

META-ANALYSIS ON ETHNOPHARMACOLOGICAL AND PHYTOCHEMICAL CONSTITUENTS OF ANTIPYRETIC PLANTS IN THE PHILIPPINES AND ITS IMPLICATION TO INDIGENOUS EDUCATION

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ABSTRACT

Traditional medicine supports the indigenous people to survive in times of pandemic. This form of survival made an interest in pharmaceutical companies. The researchers aimed to determine indigenous plants that contain antipyretic phytochemical constituents as one of the characteristics of NSAIDs and the implications of this traditional knowledge of Indigenous Education into their culture. This study is a meta analysis review that uses thematic and content analysis together with the expression of quantitative results of the present primary and secondary metabolites found in the antipyretic plants. In addition, it used an ethnopharmacological approach in determining the antipyretic properties of the indigenous plants. Findings revealed that there are ten commonly used Antipyretic indigenous plants in the Philippines. These antipyretic plants consist mainly of Flavonoids, Alkaloids, Tannins, and Saponins and based on the reviews, Flavonoid acts as NSAIDS and is found to have Antipyretic property. Added to these, nine of these plants contain flavonoids. Lastly, it was found that indigenous knowledge in the use of medicinal plants is still put into practice by the indigenous people in the Philippines. The study recommends that these plants will be explored and subjected to antipyretic clinical studies

Keywords: antipyretic plants, ethnopharmacological; citation frequency; indigenous education; NSAIDS, phytochemical constituents

INTRODUCTION

Indigenous knowledge mirrors its culture. In the Philippines, the country possessed an archipelagic characteristic that was blessed with richness in floras and faunas, marine biodiversity in pelagic seas, and diverse cultural differences in more than 7,000 Philippine islands. One proof of abundance in biodiversity is endemic species of plants and animals that consist of more than 20,000 species (Conservation International, DENR- PAWB, Haribon Foundation, n. d.). In

addition, the country's evidence of invasion of different races is the intercultural traditions that overlap both Western and Eastern cultures, but one of the best practices is cultural preservation, among these are the preservation of 100 indigenous communities and 175 ethnolinguistic groups including traditional practices such as superstition, herbalism, and indigenous knowledge. Traditional medicine survives in the different eras of pandemics. These surviving methods without the use of western medication nailed the interest of pharmacological companies

P – ISSN 2651 - 7701 | E – ISSN 2651 – 771X | www.ioer-imrj.com

DE GUZMAN - MANECLANG, R.A. C., TOMAS, E.A., CORTEZ, L.A.S., *Meta-Analysis on Ethnopharmacological and Phytochemical Constituents of Antipyretic Plants in the Philippines and its Implication to Indigenous Education*, pp. 52 - 63

to explore the diverse biodiversity of floras and faunas in the Philippines. The complex structure of plants and diversified phytochemical components proves the therapeutic potential to be more efficient in long-term remedies, which encompass thousands of years in sustainability (Garcia, 2020).

One of the most important and widely practiced aspects of Philippine traditional medicine is the use of indigenous plants. These have become an important component in the provision of safe, effective, and cheap health care for the Filipino people since they are a part of local culture and beliefs. Filipino people's traditional knowledge is a valuable resource that should be preserved. Traditional knowledge has been steadily disappearing due to technological advancements in the modern world, and only a few cultures still practice traditional and botanical knowledge. Western acculturation and modernization have put this expertise at risk in the Philippines. As cited by Tantengco et al., (2018) there is a need for systematic documentation of the traditional knowledge of indigenous peoples before it is lost.

Moreover, before the many advancements in medicine and drug production in the Philippines, people utilized and believed in natural products with healing properties such as plants, minerals, and animals (Baddu et al., 2018). Ethnic communities in Luzon have been using various plants as remedies to cure various diseases such as fever, which directly indicates plants are the best sources of natural antipyretics (Affifudden et al., 2015).

As a result of the challenges of a rapidly changing world, along with modernization and industrialization, organisms can be affected by various diseases and genetic alterations because of several contributing variables including the organism's environment. Fever is one of the most prevalent ailments that might have an impact on an organism's physiological aspects. The rise in body temperature over its usual homeostatic level is known as pyrexia or fever. When an organism experiences an increase in thyroid secretion, nervous system lesions, microbial infection, and even leukemia, pyrexia is the fundamental hallmark of physiological stress. Over-the-counter medications, such as analgesics, can help ease

the symptoms induced by pyrexia or fever. NSAIDs, or Non-Steroidal Anti-inflammatory Drugs, are commercially accessible analgesics. Abuse of analgesia substances, or excessive consumption of these synthetic drugs, can affect organ systems and produce structural problems such as gastrointestinal bleeding, indigestion, ulcers, and dyspepsia (Affifudden et al., 2015).

