste mixed with the solvent). Most of the stomach disorder, gastric pains, some of the herbal plants are boiled/decoction and administered through drinking. Decoctions constitute the most frequent form of preparation, followed by leaf extract directly applied onto the infected skin (Fig. 2). Medicinal plant preparations are applied through different routes of administration, namely, oral (most common), dermal or topical, and nasal routes (Alemayehu *et al.,* 2015). Among the *Higaonons* of Lubilan, medicines are prescribed and administered in various ways and dosage is determined by age. Children are given smaller doses of the herbal medicine than adult patients, depending on the type of illness and treatment required. Physical appearance of the visiting patients may include changes in body temperature, skin and eye color that will help the local healer identify what types of illness does the patient is experiencing although there were no standardized measurements, even for gender aspect (Lulekal *et al*., 2013) The type of disease and degree of severity further determine the frequency of treatments.

Various types of plant species were used to treat different health problems of the Higaonons and other residents of around Lake Danao. These diseases and illnesses include stomach disorders, cuts and wounds, bleeding, cough, poisoning, relapse, bone fracture, fever, animal bite poisoning and other diseases locally known as stitch or twinge, and stomach pain. Stomach disorder, wounds, and cuts are by far the most

Table 2: Conservation status of some plant species in Lubilan, Naawan, Misamis Oriental

Family	Scientific name	Local name	Conservation status
Dilleniaceae	*Dillenia philippinensis* Rolfe	Kulambog	Endemic, vulnerable[+]
Dipterocarpaceae	*Shorea guiso* (Blanco) Blume	Giho	Critically endangered[+]
Dipterocarpaceae	*Shorea negrosensis* Foxw.	Lanagon	Endemic, critically endangered[+]
Dipterocarpaceae	*Shorea contorta*	Lauan	Critically endangered[+]
Euphorbiaceae	*Myrica sp.*	Hindang	Endemic
Lauraceae	*Litsea philippinensis* Merr	Bakan	Endemic
Lauraceae	*Cinnamomum mercadoi* S. Vidal	Kalingag	Vulnerable[+]
Sterculiaceae	*Cleistanthus pilosus* C.B.Rob.	Banitlong	Endemic
Casuarinaceae	*Gymnostoma rumphianum* (Miq.) L.A.S.Johnson	Mountain Agoho	Threated species [*]
Dipterocarpaceae	*Vatica mangachapoi* Blanco		Endangered[+]

[+]IUCN Conservation Status
[*]DENR Administrative Order No. 2015

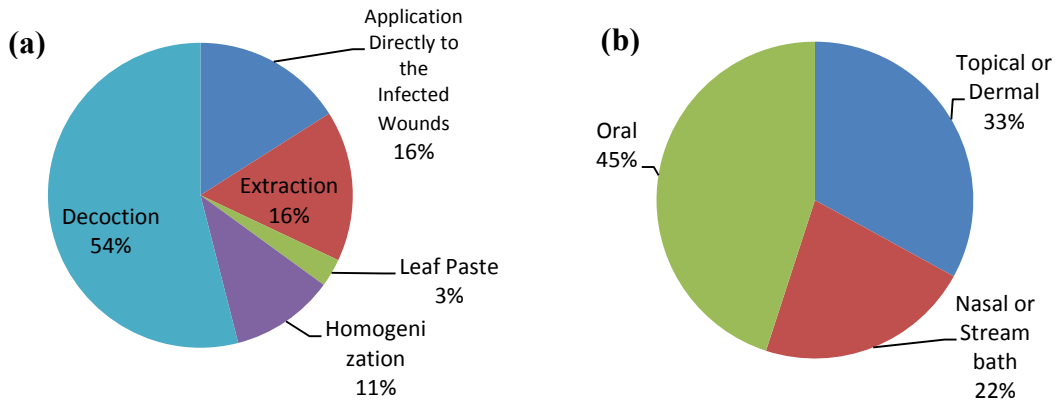

Fig. 2: Modes of preparation (a) and administration (b) of medicinal plants by *Higaonons* and other lumads in Lubilan, Naawan, Misamis Oriental.

