

Medicinal Plant Applications as Traditional and Complementary Medicine by Sabah Ethnicities and the Regulations and Economic View in Malaysia's Healthcare Industry: A Mini Review

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ABSTRACT

Plants containing medicinal and therapeutical properties have been utilized by societies around the world as their primary healthcare needs. Numbers of plants with pharmacological/medicinal benefits such as anticancer, antidiabetic, antimicrobial, and antiviral have been evaluated in research studies concerning the crude plant extracts and their phytochemical constituents. However, the traditional knowledge in Sabah, Malaysia is still under-documented despite the fact that it is the home for many different species of flora. Owing to the great biodiversity of different species of the medicinal plants in Sabah, a wide range of phytochemical compounds could be investigated and determined based on the traditional practices of the ethnicities there. The present review paper attempts to discuss the applications of these plants in Sabah in terms of Traditional and Complementary and Alternative Medicine (T&CAM) practices by five ethnicities namely, Kadazan/Dusun, Bajau, Murut, Lundayeh, and Rungus along with its advancements in scientific research to understand its effectiveness in treating intended illness or injuries with proper acknowledgement of the involved communities. Additionally, the economic aspects regarding the regulations and recognitions of medicinal plants and T&CAM practices in Malaysia will also be briefly discussed as natural products have now turned into a key issue in industrialized and developing nations.

Keywords: Biodiversity, Sabah, Traditional medicine, Ethnomedicine, Medicinal plants, Economic.

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INTRODUCTION

Sabah is located in East of Malaysia, at the great island of Borneo alongside Sarawak, Southwest of Malaysia and Kalimantan, Indonesia. Due to its unique geolocation, Sabah is referred to as the "land below the wind". It is considered the second largest state in Malaysia with its land measuring at approximately 1290 to 1450 kilometers long surrounded by the Celebes, Sulu and South China seas.^[1] The geographical structure of Sabah consists of mountainous regions, tropical rainforests and beaches. The vast land of Sabah comes with its richness of biodiversity ranging from different species of flora and fauna that are being explored every day. The conservation of biodiversity is regulated by the Sabah Biodiversity Centre located in Kota Kinabalu Sabah which was established in May 2008. Several of the protected biodiversity

and wildlife area are including the Crocker range, Danum Valey, Maliau Basin, Sepilok, Tabin, and the Kinabalu National Park which was established as a World Heritage site in the year 2000. Other than its richness in biodiversity, Sabah is also considered as a state with the most diverse demographic in Malaysia. Sabah is consisting of 42 different ethnicities with over 200 sub-ethnics.^[2] The diversified ethnicities had been praised by many for their ability to live in harmony with each other considering the differences in beliefs and religions alongside its culture and backgrounds. Sabah ethnicities include the Kadazan, Dusun, Chinese, Bajaus, Bruneians, Malays, Muruts, and many other Bumiputeras with the Kadazan, Dusun and Muruts (KDM) as the majority.^[2] Due to its rich resources of biodiversity and variations in demographic backgrounds, Sabah is a suitable place for the study of ethnomedicine within its scopes of medicinal plants.

Medicinal plant is a given term to various species of plants that are applied as herbal therapy or for consumption with regards to its phytochemical properties to cure illness or to act as health supplements.^[3] The discovery of medicinal plants is closely related to that of Traditional and Complementary and



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Alternative Medicine (T&CAM) practices across the globe. The characteristics of medicinal plants applications as treatments consist of synergic medicine usage (i.e. plants are mixed with each other to produce a synergistic effect), as additional medicine to conventional drugs, or as preventive medicine taken as supplements.^[3,4] With still arising interest and popularity among people, the T&CAM is regarded as an important industry alongside conventional medicine practices.^[5,6] However, many of the practices in medicinal plants applications are not well documented in Malaysia, specifically in Sabah. Additionally, these traditional knowledges given by the local communities are sometimes considered as a one-way street (i.e. lack of benefits shared by the product developer to the local community in return). This review intends to discuss the applications of these plants in

Sabah in terms of T&CAM practices along with its advancements in scientific research to understand its effectiveness in treating intended illness or injuries with proper acknowledgement of the involved community. Additionally, the economic aspects regarding the regulations and recognitions of medicinal plants and T&CAM practices in Malaysia will also be briefly discussed.