For these concerns, individuals often turn to traditional medicine, such as Antipyretic herbs, to treat fever. Ethnopharmacology is a method used by researchers to explore these treatments. Ethnopharmacology is a broad field that includes natural science research, indigenous science education, herbal medicine, and intercultural variations in social situations, all of which contribute to the discovery of novel medical medications. The phytochemical components or metabolites present in plants that constitute pharmacological value, where it predominantly composes the Primary and Secondary metabolites as natural components in treating various ailments, are the therapeutic qualities.

OBJECTIVES OF THE STUDY

This study aimed to provide analysis on the ethnopharmacological studies and phytochemical constituents of the indigenous antipyretic plants in the Philippines and cite the frequency of the Antipyretic plants in different areas in the Philippines. This study specifically sought to answer the following: 1) Identify the common antipyretic medicinal plants used in ethnopharmacological studies in the Philippines; 2) Classify the medicinal plants in terms of the plant family, plant species, vernacular, citation frequency, plant part used, mode of administration, and location; 3) Ascertain the phytochemical constituents present in the identified plants; 4) Determine the implications of this study to indigenous education in the Philippines.

METHODOLOGY

This study utilized Content Analysis of Antipyretic plants in the Philippines where it classifies the vernacular, plant family, plant

species, citation frequency, plant part used, mode of administration, location as themes of the study. Content analysis is a research method that entails systematically examining the contents to identify patterns and themes (Leedy & Ormod, 2011). It also employs graphical representations such as tables and graphs to express the percentage of metabolites present, implying that Descriptive-Quantitative were used in the data collection process. It also employs an ethnopharmacological method in conveying the use of indigenous plants as anti-pyrexia among several indigenous tribes and locales across the Philippines' islands.

This study followed the following procedures: Review literature on the Ethnopharmacological studies in the Philippines and classify the plants in terms of the vernacular, plant family, plant species, citation frequency, plant part used, mode of administration, and location. Identify the phytochemical Constituents present in the (10) identified antipyretic plants used in traditional medicine in the Philippines. Generalize the use of the antipyretic plants based on the given themes.

Content Analysis of Antipyretic Plants in the Philippines was employed in this study, which classified the vernacular, plant family, plant species, citation frequency, plant component used, mode of administration, and location as study themes. Content analysis is a research method that comprises a thorough and systematic assessment of the contents of a collection of materials to uncover patterns and themes (Leedy & Ormod, 2011). To categorize the given themes, thematic analysis was used.

Overall, it is Meta-analysis research, which is a quantitative research that uses numerical expressions of data to summarize the result. It also uses a formal design for assessing the research studies to derive and create conclusions to form a specific body of research. The current study uses graphical representations using tables in expressing the citation frequencies and graphs in expressing the percentage of primary and secondary metabolites present. An ethnopharmacological approach was also employed in expressing the uses of Indigenous

plants as an anti-pyrexia in some indigenous tribes and localities of the islands in the Philippines

RESULTS AND DISCUSSION

1. Indigenous Plants as Antipyretic Drugs

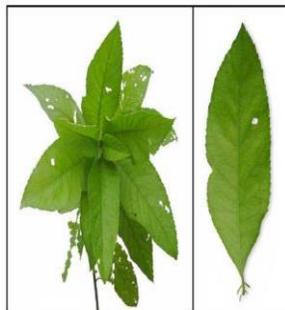
Since ancient times, plants have been known for their diverse applications. Plants play an important role in medicine because they contain a wide range of therapeutic compounds. Fever is one of the disorders that plants can help treat. Nonsteroidal anti-inflammatory medications can be used to treat fever (NSAIDs). Excessive use of synthetic medications, on the other hand, causes significant injury to the human body, particularly to the internal organs. Various plants have traditionally been used to treat fever, implying that plants are the finest natural antipyretic sources (Afiffudden et al., 2015).

Many herbal plants that were traditionally utilized by indigenous people in performing herbal therapy were not yet designated as traditional medicine by the Department of Health (DOH) in the Philippines due to the natural wealth of biodiversity. Because of the medicinal and pharmacological effects of these traditional medicines, they can be used to treat a wide range of illnesses for a long time. The pharmacological sustainability of these indigenous medicines is ensured.

