



ETHNOBOTANICAL PLANTS USED BY SELECTED INDIGENOUS PEOPLES OF MINDANAO, THE PHILIPPINES AS CANCER THERAPEUTICS

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ABSTRACT

In this study, twelve (12) ethnobotanical investigations on eight (8) ethnolinguistic groups of Mindanao, namely, B'laan, Higaonon, Maguindanaoan, Mamanwa, Manobo, Meranao, Subanen, and T'boli have been conducted to note their utilization and the mode of preparation of medicinal plants to treat various illnesses. In the advent of the growing threats brought about by climate change and other factor(s), a compilation of ethnobotanical studies conducted to assess and document plant species with high cultural value is necessary for conserving both traditional knowledge and plant resources. We compare data gathered from various ethnobotanical investigations to determine common species being utilized by different indigenous groups as well as to identify species that are unique only to a particular indigenous group. Being able to pinpoint these similarities and differences would allow a more profound understanding and appreciation of culture through various beliefs and practices. Two hundred seventy-five (275) species of medicinal plants were found to be utilized by eight different ethnolinguistic groups in Mindanao. These lists of medicinal plants are narrowed down into a list of specific illnesses and diseases that they cure viz; diabetes, stomach ache, toothache, hypoglycemia, tumorous growths, etc., according to the knowledge of the eighth ethnolinguistic groups. The lists narrowed down to sixty-nine (69) species under thirty-eight (38) families with sixty-six (66) genera that were listed to have anti-tumorous/cancer properties. Similarities and variations were observed in the number and species used in the treatment of tumors and cancers by the different ethnolinguistic groups. The preparations of these plants as medicine were in the form of decoctions, extraction of juices, infusions and taken orally or are eaten raw. Studies based on literature have shown that these plants were shown to be containing bioactive compounds known to have anticancer properties, thus may be considered as providing some biological basis for the claims of these ethnolinguistic groups. At present, there is a continuous evaluation of these ethnomedicinal plants for drug development and also for their conservation and protection. Results of the study have shown that the different communities of the ethnolinguistic groups vary in the utilization of different species of plants in the treatment of tumorous and or cancerous growths. Some share the same species, but there are also species that are only explicitly used by the specific group of ethnolinguistic groups. Literature has shown that these plants have compounds that have anti-cancer/tumor properties. Thus, it can be argued that the use of plant species to have ethnomedicinal properties against tumor/cancer by the different ethnolinguistic groups have a biological basis.

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Introduction

In many rural areas in Mindanao, the Philippines, quality of life of the poor people, especially the indigenous peoples, are greatly affected by the deplorable state of their health. The problem is attributed not only to their limited access in both private and government-owned health care services but also to the exorbitant cost of synthetic drugs. Thus, alternative sources of cure such as the use of medicinal plants are explored. There are 18 Lumad ethnolinguistic groups in Mindanao recognized by the Philippine government although are probably about 25 or more and 13 Muslim ethnolinguistic groups [1]. Most of these people dwell in the forests, mountains, lowlands, and coastal areas of Mindanao and only depend on their traditional knowledge in utilizing medicinal plants to treat various illnesses. The world health organization (WHO) estimated that about 80% of the population in the developing countries depends directly on plants for its medicine. Thus, as an initiative to preserve traditional knowledge and conserve plant species utilized as natural resources for health, this study assesses and document knowledge and practices of the indigenous peoples of Mindanao in the utilization of plants with medicinal properties primarily in the treatment of tumor/cancer, a leading cause of death worldwide [2]. Medicinal plant

