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A Review on the Pharmacological Activities of Hibiscus Rosa-Sinensis

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ABSTRACT:
The Malvaceae family of flowering plants includes the genus Hibiscus. It is properly big, with hundreds of native species from warm-temperate, subtropical, and tropical climates all over the world. Members are typically renowned for having colorful blooms. The goal of the current study is to determine and support the plant's ethnomedicinal usefulness. Shampoo, hair color, lotions for treating wounds, and skin care products all include these flowers. Numerous scientists investigated the phytochemistry and pharmacology of these blooms. According to a phytochemical investigation, Hibiscusrosa-sinensis has tannins, anthraquinones, quinines, phenols, flavanoids, alkaloids, terpenoids, saponins, cardiac glycosides, protein, free amino acids, mucilage, essential oils, and steroids. It also contains mucilage, essential oils, and steroids. Hibiscus flowers are said to have a variety of medicinal properties, including those for hypertension, atherosclerosis, antioxidants, hypercholesterolemia, antinociception, antipyretics, antimutagenics, antifungals, antibacterials, and chemoprevention. These qualities are mostly related to their polyphenolic components, hence further research into the Hibiscus species is necessary.

I. INTRODUCTION:

The plant has been a significant part of human treatments dating back to the early millennia in the traditional medical system. Eighty percent of the 122 bioactive compounds discovered were utilized for the same or comparable ethnomedical reasons and have been sourced from just 94 plant species, according to a review of plant-derived pure chemicals used as medicines in nations hosting WHO-Traditional Medicine Centres[1] In the past several years, second-generation metabolites have been utilized in the pharmaceutical business, either directly as precursors or as lead molecules. Over 25% of the medications prescribed in developed countries come either exclusively or in part from plants, despite noteworthy improvements in synthetic organic chemistry.[2] Nowadays, relatively few plants have undergone significant study, and the majority of them have no study at all.[3] Due to the rise in antibiotic resistance among gonorrhea-causing microbes like Neisseria gonorrhoeae, research into new treatment drugs derived from plant sources is being postponed. According to a WHO estimate, 333 million individuals globally get illnesses that are transmitted sexually each year, with 62 million of those incidents being gonorrhea [2,4] However, finding new anti-gonorrhea medications is critically needed for effective medical treatments. More potent antimicrobial compounds have been discovered in plants, and these compounds are showing effectiveness as treatments for a variety of infectious disorders.[5,6] In addition to morphine, additional medications including codeine, digitoxin, and quinine has further isolated from medicinal plants, some of which are still use nowadays.[1,7]

Fig.1: Hibiscus rosa-sinensis

China rose, or Hibiscus rosa-sinensis, is a member of the Malvaceae family. In some tropical

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nations, this plant is used for a number of significant medical purposes, including the treatment of stomach ulcers, alopecia, infections caused by bacteria and fungus, diabetes, inflammation, fever, and coughing. According to phytochemical research, the primary bioactive mixtures responsible for its therapeutic benefits are videlicet flavonoids, tannins, terpenoids, saponins, and alkaloids. Recent research has demonstrated that several H. rosa-sinensis extracts have a wide range of beneficial properties, including cancer prevention, diabetes management, crack repair, and abortifacient activity. [8] Hibiscus rosa-sinensis is a tiny tree or "shrub" that typically grows to a height of 4 metres, is evergreen, and has ovate branches with stalks that are 10 cm in width and 15 cm in length. [9] They are multiple designs with varying sizes, colors, and both single and double forms. The critical hues are pale red, white, yellow, and red.[10] Several plants can have both beneficial and undesirable (toxic or severe side effects) properties. The plant includes phytochemicals, which are compounds created during routine metabolic activities. The term "secondary metabolites" of plants is frequently used to describe these chemical substances.[11] Numerous secondary metabolites, including alkaloids, glycosides, fatty substances, reducing sugars, resin, sterols, and the absence of tannins and saponins, are present in the various extracts of the H. rosa-sinensis plant. We examined the fatty alcohol, fatty acid, and hydrocarbon content of H. rosa-sinensis leaves. Malvalic and sterculic, two more cyclic acids, are also recognised.[12] As a result, it is necessary to the possible hemolytic activity of numerous regularly used plants, particularly H. rosa-sinensis. Strong anticancer agents can be found in natural plant products. Previous research shows the anti-complementary, anti-diarrhetic, and anti-pho-logistic effects of H. rosa sinensis.[13] While the root is used to treat coughs, the leaves are laxatives. Boils and ulcers can be treated using the leaves and flowers of H. rosa-sinensis. The plant's leaves are used in traditional medicine for exhaustion and skin conditions.[14] pharmacologically molecules are active likely flavonoids, which have the potential for anti-inflammatory, oestrogenic, enzyme-inhibitory, antibacterial, antiallergic, antioxidant, cytotoxic, and anticancer action, are obtained.[15,16] Hibiscus rosa-sinensis flowers along with other components have been used for many maladies in the past, mainly venereal and asthmatic disorders.[17,18] Several bioactive compounds have been obtained from medicinal plants to treat illness. Cyanidin, quercetin, hentriacontane, calcium oxalate, thiamine, riboflavin, niacin, and ascorbic acid are a few types of important bioactive compounds[17] Over fifty percent of today's medications for therapy, according to recent scientific research, are derived from natural products. Many of them have made important contributions to the pharmaceutical sector and the creation of more effective treatments for several ailments.[19]

II. CLASSIFICATION

Hibiscus rosa-sinensis is a member of the phylum "Magnoliophyta" because it is a flowering plant with true leaves, stems, and roots as well as carpels enclosing ovules. It also belongs to the "class" Magnoliopsida because it is a eudicot type of plant, which means that it blooms in clusters of four or five, has veins that resemble nets,[20] Over fifty percent of today's medications for therapy, according to recent scientific research, are derived from natural products. Many of them have made important contributions to the pharmaceutical sector and the creation of more effective treatments for several ailments.[20] It is similarly a member of the Malvaceae family and may be found almost everywhere except in cold climates. It typically grows as tiny trees or bushes and releases bristly pollen. Last but not least, the H. rosa-sinensis species belongs to the 'Hibiscus genus, which has more than 250 indigenous species[21] Hibiscus rosa-sinensis is an evergreen shrub that typically grows to a height of four meters and has ovate branches with stalks that are 10 cm broad and 15 cm long.[22,23] The majority of the time, flowers are found on long stalks. They are approximately 20 cm wide, have five whorled oval petals (egg-shaped), have sleek edges, and join at the base of the central stamina column.[22,23] A style with five lobes at the apex and many yellow anthers is part of this central column. Moving on to the flower's exterior, we can see that its cup-shaped calyx measures 2.5 cm long, and its epicalyx is made up of 5 or 7 bracteoles that are each 1 cm long. the top leaves, which are typically oval in shape and glossy green with a pointy tip and pinnate veins, flowers are often borne singly.[22,23]