Table 3: Minimal inhibitory concentration of the five plant extracts against *E. coli* and *S. aureus*

Plant extract	Traditional use	*E. coli*		*S. aureus*	
		Ave. zone of inhibition (mm)	MI	Ave. zone of inhibition (mm)	MI
C. asiaticum	Infected wounds	10.67	0.33	10.67	0.33
P. indica	Infected wounds	13.33	0.67	15.67	0.96
B. purpurea	Stomach disorder	18.50	1.31	10.33	0.22
M. pentaphylla	Stomach disorder	9.33	0.17	11.67	0.43
C. mercadoi	Stomach disorder	9.83	0.23	12.00	0.50
Chloramphenicol	Synthetic antibiotic	26.33	2.29	28.17	2.52

widespread ailments while bone fracture and kidney trouble are occasional problems. The Higaonons use different diagnostic ways and treatment methods depending on the type of ailment. Patients are often diagnosed by interview and visual observation of changes in physical appearance (e.g. eye and skin color, tongue and throat regions), body temperatures and signs of bone fracture.

Results of antimicrobial tests on selected plants confirmed the claims of the respondents that the plants can cure certain illnesses as shown by their microbial indices or MI (Table 3). Plant extracts of *P. indica* was found to be more effective against *S. aureus* than the rhizome of *C. asiaticum.*

P. indica leaves are used in various treatments such as liver disease, pain from piles, urinary diseases and fever (Kirthikar and Basu, 2001; Thabrew *et al*., 1987). Its leaves having anti-inflammatory activities (Mandal *et al*., 2003) and reported analgesic activity (Golwala *et al*., 2009), and the root extract also have diuretic and purgative activity (Kumar, 2006; Roy *et al*., 2013). In addition, the extracts of *P. indica* leaves has bactericidal activities against the Gram-positive *B. subtilis* bacteria but no detectable activity against Gram-negative bacteria (*E. coli*) using the disc diffusion method (Roy *et al*., 2013). The Gram-negative bacteria are generally regarded more resistive due to the presence of lipopolysaccharides in their outer membranes that tend to prevent the entry of inhibitors (Nikaido and Vaara, 1985). *Crinum sp.,* on the other hands, is a well-known traditional herb belongs to family Amaryllidaceae. Worldwide, different *Crinum* species are commonly used to treat various conditions due to their excellent medicinal values. It has been reported that *C. mercadoi* was known to cure headaches and rheumatism (Guerrero, 1921), stomach disorder/troubles and tuberculosis (Quisimbing, 1978) and the oil of this plant has high antibacterial activity (Torres *et al*., 2003). The antibacterial activity of extracts from stem bark and roots of *C. mercadoi* showed little inhibitory effect on the test organisms while greater inhibitory effect was exhibited by *Bauhinia sp.* against *E. coli,* with zones of inhibition of 9.83mm and 18.50 mm, respectively. Antimicrobial effect of the crude extracts, however, is lower than the purified synthetic antibiotic chloramphenicol whose zone of inhibition is much larger on both bacterial strains (Table 3). The result of this study is similar to the study conducted by Torres *et al* (2003). In their study, the crude extract showed moderate activity (11.05 mm) against *Staphylococcus aureus* and strong antifungal activity against *Microsporum canis*. The oil from the bark was highly effective against *Staphylococcus aureus* and moderately effective against *E. coli*. *S. aureus* from wound pathogens was highly susceptible while urine *E. coli* showed moderate susceptibility (Torres *et al*., 2003).

Bauhinia purpurea is a flowering plant that exhibit many ethnomedicinal uses such as body pain, fever, drowsy, diarrhea, and others (Asolker *et al*. 2000; Kirthikar and Basu 2001). This species are also known for their analgesic, anti-inflammatory, antipyretic (Zakaria *et al*. 2007; Shreedhara *et al*. 2009; Annegowda *et al*., 2012). In the present study, *Bauhinia* species has the highest zone of inhibition against *E. coli* among the five test plants with a value of 18.50mm zone of inhibition. The highest zone of inhibition of *Bauhinia purpurea* can be attributed to its bioactive compounds. In some studies like the study conducted by Murugan and Mohan (2011), their results showed that *Bauhinia purpurea* has alkaloids, coumarin, flavonoids contents. These compounds are known as effective antimicrobial substances against a wide range of microorganisms (Mason and Wasserman, 1987; Ya *et al*., 1988; Tsuchiya *et al*., 1996) and known to their antioxidants (Penna *et al*., 2001; Ren *et al*., 2003).

