An update review on *Hibiscus rosa sinensis* phytochemistry and medicinal uses

Asmaa Missaum

Department of Biological and Environmental Sciences, College of Arts and sciences, Qatar University (QU), Doha, Qatar

**ABSTRACT**

*Hibiscus rosa sinensis* is known as China rose belonging to the *Malvaceae* family. This plant has various important medicinal uses for treating wounds, inflammation, fever and coughs, diabetes, infections caused by bacteria and fungi, hair loss, and gastric ulcers in several tropical countries. Phytochemical analysis documented that the main bioactive compounds responsible for its medicinal effects are namely flavonoids, tannins, terpenoids, saponins, and alkaloids. Experiment from recent studies showed that various types of extracts from all *H. rosa sinensis* parts exhibited a wide range of beneficial effects such as hypotensive, anti-pyritic, anti-inflammatory, anti-cancer, antioxidant, anti-bacterial, anti-diabetic, wound healing, and abortifacient activities. The few studies on toxicity exhibited that most extracts from all parts of this plant did not show any signs of toxicity at higher doses according to histological analysis. However, some of the extracts did alter biochemical and hematological parameters. Therefore, further research must be conducted to isolate the phytochemicals and explore their specific mechanism of action. This review summarizes the phytochemistry, pharmacology, and medicinal uses of this flower with the purpose of finding gaps demanding for future research and investigating its therapeutic potential through clinical trials.

**Keywords:** *Hibiscus rosa sinensis*, Medicinal uses, Phytochemicals, Cancer, Therapeutic potential.

**INTRODUCTION**

China rose or “Queen of tropics” is often a popular name for the gorgeous flowering plant *Hibiscus rosa-sinensis*, as it is mainly found in south-east China and some islands in the Pacific and Indian Ocean. *Hibiscus* is one of Hawaii’s admired national plants, and it is often seen worn in hair for cultural occasions [1,2]. This plant belongs to the subkingdom Magnoliophyta and to the class Magnoliopsida, meaning that it is a vascular plant that produces seeds. It belongs to the family *Malvaceae*, and it is one of the 300 species of the genus *Hibiscus* [1]. In addition, the juice extracted from the leaves and flowers has been used since a long time ago as natural remedy for some diseases and painful symptoms, as well as in herbal cosmetics as wilted [3,4]. Dark flowers’ extract is used to make eyeliners, and in shoe-blacking [4]. It was believed that the species was given the name “rosa sinensis” which means “Rose of China” in Latin, by the famous Swedish biologist, Carolus Linnaeus in the early 1750s [5].

Traditionally, *Hibiscus* flowers has been reported to possess antitumor properties, as well as have been used as analgesic, antipyretic, anti-asthmatic, and anti-inflammatory agents. Several studies have proved the presence of anti-oxidant, anti-fungal, and antimicrobial properties in flowers of *Hibiscus rosa-sinensis* [6]. Research on extracts of stems, roots, leaves, and flowers from *Hibiscus* have revealed that its photochemical components contributed to beneficial findings to human’s health such as antioxidant activity, which is the removal of free radicals that can lead to DNA damage [7]. Other examples of antioxidants sources from plants would include *Senna bicapsularis* L. flower extracts, which is simply known as *Cassia* [7,8]. The flowers were also used as a contraception agent for males and females, as well as an abortifacient in rural regions of India [9].

Current scientific literature suggests that more than 50% of today’s clinical medications were of natural product origin. Many of them have played a significant role in pharmacological industry and in developing better therapies for various diseases [10]. This plant is economically very essential owing to the herbal products and medicinal uses [10]. Because of insufficient current pharmacological information, there is not much scientific research or clinical trials conducted on the chemical extracts of *Hibiscus rosa-sinensis* that could be crucial in exploring its fast potential medicinal applications.
Classification and Botany

*Hibiscus rosa-sinensis* belongs to phylum 'Magnoliophyta', because it is a flowering plant that has true leaves, stems and roots, as well as carpels enclosing ovules, and to the 'class' Magnoliopsida, as it is a eudicot type of plant meaning that it flowers in groups of four/five, its leaves display netlike viens, and its seeds contain two cotyledons [11]. Moreover, it is classified in the order 'Malvalves' due to the fact that petals of the flower overlap, has multiple stamens, and the phloem consist of fibers that leads to a tougher bark [11]. It is also belongs to the family 'Malvaceae' as it is found in nearly all geographical areas except in extremely cold regions, habitually as small trees or shrubs, containing bristly pollen. Last but not least, *H. rosa-sinensis* species is part of the genus 'Hibiscus' which encloses more than 250 native species [12].

*Hibiscus rosa-sinensis* grows in small trees that are called ‘shrubs’ and are usually 4 meters tall, evergreen, and has ovate branches with stalks that are 10 cm wide and 15 cm long [13,14]. Flowers are primarily found on long stalks, measures about 20 cm wide, and consist of 5 whorled oval petals (egg shaped) that has smooth edges and are merged at the base to the central stamina column [13,14]. This central column includes a style that has 5 lobes at the tip, and is covered with numerous yellow anthers. Moreover, moving to external part, the flower has a 2.5 cm long calyx (cup shaped), and an epicalyx that consist of 5 or 7 bracteoles (1 cm long each). Flowers are habitually borne in single forms on upper leaves which are oval in shapes, glossy green, and have pointed tip and pinnate veins [13,14]. Some sources suggest that fruits can possibly form as 3 cm long capsules but very rarely. Although *H. rosa-sinensis* appear in variety of different corolla sizes, shapes and colors (Figure 1) such as yellow, orange, pink, and white [15,16,17], the wild type for this plant remains as bright red flowers that grow in single forms [18].

![Figure 1: Phenotypes of Hibiscus rosa sinensis : red (most common), pink, white, orange, and yellow [15,16,17,18].](image)

Phytochemistry

Each part of *H. rosa sinensis* contains a wide range of compounds (Figure 2). It was reported that phlobatannins, glucosides, saponins, flavonoids, terpenoids including other compounds such as thiamine, riboflavin and niacin are present in leaves, flowers, stem and roots [19]. According to Patel and Adhav, whose their study was conducted on four different morphotypes of *H. rosa sinensis*, glucosides, flavonoids, phytosterols, terpenoids, tannins, and phenolic compounds contributed to the pharmacological effects of the plant as they were present in all of them [20]. This suggested that although the flower color differed, the phytochemical consistions were very similar. These findings also correlates with those of another study carried out by thin layer chromatographic analysis [21].

