Jurnal Kejuruteraan dan Sains Kesihatan
Journal of Engineering and Health Sciences
Jilid 4 2020: 123 – 134

REVIEW ON *POLYGONUM MINUS*: PHARMACOLOGICAL PROPERTIES AND PHYTOCHEMICAL COMPOUNDS

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Abstract

The objective of this study is to study the biodiversity of *Polygonum* and to review its pharmacological properties and phytochemical compositions of via electronic literature search. The chemical composition, biological actions and the medicinal characteristics of *P. minus* (kesum) were mentioned in the articles. The chemical constituents include the polyphenols such as the flavonoids. The extracts were reported as anti-diabetic, anti-bacterial, anti-inflammatory and anti-cancer. This review is presented, in parallel with the laboratory experiments involving the separation of the *Polygonum* leaves extract using Thin Layer Chromatography. It is expected that the phytochemical data of the leaves would depend on the hydrophobicity of the aprotic solvent during the extraction procedure.

Keywords: chromatography, kesum, literature, *Polygonum*

1.0 INTRODUCTION

Polygonum minus Huds. (*P. minus*) belongs to the Polygonaceae family. This plant possesses antibacterial, antifungal, antiviral, antioxidant, antiulcer activity and cytotoxicity, which are useful for health benefits (Mohd Ghazali et al. 2014). It is one of the native plants in Southeast Asia countries such as in Malaysia, Thailand, Vietnam and Indonesia. The Malaysian called this plant as kesum (laksa plant) or pigmy knot weed in English (Vikram et al. 2014; Malaysia Biodiversity Information System, 2020). It is commonly used as traditional Malay medicine and cuisine, such as 'gulai ayam daun kesum' (New Straits Time, 2019). It is also utilized as a flavouring agent in Malay food delicacies due to its aroma, which are sweet and pleasant (Vikram et al. 2014). The plant grows in wild, especially in damp areas such as the side ditches or nearby rivers and lakes. *P. minus* have a slim, crawling shrub and can reach up to a height of 1.0 m in lowlands and up to 1.5 m in hilly areas. The leaves are narrow and have alternate arrangement with 5-7 cm long and 0.5-2.0 cm wide (Christapher et al. 2015). They contain high levels of essential oil and are used to treat dandruff, by applying to the scalp (Qader et al. 2012). Traditionally, kesum is used for sprains and body aches by pounding it together with rice and make it into paste. The paste is then applied on the affected area.

Figure 1: Potted kesum plant (left), fresh (middle) and dried (right) kesum leaves.

2.0 LITERATURE REVIEW

P. minus is widely available, however, there are not many scientific data about this plant. The identified chemical constituents are limited and only to the respect of pharmacological activities. Thus, the aim of this study is to review the *Polygonum* genus, prior to the examination of its chromatographic profile of the leave and twig parts. This will hopefully provide further exploration on the pharmacological properties, bioactivity-guided isolation of the active constituents and studies on their structure-activity relationship, mechanism of actions, pharmacokinetics and toxicity required, in parallel to the development of *Polygonum* as a successful therapeutic agent (Biotropics Malaysia Berhad, 2019).

Nutritionally, *P. minus* leaves are rich in vitamins such as vitamin C, carotenes, retinol equivalents, α-tocopherol (vitamin E) and minerals (Ching & Mohamed, 2001). This plant has been described to have antioxidant, antimicrobial and antiulcer activities (George et al. 2014). Unfortunately, there was an article retraction of a randomized, placebo-controlled study of the effect of *P. minus* extract on cognitive and psychosocial parameters, due to a number of reporting errors (Shahar et al. 2015).

2.0 METHODOLOGY

A literature review was conducted on the *Polygonum* species. The aim was to present a brief information on kesum, with therapeutic potentials. The search was performed electronically (via Science Finder, Medline, Scopus and Google Scholar). The Malay, Indonesian and English articles (till March 2020) were analyzed. Meanwhile, the thin layer chromatographic (TLC) methods (Globinmed, 2018) were established by using the standard parameters [silica gel 60 F_{254}, mobile phase: ethyl acetate: formic acid: glacial acetic acid: toluene = (25:3:3:5) (v/v)].

3.0 RESULTS & DISCUSSION

From the review, the Polygonaceae family contains approximately 48 genera and 1,200 species (Mohamed et al. 2020). Earlier, naturally growing

P. aviculare L. in Egypt was subjected to antimicrobial activity and phytochemical analysis (Salama et al. 2010). It was recorded that the *Polygonum* genus is represented in Argentina by merely 20 species (Derita et al. 2008), while the endemic *P. betpakdalense* grows in Kazakhstan (Shevchenko et al. 2019).

3.1 Review on the Pharmacological Properties of *Polygonum* species

Table 1 provides a number of pharmacological characteristics the *Polygonum* extracts. MeOH extract of *P. minus* has the highest antioxidant potential, which is most likely attributed to its relatively higher phenolic and flavonoid contents (Abdullah et al. 2017).