III. SCIENTIFIC CLASSIFICATION OF HIBISCUS ROSA SINENSIS

Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Megnoliophyta

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Class	Magnoliopsida
Subclass	Dilleniidae
Order	Malvaceae
Genus	Hibiscus
Species	Hibiscus rosa sinensis

IV. PHYTOCHEMISTRY

A variety of compounds may be found in H. rosa sinensis in every region of the plant. Phlobatannins, glycosides, saponins, flavonoids, terpenoids, and other substances, including thiamine, riboflavin, and niacin, were found to be present in leaves, flowers, stems, and roots, according to a report.**[24]**

A. Chemical Constituents

1. Flavonoids

Hybridin, a glycoside, has been discovered in the blooms of hybrid hibiscus plants. It contains quercetin, which may also be found in the new quercetin bioside 3-D-xylopyranoside-D-galactofuranoside.[25] The two flavonoid aglycones that were most often observed were the flavonol quercetin and anthocyanin cyanidin. The flowers' quercetin content varied from 2 to 192 mg/g, with flowers with white or cream-colored petals having the higher values.[26] A medicinal plant known as Hibiscus rosa-sinensis has a variety of beneficial therapeutic properties. This study set out to discover and define a flavonoid component present in the petals of Hibiscus rosa sinensis. The antioxidant compounds have been separated using Silica Gel G Column Chromatography.[27] At least in the United States, hibiscus species and hybrids have been reduced to the status of obscure garden plants. Although they belong to the anthocyanin class of edible flower pigments, their potential as a new source of nutritious flowers and natural food colourants makes them one of the newest of the New Crops.[26] The findings demonstrated that the H. rosa-sinensis C5 compound had phenolic and flavonoid contents and outstanding antioxidant properties when compared to ordinary ascorbic acid. The isolated molecule can be use to counteract free radicals, stop the production of hazardous chemicals, extend the shelf life of food and medicines, and more. The flavonoid compound Hibiscetin-3-glucoside (C21H20O14) from the petals of Hibiscus rosa Sinensis was convincingly demonstrated by spectrum analysis research and may also be employed as an efficient anti-cancer medicine in the field of cancer therapy.[28]

2. Anthocyanins

The anthocyanin extract from the flowers of hibiscus has been tried for the first time as a source of dye for textile dyeing, but hibiscus extract is already used to impart color and flavor to drinks and many other culinary products. The dyeability as well as the fastness qualities of the coloured fabrics were found to be improved when metal mordants including Sn, Al, and Cu were combined with Hibiscus rosa-sinensis anthocyanin extract.[29] The kidney was protected and oxidative stress was reduced by meals supplied with the dye for 20 days before the administration of cisplatin through modification of in vivo status. The dye has a nephroprotective effect since it contains 121.5 mg of cyanidin-3-rutinoside equivalent per 100g of cyan pigments, according to the analysis. H. sabdariffa dye might be a result of the sample's anthocyanin concentration.[30] Anthocyanins gained interest as antioxidants and possible sources of natural colourants. The natural colour quality is significantly influenced by the extraction technique. In the current study, anthocyanins from Hibiscus sabdariffa were extracted using a variety of extraction media, including ethanol (0–80%), acidified water (1% HCl) with ethanol (0–80%), acetic acid solution (1–2%), and acidified (0.5–2% lactic acid) 80% ethanol. Using DPPH, ABTS, and FRAP tests, the antioxidant potential of various extracts was also assessed. The anthocyanin content of hibiscus was substantially greater in the acidified (2% lactic) in 80% ethanol, acidified (1% HCl) in 50% ethanol, and acidified (2% acetic acid) solution among the other studied media (725.91, 685.78, and 634.90 mg/100g, respectively).[31]

3. Tannins

According to phytochemical analysis, Hibiscus rosa-sinensis contains tannins, quinines, phenols, flavonoids, alkaloids, terpenoids, saponins, cardiac glycosides, protein, free amino acids, carbohydrates, reducing sugar, mucilage, essential oils, and steroids.[32] The total phenol, tannin, alkaloid, and flavonoid contents of hibiscus tiliaceus L. Wood extracts from petroleum ether, ethyl acetate, and methanol were examined in this study. Comparing ethyl acetate extract to petroleum ether and methanolic extract, ethyl acetate extract showed higher phenol, alkaloid, flavonoid, and tannin concentrations.[33]

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4. Anthraquinones

The size of their fibres as well as their anatomical, physical, morphological, and chemical features are given. (Calotropisprocera — usher and Hibiscus sabdariffa var. sabdariffa — karkadeh) to see if they were suitable for manufacturing papermaking pulp. The soda-anthraquinone technique was used to pulp both species, and the usher was additionally pulped using a CMP (chemimechanical process). The core of the karkadeh plant alone or the entire stem was pulped with sodaanthraquinone, yielding high yields (47–49%) of bleachable pulp at a tolerable alkali charge (22% as NaOH) and 0–13% AQ. The whole stem's mechanical characteristics were the best, and it appears that pulping with no rejections is ideal for stem pulping. Acceptable yields (43–46%) were obtained from the soda-AQ pulping of usher with the same alkali level using mechanical[34]

5. Quinines

We looked at two prospective raw materials growing in Sudan Red H. tiliaceus heartwood ages with exposure to light. It includes hibiscus A to D and hibiscoquinones A to D, comparable to H. elatus heartwood, which exhibits similar behavior. One sample that lacked red pigments included lapachol, whereas roots from Brazil contained gossypol and Manson ones D and F. By autoxidation hibiscuses C and D in an alkaline solution, hibiscoquinone B may be produced, and subsequent hibiscoquinone synthesis can be explained by analogous mechanisms. In vivo, the hibiscuses may be converted[35]

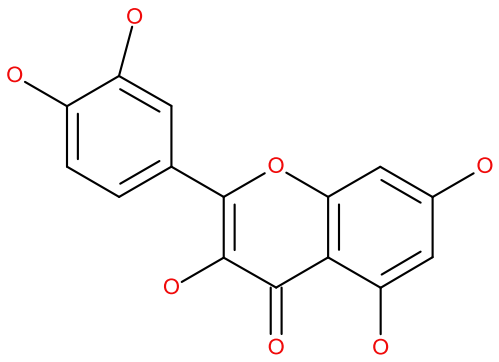
6. Phenols

As a result of their abundance in polyphenols, which function as antiaging compounds, plant extracts are increasingly being used in skin-care products. Hibiscus roseus is a perennial plant that was introduced to Italy and has lovely soft pink blossoms; its phenolic makeup and biological functions have not yet been investigated. This study's objectives include characterising and quantifying the phenolics and assessing the antioxidant, sun protection factor (SPF), and anti-collagenase properties of the ethanolic extracts of H. roseus leaves (HL) and flowers (HF).