Generally, the edible flowers contain moisture, nitrogen, fat, crude fibre calcium, phosphorus, and iron. The yellow flowers contain several flavonoids such as cyanidin-3,5-diglucoside, cyaniding-3-sophoroside3-5-glucoside quercetin-3,5-diglucoside, and quercetin-3,7diglucoside. Including the mentioned compounds, kaemperol-3-xyllosylglucoside isolate can be found in white flowers [22]. In addition to fatty acids, fatty alcohols, hydrocarbons, the leaves also contain about 7.34 mg / 100 gm of carotene, as well as gentic acid, mucilage, and catalase. On the other hand, cyclopropenoids can be found in root barks. Although flowers, stems, and leaves contain minor amounts of cyanin and cyaninidin chories, quercetin can be found in all parts of *Hibiscus rosa sinensis*. However, β-sitosterol, teraxeryl acetate, and malvalic acids can be found only in stems and leaves [22].

Using mass spectrum GC-MS interpretations, it was found that methanol extracts of *Hibiscus* flowers contained components such as Ethanimicid acid, ethyl ester, Propanal, 2,3-dihydroxy, Propanamide, N-ethyl-, Ethylenediamine, O-Methylisourea hydrogen sulfate, Ethene, ethoxy-, Hexadecanoic acid, methyl ester , 7-Formylbicyclo(4.1.0) heptanes, 2-Butanamine, (S)-, 1,3,5-Triazine-2,4,6-triamine, N-Formyl-β-alanine, (Z),6,(Z)9-Octadecadien-1-ol, Butanedial, 1-Propanol, 2-methyl-, and Methanecarbothiolic acid [23]. These components were shown to have anti-cancer, antioxidant, pesticide, hypocholesterolemic, dermatitigenic, and anemiagenic properties. Moreover, Propanal, 2,3-dihydroxy, Ethylenediamine, o-Methylisourea hydrogen sulfate, 2-Butanamine, (S), (Z)6,(Z)9-Pentadecadien-1-ol and 1-Propanol, 2-methyl- all have antioxidant and antimicrobial activities [23].

Recently, another study on antioxidant effects of *H. rosa sinensis* showed that there was a strong correlation between antioxidant activity and flavonoids, phenolics, as well as anthocyanins found in the extracts. This confirmed that these componets were responsible for the observed antioxidant activity [24]. Although most of these phytochemicals have future potential medicinal uses, which will be more discussed in the next section, anthocyanins have special natural dyeing properties [25]. It was demonstrated that using metal mordant such as Cu, Sn and Al in conjunction with *Hibiscus rosa sinensis* anthocyanin extract, the dye uptake process of cotton and silk fabrics was enhanced as compared with the controlled sample in terms of fastness [25]. This is could be mainly due to its antioxidant activity mentioned earlier.

Another molecule, known as cyanidin-3-sophoroside, was also extracted from *Hibiscus rosa-sinensis* flowers. In this study, it was successfully used as an indicator for a wide range of acid base titrations and even used lower volumes of acids and bases compared to the conventional indicators, such as methyl orange and phenolphthalein [26]. Moreover, natural pigments, such as cyanidin-3-Sophoroside, are biodegradable, eco-friendly, and non-carcinogenic compared to synthetic pigments [26]. The different extracts from all plant’s parts and their pharmacological effects are presented in Table 1.
**Figure 2:** Structures of different bioactive compounds from *H. rosa-sinensis*: Quercetin, quercetin-3-diglucoside, β-sitosterol, cyanidin-3,5-diglucoside [22], cyanidin-3-sophoroside [25,26], and luteolin-8-C-glucoside [52].

**Table 1:** List of pharmacological effects of *Hibiscus rosa-sinensis*

<table>
<thead>
<tr>
<th>Pharmacological activity</th>
<th>Part used</th>
<th>Extract/fraction</th>
<th>Dose tested/route of administration</th>
<th>Animals/cell line culture</th>
<th>Literature cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-bacterial</td>
<td>Leaves</td>
<td>Methanolic</td>
<td>80 µg/ml</td>
<td><em>S. aureus, E. aerogenes</em></td>
<td>[27]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aqueous</td>
<td>40 mg/ml</td>
<td><em>B. subtilis, E. coli, S. aureus</em></td>
<td>[28]</td>
</tr>
<tr>
<td></td>
<td>Flowers</td>
<td>Hexane</td>
<td></td>
<td><em>B. subtilis, E.coli</em></td>
<td>[29]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Methanolic</td>
<td>500 mg, 1 mg/ml</td>
<td><em>E. coli, S. aureus, S.pyogenes</em></td>
<td>[30,33]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aqueous</td>
<td></td>
<td><em>B. subtilis, E. coli</em></td>
<td>[31]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethanolic</td>
<td></td>
<td><em>Salmonella sp., P. aeruginosa</em></td>
<td>[31]</td>
</tr>
<tr>
<td></td>
<td>Roots</td>
<td>Ethyl alcohol</td>
<td>7.5 µg/ml</td>
<td><em>S. aureus, E.coli, B. subtilis</em></td>
<td>[32]</td>
</tr>
<tr>
<td>Anti-fungal</td>
<td>Leaves</td>
<td>Methanolic</td>
<td>80 µg/ml</td>
<td><em>Aspergillus niger, Candida albicans</em></td>
<td>[27]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aqueous</td>
<td>100 µg/ml</td>
<td><em>C. glabrata, A. flavus, C. albicans</em></td>
<td>[34]</td>
</tr>
<tr>
<td></td>
<td>Flower</td>
<td>50% ethanol</td>
<td>10 µg/ml</td>
<td><em>Candida parapsilosis</em></td>
<td>[32]</td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td>Ethyl alcohol</td>
<td>7.5 µg/ml</td>
<td><em>Aspergillus terreus, Aspergillus oryzae</em></td>
<td>[35]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethyl alcohol</td>
<td></td>
<td><em>Candida parapsilosis</em></td>
<td>[32]</td>
</tr>
<tr>
<td>Anti-oxidant</td>
<td>Leaves</td>
<td>Aqueous</td>
<td>DPPH and hydrogen peroxide radicals</td>
<td><em>DPPH and hydrogen peroxide radicals</em></td>
<td>[40, 41]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>70% ethanol</td>
<td>500 µg/ml</td>
<td>superoxide hydrogen peroxide, nitric oxide radicals</td>
<td>[42]</td>
</tr>
<tr>
<td>Pharmacological activity</td>
<td>Part used</td>
<td>Extract/fraction</td>
<td>Dose tested/route of administration</td>
<td>Animals/cell line culture</td>
<td>Literature cited</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------</td>
<td>------------------</td>
<td>------------------------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Anti-fertility</td>
<td>Flower</td>
<td>Methanolic Aqueous</td>
<td>100 mg/mL</td>
<td>alkaline phosphatase (<em>in vitro</em>) Spermatogenesis in male albino rats</td>
<td>[57] [58]</td>
</tr>
<tr>
<td></td>
<td>Powder</td>
<td>Propylene glycol</td>
<td></td>
<td>Albino Wister rats (<em>inhibition of implants</em>) Pregnant female albino Wister rats</td>
<td>[59] [60]</td>
</tr>
<tr>
<td>Hair growth promoting activity</td>
<td>Leaf</td>
<td>Petroleum ether</td>
<td>1%</td>
<td>Wister albino rats (Sonic stress induced alopecia)</td>
<td>[61]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethanolic</td>
<td>5% hydrochloric 2%</td>
<td>Male albino rats</td>
<td>[63] [64] [62] [65]</td>
</tr>
<tr>
<td>Neuroprotective</td>
<td>Root</td>
<td>Methanolic Aqueous</td>
<td>200 mg/kg i.p.</td>
<td>Swiss albino mice and Wistar rats</td>
<td>[66]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>300 mg/kg</td>
<td>Male Wistar strain rats</td>
<td>[67]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>300 mg/kg</td>
<td>Wistar albino rats with scopolamine-induced cognitive</td>
<td>[68]</td>
</tr>
</tbody>
</table>
Medicinal Applications