CONCLUSION

This study revealed that the forest in Lubilan is home of some endemic, critically endangered and vulnerable species. Based on the IUCN Conservation Status, three are critically endangered, two are vulnerable species, one endangered species, and some are endemic/native in the Philippines. The presence of this species can promote careful management and conservation of the forest, not just to preserve their existence but to protect the forest as a whole, as well as the community, in the future. Apart from this conservation status, the forests in Lubilan, Naawan are important source of ethnomedicine in the area. Out of the 61 species, 32 plants, comprising 52% of the total recorded species, have ethnomedicinal values for Indigenous People. Their belief on the healing components of many ethnomedicinal plants and its value provides them the right perception of preserving their forest. If the forest will be lost, their health care system will also be affected. From the antimicrobial assay, the study revealed that the ethnomedicinal plants exhibits different level of antimicrobial activity against the two test organisms. Although, synthetic drugs/medicine has higher zone of inhibition as compared to the ethnomedicinal plants extracts, still the ethnomedicine are very important in the health care system of the indigenous and non-indigenous communities around Lake Danao in Lubilan, Naawan especially the area is far from urbanization. The local community's medicinal needs are linked to the ethnomedicinal plants found within the forest. Many of tribal communities have cultivated and used biological diversity in a sustainable way for thousands of years. Some of their practices have been proven to enhance and promote biodiversity at the local level and help maintain healthy ecosystems. Furthermore, sporadic violations of forest policies place additional strain on the fragile ecosystem and resources therein. Concerted efforts by the local government, the DENR, the IPs and other communities in Lubilan are critical in enforcing policy and strategies to conserve forest resources as well as the ethnomedicinal plants therein especially that the mining in the neighboring barangay, Barangay Manticao, is currently operating. The results of this study can be a supporting documents and basis in crafting conservation and management plan for the Local Government Units in Naawan, Misamis Oriental. Preserving the indigenous culture, particularly the use of ethnomedicine, and respecting the rights of the Higaonon people to their ancestral domain, can help protect the forest and the resources therein. More research initiatives into biodiversity (e.g. faunal diversity of Lake Danao) regarding the medicinal uses of plants should be carried out for further information on ethnomedicine.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

ABBREVIATIONS

B. balsamifera	*Blumea balsamifera*
B. purpurea	*Bauhinia purpurea*
B. subtilis	*Bacillus subtilis*
°C	Degree celsius
C. asiaticum	*Crinum asiaticum*
C. mercadoii	*Cinnamomum mercadoii*
C. odorata	*Chromolaena odorata*
CFU	Colony-Forming Unit
DENR	Department of Environment and Natural Resources
E. coli	*Escherichia coli*
Eq.	Equation
G. pictum	*Graptophyllum pictum*
IP	Indigenous people
IUCN	International Union for Conservation of Nature
km	Kilometer
m	Meter
M. pentaphylla	*Mollugo pentaphylla*
m^2	Meter square

MI	Microbial index
mm	Millimeter
P. indica	*Pavetta indica*
S. aureus	*Staphylococcus aureus*
TSB	Typhon soy broth

REFERENCES

Afolayan, A. J., (2003). Extract from the shoots of Arctotis artototdes inhibit the growth of bacteria and fungi. Pharm Biol. (41):22-25 (**4 pages**).

Alemayehu, G.; Asfaw, Z.; Kelbessa, E. (2015). Ethnobotanical study of medicinal plants used by local communities of Minjar-Shenkora District, North Shewa Zone of Amhara Region, Ethiopia. Journal of Medicinal Plants Studies; 3(6): 01-11 (**11 pages**).

Alves, R.R.N.; Rosa, I.L., (2005). Why study the use of animal products in traditional medicines? J. Ethnobiol. Ethnomed., (1): 1-5 (**5 pages**).

Andrews, W., (1992). Manuals of food quality control–Microbiological analysis, FAO food and nutrition paper, Food and Agriculture Organization of the United Nations, (**338 pages**).