Medicinal Plant Applications as Traditional and Complementary Medicine

Medicinal plants used by the Kadazan/Dusun ethnicity in Sabah

Traditional medicinal plants have been used to cure and treat many infectious diseases by the local communities since generations to generations long before the introduction of modern medical systems.^[7] In recent years, most countries in the world has shown

Table 2.1: Medicinal plants used by the Kadazan/Dusun ethnic community based on the interview in Penampang, Tambunan and Keningau of Sabah.

Scientific name	Local name	Part used	Medicinal uses
<i>Acorus calamus</i> L. (Acoraceae)	Kamburongoh (Kadazan/Sabah) Jerangau putih (Melayu/Brunei)	Root	The fresh rhizome is eaten in order to relieve diarrhea, gastritis and also act as antidote to poison such as bee stings.
<i>Aloe vera</i> (L.) Burm. F. (Asphodelaceae)	Dihabuazo (Kadazan/Sabah) Lidah buaya (Melayu/Brunei)	Leaves	The sticky sap from the leaves are applied on skin to relieve itchiness, cuts, burns and also to relieve stomachache. In addition, the Bajau community also applied the plant leaves similarly to treat kidney stones. ^[14]
<i>Artocarpus heterophyllus</i> Lam. (Moraceae)	Nanko (Kadazan/Sabah) Nangka (Melayu/Brunei)	Leaves	Leaves are boiled and drank to relieve a sore throat. Heated leaves used to treat infectious skin daily.
<i>Annona muricata</i> L. (Annonaceae)	Hampun kapal (Kadazan/Sabah) Durian salat (Melayu/Brunei)	Roots	The roots are mixed together with the roots of other plants such as the <i>Imperata cylindrica</i> to treat fever and coughs. It is also a good addition to warm the body during cold weather.
<i>Areca catechu</i> L. (Arecaceae)	Lugus (Kadazan/Sabah) Pinang (Melayu/Brunei)	Seeds	The unripe seed is pounded where the juice is then applied to cuts and scabies. The seeds also are sometimes chewed with <i>Piper betle</i> as relaxant. In Chinese medicine, it is used to slow the heart rate and to decrease the blood pressure. ^[55]
<i>Piper betle</i> L. (Piperaceae)	Daing (Kadazan/Sabah) Sireh (Melayu/Brunei)	Leaves	Pounded leaves are applied on cuts, wounds, scabies, swollen and burnt areas. It is also used as preventive medicine to treat epilepsy and act as antibacterial. ^[56]
<i>Imperata cylindrica</i> L. P. Beauv. (Poaceae)	Paka (Kadazan/Sabah) Lalang (Melayu/Brunei)	Roots	The roots are boiled and cooked before it is consumed for treating chickenpox and fevers.
<i>Cymbopogon citrates</i> DC. Stapf (Poaceae)	Sagumau (Kadazan/Sabah)	Stem	The stem mixtures are consumed as a tonic drink.
<i>Hibiscus rosa-sinensis</i> L. (Malvaceae)	Tongkuango (Kadazan) Bunga raya (Melayu/Brunei)	Flowers, leaves and shoots	The flowers are crushed and the paste are applied to wounds and swollen areas. Similarly, the leaves are often pounded and are applied to cuts, swollen and sprain areas. Sap from the shoot of the plants are drank to treat breathing problems such as asthma.

interest in the collection and extended use of these traditional plants for medicinal purposes.^[8-10] In Sabah, various ethnicities who live in the interior/rural area (i.e. far from urbanization) believe that some of the traditional plants have the properties to treat diseases and had been practicing them with “claimed” success.^[11] Knowledge of medicinal plants is an important key for their survival because until today communities who live far from towns are still depending on the traditional medicinal plants. It is important to note that even with the availability of modern medicines, it is difficult to access to modern facilities provided by government from where they reside hence, traditional medicine is more acceptable by local community. There are more than 40 ethnicities that reside in Sabah; however, this review will only evaluate the medicinal plants used by five of the ethnic communities which are Kadazan/Dusun, Bajau, Murut, Lundayeh and Rungus. More studies on the other ethnicities should be carried out for future reviews.