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species, which are utilized for their natural products, have been used as a source of people's drugs for the treatment and prevention of diseases along with many disorders. Unfortunately, indigenous knowledge is disappearing swiftly [3], and this affects the passage of this knowledge from one generation to another. Efforts of the scientific community resulted in the development of databases and compilation of medicinal plants in the Philippines [4-6]. However, there is no existing comprehensive paper available for medicinal plants that can cure cancer/ tumor used by a specific group of tribes/ ethnolinguistic groups in Mindanao. In this study, the application of different techniques and approaches such as the use of data mining of the Philippine medicinal plants was employed to document the availability of plants used by the different ethnolinguistic groups in Mindanao, the Philippines, for future therapeutics especially for the cure of tumors/cancer. Data mining has been successfully employed in various researches and has been contributing to the discovery of new plants and herbs. Some of the investigations in data mining has led in the treatment of many diseases such as dysmenorrhea [7], diabetic nephropathy impairment [8], chronic cough [9], etc. Thus, it is argued that this study is able to construct a significant profile on different medicinal plants used by different tribes/ ethnolinguistic groups to cure cancer/ tumor, preserve and conserve traditional knowledge, and to contribute in continuous search of novel medicinal plants for future experimental and clinical studies.

Methodology

Data mining was used to seek and extract useful new information from survey research, unstructured, or semi-structured sources to address the most crucial questions [10]. This mining approach with some modification is adopted to supplement the data to be able to construct a significant profile on different medicinal plants used by the various tribes/ ethnolinguistic groups from Mindanao, the Philippines to cure cancer/ tumor. Unpublished research from the Department of Biological Sciences and Premier Research Institute of Science and Mathematics (PRISM) of the Mindanao State University- Iligan Institute of Technology (MSU-IIT) were also used. Information from databases like Stuartxchange [4] and other resources was checked to see which plants have also been used for cancer therapeutics. Scientific names and plant families were confirmed using internet sources such as taxonomic and pictorial keys from legitimate databases [5, 11] and journal publications [12-14] for literature on different plant species viz; the diseases that they cure and the compounds they contain that has anticancer properties. Compiled data from each study were encoded in excel spreadsheets and were grouped accordingly depending on the category. Graphical representations such as bar graphs, pie charts, and tables were used to present and compare ethnobotanical data.

Results and Discussion

Two hundred eighty-five (285) species of medicinal plants were found to be utilized by the different ethnolinguistic groups or tribes in Mindanao. For the treatment of cancer, the lists were narrowed down into sixty-nine (69) species (Fig. 1). The plant families utilized to treat cancer were Leguminosae (Fabaceae) (5), Meliaceae, and Clusiaceae (Guttiferae) (4), Compositae (Asteraceae), Lamiaceae, Malvaceae, Molluginaceae, and Zingiberaceae (3) (Table 1). Other plant families have 2 or 1 species each. Among the sixty-nine (69) medicinal plant species recorded, trees have the highest number (n=26), followed by species of herbs (n=24), shrubs (n=10), vines (n=6), and grasses (n=3) (Fig. 1).

Table 1. List of families of the documented medicinal plant species that can cure cancer/tumor

Family	No. of Species	Family	No. Of species
Acanthaceae	1	Lecythidaceae	1
Amaranthaceae	1	Leguminosae (Fabaceae)	5
Amaryllidaceae	2	Malvaceae	3
Apocynaceae	2	Meliaceae	4
Araceae	1	Moraceae	2
Basellaceae	1	Moringaceae	1
Brassicaceae (Cruciferae)	1	Molluginaceae	3
Boraginaceae	1	Muntingiaceae	1
Cannaceae	1	Oxalidaceae	1
Caricaceae	1	Piperaceae	2
Clusiaceae (Guttiferae)	4	Phyllanthaceae	2
Commelinaceae	1	Poaceae	2
Compositae (Asteraceae)	3	Rubiaceae	2
Crassulaceae	1	Rutaceae	2

Cucurbitaceae	2	Sapindaceae	2
Cyperaceae	1	Solanaceae	1
Euphorbiaceae	2	Vitaceae	1
Lamiaceae	3	Xanthorrhoeaceae	1
Lauraceae	1	Zingiberaceae	3