2. Common Antipyretic Medicinal Plants

Sambong is the first antipyretic plant on the list (*Blumea balsamifera*). In this investigation, 13 local studies identified *sambong* as a fever therapy. According to the findings, several regions in the country used *sambong* leaves to treat fever, including La Union, Cagayan, Bataan, Manila, Laguna, Cavite, Mindoro Island, Aklan, Region 6 and 7, Zamboanga Sibugay, Iligan City, North Cotabato, and even Lanao del Sur. For hundreds of years, Asians have utilized *sambong* to treat a variety of health issues. It grows all over Asia's tropics, including the Philippines, where *sambong* is well renowned as a potent healing agent (Lumiere, 2020). *Sambong* roots and leaves are being used as a natural fever remedy; the roots

and leaves are crushed and submerged in cold water. To reduce body temperature, a soft cloth may be placed over the nape, forehead, underarms, and other body areas.



Sambong
Source:

<http://www.stuartxchange.org/Sambong.html>



Lagundi
Source:

<http://www.stuartxchange.org/Lagundi>

Lagundi (Vitex negundo), which is widely recognized as a natural remedy for respiratory diseases, is now being used to cure fever in *La Union, Cagayan, Benguet Province, Bataan, Cavite, Mindoro Island, Leyte, Zamboanga del Sur, and North Cotabato*. *Vitex negundo* contains phytochemicals with the relevant biological properties: antimalarial activity, anthelmintic activity, antipyretic action, wound healing, antioxidant activity, antibacterial activity, and antifungal activity (Boy et al., 2018).

Tawa-Tawa (Euphorbia hirta) or *gatas-gatas* comes in third place. The entire plant, particularly the stem and leaves of Tawa-Tawa, is used to prepare a decoction that is thought to ease viral infection and related fever in *La Union, Cavite, Zamboanga Sibugay, Ozamis City, Iligan City, North and South Cotabato, and Northern Surigao del Sur*. *E. hirta* is a member of the Euphorbiaceae plant family and the genus Euphorbia. Tawa-Tawa chemicals exhibit anxiolytic, analgesic, antipyretic, and anti-inflammatory properties when isolated and used in clinical investigations (Kumar et al., 2010). It was first used to treat fever in the Philippines in the late 1940s, but it was later also used to treat dengue fever in the 1980s.



Tawa tawa
Source:

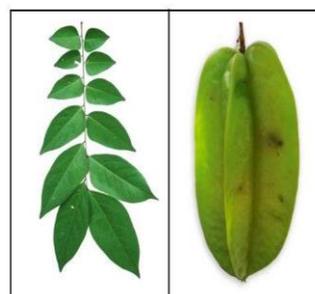
<http://www.stuartxchange.org/GatasGatas.html>



Damong Maria
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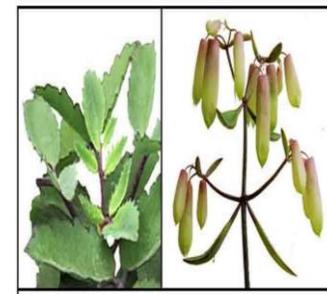
<http://stuartxchange.com/Damong.html>

Damong Maria (Artemisia vulgaris) is ranked fourth and has been traditionally used to treat fever in *Bataan, Cavite, Aklan, Leyte, Zamboanga Sibugay, Northern Surigao del Sur, and North Cotabato*, in that order. It is commonly grown in and around low to medium altitude communities throughout the Philippines, from the *Batan Islands and northern Luzon to Mindanao*. *Damong Maria* can be found in any country that is warm or tropical. Clinical experiments have demonstrated that the crude leaf extract contains anti-malarial, antipyretic, and anti-thrombocytopenia properties, as well as the capacity to reverse thrombocytopenia.



Balimbing
Source:

<http://www.stuartxchange.org/Balimbing>



Katakataka
Source:

<http://www.stuartxchange.org/Katakataka>

Balimbing (Averrhoa carambola) of the fifth rank has traditionally been utilized as an antipyretic

plant in Cavite, Zamboanga Sibugay, Northern Surigao del Sur, and North Cotabato. It is grown across the Philippines. According to clinical investigations, *balimbing* fruit has laxative properties and is used in folk medicine to treat skin problems, high blood pressure, diabetes, and fever.