The Kadazan/Dusun is the largest ethnic community in Sabah which traditionally celebrate the Harvest Festival annually on 30th & 31st May. This festival was celebrated to honor the ‘Rice Spirit’ and to give thanks for a plentiful harvest season. A previous survey conducted in the Penampang, Tambunan and Keningau of Sabah obtain many of the information about the medicinal plants used by Kadazan/Dusun ethnic group.^[12] The practitioners usually prepare traditional medicine either by; 1) casual and simple or 2) sophisticated method. For example, casual method involves only a single preparation using a plant material from a single species whereby this medicine is deliberately prepared for common ailments such as fever, cold, and stomachache. On the other hand, for the sophisticated method, the practitioner needs to mix various species of plants for a concoction recipe and depending on the ailments of the patients, the medicine is prescribed as liniments, infusions, decoctions, poultices, lotions, or tinctures. With reference to the study, some of the few medicinal plants’ applications used by the Kadazan/Dusun ethnic in Sabah are listed in Table 2.1.

Medicinal plants used by the Bajau ethnicity in Sabah

The Bajau ethnicity in Sabah is considered a minority when compared to the Kadazan/Dusun and Malays. They are however considered as the largest Muslim community in Sabah.^[13] A study carried out in Kota Belud (a district located on the West Coast of Sabah) on the Sama-Bajau community in the area gives a brief information on the traditional medicinal plants utilized by the local community there as shown in Table 2.2.^[14]

Medicinal plants used by the Murut ethnicity in Sabah

Murut people in Sabah often used the forest resources as their daily supplies and sometimes for their personal income. They usually sell wild vegetables, fruits and medicinal plants in the market or ‘Tamu’ as an additional income. A previous study

conducted on the review of medicinal plants used by the Murut ethnic community in Sabah gives several indications of their applications. Previous study focuses on several Muruts villages such as Kg. Melalap in Tenom, Kg Melinja and Bahagia B in Keningau, Kg Ulu Kalabakan in Kalabakan, and Kg. Murni Empat and Enam in Nabawan/Pensiangan of Sabah. Table 2.3 shows some of the medicinal plants used by the Murut ethnic community in Sabah.^[15]

Medicinal plants used by the Lundayeh ethnicity in Sabah

The Lundayeh ethnicity are considered a minority but resides in many parts of Sabah. Reference was made to the previous data that was collected at various Lundayeh villages in Sipitang such as Kg. Ranau-Ranau, Kg. Seri Menanti, Kg. Kaban, Kg. Ulu, Kg. Long Pa Sia and many more.^[16] There is not much left of the Lundayeh traditional medicinal plants because most of the younger generation depends very much on the modern medicine.^[16] However, the elders can still be found practicing and have the knowledge regarding the curative aspects of the community’s traditional plants. Table 2.4 shows the medicinal plants used by the Lundayeh ethnic community in Sipitang, Sabah.

Medicinal plants used by the Rungus ethnicity in Sabah

Lastly, a study has been conducted in 1995 in order to identify the medicinal plants used by Rungus community in Kudat, Sabah.^[17] The Rungus people are a part of the Kadazan/Dusun family. Traditionally, they live in a longhouse and many of them are still holding onto the spiritual beliefs, although some of them have religion. This study was conducted amongst traditional healers in villages near to Kudat. Table 2.5 shows the medicinal plants used by the Rungus ethnic community in Kudat, Sabah.

The Effectiveness of Traditional Medicinal Plants in Healthcare from Research Perspective

Advancement in the scientific research has paved its way to understand various kind of chemical compounds contained within medicinal plants. The increasing interest in medicinal plant research and analysis is reflected by a three-fold increment of publications from 4,686 during the year 2008 to 14,884 in 2018.^[18] The T&CAM practices are acknowledged as the “door opener” to the discovery of quality medicinal plants and the molecular structure and functionality of the chemical compounds contained within, which can be further explored and commercialized. It is important to note that the T&CAM is considered as a primary healthcare mode for approximately 85% of the world’s population.^[18] It is evidently supported by the fact that almost 80% of current synthetic drugs are derived from the medicinal plants.^[19] Several promising plants that are being utilized by local communities/ethnicities in Sabah have been the subject of research scientific studies and have

Table 2.2: Medicinal plants used by the Bajau ethnicity based on the interview conducted in Kota Belud, Sabah.