Table 2: The pharmacological properties of *Polygonum* extract.

Pharmacological Properties	Key points	Source
Anti-Alzheimer	Anti-Alzheimer's studies were conducted on β-sitosterol from *P. hydropiper*	Muhammad et al. 2017
Anti-bacterial	*P. aviculare* extracts demonstrated a broad spectrum of anti-bacterial activity	Salama et al. 2009
	Methanolic extract of *P. maritimum* inhibited Gram-positive bacteria	Shen et al. 2018
Anti-cancer	*P. minus* has the potential in the treatment of leukaemia, colorectal and breast cancers and as an anti-HIV agent	Ahmad et al. 2018
Anti-diabetes	*P. cuspidatum* has a potential application for treatment of diabetic	Sheng et al. 2019

Anti-oxidant	*P. minus* ethyl acetate crude extract showed high antioxidant capacity and selective antiproliferative activity against HepG2 cells, probably attributed to its polyphenolic content	Vimala et al. 2011, Mohd Ghazali et al. 2014; Abdullah et al. 2017

3.2 Review on the Phytochemical Compositions of *Polygonum* species

a. *Phenolics and flavonoids*

The phenolic compounds, for example, gallic and coumaric acids, are responsible for the biological activities, including antioxidant and antiulcer activities. The presence of gallic acid, rutin, coumaric acid and quercetin (Figure 2) were shown in leaves extracts (Qader et al. 2012).

Another polyphenolic compounds, for example the flavonoids, showed multiple beneficial health-promoting activities including lessening the risk of dementia, avoiding LDL-oxidation and atherosclerosis, bringing down the level of cholesterol, antioxidant and antihypertensive activities. The hydroxyl group are responsible for the antioxidant activity (Abdullah et al. 2017). These compounds are reported to be a vital bioactive constituents of *Polygonum* species, which includes quercetin-3-O-rhamnoside (quercitrin) (Figure 2).

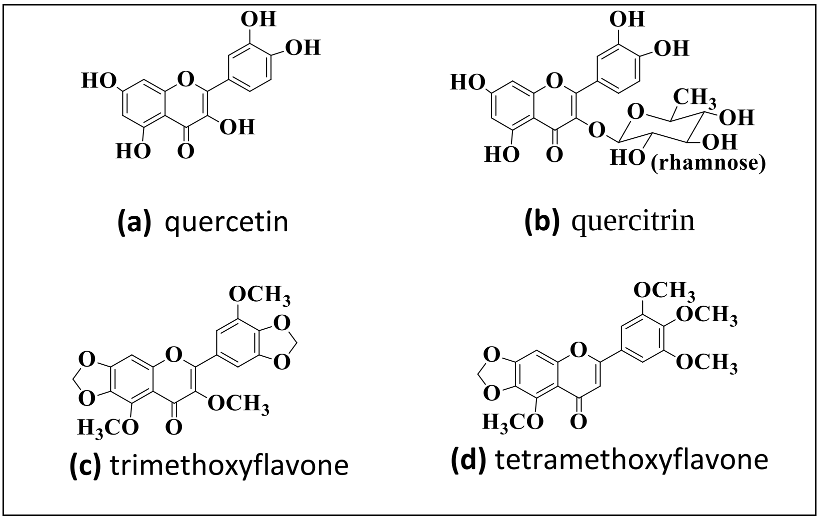


Figure 2: The chemical structure of quercetin, quercitrin (3-*O*-α-L-rhamnopyranosyloxy-3’,4’5,7-tetrahydroxyflavone), trimethoxyflavone and tetramethoxyflavone (Urones et al. 1990; Zhao et al. 2003).

Urones et al. (1990) isolated two new components which were a flavone; 6,7methylenedioxy-5,3’,4’,5’-tetramethoxyflavone and a methyl flavonol; 6,7-4’,5’dimethylenedioxy-3,5,3’-trimethoxyflavone, from ether extract of *P. minus* (Figure 2). The structures of both components were determined by spectroscopic method. The UV spectrum had bands at A_{max} 319, 277 and 235 nm, indicating the presence of a flavone.

George et al. (2014) studied the anti-inflammatory activity of ethanolic and aqueous extracts of *P. minus* using in vitro and in vivo approaches. It was found that flavonoids could interrupt the oxidative generation of acetaldehyde from phospholipids and decrease the downstream production of inflammatory metabolites from amino acids metabolism, oxidative damage and induction of inducible inflammatory pathways due to their potent antioxidant capacity. The aqueous extract of *P. minus* contain flavonoids such as quercetin (Figure 2), which possess inhibitory effect on histamine release in mast cells. In patient suffering chronic inflammation, flavonoids with antioxidant capacity could reduce the cellular conversion of acetaldehyde to malondialdehyde.

