



Herbal Medicines Used by Tuberculosis Patients in Myanmar

Soe Moe¹, Khin Saw Naing² and Mila Nu Nu Htay^{1*}

¹Melaka-Manipal Medical College (MMMC), Bukit Baru, Melaka, Malaysia.

²Department of Community and Rural Medicine, School of Medicine, Universiti Malaysia Sabah, Malaysia.

Authors' contributions

This work was carried out in collaboration between all authors. Authors SM and MNNH managed the literature search. Authors SM and KSN managed for data collection. Author SM performed the data analysis. Authors SM and MNNH wrote the initial draft of the manuscript. Author KSN managed the literature search and advised for initial draft of the manuscript. Authors SM and MNNH wrote final draft of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/EJMP/2018/37341

Editor(s):

- (1) Ghalem Bachir Raho, Biology Department, Sidi Bel Abbes University, Algeria.
(2) Marcello Iriti, Professor, Plant Biology and Pathology, Department of Agricultural and Environmental Sciences, Milan State University, Italy.

Reviewers:

- (1) Elizabeth B. Famewo, University of Fort Hare, South Africa.
(2) Ronald Bartzatt, University of Nebraska, USA.
(3) Mini N. Vijayan, Carmel College of Arts, Science & Commerce, India.
(4) Edson Mollel, Kilimanjaro Christian Medical University College, Tanzania.
Complete Peer review History: <http://www.sciencedomain.org/review-history/22658>

Original Research Article

Received 12th October 2017
Accepted 12th December 2017
Published 9th January 2018

ABSTRACT

Aims: This study attempted to explore the natural products commonly used by the TB patients in a selected township of Myanmar.

Study Design: Secondary data analysis of qualitative data.

Methodology: This is a secondary data analysis of qualitative data focusing on the herbal plants used by the tuberculosis patients in Myanmar. A checklist was used for data analysis to explore the herbs used by TB patients and related information. The researcher also searched the literature using the both vernacular & botanical names of the herbs.

Results: Four herbal plants namely Lauk Thay (*Desmodium triquetrum*), Owe Pote (*Melastoma malabathricum*), Mu Yargyi (*Justicia adhatoda*) and Mee Quin Gamone (*Rhoeo discolor*) were identified in this study. There are two methods of administration of the herbal leaves. In several

instances, the TB patients first make use of the herbs before seeking proper anti-TB treatment. Also, the patients and traditional healers alike accepted that the medicines provided by DOTS programme could cure the disease.

Conclusion: This study revealed that self-medication with herbs is a common practice among TB patients. As the herbal plants identified were well known medicinal plants in different parts of the world, their therapeutic value and efficacy should be further explored in the light of developing effective complimentary medicines for TB.

Keywords: Tuberculosis (TB); herbs; complimentary medicine; herbal medicine; Myanmar.

1. INTRODUCTION

Tuberculosis (TB), once considered as a disease with high possibility of worldwide elimination, is now recognized as a global priority because of its resurgence in this millennium [1]. An estimated 10.4 million incident cases and 1.8 million patients death were reported by the World Health Organization (WHO) in 2015 [2]. The majority of estimated number (46%) occurred in Asia [3]. In Myanmar, with a population of more than 54 million, the new cases of TB have been estimated to be 200 per 100,000 population in 2015 [4]. The DOTS strategy was introduced in Myanmar in the late 1990s [5]. In line with the Stop TB strategy recommended by WHO, Myanmar has aggressively pursued high-quality DOTS expansion and enhancement. The results were evident as the treatment success for new smear positive cases had been increased from 82% (1998) to 87% in 2014 in relation to the cohort size of 10,000 to 135,984 respectively [4,6]. However, Myanmar still got an estimated incidence of 365 TB cases per 100,000 population in the year 2015, highlighting the heavy burden of National Tuberculosis Control Programme (NTP) of Myanmar [7].

Myanmar, bearing the burden of TB, had been struggling to limit the problem through intensive preventive and control measures. However, Multidrug-resistant TB (MDR-TB) and extensive drug-resistant TB (XDR-TB) are challenging the success of TB control [8]. The geographical terrain and frequently violent weather conditions occasionally deterred the activities of NTP. At the same time, the cultural and traditional adherence to indigenous medicines would influence the treatment-seeking behaviour of patients leading to late treatment. Sometimes, the patients, while undergoing the standard anti-TB regime provided by the National Health System, also sought for traditional medicine and natural products to alleviate the symptoms and or minimize their sufferings [9]. Research on traditional medicine and natural products are being conducted to

identify the potential raw materials for new anti-TB medicines.