Scientific Name	Local Name	Part Used	Medicinal Uses
<i>Clinacanthus nutans</i> (Acanthaceae)	Belalai gajah	Leaves	The leaves are consumed to treat high blood pressure and diabetes.
<i>Annona muricata</i> (Annonaceae)	Durian belanda	Fruits & leaves	Similar to <i>Hydnophytum formicarium</i> applications by the Lundayeh ethnicity, <i>Annona muricata</i> are believed to cure cancer by means of drinking the leaves mixture or eating the fruits flesh. ^[16]
<i>Abelmoschus esculentus</i> (Malvaceae)	Kacang bendi	Fruits	Eaten as to act as preventive fever medicine and also to relieve flu.
<i>Curcuma caesia</i> (Zingiberaceae)	Kunyit hitam	Leaves	The leaves solution mixture is cooked and consumed to treat cough or simply by boiling the crushed leaves in hot water.
<i>Pandanus amaryllifolius</i> (Pandanaeae)	Pandan wang	Leaves	Use as supplements to reduce cholesterol level in the body.

Table 2.3: Medicinal plants used by the Murut ethnicity in Sabah.

Scientific name	Local name	Part used	Medicinal uses
<i>Justicia gendarussa</i> L. (Acanthaceae)	Insasahi	Leaves	The leaves are often boiled and drank to relieved stomachache.
<i>Cyathula prostrate</i> (L.) (Amaranthaceae)	Sansam Bawi	Leaves	The leaves are pounded into paste and are applied on skin to reduce itchiness from insect bites.
<i>Acorus calamus</i> L. (Araceae)	Kusul	Rhizome	The plants rhizomes are boiled and drank to treat stomachache and fever. The root is also known to be used by the Kadazan/Dusun ethnicity to relieve diarrhea, gastritis and also act as poison antidotes. ^[12]
<i>Oroxylum indicum</i> (L) (Bignoniaceae)	Ulanan sangku	Bark	The bark is first soaked in hot water before being applied on affected area to treat swelling.
<i>Coctus speciosus</i> Koen. (Costaceae)	Insasabu	Sap from the young stem	The sap from the young stem is consumed to treat asthma.

potential for future developments as shown in Table 3. For instance, Bajau ethnicity consumed the *Annona muricata* fruit or drink the leaves mixture as they believe that would treat or cure cancer. Their belief turns out to be correct and justified by multiple research studies as bioactive compounds such as alkaloids, annonacin, and acetogenins in the fruit and leaves are responsible in targeting and causing cancer cell death (i.e. anticancer properties against skin malignant melanoma, breast cancer, and pancreatic cancer).^[20] Additionally, phytochemicals from *Annona muricata* can modulate immune regulation and function as anti-inflammatory. Research studies also showed that each part of the *Annona muricata* (i.e. plant materials) contains different types and level of bioactive compounds, which render different kind of benefits and could be extracted using various kind of solvents.^[21] Some bioactive components may present when extracted using one solvent while some may require other type of solvent.^[21] Of note, there are more than 120 acetogenins have been reported from the leaves, seeds, pulp, stem, bark, and fruit peel of this plant.^[22] Other than that, *Aloe*