**Anti-bacterial activity**

The methanol extracts prepared from the leaves of the *H. rosa-sinensis* were shown to have antimicrobial activities against *Pseudomonas aeruginosa*, *Escherichia coli*, *Enterobacter aerogenes*, and *Streptococcus pyogenes*. Using well diffusion method and after an incubation period of 24 hours at 37°C, the maximum observed zone of inhibition was 13 ± 0.00 mm and it was against *E. coli* followed by 12 ± 0.00 mm against both *S. aureus* and *E. aerogenes* at 80 μg/ml concentration of leaves methanolic extract [27]. These microorganisms were obtained from infected skins, and the chemical compounds responsible for the antibacterial activity may be due to flavonoids, tannins, terpenoids, saponins, or alkaloids identified in the study [27].

In another study conducted using disc diffusion method, aqueous leaves extracts of 40 mg/ml showed maximum zone of inhibition against *Bacillus subtilis* (14.00 ± 1.05 mm), *E. coli* (12.30 ± 0.95 mm) and *S. aureus* (11.00 ± 1.20 mm), while the methanol extract showed the following zones of inhibitions against *B. subtilis* (18.82 ± 0.18 mm), *E. coli* (17.30 ± 0.51 mm), *S. aureus* (15.20 ± 0.90 mm) after 48 hours of incubation at 34°C. The screened phytochemicals were cardiac glycosides, anthraquinones, and phlobatannins, including those mentioned earlier [28]. Interestingly, another research reported similar results as the aqueous extracts showed a maximum zone of inhibition against *B. subtilis* as 15.00 ± 2.81 mm, and *E. coli* as 12.50 ± 1.81 mm, while hexane extracts gave the highest zone of inhibition against *B. subtilis* as 18.86 ± 0.15 mm, and *E. coli* as 18.00 ± 1.53 mm [29]. Although same methodology was applied, however, in this study flowers of *H. rosa-sinensis* were used and the results were observed after an incubation period of only 24 hours [29].

Antibacterial activity has been also observed using disc diffusion method against *E. coli* and *S. aureus* at different concentrations of methanolic flower and leave extracts varying from 31.25 to 500 mg/ml. These were compared with positive control gentamicin (1 mg/ml) and methanol as negative control [30]. In both extracts’ types, the antibacterial activity was increased with extract concentration. The highest zones of inhibitions respectively at concentration 500 mg [30].

### Wound healing activity

<table>
<thead>
<tr>
<th>Type</th>
<th>Extract Type</th>
<th>Concentration</th>
<th>Species</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flower</td>
<td>Ethanol</td>
<td>12 mg/kg</td>
<td>Sprague Dawley rats</td>
<td>[70]</td>
</tr>
<tr>
<td>Leaves</td>
<td>Aqueous</td>
<td>0.01g/ml</td>
<td>Sprague Dawley rats</td>
<td>[71]</td>
</tr>
<tr>
<td></td>
<td>Ethanol</td>
<td>200 mg/kg, p.o.</td>
<td>Swiss albino mice</td>
<td>[72]</td>
</tr>
<tr>
<td>Anti-inflammatory</td>
<td>Leaves</td>
<td>Hydroalcoholic</td>
<td>Acetic acid induced colitis in male</td>
<td>[73]</td>
</tr>
<tr>
<td>Flower, leaves</td>
<td>Ethanol</td>
<td>100 mg/kg</td>
<td>Wister rats</td>
<td>[74]</td>
</tr>
</tbody>
</table>