The primary phenolic chemicals found were flavonoids quercetin and kaempferol, as well as derivatives of p-coumaric, chlorogenic, and trans-ferulic acids. While phloridzin was only found in HL, which also had higher levels of hydroxycinnamic acid, catechin, epicatechin, kaempferol-3-O-rutinoside, kaempferol-3-O-glucoside, kaempferol-7-O-glucoside, tiliroside, oenin, and peonidin-3-Oglucoside were only found in HF.[36]

7. Alkaloids

This study intended to ascertain the range of concentrations of the fractions comparable to the acetylcysteine impact of 0.1% and the effect of fractions containing alkaloids of red hibiscus flower types regarded as mucolytics in vitro. This research used maceration, VLC fractionation, identification of alkaloid-containing fractions, and mucolytic activity tests on alkaloid-containing fractions. To reduce the viscosity of bovine mucus, an in vitro test for mucolytic activity was carried out.[37]



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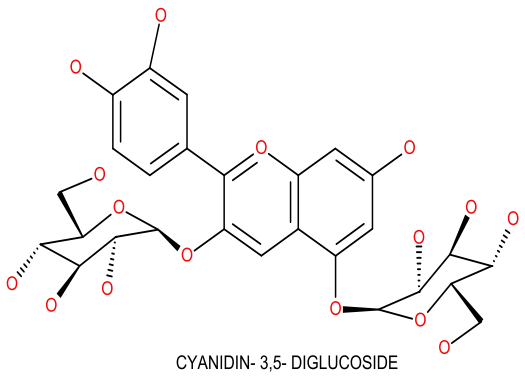

CYANIDIN- 3,5- DIGLUCOSIDE

V. PHARMACOLOGICAL ACTIVITIES:

1. 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

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inhibition was 13 ± 00 mm and it was against E. coli followed by 12 ± 00 mm against both S. aureus and E. aerogenes at 80 µg/ml concentration of leaves methanolic extract [38] These microorganisms were obtained from infected skins, and the chemical coumpounds responsible for the antibacterial activity may be due to flavonoids, tannins, terpenoids, saponins, or alkaloids identified in the study [38].

In another study conducted using disc diffusion method, aqeuous 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 glyxosides, anthraquinones, and phlobatanins, including those mentioned earlier [39]. Intresingly, another research reported similar Results showed that the maximal zone of inhibition against B. subtillis was 15.00 mm by 2.81 mm in aqueous extracts and against E. coli was 12.50 mm by 1.81 mm in hexane extracts, whereas B. subtillis had the highest zone of inhibition in aqueous extracts.E. coli was measured as 18.00 1.53 mm and S. subtillis as 19.86 0.15 mm [39].

Although the same protocol was utilised, flowers from H. rosa sinensis were used in this investigation, and the results were seen after only 24 hours of incubation Using the disc diffusion method, antibacterial activity against E. coli and S. aureus has also been seen at various doses of methanolic flower and leaf extracts, ranging from 31.25 to 500 mg/ml. These were contrasted with gentamicin (1 mg/ml), a positive control, and methanol, a negative control [3]. The bactericidal activity of both types of extracts increased with extract concentration. The maximum zones of inhibitions for E. coli were 23 1.01 mm and 13.75 0.99 mm for leaf and flower methanolic extracts, respectively, at a dosage of 500 mg. For S.aureus, however, methanolic leaf and flower extracts had the greatest zones of inhibition at 500 mg concentrations, measuring 19.33 0.29 mm and 9.75 0.76 mm, respectively [40].

In this work, glycosides, tannin, phenols, and flavonoids from leaf extracts were discovered together with carbohydrates, phytosterols, and proteins from floral extracts. However, both extracts included alkaloids and saponins. The maximum zones of inhibition against B. subtillis and E. coli were found in the cold aqueous extractions of flowers, which measured 17.00 2.94 mm and 14.50 1.71 mm, respectively. In contrast, the maximal zones of inhibition for the hot aqueous extraction were 11.60 3.14 mm for E. coli and 10.66 3.09 mm for Salmonella sp. [41]. The maximum zones of inhibition against B. subtillis and E. coli by the methanol extracts were 18.86 0.18 mm and 18.00 1.63 mm, respectively. Zones of inhibition against Salmonella sp. and P. aeruginosa were determined by the ethanol extracts to be 20.40 1.54 mm and 16.30 0.94 mm, respectively. All of the aforementioned microbes are regarded as human pathogens Both pure and crude proteins from flowers were tested for their antibacterial properties. The results showed 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, while pure protein inhibited the growth of Staphylococcus sp. for 11.4 1.74 mm and E. coli for 12.25 0.97 mm. Additionally, the crude protein sample from the H. rosa-sinensis flower was processed in poly acrylamide gel electrophoresis (PAGE), which produced a number of bands [42]. This implies that alkaloids, flavonoids, triterpenoids, and tannins may be present in the crude extract. For instance, flavonoids are regarded as antibacterial agents because they have the capacity to combine with elements of bacterial cell walls and ultimately destroy them [43].

Investigated was the antibacterial activity of H. rosa sinensis root extracts. At a concentration of 7.5 g/ml, it was reported that using the disc diffusion method, ethyl alcohol root extracts inhibited the growth of S. aureus for 2 cm, E. coli, and B. subtilis for 1.5 cm as the highest zones of inhibition [44]. Similar to this, methanol flower extracts showed the largest inhibition zones against E. coli (27 0.12 mm), S. aureus (21 0.41 mm), and Streptococcus pyogenes (18 0.65 mm) at a dosage of 1 mg/ml. in contrast to 10 mg of chloramphenicol, which was utilised as a positive control and produced an inhibitory zone that was about 24 mm [6]. All phytochemicals implicated in the antimicrobial action were found in the methanol extract, as opposed to other extracts like the ethyl acetate, ethanol, and water extracts. This implies that it is a valuable extract for additional study [45].