vera (L.) has been used mainly in cosmetic and dermatological products as it can improve the hydration of skin due to its high content of antioxidant properties, which slows down the aging processes.^[23] Presence of bioactive components like tannins, terpenoids and flavonoids gives the *Aloe vera* its antibacterial, antiviral, and antifungal properties.^[24] Moreover, saponin extract from the *Aloe vera* gel had shown antiseptic properties which was used against bacteria, virus and fungi.^[25] Previous study indicates that the leaf skin of *Aloe vera* contains the highest amount of saponin extract (1.212 mg/g) compared to the other parts such as tip leaf, middle leaf, bottom leaf, and leaf flesh (0.689 mg/g, 0.579 mg/g, 0.806 mg/g, and 0.253 mg/g, respectively).^[26] Of note, this finding together with the information about optimum extraction time, temperature, and solvent used from research studies would be beneficial to local communities (i.e. transfer of knowledge). In addition, *Piper betle* known as Daing or Sireh ground leaves are applied to cuts and scabies traditionally.^[12] Bajau and Kadazan women also have habits to chew the leaves along with areca nut, gambir, and lime from boiled sea shell to create sense of

Table 2.4: Medicinal plants used by the Lundayeh ethnicity in Sipitang, Sabah.

Scientific name	Local name	Part used	Medicinal uses
<i>Anisophyllea disichia</i> (Anisophylleaceae)	Lapad tulang	Root	The roots are soaked into water and massage to treat joints.
<i>Hydnophytum formicarium</i> (Rubiaceae)	Angang	The whole plant	Used to cure cancer or tumor.
<i>Curculigo latifolia</i> (Hypoxidaceae)	Tambaka	Rhizome	The rhizomes are warmed for external application such as abdomen pain.
<i>Garnotia acutigluma</i>	Udu bulu	Root	The roots are ingested to treat venereal diseases which is a type of a sexually transmitted disease.
<i>Lophatherum gracile</i>	Both this plant and <i>Garnotia acutigluma</i> are referred locally as Udu bulu	Rhizome	The plant rhizome is taken as supplements to treat pancreas disease.
<i>Hanguana malayana</i> (Hanguanaceae)	Bunga	Fruit	Fruits are crushed and applied to affected area to treat fungal skin infections.
<i>Psidium guajava</i> (Myrtaceae)	Giabas	Young leaves	Young leaves are taken through ingestion or infusion to treat diarrhea.
<i>Lygodium salicifolium</i> (Schizaeaceae)	Ubat amur	Whole plant	Washing or bath to prevent small-pox and chicken-pox.

Table 2.5: Medicinal plants used by the Rungus ethnicity in Kudat, Sabah.

Scientific name	Local name	Part used	Medicinal uses
<i>Blumea balsamifera</i> L. (Asteraceae)	Tawawo	Roots and leaves	Roots and leaves are boiled and drank to expel tape worms. In addition, these plants are used by the Kadazan ethnicity to relieve the pain during childbirth and also for wound healing treatments. ^[12]
<i>Cassia alata</i> L. (Fabaceae)	Kurubau	Root	The root decoction is consumed to relieve stomachache.
<i>Dillenia indica</i> L. (Dilleniaceae)	Pampan	Stem and bark	Stem and bark decoction are used as a mouthwash and drank to relieve toothache.
<i>Eupatorium odoratum</i> L. (Asteraceae)	Gonol	Leaves	Pounded leaves are used to treat wounds.
<i>Flagellaria indica</i> L. (Flagellariaceae)	Sogoto tumolong	Root	Roots decoction are consumed to treat vomiting, influenza and coughs.

euphoria, warm sensation of the body, heightened alertness, and increased capacity to work.^[27] Many studies have been conducted to study the benefits of this plant with many of them had confirmed that the *Piper betle* leaves can be used to treat inflammation on oral cavity.^[28] Allylpyrocatechol, which is extracted from the leaves of the plant had also been found to inhibit oral anaerobes that are responsible in producing mouth odor.^[29] Oral cancer is common to indigenous people of Sabah because of their habit in chewing and smoking tobacco, thus this can pave a way in reducing this rate in the local communities. A study conducted using cream formulation containing 10% of *Piper betle* to treat Wistar albino female rats shows a significant result when compared to control group.^[30] The polyphenols in *Piper*

betle are associated with antibacterial activity they can inhibit Gram-positive and Gram-negative bacteria such as *Staphylococcus cohnii*, *Micrococcus luteus*, *Salmonella enterica* and *Pseudomonas aeruginosa*.^[31] Other than that, *Clinacanthus nutans* leaves are consumed for general health such as controlling diabetes in various South East Asia countries. Research study by Imam and his colleague corroborates the efficacies observed in its traditional as type II diabetic induced-rats treated with *Clinacanthus nutans* extract showed significantly lower fasting blood glucose level and total cholesterol when compared with the control group.^[32] Other than that, phytochemicals in *Clinacanthus nutans* such as 1,2-O-di linolenoyl-3-O-β-d-glucopyranosyl-sn-glycerol, trigalactosyl, and digalactosyl diglyceride compounds have anti-viral activities

