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ETHNOBOTANICAL AND ETHNOPHARMACOLOGICAL STUDY OF PLANTS USED BY THE DUMAGAT TRIBE IN ANGAT DAM WATERSHED, NORZAGARAY, BULACAN, PHILIPPINES

Lopez, John Angelo G. [1)], Camacho, Larien D. [1)], Dela Cruz[1)], Rachelle T., Perez, Kareen M. [1)], Tumale, Ara Nicole G. [1)], Jazul, Regina A. [1)]

1) Pharmacy Department, Centro Escolar University, Malolos,City 3000, Bulacan, Philippines

*Correspondence to: rjazul@ceu.edu.ph

Abstract: This research on Ethnobotanical and Ethnopharmacological study is a documentation of plants used by the Dumagat Tribe in Angat Dam Watershed, Norzagaray, Bulacan, Philippines. The researchers used snowball sampling technique as a method to identify potential subjects of the study. A total of 100 respondents were interviewed using validated semi-structured questionnaire including the demographic profile of respondents, together with the Ethnobotanical and Ethnopharmacological data of plants. It was noted that most of the respondents are aged between 51-59 years old, majority were male, married, catholic, with rattan making as their source of livelihood. 124 plants were collected and presented to the respondents and noted that leaves was the most frequently used part. The use value (UV), fidelity level (FL), and informant consensus factor (ICF) were calculated for each plant species used to treat various ailments. The plant with the highest use value was Blumea balsamifera (0.69) and the maximum fidelity level of 100% was found for 23 plant species. In the case of ICF, the highest value of 0.9501 was cited for diseases of the respiratory system. The wide variety of plants documented in Angat Dam Watershed can open path for furnishing novel information leading to future studies that would provide recognition of this undocumented knowledge to improve healthcare.

Keywords: Authentication, Indigenous People, Use Value, Fidelity Level, Informant Consensus Factor

INTRODUCTION

The use of herbal therapy has pronounced even in the ancient era and is still practiced in the present time. Of the 422,000 flowering plants found globally (Govaerts, 2001), more than 50,000 are used for medicinal purposes (Schippmann, et. al., 2002). The practices of plant-based traditional medicine are based on hundreds of years of belief and observations, which predate the development of modern medicine (Aburjai et. al., 2007). Philippine islands provide habitats for a variety of flowering plants, herbs, bushes, and trees, including many endangered flora. The country's archipelago offers the best habitats for the growth of some of the unique flora on the planet (Robinson and Madulid, 2012). In the age of fast innovations and uncountable ideas for the common good, there are still pieces of knowledge that remains untouched and overlooked. Indigenous knowledge is usually perceived as primitive and perhaps less technological in relation with modern methods (D. Srikantaiah, 2008), but in this study, it will be treated differently, for its potential of being a source of new discoveries.

The Philippines, a developing country in South East Asia, is a home to more than 110 ethno-linguistic groups (Balilia & McHenry, 2013). The fast-growing areas of medicinal innovation have influenced the healthcare system of the modern generation, but despite of this modernization, the majority of the Filipinos are still

practicing the traditional herbal therapy. In the different rural communities such as the Angat Dam Watershed Reservation in Norzagaray, Bulacan, the knowledge inherited bythe Filipinos from the great ancestors through oral tradition in the use of plants in treating different illnesses and minor illness is still being practiced. Angat Dam Watershed in Norzagaray, Bulacan serves as the primary habitat of the Dumagat tribe. Due to the geographical location of the Watershed, they do not yet embrace modernization. Nevertheless, accessibility to modern healthcare system is a major concern. The Dumagat tribe usually rely on farming and agriculture as their source of income, thus, their financial limitation make them incapable of availing modern medical treatment whenever they get sick. Accessibility to hospitals in the area is also a problem due to distance and difficulty of transportation. These concepts served as the fundamental idea for the researchers to document the traditional use of plants by the indigenous people living in the Angat Dam Watershed Norzagaray, Bulacan.

METHODS

Setting of the Study

The fieldwork was undertaken by the assistance of the Dumagat community on Angat Dam Watershed, Norzagaray, Bulacan, Philippines. According to the National Commission on Indigenous People, it has a population of 111,348. In the course of the survey, local forest guides or government units identified certain areas within the vicinity that cannot be surveyed for health and safety reasons. The survey was only conducted to selected sitios which are Sitio Pinag-anakan, Sitio Iyak, Sitio Pinagminahan, Sitio Manalo and Sitio Dyke. These geographical restrictions were, therefore, be respected by the researcher. Before the survey commenced, permits were secured from local government units within the area of survey. Permits were secured on the implicit understanding that human rights of the respondents must be respected, particularly with issues on privacy and anonymity, and that biodiversity rights must also be recognized to ensure that plants with threatened, vulnerable or endangered conservation status are preserved in their natural habitats.