2. Anti-Fungal Properties

Previous research has demonstrated that methanol extracts made from Hibiscus rosa-

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sinensis leaves have antibacterial effects on Trichophyton rubrum, Candida parapsilosis, Aspergillus niger, Candida albicans, and the fungus Candida albicans. The greatest observed zone of inhibition was 9.3 0.57 mm using the well diffusion method, and it was against Aspergillus niger after a 24-hour incubation period at 37° C, followed by 6.6 0.57 mm against Candida albicans at an 80 g/ml concentration of leaves methanolic extract [46].

These fungi were acquired from sick skin, and the study's identification of flavonoids, tannins, terpenoids, saponins, and alkaloids may be to blame for the chemical compounds that have the antifungal action [47].

Investigations were also conducted on the antifungal properties of H. rosa sinensis root, leaf, and flower ethanol extracts. Using the disc diffusion approach, it was reported that both Candida At a dosage of 10 g/ml, floral extracts inhibited parapsilosis and Aspergillus niger for 1.5 cm as the maximum zones of inhibition [48]. Additionally, extracts from the leaves suppressed Candida parapsilosis at optimal levels for 2.2 cm and 1.5 cm, respectively, at concentrations of 10 g/ml and 7.5 g/ml [32]. At a dosage of 100 mg/ml, H. rosa sinensis methanol leaf extracts also prevented the development of Candida albicans for 20 mm, C. glabreta for 19 mm, and A. flavus for 17 mm [48].

3. Anti-oxidant function

While ascorbic acid, a common antioxidant, produced 76.33 1.25% radical scavenging activity at a dosage of 100 g/ml, ethanolic floral extract (95.0%) inhibited hydrogen peroxide for 96 2.35% at a concentration of 50 g/ml. According to a research, the majority of the compounds discovered by GC-MS analysis belonged to the classes of alkaloids, tannins, steroids, glycosides, and flavonoids [49]. These molecules may also be the cause of the significant radical scavenging capacity. The development of tissue damage is greatly aided by free radicals, such as those produced by hydrogen peroxide. Any compounds that can eliminate them, such as the phytochemicals found in H. rosa sinensis, will shield the cell system and its constituent parts from cytotoxic harm. When compared to BHT as a positive control, the DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity of flower extracts in 80% methanol and ethanol was 75.46 4.67% and 64.98 2.11%, respectively. A UV visible spectrophotometer was used to assess the scavenging of DPPH free radicals at 515 nm [50]. Additionally, the methanolic and ethanolic extracts had total phenolic contents of 61.45 mg, 3.23 mg, and 59.31 mg, 4.31 mg/100g dry extract, respectively, and total flavonoid levels of 53.28 mg, 1.93 mg, and 32.25 mg, 1.21 mg/100g dry extract. This definitely suggests that they are responsible for the anti-oxidant action because it was shown that methanolic extract had higher amounts of phenolics and flavonoids and contributed to higher scavenging activity than ethanolic extract Because methanolic extract was found to have a higher concentration of phenolics and flavonoids and to have a better scavenging activity than ethanolic extract, This suggests with great certainty that they are in charge of the antioxidant action Another study found that methanolic stem extracts only showed 9.75 1.15 scavenging activity against DPPH radicals, while aqueous stem extracts showed 15.1 4.5 scavenging activity. However, both extract types had comparable effects on hydrogen peroxide radicals, superoxide anions, and nitric oxide [38]. Additionally, flower water extracts with a concentration of 1 mg/ml efficiently scavenged DPPH radicals for 71.9%. The iron concentration of H. rosa sinensis petals, which were isolated by TLC and partially purified by silica gel column chromatography, was revealed to be the cause of this activity. The lyophilized petal powder contained 0.8 mg/g of iron, according ICP-OES measurement [51].

Similar to this, ethanolic extracts of H. rosa sinensis leaves had much higher scavenging activity in tests involving ferric reducing and nitric oxide than ethanolic extracts did when testing antioxidant activity against DPPH and hydrogen peroxide radicals [52].

Using the DPPH assay, the association between the plant's leaf antioxidant activity and the quantity and colours of its flowers was also looked into. In this study, leaves from a single plant were collected independently for each of the nine hues (pink, yellow, white, orange, yellow/pink, white/pink, orange/pink, and two varieties of red shades) [52]. White/pink had the highest reported antioxidant activity and the lowest IC50 values (0.20). methanol extracts from several petals, and 0.19 from and yellow ethanol extracts from five petals. The samples with the least antioxidant activity, however, were red with five petals and orange/pink with several petals, both of which were ethanol extracts [41]. These values were 1.17 and 4.49, respectively. Using butylated hydroxyanisole (BHA) as a reference material, the radical

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scavenging activity of 70% ethanol extracts from leaves was investigated. The highest antioxidant activity against superoxide radicals was found to be 60.4 2.19%, compared to 48.52 3.03% scavanging activity against hydrogen peroxide, and 36.3 2.47% against nitric oxide, all at a concentration of 500 g/ml. The following scavenging activities were produced by the 200 g/ml of BHA: 61.6 3.15%, 65.8 2.21%, and 37.3 3.6%, respectively [53].

4. Cancer Prevention

75 and 125 mg of H. rosa sinensis oil extract were applied to oral cancer cell lines KB (ATCC CCL-17) for 24 hours. The DNA of the treated cells from both concentrations has been found to be fragmented in comparison to the control sample after the treated cells were subjected to a DNA fragmentation assay and agarose gel electrophoresis. This indicates that Hibiscus extract reduced oral cancer cell growth DNA from each of the cells' origins was found to be Comparing the concentrations to the control sample, they are fragmented. This indicates that Hibiscus extract restricted the development.[53]

5. Diabetic prevention

The alcohol leaves extract of Hibiscus rosa sinensis was shown to be an oral hypoglycemic agent in non-obese type I diabetic mice. Using concentrations of 100 and 200 mg/kg of body weight, it decreased blood glucose levels from 281.6 3.7 mg/dI to 92.2 2.63 and 83.8 3.15 mg/dI, respectively, in contrast to 103.37 2.13 mg/dI in insulin-injected NOD mice, which was utilised as the positive control [49]. After 5 weeks of oral dosing, the studied extracts also significantly decreased levels of triglycerides, blood urea, glycosylated haemoglobin, and cholesterol [53]. Root extracts of 500 mg/kg of bw concentration decreased blood glucose levels in alloxan-induced type II diabetic rats (150 mg/kg) from 300.23 32.20 to 220.41 20.40 mg/dl, compared to 175.38 11.67 mg/dl in glibenclamide.H. rosa sinensis leaf extracts in ethanol have anti-diabetic properties. on rats with hyperglycemia brought on by alloxan was also looked into. Blood glucose levels were seen to be at 2 mg/kg bw concentration. compared to those of rats administered with metformin, which decreased from 16.94 0.51 to 12.90 0.38 mmol after 4 hours [54].