Annegowda, H.V.; Mordi, M. N.; Ramanathan, S.; Hamdan, M. R.; Mansor, S. M., (2012). Effect of Extraction Techniques on Phenolic Content, Antioxidant and Antimicrobial Activity of *Bauhinia purpurea*: HPTLC Determination of Antioxidants. Food Anal. Methods, (5): 226.

Arances, J.; Amoroso, V.B.; Gorne, N.D.; Ruba, R.P.; Rufila, L.V.; Opiso, G.S.; Demetillo, M.T.; Noval, K.G.; Vanden Berg, A.; Stortelder, A.; Kessler, P.J.A.; Gruezo, W. S.M.; Lagunzad, D.A.; Tan, B.C.; Co, L.L.; Aranico, E.C.; Roscom, B.A.; Alava, C.G., (2006). Plant diversity and status in the northern landscape of Mt. Malindang range and environs, misamis occidental, Phillipines. BRP Monograph Series No.8. Biodiversity research program for development in Mindanao: Focus on Mt. Malindang and Environs. SEARCA, College, Laguna.

Asolker, L.V.; Kakkar, K.K.; Chakre, O.J., (2000). Supplement to glossary of Indian medicinal plants. Part-I (A-K). National Institute of Science Communication, New Delhi,, 116–117 (**2 pages**).

Ayinam, C., (1995). Ecology and ethnomedicine: Exploring links between current environmental crisis and indigenous medical practices. Soc. Sci. Med., 40 (3): 321-329 (**9 pages**).

Ayyanar, M.; Ignacimuthu, S., (2005). Traditional knowledge of Kani tribals of Kouthalai of Tirunelveli hills, Tamil Nadu, India. J. Ethnopharmacol., 102: 246-255 (**10 pages**).

Barbour, E.K., Mohammed Al Sharif, Sagherian, A.K., Habre, A.N., Talhouk, R.S., Talhouk, S.N. (2004). Screening of selected indigenous plants of Lebanon for antimicrobial activity. J. Ethnopharmacol., 93: 1–7 (**7 pages**).

Balick, M.; Cox, P.A., (2003). Plants that heal. In their book Plants, people, and culture: the science of ethnobotany. New York, USA. Sci. Am. Library, 25-61 (**37 pages**).

Beaglehole, R.; Irwin, A.; Prentice, T., (2004). The World health report 2004, changing history. Statistical Annex. Deaths by cause, sex and mortality stratum in WHO regions, estimates for 2002. WHO, Geneva, 120–122 (**3 pages**).

Bhalodia, N.R.; Shukla, V.J., (2011). Antibacterial and antifungal activities from leaf extracts of *Cassia fistula*l.: An ethnomedicinal plant. J. Adv. Pharm. Tech. Res., 2(2): 104–109 (**6 pages**).

Bletter, N., (2007). A quantitive synthesis of the medicinal ethnobotany of the Malinke of Mali and the Ashaninka of Peru, with the a new theoretical framework. J. Ethnobiol. Ethnomed., 3(36): 1-47 (**47 pages**).

Cowan, M.M., (1999). Plant products as anti-microbialagents. Clin. Microbiol. Rev.;12: 564–82 (**19 pages**).

Dahanukar, S.A.; Kulkarni, R.A.; Rege, N.N., (2000). Pharmacology of medicinal plants and natural products. Indian J. Pharmacol., 32: S81–118 (**28 pages**).

Drew, W.L.; Barry, A.L.; O'toole, R.; Sherris, J.C.M., (1972). Reliability of the kirby-bauer disc diffusion method for detecting methicillin-resistant strains of *Staphylococcus aureus*. Appl. Microbiol., 24(2): 240-247 (**8 pages**).

Eloff, J.N., (1988). Which extractant should be used for the screening and isolation of antimicrobial components from plants? J. Ethnopharmacol., 60: 1–8 (**8 pages**).

Fadeyi, M.O.; Akpan, U.E., (1989). Antimicrobial activities of the leaf extracts of *Eugenia uniflora* LINN (Synonm Stenocalyx Michelli LINN) myrtaceae. Phototherapy Res. J., (3): 154. (**2 pages**).

