Hibiscus syriacus L.: A Critical Review of Medicinal Utility & Phytopharmacology with Mechanistic Approach

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ABSTRACT

Herbal medicine is an ancient form of medicine that has been used by humans for thousands of years. The vital systems of primordial medicines include Ayurveda, Siddha, Unani, and folk medicine and, the most developed and widely practiced medicinal system in India is Ayurveda. Hibiscus species are commonly shrubs, herbs or trees with many useful properties, of which H. syriacus is one of the prime species of the genus. It is endowed as the national flower of South Korea, commonly known as ‘Rose of Sharon’ and is found along valleys, open slopes, roadsides and sea cliffs. The plant species is used as a medicine in many diseases such as amoebic colitis, hemorrhoids, hemorrhoidal bleeding, migraine, headache, cold, cough, nausea, vomiting, abdominal pain, scabies, ulcers, vertigo etc. It is used against many diseases such as amoebic colitis, ascariasis, abdominal pain, cold, cough, colitis, diarrhoea, dysentery, dyspepsia, gas, stomach ache, haematochezia, ascariasis etc. Several biological activities of the plant are attributed to the presence of various active compounds like botulin, coumarins, fumaric acid, hydroquinone, is vitesin, linoleic acid, nonanoic acid, naringenin acid, Para hydroxybenzaldehyde, palmitic acid, Syracusans A-C, triterpenoids and vanillin acid. Some phytochemicals, including linoleic acid, palmitic acid, hydroxyhobiscone A, hibiscuses D, Syracusans A, pentacyclic triterpene esters, triterpenoid, nonanoic acid, anthocyanins, and others, are responsible for its biological importance like anti-cancer, anti-aging, anti-depressant, anti-fungal, anti-melanogenic, anti-oxidant, cytoprotective, neuroprotective, etc. Detailed information extracted by reviewing the medicinal utilities & Phytopharmacological properties, provide elaborated evidences for the application of H. syriacus in many ailments.

Keywords: Hibiscus Syriacus, Phytoconstituents, Ethno-Medicinal, Pharmacology, Medicinal Uses.

INTRODUCTION

In the modern world, as people become more aware of the strength and side effects of synthetic pharmaceuticals, there is an increasing interest in natural product cures. Throughout history, herbal-based medicines have been used to treat a variety of infectious illnesses, and several scientific investigations have underlined the importance and contribution of various plant species. Ayurvedic as well as, natural herbs had been used since ancient times by all the civilizations in history. Herbal remedies have shown modest growth in recent decades [1]. According to the World Health Organization, traditional medicines are used by more than 80% of the world’s population for primary healthcare [2].

Hibiscus has around 250 species that are extensively dispersed throughout the world's tropical and subtropical climates, with approximately 40 species found in India. Many species are grown for their decorative value. H. syriacus is an important species in the genus, which have great economic and medicinal value and is also used in beverages, in Asian countries [3]. It is used against many diseases such as amoebic colitis, ascariasis, abdominal pain, cold, cough, colitis, dermophytes, diarrhoea, dysentery, dyspepsia, gas, haemorrhoids, haematochezia, hemorrhoidal bleeding, headache, itchiness, migraine, nausea, psoriasis, painful skin diseases, stomach ache, scabies, ulcers, vomiting, vertigo etc. It also contains numerous secondary metabolites which have anti-inflammatory, anti-bacterial, anti-fertility, anti-fungal, anti-oxidative, anti-hypertensive and hypoglycemic like biological activities [4].