The WHO is promoting herbal use in Primary Health Care as well as strengthening research on efficacy, safety and quality of herbal medicine [10]. Myanmar Ministry of Health also encourages the development of traditional medical practice and promotes its role in National Health Care through systematic recording and scientific researches [11]. As such, several indigenous therapeutic means for TB were identified and recorded. However, very few studies have been carried out revealing the scientific evidence. This study attempts to explore the possible informations related to herbal plants used by TB patients in Myanmar. The objectives are (1) to identify the herbs commonly used by TB patients in addition to the standard anti-TB drugs, (2) to explore the methods of administration of the herbal plants and the participants' beliefs on them, in a selected township of Myanmar and (3) to search the literature on the medicinal plants identified to check their toxicity and possible effects.

2. MATERIALS AND METHODS

This study is a secondary data analysis of the research project on "Burden of TB patients" [9]. The twenty-two TB patients who had just completed treatment or were taking treatment with the standard anti-TB regimes of the National Tuberculosis Programme of Myanmar were selected for the study. The TB patients diagnosed by either physician or TB campaign in Myanmar were included in that study after taking the written informed consent. The patients were both men and women age ranges from 22-49 years. They were invited and recruited to the research through snowball methods.

A total of four Focus Group Discussions (FGD) were conducted with patients, their family members, and community members. In-depth interviews were conducted with 20 TB patients.

Three key informant interviews were done with the traditional healers of the study area in the "Burden of TB patients" project [9].

In this study, the researchers did the secondary data analysis from that project which focused only on the information about herbal plants used by TB patients.

During the thematic analysis of the secondary data on herbal plants, the researchers used the checklist, which included (1) name of the herbs to identify the herbs used by TB patients, (2) mode of administration and duration to investigate the amount, method and duration of treatment, (3) the favourable and unfavourable experiences on their usage and (4) beliefs or opinion on the effect of herbs on TB to explore their perceptions towards the use of traditional herbs.

3. RESULTS AND DISCUSSION

The secondary qualitative data analysis revealed that the four herbal plants namely Lauk Thay (*Desmodium triquetrum*), Owe Pote (*Melastoma malabathricum*), Mu Yargyi (*Justicia adhatoda*) and Mee Quin Gamone (*Rhoeo discolor*) were used by the study participants in Myanmar. Moreover, the study also revealed the patients' knowledge and experiences of using herbal medicines prepared by local healers, which were applied as the complementary, or alternative to the western medicine.

3.1 Herbs Used by TB Patients

The four herbal plants, *Desmodium triquetrum*, *Melastoma malabathricum*, *Justicia adhatoda* and *Rhoeo discolor* leaves were commonly used by the TB patients (Table 1). These plants were easily available in the study area.

3.2 Methods of Administration of Herbal Plants

The study revealed the methods of administration of the herbal leaves. The methods are as follows:

1. Pinch of fresh leaves are boiled in 200 ml of water to make a concentrate of 70 ml.
2. Pinch of dried leaves are boiled in 700 ml of water and used as tea.

Due to lack of knowledge on the most efficient way of preparation, amount of herbs and duration to be taken, the effect on symptomatic

improvement was not remarkable and they switched on from one herb to another.

3.3 Experiences of TB Patients for Taking the Herbs

Some TB patients used the herbs as complimentary to the western medicine. The following information showed their practices.

A 47 years old TB patient said that he drank the western medicine in the morning and herbs in the evening. A 37 years old female TB patient said that the remedy is bitter and the smell is bad. Another TB patient said that his sputum was checked in the hospital and no TB germ was found. He was happy but in case some TB germs are left, the herbs can kill the germ. His concern rooted in the incomplete knowledge on the previously recommended anti-TB treatment regimen, which lasted for one year to complete the treatment. If health personal had explored the idea, concern of the TB patient, and take time for explanation unnecessary worries can be prevented.

3.4 Perspective of TB Patient's Family Members of Patients and Community on Usage of Herbal Medicine

Although the TB patients were taking herbs, their family members and community considered them as the symptomatic treatments for tuberculosis. They did not consider herbal plants as the curative therapy.

A 24 years old wife of TB patient said that she heard that people get cure with herbs, but only one in ten. Herbs relieve only the symptoms, and therefore the patients must take standard regimen to be cured completely; says a 33 years old community member. Although the patients were taking the herbs as traditional custom in Myanmar, the community believed more on the western medicine as curative treatment for the disease. This reflects the awareness and believes on DOTs strategy among the population in Myanmar.