Table 3: Scientific and local name of the plants and the presence of active compounds contributing to their medicinal properties.

Scientific name	Local name	Traditional usage	Medicinal properties	Active compound
<i>Areca catechu</i>	Lugus (Sabah) Pinang (Malay/ Brunei)	Seed is warped with leaves of <i>Piper betle</i> as a relaxant. Unripe seed is ground and the juice is applied on cut and scabies.	This plant exhibits antimicrobial properties against human and fish pathogens. It can also inhibit oral microbes such as <i>Streptococcus mutans</i> , <i>Fusobacterium nucleatum</i> and <i>Streptococcus aureus</i> . However, chewing of this plant nut is not recommended. ^[57]	Tannin (phenolic acid) Alkaloids ^[57]
<i>Carica papaya</i>	Tepayas (Sabah) Kepayas (Dusun/ Brunei) Betik (Malay)	The root is boiled with water for birth control, uterine contraction after childbirth and to counter menstruation problem.	Papaya contain active compound in leaves and seeds which has antibacterial and antimicrobial activity. Flavonoids in papaya have anti-inflammatory properties. ^[58]	Flavonoid Alkaloids Tannins Steroids Saponins
<i>Centella asiatica</i>	Pegagoh (Sabah) Pegaga (Malay/ Brunei)	The plant is boiled and consumed for treating hypertension, diarrhea and for urinary infection. It also acts as detoxicant, used to lower blood and slow the heart rate.	This plant can be used in wound healing by increasing production of collagen and cellular proliferation. It is also an excellent anti-inflammatory agent and can be used to reduce sensitivity of pain. ^[59]	Saponins Tannins Flavonoids Alkaloids Phenolic acids
<i>Garcia parvifolia</i>	Takod-akod (Sabah) Kedundong (Brunei)	The fruit usually eaten raw or added into food for additional flavor.	Presence of active compound in this plant associated with antimicrobial and antibacterial activities. In addition, it can reduce chance of atherosclerosis. ^[60,61]	Alkaloids Flavonoids Steroids Terpenoids Phenolic compounds
<i>Hibiscus rosa-sinensis</i>	Tongkuango (Kadazan) Bunga Raya (Malay/ Brunei)	The leaves of this plant are ground as a paste to be applied on swollen finger, cut and sprains. Sap extract from shoot can be consumed to treat asthma.	The leaves and flower can help in aiding to heal ulcer and promote hair growth. Extraction of the flower with ethanol can be used in wound healing. ^[62] A study also shows its effect in hypolipidemic and hypoglycemic activities. ^[62]	Flavonoids Phenolic compounds Anthraquinones Alkaloids Saponins Terpenoids ^[63]
<i>Imperata cylindrica</i>	Paka (Sabah) Lalang (Malay/ Brunei)	Root of the plant is boiled and consumed to cure fever and chickenpox.	This plant has high content of antioxidants activity. The root of the plant can be used to treat nosebleed, jaundice, blood urine and haematemesis. ^[64]	Flavonoid Phenolic compound

