

ETHNOBOTANY OF TRADITIONAL VEGETABLES USED BY SAMA-BAJAU
COMMUNITY IN KOTA BELUD, SABAH, AND PHYTOCHEMICAL AND
ANTI-AGING INVESTIGATION OF *CRASSOCEPHALUM CREPIDIOIDES*

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fulfilment of the requirement for the award of
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DEDICATION

This work is dedicated to;

My parents; Hj Awang Kanak Hj Mokti (BK, BSK, ADK) and Hjh Dang Ismah Awang Damit

My family; Razman (husband), Faizal, Fazilley, Faizurah, Firdaus, Zabesah, Babu Kasum, Norlizah, Fatihah, Faris, Faiz, Faizi.

My friends, colleagues, and students.



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ABSTRACT

Recording of traditional knowledge (TK) on ethnobotany could be a useful tool to discover new alternative for antioxidant and anti-aging agent from local vegetables. The objectives of this study were: to record ethnobotany of traditional vegetables (ulam) as aging prevention materials, to investigate phytochemical, antioxidant, and anti-aging content of *Crassocephalum crepidioides*, to determine the anti-aging activity and postulate the efficacy of the selected *C. crepidioides* extracts (CCE) against the effect of induced UVB radiation in human dermal cells line (HSF1184). TK were qualitatively evaluated using semi-structured interviews with six informants. A total of 46 species of traditional vegetables from 41 genera and 25 families were recorded. The informants believed eating ulam would provide them with nutrition and as functional food for anti-aging. Jaccard's index of similarity for ulam species between Kampung Taun Gusi and Kampung Menunggu was $J = 0.348$. In average, informants cited 7.67 ± 3.89 vegetable taxa, and there was no significance difference (paired t-test, two tailed ($\alpha = 0.05, d.f. = 2$) = 4.30, $p > 0.05$) between genders and knowledge on traditional vegetables (ulam). Distilled water, hot water, and ethanol crude extracts of *C. crepidioides* (CCE) were tested for total phenolic content (TPC) (Folin-Ciocalteu method), total flavonoid content (TFC) (aluminium chloride colorimetric method), and three antioxidant assays (DPPH scavenging, ABTS decolourization, and FRAP assays). The identification of phytochemical compound was analyzed using High Performance Liquid Chromatography method (HPLC), which revealed the presence of polyphenols, namely, chlorogenic acid, epicatechin, and rutin. Gas Chromatography Mass Spectrometry (GCMS) analysis of ethanol extract revealed 44 phytocompound. Ethanol extract has shown higher TPC ($175.06 \pm 0.574 \mu\text{g/ml}$) and TFC ($139.72 \pm 0.923 \mu\text{g/ml}$) compared to water extracts. Anti-aging efficacy of CCE was further evaluated in fibroblast dermalcell line (HSF1184),



which was induced for photodamage using UVB radiation and hydrogen peroxide. Findings revealed that at lower concentration CCE water extracts exhibited no cytotoxicity at lower concentration ($\leq 200 \mu\text{g/ml}$) on proliferation of tested dermal cells line (HSF1184). Meanwhile for ROS scavenging assay in fibroblast cell line, hot water extract has shown the higher scavenging $49.64\% \pm 3.77\%$ at $250 \mu\text{g/ml}$ treatment, compared to distilled water extract ($39.66\% \pm 10.82\%$) and ethanol extract ($18.69\% \pm 4.44\%$) at the same concentration. The inhibition of elastase by CCE were found at concentration range of 0-100 $\mu\text{g/ml}$. Collagen content of UV induced cells were observed increased after treated with various concentration (0-100 $\mu\text{g/ml}$) of CCE. The traditional claim of obtaining anti-aging and antioxidant benefits from eating ulam were scientifically validated in this work.



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ABSTRAK

Merekodkan pengetahuan tradisional (TK) tentang etnobotani boleh menjadi alat yang berguna untuk penemuan alternatif baru agen anti oksida dan anti penuaan dari sayuran tempatan. Objektif kajian ini ialah: merekodkan etnobotani sayuran tradisional (ulam) sebagai bahan pencegah penuaan, menyelidik kandungan fitokimia, aktiviti anti oksida, dan anti penuaan *Crassocephalum crepidioides*, menentukan aktiviti anti penuaan dan menyarankan keberkesanan ekstrak *C. crepidioides* (CCE) melawan kesan radiasi UVB yang diaruhkan dalam sel kulit manusia (HSF1184). Dokumentasi TK dinilai secara kualitatif dari temubual separa berstruktur dengan enam informan. Sebanyak 46 spesies sayuran tradisional dari 41 genera dan 25 famili telah direkodkan. Para informan percaya memakan ulam akan memberikan mereka nutrisi dan makanan berfungsi sebagai anti penuaan. Purata, informan menyebut 7.67 ± 3.89 taksa sayuran, dan tiada perbezaan signifikan (paired t-test, two tailed ($\alpha = 0.05, d.f. = 2$) = 4.30, $p > 0.05$) antara jantina dan pengetahuan sayuran tradisional. Ekstrak air suling, air panas, dan etanol *C. crepidioides* (CCE) telah diuji untuk kandungan fenolik (kaedah Folin-Ciocalteu), kandungan flavonoid (kaedah kolorimetrik aluminium klorida), dan tiga asai anti oksida (DPPH, ABTS, FRAP). Pengecaman sebatian fitokimia telah dianalisis menggunakan kaedah High Performance Liquid Chromatography (HPLC) telah mengenalpasti kehadiran polifenol, iaitu asid klorogenik, epicatechin, dan rutin. Analisis Gas Chromatography Mass Spectrometry (GCMS) untuk ekstrak etanol telah mengenalpasti 44 sebatian fito. Ekstrak etanol telah menunjukkan TPC ($175.06 \pm 0.574 \mu\text{g/ml}$) dan TFC ($139.72 \pm 0.923 \mu\text{g/ml}$) lebih tinggi berbanding ekstrak air. Corak yang sama didapati untuk asai antioksidan, ekstrak etanol mempamer nilai lebih tinggi berbanding ekstrak air. Penilaian keberkesanan anti penuaan CCE telah dilanjutkan didalam jujukan sel dermal fibroblas (HSF1184) yang telah diradiasi dan dilakukan dengan sinaran UVB dan hidrogen peroksida untuk mengaruhkan kecederaan foto. Kajian mendapati pada



kepekatan rendah ($\leq 200 \mu\text{g/ml}$), ekstrak air CCE tidak menyebabkan sitotoksik ke atas proliferasi jujukan sel dermal. Manakala, asai penguraian ROS dalam jujukan sel fibroblast mendapati, ekstrak air panas mempunyai peratusan penguraian ROS lebih tinggi $49.64\% \pm 3.77\%$ pada perlakuan $250 \mu\text{g/ml}$, berbanding dengan ekstrak air suling ($39.66\% \pm 10.82\%$) and ekstrak etanol ($18.69\% \pm 4.44\%$) pada kepekatan yang sama. Perencatan elastase oleh CCE didapati pada julat kepekatan $0-100 \mu\text{g/ml}$. Kandungan kolagen dalam sel yang dicetuskan dengan UV telah meningkat selepas diperlakukan dengan pelbagai kepekatan CCE ($0-100 \mu\text{g/ml}$). Kenyataan tradisional tentang faedah anti penuaan dan anti oksida hasil dari memakan ulam telah ditahkikkan secara saintifik dalam penyelidikan ini.



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LIST OF SYMBOLS AND ABBREVIATIONS

<	-	less than
%	-	Percentage
>	-	greater than
±	-	standard deviation
≤	-	less than or equal
≥	-	more than or equal
µg	-	Microgram
µl	-	Microliter
°C	-	degree Celsius
ABS	-	Access benefit sharing
ABTS	-	2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid)
BORH	-	Borneensis Herbarium
CBD	-	Convention on Biological Diversity
DCFDA	-	2',7'-dichlorofluorescein diacetate
DH2O	-	distilled water extract
DMEM	-	Dulbecco's Modified Eagle's Medium
DMSO	-	dimethyl sulfoxide
DPPH	-	2,2-diphenyl-1-picrylhydrazyl
EtOH	-	ethanol extract
FBS	-	fetal bovine serum
FC	-	frequency of citation
FIC	-	Informant Consensus Factor
FL	-	fidelity level
FRAP	-	ferric reducing antioxidant power
G	-	Gram
H ₂ O ₂	-	hydrogen peroxide



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LIST OF PUBLICATIONS

Scopus indexed publications:

- i. **Awang-Kanak, F.** & Abu Bakar, M. F. (2020). Traditional vegetables salad (ulam) of Borneo as source of functional food. *Food Research*. Volume 3, No. 1. Pp. 1-12.
- ii. **Awang-Kanak, F.**, Abu Bakar, M. F., & Matawali, A. (2020). Ethnobotanical Indices for Traditional Vegetable and Herbal Medicine Species Consumed in Kota Belud, Sabah, Malaysia. *IOP Conf. Ser.: Earth Environ. Sci.* 549 012028



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CHAPTER 1

INTRODUCTION

1.1 Background of study

The tropic weather of Malaysia is the main precursor of its exorbitant biodiversity, this naturally conducive environment paths way for species, including plants, to flourish. Consequently, this sets Malaysia as a vessel of resources for many plant species either for highly commercial such as timber species or plants for many other purposes including non-timber forest products (Andersen *et al.*, 2003; Howell *et al.*, 2010; Kodoh *et al.*, 2017). Since Malaysia is a nation built on multi-ethnic and multicultural background, the practice of plant usage as food is rather ethnics centric (Normiadilah & Noriah, 2012). The study of human and plant relationship, be it as food, indigenous medicine, cultural significance, all these purposes could be assembled up as ethnobotany (Halina & Said atul, 2008; Wan Izatul, 2013; Foo *et al.*, 2014; Solehah & Nasuruddin, 2014; Foo *et al.*, 2016; Sabran *et al.*, 2016;). The ethnobotany researches in Malaysia often combined the study of wild vegetables with medicinal plants survey used by the communities (Fasihuddin & Hasmah, 1993; Mashitah *et al.*, 2002; Fasihuddin & Ghazally, 2003; Kulip 2003; Jantan, 2004; Kulip 2005; Al-Adhroey *et al.*, 2010; Wan Izatul, 2013; Sabran *et al.*, 2016; Abubakar & Loh, 2016; Kanniah, 2017; Lambin *et al.*, 2018).