Currently, the anti-proliferative effect of root bark against cancer cells has recently been discovered, and various triterpenoids have been identified as active chemicals responsible for the activity [5]. Although, several research works have been already performed previously, but a comprehensive review is still lacking which may aid in future research. The current study has been attempted to summarise the most recent knowledge on pharmacological actions, ethnomedicinal and phytochemical properties of H. syriacus, which in-turn will be valuable for future implications. The study will deliver detailed authentication for the application of the plant in various maladies.
METHODOLOGY

This review article was created by combining and evaluating existing studies on therapeutic applications, Phyto-constituents, and scientific validation of *H. syriacus* L. A total of 70 published publications were consulted using several data sources, including PubMed, Google Scholar, Science Direct, Web of Science, Scopus, and among others. Only published publications in English were chosen for performing search targets across several databases using a combination of key phrases including *H. syriacus*, ethno-pharmacology, Phyto-chemistry, pharmacological terms such as anti-microbial, anti-inflammatory, anti-oxidant capabilities, etc. The literature search in this paper was limited to scientific publications included in the above-mentioned databases that may be available to the scientific community for reference, though we acknowledge that there may be some additional data in less accessible forms such as unpublished thesis and reports that were not included in this study. All of the previously published data is presented in two tables (Phyto-constituents construction and pharmacological activity) and five figures. Chemical components reported from the species are provided, together with their IUPAC names, chemical and structural formulas, and are drawn and validated by PubChem.

COMPREHENSIVE LITERATURE-BASED INFORMATION ON HIBISCUS SYRIACUS L.

Morphological description

It is a shrub or small tree, 4 m tall. Stems erect or ascending, sparsely to moderately hairy when young, becoming glabrous or nearly so with age. Leaves stipulate, petiole densely hairy adaxially. Inflorescence has solitary flowers or few-flowered clusters in the axil of distal leaves. Flowers horizontal or ascending, sometimes double, pedicel 1.5 cm long, minutely, densely, stellate-hairy, epicalyx bracts 7 or 8, 0.9-2.2 cm long, linear or narrowly ob lanceolate, margin not ciliate, densely stellate-hairy throughout, calyx lobed, broadly campanulate, 1.6-2 cm long, lobes triangular, apices sharp or short-acuminate, minutely and thickly stellate-hairy throughout, corolla broadly funnel shape, staminal column 2.5-3.5 cm long, white, carrying filaments virtually throughout, free section of filaments not secund, generally 1.5-3 mm long, style 8 mm long, white, branches sometimes of unequal lengths, stigma white. Fruits capsules, 1.5-2.5 cm long, greenish tan, ovoid, apex apiculate, minutely, densely stellate-hairy. Seeds 5-8 per locule, 4-5 mm long, reniform-ovoid, laterally flattened, reddish brown, laterally glabrous, dorsally long, hairy, hair straight, reddish orange in colour [8-7].

Distribution and Habitat

This species of *Hibiscus* is native to China & Taiwan and widely distributed in Belgium, Cameroon, Cuba, Ecuador, Georgia, Greece, India, Italy, Japan, Korea, Mexico, Tadzhikistan, Uzbekistan, United States of America, Vietnam and Yugoslavia [7,8]. It has been grown in Fujian, Guizhou, Hainan, Hebei, Henan, Hunan, Jiangxi, Shaanxi, Shandong, and Xizang since ancient times [9]. This species is found along streams, disturbed areas, forest edges, hillsides, in valleys, open slopes, roadsides and sea cliffs, at an elevation range of 2600 m [8-11]. The detailed taxonomical features are shown in Figure 1.

Vernacular names of *Hibiscus syriacus* L.

*H. syriacus* has various vernacular names, which vary area, region and country-wise. Linnaeus called *H. syriacus* or Althea frutex, sweet job in Bengali, after claiming that the plant was native to Syria. The wonderful name ‘Rose of Sharon’ was most likely given for the same purpose, but it is now thought to have originated in China. Shrubby Althea is another name for it that is used in some areas. It grows to approximately 2.7 metres and has gorgeous white, blue, or mauve blooms that are either solitary or double. They appear in the axils of the leaves, much like hollyhocks. It has been widely planted, even as far north as Ontario, and given various descriptive names, as have other *Hibiscus* species [12]. Figure 2 depicts some of the World’s Vernacular names, along with their respective languages and nations.