Scientific name	Local name	Traditional usage	Medicinal properties	Active compound
<i>Nicotiana tabacum</i>	Sigup (Kadazan) Tembakau (Malay/Brunei)	Ground leaves are used for wound, cut or insect bites.	Tobacco was found to promote wound healing. ^[65] Additionally, other study stated that tobacco can also be applied as a biodegradable and non-toxic sedative when transporting live fish replacing other commercial drugs. ^[66]	Alkaloids Cardiac glycosides Resins Phenolic compounds Polyphenols Flavonoid ^[67]
<i>Physalis minima</i>	Tulapak (Sabah)	Juice of plant can be consumed to cure malaria, hypertension and diabetes	This plant has the potential as an anti-inflammatory and anti-cancerous agent. A study conducted by using methanolic extract with the leaves has potential to treat ulcer. ^[68]	Arachidic acids Alkaloids Linoleic acids
<i>Psidium guajava</i>	Liabas/Siabas (Kadazan) Biabas (Dusun, Brunei)	Young leaves of this plant are used to relieve diarrhea and stomachache by steeped them in hot water and drink it.	The leaf extract can be used to relieve cough. The leaf and bark have high antimicrobial properties which can inhibit bacteria such as Salmonella and Bacillus. Guava also has anti-inflammatory and anti-diarrheal activity. Besides, ethanolic extract of guava can increase sperm production. It can be used to treat infertility in males. ^[69]	Tannin Polyphenols Phenolic compound Flavonoid Triterpenoid acid Alkaloid Saponin ^[70]
<i>Sida rhombifolia</i>	Lingkabau (Kadazan) Timah-timah (Brunei)	Ground leaves are used to cure swelling and headache. Root of the plant can be consumed to treat diarrhea.	This plant shows potential as antioxidant, antibacterial, antifungal and anti-inflammatory. The stem of the plant can be used for tooth brush. The leaves and barks also can be used in wound healing. Flavonoids present in this plant can be used to treat anxiety. ^[71]	Alkaloid Saponin Terpenoids Flavonoids Steroid Phenolics
<i>Alpinia galanga</i> and <i>Kaempferia galanga</i>	Halia (Malay/Brunei)	The rhizome is usually cooked alongside food or boiled in water before consumed. It is taken to reduce fever, coughing, bloating and migraines. Some even use it to increase fertility.	The rhizome of both plants was proven to content pharmacological activities such as antimicrobial, antioxidant, anti-inflammatory and analgesic, and anticancer. Both plants were proven to inhibit the growth of bacteria such as <i>Staphylococcus aureus</i> , <i>Bacillus cereus</i> and <i>Salmonella thyphimurium</i> . ^[72]	Saponins flavonoids tannins steroids phenols terpenoid

against *Herpes simplex virus* (HSV).^[33,34] Moreover, *Clinacanthus nutans* extract has antioxidant properties as it can reduce oxidative free-radical production by phorbol 12-myristate

13-acetate (PMA)-stimulated rat macrophages while also been postulated to have anti-proliferative effects towards cervical cancer cell line.^[35] Moreover, ethanolic extract of *Clinacanthus*

nutans could also reduce tumor growth in a mouse HepA hepatoma model, producing better result than an established chemotherapeutic drug, namely fluorouracil.^[36]

Medicinal Plants Regulations and Economic Views in Malaysia's Global Healthcare Industry

The medicinal plants are considered as an important economic contributor to the healthcare system of a developing country when faced with a constant threat of global economic recessions.^[37] Economic recessions will not only affect the economy of the country but also its people which can be observed during the COVID-19 pandemic crisis. Most conventional medicine becomes an expensive choice for many, especially in private sectors thus creating a necessity for finding alternative treatments. T&CAM has been acknowledged in bringing significant value to the expenditure of developing health treatments for human beings which had been practiced for thousands of years.^[38] Globally, T&CAM is considered to be a good value for consumers that emphasize on a healthy lifestyle.^[39,40] People opt for medicinal plants as their alternative or main treatments for their illnesses due to its availability and can be purchased at affordable prices when compared to conventional drugs, which sometimes can be rather expensive.^[41] Furthermore, modern societies still maintain their high beliefs in the effectiveness of traditional medicine therapy even though modern medications of the same treatments had already been prescribed in the public hospitals.^[42]