Ethnobotanical study in Peninsular Malaysia always involves mainly Orang Asli community and also traditional Malay people (Ong & Norzalina, 1999; Lin 2005; Samuel *et al.*, 2010; Ong *et al.*, 2011; Azliza *et al.* 2012; Ong *et al.*, 2012; Sabran *et al.*, 2016). There are three dominant tribal groups namely Semang, Senoi, and Proto Malay (Lambin *et al.*, 2018). Orang Asli only represent approximately 1% of Malaysia population, they are the indigenous who still incorporate and practice traditional healings that they have obtained through experience as their system of

healthcare (Lambin *et al.*, 2018). Previous ethnobotany studies in Sabah were having great inclination toward medicinal plants. The ethnobotany studies in Sabah were continued by many other researchers who had recorded ethnobotanical resources on medicinal plants and other useful plants utilized by various ethnic groups from many localities. The involved ethnics were Kadazan/Dusun in Ranau, Tambunan, Keningau, Crocker Range, Kimanis, Papar; Murut in Ulu Kinabatangan, Nabawan, Sapulut, Pensiangan, Kalabakan; Orang Sungai of Bukit Garam, Sandakan; Illanun of Rampayan Laut, Kota Belud; Bajau of Serusop, Tuaran; and Idahan of Lahad Datu (Ghazally *et al.*, 1989; Mat-Salleh *et al.*, 2000; Mashitah *et al.*, 2002). the study done specifically documenting the TK of Sama-Bajau on traditional vegetables is not available.

This study covers the scope of ethnobotanical knowledge on traditional vegetables (ulam) that have been used by Sama-Bajau people in Kota Belud, Sabah. Bajau is the second largest native group that represents 13.4 % of the total population in Sabah. Bajau is a collective term to describe several related subgroups, however there are two commonly known subgroups, which are; the Sama-Bajau and the A'a Bajau. The diaspora of Bajau scattered along the coastlines of Sabah, which are; Kudat, Kota Belud, Tuaran, Putatan, and Papar, in the west coast, while in the east coast, the Bajau are notable in area of Semporna and Lahad Datu. The Sama-Bajau are also known as inland Bajau who traditional livelihood often involve in farming activities and exposed to sunlight. Meanwhile, the Aa'a Bajau (sea Bajau) is the seafaring tribe who regular along coastline of Semporna and surrounding islands (Gusni 2003; Miller 2011; Halina 2013).

In Malay culture, one of practices of consuming plant as food is to eat traditional vegetables or described as "ulam" (Liliwirianis *et al.*, 2011). The intake of "ulam" or fresh vegetables and fruits is related to the belief these "ulam" are beneficial for health maintenance and as a medicinal plant. The consumption of "ulam" in Peninsular Malaysia is not practiced only by Malay, but also practiced by other ethnics; Chinese, Indian, and Orang Asli (Izzah *et al.*, 2012). The writing about "ulam" in this work is elaborated in literature review. Meanwhile, in Sabah and Sarawak, where demographic of ethnics are more diverse compared to in Peninsular Malaysia, the consumption of traditional vegetables is also embedded in many indigenous community groups such as Kadazandusun and Murut in Sabah, Iban in Sarawak, (Kulip, 2005; Kulip, 2007; Chai, 2016; Foo *et al.*, 2016; Khairunnisa *et al.*, 2012).

These wild edible vegetables are harvested directly from forest or home garden, and also available for purchase in local markets or branded as “tamu” in Sabah (Kulip, 2003; Kulip, 2005; Kodoh *et al.*, 2009; Kamarul *et al.*, 2012; Foo *et al.*, 2016).

The importance of vegetables is not just great as dietary resource, but also has been verified as scientifically significant in many previous researches. “Ulam” has been proven to have effective properties with medicinal benefit such as reducing blood sugar, improving blood circulation, anti-aging, antioxidants, antibacterial, antirheumatics, anti-tumor, and antimicrobial (Faridah *et al.*, 2006; Mamot, 2009; Rasdi *et al.*, 2010; Chai *et al.*, 2012; Fatimah *et al.*, 2012; Sabli *et al.*, 2012; Alsarhan *et al.*, 2014; Bachok *et al.*, 2014; Hassanain *et al.*, 2016; Jualang *et al.*, 2016). All these scientific researches added more value and justify the protection of traditional knowledge and genetic resources in Malaysia (de Boer *et al.*, 2012; Wan Izatul, 2013).

Recently, studying the phytochemical contents in concert with their antimicrobial and antioxidant activities has become trending research interest among researchers. Some well-known traditional vegetables have been reported to have both antimicrobial and antioxidant activities such as *Centella asiatica* or “pegaga”, *Cosmos caudatus* or “ulam raja”, and *Kaempferia galanga* or cekur (Faridah *et al.*, 2006; Lee & Vairappan, 2011; Umar *et al.*, 2011; Fatimah *et al.*, 2012). However, the study of phytochemicals are not limited to wild plant only as there are also studies done on wild edible mushrooms, since it is not uncommon for people to treat and administered wild mushrooms as vegetable or added to salad in their daily food intake (Abdullah & Rusea, 2009; Wong & Chye, 2009). Wild edible plants are often neglected by agriculture industry, and indigenous people in Sabah are still utilizing the forest produce as their source of food. Thus, the edible forest produce become importance dietary and antioxidant resources for the community. The demand of traditional vegetables would give implication in local economy, sustainable harvest, and conservation value of the species (Foo *et al.*, 2014; Foo *et al.*, 2016; Jualang *et al.*, 2016; Kodoh *et al.*, 2017). Antioxidants are microconstituents present in diet that can delay or halt lipid oxidation and also functional in scavenging free radical. Antioxidant properties had been enormously reported from plant containing phytochemicals such as polyphenols and flavonoids (Szöllösi & Varga, 2002). Many flavonoids such as quercetin, luteolin and catechins are better antioxidants than



REFERENCES

- Abdullah, F., & Rusea, G. (2009). Documentation of inherited knowledge on wild edible fungi from Malaysia. *Blumea-Biodiversity, Evolution and Biogeography of Plants*, 54(1-1), 35-38.
- Abdul Aziz, R., Sarmidi, M. R., Kumaresan, S., Taher, Z. M., & Foo, D. C. Y. (2003). Phytochemical processing: The next emerging field in chemical engineering— aspects and opportunities. *Jurnal Kejuruteraan Kimia Malaysia*, 3, 45-60.
- Abubakar, I. B., & Loh, H. S. (2016). A review on ethnobotany, pharmacology and phytochemistry of *Tabernaemontana corymbosa*. *Journal of Pharmacy and Pharmacology*, 68, 423-432.
- Abu Bakar, M.F., Abdul Karim, F. and Perisamy, E. (2015). Comparison of phytochemicals and antioxidant properties of different fruit parts of selected *Artocarpus* species from Sabah, Malaysia. *Sains Malaysiana*, 44(3), 355-363. <https://doi.org/10.17576/jsm-2015-4403-06>.
- Abu Bakar, M. F., Ahmad, N. E., Karim, F. A., & Saib, S. (2014). Phytochemicals and antioxidative properties of Borneo indigenous liposu (*Baccaurea lanceolata*) and tampoi (*Baccaurea macrocarpa*) fruits. *Antioxidants*, 3(3), 516-525.
- Abu Bakar, M. F., Mohamed, M., Rahmat, A., & Fry, J. (2009). Phytochemicals and antioxidant activity of different parts of bambangan (*Mangifera pajang*) and tarap (*Artocarpus odoratissimus*). *Food chemistry*, 113(2), 479-483.
- Adil, M. D., Kaiser, P., Satti, N. K., Zargar, A. M., Vishwakarma, R. A., & Tasduq, S. A. (2010). Effect of *Embllica officinalis* (fruit) against UVB-induced photoaging in human skin fibroblasts. *Journal of Ethnopharmacology*, 132(1), 109-114.
- Adjatin, A., Dansi, A., Eze, C. S., Assogba, P., Dossou-Aminon, I., Akpagana, K., & Sanni, A. (2012). Ethnobotanical investigation and diversity of Gbolo (*Crassocephalum rubens* (Juss. ex Jacq.) S. Moore and *Crassocephalum crepidioides* (Benth.) S. Moore), a traditional leafy vegetable under domestication in Benin. *Genetic resources and crop evolution*, 59(8), 1867-1881.