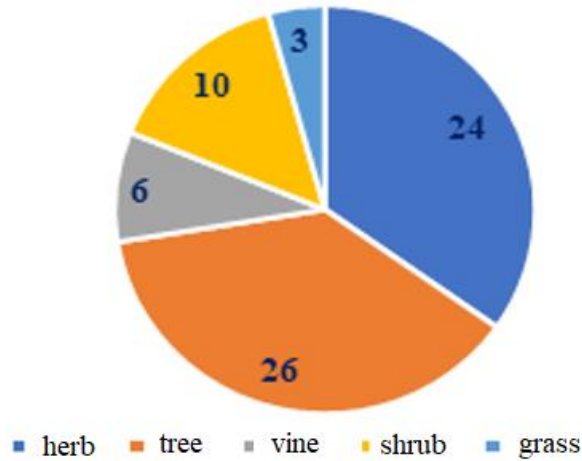


Figure 1. Number of species belonging to the different group of plants

Seriation analysis shows populations of the various communities of indigenous people's group had differences in the number and kind of plants used (Fig. 2). Meranaos have the highest number of reported medicinal plants while the Maguidanaoans have the lowest. Results showed that there are tribes that use particular therapeutic plant species that are unique to them. These species are *Celosia argentea* L., *Citrus maxima* (Burm.) Merr., and *Cardiospermum halicacabum* L., which is only utilized by Mamanwa; *Sesbania grandiflora* (L.) Pers. which is unique to the Meranao; *Calophyllum inophyllum* L., *Mollugo pentaphylla* L., *Litchi chinensi* Sonn., *Phyllanthus virgatus* G.Forst, *Rubia cordifolia* L., *Parameria laevigata* (Juss.) Moldenke, *Barringtonia racemose* (L.) Spreng., and *Calophyllum blanco* Planch. & Triana which are utilized by the Manobo; and lastly, *Mikania cordata* (Burm.f.) B.L.Rob., *Erythrina variegata* L., *Melia azedarach* L., *Abutilon indicum* (L.) Sweet, and *Ehretia microphylla* Lam. which is only utilized by the Subanen (Table 2). It can also be observed that there are species of plants that are commonly used by the communities within the different ethnolinguistic groups. For the five (5) communities of the Manobo tribe, the number of species used but not shared ranged from 1 to 6 species, in the four Higaonon communities ranged from two to five species, in the six Maranao communities the number range from 1 to 8 species, and for the two Mamanwa communities, the number was from 1 to 15 species (Table 2).