Were decreased from 17.5 0.69 to 13.8 0.36 mmol. 400 mg/kg of a methanolic extract of leaves was able to reduce blood glucose levels in streptozotocin-induced diabetic rats from 326.67 25.76 to 154.11 17.91 mg/dI. Additionally, it decreased levels of uric acid, creatinine, AST (aspartate aminotransferase) (AST), and ALT (alanine aminotransferase), suggesting protective effects on the kidneys and liver, which were supported by H&E histological investigation It's interesting to note that the NMR spectroscopy-identified compounds orientin (Luteolin-8-C-glucoside) and verbascoside (phenylpropanoids glycoside) are largely responsible for this anti-diabetic effect [55].

In a different investigation, Wister rats with hyperlipidemia were given 500 mg/kg of an ethanolic floral extract, which demonstrated the highest antidiabetic and anti-hyperglycemic action against alloxan-induced diabetes [56]. This was also noted when the impact of flower aqueous extract on pregnant female rats was assessed. Prior to mating, streptozotocin was used to make these Wister rats diabetic. Although the non-diabetic pregnant rats did not benefit from the medication, the pregnant diabetic rats and their pups did [57].

6. Obstructed Conception

Methanolic extract from Hibiscus rosa sinensis flowers has been shown to be beneficial in vitro against alkaline phosphatase activity. The water soluble component of quercetin was used to isolate quercetin-7-Ogalactoside. reached 100% inhibition of the enzyme activity at a dosage of 100 mg/mL [57]. Complete inhibition of this enzyme was linked to suppression of implantation, a mechanism that is intimately connected to the method of contraception [57]. Male albino rats' spermatogenesis was similarly impacted by oral treatment of aqueous floral extract. Longer treatment times with higher extract dosages, according to histological analysis with H&E stain, have resulted in changes like broken and discontinous base membranes, complete disorganisation of spermatogenic cells, fragmented Sertoli cells, and absence of Leydig cells and mature spermatozoa [58]cells with oral cancer [59]. It was also demonstrated that 250 g of 90% methanolic leaves extratc completely suppressed the growth of the HT-29 colorectal AGS cell lines. The MTT assay was used to measure the cell viability percentage, and the determined IC50 value of 90.79 g/ml was discovered. The phytochemical research revealed that the presence of flavonoids and terpenoids in the leaves was primarily responsible for this high anticancer effect [60]. a different experiment, albino Wister rats were given

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propelyne glycol and H. rosa sinensis powder orally before mating. When compared to Overal L, the positive control, this therapy completely inhibited implantation in pregnant rats [59]. Compared to animals treated with Overal L and H. rosa sinensis extract, the group treated with propelyne glycol as a negative control provided 100% deliveries at full term [59]. Similar to this, progesterone and oestrogen levels were decreased in pregnant female albino Wister rats by H. rosa sinensis flower extracts. Due to endometrial changes brought on by this, the estrous cycle was thrown off, and non-receptive circumstances prevented blastocyst implantation. [60]

7. **Hair growth promoting activity**

In a study utilising Wister albino rats, the petroleum ether leaf extract of Hibiscus rosa sinensis was found to be an effective hair growth booster. The 5% w/w extract ointment produced 4.91 mm of hair length after 14 days as opposed to 6.06 mm in the 2% minoxidil treatment group and 2.21 mm in the negative control group In comparison to Minoxidil, which contributed 2315 05.78 hairs per cm2 of area, the extract also contributed 1937 37.84 hairs per cm2. In contrast to synthetic hair growth boosting ointments, exposure to sonic stress caused alopecia, although there were no side effects such erythema or edoema [61]. Similarly, an ointment containing 5% hydrolcholic leaf extract showed 2058 19.23 hairs per cm2 of surface area and 5.97 0.13 mm hair length [62].

The extract also supplied 1937 37.84 hairs per cm2, in contrast to Minoxidil's 2315 05.78 hairs per cm2 of area. Although there were no negative effects like erythema or edoema, exposure to sonic stress caused alopecia in contrast to synthetic ointments that promote hair development [61]. A similar treatment with 5% hydrolcholic leaf extract revealed 5.97 0.13 mm of hair length and 2058 19.23 hairs per cm2 of surface area [62].

The extract also supplied 1937 37.84 hairs per cm2, in contrast to Minoxidil's 2315 05.78 hairs per cm2 of area. Although there were no negative effects like erythema or edoema, exposure to sonic stress caused alopecia in contrast to synthetic ointments that promote hair development [61]. A similar treatment with 5% hydrolcholic leaf extract revealed 5.97 0.13 mm of hair length and 2058 19.23 hairs per cm2 of surface area [62]. Both in vitro and in vivo evaluations were done on the H. rosa sinensis aqueous flower extract's ability to promote hair development. In Wister rats, 2% of extract led to a mean hair length of 18.68 0.3 mm after 30 days as opposed to 19.24 0.4 mm with 2% of minoxidil. After 72 hours of incubation, an increase in hair follicle length of 1.73 0.18 mm was seen in-vitro, as opposed to the positive control's 1.95 0.14 mm [63]

8. **Neuroprotective activity**

The capacity of the aqueous flower extract of H. rosa sinensis to encourage hair growth was assessed both in vitro and in vivo. After 30 days, 2% of the extract in Wister rats produced a mean hair length of 18.68 0.3 mm as opposed to 19.24 0.4 mm with 2% of the minoxidil. In-vitro measurements after 72 hours of incubation revealed a 1.73 0.18 mm increase in hair follicle length as contrasted to the positive control's 1.95 0.14 mm [64] Lithium reduced the amount of head twitches compared to a positive control, ondansetron, a 5HT3 antagonist, which was 9.0 1.7, to 10.2 1.06. Pentobarbital's ability to induce sleep was also prolonged, which suggests that it has a sedative effect by inhibiting dopaminergic transmission [65].