Figure 1: Foliage of *H. syriacus*

Figure 2: Vernacular names of *H. syriacus* across the globe

AN OUTLINE OF PHYTO-CONSTITUENTS

Phytochemicals and their derivative compounds are becoming more widely recognised as effective treatments for a wide range of illnesses. Some are actively participating in various therapies such as Syracusans A-C, a chemical marker of *H. syriacus*, was being revealed as an anti-oxidant and enzyme inhibitory agents, among other things. Chemiosmosis A, C & D are anti-oxidant agents,
whereas nonanoic acid possess antifungal property. In addition to these, numerous other compounds.

Table 1: Major Chemical Groups & Compounds of *H. syriacus*

| S. No. | Phyto-constituents | Chemical Formula | IUPAC Name | Class of Compounds | Structure | Properties | References |
|--------|--------------------|------------------|------------|--------------------|-----------|-----------|------------|
| 1.     | Linoleic acid      | C18H32O2         | (9Z,12Z)-octadeca-9,12-dienoic acid | Fatty acid | Anti-aging | 13         |
| 2.     | Palmitic acid      | C16H32O2         | -          | Fatty acid         | -         | Anti-aging | 13         |
| 3.     | Isovitexin         | C21H20O11        | 5,7-dihydroxy-2-(4-hydroxyphenyl)-6-[(2S,3R,4R,5S,6R)-3,4,5-trihydroxy-6-(hydroxymethyl)oxan-2-yl]chromen-4-one | Flavones   | Enzyme inhibitory | 14         |
| 4.     | Syracusan A        | C13H20O1        | 2,7-dihydroxy-8-methoxy-6-methylnaphthalene-1-carbaldehyde | -         | Enzyme inhibitory | 14         |
| 5.     | Hydroquinone       | C6H8O4          | benzene-1,4-diol | Depigmenting agent | -         | Neuroprotective | 15         |
| 6.     | Naringenin acid    | C4H8O4          | (E)-3-(4-hydroxyphenyl)prop-2-enoic acid | Flavanone | -         | 15         |
| 7.     | P-hydroxybenzaldehyde | C7H8O3      | 2-hydroxybenzaldehyde | Aldehyde | -         | 15         |
| 8.     | Vanillic acid      | C9H8O4          | 4-hydroxy-3-methoxybenzoic acid | Dihydroxybenzoic acid derivative | -         | Neuroprotective | 15         |
| 9.     | Fumaric acid       | C4H6O4          | (E)-3-(4-hydroxy-3-methoxyphenyl)prop-2-enoic acid | Hydroxycinamic acid | -         | Neuroprotective | 15         |
| 10.    | Triterpenoids      | C29H46O3        | 1-1,3,4,5,6,6a,7,10,11,12,13,14,15-b-dodecahydrocyclopiene-4α-carboxylic acid | Tetracyclic and pentacyclic compounds | -         | Anti-cancer | 16         |
| 11.    | Botulin            | C30H46O2        | -          | Terpenoid           | -         | Anti-cancer | 16         |
| 12.    | Nonanoic acid      | C6H12O2         | -          | Fatty acid          | -         | Anti-fungal | 17         |
| 13.    | Syracusan B        | C12H20O1        | 2-hydroxy-6-(hydroxymethyl)-7,8-dimethoxynaphthalene-1-carbaldehyde | -         | Anti-oxidant | 18         |
| 14.    | Syracusan C        | C10H16O1        | 5-hydroxy-11-methoxy-10-methyl-2-oxatricyclo[6.3.1.0^{11}]dodeca-1(11),4,6,8(12),9-pentaen-3-one | -         | Anti-oxidant | 18         |
| 15.    | Chemiosmosis A     | C10H14O1        | (2R,3R)-3-(4-hydroxy-3-methoxyphenyl)-2-(hydroxymethyl)-5-methoxy-2,3-dihydropyran[3,2-h][1,4]benzodioxin-9-one | -         | Anti-oxidant | 19         |
16. Chemiosmosis C \( \text{C}_{21}\text{H}_{20}\text{O}_{9} \) - Anti-oxidant 19

17. Chemiosmosis D \( \text{C}_{21}\text{H}_{20}\text{O}_{9} \) - Anti-oxidant 19

Ethnomedicinal Uses of Hibiscus Syriacus L.