### Immune response

<table>
<thead>
<tr>
<th>Type</th>
<th>Extract Type</th>
<th>Concentration</th>
<th>Species</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flower</td>
<td>Aqueous</td>
<td>500 mg/kg</td>
<td>Male Swiss albino mice</td>
<td>[75]</td>
</tr>
<tr>
<td></td>
<td>ethyl acetate</td>
<td>100 mg/kg</td>
<td>Albino Wistar rats</td>
<td>[76]</td>
</tr>
<tr>
<td>Cardioprotective</td>
<td>Leaves</td>
<td>Aqueous</td>
<td>Hypertensive and non-hypertensive albino rats</td>
<td>[77]</td>
</tr>
<tr>
<td>Flowers</td>
<td>Aqueous</td>
<td>360 μg/mL</td>
<td>Langendorff-perfused hearts of Wistar rats</td>
<td>(In Vitro) [78]</td>
</tr>
<tr>
<td>Gastroprotective</td>
<td>Aerial parts</td>
<td>Aqueous-ethanolic</td>
<td>500 mg/kg</td>
<td>Albino Wistar rats</td>
</tr>
<tr>
<td></td>
<td>Flower</td>
<td>Aqueous</td>
<td>500 mg/kg</td>
<td>Albino Wistar rats</td>
</tr>
<tr>
<td>Anti-pyritic</td>
<td>Root</td>
<td>Aqueous</td>
<td>Yeast-induced pyrexia in albino Swiss rats</td>
<td>[81]</td>
</tr>
<tr>
<td></td>
<td>Leaves</td>
<td>Aqueous</td>
<td>500 mg/kg b.w</td>
<td>mice</td>
</tr>
<tr>
<td>Antihyperlipidemic</td>
<td>Flower</td>
<td>Ethanol</td>
<td>Triton and atherogenic diet induced hyperlipidemia in albino Wistar rats</td>
<td>[83]</td>
</tr>
<tr>
<td>Hepatoprotective</td>
<td>Leaves</td>
<td>Ethanol</td>
<td>Piroxicam induced liver toxicity in Swiss albino mice</td>
<td>[84]</td>
</tr>
</tbody>
</table>

J Ayu Herb Med | Vol 4 Issue 3 | July-September 2018
The cold aqueous extractions of flowers gave highest zones of inhibition against *B. subtilis* as 17.00 ± 2.94 mm, and against *E. coli* as 14.50 ± 1.71 mm. In contrast, the hot aqueous extraction inhibited *E. coli* growth for 11.60 ± 3.14 mm, and *Salmonella* sp. for 10.66 ± 3.09 mm as maximum zones of inhibition [31]. The methanol extracts showed highest zones of inhibition against *B. subtilis* as 18.86 ± 0.18 mm, against *E. coli* as 18.00 ± 1.63 mm. The ethanol extracts gave zones of inhibition against *Salmonella* sp. as 20.40 ± 1.54 mm, and *P. aeruginosa* as 16.30 ± 0.94 mm. All these mentioned microorganisms are considered as human pathogens [31]. The antibacterial activities of both pure and crude protiens from flowers were also investigated such that crude protein inhibited the growth of *Salmonella* sp. for 16.55 ± 1.16 mm, and *E. coli* for 14.30 ± 2.86 mm as maximum inhibition zones, compared to pure protein which inhibited *Staphylococcus* sp for 11.4 ± 1.74 mm, *E. coli* for 12.25 ± 0.97 mm. Moreover, the pure and crude *H. rosa-sinensis* flower proteins were run in poly acrylmdye gel electrophoresis (PAGE), which resulted in various bands for the crude protein sample [31]. This suggests that the crude extract may contain components such as flavonoids, triterpenoids, tannins, alkaloids. For example, flavonoids are considered antimicrobial agent as they are able to complex with components of the bacterial cell wall and eventually deteriorate it [31].

The antibacterial activity of root extracts from *H. rosa sinensis* was also investigated. It was reported that using disc diffusion method, the ethyl alcohol root extracts inhibited the growth of *S. aureus* for 2 cm and *E.coli* and *B. subtilis* for 1.5 cm as highest zones of inhibition at the concentration 7.5 µg/ml [32]. Similarly, methanol flower extracts exhibited highest inhibition zones at the concentration of 1 mg/ml against *E.coli* (27 ± 0.12 mm), *S. aureus* (21 ± 0.41 mm), and *Streptococcus pyogenes* (18 ± 0.65 mm), compared to 10µg of Chromamphenicol which was used as a positive control and resulted in a zone of inhibition of approximately 24 mm [33]. Compared to other extracts such as ethyl acetate extract, ethanol extract, and water extract, all phtochemicals that were involved in the antimicrobial activity were detected from the methanol extract. This suggests that it is a useful extract for further research [33].

Therefore, the flowers, leaves, and roots extracts can be used as vital antibiotics components to treat diseases caused by the different strains of bacteria. Even these results are encouraging, precise assessment is absolutely necessary before undergoing further pharmacological evaluation. Because pathogenic microorganisms are getting resistant to current antimicrobial agents, scientific research has continued to search for other sources of antimicrobial compounds.

**Antifungal activity**

According to previous studies, the methanol extracts prepared from the leaves of the *Hibiscus rosa-sinensis* were shown to have antimicrobial activities against *Candida albicans*, *Aspergillus niger*, *Candida parapsilosis* and *Trichophyton rubrum*. Using well diffusion method and after an incubation period of 24 hours at 37° C, the maximum observed zone of inhibition was 9.3 ± 0.57 mm and it was against *Aspergillus niger* followed by 6.6 ± 0.57 mm against *Candida albicans* at 80 µg/ml concentration of leaves methanolic extract [27]. These fungi were obtained from infected skins, and the chemical compounds responsible for the antifungal activity may be due to flavonoids, tannins, terpenoids, saponins, or alkaloids identified in the study [27].

The antifungal activity of root, leaves, and flowers ethyl alcohol extracts from *H. rosa sinensis* was also investigated. It was reported that using disc diffusion method, the growth of both *Candida parapsilosis* and *Aspergillus niger* for 1.5 cm were inhibited by flower extracts as highest zones of inhibition at the concentration 10 µg/ml [32]. In addition, *Candida parapsilosis* was inhibited optimally for 2.2 mm by leaves extracts and for 1.5 cm by roots extracts at 10 µg/ml and 7.5 µg/ml concentrations respectively [32].

*H. rosa sinensis* methanol leaf extracts also inhibited the growth of *C. glabreata* for 19 ± 00 mm, *A. flavus* for 17 ± 00 mm, and *C. albicans* for 20 ± 00 mm as highest inhibition zones at a concentration of 100 mg/ml [34]. Moreover, using agar disc diffusion method, flower extract was found to be active against all tested fungi except *Aspergillus flavus*. The highest inhibition zones recorded for each fungi were: *Aspergillus niger* (9 mm), *Aspergillus terreus* (17 mm), *Aspergillus oryzae* (17 mm), *Fusarium solani* (10 mm), *Fusarium verticillioides* (13 mm), and *Penicillium sp.* (15 mm) at 50 % ethanol concentration [35].