Subject of the Study

Ethnobotanical and Ethnopharmacological data were obtained from the informants which includes forest guides, traditional healers (herbolarios, albolaryos), local leaders, farmers and other inhabitants who possess profound knowledge on plants, aged 18 and above with males and females from the Dumagat Tribe based on a survey questionnaire.

Accomplishment of IERC, NCIP and NPC Permit

In accordance with the legal requirements, researchers have accomplished IERC permit for the purpose of seeking approval regarding the use of humans as the subject in the study. An approval from the National Commission on Indigenous People was also fulfilled to gain permission on the involvement of Dumagat indigenous people in the study. In addition, a permit was secured from the National Power Corporation who is in-charge of the facility. The permit was granted and came to the agreement that the researchers are only allowed to collect the aerial parts of every plant sample.

Plant and Data Collection

Fieldwork was carried out for a total of 1 week during the months of October to November 2018 on Angat Dam Watershed. Plants were collected, tagged and preserved to dry for the purpose of authentication. The researchers used a snowball sampling or chain referral sampling which is a nonprobability technique and a leader of the Dumagat tribe was the first respondent of the study. The data were collected through interview with the aid of a semi-structured questionnaire which was validated prior to the interview. During the interview proper, the respondents were asked to identify the plants and photograph of each plant was shown to provide a more accurate answer from the respondents. The respondents were asked about their knowledge of the plants regarding its cultivation and method of collection. They were also asked what diseases were being treated by each plant, the parts of the plant used, the method of preparation, and

details concerning how each plant is administered to the respondents, how such knowledge is obtained and transmitted and the frequency of use.

Plant Authentication

The researchers selected various plant samples along the trail of the location and collect them by taking some of the aerial parts like leaves, stem, and fruits of each individual plant used for authentication process. The collected parts undergone simple method of preservation and after that the researchers contained the samples in the prepared plant press which served as temporary storage medium for the plants. All the collected plants samples were allowed to dry for some time and contained with the use of herbarium. The researchers sentthe plant samples to the authentication department of the University of the Philippines, Diliman, Quezon City which were examined and in turn be identified.

Data Analysis

Use Value of the Plants
The researchers computed the use value (UV) for plants to provide a quantitative measure for the relative importance of locally known species. The formula was: $UV=(\Sigma Ui)/n$, where Ui is the number of use-reports cited by each informant for a given species, and n refers to the total number of informants. Use values are high (approaching 1) was obtained when there are many use-reports for a plant, which implies that the plant is important, and low (approaching 0) when there are few reports related to its use.

Fidelity Level of the Plants
The fidelity value was computed to determine the most preferred species used for the treatment of a particular ailment because many plant species may be used in the same use category and the formula was $FL=Np/N$, where Np is the number of use-reports cited for a given species for a particular ailment, and N is the total number of use reports cited for any given species. High FL values (near 100%) were obtained for plants for which almost all use-reports refer to the same method of use (that is, the plants where considered the most preferred species for a particular ailment), whereas low FLs were obtained for plants that are used for many different purposes.

Informant Consensus Factor
In order for the researchers to determine the agreement between the informants over which plant is to be used for each category of ailment, informant consensus factor was calculated using the formula $ICF=(Nur-Nt)/(Nur-1)$, where Nur refers to the number of use-report in each category and Nt refers to number of taxa used for a particular category by all informants. It was interpreted as with the range of 0-1, where high use values (approaching 1) was obtained when there is a well-defined selection criterion in the community, in contrast, low use values (near 0) means that plants were chosen randomly and there was no exchange of information about their use.

Statistical Treatment of Data
Descriptive statistical method using the percentage, frequency, and rank were employed to analyze and summarize the ethnobotanical and ethnopharmacological data on the reported medicinal plants and associated knowledge. The percentage and frequency were used in presenting the demographic profile of the respondents as well as the ethnobotanical and ethnopharmacological data. The method of ranking was applied in obtaining the top ten medicinal plants that were mostly used by the respondents.