Katakataka (Bryophyllum pinnatum) leaves have traditionally been used to treat fever in Ifugao, Cavite, and North Cotabato. Various types of *B. pinnatum* in the Philippine Islands. Traditional remedies made from *Pinnatum* are used. It can be used to treat a variety of pains and inflammations, as well as bacterial, viral, and fungal infections, earaches, upper respiratory infections, stomach ulcers, flu, and fever, both externally and internally. Anti-inflammatory, analgesic, antihypertensive, antihistamine, and anti-allergic activities are also found in the leaves of this plant (Kamboj & Saluja, 2009).

Guyabano (Annona Muricata) leaves are used in Cagayan, Cavite, Mindoro Island, and Zamboanga del Sur for its anti-fever effects. It grows in rainforests in Africa, Latin America, and East Asia, and is cultivated for its edible fruit. Furthermore, Guyabano has been shown to have several health benefits in both clinical and cultural studies.



Guyabano

Source:

<http://www.stuartxchange.org/Guyabano>

Ikmo

Source:

<http://www.stuartxchange.com/Ikmo.html>

It helps to lower body warmth, muscle aches, heart rate, and blood pressure. It can also help with pain, inflammation, and asthma. The fruit

and juice are used to treat worms and parasites, as well as to reduce fever and increase breast milk production after childbirth (Stuart, 2019).

In Mindoro Island, Aklan, and North Cotabato, *Tanglad (Cymbopogon citratus)* leaves and roots are used as a traditional fever remedy. In most parts of the Philippines, this plant's fragrant leaves are grown. According to studies, *Tanglad* has antioxidant, hepatoprotective, antimicrobial, neurobehavioral, analgesic, anti-inflammatory, antimutagenic, insecticidal, gastroprotective, antileishmanial, hypotensive, diuretic, and antimalarial properties.

In *Mindoro* and *Aklan*, *Ikmo (Piper betle)* leaves are crushed and administered topically to treat fever. It is farmed across the Philippines but grows wild in the majority of Luzon provinces (Philippine Medicinal Plants, n.d.). *Piper betle* is widely used as a therapeutic plant in the Country to treat a variety of maladies such as headaches, fevers, stomachaches, coughs, cuts, and wounds (Balinado & Jamelarin, 2019).



Tanglad

Source:

<http://www.stuartxchange.org/Tanglad>

Luyang Dilaw

Source:

<http://www.stuartxchange.com/Dilaw.html>

Finally, the *Luyang Dilaw (Curcuma longa)* rhizomes are gathered in Batangas and boiled in Mindoro Island to treat fever. In the Philippines, it is widely available. The ginger family Zingiberaceae includes *Luyang Dilaw*. The

rootstocks of these towering, smooth plants offer significant aromatic qualities. Its medicinal properties have been discovered in its nourishing roots, crowns, and even leaves. Luyang Dilaw has traditionally been used to treat colds, coughing, fevers, and throat irritation as a homeopathic remedy (Stuart, 2017).

Because of their prevalence and ease of preparation, leaves are often employed in herbalism to cure fever or pyrexia. Harvesting leaves for herbal medicine causes minimal damage to the entire plant and allows it to recover for the following outsourcing. Furthermore, additional plant components, such as the root, fruit stem, and others, were discovered by local people to contain active elements for healing various diseases through herbal medicine. The manner of administration is dominated by decoction as the mode of preparation. A decoction is the simplest and most popular method of preparing plant medicine.

This process entails simmering the plant materials for a prolonged time for the plant's hard substance to dissolve and unleash its beneficial properties. Simmering, poultice, extraction, direct consumption, and direct application on the skin are some more methods of preparation. Traditionally used antipyretic medicinal plants in all the regions of the country were explored and included in the study. Many indigenous civilizations around the world continue to preserve and enhance knowledge about the use of plants in traditional medicine. Many traditional plants used can be obtained from local groups in general.

This knowledge is passed down through the generations in the Philippines from great forefathers. Most of the knowledge hasn't been thoroughly evaluated because it's simply passed down through the generations and is only communicated verbally. Knowledge of folk medicine is an important part of human culture. Plants are used for several purposes, such as food, shelter, clothing, and medicine. Indigenous medicinal plants have long been used, and their efficacy in treating a variety of ailments has been

shown over time. Traditional culture, on the other hand, has been preserved only among local groups since it has only been passed down through verbal communication. It has been observed that today's generation does not retain indigenous traditions because the majority of them leave society; as a result, this information is particularly entrenched inside previous generations.