**Antioxidant activity**

Ethanolic (95.0%) extract of flowers strongly scavenged hydrogen peroxide for 96 ± 2.35 % inhibition with a concentration of 50 µg/ml while the standard antioxidant, ascorbic acid produced 76.33 ± 1.25 % radical scavenging activity at 100 µg/ml concentration. It was reported that molecules identified by GC-MS analysis mainly belonged to classes of alkaloids, tannins, steroids, glycosides, and flavonoids, and may be also the reason behind the high radical scavenging activity [36]. Free radicals such as those generated from hydrogen peroxide play a crucial role in the progress of tissue damage. Any substances which have the ability to remove these, such as *H. rosa sinensis* phytochemicals, will protect the cell system and components from cytotoxic damage [36].

DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity was observed using 80% methanol flower extract as 75.46 ± 4.67 %, and 80% ethanol flower extract as 64.98 ± 2.11%, compared to 77.54 ± 4.77% for BHT as a positive control. The scavenging of DPPH free radicals was measured at 515 nm using a UV visible spectrophotometer [37]. Moreover, the total phenolic contents of the methanolic and ethanolic extracts were 61.45 ± 3.23 and 59.31 ± 4.31 mg/100g dry extract, and total flavonoid contents were 53.28 ± 1.93 and 32.25 ± 1.21 mg/100g dry extract respectively. Because it was observed that methanolic extract had higher amount of phenolics and flavonoids as well as contributed to higher scavanging activity than ethanolic extract, this strongly suggest that they are responsible for the anti-oxidant activity [37].

According to another study, aqueous stem extracts resulted in 15.1 ± 4.5 scavenging activity against DPPH radicals compared to methanolic extracts which exhibited only 9.75 ± 1.15 scavenging activity per molecule. However, both extract types gave similar results towards nitric oxide, superoxide anions, and hydrogen peroxide radicals [38]. In addition, water extracts of petals scavanged DPPH radicals optimally for 71.9% with a concentration of 1 mg/ml. It was reported that this activity was due to iron content in *H. rosa sinensis* petals, which was isolated using TLC and partially purified by silica gel column chromatography. According to ICP-OES analysis, there was 0.8 mg/g of iron in the lyophilized petal powder [39].

Similarly, aqueous extracts of *H. rosa sinensis* leaves exhibited slightly higher antioxidant activity than those of ethanol extracts against DPPH and hydrogen peroxide radicals, and in case of nitric oxide and ferric reducing antioxidant power assays, the ethanolic extracts contributed to much higher scavanging activity [40].

The relationship between number and flowe colors (pink, yellow, white, orange, yellow/pink, white/pink, orange/pink, and two types of red shades) were collected separately [41]. The highest observed antioxidant activities with least IC50 values were 0.20 from white/pink
with many petals methanol extracts, and 0.19 from and yellow with 5 petals ethanol extracts. On the other hand, the samples orange/pink with many petals methanol extracts and red with five petals ethanol extracts exhibited least antioxidant activity as 1.17 and 4.49 respectively [41].

The radical scavenging activity of 70% ethanol extracts from leaves were examined using butylated hydroxyanisole (BHA) as a standard, and highest antioxidant activity found against superoxide radicals was 60.4 ± 2.19 %, compared to 48.52 ± 3.03 % scavenging activity against hydrogen peroxide, and 36.3 ± 2.47 % against nitric oxide, all using a concentration of 500 µg/ml. The 200 µg/ml of BHA gave the following scavenging activities: 61.6 ± 3.15 %, 65.8 ± 2.21 %, and 37.3 ± 3.6 % respectively [42]. However, the total antioxidant capacity of *H. rosa sinensis* extract was nearly two-fold higher than that of BHT (butylated hydroxytoluene) that used as a standard with the same concentration of 500 µg/ml. This was investigated by the reduction of Fe2+ to Fe3+ and measuring the absorbance of the formed prussian blue complex at 700 nm. The higher the absorbance value, the higher the capabilities of both reducing power and the antioxidant activity of the extract [42]. This activity could be generally due to flavonoids, the natural phenolics are which contain hydroxyl functional groups. BHT and BHA, which are synthetic antioxidants added in food, have been suspected correlated to carcinogenesis and liver damage. Therefore, it is important to use extracts from *H. rosa sinensis* as potential sources of natural antioxidants [42].

**Anti-diabetic activity**

In non-obese type I diabetic mice, the alcoholic leaves extracts of *Hibiscus rosa sinensis* was proven to be an oral hypoglycemic agent. It reduced blood glucose levels from 281.6 ± 3.7 mg/dl to 92.2 ± 2.63 and 83.8 ± 3.15 mg/dl using the concentrations 100 and 200 mg/kg of body weight respectively, compared to 103.37 ± 2.13 mg/dl in insulin injected NOD mice, which was used as positive control [49]. The tested extracts also reduced levels of triglycerides, blood urea, glycosylated hemoglobin, and cholesterol significantly after 5 weeks of oral administration [49]. In alloxan induced diabetic type II rats (150 mg/kg), root extracts of 500 mg/kg of bw concentration decreased blood glucose levels from 300.23 ± 32.20 to 220.41 ± 20.40 mg/dl, compared to 175.38 ± 11.67 mg/dl in glibenclamide (600 µg/kgbw) treated rats, after 15 days of oral administration [50].

The anti-diabetic effect of ethanolic leaves extracts of *H. rosa sinensis* on alloxan induced diabetes in rats was also investigated. It was observed that at 2 mg/kg bw concentration, the blood glucose levels were reduced from 17.5 ± 0.69 to 13.8 ± 0.36 mmol, compared to those of metformin treated rats, which were reduced from 16.94 ± 0.51 to 12.90 ± 0.38 mmol after 4 hours [51]. In streptozotocin induced diabetic rats, 400 mg/kg of leaves methanolic extract has managed to lower blood glucose levels from 326.67 ± 25.76 to 154.11 ± 17.91 mg/dl. Moreover, it reduced levels of uric acid, creatinine, AST (aspartate aminotransferase) (AST), and ALT (alanine aminotransferase), suggesting renal and hepatic protective effects as confirmed by H&E histological analysis [52]. Interestingly, the compound verbascoside (phenylpropanoids glycoside) and orientin (Luteolin-8-C-glucoside) that were identified by NMR spectroscopy, are highly responsible for this anti-diabetic activity [52].

