A Narrative Review onInvitro Study of Antioxidant, Anti - Inflammatory Activities of Hibiscus Rosasinensis Leaves

Dhabal Kumar Satapathy[1*], Namala Renuka devi[2], Nocharla Sai Durga Bhavya[3], Talupuri Ooha Durga[4], Digamarthi Jyothi[5], Kancharla kota Manikanta Eswari[6], Baddi Prem kumar[7], Vatchavai Bhaskara Raju[8], Matta Srinivasu[9]

[1]Associate professor Department of Pharmacology, Sri Vasavi Institute of Pharmaceutical Sciences, Tadepalligudem, Andhra Pradesh, India

[2, 3, 4,5,6,7]Students Sri Vasavi Institute of Pharmaceutical Sciences, Tadepalligudem, Andhra Pradesh, India

[8]Principal, Sri Vasavi Institute of Pharmaceutical Sciences, Tadepalligudem, Andhra Pradesh, India

[9]Professor, Sri Vasavi Institute of Pharmaceutical Sciences, Tadepalligudem, Andhra Pradesh, India

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ABSTRACT

Hibiscus rosa-sinensis, an evergreen herbaceous shrub, is known as the "rose of China."

This tropical hibiscus plant, often called Chinese hibiscus or shoeblack herb, is native to China and is now extensively grown as a decorative plant in tropical and subtropical areas. The plant Hibiscus Rosa sinensis belongs to the **Malvaceae** family and is found all over the world. Its leaves, bark, roots, and flowers all been used to cure a range of ailments in traditional Indian medicine. Its deep green leaves contain antioxidant, and anti-inflammatory qualities, as well as phytochemicals like as flavonoids, tannins, saponins, and phenolic acids, and have long been used in traditional medicine.Flavonoids, in particular, are known to promote wound healing due to their astringent and antibacterial effects. Furthermore, Hibiscus rosa-sinensis is commonly utilized in herbal combinations and beverages.The leaves of Hibiscus rosa-sinensis have been utilized in ethno medicine to cure a number of human illnesses, such as cancer, diabetes mellitus, wound healing, hypertension, and aphrodisiac.This review summarizes the reported invitro antioxidant and anti-inflammatoryactivities of hibiscus rosa sinenis leaves, along with their phytochemical constituents, extraction methods, pharmacological properties and therapeutic applications.previous studies have reported the presence flavonoids and phenolic compounds in Hibiscus Rosa Sinensis leaf extracts.

Keywords- Anti-inflammatory, Antioxidant, Flavonoids, Aphrodisiac, Astringent, Hibiscus Rosa Sinensis leaves

INTRODUCTION

Due to the rise in sicknesses, natural plant products are becoming more and more popular. The plant Hibiscus Rosa sinensis belongs to the Malvaceae family and can be found anywhere in the world. In traditional Indian medicine, its leaves, barks, roots, and flowers have been used to treat a variety of illnesses. The Chinese hibiscus, or Hibiscus Rosa sinensis, is a plant with long-standing traditional medical applications. Previous in-vitro studies have investigated the antioxidant and anti-inflammatory potential of hibiscus rosa sinensis leaf extracts. Chemical entities with one or more unpaired electrons are known as free radicals, and they are very unstable. In an attempt to stabilize themselves, they harm other molecules by stealing their electrons. Free radicals and other reactive oxygen species (ROS) by-products are produced by physiological and metabolic processes in living cells. Many diseases are brought on by free radicals through lipid peroxidation and DNA

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damage. It has been demonstrated that hibiscus plant extracts have antioxidant qualities that can scavenge free radicals. Hibiscus has proven therapeutic advantages for human health such as anti-oxidant property, which is prevention of free radicals that may damage deoxyribonucleic acid. In several tropical countries, this herb is used to treat a variety of conditions, including gastric ulcers, hair loss, bacterial and fungal infections, diabetes, fever, cough, inflammation, and wounds. Antioxidant chemicals found in hibiscus leaf extract have anti-hyperlipidemic and anti-LDL oxidation properties that may help to prevent atherosclerosis in humans. Additionally, the extract showed hypoglycemic action. Proteins, vitamin C, organic acids (mainly malic acid), flavonoids and anthocyanins were detected in leaf extract. Inflammation is a complex biological response of human tissues to harmful stimuli such as pathogens, damaged cells, irritants, injury, infection, or destruction, manifests as heat, redness, discomfort, swelling, and altered physiological processes. Its trigger is chemical mediators released from the injured tissue and migratory cells. Inflammatory illnesses are frequently treated with non-steroidal anti-inflammatory drugs (NSAIDs). These drugs prevent prostaglandin production by COX-1 and COX-2 enzymes. Among the most dangerous adverse effects of NSAIDs are stomach inflammation and the consequent development of gastric ulcers. Long-term use of these drugs can harm the liver, digestive system, and other human biological systems. Thus, a new anti-inflammatory drug that is harmless, safe, and effective or less toxic is needed. Because anti-inflammatory drugs stabilize the membrane against hemolysis caused by hypotonicity, they reduce the amount of hemoglobin released from red blood cells under hypotonic stress. This is a highly helpful in vitro method for assessing the anti-inflammatory efficacy of hibiscus rosa sinensis.