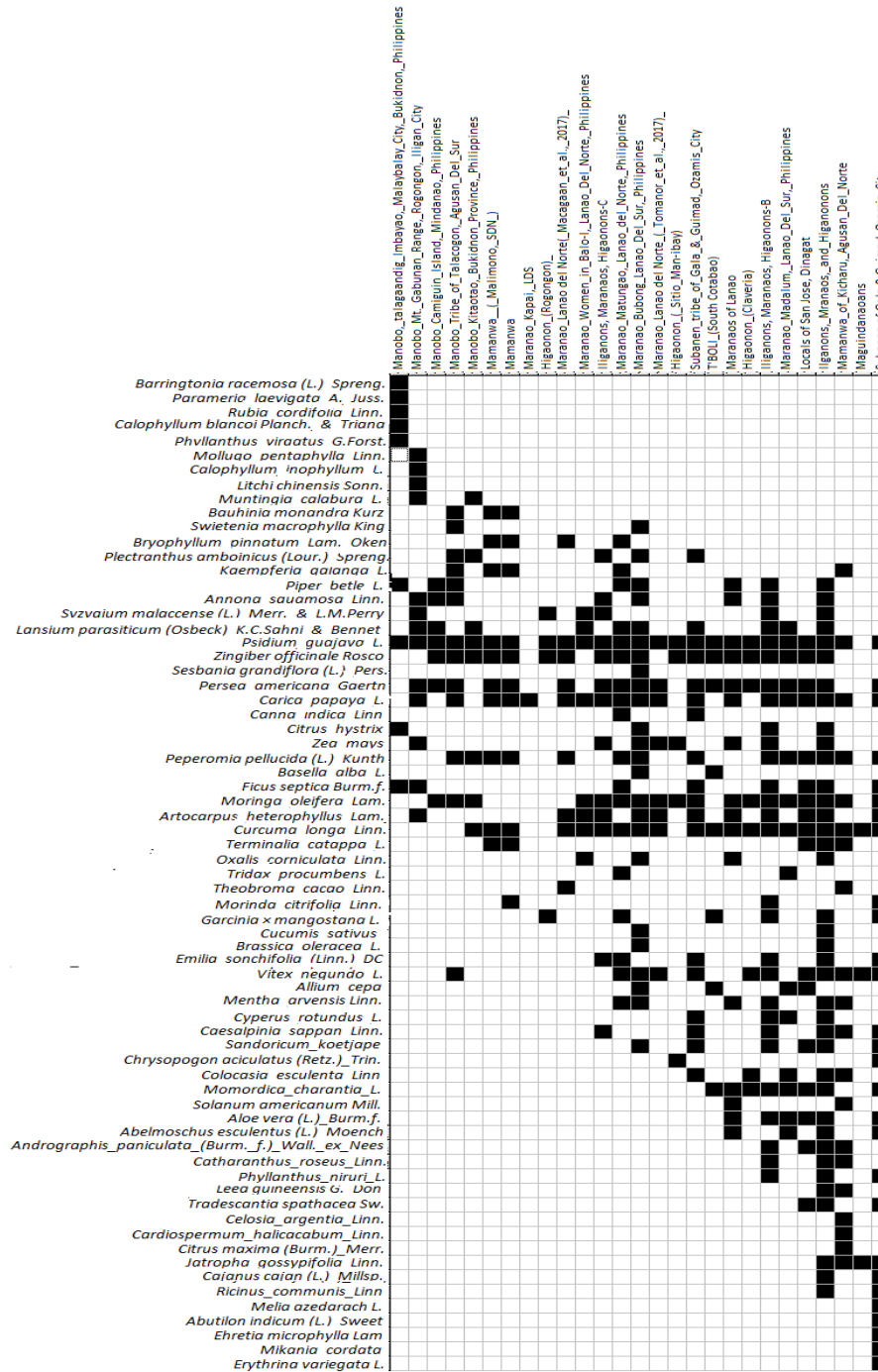


Figure 2. Seriation of data showing the medicinal plants used for cancer/tumor therapeutics by selected communities of indigenous peoples from Mindanao, Philippines.

Table 2. Variations between communities of ethnolinguistic groups in the utilization of plant species for the treatment of cancer/tumor.

MANOBO					HIGAONON			MAMANWA	
Talacogon, Agusan del Sur	Mt. Gabunan Range, Rogongon Area, Iligan city	Kitaotao, Bukidnon province	Imbayao, Malaybalay City, Bukidnon	Claveria	Rogongon	Sitio Man-Ibay	Claveria	Kicharu, Agusan del Norte	Malimono, Sultan Naga Dimaporo
<i>Bauhinia monandra</i> Kurz.	<i>Litchi chinensis</i> Sonn.	<i>Curcuma longa</i> L.	<i>Parameria laevigata</i> (Juss.)	<i>Momordica Charantia</i> L.	<i>Syzygium Malaccense</i> (L.) Merr &	<i>Zea mays</i> L.	<i>Momordica charantia</i> L.	<i>Jatropha gossypifolia</i> L.	<i>Morinda citrifolia</i> L.