3.5 Perspective of Local Healers and Supernatural Healers on Usage of Herbs

In this study, all patients tried traditional medicines locally available in the store or prepared by local healers when they were contracted with TB. Local healers were

Table 1. Herbs used by tuberculosis patients in Myanmar

Name of herb	Frequency	Percent (%)
Lauk Thay (<i>Desmodium triquetrum</i> or <i>Tadehagi triquetrum</i>)	22	100
Owe Pote (<i>Melastoma malabathricum</i>)	2	9
Mu Yar Gyi (<i>Justicia adhatoda</i>)	5	23
Mee Quin Gamone (<i>Rhoeo discolor</i> or <i>Rhoeo spathacea</i> or <i>Tradescantia spathacea</i>)	7	32

approached with the hope of getting information on herbs they used for TB or respiratory symptoms. They all mentioned that they usually refer the patients to government health clinics as they realized that anti-TB drugs under DOTS programme were better than their medication (Field notes). A traditional healer admitted that, western medicines are better than herbs and traditional medicine so he always referred the patient to health clinic, but to relieve their symptom, he prepared herbs for them.

Further investigation revealed that they had past experience of using Mu Yar Gyi (*Justicia adhatoda*) for respiratory symptoms but they have no records. Empowerment of local healers and supernatural healers to keep records and reflect on their healing practices will lead to improvement of alternative and complementary medicine.

This study revealed that drug stores, local healers and supernatural healers were the first points of contact in contrast to other studies where general practitioners were the first point of contact of TB patients [12]. Therefore, drug store owners, local healers and supernatural healers should be recruited as community educators and considered as possible human resources for case detection.

3.6 Literature on Herbs Used by the TB Patients in Myanmar

Various herbal plants have been used to treat the tuberculosis infection especially in developing countries including African and Asian countries [13,14]. However, in this study, the literature search focused on the four plants, which were identified during the secondary data analysis of the "Burden of TB patients" project [9]. They are listed below:

3.6.1 Lauk thay (*Desmodium triquetrum* or *Tadehagi triquetrum*)

Lauk Thay (*Desmodium triquetrum* or *Tadehagi triquetrum*) was the most commonly described

herbal leaves reported to be used by the TB patients as shown in Table 1 and Fig. 1. The family members of the patients were also familiar with the plant. The herbs are available in the forest fringes but sometimes available in local markets of rural areas.

Studies revealed that *Desmodium triquetrum* contains carotenoids, terpenoids, phenolic and nitrogen compounds which have antioxidant properties [15,16]. Moreover, *Desmodium triquetrum* leaves have significant anti-inflammatory activity [16] (Table 2). A study in Myanmar proved that aqueous extract of *Desmodium triquetrum* has bactericidal activity on 10 pathogenic bacteria [17]. In the northeastern part of India, it was used by Jaintia tribes to get rid of worm infestation [18] but in another part of India, it was well known for wound healing [19].

3.6.2 Owe pote (*Melastoma malabathricum*)

This was the least commonly mentioned herb which was used alternatively with *Desmodium triquetrum* according to the availability (Table 1, Fig. 2).

Phytochemical and bioactivity studies revealed that the compounds in the flowers of *Melastoma malabathricum* have radical scavengers effect [20]. Many studies have revealed that the aqueous extract of its leaves had antipyretic, anti-inflammatory, gastroprotective and have antioxidant property [20-22]. It also affects the intrinsic pathway of coagulation cascade by reducing the clotting factor, hence, has anticoagulant activity [23] (Table 2).

3.6.3 Mu yargyi (*Justicia adhatoda*)

This plant is used by traditional healers for relief of respiratory symptoms (Fig. 3). It is regarded as an effective medicinal plant by the traditional practitioners. Thus, they would prescribe this medicinal plant in raw form or in different combinations.