In another study, 500 mg/kg of ethanolic flower extract exhibited best antidiabetic activity as well as anti-hyperglycemic activity against alloxan induced diabetes in hyperlipidemic Wister rats [53]. This was also noticed when the effect of flower aqueous extract was evaluated on female pregnant rats. The diabetic condition of these Wister rats was induced by streptozotocin before the mating. The treatment somewhat benefited the diabetic pregnant rats and their offspring, but not the non-diabetic pregnant ones [54]. This study would have been better conducted by extending treatment period and using alloxan instead, as it could have increased blood glucose levels more moderately for fairer evaluation [54].

Using albino rabbits as study models, flower ethanol extracts managed to lower blood glucose levels in a progressive manner in 72 hour period using all graded doses 50, 100, and 200 mg/kg. Glibenclamide (200 mg/kg p.o.), which was used as positive control, caused a sharp decrease in blood sugar levels in 24 hour period, which is not desirable in clinical situations [55]. The antidiabetic activity of *H. rosa sinensis* was also evaluated in clinical trials, as 2 g of flower’s powder was subjected to type II diabetes mellitus patients aged from 30 to 60 years. After daily oral administration for 60 days, fasting blood glucose levels were reduced from 147.8 ± 43.54 to 111.6 ± 35.32 mg/dl [56].

Post prandial glucose levels were also reduced from 184.6 ± 81.86 to 126.5 ± 34.14 mg/dl, compared to no change in control groups for both cases. The flower’s powder resulted as well in significant decreases in total cholesterol and triglyceride levels [56].
**Anti-fertility activity**

_Hibiscus rosa sinensis_ flower methanolic extract was proven to be effective against alkaline phosphatase in vitro activity. Quercetin-7-O-galactoside, which was isolated from its water soluble fraction, inhibited the enzyme activity reaching 100% at a concentration of 100 mg/mL [57]. This enzyme complete inhibition was correlated with inhibition of implantation, a mechanism that is closely related to the process of contraception [57]. Oral administration of aqueous flower extract also affected the spermatogenesis in male albino rats. According to histological analysis using H&E stain, prolonging treatment time with increased dosage of extract has lead to changes, such as broken and discontinuous base membrane, total disorganization of spermatogenic cells, fragmented Sertoli cells, and absence of Leydig cells and mature spermatozoa [58]. However, after discontinuing the treatment for 30 days, the effect was completely reversed suggesting that it can be useful for temporary contraception [58].

In another study, _H. rosa sinensis_ powder mixed with propylene glycol was orally subjected to albino Wister rats before mating. This treatment resulted in 100% inhibition of implants in pregnant rats, compared with Overall L that was used as positive control [59]. The group treated with propylene glycol as negative control, gave 100% deliveries on full term compared to 0% from groups treated with Overall L and _H. rosa sinensis_ extract [59]. The phytochemical analysis of the aqueous extract showed that steroids and saponins could have contributed to this anti-fertility activity [59]. Similarly, flowers of _H. rosa sinensis_ has also lowered progesterone and estrogen levels in pregnant female albino Wister rats. This has lead to endometrial changes that in turn disrupted the estrous cycle, and caused non receptive conditions preventing blastocyst implantation [60].

**Hair growth promoting activity**

The petroleum ether leaf extract of _Hibiscus rosa sinensis_ was proven to be a good hair growth promoter in a study involving Wister albino rats. After 14 days, the 5% w/w extract ointment resulted in 4.91 ± 0.261 mm hair length compared to 6.06 ± 0.431 mm in 2% minoxidil treated group, and 2.21 ± 0.108 mm in negative control group [61]. The extract also contributed to 1937 ± 37.84 hairs per cm² area, while Minoxidil gave 2315 ± 05.78 hairs per cm² area. The alopecia was induced by exposure to sonic stress, and there were no side effects such as erythema or edema, compared to synthetic hair growth promoting ointment [61]. Similarly, 5% hydrocholic leaves extract ointment exhibited 5.97 ± 0.13 mm hair length, and 2058 ± 19.23 hairs per cm² area [62].

The effect of leaf petroleum ether extract was also investigated in male albino rats. The 1% extract resulted in 65% anagen, 2% catagen and 33% telogen in hair follicle population, compared to anagen 64%, catagen 1%, and 35% telogen in minoxidil treated group [63]. Phytosterols and triterpenoids found in this extract are advantageous for hair growth while tannins, which are absent, suppress hair growth [63]. Leaf ethanolic extract contributed to 17 ± 1.2 mm hair length, compared to 19.36 ± 0.4 mm with minoxidil after 30 days. Although flower extract showed poorer results, this difference was insignificant [64].

The hair growth potential of _H. rosa sinensis_ aqueous flower extract was evaluated In-vitro and In-vivo. After 30 days, 2 % of extract resulted in a mean of 18.68 ± 0.3 mm of hair length, compared to 19.24 ± 0.4 mm with 2% of minoxidil in Wister rats. Increase in hair follicle length was observed In-vitro as 1.73 ± 0.18 mm, in comparison to 1.95 ± 0.14 mm by positive control, after 72 hours of incubation [65].

**Neuroprotective activity**

The methanolic extract of _H. rosa-sinensis_ roots has beneficial effects on the central nervous system in Swiss albino mice and Wistar rats. Using acetic acid to induce withing, 200 mg/kg i.p of extract resulted in a analgesic activity as inhibited the pain sensation by 78.5 %, compared to 81.0 % in 30 mg/kg Diclofenac treated group [66]. The number of head twitches induced by lithium was lowered to 10.2 ± 1.06, compared to 9.0 ± 1.7 by ondansetron, a 5HT3 antagonist, as a positive control. Pentobarbital induced sleeping period was also extended, suggesting sedative effect by reducing dopaminergic transmission [66]. The anxiolytic effect of roots extract was also demonstrated, as in elevated plus maze, mice spent more time in open arms. In addition, the extract’s phytochemicals were tannins, flavonoids, saponins, and glycosides [66].