			Moldenke		L.M.Perry				
<i>Vitex negundo</i> L.	<i>Syzygium malaccense</i> (L.) Merr. and L.M. Perry		<i>Rubia cordifolia</i> L.	<i>Curcuma longa</i> L.	<i>Garcinia x mangostana</i> L.	<i>Chrysopogon aciculatus</i> (Retz.) Trin.,	<i>Curcuma longa</i> L.	<i>Solanum Americanum</i> Mill.	
<i>Swietenia macrophylla</i> King	<i>Calophyllum blancoi</i> Planch and Triana		<i>Phyllanthus virgatus</i> G.Forst.	<i>Persea americana</i> L.			<i>Persea americana</i> L.	<i>Andrographis paniculata</i> (Burm.f.) Nees.	
<i>Kaempferia galanga</i> L.	<i>Artocarpus heterophyllus</i> Lam.		<i>Citrus hystrix</i> DC.	<i>Colocasia Esculenta</i>			<i>Colocasia esculenta</i> (L.) Schott.	<i>Celosia argentea</i> L.	
	<i>Mollugo pentaphylla</i> L.		<i>Calophyllum blancoi</i> Plach & Triana	<i>Vitex negundo</i> L.			<i>Vitex negundo</i> L.	<i>Caesalpinia sappan</i> L.	
	<i>Zea mays</i> L.		<i>Barringtonia racemosa</i> (L.) Spreng.					<i>Theobroma cacao</i> L.	
MERANAO									
Women in Balo-I, Lanao Del Norte, Philippines	Bubong Lanao Del Sur, Philippines	Madalum, Lanao Del Sur, Philippines	Matungao, Lanao Del Norte, Philippines	Maranaos of Iligan	Lanao del Norte			<i>Leea guineensis</i> G. Don.	
<i>Syzygium malaccense</i> (L.) Merr. and L.M. Perry	<i>Sandoricum koetjape</i> (Burm.f.) Merr.	<i>Colocasia esculenta</i>	<i>Garcinia x mangostana</i> L.	<i>Solanum americanum</i> Mill.	<i>Theobroma cacao</i> L.			<i>Colocasia esculenta</i> (L.) Schott.	
	<i>Swietenia macrophylla</i> King	<i>Cyperus rotundus</i>	<i>Canna indica</i> L.					<i>Vitex Negundo</i> L.	
	<i>Cucumis sativus</i> L.		<i>Emilia sonchifolia</i> (L.) DC. ex DC.					<i>Citrus maxima</i> (Burm.) Merr.	
	<i>Sesbania Grandiflora</i> (L.) Pers.		<i>Ficus Septica</i> Burm . F.					<i>Moringa oleifera</i> Lam.	
	<i>Citrus hystrix</i> DC		<i>Kaempferia galangal</i> L.					<i>Catharanthus roseus</i> (L.) G. Don.	
	<i>Brassica oleracea</i> L.							<i>Cardiospermum halicacabum</i> L.	
	<i>Plectranthus amboinicus</i> (Lour.) Spreng.								
	<i>Basella alba</i> L.								

A summary of ethnomedicinal preparation, and mode of application of the plant parts of the different species of plants used by the indigenous peoples are shown in Table 3. Plant parts are either boiled and drank, serve as a poultice, infusion, or plain topical application on the directed affected areas.

Table 3. Ethnomedicinal preparation, mode of application of the plant parts for cancer therapeutic use.

Species	Part Used	Preparation and Mode of Application
<i>Andrographis paniculata</i> (Burm.f.) Nees	Leaf	Decoction
<i>Celosia argentea</i> L.	Seeds, Leaves, Stems, Roots	Leaves are eaten raw; Decoction
<i>Allium cepa</i> L.	Whole	Extraction
<i>Annona squamosa</i> L.	Leaves	Mix with hot water
<i>Catharanthus roseus</i> (L.) G.Don	Whole Plant	Decoction, Infusion
<i>Parameria laevigata</i> (Juss.) Moldenke	Bark, Twigs, Leaves.	The bark is macerated in coconut oil