T&CAM is a fast-growing industry not only here in Malaysia but also globally. Most of the industry growth are impacted by the increase in the demand of herbal-based supplements, plant-based beauty products, and natural food.^[43] The market size for global medicinal herbs products in was reported at USD 151.91 billion in 2021 and are expected to rise further to USD 165.66 billion in 2022 and can reach up to USD 347.50 billion by 2029 with a compound annual growth rate (CAGR) of 11.16%.^[44] In many Western countries, most cancer patients (40-90%) prefer to use T&CAM application with or without conventional medications.^[45-47] Accordingly, Malaysian population were reported to have a high prevalence in herbal consumptions with many of them applying it for health maintenance and health problems treatments.^[48] Today, the global herbal industry is significantly influenced by both India and China that exports 32, 000 and 120, 000 tons of herbal-based medicines annually, respectively with Europe as their major consumer.^[37] As expected, this value will further increase considering that the number of national research institute for T&CAM in the world had also increased by 74.7% since 1999 with South-East Asia region having the highest number of expert committees for T&CAM.^[49] Furthermore, it was reported that the regulations of herbal medicines had also increased by almost 50% with most of them being exclusive or partially exclusive to medicinal plants. Both the herbal industry and T&CAM are considered to be closely linked

in their importance towards the country's economy. Additionally, Malaysia's new key economic areas (NKEA) entry point project (EPP) in regards to herbal industry is considered align with the T&CAM regulations as stated by Malaysia's Ministry of Health (MOH).^[43] This just shows that the T&CAM practices at global scale are getting more recognition with its growing number of improvements and regulations.

Although the developments of drugs had been tremendously successful along the years with the advancement in production of synthetic compounds, medicinal plants are still considered as an important initial point for finding new discoveries in treating illnesses.^[37,50] The practices of T&CAM as stated in the Laws of Malaysia under Act 775 Traditional and Complementary Medicine Act, (2016), includes practices such as traditional Chinese medicine, homeopathy, traditional Indian medicine, complementary therapies, Islamic medical practices and traditional Malay medicine. The listed practices, however, is nowhere near as complete considering there are many more ethnicities of various background here specifically in Sabah. It is of importance to note that there is only a total of nine public hospitals in Malaysia that integrates the practices of T&CAM within their treatment protocols with one of them in Sabah at the Duchess of Kent Hospital located in Sandakan.^[38,51] The incorporation of CAM practitioners should be made available in many more governmental sectors considering its lower-cost approaches which may benefit the people and the healthcare systems.^[52]

As already stated, T&CAM practices are not considered new in Malaysia healthcare industry and even so globally. There has been assimilation of T&CAM practices which contributed to the positive changes in modern healthcare system.^[53] However, there are many aspects that still need to be improved with the consideration of the national regulations of Traditional and Complementary Medicine Act 2016. The current applications and commercialization of these plants seems to be often unregulated and poorly studied which is a major concern thus the need for quality control testing and clinical trials which can give the products a scientific prove of effectiveness.^[37,54] It is therefore, calls for improvements to the already existing regulations with proper guidance to the people before enforcement by authorities can be made.

CONCLUSION

The utilization of medicinal plants as T&CAM is increasing in popularity at the global scale. In recent years, more countries had taken into notice some of its importance in healthcare and commercial values. Sabah is a state rich with abundance of biodiversity resources and cultures with a potential of major development and expenditure towards its healthcare industry. Medicinal plants used by the local communities from several ethnics in Sabah shows these potentials of treatments

for illnesses such as coughs, fevers, wounds, stomachache, diarrhea, chickenpox, influenza and many more. T&CAM practices in Sabah are still considered pre-mature and are not yet properly regulated by the governmental bodies. However, it is acknowledged that there had been several movements towards this regulations and developments such as the Traditional and Complementary Medicine Act, (2016) and also several other programs carried out by the Sabah Biodiversity Centre. The potential of Malaysia T&CAM practices using medicinal plants especially here in Sabah still have a long way to go for its future commercialization. Although there had already been many efforts in studying its potential, a more comprehensive design of product development must be considered for future studies. Furthermore, with the available modern technology that we have today in the field of medical sciences, a much-needed foundation which grants access to these plants reserved natural compounds can surely be achieved as had been seen in several other past studies. Finally, the importance of cultural preservation and community involvements in the development of these medicinal plants should also be considered to appreciate the traditional knowledge given by the communities.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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