According to another study, 300 mg/kg of methanol root extract improved best learning and memory deficits in male Wistar strain rats, as well as anxiety induced by cerebral ischemia. This was investigated using elevated plus maze and Open field tests [67]. After 6 days, the extract managed to lower lipid peroxidation and raise superoxide dismutase, catalase and glutathione reductase levels that were altered after bilateral common carotid artery (BCCA) occlusion [67]. Similarly, Petroleum ether flower extract of _H. rosa-sinensis_ at 300 mg/kg dosage increased spatial working and spatial reference memories, in Wistar albino rats with scopolamine-induced cognitive decline [68]. This was evaluated using Morris water maze, rectangular maze, and pole climbing apparatus. Moreover, acetylcholinesterase and malondialdehyde levels were reduced whereas DPPH and CAT levels were raised compared to control group, indicating antioxidant and neuroprotective activity [68].

Ethanolic extract of _H. rosa sinensis_ roots also exhibited an important antidepressant activity on both mice and rats. In forced induced swimming test using rats, 14 days of extract (500 mg/kg) administration reduced immobility time to 93.33 ± 9.66 seconds, compared to 107.50 ± 9.4 seconds in fluoxetine (15 mg/kg) group as positive control [69]. In tail suspension test using mice, the extract and fluoxetine decreased the immobility time significantly by 43.62% and 47.04%, respectively [69].

**Wound healing property**

The treatment of _Hibiscus rosa-sinensis_ flowers ethanolic extract, which contained polyphenols, tannins, carboxylic acids, triterpenoids, and alkaloids, demonstrated wound healing activity in Sprague Dawley rats. After 15 days, using a daily dosage of 120 mg kg⁻¹ decreased period of epithelialization to 11.2 ± 0.13, and resulted in 49% reduction in the wound area compared to only 33% in control group, evaluated by excision model [70]. In dead space wounds and incision models, the extract also increased strength of skin breaking to 515.0 ± 39.56, as well as granulation tissue’s dry weight and hydroxyproline content to 33.50 ± 2.89 and 47.66 ± 10.64, respectively [70].

On the other hand, 0.01g/ml of leaves aqueous and ethanolic extracts exhibited 56.322 ± 10.17 and 62.855 ±12.41 g/mm2 tensile strengths respectively, compared to 62.433 ± 7.33 g/mm2 in 10 % cetrimide treated group as positive control [71]. H&E stain histological analysis also showed that wounds were re-epithelialized with nearly healed hair follicles, arranged collagen fibres, and replaced granulation tissues by fibrosis [71]. In Swiss albino mice, 200 mg/kg, p.o. of leaves ethanolic extract increased wound closure percentage and wound breaking strength to 96.41 ± 2.07 and 338.82 ± 6.91, compared to 97.23 ± 1.62 and 385.03 ± 4.91 in povidone iodine treated group, respectively [72]. Moreover, the epithelisation periods for extract increased dosages of extract has lead to changes, as in elevated plus maze, mice spent more time in open arms. In addition, the extract’s phytochemicals were tannins, flavonoids, saponins, and glycosides [66].
Anti-inflammatory activity

In male Wister rats, H. rosa sinensis hydroalcoholic leaves extract had an ameliorative effect on 4% acetic acid induced colitis via rectal administration. The 7 days treatment with 200 mg/kg, p.o. of extract reduced the ulcer area of colon to 20.67 ± 2.40 mm², as compared to 10.00 ± 1.23 mm² from prednisolone treatment group taken as positive control, and 41.67 ± 1.96 mm² from negative control group [73]. The phytochemicals that were present such as steroids, polyphenols, alkaloids, and flavonoids, might have contributed to this activity [73].

Ethanol extracts of flowers and leaves from two H. rosa-sinensis morphotypes were also tested on carrageenan induced paw edema in Sprague-Dawley rats. After 6 hours, the paw volume (ΔV, ml) was measured using phylsytometer, and 100 mg/kg dosage was observed to have most remedial effects [74]. The red Hibiscus (H. rosa-sinensis L.) flower and leaf extracts reduced edema to 0.04 ± 0.02 and 0.02 ± 0.02, respectively. Whereas the white Hibiscus (H. rosa-sinensis var alba) flower and leaf extracts reduced it to 0.08 ± 0.02 and 0.04 ± 0.02, respectively. Diclofenac treated group as positive control reduced in 0.02 ± 0.02, compared to 0.20 ± 0.03 edema volume from negative control group [74].

Immune response activity

The effect of aqueous extracts of flowers on immunomodulation was studied by intraperitoneally injecting 500 mg kg⁻¹ BW of extract in male Swiss albino mice. After 15 days of treatment, cytokine IL-1α serum levels increased by 14.27% and IL-2 levels decreased by 32.70% in comparison to control group. The antibody titre also increased to 2.39 ng ml⁻¹ compared to 1.73 ng ml⁻¹ in control group [75]. Moreover, the extract increased the macrophage yield and viability, as well as the phagocytic index to 76.76 ± 1.40, which is only 72.85 ± 1.07 in control group. HPTLC chromatogram proved that it contains alkaidol and flavonoids [75].

Using forced swim test and albino Wistar rats as study models, ethyl acetate extract of H. rosa sinensis petals was evaluated at 100 mg/kg dosage. The treatment increased mean swim time by two fold, indicating better tolerance to stress, and nearly restored back the normal levels of enzymes such as alanine aminotransferase (73.81 ± 1.88 IU/L), and aspartate aminotransferase (101.6 ± 1.93 IU/L), compared to control values 66.79 ± 1.44 and 93.61 ± 4.49 IU/L, respectively [76].  Other physical stress indicators, such as glucose, cholesterol, and triglycerides, were also restored to their normal values compared to control groups [76].

Cardioprotective activity

The administration of 200 mg/kg of aqueous extracts of H. rosa-sinensis Linn leaves in lowered blood pressure in both hypertensive and non-hypertensive albino rats. After the four weeks, the mean systolic and diastolic pressures were 155.0 ± 4.39 and 141.0 ± 2.45 mmHg, respectively in hypertensive treated group, compared to 92.0 ± 7.54 and 67.0 ± 8.67 mmHg, respectively in non-hypertensive treated group [77]. The hypertensive control group gave mean systolic and diastolic pressures of 72.85 ± 1.07 in control groups [76]. The extract decreased the number of VPB (ventricular premature beats) and lowered the VT (ventricular tachycardia) period to 13.2 ± 5.1 s, when compared with nontreated control group, suggesting antiarrhythmic protection [78].