		pounded leaves and twigs Infusion and decoction
<i>Colocasia esculenta</i> (L.) Schott	Roots and Leaves	Decoction
<i>Basella alba</i> L.	Leaves	Decoction
<i>Brassica oleracea</i> L.	Seeds and Leaves	Decoction of leaves
<i>Ehretia microphylla</i> Lam.	Leaves and Roots	Decoction and infusion
<i>Canna indica</i> L.	Leaves and Roots	Direct application: maceration, poultice; decoction
<i>Carica papaya</i> L.	Young Fruit	Eat the young in raw
<i>Garcinia x mangostana</i> L.	Leaves	Boil the leaves and then drink a glass of it
<i>Calophyllum inophyllum</i> L.	Kernels, Bark, Leaves	Kernels are crushed and applied to body parts infusion or decoction of leaves
<i>Terminalia catappa</i> L.	Leaves, Roots, and Bark	Leaves mixed with oil are rubbed onto body parts. A decoction of bark and roots
<i>Tradescantia spathacea</i> Sw	Leaves	Decoction of leaves
<i>Emilia sonchifolia</i> (L.) DC. ex DC.	Whole	Wash the plant thoroughly and then soak in water and drink it as replacement of water
<i>Mikania cordata</i> (Burm.f.) B.L.Rob	Leaves and Roots	Pound and squeeze the juice to the affected area Wash the roots thoroughly, soak it in fresh water and then drink thrice a day
<i>Tridax procumbens</i> (L.) L.	Leaves	Decoction, Extraction
<i>Calophyllum blancoi</i> Planch. & Triana	Bark	A piece of cloth moistened with the sap of the bark applied to the breast
<i>Bryophyllum pinnatum</i> (Lam.) Oken	Leaves	Fever, boils, wounds, sprain
<i>Cucumis sativus</i> L.	Fruits, Seeds, Leaves	Raw fruit is peeled, sliced thin young leaves are eaten raw or steamed decoction of leaves
<i>Momordica charantia</i> L.	Fruit	Eat the fruit raw
<i>Cyperus rotundus</i> L.	Rhizome	Wash and sun-dry dried materials are boiled to concentration. Decoction
<i>Jatropha gossypifolia</i> L.	Seeds and Stem	Roast the seeds and pound thoroughly then mixed with tobacco ash and then apply to all the joints Scrape, then partly roast and then rub to the body
<i>Ricinus communis</i> L.	Stem	Scrape the stem, partly roast and then apply overnight
<i>Plectranthus amboinicus</i> (Lour.) Spreng.	Young Leaves	Heat the leaves with fire and extract. [at least 20 pieces of leaves]
<i>Mentha arvensis</i> L.	Leaves	Pounding
<i>Vitex negundo</i> L.	Leaves	Boil with water and drink thrice a day
<i>Persea americana</i> Mill.	Leaves	Boil the leaves usually mixed with leaves of guava and star apple and then drank thrice a day
<i>Barringtonia racemosa</i> (L.) Spreng.	Leaves	Decoction
<i>Bauhinia monandra</i> Kurz	Leaves	Decoction
<i>Caesalpinia sappan</i> L.	Leaves	Decoction
<i>Cajanus cajan</i> (L.) Millsp.	Leaves and Roots	Decoction or infusion of leaves roots and leaves are washed and then chewed.
<i>Erythrina variegata</i> L.	Roots and Stem	Scrape the roots and stem, partly roast them and then apply to the affected part
<i>Sesbania grandiflora</i> (L.) Pers.	Root, Flowers, Bark, Leaves.	Flowers and pods are eaten raw or steamed.