- Aguilar, G. (2001). Access to genetic resources and protection of traditional knowledge in the territories of indigenous peoples. *Environmental Science & Policy*, 4(4-5), 241-256.
- Akiba, S., Shinkura, R., Miyamoto, K., Hillebrand, G., Yamaguchi, N., & Ichihashi, M. (1999). Influence of chronic UV exposure and lifestyle on facial skin photo-aging--results from a pilot study. *Journal of epidemiology*, 9(6sup), 136-142.
- Ala, A. A., Olotu, B. B., & Ohia, C. M. D. (2018). Assessment of cytotoxicity of leaf extracts of *Andrographis paniculata* and *Aspilia africana* on murine cells in vitro. *Archives of basic and applied medicine*, 6(1), 61.
- Alam, A., Ferdosh, S., Ghafoor, K., Hakim, A., Juraimi, A. S., Khatib, A., & Sarker, Z. I. (2016). *Clinacanthus nutans*: A review of the medicinal uses, pharmacology and phytochemistry. *Asian Pacific journal of tropical medicine*, 9(4), 402-409.
- Al-Adhroey, A. H., Nor, Z. M., Al-Mekhlafi, H. M., & Mahmud, R. (2010). Ethnobotanical study on some Malaysian anti-malarial plants: A community based survey. *Journal of ethnopharmacology*, 132(1), 362-364.
- Albuquerque, U. P., Nascimento, A. L. B., Soldati, G. T., Feitosa, I. S., Campos, J. L. A., Hurrell, J. A., & Júnior, F. (2019). Ten important questions/issues for ethnobotanical research. *Acta Botanica Brasilica*, (AHEAD).
- Alsarhan, A., Sultana, N., Al-Khatib, A., Rafiq, M., & Kadir, A. (2014). Review on some Malaysian traditional medicinal plants with therapeutic properties. *Journal of Basic & Applied Sciences*, 10, 149-159.
- Analyst, G. I. (2015). MCP-6498: Nutricosmetics - A Global Strategic Bussiness Report. Retrieved March 6, 2017, from <http://www.strategyr.com/pressMCP-6498.asp>.
- Andersen, J., Nilsson, C., de Richelieu, T., Fridriksdottir, H., Gobilick, J., Mertz, O., & Gausset, Q. (2003). Local use of forest products in Kuyongon, Sabah, Malaysia. *ASEAN Review of Biodiversity and Environmental Conservation (ARBEC)*, 1-18.
- Aniya, Y., Koyama, T., Miyagi, C., Miyahira, M., Inomata, C., Kinoshita, S., & Ichiba, T. (2005). Free radical scavenging and hepatoprotective actions of the medicinal herb, *Crassocephalum crepidioides* from the Okinawa Islands. *Biological and Pharmaceutical Bulletin*, 28(1), 19-23.



- Anke, S., Niemüller, D., Moll, S., Hänsch, R., & Ober, D. (2004). Polyphyletic origin of pyrrolizidine alkaloids within the Asteraceae. Evidence from differential tissue expression of homospermidine synthase. *Plant physiology*, 136(4), 4037-4047.
- Antons, C. (2010). The role of traditional knowledge and access to genetic resources in biodiversity conservation in Southeast Asia. *Biodiversity and conservation*, 19(4), 1189-1204.
- Aslantürk, Ö. S. (2018). *In Vitro Cytotoxicity and Cell Viability Assays: Principles, Advantages, and Disadvantages* (Vol. 2, p. 64). InTech.
- Aubel, J. (2006). *Grandmothers promote maternal and child health: The role of Indigenous knowledge systems' managers* (Report No: 35458). The Africa region's Knowledge and Learning Center.
- Andersen, J., Nilsson, C., de Richelieu, T., Fridriksdottir, H., Gobilick, J., Mertz, O., & Gausset, Q. (2003). Local use of forest products in Kuyongon, Sabah, Malaysia. *ASEAN Review of Biodiversity and Environmental Conservation (ARBEC)*, 1-18.
- Asyira, S. A., Sarbini, S. N. S., & Harah, Z. M. (2016). Mineral Content of Five Indigenous Leafy Vegetable from Bintulu Market, Sarawak Malaysia. *Journal of Medicinal Herbs and Ethnomedicine*, 26-35.
- Azliza, M. A., Ong, H. C., Vikineswary, S., Noorlidah, A., & Haron, N. W. (2012). Ethno-medicinal resources Used by the Temuan in Ulu Kuang Village. *Ethno Medicine* 6(1), 17-22.
- Bachok, M. F., Yusof, B. N. M., Ismail, A., & Hamid, A. A. (2014). Effectiveness of traditional Malaysian vegetables (ulam) in modulating blood glucose levels. *Asia Pacific journal of clinical nutrition*, 23(3), 369-376.
- Bae, Y. S., Oh, H., Rhee, S. G., & Do Yoo, Y. (2011). Regulation of reactive oxygen species generation in cell signaling. *Molecules and cells*, 32(6), 491-509.
- Balick, M.J. and Cox, P.A. 1997. Ethnobotanical Research and Traditional Health Care in Developing Countries. *In: Bodeker, G., Bhat, K.K.S., Burley, J. and Vantomme, P. (Eds), Medicinal Plants for Forest Conservation and Health Care*. FAO, Rome, pp. 12-23.
- Barton, H., & Paz, V. (2007). Subterranean diets in the tropical rain forests of Sarawak, Malaysia. *Rethinking agriculture: archaeological and ethnoarchaeological perspectives*, 50-77.



- Baumann, L. S. (2007). Less-known Botanical Cosmeceuticals. *Dermatologic Therapy*, 20, 330–342.
- Brodie, J., & Giordano, A. (2011). Small carnivores of the Maliau Basin, Sabah, Borneo, including a new locality for Hose's Civet *Diplogale hosei*. *Small Carnivore Conservation*, 44, 1-6.
- Briante, R., Febbraio, F., & Nucci, R. (2003). Antioxidant properties of low molecular weight phenols present in the Mediterranean diet. *Journal of agricultural and food chemistry*, 51(24), 6975-6981.
- Caldwell, M. M., Björn, L. O., Bornman, J. F., Flint, S. D., Kulandaivelu, G., Teramura, A. H., & Tevini, M. (1998). Effects of increased solar ultraviolet radiation on terrestrial ecosystems. *Journal of Photochemistry and Photobiology B: Biology*, 46(1-3), 40-52.
- Chai, P. P. (2016). Midin (*Stenochlaena palustris*), the popular wild vegetable of Sarawak. *UTAR Agriculture Science Journal 2* (2), 1-4.
- Chiang, H. M., Chiu, H. H., Liao, S. T., Chen, Y. T., Chang, H. C., & Wen, K. C. (2013). Isoflavonoid-rich *Flemingia macrophylla* extract attenuates UVB-induced skin damage by scavenging reactive oxygen species and inhibiting MAP kinase and MMP expression. *Evidence-Based Complementary and Alternative Medicine*, 2013.
- Chiu, M. T., Tham, H. J., & Lee, J. S. (2017). Optimization of osmotic dehydration of Terung Asam (*Solanum lasiocarpum* Dunal). *Journal of food science and technology*, 54(10), 3327-3337.
- Chung, A. Y. (2008). An overview of edible insects and entomophagy in Borneo. *Forest insects as food: Humans bite*, 1-9.
- Chung, A. Y., Chey, V. K., Unchi, S., & Momin, B. 2002. Edible insects and entomophagy in Sabah, Malaysia. *The Malayan Nature Journal*, 56(2): 131-144.
- Chung, J. H. (2001). The effects of sunlight on the skin of Asians. In *Comprehensive Series in Photosciences* (Vol. 3, pp. 69-90). Elsevier.
- Cieślak, E., Topolski, K., & Antkiewicz, P. (2004). The frequency of fruit and vegetable consumption in the Beskid Sadecki region. *Acta Scientiarum Polonorum Technologia Alimentaria*, 3(2), 163-170.



- de Albuquerque, U. P., & Hanazaki, N. (2009). Five problems in current ethnobotanical research—and some suggestions for strengthening them. *Human Ecology*, 37(5), 653-661.
- de Boer, H. J., Lamxay, V., & Björk, L. (2012). Comparing medicinal plant knowledge using similarity indices: A case of the Brou, Saek and Kry in Lao PDR. *Journal of Ethnopharmacology*, 141(1), 481-500.
- de Boer, H. J., & Cotingting, C. (2014). Medicinal plants for women's healthcare in southeast Asia: a meta-analysis of their traditional use, chemical constituents, and pharmacology. *Journal of ethnopharmacology*, 151(2), 747-767.
- Draelos, Z. D. (2010). Nutrition and Enhancing Youthful-Appearing Skin. *Clinics in Dermatology*, 28(4), 400–408.
- Ekor, M. (2014). The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in pharmacology*, 4, 177.
- Eldeen, I. M., Effendy, M. A., & Tengku-Muhammad, T. S. (2016). Ethnobotany: challenges and future perspectives. *Research Journal of Medicinal Plants*, 10(6-7), 382-387.
- Emri, G., Paragh, G., Tószaki, Á., Janka, E., Kollár, S., Hegedűs, C., ... & Remenyik, É. (2018). Ultraviolet radiation-mediated development of cutaneous melanoma: An update. *Journal of Photochemistry and Photobiology B: Biology*, 185, 169-175.
- Farazimah, Y., Malai, H.S.A.H., Norhayati, A., Aida, M.B. and Mohamed, A.M. (2017). The screening of anti-oxidant activity, total phenolic and flavonoid contents of local ulam-ulaman of Brunei Darussalam. *International Conference of Natural Products. Malaysia: Malaysian Natural Product Societt (MNPS)*.
- Faridah, A., Lajis, N. H., Israf, D. A., Khozirah, S., & Kalsom, Y. U. (2006). Antioxidant and nitric oxide inhibition activities of selected Malay traditional vegetables. *Food Chemistry*, 95(4), 566-573.
- Farrukh, M. R., Nissar, U. A., Kaiser, P. J., Afnan, Q., Sharma, P. R., Bhushan, S., & Tasduq, S. A. (2015). Glycyrrhizic acid (GA) inhibits reactive oxygen Species mediated photodamage by blocking ER stress and MAPK pathway in UV-B irradiated human skin fibroblasts. *Journal of Photochemistry and Photobiology B: Biology*, 148, 351-357.