RESULT AND DISCUSSION

Profile of the Respondents
The profile of the respondents is being enumerated in terms of age, gender, demographic location, occupation, religion, marital status, highest educational attainment, average monthly salary. The majority of respondents are between the ages of 51 and 59 years, corresponding 68% of the total population surveyed. Most of the respondents are male (58%) and the female comprise 42% of the surveyed respondents. The total respondents are subdivided in five different sitios in which the most number of respondents are currently residing in Sitio Dyke (33%) followed by Sitio Pinag-minahan (22%), Sitio Iyak (18%), Sitio Manalo (15%), and Sitio Pinag-anakan (12%). Out of the total participants who responded to the questions, taking

rattan as their source of income obtained the highest value (38%), followed by being a fisherman (27%), farmer (22%), seller of livelihood products (8%) and the remaining 5% works as government officials. Majority of the respondents are Roman Catholics (51%), followed by Iglesia Ni Cristo (44%) and Jehovah's Witnesses which has the least member comprising of 5%.
The majority of the respondents are married (50%), followed by the singles (47%), and lastly by the widowed (3%). Among all of the 100 participants, almost all of the respondents don't have formal education comprising of 62%. Other respondents finished preschool (25%), followed by elementary (8%), and only few of them finished high school which comprises of 5%. All of the respondents who participated in the study (100%) are earning below the per capital income less than the official poverty threshold which means that they earn less than PhP 7, 890.00 per month and are therefore classified as poor.

Knowledge of Medicinal Plants
Out of the total respondents, 42% acquired their knowledge from their family, followed by herbolarios (39%), personal (10%) and the remaining 9% came from their neighbors. Out of the total respondents, 54% of the population acquire plant information through tradition, followed by 46% which learned through words of mouth, while none of them obtained their knowledge from trial and error.

Ethnobotanical and Ethnopharmacological Data of Plants
Most of the plants collected are obtained from the wild which comprises of (87.22%) and the rest of the other plants are cultivated having (12.77%), this value is dominated by plants used recreationally and usually used for non-medicinal purposes, little percentage only represent the cultivated medicinal plants.
Majority of the plants documented were collected through handpicking with 75.50% while the collection through mechanical means only comprises 24.50%.
Majority of the plants collected came from Sitio iyak (49%) followed by Sitio pinag-anakan (18%), Sitio Pinagminahan (13%), Sitio Manalo (11%) and Sitio Dyke (9%).
The main method of preparation was use of decoction (51.13%) followed by intact plants (24.11%), pounding or crushing (14.69%), burning and drying (3.58%), heating (3.30%) while steaming (3.20%) represented the least used preparation method). In other words, (38.80%) of the plants are used fresh while the majority are heated somehow comprising of (61.20%). (See Figure 1.) The characteristics of respondents obtained based on the results of the study are shown in table I as follows.

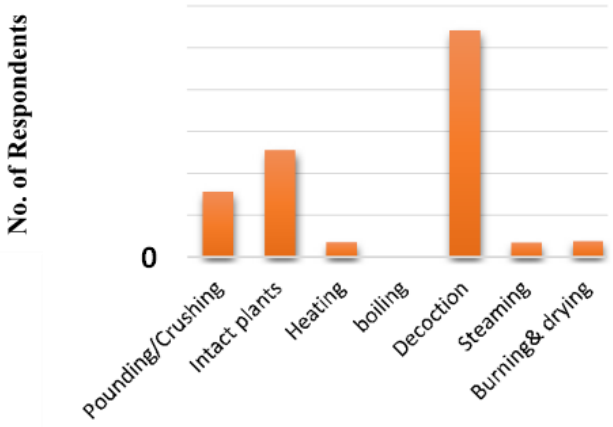

Figure 1. Profile of Plants in Terms of Method of Preparation

Majority of the plants collected in the area of the Angat Dam are used as a medicinal agent, various parts of these plants are utilized to treat different kinds of diseases. The most frequently used part is the leaves (58.62%) followed by the fruit (13.47%), bark (9.11%), root (6.59%), seed with (3.20%), resin (2.52%), whole plant and rhizome (1.84%), flower (1.45%), and lastly stem (1.36%). (See Figure 2.)

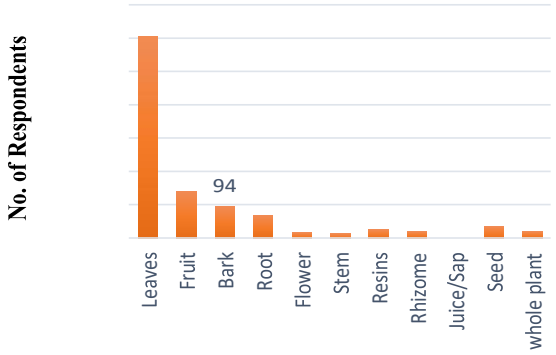

Figure 2. Profile of Plants in Terms of Plant Parts Used

The most treated body part is the abdominal area 28.96% followed by chest 22.11%, pelvic area 15.94%, skin 11.90%, head 9.76%, lower extremities 6.96%, blood 2.02%, mouth 1.23%, and lastly, the upper extremities 1.12%.
Majority of the plants collected are taken internally 66.57% while the remaining 33.43% are being utilized through external administration.
In terms of route of administration, most of the preparations were taken perorally, 66.50%; followed by topical administration, 27.55%; Oral, 5.55%; and lastly, inhalational 0.40%. There were no reported preparations for rectal use.