Geetha R.V.; Roy, A.; Lakshmi, T., (2011). Nature's Weapon Against Urinary Tract Infections. Int. J. Drug Dev. Res., 3(3): 85-100 (**16 pages**).

Golwala D.K.; Patel L.D.; Bothara S.B.; Patel P.M.; Vaidya S.K.; Raval, M.K., (2009). Analgesic activity of ethanolic leaf extract of *Pavetta indica*. Int. J. Pharm. Sci. Drug Res., (1): 119-120 (**2 pages**).

Guerrero, L.M., (1921). Medicinal uses of Philippines plants. Philippines Bur. Forestry Bull., 22: 149-246 (**97 pages**).

Heinrich, M.; Barnes, J.; Gibbons, S.; Williamson, E.M., (2004). Fundamentals of pharmacognosy and phytotherapy. Churchill Livingstone, Edinbrugh, 245–252 (**8 pages**).

IUCN, (2011). IUCN Red list of threatened species. Version 2011.1.

Jeruto, P.; Lukhoba, C.; Ouma, C.; Otieno, G.; Mutai, C., (2008). An ethnobotanical study of medicinal plants used by the Nandi people in Kenya. Journal of Ethnopharmacology 116, 370–376 (**7 pages**).

Kirthikar, K.R.; Basu, D.B., (2001). Indian medicinal plants, vol. 4, 2nd edn. Oriental Enterprises, Dehradun, 1255–1257 (**3 pages**).

Kumar, A. (2006). Sri Lakshmi Narasimha College of Pharmacy India. The 9th International Congress on Ethnopharmacology NICE.

Lulekal, E.; Asfaw, Z.; Kelbessa, E.; Damme, P.V., (2013). Ethnomedicinal study of plants used for human ailments in Ankober District, North Shewa Zone, Amhara Region, Ethiopia. J. Ethnobiol. Ethnomed., 9(63): 1-13 (**13 pages**).

Madulid, D.A., (2001). A dictionary of Philippine plant names. Bookmark, Inc. 1: 781 (**781 pages**).

Mandal S. C.; Lakshmi S. M.; Kumar C. K. A.; Sur T. K.; Boominathan R., (2003). Evaluation of anti-inflammatory potential of Pavetta indica Linn. leaf extract (family: Rubiaceae) in rats. Phytother Res. (17): 817-820 (**4 pages**).

Mason, T.C.; Wasserman, B.P., (1987). Inactivation of red beet betaglucan synthase by native and oxidized phenolics compounds. Phytochem., (26): 2197-2202 (**6 pages**).

McGregor, D.H.; Chu, L.L.; MacGregor, R.R. ; Cohn, D.V., (1997). Disruption of the Golgi zone and inhibition of the conversion of proparathyroid hormone to parathyroid hormone in human parathyroid tissue by tris (hydroxymethyl) aminomethane. Am. J. Pathol., 87(3): 553–568 (**16 pages**).

Murugan, M.; Mohan, V.R., (2011). Evaluation of phytochemical analysis and antibacterial activity of Bauhinia purpurea L. and Hiptage benghalensis L. Kurz. J. Appl. Pharm. Sci., 01 (09): 157-160 (**4 pages**).

Nikaido, H.; Vaara, M., (1985). Molecular basis of bacterial outer membrane permeability. Microbiol. Rev. 49: 1-32 (**32 pages**).

Owolabi, J.; Omogbai, E.K.I.; Obasuyi, O., (2007). Antifungal and antibacterial activities of the ethanolic and aqueous extract of Kigella africana (Bignoniaceae) stem bark. Afr.J. Biotechnol., 6: 882-885 (**4 pages**).

Penna, C.; Marino, S.; Vivot, E.; Cruanes, M.C.; de D Munoz, J.D.; Cruanes, J.; Ferraro, G.; Gutkind, G.; Martino, V., (2001). Antimicrobial activity of Argentine plants used in the treatment of infectious diseases: isolation of active compounds from *Sebastiania brasiliensis*. J Ethnopharmacol., (77): 37–40 (**4 pages**).