- Fasihuddin, A. & Ghazally., I. (2003). Medicinal plants used by Kadazandusun communities around Crocker Range. *ASEAN Review of Biodiversity and Environmental Conservation (ARBEC)*, 1-10.
- Fasihuddin, A., & Hasmah, R. (1992). Medicinal plants of the Murut community in Sabah. *Forest Biology and Conservation in Borneo*, 460-467.
- Fasihuddin, A., & Holdsworth, D. K. (1994). Medicinal Plants of Sarawak, Malaysia, Part I. The Kedayans. *International journal of pharmacognosy*, 32(4), 384-387.
- Fauzya, A. F., Astuti, R. I., & Mubarik, N. R. (2019). Effect of ethanol-derived clove leaf extract on the oxidative stress response in yeast *Schizosaccharomyces pombe*. *International Journal of Microbiology*, 2019.
- Fatimah, A. M. Z., Norazian and, M. H., & Rashidi, O. (2012). Identification of carotenoid composition in selected “ulam” or traditional vegetables in Malaysia. *International Food Research Journal*, 19(2), 527-530.
- Finetti, C. (2011). Traditional Knowledge and the Patent System: Two Worlds Apart? *World Patent Information*, 33 (1), 58-66.
- Fisal, A., Sulaiman, M.R., Saimon, W., Yee, C.F. and Matanjun, P. (2016). Proximate compositions and total phenolic contents of selected edible seaweed from Semporna, Sabah, Malaysia. *Borneo Science*, 31, 74-83.
- Foo, J., Mohamad, A. L., Omar, M., & Amir, A. A. (2016). Ethnobotanical Survey of Medicinal Plants Traded at Tamu in Sabah Urban Area. *Int J Malay World Civil*, 4, 79-87.
- Foo, J., Omar, M., Amir, A. A., & Mohamad, A. L. (2014). Faktor kelangsungan pasaran tumbuhan ubatan di Tamu Pantai Barat Sabah: Satu tinjauan awal (Factors affecting the market viability of medicinal plants–The case of the tamu (local market) of West Coast, Sabah). *Geografia-Malaysian Journal of Society and Space*, 10(2).
- Franco, F. M., Hidayati, S., Abdul Ghani, B. A., & Ranaivo-Malancon., B. (2015). Ethnotaxonomic systems can reflect the vitality status of indigenous languages and traditional knowledge. *Indian Journal of Traditional Knowledge* 14 (2) pp.175-182



PERPUSTAKAAN TUNJUKU AMINAH

- Gaoue, O. G., Coe, M. A., Bond, M., Hart, G., Seyler, B. C., & McMillen, H. (2017). Theories and major hypotheses in ethnobotany. *Economic Botany*, 71(3), 269-287.
- Gerique, A. (2006). An introduction to ethnoecology and ethnobotany: Theory and methods. *Integrative assessment and planning methods for sustainable agroforestry in humid and semiarid regions. Advanced Scientific Training. Loja.*
- Ghazally, L., Hassan, A. K. A., Tanjiwan, B., & Ali, L. (1989). Medicinal plants of the Idahan community in Kampung Segama, Lahad Datu, Sabah. *Sabah Museum Monograph*, 3, 63-72.
- Ghersetich, I., Troiano, M., De Giorgi, V., & Lotti, T. (2007). Receptors in skin ageing and antiageing agents. *Dermatologic clinics*, 25(4), 655-662.
- Ghimeray, A. K., Jung, U. S., Lee, H. Y., Kim, Y. H., Ryu, E. K., & Chang, M. S. (2015). In vitro antioxidant, collagenase inhibition, and in vivo anti-wrinkle effects of combined formulation containing *Punica granatum*, *Ginkgo biloba*, *Ficus carica*, and *Morus alba* fruits extract. *Clinical, cosmetic and investigational dermatology*, 8, 389.
- Ghorbani, A., Naghibi, F., & Mosaddegh, M. (2006). Ethnobotany, ethnopharmacology and drug discovery. *Iranian Journal of Pharmaceutical Sciences*, 2(2), 109-118.
- Giday, M., Asfaw, Z., Elmqvist, T., & Woldu, Z. (2003). An ethnobotanical study of medicinal plants used by the Zay people in Ethiopia. *Journal of ethnopharmacology*, 85(1), 43-52.
- Gilchrest, B. A. (2013). Photoaging. *The Journal of investigative dermatology*, 133(E1), E2.
- González-Parra, E., Gracia-Iguacel, C., Egado, J. and Ortiz, A. (2012). Phosphorus and nutrition in chronic kidney disease. *International Journal of Nephrology*, 2012, 1-5. <https://doi.org/10.1155/2012/597605>
- Griffiths, C. E. M. (2001). The role of retinoids in the prevention and repair of aged and photoaged skin. *Clinical and experimental dermatology*, 26(7), 613-618.
- Gusni, S. (2003). The identity and social mobility of Sama-Bajau. *SARI: Jurnal Alam dan Tamadun Melayu*, 21, 3-11.
- Halim, A. A., Jawan, J. A., Ismail, S. R., Othman, N., and Masnin, M. H. (2013). Traditional knowledge and environmental conservation among indigenous



- people in Ranau, Sabah. *Glob. J. Hum. Soc. Sci. Geogr. Geo Sci. Environ. Disaster Manag.* 13, 5–12.
- Halina, S. M. Y. (2013). Cosmology and world-view among the Bajau: the supernatural beliefs and cultural evolution. *Mediterranean Journal of Social Sciences*, 4(9), 184 .
- Halina, S. M. Y., & Saidatul, N. H. M. (2008). Duang: the semiotic interpretation and perception of the Bajau-Sama community in Sabah. *Jurnal Komunikasi*, 24, 63-71.
- Haruyama, T. (2003). Transmission mechanism of traditional ecological knowledge [en ligne]. *Revue chinoise*, 11(1), 109-118.
- Haruyama, T. (2004). Nature of Traditional Ecological Knowledge Loss: A Quantitative Approach. *Policy Science*, 11(2) 147–155.
- Hassanain, A-T., Ali, N. D. M., Suhaimi, M. H., Rosli, S. S. N., Othman, N. H., Mansor, N. A. S., & Al-Khateeb, A. 2016. Anti-microbial effect of Malaysian vegetables against enteric bacteria. *Asian Pacific Journal of Tropical Biomedicine*, 6(3), 211-215.
- Hastin, E. C., Kresnatita, S., & Miranda, Y. (2013). Ethnobotanical study and nutrient content of local vegetables consumed in Central Kalimantan, Indonesia. *Biodiversitas Journal of Biological Diversity*, 14(2).
- Heo, S. J., & Jeon, Y. J. (2009). Protective effect of fucoxanthin isolated from *Sargassum siliquastrum* on UV-B induced cell damage. *Journal of Photochemistry and Photobiology B: Biology*, 95(2), 101-107.
- Hitchner, S. L. (2010). Heart of borneo as a 'Jalan Tikus': Exploring the links between indigenous rights, extractive and exploitative industries, and conservation at the World Conservation Congress 2008. *Conservation and Society*, 8(4), 320.
- Hoffman, B., & Gallaher, T. (2007). Importance indices in ethnobotany. *Ethnobotany Research and Applications*, 5, 201-218.
- Honigman, R., & Castle, D. J. (2006). Aging and cosmetic enhancement. *Clinical interventions in aging*, 1(2), 115.
- Howell, C. J., Schwabe, K. A., & Samah, A. H. A. (2010). Non-timber forest product dependence among the Jah Hut subgroup of Peninsular Malaysia's Orang Asli. *Environment, development and sustainability*, 12(1), 1-18.
- Huang, Y. H., Wu, P. Y., Wen, K. C., Lin, C. Y., & Chiang, H. M. (2018). Protective effects and mechanisms of *Terminalia catappa* L. methenolic extract on