3. Roles of Metabolites

Primary metabolites are in charge of the physiological processes that occur in the organism and are closely engaged in growth, development, or reproduction.

Secondary metabolites are those that do not include organism growth; they are referred to as specialized metabolites. As phytochemical ingredients, each metabolite has a distinct purpose. Alkaloids have analgesic, muscle relaxant, antioxidant, antifungal, and antibacterial properties. Despite the negative consequences of certain alkaloids, such as suffocation, paralysis, or poisoning, it is nevertheless used in medications (Roy, 2010). Saponins are molecules that have physicochemical features such as anti-cancer and anti-cholesterol activity, which lead to commercial applications.

Tannins are antibacterial, antiviral, and anti-tumor. Several tannins have been shown to inhibit HIV replication. Antioxidants, antimicrobials, photoreceptors and antiviral, anti-inflammatory, and anti-allergenic characteristics have all been documented for flavonoids (Panche et al., 2016). Steroids are anti-inflammatory drugs that are used to treat asthma. Antioxidant and anti-inflammatory lipid derivatives include essential oils, fatty acids, flavonoids, and steroids. Antiviral metabolites include essential oils, polyphenols, and glycosides. Steroids, also known as plant sterols, can help to decrease cholesterol levels and are available as dietary supplements. Aldehydes are utilized as analgesics, local anesthetics, and relaxants, whereas ketones are needed to maintain homeostasis (Sultan, 2015).

Table 1
Antipyretic Plants and their Bioactive Metabolites

Antipyretic Plant	Bioactive Metabolites
Sambong	Sesquiterpenes and limonene, sesquiterpene alcohol, saponin, tannin, palmitin, diterpenes, organic acid, flavonoids, ester, alcohol, and sterol
Lagundi	Indoids, phenolic acids, flavonols, and flavonoids
Tawa- tawa	Alkaloids, flavonoids, steroids, tannins, and polyphenols
Damong Maria	Plant- volatile oil (cineol, thujone, paraffin, and aldehyde) Roots- inulin, tannin, resin, and volatile oil, 0.1 percent. crude extract- alkaloids, coumarins, flavonoids, saponins, sterols, tannins, and terpenes.
Balimbing	Alkaloids, flavonoids, tannins, saponins
Katakataka	Glycosides, flavonoids, steroids, alkaloids, lipids, organic acids, and butadienolides and triterpenes
Guyabano	Tannins, cardiac glycosides, myricil alcohol, essential oils, sitosterol, stearic acid, fatty acid, anonol and diphydic alcohol
Tanglad	Plant- flavonoids and phenolic compounds--luteolin, isoorientin 2'-O-rhamnoside, quercetin, kaempferol, and apigenin. Essential oils- hydrocarbon terpenes, alcohols, aldehyde, ketones and ester leaves and roots- saponin, alkaloids, terpenes, a-sitosterol, alcohol, flavonoid, ketone, chlorogenic acid, caffeic acid, p-coumaric acid and sugar.
Ikmo	Alkaloids, flavonoids, tannins, saponins, steroids, sterols glycosides, and phenols
Luyang Dilaw	flavonoid curcurim, volatile oils, tumerone, atlantone, zingiberone, alkaloids, glycosides, tannin, resins, sterols, fixed oil and saponins, reducing sugars

PRIMARY METABOLITES FREQUENCY

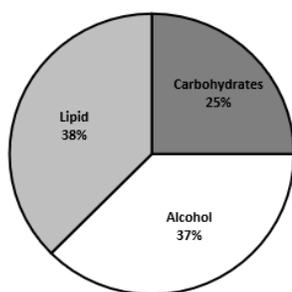


Figure 1. The Primary Metabolites present in the 10 Antipyretic Plants in the Philippines

Figure 1 exhibits that the highest Primary metabolites present in the Antipyretic Plants in the Philippines is Lipids and Alcohol and carbohydrates have the least component among the three Primary metabolites present in the 10 antipyretic plants.