Table 2. Properties and compounds of herbal plants used by tuberculosis infected patients in Myanmar

Herbal plants	Anti-inflammatory	Anti- tuberculous	Anti- bacterial	Anti- spasmodic	Other protective and toxic effect	Chemical compound
Lauk Thay (<i>Desmodim Triquetrum</i>)			Anti- bacterial [17,33]		Anti-oxidant Hepatoprotective [34]	Alkaloids, Flavonoids, Triterpene steroids, Tannins [33]
Owe Pote (<i>Melastoma Malabathricum</i>)	Anti-inflammatory [35]				Anti-oxidant Antipyretic Antinociceptive [35,36]	a-Amyrin , Betulinic acid , Quercetin Quercitrin , Cedrol (positive control) [35] Flavonoids, Triterpene steroids [36]
Mu Yargyi (<i>Justicia adhatoda</i>)	Anti-inflammatory [24,25]	Anti- tuberculous [26]	Anti- bacterial[24,25]	Broncho-dilation [24,25]	Abortifacient Anti-fertility Cardioprotective	essential oils, fats, resins, sugar, gum, amino acids, proteins and vitamins 'C', phenols, tannins, alkaloids, anthraquinone, saponins, flavonoids quinazoline vasicine [24,25] Ca+ Na+ S, Iron, Zinc [25]
Mee Quin Gamone <i>Rhoeo discolor</i> (or) <i>Rhoeo spathacea</i>		Anti- tuberculous [28]			Anti- mutagenic [37] Anti-oxident	flavonoids, anthocyanins, saponins, carotenoids, waxes, terpenoids, and coumarinic and steroidal compounds [38]



Desmodium truquetrum or *Tadehagi triquetrum*

Fig. 1. Lauk thay leaves and plant



Melastoma alabathricum

Fig. 2. Owe pote leaves and plant



Justicia adhatoda

Fig. 3. Mu yargyi leaves and plant



Rhoeo discolor or *Tradescantia spathacea*

Fig. 4. Mee quin gamone leaves and plant

Some studies found out that *Justicia adhatoda* had bronchodilation, abortifacient, anti-fertility, and cardio protective effects [24,25]. *In silico* study showed that *Justicia adhatoda* is the inhibitor of FtsZ protein of *Mycobacterium tuberculosis* [26]. Therefore, further studies of compounds in *Justicia adhatoda* should be conducted to investigate its effectiveness on the bacterium (Table 2). But Anti-fertility and abortifacient effect of *Justicia adhatoda* may pose problems in the drug administration.

3.6.4 Mee quin gamone (*Rhoeo discolor* or *Rhoeo spathacea* or *Tradescantia spathacea*)

This is a popular species grown in Myanmar and the traditional healers used it in dried form or in extracted products. (Fig. 4)

The ethanolic crude extract of *Rhoeo discolor* had anti- mutagenic and antioxidant activities in a study conducted in 2003 [27]. A recent study discovered that aqueous extracts of *Rhoeo spathacea* had 100% inhibitory effect on H37RV strain and multi-drug resistant (MDR) strain of tuberculosis [28] (Table 2).

These four plants are known for their medicinal properties across the world [19,29-32]. Our literature search did not come across a study on harmful effect of the plants on animal or human being.

4. CONCLUSION

This study gives insights into complementary and traditional medical practices of TB patients. It

disclosed that self-medication with herbs by TB patients was a common practice in certain parts of Myanmar. The medicinal plants used by TB patients, Lauk Thay (*Desmodium triquetrum*), Owe Pote (*Melastoma malabathricum*), Mu Yargyi (*Justicia adhatoda*) and Mee Quin Gamone (*Rhoeo discolor*) should not be neglected. These herbal plants identified were well-known medicinal plants in different parts of the world; their therapeutic value and efficacy should be further explored for developing effective complimentary medicines for TB.

CONSENT

All authors declared that written informed consent was obtained from all the participants.

ETHICAL APPROVAL

It is not applicable.