The medicinal herbs have considerable importance to be used as food material as well as, for the treatment of many diseases. They provide minerals, proteins and enzymes, which act as various structural and functional components in our body. On the basis of ethnomedicinal, pharmacological and phytochemical information available, this study evaluates the efficacy of \( H. \ syriacus \) in the treatment of a variety of disorders and risk factors. Different parts of the plant are being used in Indian and other traditional medicine systems for the treatment of various diseases such as abdominal pain, ascariasis, colitis, diarrhea, dysentery, dyspepsia, gastro-intestinal dysfunctions etc. [11,20-26], in Figure 3. Henceforth, the species plays an important role in traditional medicinal systems mentioned in Figure 4.

Scientific Evidences

The active phytochemicals and secondary metabolites found in \( H. \ syriacus \) plant extracts and isolated compounds include linolenic acid, palmitic acid, hydroxyhibiscone A, hibiscuses D, Syracusans A, pentacyclic triterpene esters, triterpenoid, nonanoic acid, anthocyanins, and others, which are responsible for its pharmacological effects and related properties like anti-aging, anti-cancer, anti-depressant, anti-fungal, anti-melanogenic, anti-oxidant, cytoprotective, etc., mentioned in Table 2.

Mechanistic insight of various pharmacological properties of Hibiscus syriacus L.