Prasuna, M.L.; Chandel, U., (2015). Studies of antibacterial activities of leaf extract of selected etheno –medicinal plants. IOSR J. Environ. Sci. Toxicol. Food Tech., 1(3): 65-66 (**2 pages**).

Quisumbing, E., (1978). Medicinal plants of the phils. Katha Publishing Co., Inc. 321-322 (**2 pages**).

Ren, W.; Qiao, Z.; Wang, H.; Zhu, L.; Zhang, L., (2003). Flavonoids: promising anticancer agents. Med. Res. Rev., (23): 519–534 (**16 pages**).

Rios, J.L.; Recio, M.C., (2005). Medicinal plants and antimicrobial activity. J. Ethnopharmacol., 100: 80–84 (**5 pages**).

Roy, A.; Gupta, V.K.; Kaur, C.; Simlai, A., (2013). Antimicrobial activity of pavetta indica leaves. J. Appl. Pharm. Sci., 3(4): 078-082. (**4 pages**).

Rojo, J.P., (1999). Revised lexicon of Philippine trees. Forest Products Research and Development Institute. Department of Science and Technology, (**484 pages**).

Sarac, N.; Ugur, A., (2007). Antimicrobial activities and usage in folkloric medicine of some Lamiaceae species growing in Mugla, Turkey. Eur. Asia J. Bio. Sci., (4): 28-37 (**9 pages**).

Selvamohan, T.; Ramadas, V.; Shibila Selva Kishore, S., (2012). Antimicrobial activity of selected medicinal plants against some selected human pathogenic bacteria. Adv. Appl. Sci. Res., 3 (5): 3374-3381 (**8 pages**).

Shaikh, D.; Malika, F.A.; Rafi, S.M.; Naqui B., (1994). Studies of antibacterial activity of ethanolic extract from *Nericum indicum* and *Hibiscus rosasinensis*. J. Islamic Acad Sci., 7: 167–168 (**2 pages**).

Shreedhara, C.S.; Vaidya, V.P.; Vagdevi, H.M.; Latha, K.P.; Muralikrishna, K.S.; Krupanidhi, A.M., (2009). Screening of Bauhinia purpurea Linn. for analgesic and anti-inflammatory activities. Indian J. Pharmacol., 41 (2): 75–79 (**5 pages**).

Tambekar, D.H.; Dahikar, S.B., (2011). Exploring antibacterial potential of some Ayurvedic preparations to control bacterial enteric infection. J. Chem. Pharm. Res. 5:494-501 (**8 pages**).

Thabrew M. I.; Joice P. D.; Rajatissa W., (1987). A comparative study of the efficacy of *Pavetta indica* and *Osbeckia octanda* in the treatment of liver dysfunction. Planta Med. (53): 239-241 (**3 pages**).

Torres, R.C.; Sison, F.M.; Ysrael, M.C., (2003). Phytochemical screening and biological studies on the Crude Methanol Extract of Cinnamomum Mercadoi, Vidal. Philippine J. Sci., 132 (1): 27-32 (**6 pages**).

Tsuchiya, H.; Sato, M.; Miyazaki J.; Fujiwara, S.; Tanigaki, S.; Ohyama, M.; Tanaka, T.; Inuma, M., (1996). Comparative study on the antibacterial activity of phytochemical flavanones against methicillin - resistant Staphylococcus aureus. J. Ethnopharmacol., (50): 27-34 (**8 pages**).

WHO, (1993). Summary of WHO guidelines for the assessment of herbal medicines. World Health Organization, Herbal Gram. 28: 13-14 (**2 pages**).

Ya, C.; Craffiney, S.H.; Lilley, T.H.; Hartam, E., (1988). Carbohydrate polyphenol complexation. In: chemistry and significance of condensed tannins. Hemingway, R.W. and kenchesy, J.J. (Eds). Plenum press, New York, (**553 pages**).

Zakaria, Z.A.; Wen, L.Y.; Abdul Rahman, N.I.; Abdul Halim, A.A.; Sulaiman, M.R.; Gopalan, H.K., (2007). Antinociceptive, anti-inflammatory and antipyretic properties of the aqueous extract of *Bauhinia purpurea* leaves in experimental animals. Med. Princ. Pract., (16): 443–449 (**7 pages**).

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