9. **Inflammatory-Reduction Capacity**

Rectal injection of a hydroalcoholic leaf extract from H. rosa sinensis exhibited an ameliorative effect on 4% acetic acid-induced colitis in male Wister rats. The ulcer area of the colon was reduced to 20.67 2.40 mm2 after 7 days of therapy with 200 mg/kg, p.o. of extract, as opposed to 10.00 1.23 mm2 and 41.67 1.96 mm2 from the prednisolone treatment group chosen as positive controls, respectively [66]. This activity may have been influenced by the phytochemicals that were present, such as steroids, polyphenols, alkaloids, and flavonoids [67].

10. **Cardiovascular Protection**

Both hypertension and non-hypertensive albino rats had their blood pressure decreased by 200 mg/kg of aqueous extract of H. rosasinensis Linn leaves. After four weeks, the mean systolic and diastolic pressures in the hypertension treatment group were 155.0 4.39 and 141.0 2.45 mmHg, respectively, as opposed to 92.0 7.54 and 67.0 8.67 mmHg, respectively, in the non-hypertensive treatment group [77]. Mean systolic and diastolic pressures for the hypertension control group were 168.0 1.71 and 144.0 1.76 mmHg, respectively. However, the extract raised the levels of urea and sodium in both groups, indicating that

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it might interfere with kidney function and cause more salt retention [68].

CONCLUSION:

The present review covered This review discussed Hibiscus rosa-sinensis' chemical components, pharmacological effects, and therapeutic significance as a promising medicinal plant with a wide range of pharmacological activities that could be used in a variety of medical applications because of its efficacy and safety.

REFERENCE

[1]. Pendota SC, Aderogba MA, Moyo M, McGaw LJ, Mulaudzi RB, Van Staden J. Antimicrobial, antioxidant and cytotoxicity of isolated compounds from leaves of Pappea capensis. South African Journal of Botany. 2017 Jan 1;108:272-7.

[2]. Vijayakumar SA, Yabesh JM, Arulmozhi P, Praseetha PK. Identification and isolation of antimicrobial compounds from the flower extract of Hibiscus rosa-sinensis L: In silico and in vitro approaches. Microbial pathogenesis. 2018 Oct 1;123:527-35.

[3]. Clokie MR, Millard AD, Letarov AV, Heaphy S. Phages in nature. Bacteriophage. 2011 Jan 1;1(1):31-45.

[4]. Chomnawang MT, Surassmo S, Wongsariya K, Bunyapraphatsara N. Antibacterial activity of Thai medicinal plants against methicillin-resistant Staphylococcus aureus. Fitoterapia. 2009 Mar 1;80(2):102-4.

[5]. Gupta D, Dubey J, Kumar M. Phytochemical analysis and antimicrobial activity of some medicinal plants against selected common human pathogenic microorganisms. Asian Pacific Journal of Tropical Disease. 2016 Jan 1;6(1):15-20.

[6]. Patel AL, Chaudhry U, Sachdev D, Sachdeva PN, Bala M, Saluja D. An insight into the drug resistance profile & mechanism of drug resistance in Neisseria gonorrhoeae. Indian Journal of Medical Research. 2011 Oct 1;134(4):419-31.

[7]. Balunas MJ, Kinghorn AD. Drug discovery from medicinal plants. Life sciences. 2005 Dec 22;78(5):431-41.

[8]. Missoum A. An update review on Hibiscus rosa sinensis phytochemistry and medicinal uses. J Ayu Herb Med. 2018;4(3):135-46.

[9]. Begum Z, Younus I, ALI S. Anti-inflammatory, analgesic and anti-pyretic activities of Hibiscus rosa-sinesnsis Linn and phytochemicals. World Journal of Pharmacy and Pharmaceutical Sciences. 2015;4(12):116-23.

[10]. Kalita S, Kumar G, Karthik L, Rao KV. A Review on Medicinal Properties of Lantana camara Linn. Research Journal of Pharmacy and Technology. 2012;5(6):711-5.

[11]. Okwu DE. Phytochemical and vitamin content of indigenous spices of South Eastern Nigeria. J. Sustain. Agric. Environ. 2004;6:30-4.

[12]. Jadhav VM, Thorat RM, Kadam VJ, Sathe NS. Hibiscus rosa sinensis Linn–‘‘Rudrapuspa’’: a review. J Pharm Res. 2009 Jul;2(7):1168-73.

[13]. Arullappan S, Muhamad S, Zakaria Z. Cytotoxic activity of the leaf and stem extracts of Hibiscus rosa sinensis (Malvaceae) against Leukaemic Cell Line (K-562). Tropical Journal of Pharmaceutical Research. 2013 Oct 29;12(5):743-6.

[14]. Kasture VS, Chopde CT, Deshmukh VK. Anticonvulsive activity of Albizzia lebbeck, Hibiscus rosa sinesis and Butea monosperma in experimental animals. Journal of Ethnopharmacology. 2000 Jul 1;71(1-2):65-75.

[15]. Cushnie TT, Lamb AJ. Antimicrobial activity of flavonoids. International journal of antimicrobial agents. 2005 Nov 1;26(5):343-56.

[16]. Cushnie TT, Lamb AJ. Antimicrobial activity of flavonoids. International journal of antimicrobial agents. 2005 Nov 1;26(5):343-56

[17]. Ruban P, Gajalakshmi K. In vitro antibacterial activity of Hibiscus rosa–sinensis flower extract against human pathogens. Asian pacific journal of tropical biomedicine. 2012 May 1;2(5):399-403.

[18]. Yabesh JM, Prabhu S, Vijayakumar S. An ethnobotanical study of medicinal plants used by traditional healers in silent valley of Kerala, India. Journal of ethnopharmacology. 2014 Jul 3;154(3):774-89.

[19]. Udo IJ, Ben MG, Etuk CU, Tiomthy AI. Phytochemical, proximate and

antibacterial properties of Hibiscus rosa-sinensis L. Leaf. Journal of Medicinal Plants Studies. 2016;4(5):193-5.

[20]. Pekamwar SS, Kalyankar TM, Jadhav AC. Hibiscus rosa-sinensis: a review on ornamental plant. World Journal of Pharmacy and Pharmaceutical Sciences (WJPPS). 2013;2(6):4719-27.