\( H. \ syriacus \) L. contains anthocyanin, which has anti-melanogenic, cytoprotective, anti-inflammatory, enzyme inhibitory, and other biological activities. Anthocyanin reduces MITF and tyrosinase in \( \alpha \)-MSH-treated B16F10 cells while, increasing melanin pigmentation in Zebrafish larvae. Furthermore, anthocyanin improves the viability of HaCaT keratinocytes in the presence of \( \text{H}_{2}\text{O}_{2} \). In BV2 microglia cells, anthocyanin inhibits the LPS/ATP-mediated NLRP3 inflammasome, NF-\( \kappa \)B and ER stress-induced \( \text{Ca}^{2+} \) buildup, mitochondrial ROS generation, and IL-1\( \beta \) and IL-18 release. The action of mushroom tyrosinase was significantly reduced by anthocyanin (in vitro). A minor reduction in mitochondrial impact was detected at higher concentrations (over 200 \( \mu \)g/ml) of anthocyanin, however this did not result in an increase in the population of dead cells, cell viability, or total cell counts. In B16F10 cells, melanin synthesis was reduced both extracellularly and intracellularly. Figure 5 depicts a diagram-based mechanistic perspective of anthocyanin from \( H. \ syriacus \) L. numerous pharmacological actions.
| S. No. | Parts/Extract/ Isolated Compounds | Dose/Routes of Administration | Pharmacological Activity/Model/ Method | Interpretations |
|-------|---------------------------------|-----------------------------|--------------------------------------|-----------------|
| 1.    | Root & stem bark/ Aqueous, linoleic acid (LA) & palmitic acid (PA) | HSL 250μg/ml; LA(0.25 μg/ml) & PA (0.25 & 2.5 μg/ml) p.o. | Anti-aging \textit{in vivo} & \textit{in vitro} | HSL↑ type I procollagen expression, ↓matrix metalloprotease-1 (MMP-1), mitogen-activated protein kinases (MAPKs), protein-1 (AP-1) expression and intracellular ROS; ↓ mRNA level of MMP-1, ROS production & ↑ mRNA level of type I procollagen |
| 2.    | Root bark/ hydroxyhibiscone A, hibiscone D | | Anti-aging \textit{in vitro}/Human neutrophil elastase (HNE) assay | IC50 (5.2 & 4.6 μM) |
| 3.    | Flower & leaves/ Petroleum ether (PEE), chloroform (CE), ethyl acetate (EAE), n-butanol (BE) and water (WE) | 500 μg/ml | Anti-cancer/MCF-7, BALL-1, Huh-7 and HeLa/ \textit{in vitro} | PEE: IC50 (32.16 > 250 μg/ml); CE (34.32 - 219.40 μg/ml) |
| 4.    | Root bark/syriacusins A | | Anti-cancer/ ACC62 (melanoma), MCF7 (breast), NCI-H23 (lung), ACHN (renal), PC-3 (prostate), SW620 (colon) & SF539 (central nervous system) human tumor cell lines/ \textit{in vitro}. | ED50: ACHN (1.46 μg/ml); SF539 (1.53 μg/ml); SW620 (1.56 μg/ml) & UACC62 (1.73 μg/ml) |
| 5.    | Root bark/pentacyclic triterpene esters (1,2) | | Anti-cancer/ Human lung adenocarcinoma cell line A549/ \textit{MTT} assay | ED50: 1 - ACHN (1.2 μg/ml), PC-3 (1.6 μg/ml), SW620 (1.1 μg/ml), HCT15 (0.8 μg/ml), SF539 (1.4 μg/ml), 2 - SW620 (1 μg/ml) & HCT15 (1.3 μg/ml) cell lines |
| 6.    | Root bark/triterpenoid | | Anti-cancer/Breast cancer cell lines MDA-MB-231 and HBL100/ \textit{MTT} assay | 12-IC50 (4.3 μM) |
| 7.    | Root bark/triterpenoid betulin (K02) and its derivatives (K03, K04, and K06) | | Anti-cancer/breast cancer cell lines MDA-MB-231 and HBL100/ \textit{MTT} assay | Induced apoptosis |
| 8.    | Root bark/ Ethanol | HSR (100 & 200 mg/kg); (200 and 400 mg/kg) | Anti-fungal/trichophyton mentagrophytes \textit{in vitro}/agar diffusion assay | Inhibition zone (16 mm) |
| 9.    | Root/Nonanoic acid | | Anti-melanogenic/e-MSH-treated B16F10 cells, invitro and Zebrafish larvae, invivo. | |
| 10.   | Anthocyanins | 25, 100 & 400 μg/ml | Anti-fungal/trichophyton mentagrophytes \textit{in vitro}/agar diffusion assay | \textit{Microphthalmia}-associated transcription factor (MITF) and tyrosinase & melanin pigmentation |
| 11.   | Stem & root bark/Aqueous | 250 μg/ml | Anti-oxidant \textit{in vitro}/DPPH, ABTS assay | Inhibition (10.7 & 56.2%) |
| 12.   | Root bark/Naphtha lenes (Syracusans A-C) | | Anti-oxidant \textit{in vitro}/rat liver microsomes/lipid peroxidation assay | IC50 (0.54, 5.90 & 1.02 μg/ml) |
| 13.   | Root bark/Pentacyclic triterpene esters | | Anti-oxidant \textit{in vitro}/rat liver microsomes/lipid peroxidation assay | IC50 (2.3 & 1.1 μg/ml) |
| 14.   | Stem & root/ Hydroalcholic | | Anti-oxidant/ \textit{in vitro}/DPPH | IC50 (1.4 & 2.6 mg/ml) & (3.8 & 6.5 mg/ml) |
| 15.   | Root bark/ coumarin(V,III) | | Anti-oxidant/ \textit{in vitro}/rat liver microsomes/lipid peroxidation assay | IC50 V(0.7 μg/ml), III (1.4 μg/ml). |
CONCLUSION