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- hydrogen-peroxide-induced oxidative stress in human skin fibroblasts. *BMC complementary and alternative medicine*, 18(1), 266.
- Hwang, K. A., Hwang, Y. J., & Song, J. (2016). Antioxidant activities and oxidative stress inhibitory effects of ethanol extracts from *Cornus officinalis* on raw 264.7 cells. *BMC complementary and alternative medicine*, 16(1), 196.
- Iannitti, T., Bingöl, A. Ö., Rottigni, V., & Palmieri, B. (2013). A new highly viscoelastic hyaluronic acid gel: rheological properties, biocompatibility and clinical investigation in esthetic and restorative surgery. *International journal of pharmaceutics*, 456(2), 583-592.
- Iziq, E. I. & Abdullah, S. A. (2015). Spatial Arrangement of Coastal Sama-Bajau Houses Based on Adjacency Diagram. *International Journal of Built Environment and Sustainability*, 2(4).
- Izzah, A. N., Aminah, A., Pauzi, A. M., Lee, Y. H., Rozita, W. W., & Fatimah, S. (2012). Patterns of fruits and vegetable consumption among adults of different ethnics in Selangor, fMalaysia. *International Food Research Journal*, 19(3), 1095-1107.
- Jaiswal, B. S. (2012). *Solanum torvum*: a review of its traditional uses, phytochemistry and pharmacology. *International Journal of Pharma and Bio Sciences*, 3(4), 104-111.
- Jantan, I. (2004). Medicinal plant research in Malaysia: scientific interests and advances. *Jurnal Sains Kesihatan Malaysia*, 2(2), 27-46.
- Jantan, I. (2006). The scientific values of Malaysian herbal products. *Jurnal Sains Kesihatan Malaysia*, 4(1), 59-70.
- Jeevanandam, J., Aing, Y. S., Chan, Y. S., Pan, S., & Danquah, M. K. (2017). Nanoformulation and application of phytochemicals as antimicrobial agents. In *Antimicrobial Nanoarchitectonics* (pp. 61-82). Elsevier.
- John, H. E., & Price, R. D. (2009). Perspectives in the selection of hyaluronic acid fillers for facial wrinkles and aging skin. *Patient preference and adherence*, 3, 225.
- Joshi, R. K. (2014). Study on essential oil composition of the roots of *Crassocephalum crepidioides* (Benth.) S. Moore. *Journal of the Chilean Chemical Society*, 59(1), 2363-2365.



- Jualang, A. G., Adznila, E., & How, S. E. (2016). In vitro bioactivities and phytochemicals content of vegetables from Sabah, Malaysia. *Borneo Science*, 37(1), 37-53.
- Jung, H. Y., Shin, J. C., Park, S. M., Kim, N. R., Kwak, W., & Choi, B. H. (2014). Pinus densiflora extract protects human skin fibroblasts against UVB-induced photoaging by inhibiting the expression of MMPs and increasing type I procollagen expression. *Toxicology reports*, 1, 658-666.
- Kamarul, M. M., Langgat, J., Dahnil, M. I., & Noor Fzlinda, F. (2012). Articles: Visitor motivation, expectation and satisfaction of local cultural event in Sabah-A case study of Tamu Besar, Kota Belud. *International Journal of Culture and Tourism Research*, 5(1), 39-50.
- Kammeyer, A., & Luiten, R. M. (2015). Oxidation events and skin aging. *Ageing research reviews*, 21, 16-29.
- Kanasi, E., Ayilavarapu, S., & Jones, J. (2016). The aging population: demographics and the biology of aging. *Periodontology 2000*, 72(1), 13-18.
- Kanniah, R. (2017). Protection of traditional knowledge in agriculture: A review of the laws in Malaysia. In *Intellectual Property, Cultural Property and Intangible Cultural Heritage* (pp. 205-220). Routledge.
- Kassim, D. H. A., Raduan, S. Z., Aziz, M. A., Chelum, A., Morni, A. A. M., & Wahab, R. A. (2016). Indigenous knowledge of medicinal plants used and its implication towards health-seeking behavior among the Melanau in Pulau Brait, Sarawak, Malaysia. *J Adv Res Soc Behav Sci*, 4(2), 136-145.
- Kaur, C. D., & Saraf, S. (2012). Development of photoprotective creams with antioxidant polyphenolic herbal extracts. *Research Journal of Medicinal Plant*, 6, 83-91.
- Kebede, A., Ayalew, S., Mesfin, A., & Mulualem, G. (2016). Ethnobotanical investigation of traditional medicinal plants commercialized in the markets of Dire Dawa city, eastern Ethiopia. *Journal of Medicinal Plants Studies*, 4(3), 170-178.
- Kettle, C. J., Ghazoul, J., Ashton, P., Cannon, C. H., Chong, L., Diway, B., & Koh, L. P. (2011). Seeing the fruit for the trees in Borneo. *Conservation Letters*, 4(3), 184-191.
- Khairunisa, I. O., Ab Karim, M. S., Karim, R., Adzhan, N., Halim, N. A., & Osman,



- S. (2012). Factors influencing fruits and vegetables consumption behaviour among adults in Malaysia. *Journal of Agribusiness Marketing*, Vol. 5, December 2012, p. 29-46.
- Khatijah H. (2006). *Anatomical Atlas of Malaysian Medicinal Plants*. Vol 1. Malaysia, Universiti Kebangsaan Malaysia Bangi, Selangor.
- Kibong, S. B., Amat, A., & Samad, L. A. (2017). Penggunaan Bosoon dan Herba bagi Merawat Sakit Perut dalam Masyarakat Bajau Sama'di Daerah Tuaran, Sabah~ The Use of Bosoon and Herbs for Treating Stomach Ache in the Bajau Sama'Community of the Tuaran District, Sabah. *MANU: Jurnal Pusat Penataran Ilmu dan Bahasa (PPIB)*.
- Kim, D., Hwang, Y., Chang, B., Cho, H., & Kim, S. (2019). Effects of the *Syzygium aromaticum* L. extract on antioxidation and inhibition of matrix metalloproteinase in human dermal fibroblast. *Asian Pacific Journal of Tropical Biomedicine*, 9(2), 53-53.
- Kim, J. K., Mun, S., Kim, M. S., Kim, M. B., Sa, B. K., & Hwang, J. K. (2012). 5, 7-Dimethoxyflavone, an activator of PPAR α/γ , inhibits UVB- induced MMP expression in human skin fibroblast cells. *Experimental dermatology*, 21(3), 211-216.
- Kodoh, J., Mojiol, A. R., & Lintangah, W. (2009). Some Common Non-Timber Forest Products Traded by Indigenous Community in Sabah, Malaysia. *Journal of Sustainable Development*, 2(2), 148.
- Kodoh, J., Mojiol, A. R., Lintangah, W., Gisiu, F., Maid, M., & Liew, K. C. (2017). Traditional knowledge on the uses of medicinal plants among the ethnic communities in Kudat, Sabah, Malaysia. *International Journal of Agriculture, Forestry, and Plantation*, 5, 79-85.
- Koteswara Rao, K. (2016). Cultural ecology in the erosion of local knowledge: folklore among Konda Reddis of South India. *Asian Anthropology*, 15(1), 21-35.
- Kulip, J. (2003). An ethnobotanical survey of medicinal and other useful plants of Muruts in Sabah, Malaysia. *Telopea*, 10(1), 81-98.
- Kulip, J. (2005). Similarity of Medicinal Plants Used by Two Native Communities in Sabah, Malaysia, 1, 81-85.
- Kulip, J. (2007). Gingers in Sabah and their traditional uses, *Sepilok Buletin*. 7: 23-44.



PTT A U T H M
PEPUSATKAN POKKIL TUN AMINAH

- Kulip, J. (2009). Medicinal plants of Sabah, Malaysia: Potential for agroforestry. *JIRCAS Work. Rep*, 60, 47-48.
- Kulip, J. (2014). The ethnobotany of Dusun people in Tikolod village, Tambunan district, Sabah, Malaysia. *REINWARDTIA*, 14(1), 101-121.
- Kulip, J., Indu, J. P., & Mision, R. (2005). Ethnobotanical Survey of Medical Plants In The Village Of Kaingaran In Sabah, Malaysia. *Journal of Tropical Biology & Conservation (JTBC)*, (1).
- Lailawati, B. M., Seok, C. B., Mutang, J. A., Baharudin, S. A., & Joo, H. C. (2014). The prejudice of Bajau: from own and others ethnic perspective: A preliminary study in Sabah. *International Journal of Information and Education Technology*, 4(3), 244
- Lam, Y. T., Aung-Htut, M. T., Lim, Y. L., Yang, H., & Dawes, I. W. (2011). Changes in reactive oxygen species begin early during replicative aging of *Saccharomyces cerevisiae* cells. *Free Radical Biology and Medicine*, 50(8), 963-970.
- Lambin, R., Wahab, N. A., Choo, G. S., Mustapha, R., & Abdullah, R. (2018). A case study of orang asli indigenous knowledge in traditional medicine. *International Journal of Academic Research in Business and Social Sciences*, 8(4), 998-1010.
- Lasimbang, R. 1991. Tradisional herbal medicines used by the Dusun/Kadazan people. In K.H. Teh (Ed.). *Ke arah menghidupkan penggunaan tradisional tumbuhan Tempatan: Prosiding Seminar Kebangsaan Etnobotani Pertama*, Serdang, Pp. 27-43.
- Lapian, A. B., & Kazufumi, N. (1996). Research on Bajau communities: maritime people in Southeast Asia. *Asian Research Trends*, 45-70.
- Lee, T. K., & Vairappan, C. S. (2011). Antioxidant, antibacterial and cytotoxic activities of essential oils and ethanol extracts of selected South East Asian herbs. *Journal of Medicinal Plants Research*, 5(21), 5284-5290
- Lim, T. G., Lee, S. Y., Huang, Z., Chen, H., Jung, S. K., Bode, A. M., Lee, K. W., & Dong, Z. (2014). Curcumin suppresses proliferation of colon cancer cells by targeting CDK2. *Cancer Prevention Research*, 7(4), 466-474.
- Lin, K. W. (2005). Ethnobotanical study of medicinal plants used by the Jah Hut peoples in Malaysia. *Indian Journal of Medical Sciences*, 59(4), 156-161.