[21]. Noman A, Aqeel M, Javed MT, Zafar S, Ali Q, Islam W, Irshad MK, Buriro M, Kanwal H, Khalid N, Khan S. Histological changes in Hibiscus rosa-sinensis endorse acclimation and phytoremediation of industrially polluted sites. JAPS: Journal of Animal & Plant Sciences. 2017 Oct 1;27(5).

[22]. El-Sayed ZI, Ateya AM, Fekry M. Macro- and micromorphological study of the leaf, stem, flower and root of Hibiscus rosa-sinensis L. Journal of Applied Sciences Research. 2012(January):34-56.

[23]. Begum Z, Younus I, ALI S. Anti-inflammatory, analgesic and anti-pyretic activities of Hibiscus rosa-sinesnsis Linn and phytochemicals. World Journal of Pharmacy and Pharmaceutical Sciences. 2015;4(12):116-23.

[24]. Salem MZ, Olivares-Pérez J, Salem AZ. Studies on biological activities and phytochemicals composition of Hibiscus species-A review. Life Science Journal. 2014;11(5):1-8.

[25]. Puckhaber LS, Stipanovic RD, Bost GA. Analyses for flavonoid aglycones in fresh and preserved Hibiscus flowers. Trends in new crops and new uses. ASHS Press, Alexandria. 2002 Jun 8:556-63.

[26]. Rengarajan S, Melanathuru V, Govindasamy C, Chinnadurai V, Elsadek MF. Antioxidant activity of flavonoid compounds isolated from the petals of Hibiscus rosa sinensis. Journal of King Saud University-Science. 2020 Apr 1;32(3):2236-42.

[27]. Vankar PS, Srivastava J. Comparative study of total phenol, flavonoid contents and antioxidant activity in Canna indica and Hibiscus rosa sinensis: Prospective natural food dyes. International journal of food engineering. 2008 May 6;4(3).

[28]. Vankar PS, Shukla D. Natural dyeing with anthocyanins from Hibiscus rosa sinensis flowers. Journal of Applied Polymer Science. 2011 Dec 5;122(5):3361-8.

[29]. Ademiluyi AO, Oboh G, Agbebi OJ, Akinyemi AJ. Anthocyanin–rich red dye of Hibiscus sabdariffa calyx modulates cisplatin-induced nephrotoxicity and oxidative stress in rats. International Journal of Biomedical Science: IJBS. 2013 Dec;9(4):243.

[30]. Saptarini NM, Hadisoebroto G, Herawati IE. Anthocyanin content of petal of red rose (Rosa damascene mill.) and red china rose (Hibiscus rosa-sinensis L.) from maceration and percolation method. J. Pharm. Sci. Res. 2018;10:86-9.

[31]. Mohamed RK, Gibriel AY, Rasmy NM, Abu-Salem FM. Extraction of anthocyanin pigments from Hibiscus sabdariffa L. and evaluation of their antioxidant activity. Middle East Journal of Applied Sciences. 2016;6:856-66.

[32]. Prof Dr Ali Esmail Al-Snafi., Chemical constituents, pharmacological effects and therapeutic importance of Hibiscus rosa-sinensis.IOSR Journal Of Pharmacy volume 8, Issue 7 version 2 (July2018)PP-101-119

[33]. Vijay D Tambe, Rajendra S Bhambar. Estimation of total phenols, tannin, alkaloid and flavonoid in hibiscus tiliaceus Linn. Wood extracts. Research and reviews journal of pharmacognosy and phytochemistry /volume/ issue 4 /octdec 2014.

[34]. Khristova P, Tissot M. Soda-anthraquinone pulping of Hibiscus sabdariffa (karkadeh) and Calotropis procera from Sudan. Bioresource technology. 1995 Jan 1;53(1):67-72.

[35]. Ali S, Singh P, Thomson RH. Naturally occurring quinones. Part 28. Sesquiterpenoid quinones and related compounds from Hibiscus tiliaceus. Journal of the Chemical Society, Perkin Transactions 1. 1980:257-9.

[36]. dos Santos Nascimento LB, Gori A, Raffaelli A, Ferrini F, Brunetti C. Phenolic compounds from leaves and flowers of Hibiscus roseus: Potential skin cosmetic applications of an under-investigated species. Plants. 2021 Mar 10;10(3):522.

[37]. Ami Afiyati, MimiekMurrukmihadi. The Effect Of Fraction Containing Alkaloids Of Hibiscus Flower (Hibiscus Rosa-

sinensis L.) Red Variety To Mucolytic Activities In Vitro.2013

[38]. Hemarana K, Jeyashree KV, Babu MM, Kannan M. Preliminary bioactive compounds screening and antibacterial activity of methanolic extract of Hibiscus rosasinensis against selected skin pathogens. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2014;5(2):1210-8.

[39]. Udo IJ, Ben MG, Etuk CU, Tiomthy AI. Phytochemical, proximate and antibacterial properties of Hibiscus rosa-sinensis L. Leaf. Journal of Medicinal Plants Studies. 2016;4(5):193-5.

[40]. Missoum A. An update review on Hibiscus rosa sinensis phytochemistry and medicinal uses. J Ayu Herb Med. 2018;4(3):135-46.

[41]. Ruban P, Gajalakshmi K. In vitro antibacterial activity of Hibiscus rosa–sinensis flower extract against human pathogens. Asian pacific journal of tropical biomedicine. 2012 May 1;2(5):399-403.

[42]. Kumari OS, Rao NB, Reddy VK. Phyto-chemical analysis and antimicrobial activity of Hibiscus rosa-sinensis. World Journal of Pharmacy and Pharmaceutical Sciences. 2015 Mar 18;4(5):766-71.

[43]. Sobhy EA, Abd Elaleem KG, Abd Elaleem HG. Potential antibacterial activity of Hibiscus rosa-sinensis Linn flowers extracts. Int. J. Curr. Microbiol. Appl. Sci. 2017;6(4):1066-72.

[44]. Rathi SG, Patel KR, Bhaskar VH. Isolation of herbal plants: antifungal and antibacterial activities. Journal of Pharmaceutical Science and Bioscientific Research. 2012;2(1):25-9.

[45]. Nilima KW, Deepavali DS. Antifungal activity of selected plant extracts against important seed borne fungi of maize. International Journal of Pharma and Bio Sciences. 2013;4(3).