Use Value, Fidelity Level, Use Category, and Informant Consensus factor of various medicinal plants collected.

Table 1. TOP 10 Plants With High Use Value

Scientific Name	Use Value
Blumea balsamifera	0.69
Vitex negundo L	0.68
Dillenia philippinensis Rolfe	0.68
Psidium guajava	0.67
Chrysophyllum caimito	0.65
Lagerstonia speciosa (L.) Pers	0.64
Ananas comosus	0.61
Artemisia vulgaris L.	0.59
Premna odorata Blanco	0.56
Scoparia dulcis L.	0.56

The highest Use value obtained was 0.69, 0.68, and 0.67 were given to Blumea balsamifera, Vitex negundo L, and Dillenia philippinensis Rolfe, respectively. This means that the three plant species were most frequently used for their medicinal value while Narra and Malunggay obtained the lowest Use value (See Table 3) which was calculated at 0.01, which means that these are least used by the Dumagat people for medicinal value.

As to the plants Fidelity value, the researchers noted 23 plants species with a fidelity value of 100 %. This includes Bayabas, Buko, Chinese malunggay, Dilang baka, Duhat, Gabi, Guyong, Kamias, Kamoteng kahoy, Malunggay, Nito, Pandan, Pansit-pansitan, Patis-patisan, Rambutan, Saging, Santol, Suha, Talbak, Talong, Tuay, Wild Strawberry and lastly, Yantok. These plants therefore, are the most preferred species for treating certain ailment. The lowest Fidelity value was found to be Langka with 22.22%, indicating that it is the least preferred species for the treatment of a certain ailment. It was also noted that Bayabas for diarrhea, Talbak for edema and Santol for diarrhea were the plant species having the most number of use mentions.

The highest ICF value of 0.9501 was noted to be the Disease of the Respiratory System indicating that only one or few plant species were being used by high number of respondents for a particular category. Out of 21 plant species used for the Diseases of the Respiratory System, Lagundi obtained the highest number of use report corresponding to 402. Lowest ICF value was noted to be Disease of the Musculoskeletal System and Connective Tissue indicating that respondents disagree over which plant to use to treat a particular diseas category. Out of the 18 plant species reported to be used for the Musculoskeletal System and Connective Tissue. Alagaw got the highest contribution in the 100 use report. (See Table 2.)

Table 2. Informant Consensus Factor

Use Category	No. of Use Report	No. of Species	Most used species	ICF
Diseases of the respiratory tract	402	21	Lagundi	0.9501
Diseases of the eye	9	2	Takip-kuhol	0.8750
Diseases of the circulatory system	45	8	Amarillo	0.8409
Injury and poisons of external causes	96	10	Bayabas	0.905
Diseases of the genitourinary system	166	14	Banaba	0.9212
Undefined pains and illness	296	28	Kugon	0.9085
Diseases during the postpartum syndrome	185	19	Makahiya	0.9022
Infectious and parasitic diseases	49	7	Bunga	0.8750
Diseases of the skin and subcutaneous tissues	137	15	Gumamela	0.897
Diseases of the digestive system	414	28	Alateres	0.9346
Endocrine, nutritional and metabolic diseases	1	1	Palo Santo	0
Diseases of the musculoskeletal system and connective tissues	100	18	Alagaw	0.8282

CONCLUSION

This study confirms that wide variety of plants resides in Angat Dam Watershed, Norzagaray, Bulacan, Philippines, given the fact that they live within the immediate vicinity of the Angat Dam Watershed forests where various plant species can be found. It was also noted that various mode of administration and preparation was employed for every medicinal plants. Leaves was the dominant part used for medicinal preparations and aside from medicinal use, plants also provide a source of livelihood for the inhabitants.

Based on Use Value, Blumea balsamifera was noted to be the most frequently used plant among all the others collected while Pterocarpus indicus was concluded to be the least used plant. In terms of Fidelity Value, 23 species of plants were used as a treatment for a specific ailment. Additionally, the researchers conclude that the respondents consistently use few species in diseases of the Respiratory system. The documentation of this rich ethnopharmacological knowledge will open path for furnishing novel information and lead to future studies that would not only provide recognition of this undocumented knowledge but also could provide new avenues for pharmacological investigations to improve healthcare for a range of ailments and even possible discoveries for new active pharmaceutical ingredients which are still waiting to be further studied.

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