Findings suggested that *H. syriacus* possess significant biological potential. The review deals with the detailed information associated with ethnomedical & phytopharmacological properties of the plant which suggests its protective role in many diseases. Its various ethnomedical uses vary from country to country, and some important medical uses such as eczema, scabies, and dysentery are almost common. *H. syriacus*, as an herbal medicine, has attracted researchers for decades due to its therapeutic properties. More importantly, there is no research to prove its adverse effects or toxicity. The current evidence is mainly limited to the correlation between the identified plant chemical constituents and the mode of action of any pharmacological activity. However, study into the mechanism of action should pave the way for the development of new medications with superior pharmacological qualities. This may be accomplished by molecular model studies including the interaction of *H. syriacus* bioactive phytochemicals with their respective molecular targets, and the extract can be further studied in the future as a source of valuable phytochemicals in the pharmaceutical business.

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Conflict of Interest

None declared.

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REFERENCES

1. Hariprasad PS, Ramakrishnan N. GC-MS analysis of Rumex vesicarius L. JJDDR. 2011;3(2):256-63.
2. Derwich E, Manar A, Benziane Z, Boukir A. GC/MS analysis and in vitro antibacterial activity of the essential oil isolated from leaf of Pustacia lentiscus growing in Morocco. World Applied Sciences Journal. 2010;8(10):1267-76.
3. Kumari SUMAN, Pandey RK. In vitro plant regeneration form shoot tip explants of Hibiscus syriacus (L.). Int J Life Sci. 2011;6:647-48.
4. Vasudeva N, Sharma SK. Biologically Active Compounds from the Genus Hibiscus. Pharmaceutical Biology. 2008;46(3):145-53.
5. Yeon SW, Kwon HY, Nam JL, Ahn JH, Jo YH, Turk A, et al. Three new naphthalenes from the roots of Hibiscus syriacus. Phytochemistry Letters. 2019;33:110-13.
6. Tropicos: Hibiscus syriacus. 2021.
7. Efross: Hibiscus. 27 November 2014.
8. Kew Eflora: Hibiscus. 27 November 2014.
9. Lim TK. Edible medicinal and non medicinal plants. Vol. 8. Flowers. Houten, Netherlands: Springer Science & Business Media. 2013;e1024.
10. Cowen DV. Flowering Trees & Shrubs in India. Bombay, India: Thacker Spink & Co. Ltd. 1950.
11. Yang JE, Ngeo HT, Hwang E, Soy SA, Park SW, Yi TH, et al. Dietary enzyme-tREATED hibiscus syriacus L. protects skin against chronic UVB-induced photaging via enhancement of skin hydration and collagen synthesis. Archives of Biochemistry and Biophysics. 2019;662:190-200.
12. Wei Q, Xi XY, Xu F, Li QR, Yin H. Chemical constituents from leaves of Hibiscus syriacus and their α-glucosidase inhibitory activities. Zhong yao zhi. 2015;38(5):975-79.
13. Shi LS, Wu CH, Yang TC, Yao CW, Lin HC, Chang WL, et al. Cytoxic effect of triterpenoids from the root bark of Hibiscus syriacus. Fioterapia. 2014;97:184-91.
14. Huo RJ, Huo YC, Chen SP, Fu CL, Yu JC, Chang FW, et al. The triterpenoids of Hibiscus syriacus induce apoptosis and inhibit cell migration in breast cancer cells. BMC Complementary and Alternative Medicine. 2015;15(65):1-9.
15. Jang YW, Jung JY, Lee IK, Kang SY, Yun BS. Nonanoic acid, an antifungal compound from Hibiscus syriacus Ggoma. Mycobiology. 2012;40(2):145-46.