Gastroprotective activity

The aqueous-ethanolic extract of Hibiscus rosa sinensis aerial parts exhibited protection of mucosal layer in albino Wistar rats gastric tissues subjected to 600 μg/kg carbachol and pylorus ligation. Extract treatment at the dose of 500 mg/kg resulted in 82% had protection percentage compared to control group, whereas treatment with 2.5 mg/ kg cimidine and 10 mg/kg b.w verapamil resulted in 88% and 81% protection, respectively [79]. Decline in gastric secretion volume, free and total acidity, with an increase in gastric juice pH was also observed. The extract treatment lowered ulcer index to 3.00 ± 0.22 from 16.90 ± 1.30 (negative control), in comparison to 2.10 ± 0.40 and 3.20 ± 0.15 from cimidine and verapamil control groups, respectively. Moreover, the phytochemical screening indicated that carbohydrates, sterols, flavonoid, glycosides, and tannins are present [79].

In another study, aqueous flower extract at 500 mg/kg dosage had the best gastroprotective activity against pylorus ligation, aspirin, and ethanol induced ulceritis models in albino Wister rats, resulting in protection percentages of 81.85%, 73.7%, and 76.8%, respectively, whereas 8 mg/kg Lansoprazole treated group (positive control) resulted in 84.99%, 80.10%, and 78.12% protection percentages, correspondingly [80]. This is highly attributed to free radical scavenging activity of tannins and flavonoids present in flower extract [80].

Anti-pyritic activity

The antipyretic effects of 250 mg/kg H. rosa sinensis aqueous root extract was investigated using yeast-induced pyrexia in albino Swiss rats. After 3 hours, the half, extract reduced the rectal temperature from 39.0 ± 0.145 to 37.5 ± 0.25 ºC, whereas treatment with 30 mg/kg b.w paracetamol as positive control maintained it as 37 ºC [81]. The extract analgesic potentials were also examined at the same dosage using tail flicking test. The treatment increased reaction time as compared to 45 mg/kg b.w. diclofenac sodium treated and control groups, meaning that it weakened pain response [81]. Similarly, 500 mg/kg b.w of aqueous leaf extract managed to lower mice rectal temperature by 1.55 ºC, 5 hours after extract consumption, compared to 2.00 ºC using 10 mg/kg b.w acetaminophen as positive control [82].

Antihyperlipidemic activity

Oral administrations of H. rosa-sinensis Linn flowers ethanolic extract at 500 mg/kg b.w dosage were evaluated using 400 mg/kg triton and atherogenic diet induced hyperlipidemia in albino Wistar rats. After 48 hours, the extract has managed to lower serum lipid levels to 79.5 ± 1.652 total cholesterol, 80 ± 2.287 triglycerides, 87.16 ± 2.543 phospholipids, 68.16 ± 2.1 LDL, 19.33 ± 1.4 mg/dl VLDL, and increased HDL level to 35 ± 2.3 mg/dl in Triton model, compared to negative control and 10 mg/kg b.w simvastatin positive control values significantly [83].

In atherogenic diet induced model, the ethanolic extract reduced serum lipid levels after 14 days to 70 ± 2.854 total cholesterol, 68.66 ± 1.240 triglycerides, 71 ± 3.287 phospholipids, 45 ± 2.606 LDL, 35 ± 1.141 mg/dL VLDL, and increased HDL level to 29.16 ± 2.365 mg/dl significantly in comparison to all control groups [83].

Hepatoprotective effects

According to a recent study, Hibiscus rosa-sinensis ethanolic leaf extracts ameliorated piroxicam (6.6 mg/kg b.w) induced liver toxicity in Swiss albino mice. After oral treatment with 30 mg/kg b.w. of extract for 15 days, alanine transaminase, aspartate transaminase, and alkaline

J Ayu Herb Med | Vol 4 Issue 3 | July- September 2018
phosphatase serum activities were reduced to 12.87 ± 0.77, 51.82 ± 2.32, and 73.44 ± 4.32 respectively when compared to piroxicam treated group [84]. The treatment also significantly lowered lipid peroxidation and elevated levels of superoxide dismutase, catalase, and glutathione peroxidase in comparison to piroxicam treated group. This suggests combating hepatic damage induced by oxidative stress [84].

Toxicity

The Sprague Dawley male rats were subjected to 14 days oral administration of ethanol flower and leaf extracts of *H. rosa sinensis* up to dosage of 500 mg/kg. The histological studies showed that regardless the extract type or the flower morphotype (red and white); there were no toxicological effects on the liver that could have lead to hepatic injury [74].

In Balb/c mice bone marrow blood cells, treatment with 400 mg/kg of methanolic flower extract showed similar micronuclei frequency to negative control group suggesting no genotoxicity [85]. In cyclophosphamid (20 mg/kg) induced DNA damage, using the same dosage reduced the number of micronucleated polychromatic erythrocyte by 67.80%. However, 1600 mg/kg dose resulted in 20% mortality [85].

It was reported that 500 mg/ml of *H. rosa sinensis* powder given orally with water for one month, histologically did not produce any signs of toxicity in livers of Swiss albino mice compared to control groups [86]. Similarly, subjecting mice orally with 2000 mg/kg of leaves methanol extract did not cause mortality or show any signs of toxicity during 14 days of observation [87]. The experiment however showed that administration of 800 mg/kg dose increased levels of alanine aminotransferase, aspartate aminotransferase, total bilirubin, urea and creatinine significantly. The histopathology of kidneys and liver was also altered showing tubules and glomeruli disorganization, dilated sinusoids and inflamed sinusoidal capillaries, and apoptotic nuclei [87].

**CONCLUSION**

*Hibiscus rosa sinensis*, which belongs to Malvaceae family, has been widely used as a traditional remedial plant in China and several tropical countries. All of its parts have been used in the treatment of fever, inflammation, bacterial infections, and even as contraceptive agent. Flavonoids, tannins, terpenoids, saponins, and alkaloids are the main phytochemicals as they are present in different extracts, and are more likely responsible for their biological activities. Lower toxicity of this plant can be an advantage to qualify it to be used as new therapeutic agent.

This review has presented a comprehensive summary of recent studies on the phytochemistry and the medicinal uses of *H. rosa sinensis*. In some areas, the research is very limited and therefore further studies must be carried out to explore the phytochemicals mechanism of action such as anti-cancer activity. However, these biological compounds must be first isolated and identified successfully. Moreover, clinical trials on the toxicity of this plant and its pharmacological effects must be carried out to assess its safe application and desirable side effects.

**REFERENCES**