- Ling, A. L. M., Yasir, S., Matanjun, P., & Bakar, M. F. A. (2015). Effect of different drying techniques on the phytochemical content and antioxidant activity of *Kappaphycus alvarezii*. *Journal of applied phycology*, 27(4), 1717-1723.
- Liliwirianis, N. M., Zain, W. Z. W. M., Kassim, J., & Karim, S. A. (2011). Preliminary studies on phytochemical screening of ulam and fruit from Malaysia. *Journal of Chemistry*, 8(S1), S285-S288.
- Lusia, M.B., Hasmadi, M., Zaleha, A.Z. and Fadzelly, A.M. (2015). Effect of different drying methods on phytochemicals and antioxidant properties of unfermented and fermented teas from Sabah Snake Grass (*Clinacanthus nutans* Lind.) leaves. *International Food Research Journal*, 22(2), 661.
- Mackeen, M. M., Ali, A. M., El-Sharkawy, S. H., Manap, M. Y., Salleh, K. M., Lajis, N. H., & Kawazu, K. (1997). Antimicrobial and cytotoxic properties of some Malaysian traditional vegetables (ulam). *International Journal of Pharmacognosy*, 35(3), 174-178.
- Mamot, S. (2009). Traditional Malaysian salads (ulam) as a source of antioxidants. In *Prosiding Seminar Kimia Bersama UKM-ITB* (Vol. 7, pp. 9-11).
- Martin, G. J. (1995). *Ethnobotany: a methods manual* (Vol. 1). Earthscan.
- Martin, G., & Vermeulen, S. (2005). Intellectual property, indigenous knowledge, and biodiversity. *Capitalism Nature Socialism*, 16(3), 27-48.
- Mamedov, N. (2012). Medicinal plants studies: history, challenges and prospective. *Med Aromat Plants*, 1(8), e133.
- Mashitah, M. Y., Julius, A., & Mohamed, M. (2003). Plants Used in The Traditional Healthcare of the Orang Sungai Communities in the Kinabatangan Floodplain. In M. Mohamed, A. Takano, B. Goossens & R. Indran (Eds.), *Lower Kinabatangan Scientific Expedition 2002* (pp. 121-138). Kota Kinabalu: Universiti Malaysia Sabah.
- Mat-Salleh, K., Kusalah, G., & Latiff, A. (2001). Peranan Tumbuhan Di Dalam Budaya Masyarakat Tempatan: Status Kajian Etnobotani Masa Kini Di Malaysia. *Unpublished manuscript*.
- McClatchey, W. C., Mahady, G. B., Bennett, B. C., Shiels, L., & Savo, V. (2009). Ethnobotany as a pharmacological research tool and recent developments in CNS-active natural products from ethnobotanical sources. *Pharmacology & therapeutics*, 123(2), 239-254.
- Mechanism matters. (2010). *Nature Medicine*, 16 (4).



- Meijaard, E., Abram, N.K., Wells, J.A., Pellier, A.S., Ancrenaz, M., Gaveau, D.L., Runting, R.K., & Mengersen, K. (2013). People's perceptions about the importance of forests on Borneo. *PloS one*, 8(9), p.e73008.
- Mertz, O. (2007). The potential of wild vegetable as permanent crops or to improve fallows in Sarawak, Malaysia. In Cairns, M. (Ed.), *Voices from the Forest: Integrating Indigenous Knowledge into Sustainable Upland Farming*, p. 73–86. London: Routledge
- Miller, M.T. (2011) Social Organization of West Coast Bajau. *SIL Electronic Working Papers* 2011-009.
- Mithieux, S. M., & Weiss, A. S. (2005). Elastin. In *Advances in protein chemistry* (Vol. 70, pp. 437-461). Academic Press.
- Mojiol, A. R., Adella, A., Kodoh, J., Lintangah, W., & Wahab, R. (2010). Common medicinal plants species found at burned and unburned areas of Klias peat swamp forest, Beaufort, Sabah Malaysia. *Journal of Sustainable Development*, 3(1), 109.
- MoNRE (2012). *National Policy on Biological Diversity 2016-2025*. Putrajaya : Ministry of Natural Resources and Environment.
- Moustafa, M. F., Alamri, S. A., Taha, T. H., & Alrumman, S. A. (2013). *In vitro* antifungal activity of *Argemone ochroleuca* Sweet latex against some pathogenic fungi. *African Journal of Biotechnology*, 12(10).
- Muhamad, B. Z., & Mustafa, A. M. (2010). *Traditional Malay medicinal plants*. ITBM.
- Muhammed, N., & Muthu, T. A. (2015). Indigenous people and their traditional knowledge on tropical plant cultivation and utilization: A case study of Murut communities of Sabah, Borneo. *J. Trop. Resour. Sustain. Sci*, 3, 117-128.
- Narayanaswamy, R., & Ismail, I. S. (2015). Cosmetic potential of Southeast Asian herbs: an overview. *Phytochemistry Reviews*, 14(3), 419-428.
- Natarajan, S., Shunmugiah, K. P., & Kasi, P. D. (2013). Plants traditionally used in age-related brain disorders (dementia): An Ethanopharmacological Survey. *Pharmaceutical Biology*, 51 (4), 492–523.
- Ndhlala, A. R., Stafford, G. I., Finnie, J. F., & Van Staden, J. (2011). Commercial herbal preparations in KwaZulu-Natal, South Africa: The urban face of traditional medicine. *South African Journal of Botany*, 77(4), 830-843.
- Nema, N. K., Maity, N., Sarkar, B., & Mukherjee, P. K. (2011). *Cucumis sativus* Fruit-Potential Antioxidant, Anti-Hyaluronidase, and Anti-Elastase Agent.



Archives of Dermatological Research, 303, 247–252.

- Ng, X.N., Chye, F.Y. and Mohd Ismail, A (2012). Nutritional profile and antioxidative properties of selected tropical wild vegetable. *International Food Research Journal*, 19(4), 1487-1496.
- Nor, N. M., Sharif, M. S. M., Zahari, M. S. M., Salleh, H. M., Isha, N., & Muhammad, R. (2012). The transmission modes of Malay traditional food knowledge within generations. *Procedia-Social and Behavioral Sciences*, 50, 79-88.
- Nordin, R., Hassan, K., & Zainol, Z. (2012a). Traditional knowledge documentation: preventing or promoting biopiracy. *Pertanika Journal of Social Sciences & Humanities*, 20, 11-22.
- Nordin, R., Hassan, K. H., Zainol, Z. A., Shapiee, R., Jalil, F., Witbrodt, M. A., & Hassan, M. S. (2012b). Regulating access to genetic resources and the sharing of benefit through the Sarawak access benefit-sharing legislation. *Research Journal of Applied Sciences*, 7(3), 185-193.
- Normiadillah, A. & Noriah, O. 2012. The relationship between plants and the Malay culture. *Procedia-Social and Behavioral Sciences*, 42, pp.231-241.
- Noweg, T., Abdullah, A. R., & Nidang, D. (2003). Forest plants as vegetables for communities bordering the Crocker Range National Park. *ASEAN Review of Biodiversity and Environmental Conservation (ARBEC)(January-March)*, 1-18.
- Nurulita, Y., Dhanutirto, H., & Soemardji, A. A. (2012). Penapisan aktivitas dan senyawa antidiabetes ekstrak air daun Dandang Gendis (*Clinacanthus nutans*). *Jurnal Natur Indonesia*, 10(02).
- Ohtsuka, T. (1999). Early stages of secondary succession on abandoned cropland in north- east Borneo Island. *Ecological Research*, 14(3), 281-290.
- Ong, H. C., Faezah, A. W., & Milow, P. (2012). Medicinal plants used by the Jah Hut Orang Asli at Kampung Pos Penderas, Pahang, Malaysia. *Ethno Med*, 1, 11-15.
- Ong, H. C., & Norzalina, J. (1999). Malay herbal medicine in Gemencheh, Negeri Sembilan, Malaysia. *Fitoterapia*, 70(1), 10-14.
- Ong, H. C., Zuki, R. M., & Milow, P. (2011). Traditional knowledge of medicinal plants among the Malay villagers in Kampung Mak Kemas, Terengganu, Malaysia. *Ethno Med*, 5(3), 175-185.
- Osman, H., Nasarudin, R., & Lee, S. L. (2004). Extracts of cocoa (*Theobroma cacao*



PTFAUTHM
PERPUSTAKAAN FAKULTAS UIN AR-RANIRY

- L.) leaves and their antioxidation potential. *Food Chemistry*, 86(1), 41-46.
- Othman, A., Mukhtar, N. J., Ismail, N. S., & Chang, S. K. (2014). Phenolics, flavonoids content and antioxidant activities of 4 Malaysian herbal plants. *International Food Research Journal*, 21(2), 759.
- Owokotomo, I. A., Ekundayo, O., Oladosu, I. A., & Aboaba, S. A. (2012). Analysis of the essential oils of leaves and stems of *Crassocephalum crepidioides* growing in south western Nigeria. *International Journal of Chemistry*, 4(2), 34.
- Park, M. A., Sim, M. J., & Kim, Y. C. (2017). Anti-photoaging effects of *Angelica acutiloba* root ethanol extract in human dermal fibroblasts. *Toxicological research*, 33(2), 125.
- Patwardhan, B. (2005). Ethnopharmacology and drug discovery. *Journal of ethnopharmacology*, 100(1-2), 50-52.
- Payumo, J. G., Jussaume, R., & Grimes, H. D. (2009). Protecting and preserving traditional knowledge and plant genetic resources: Is ASEAN there yet? *Plant Genetic Resources: Characterization and Utilization*, 8 (1), 26–34.
- Petrovska, B. B. (2012). Historical review of medicinal plants' usage. *Pharmacognosy reviews*, 6(11), 1.
- Pittayapruek, P., Meephansan, J., Prapapan, O., Komine, M., & Ohtsuki, M. (2016). Role of matrix metalloproteinases in photoaging and photocarcinogenesis. *International Journal of Molecular Sciences*, 17(6), 868.
- Poulsen, A. D., & Christensen, H. (2003). *Etilingera kenyalang* (Zhgiberaceae)—a new species from Sarawak, Borneo, with notes on its ecology and Iban ethnobotany. *Nordic Journal of Botany*, 23(4), 407-413.
- Poulsen, A. D., & Pendry, C. A. (1995). Inventories of ground herbs at three altitudes on Bukit Belalong, Brunei, Borneo. *Biodiversity & Conservation*, 4(7), 745-757.
- Radzi, N. C., Kamaruzaman, M. F. M., Mustapa, A. N., Azizi, M., & Yunus, C. (2020). Extraction of Essential Oil from Indigenous Herb *Physalis angulata* Linn using Microwave Assisted Extraction. *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 72 (1), 138-147
- Rafidah, S. (2014). *Native courts system in Sabah: Will it continue to survive?* Paper presented at International Conference on law, policy, and social justice, Penang Malaysia. 10-11 September 2014.