		A decoction of roots and bark
<i>Abelmoschus esculentus</i> (L.) Moench	Young Fruit	Soak the young fruit in water and drink
<i>Abutilon indicum</i> (L.) Sweet	Leaves	Partly roast and apply
<i>Theobroma cacao</i> L.	Fruit	Scrape the peeling of the fruit and apply around the boils or wound as a poultice
<i>Swietenia macrophylla</i> King	Bark	Decoction
<i>Lansium parasiticum</i> (Osbeck) K.C.Sahni & Bennet	Leaves, Bark, Resins	Decoction, Extraction
<i>Melia azedarach</i> L.	Leaves	Pound the leaves, extract the juice, mix with little kerosene, and apply to the affected area.
<i>Sandoricum koetjape</i> (Burm.f.) Merr	Roots	A decoction of roots and then drink
<i>Artocarpus heterophyllus</i> Lam	Leaves	Boil with water, drink thrice a day
<i>Ficus septica</i> Burm.f.	Leaves and Stem	Boil with water then drink twice a day Scrape the stem and then apply it overnight
<i>Moringa oleifera</i> Lam.	Roots, Seeds, and Leaves	A decoction of roots and or seeds and then drink thrice a day Pound the leaves and rub it to the affected area
<i>Mollugo pentaphylla</i> L.	Whole Plant	Decoction
<i>Psidium guajava</i> L.	Newly Sprouted Leaves and Young Leaves	Pound the leaves and rub it to the wound Boil with water and use the juice to clean the wound Boil with water and drink it thrice a day (usually mixed with avocado and star apple leaves) partly roast and apply overnight
<i>Syzygium malaccense</i> (L.) Merr. & L.M.Perry	Leaves	A decoction of the leaves and then drink as replacement of water
<i>Muntingia calabura</i> L.	Leaves and Flowers	Decoction
<i>Oxalis corniculata</i> L.	Entire Plants	Rinse, sun-dry Decoction of leaves
<i>Piper betel</i> Blanco (syn.: <i>Piper betle</i> L.)	Leaves	Apply the leaves upside down to the breast and back overnight
<i>Peperomia pellucida</i> (L.) Kunth	Whole Plant	Boil and drink at least once a day
<i>Phyllanthus niruri</i> L.	Leaves	Partly roast the leaves and then rub it all over the body (usually mixed with other herbal plants like guava leaves)
<i>Phyllanthus virgatus</i> G.Forst.	Leaves, Flowers, And Seeds	Decoction
<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Roots and Flower Stalk	Boil the roots and drink Extract the juice and drop to the bitten area
<i>Zea mays</i> L.	Leaves and Roots	Boil with water
<i>Morinda citrifolia</i> L.	Leaves	Apply overnight usually mixed with leaves of guava and wild tea
<i>Rubia cordifolia</i> L.	Roots, Stem, Leaves, Fruits.	Decoction
<i>Citrus maxima</i> (Burm.) Merr.	Newly Sprouted Leaves	Mixed in water used for taking a bath
<i>Citrus hystrix</i> DC.	Leaves	Boil with water, drink thrice a day
<i>Cardiospermum halicacabum</i> L.	Leaves and Roots	Decoction. Leaves are externally applied as oil embrocation.
<i>Litchi chinensis</i> Sonn.	Fruit, Seeds, Bark, Flowers.	Decoction fruit peel boiled until concentrated
<i>Solanum americanum</i> Mill.	Leaves	Young shoots, eaten after boiling
<i>Leea guineensis</i> G. Don	Roots, Branches, and Leaves	Decoction

<i>Aloe vera</i> (L.) Burm.f.	Leaves	Extract and juice and used it as shampoo every bath Extract the juice and then apply it to the affected area now and then
<i>Curcuma longa</i> L.	Stem/ Rhizome	Boil with water, drink thrice a day
<i>Kaempferia galanga</i> L.	Rhizome	Direct application, pounding, poultice
<i>Zingiber officinale</i> Roscoe	Rhizomes	Eaten fresh and or make it as candy or pound it then rubs to the affected part

There are already various pieces of literature that state natural products are major sources of anti-cancer agents. The use of these natural remedies has become popular because of the known toxicity of chemotherapeutics [15-20]. For the different communities of indigenous tribes in Mindanao, the use of medicinal plants to treat various ailments and other health care problems is vital to address their needs. Although this knowledge is passed down from generation to generation only by word of mouth without scientific explanations [21-26], still it can be argued that it has healing effects since it was used repeatedly by these peoples. Data mining studies of medicinal plant species report the existence of species with therapeutic properties but not commonly found to be used by the communities within the group. The absence can be attributed to the non-availability of the species in a particular area as well as differences in the beliefs and practices of these indigenous groups. Since cancer has become one of the most dreaded diseases in every country in the world [2], to intensify the efforts in searching for an effective and affordable cure, data mining is a helpful strategy in extracting indigenous medicinal plant sources for cancer/tumor treatment and prevention. Moreover, it could be expected that identified plants in the study may be useful for future experimental and clinical studies, and the development of future therapies for cancer.

Conclusion

The study has shown that the information generated from data mining published and unpublished sources can provide vital information in the identification of plant species for therapeutic use and treatment of cancer and tumor. Since the data is tribe-specific, it can be argued that their application has potentials for the development of drugs that are nature-based and less toxic. Since the Philippines is archipelagic, it is possible to have more plant species that can be of potential natural source of therapeutic drugs.

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