ACKNOWLEDGEMENTS

We would like to thank Professor Daw Win Kyi, Former Professor, and Head of the Department of Botany, University of Distance Education, Yangon, Myanmar for her explanation and provision of useful literature. I am also very grateful to all the TB patients, key informants, and traditional healers, without their participation, this research would not have been possible.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Lapa E, Silva JR, Boechat N. The resurgence of tuberculosis and the impact of the study of pulmonary immunopathogenesis. *J. bras. pneumol.* 2004;30:388-394.
Available:<https://dx.doi.org/10.1590/S1806-37132004000400014>
2. World Health Organization (WHO). Global Tuberculosis Report; 2016.
Available:http://www.who.int/tb/publications/global_report/en/
(Accessed 26 September 2017)
3. World Health Organization (WHO). Ministerial meeting towards ending TB in the South-East Asia; 2017.
Available:<http://www.searo.who.int/tb/en/>
(Accessed 26 September 2017)
4. World Health Organization (WHO). Tuberculosis country profiles, Myanmar; 2017.
Available:https://extranet.who.int/sree/Reports?op=Replet&name=%2FWHO_HQ_Reports%2FG2%2FPROD%2FEXT%2FTBCountryProfile&ISO2=MM&LAN=EN&outtype=html
(Accessed 26 September 2017)
5. World Health Organization (WHO). Improving measurements for the global burden of TB: Global tuberculosis control WHO Report. 2010;37-41.
Available:http://apps.who.int/iris/bitstream/10665/44425/1/9789241564069_eng.pdf
(Accessed 26 September 2017)
6. World Health Organization (WHO). Progress in implementing stop TB strategy: Global tuberculosis control WHO Report. 2010;10-24.
Available:http://apps.who.int/iris/bitstream/10665/44425/1/9789241564069_eng.pdf
(Accessed 26 September 2017)
7. WHO Regional Office for South-East Asia, Bending the curve - ending TB: Annual report; 2017.
Available:<http://apps.who.int/iris/bitstream/10665/254762/1/978929022584-eng.pdf>
(Accessed 26 September 2017)
8. World Health Organization (WHO). Multidrug and extensively drug-resistant TB (M/XDR-TB): Global Report on surveillance and response; 2010.
Available:http://apps.who.int/iris/bitstream/10665/44286/1/9789241599191_eng.pdf
(Accessed 26 September 2017)
9. Moe S. Burden of tuberculosis in Myanmar: Social science perspectives. Un Published Thesis for the fulfilment of Master of Arts (Health Social Sciences). Mahidol University Thailand; 2002.
10. World Health Organization Country Office Myanmar. The use of herbal medicine in primary health care: Report of the Regional Meeting. 2009;1-4.
Available:<http://apps.who.int/medicinedocs/documents/s22295en/s22295en.pdf>
(Accessed 26 September 2017)
11. Ministry of Health, National Health Plan (2006-2011).
Available:https://www.ghdonline.org/uploads/Myanmar_National_Health_Plan_2006-2011_.pdf
(Accessed 26 September 2017)
12. Saw S, Manderson L, Bandyopadhyay M, Sein TT, Mon MM, Maung W. Public and/or private health care: Tuberculosis patients' perspectives in Myanmar. *Health Res Policy Syst.* 2009;7:19.
13. Buwa LV, Afolayan AJ. Antimicrobial activity of some medicinal plants used for the treatment of tuberculosis in the Eastern Cape Province, South Africa. *Afr. J. Biotechnol.* 2009;8:6683-6687.
14. Rai R. Herbal remedies in cure of tuberculosis prevalent among ethnic communities in Central India. *Trop. Plant Res.* 2016;3:344-353.
15. Zheng W, Wang SY. Antioxidant activity and phenolic compounds in selected herbs. *J Agri Food Chem.* 2001;49:5165-5170.
16. Kalyani GA, Ashok P, Taranalli AD, Ramesh CK, Krishna V, Viswanatha Swamy AHM. Anti-inflammatory and *in vitro* antioxidant activity of *Desmodium triquetrum* (L.). *Indian J Pharmacol.* 2011;43:740-741.
17. Lwin HS, Tu M. Effect of *Desmodium Triquetrum* extract on some pathogenic bacteria. *Union Burma J Life Sci.* 1968;1:66-70.
18. Sajem AL, Gosai K. Traditional use of medicinal plants by the Jaintia tribes in North Cachar Hills district of Assam,