Flavonoids in kesum leaves are believed to have antioxidant and anti-proliferative effects. Based on liquid chromatography and mass spectrometry analyses of *P. minus*, the methanol extract contains tannins and flavonoids including apigetrin, hyperoside, isoquercetin, astragalin, miquelianin, quercetin and quercitrin (Figure 2) (Abdullah et al. 2017). The *in vitro* antioxidant and anti-proliferative activities of *P. minus* were obtained through sequential extraction by using four solvents of varying polarities such as hexane, ethyl acetate, methanol and water. The flavonoids were detected in all extracts. The methanol extract showed the highest total flavonoid content, followed by ethyl acetate, water and hexane extracts. It was found that the methanol extract showed the highest yield, followed by the water extract. It was suggested that *P. minus* leaf extracts had more polar components. The distinctive structures and functional group of plant phytochemicals are known to affect their polarity and solubility in extraction solvents used, thus the yield would be dependent on that characteristics. Based on the chemical structure of flavone (6,7-methylenedioxy-5,3',4',5'-tetramethoxyflavone), it contains a number of methoxy group as the functional group (Figure 2).

b. *Non phenolic compounds*

The pungent drimane-type of sesquiterpene dialdehyde (-)polygodial (Figure 3) was found in two species of *Polygonum* genus belonging to *Persicaria* section, including *P. hydropiper* (Derita et al. 2008). The presence of decanal, dodecanal and many other aldehydes in *P. minus*, resulted in the preparation of perfume (Vikram et al. 2014).

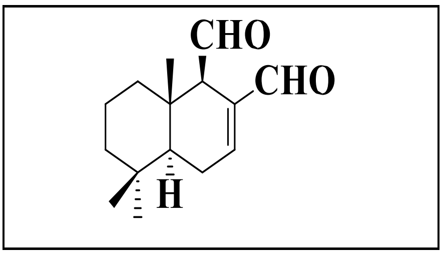
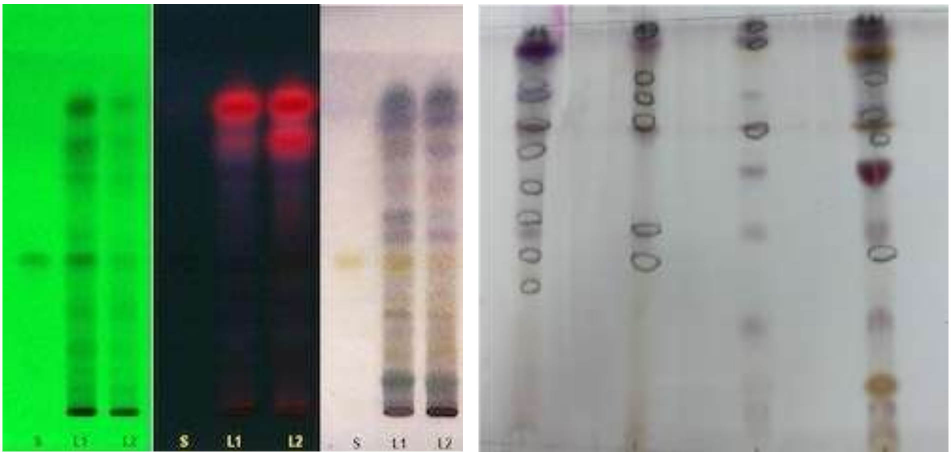


Figure 3: The chemical structure of polygodial (Derita et al. 2008).

c. The Chromatography of *Polygonum* species

The presence of quercitrin could be observed in the methanol extracts of kesum dried leaves and twigs powder (Malaysian Herbal Monograph (Globinmed, 2018). This compound can be detected through Thin Layer Chromatography (TLC), under UV light at the wavelength of 254 nm and 366 nm before spraying (Figure 4). Quercitrin can also be detected under visible light, after spraying with vanillin-sulphuric acid reagent. A similar yellow spot was also observed in the experimental work, however, it showed lower Rf value (Rf = 0.2).



(a) (b) (c) (d) (e) (f) (g)

Figure 4 : The TLC profiles of quercitrin (S) and methanol extracts of *P. minor* dried leaves powder (L1) and dried twigs powder (L2) observed under (a) UV at 254 nm; (b) UV at 366 nm; (c) visible light after spray (Source: Globinmed, 2018). Meanwhile, the experimental TLC profiles of *P. minor* extracts (d) dried twigs, (e) dried leaves, (f) fresh twigs and (g) fresh leaves after sulphuric anisaldehyde spray (Amiruddin, 2020).

4.0 CONCLUSION

The intake of kesum could improve general health. However, more clinical studies are required, e.g. to investigate the role of alkaloids from this local green salad. The pharmacological characteristics of *P. minus* include antioxidant, antibacterial, antifungal, antiulcer, anti-inflammatory and antiproliferative activities, owing to the presence of phenolic compounds such as gallic acid, rutin, coumaric acid and quercetin in leaves extracts. Future research would consist of anticancer and anti-aging testings. Meanwhile, the chromatography technique for the separation of the natural molecules from kesum, could be further investigated.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Faculty of Pharmacy, UiTM, for the support.

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