Table 3
Frequency of the Secondary metabolites

Metabolites	Frequency
Flavonoid	7
Alkaloid	7
Tannin	5
Saponin	4
steroids	3
Sterols	3
Terpine	3
Glycosides	3
Volatile oil	2
Limonene	1
Flavonols	1
Paraffin	1
Triterpene	1
Resine	1
Fatty acid	1
Anonol	1
Ketone	1
Aldehyde	1
Essential oil	1

4. Secondary Metabolites of 10 Antipyretic plants in the Philippines

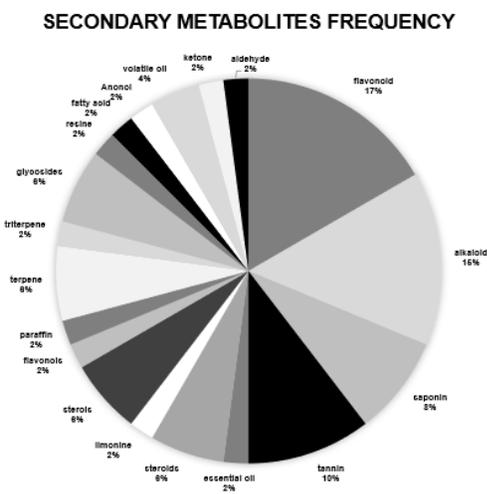


Figure 2. The Percentage Secondary Metabolites present in the 10 Antipyretic Plants

Based on the given graph above, the most numbered metabolite present is Flavonoid, nine of the antipyretic plants were contained flavonoid, followed by Alkaloid, Tannin, and Saponin. A little number of secondary metabolites such as Steroids, Sterols, Terpene, Triterpene, Glycosides, Limonene, Paraffin, Resine, Fatty Acid, Anonol, Volatile oil, Ketone, and Aldehydes are found in the 10 antipyretic plants.

5. Implications of Antipyretic Plants to Indigenous Education

Medicinal plants and traditional cultures are both endangered when expertise is not preserved and is only passed down through the generations. Acculturation and modernization have resulted in the extinction of their medical heritage due to a lack of good documentation and local knowledge (Binag et al., 2020). According to the results of the study, Indigenous expertise with the use of medicinal plants is still practiced by indigenous groups in the Philippines. These indigenous plants used in traditional medicine have been shown to have natural components that can cure ailments such as fever and headache. Based on the result of the study, there are still local tribes that practice

traditional medicine in the Philippines, however, the traditional knowledge is only passed down within their ethnic community.

The following generation preserves their indigenous wisdom if traditional knowledge is put into practice. Indigenous ancestors perish without being likely to transmit down their experience and practices, therefore, their old knowledge remains unchanged due to the young's addiction to the new patterns of living that impact the globe. The revitalization focuses on educational institutions as the major agent in supporting the threatened indigenous culture. Norms are required for a community's distinctive and rich knowledge to be passed on to the next generation (Agtarap et al., 2020).

CONCLUSION

In this study, ten antipyretic plants which are commonly used in the Philippines were identified: Sambong (*Blumea balsamifera*), Lagundi (*Vitex negundo*), *Tawa-tawa* (*Euphorbia hirta*), *Damong Maria* (*Artemisia vulgaris*), *Balimbing* (*Averrhoa carambola*), *Katakataka* (*Bryophyllum pinnatum*), *Guyabano* (*Annona murica* (*Curcuma longa*)). According to research, the majority of antipyretic plants use their leaves to treat fever. These antipyretic plants are usually provided via decoction in local areas. These antipyretic plants are frequently employed as part of indigenous knowledge in the Philippines.

More so, the antipyretic herbs contain both primary and secondary metabolites. Flavanoids, Alkaloids, Tannins, Saponins, Sterols, Terpenes, Triterpenes, Glycosides, Limonene, Paraffin, Resine, Fatty Acid, Anonol, Volatile, Ketones, and Aldehydes indigenous plants were employed in traditional system of medicine and have been shown to have organic ingredients that can cure ailments such as fever and headache. The future generation will be able to preserve indigenous knowledge if this cultural knowledge is put into practice. An educational institution supports indigenous culture; rules are required for the group to survive the following generation.

RECOMMENDATION

Flavonoids, Alkaloids, Tannin, Saponin, as well as some other secondary metabolites, have been shown to have analgesic and antipyretic qualities; therefore, it is advised that the ten antipyretic plants be studied for further investigations for medicinal applications as antipyretic medicine. For the reason that leaves are the most studied plant component utilized in medicinal plants, it is also proposed that other plant parts be employed by indigenous people for therapeutic reasons be studied. Because there have been few studies on the analgesic and antipyretic activities of indigenous plants, it is advised that the antipyretic characteristics of the ten indigenous plants be tested.

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