- Randrianarivony, T. N., Ramarosandratana, A. V., Andriamihajarivo, T. H., Rakotoarivony, F., Jeannoda, V. H., Randrianasolo, A., & Busmann, R. W. (2017). The most used medicinal plants by communities in Mahaboboka, Amboronabo, Mikoboka, Southwestern Madagascar. *Journal of Ethnobiology and Ethnomedicine*, 13(1), 19.
- Rahal, A., Kumar, A., Singh, V., Yadav, B., Tiwari, R., Chakraborty, S., & Dhama, K. (2014). Oxidative stress, prooxidants, and antioxidants: the interplay. *BioMed research international*, 2014.
- Rahu, A. A., Hidayat, K., Ariyadi, M., & Hakim, L. (2014). Management of Kaleka (traditional gardens) in Dayak community in Kapuas, Central Kalimantan. *International Journal of Science and Research*, 3(3), 205-210.
- Ramachandran, S., Prasad, N. R., & Karthikeyan, S. (2010). Sesamol inhibits UVB-induced ROS generation and subsequent oxidative damage in cultured human skin dermal fibroblasts. *Archives of dermatological research*, 302(10), 733-744.
- Rasdi, N. H. M., Samah, O. A., Sule, A., & Ahmed, Q. U. (2010). Antimicrobial studies of *Cosmos caudatus* Kunth. (Compositae). *Journal of Medicinal Plants Research*, 4(8), 669-673.
- Reid, A. (1997). Endangered identity: Kadazan or Dusun in Sabah (East Malaysia). *Journal of Southeast Asian Studies*, 28(1), 120-136.
- Reuter, J., Merfort, I., & Schempp, C. M. (2010). Botanicals in dermatology. *American journal of clinical dermatology*, 11(4), 247-267.
- Robinson, D. F. (2014). *Biodiversity, access and benefit-sharing: Global case studies*. Routledge.
- Rohana, A. R., Lim, H. F., & Ismariah, A. (2014). Socio-economic background and income generation of herbal cultivators in Peninsular Malaysia. In *Proceedings of The Conference on Forestry and Forest Products Research 2013* (p. 179).
- Royer, M., Prado, M., García-Pérez, M. E., Diouf, P. N., & Stevanovic, T. (2013). Study of Nutraceutical, Nutricosmetics and Cosmeceutical Potentials of Polyphenolic Bark Extracts from Canadian Forest Species. *Pharma Nutrition*, 1(4), 158-167.
- Royyani, M. F., & Efendy, O. (2015). Kajian etnobotani masyarakat dayak di desa Tau Lumbis, Kabupaten Nunukan, Propinsi Kalimantan Utara, Indonesia. *Berita Biologi*, 14(2), 177-185.



Sabah Biodiversity Enactment 2000.

Sabah Native Court Enactment 1992.

Sabli, F., Mohamed, M., Rahmat, A., Ibrahim, H., & Abu Bakar, M. F. (2012). Antioxidant properties of selected *Etilingera* and *Zingiber* species (Zingiberaceae) from Borneo Island. *International Journal of Biological Chemistry*, 6(1), 1-9.

Sabran, S. F., Mohamed, M., & Abu Bakar, M. F. (2016). Ethnomedical knowledge of plants used for the treatment of tuberculosis in Johor, Malaysia. *Evidence-Based Complementary and Alternative Medicine*, 2016.

Sakihama, Y., Cohen, M. F., Grace, S. C., & Yamasaki, H. (2002). Plant phenolic antioxidant and prooxidant activities: phenolics-induced oxidative damage mediated by metals in plants. *Toxicology*, 177(1), 67-80.

Sade, A., Ali, I., Ariff, M. and Raduan, M. (2006). The seaweed industry in Sabah, East Malaysia. *Journal of Southeast Asian Studies*, 11(1), 97-107.

Safarzadeh, E., Shotorbani, S. S., & Baradaran, B. (2014). Herbal medicine as inducers of apoptosis in cancer treatment. *Advanced pharmaceutical bulletin*, 4 (Suppl 1), 421

Saigol, P. 1986. *Kegunaan Palmae, Gramineae, Marantaceae dan Pandanaceae dari segi etnobotani oleh kaum Bidayuh, Iban dan Melayu di Sarawak*. Kertas kerja Universiti Pertanian Malaysia.

Saidatul, N. H. M. (1999). Mantera: Satu penelitian awal dalam kalangan petani Bajau. *Jurnal Kinabalu*, Vol.V, hlm. 51–82.

Saidatul, N. H. M. (2010). Perbandingan Dialek Bajau Kota Belud dan Bajau Semporna, Sabah. *Jurnal Melayu*, 5 333-374.

Saidatul, N. H. M. (2018). Ngalai: Ritual Penyembuhan dalam Kalangan Orang Bajau di Kota Belud, Sabah (Ngalai: A Healing Ritual of Kota Belud's Bajau Society). *Akademika*, 88(3) 101-112.

Saifudin, A., Usia, T., AbLallo, S., Morita, H., Tanaka, K., & Tezuka, Y. (2016). Potent water extracts of Indonesian medicinal plants against PTP1B. *Asian Pacific Journal of Tropical Biomedicine*, 6(1), 38-43.

Sakai, S., Choy, Y. K., Kishimoto-Yamada, K., Takano, K. T., Ichikawa, M., Samejima, H., & Nakashizuka, T. (2016). Social and ecological factors associated with the use of non-timber forest products by people in rural Borneo. *Biological conservation*, 204, 340-349.



PTTAUTHM
REPUSTAKAAN FUNKSI KURAMINAH

- Salick, J., Biun, A., Martin, G., Apin, L., & Beaman, R. (1999). Whence useful plants? A direct relationship between biodiversity and useful plants among the Dusun of Mt. Kinabalu. *Biodiversity & Conservation*, 8(6), 797-818.
- Samuel, A. J. S. J., Kalusalingam, A., Chellappan, D. K., Gopinath, R., Radhamani, S., Husain, H. A., & Promwichit, P. (2010). Ethnomedical survey of plants used by the Orang Asli in Kampung Bawong, Perak, West Malaysia. *Journal of ethnobiology and ethnomedicine*, 6(1), 5.
- Sanidad, K. Z., Yang, H., Wang, W., Ozay, E. I., Yang, J., Gu, M., & Xiao, H. (2018). Effects of consumer antimicrobials benzalkonium chloride, benzethonium chloride, and chloroxylenol on colonic inflammation and colitis-associated colon tumorigenesis in mice. *Toxicological Sciences*, 163(2), 490-499.
- Schagen, S. K., Zampeli, V. A., Makrantonaki, E., & Zouboulis, C. C. (2012). Discovering the link between nutrition and skin aging. *Dermato-endocrinology*, 4(3), 298-307.
- Schieber, M., & Chandel, N. S. (2014). ROS function in redox signaling and oxidative stress. *Current biology*, 24(10), R453-R462.
- Shaffiq, S. M. A., Sidik, B. J., Harah, Z. M., & Devi, R. S. (2013). Marketable wild fruits of Sarawak, Borneo: Their mode of consumption, uses and sugar profiles. *Indian Journal of Traditional Knowledge*, 12(2), 195-201.
- Shin, C. K., Yee, C. F., Shya, L. J., & Atong, M. (2007). Nutritional properties of some edible wild mushrooms in Sabah. *J. Applied Sci*, 7, 2216-2221.
- Shirazi, O.U., Khattak, M.A.K., Shukri, N.A.M. and Nasyriq, M.N. (2014). Determination of total phenolic, flavonoid content and free radical scavenging activities of common herbs and spices. *Journal of Pharmacognosy and Phytochemistry*, 3(3), 104-108.
- Silva, H. C. H., Caraciolo, R. L. F., Marangon, L. C., Ramos, M. A., Santos, L. L., & Albuquerque, U. P. (2014). Evaluating different methods used in ethnobotanical and ecological studies to record plant biodiversity. *Journal of ethnobiology and ethnomedicine*, 10(1), 48.
- Silva, A. C. O., Santana, E. F., Saraiva, A. M., Coutinho, F. N., Castro, R. H. A., Pisciotano, M. N., & Albuquerque, U. P. (2013). Which approach is more effective in the selection of plants with antimicrobial activity?. *Evidence-Based Complementary and Alternative Medicine*, 2013.