16. Yoo ID, Yun BS, Lee IK, Ryoo II, Choung DH, Han KH, et al. Three naphthalenes from root bark of Hibiscus syriacus. Phytochemistry. 1998;47(5):799-02.
17. Yun BS, Lee IK, Ryoo II, Joo ID. Coumarins with monoamine oxidase inhibitory activity and antioxidative coumarino lignans from Hibiscus syriacus. Journal of Natural Products. 2001;64(9):1238-40.
18. Huang KC. The pharmacology of Chinese herbs. 2nd ed. Boca Raton, Florida: CRC Press.1999.
19. Li TSC. Chinese and related North American: herbs, phyto pharmacology and therapeutic values. 2nd ed. Boca Raton, Florida: CRC Press. 2009.
20. Quattrocchi U. CRC World dictionary of medicinal and poisonous plants. Vol. 3. Boca Raton, Florida: CRC Press. 2012:e3960.
21. Chowdhury HJ, Panday DS. Plants of Indian botanical garden. Kolkata, India: Botanical Survey of India. 2007:e776.
22. Deshpande DJ. A hand book of medicinal herbs: A source book of herbal remedies, chemical constituents, biological activities and usage. Jodhpur, India: Agrobios. 2010(2(10)):311-16.
23. Khan MH, Yadava PS. Ethno medicinal plants of Manipur, North-East India (Thoubal district). Dehradun, India: Bishen Singh Mahendra Pal Singh 2014:e295.
24. Soumyanath A. Traditional medicines for modern times: antidiabetic plants. CRC press. 2005:336.
25. Ryoo U, Yun BS, Lee IK, Kim YH, Lee IS, Ahn JS, et al. Hydroxylhibiscione A, a novel human neutrophil elastase inhibitor from Hibiscus syriacus. Journal of Microbiology and Biotechnology. 2010;20(8):1189-91.
26. Liang L, Pan H, Li H, Zhao Y, Feng Y. In vitro anticancer activity and cytotoxicity screening of phytochemical extracts from selected traditional Chinese medicinal plants. JBUON. 2017;22(2):543-51.
27. Yun BS, Ryoo II, Lee IK, Park KH, Choung DH, Han KH, et al. Two bioactive pentacyclic triterpene esters from the root bark of Hibiscus syriacus. Journal of Natural Products. 1999;62(5):764-66.
28. Kim YH, Im AR, Park BK, Paek SH, Choi G, Kim YR, et al. Antidepressant-like and neuroprotective effects of ethanol extract from the root bark of Hibiscus syriacus L. BioMed Research International. 2018;30581865.
29. Karunarathne WAHM, Molagoda IMN, Park SR, Kim JW, Lee OK, Kwon HY, et al. Anthocyanins from Hibiscus syriacus L inhibit melanogenesis by activating the ERK signaling pathway. Biomolecules. 2019(9(11):E645.
30. Kwon SW, Hong SS, Kim JJ, Ahn IH. Antioxidant properties of heat treated Hibiscus syriacus. Biology Bulletin. 2003;30(1):15-16.
31. Eland SC. Plant Biographies. Wincanton, England: Plant Biographies, 2013.
32. Zhang RR, Hu RD, Lu XY, Ding XY, Huang GY, Duan LX, et al. Polyphenols from the flower of Hibiscus syriacus Linn ameliorate neuroinflammation in LPS-treated SH-SY5Y cell. Biomedicine & Pharmacotherapy. 2020;130:110517.
33. Di Martino O, Tito A, De Lucia A, Cimmino A, Ciccoti F, Apone F, et al. Hibiscus syriacus extract from an established cell culture stimulates skin wound healing. BioMed Research International. 2017;7:9732019.
34. Molagoda IMN, Lee KT, Choi YH, Jayasingha JACC, Kim GY, et al. Anthocyanins from Hibiscus syriacus L. Inhibit NLRP3 Inflammasome in BV2 Microglia Cells by Alleviating NF-κB and ER Stress-Induced Ca2+ Accumulation and Mitochondrial ROS Production. Oxidative medicine and cellular longevity. 2021;1246491.

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