[46]. Ghosh A, Dutta A. GC-MS analysis and study of potential antioxidant activity of the crude ethanolic flower extract of Hibiscus rosa sinensis L (wild variety) by hydrogen peroxide scavenging assay. International Journal of Current Trends in Science and Technology. 2017;7(11):20405-10.

[47]. Khan ZA, Naqvi SA, Mukhtar A, Hussain Z, Shahzad SA, Mansha A, Ahmad M, Zahoor AF, Bukhari IH, Janjua MR, Mahmood N. Antioxidant and antibacterial activities of Hibiscus Rosa-sinensis Linn flower extracts. Pak J Pharm Sci. 2014 May 1;27(3):469-74.

[48]. Garg D, Shaikh A, Muley A, Marar T. In-vitro antioxidant activity and phytochemical analysis in extracts of Hibiscus rosa-sinensis stem and leaves. Free Radicals and Antioxidants. 2012 Jul 1;2(3):41-6.

[49]. Johson S, Razack SA, Sellaperumal P, Ramakrishnan G, Jayakrishnan P, Sivanesan K, Sahadevan R. Antioxidant activity of iron isolated from petals of Hibiscus rosaSinensis. EC Microbiology. 2017;7(1):14-20.

[50]. Prasanna R. Evaluation of antioxidant activity of phenol, Hibiscus rosa-sinensis, neem and leaves extract at different infusion times. Int. J. Adv. Res. Ideas Innov. Technol. 2017;3:281-6.

[51]. Prasad MP. In vitro phytochemical analysis and antioxidant studies of Hibiscus species. Int J Pure App Biosci. 2014;2(3):83-8.

[52]. Ghaffar FR, El-Elaimy IA. In vitro, antioxidant and scavenging activities of Hibiscus rosa sinensis crude extract. Journal of applied pharmaceutical science. 2012 Feb 27(Issue):51-8.

[53]. Hinaz N, Gayathri R, Vishnu V. Genotoxicity of Hibiscus rosa sinensis on oral cancer cell line. Int. J. Pharm. Sci. Rev. Res. 2017;44(1):21-3..

[54]. Divya MJ, Sowmia C, Dhanya KP, Joona K. Screening of antioxidant, anticancer activity and phytochemicals in methanolic extract of Hibiscus rosa-sinensis leaf extract. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2013;4(2):1308-16.

[55]. Savale AR, Sonavne IK. The Review on Medicinal Uses of Hibiscus Flower. IJFMR-International Journal For Multidisciplinary Research. 2022 Oct 27;4(5)..

[56]. Arullappan S, Muhamad S, Zakaria Z. Cytotoxic activity of the leaf and stem extracts of Hibiscus rosa sinensis (Malvaceae) against Leukaemic Cell Line (K-562). Tropical Journal of

Pharmaceutical Research. 2013 Oct 29;12(5):743-6.

[57]. Desai H, Raut S, Patil A, Desai A, Chougule N. A Review on Phytochemical and Pharmacological Screening of Hibiscus rosa-sinensis L. IJFMR-International Journal For Multidisciplinary Research. 2022 Dec 29;4(6).

[58]. Goldberg KH, Yin AC, Mupparapu A, Retzbach EP, Goldberg GS, Yang CF. Components in aqueous Hibiscus rosa-sinensis flower extract inhibit in vitro melanoma cell growth. Journal of traditional and complementary medicine. 2017 Jan 1;7(1):45-9.

[59]. Moqbel FS, Naik PR, Najma HM, Selvaraj S. Antidiabetic properties of Hibiscus rosa sinensis L. leaf extract fractions on non-obese diabetic (NOD) mouse.

[60]. Kumar V, Mahdi F, Khanna AK, Singh R, Chander R, Saxena JK, Mahdi AA, Singh RK. Antidyslipidemic and antioxidant activities of Hibiscus rosa sinensis root extract in alloxan induced diabetic rats. Indian Journal of Clinical Biochemistry. 2013 Jan;28:46-50.

[61]. Mamun A, Islam S, Alam AK, Rahman MA, Rashid M. Effects of ethanolic extract of Hibiscus rosa-sinensis leaves on alloxan-induced diabetes with dyslipidemia in rats. Bangladesh Pharmaceutical Journal. 2013 Apr 7;16(1):27-31.

[62]. Zaki LH, Mohamed SM, Bashandy SA, Morsy FA, Tawfik KM, Shahat AA. Hypoglycemic and antioxidant effects of Hibiscus rosa-sinensis L. leaves extract on liver and kidney damage in streptozotocin induced diabetic rats. African Journal of Pharmacy and Pharmacology. 2017 Apr 8;11(13):161-9.

[63]. Ghosh A, Dutta A. Antidiabetic effects of ethanolic flower extract of Hibiscus rosa sinensis(L) on alloxan induced diabetes in hyperlipidaemic experimental Wister rats (WNIN). International Journal of Engineering Development and Research. 2017;5(4):674-9.

[64]. Afiune LA, Leal-Silva T, Sinzato YK, Moraes-Souza RQ, Soares TS, Campos KE, Fujiwara RT, Herrera E, Damasceno DC, Volpato GT. Beneficial effects of Hibiscus rosa-sinensis L. flower aqueous extract in pregnant rats with diabetes. PLoS One. 2017 Jun 23;12(6):e0179785.

[65]. Pethe M, Yelwatkar S, Gujar V, Varma S, Manchalwar S. Antidiabetic, hypolipidimic and antioxidant activities of Hibiscus rosa sinensis flower extract in alloxan induced diabetes in rabbits. Int J Biomed Adv Res. 2017;8:138-43.

[66]. Sharma K, Pareek A, Chauhan ES. Evaluation of hyperglycemic and hyperlipidemic mitigating impact of Hibiscus rosa-sinensis (Gudhal) flower in type II diabetes mellitus subjects. International Journal of Applied Biology and Pharmaceutical Technology. 2016;7(2):223-8.

[67]. Salib JY, Daniel EN, Hifnawy MS, Azzam SM, Shaheed IB, Abdel-Latif SM. Polyphenolic compounds from flowers of Hibiscus rosa-sinensis Linn. and their inhibitory effect on alkaline phosphatase enzyme activity in vitro. Zeitschrift für Naturforschung C. 2011 Oct 1;66(9-10):453-9.

[68]. Missoum A. An update review on Hibiscus rosa sinensis phytochemistry and medicinal uses. J Ayu Herb Med. 2018;4(3):135-46.