- Simioni, C., Zauli, G., Martelli, A. M., Vitale, M., Sacchetti, G., Gonelli, A., & Neri, L. M. (2018). Oxidative stress: role of physical exercise and antioxidant nutraceuticals in adulthood and aging. *Oncotarget*, 9(24), 17181.
- Singh, A. (2011). *Herbalism, phytochemistry and ethnopharmacology*. CRC Press.
- Solehah, I., & Nassuruddin, M. G. (2014). Traditional Malay Healing Practices: Expressions of Cultural and Local Knowledge. *Procedia-Social and Behavioral Sciences*, 140, 291-294.
- Soetan, K.O., Olaiya, C.O. and Oyewole, O.E. (2010). The importance of mineral elements for humans, domestic animals and plants-A review. *African Journal of Food Science*, 4(5), 200-222.
- Son, Y., Cheong, Y. K., Kim, N. H., Chung, H. T., Kang, D. G., & Pae, H. O. (2011). Mitogen-activated protein kinases and reactive oxygen species: how can ROS activate MAPK pathways?. *Journal of signal transduction*, 2011.
- Stahl, W., & Sies, H. (2012). Photoprotection by dietary carotenoids: concept, mechanisms, evidence and future development. *Molecular nutrition & food research*, 56(2), 287-295.
- Street, R. A., Stirk, W. A., & Van Staden, J. (2008). South African traditional medicinal plant trade—challenges in regulating quality, safety and efficacy. *Journal of Ethnopharmacology*, 119(3), 705-710.
- Sudha, T., Chidambarampillai, S., & Mohan, V. R. (2013). GC-MS analysis of bioactive components of aerial parts of *kirganelia reticulata* Poir (Euphorbiaceae). *J. Curr. Chem. Pharm. Sc*, 3(2), 113-122.
- Suhaini, S., Liew, S.Z., Norhaniza, J., Lee, P.C., Jualang, G., Embi, N. and Hasidah, M.S. (2015). Anti-malarial and anti-inflammatory effects of *Gleichenia truncata* mediated through inhibition of GSK3 β . *Tropical Biomedicine*, 32(3), 419-433.
- Szöllösi, R., & Varga, I. S. 2002. Total antioxidant power in some species of Labiatae (Adaptation of FRAP method). *Acta Biologica Szegediensis*, 46(3-4), 125-127.
- Taeymans, J., Clarys, P., & Barel, A. O. (2014). Use of Food Supplements as Nutricosmetics in Health and Fitness. In Barel, A. O., Paye, M., Maibach & H. I. *Handbook of Cosmetic Science and Technology*. 4th ed. United State : CRC Press. pp. 583–596.
- Tair, R., & Dell, L. (2018). Spring-Water as An Alternative Resource After Earthquake for Villagers, Kota Belud Sabah. *Geological Behavior (GBR)*, 2(1), 5-11.



- Tapani, E., Taavitsainen, M., Lindros, K., Vehmas, T., & Lehtonen, E. (1996). Toxicity of ethanol in low concentrations: experimental evaluation in cell culture. *Acta Radiologica*, 37(6), 923-926.
- Taylor, J. L. S., Rabe, T., McGaw, L. J., Jäger, A. K., & Van Staden, J. (2001). Towards the scientific validation of traditional medicinal plants. *Plant growth regulation*, 34(1), 23-37.
- Teixeira, M. P., Cruz, L., Franco, J. L., Vieira, R. B., & Stefenon, V. M. (2016). Ethnobotany and antioxidant evaluation of commercialized medicinal plants from the Brazilian Pampa. *Acta Botanica Brasilica*, 30(1), 47-59.
- Tey, N. P., Siraj, S. B., Kamaruzzaman, S. B. B., Chin, A. V., Tan, M. P., Sinnappan, G. S., & Müller, A. M. (2015). Aging in multi-ethnic Malaysia. *The Gerontologist*, 56(4), 603-609.
- Thring, T. S., Hili, P., & Naughton, D. P. (2009). Anti-collagenase, anti-elastase and anti-oxidant activities of extracts from 21 plants. *BMC complementary and alternative medicine*, 9(1), 27.
- Ting, S. H., & Tham, F. L. (2014). Vitality of Kadazandusun language in Sabah, Malaysia. *Asia-Pacific Studies*, 1(1), 44-57.
- The Convention on Biological Diversity 1992.
- Umar, M. I., Asmawi, M. Z. B., Sadikun, A., Altaf, R., & Iqbal, M. A. (2011). Phytochemistry and medicinal properties of *Kaempferia galangal* L. (Zingiberaceae) extracts. *African Journal of Pharmacy and Pharmacology*, 5(14), 1638-1647.
- Vairappan, C.S. and Mikio, K. (2008). Nutritional properties, antioxidant potential and antibacterial activity of two edible seaweeds, *Kappaphycus alvarezii* and *Eucheuma denticulatum* (Gigartinales, Rhodophyta). *Malaysian Journal of Science*, 27(2), 53-65.
- Van Overwalle, G. (2005). Protecting and sharing biodiversity and traditional knowledge: Holder and user tools. *Ecological Economics*, 53(4), 585-607.
- Vanijajiva, O., & Kadereit, J. W. (2009). Morphological and molecular evidence for interspecific hybridisation in the introduced African genus *Crassocephalum* (Asteraceae: Senecioneae) in Asia. *Systematics and Biodiversity*, 7(3), 269-276.
- Veeresham, C. (2012). Natural products derived from plants as a source of drugs. *Journal of Advanced Pharmaceutical Technology & Research* 3 (4), 200-201.



- Vickers, A., & Zollman, C. (1999). Herbal medicine. *Bmj*, 319(7216), 1050-1053.
- Voon, B.H., & Kueh, H.S., 1999. The nutritional value of Indigenous fruits and vegetables in Sarawak. *Asia Pacific Journal Clinical Nutrition* 8, 24–31.
- Wan Izatul, A. W. T. (2013). Protection of the associated traditional knowledge on genetic resources: beyond the Nagoya Protocol. *Procedia-Social and Behavioral Sciences*, 91, 673-678.
- Wen, K. C., Fan, P. C., Tsai, S. Y., Shih, I., & Chiang, H. M. (2012). *Ixora parviflora* protects against UVB-induced photoaging by inhibiting the expression of MMPs, MAP kinases, and COX-2 and by promoting type I procollagen synthesis. *Evidence-Based Complementary and Alternative Medicine*, 2012.
- Wen, K.C., Fan, P.C., Tsai, S.Y., Shih, I. and Chiang, H.M. (2012). *Ixora parviflora* protects against UVB-induced photoaging by inhibiting the expression of MMPs, MAP kinases, and COX-2 and by promoting type I procollagen synthesis. *Evidence-Based Complementary and Alternative Medicine*, 2012, 1-11. <https://doi.org/10.1155/2012/417346>
- Wen, K. C., Shih, I., Hu, J. C., Liao, S. T., Su, T. W., & Chiang, H. M. (2011). Inhibitory effects of *Terminalia catappa* on UVB-induced photodamage in fibroblast cell line. *Evidence-Based Complementary and Alternative Medicine*, 2011.
- Wong, J.Y. & Chye, F.Y., 2009. Antioxidant properties of selected tropical wild edible mushrooms. *Journal of Food Composition and Analysis*, 22(4), pp.269-277.
- Wong, J. Z., Etoh, S., & Sujang, A. B. (2009). Towards sustainable community-based fishery resources management: the Tagal system of Sabah, Malaysia. Secretariat, Southeast Asian Fisheries Development Center.
- Yahara, S., Yamashita, T., Nozawa, N., & Nohara, T. (1996). Steroidal glycosides from *Solanum torvum*. *Phytochemistry*, 43(5), 1069-1074.
- Yuan, H., Ma, Q., Ye, L., & Piao, G. (2016). The traditional medicine and modern medicine from natural products. *Molecules*, 21(5), 559.
- Zhang, J., Wang, X., Vikash, V., Ye, Q., Wu, D., Liu, Y., & Dong, W. (2016). ROS and ROS-mediated cellular signaling. *Oxidative medicine and cellular longevity*, 2016.
- Zaki, A. M., Fazwa, M. F., Lokmal, N., Norhayati, S., Nabilah, S. S., & Norfadilah, W. (2014). Production of highquality planting materials of *Eurycoma*



longifolia and *Labisia pumila* in FRIM. In *Proceedings of The Conference on Forestry and Forest Products Research 2013*(p. 190).

Zaki, W. W., & Rani, A. M. (2014). Country status report on medicinal and aromatic plants in Malaysia. *Expert consultation on promotion of medicinal and aromatic plants in the Asia-Pacific region: Proceedings*, 174.

Zhonghong, G., Huang, K., Yang, X., Xu, H. 1999. Free radical scavenging and antioxidant activities of flavonoids extracted from the radix of *Scutellaria baicalensis* Georgi. *Biochimica et Biophysica Acta (BBA)-General Subjects*, 1472(3), 643-650.

Zollo, P. H. A., Kuate, J. R., Menut, C., & Bessiere, J. M. (2000). Aromatic plants of tropical Central Africa. XXXVI. Chemical composition of essential oils from seven Cameroonian *Crassocephalum* species. *Journal of Essential Oil Research*, 12(5), 533-536.



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