- northeast India. J Ethnobiol Ethnomed. 2006;2.
19. Shirwaiker A, Jahagirdar S, Udupa AL. Wound healing activity of *Desmodium triquetrum* leaves. Indian J Pharm Sci. 2003;65:461-464.
 20. Susanti D, Sirat HM, Ahmad F, Ali RM, Aimi N, Erratum MK. Antioxidant and cytotoxic flavonoids from the flowers of *Melastoma malabathricum* L. Food Chem. 2007;103:710–716.
 21. Zakaria ZA, Raden Mohd Nor RNS, Kumar GH, Abdul Ghani ZDF, Sulaiman MR, Deveji GR, Jais AMM, Somchit MN, Fatimah CA. Antinociceptive, anti-inflammatory and antipyretic properties of *Melastoma malabathricum* leaves aqueous extract in experimental animals. Can J Physiol Pharmacol. 2006;84:1291-1299.
 22. Hussain F, Abdulla MA, Noor SM, Ismail S, Ali HM. Gastroprotective effects of *Melastoma malabathricum* aqueous leaf extract against ethanol-induced gastric ulcer in rats. Am J Biochem Biotechnol. 2008;4:38-441.
 23. Hamid M, Manicam C, Abdullah JO, Tohit REM, Seman Z, Chin SC. *In vitro* anticoagulant activities of *Melastoma malabathricum* Linn. aqueous leaf extract: A preliminary novel finding. J Med Plant Res. 2010;4:1464-1472.
 24. Dhankhar S, Kaur R, Ruhil S, Balhara M, Dhankhar S, Chhillar AK. A review on *Justicia adhatoda*: A potential source of natural medicine. Afr. J. Plant Sci. 2011;5:620-627.
 25. Gulfranz M. Investigation for bioactive compound of *Berberis lyceum royle* and *Justicia adhatoda*. Ethnobotanical Leaflets; 2005.
 26. Vinukonda VP, Palakeerti SK, Nalakarathi BC, Palleti DJ. *In silico* studies of *Justicia Adhatoda*, *Ocimum Sanctum* plant compounds as *Mycobacterium Tuberculosis* FTSZ inhibitors. 2012;01:22-25.
 27. Avila MG, Alba MA, Garza MDL, HernándezPretelín MDC, Domínguez-Ortíz MA, Fattel-Fazenda S, Villa-Treviño S. Antigenotoxic, antimutagenic and ROS scavenging activities of a *Rhoeo discolor* ethanolic crude extract. Toxicol *In vitro*. 2003;17:77-83.
 28. Radji M, Kurniati M, Kiranasari A. Comparative antimycobacterial activity of some Indonesian medicinal plants against multi-drug resistant *Mycobacterium tuberculosis*. J App Pharm Sci. 2015;5:19-22.
 29. Reddy KN, Reddy CS, Trimurthulu G. Ethnobotanical survey on respiratory disorders in Eastern Ghats of Andhra Pradesh, India. Ethnobotanical Leaflets. 2006;10:139-148.
 30. Sulaiman MN, Somchit DA, Israf Z, Ahmad, Moin S. Antinociceptive effect of *Melastoma malabathricum* ethanolic extract in mice. Fitoterapia. 2004;75:667-672.
 31. Rosales-Reyes T, la Garza M, Arias-Castro C, Rodríguez-Mendiola M, Fattel-Fazenda S, Arce-Popoca E, Hernandez-Garcia S, Villa-Trevino S. Aqueous crude extract of *Rhoeo discolor* a Mexican medicinal plant, decreases liver preneoplastic foci in rats. J Ethnopharmacol. 2008;115:381-386.
 32. Bitterroot Restoration. Herbal medicine: Adhatoda is an important medicinal plant. Available:<http://www.bitterrootrestoration.com/medicinal-plants/adhatoda.html> (Accessed 26 September 2017)
 33. Chit K, Myint W, Thein K, Maw WW, Myint MM, Than A, Khin M. Cyclic AMP phosphodiesterase inhibitory activity and chemical screening of four medicinal plants. Pharm Biol. 2001;39:181-183.
 34. Kalyani GA, Ramesh CA, Krishna V. Hepatoprotective and antioxidant activities of *Desmodium triquetrum* DC. Indian J Pharm Sci. 2011;73(4):463-466.
 35. Mazura MP, Susanti D, Rasadah MA. Anti-inflammatory action of components from *Melastoma malabathricum*. Pharm Biol. 2007;45:372-375.
 36. Kumar S, Joseph L, George M, Sharma A. A review on anticoagulant/antithrombotic activity of natural plants used in traditional medicine. Int. J Pharm Sci Rev Res. 2011;8:70-74.
 37. González-Avila M, Arriaga-Alba M, de la Garza M, del Carmen Hernández Pretelín M, Domínguez-Ortíz MA, Fattel-Fazenda S, Villa-Treviño S. Antigenotoxic, antimutagenic and ROS scavenging activities of a *Rhoeo discolor* ethanolic crude extract. Toxicol *In vitro*. 2003;17:77-83.

38. Rosales-Reyes T, de la Garza M, Arias-Castro C, Rodríguez-Mendiola M, Fattel-Fazenda S, Arce-Popoca E, Hernández-García S, Villa-Treviño S. Aqueous crude extract of *Rhoeo discolor*, a Mexican medicinal plant, decreases the formation of liver preneoplastic foci in rats. *J Ethnopharmacol.* 2008;115:381-386.

© 2018 Moe et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://sciencedomain.org/review-history/22658>