Taxonomical Classification

Kingdom	:	Plantae
Division	:	Tracheophyta
Subdivision	:	Spermatophytina
Class	:	Magnoliopsida
Superorder	:	Rosanae
Order	:	Malvales
Family	:	Malvaceae
Subfamily	:	Malvoideae

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Genus : Hibiscus

Species : Hibiscus Rosa-sinensis

Fig 1: Hibiscus rosa sinensis leaves and flowers

Phytochemical Constituents

Chemical constituents	**Confirmatory tests**
Alkaloids	Dragendorff's test, Wagner's test
Flavonoids	Shinoda test, alkaline reagent test
Tannins	Ferric chloride test, Lead Acetate test
Saponins	Foam test
Terpenoids	Salkowski test
carbohydrates	Molisch test, benedicts test
phenols	Ferric chloride test
steroids	Liebermann-Burchard test
proteins	Millon's test, biuret test
Amino acids	Ninhydrin test
Glycosides	Keller-killiani test

Structures of chemical constituents

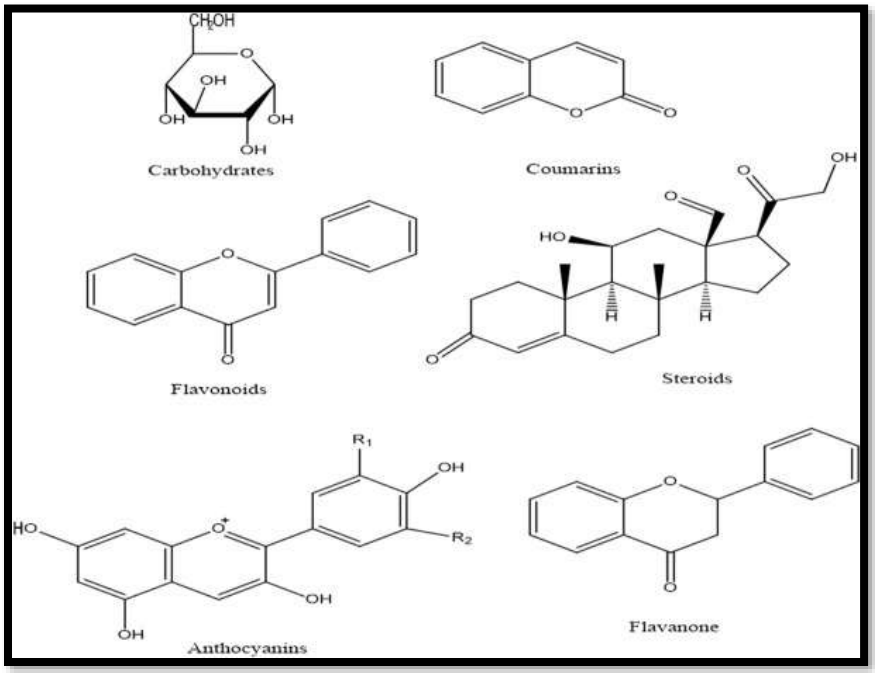

Fig 2: Chemical structures

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Confirmatory Tests for Phytochemicals

Alkaloids

Examples of the alkaloids present in hibiscus rosa sinensis are choline, betaine.

Dragendorff's test: Dragendorff's reagent has been used to identify the alkaloids in leaf extract. By combining the ethanol and chloroform floral extract of H. rosa-sinensis with one or two drops of Dragendorff's reagent. Alkaloids are present in the flower and leaf extract when brick-red precipitates forms.

Wagner's test: 2mlof extract was combined with two drops of Wagner reagent and thoroughly stirred. Alkaloids are indicated by the presence of red color.

Flavonoids

Examples of flavonoids present in hibiscus rosa sinensis are quercetin, kaempferol, Hibiscetin, rutin.

Shinoda test: To the extract add few ml of hydrochloric acid and few magnesium turnings, a pink scarlet red or occasionally green to blue color appears after sometime.

Alkaline reagent test: To the extract few drops of sodium hydroxide solution is added which results in a bright yellow color that goes colorless when a few drops of dilute acid are added, indicating the presence of flavonoids.

Tannins

Examples of tannins present in hibiscus rosa sinensis are gallic acid, ellagic acid, catechin, epicatechin.

Ferric chloride test: To the extract add ferric chloride solution, if hydrolysable tannins are present, the extract will turn blue if condensed tannins are present, it will turn green.

Lead acetate test: The extract was dissolved in distilled water and 10% lead acetate solution is added. A bulky white precipitate appears indicating the presence of tannins.

Saponins

Foam test: Place 2ml of drug solution and water in a test tube and shake well a stable froth or foam is formed.

Terpenoids

Examples of terpenoids present in hibiscus rosa sinensis are lupeol, β-sitosterol.

Salkowski test: Concentrated sulfuric acid is added after the plant extract and 2ml of chloroform was added. The presence of terpenoids was verified by the lower layer's red color.

Steroids

Examples of steroids present in hibiscus rosa sinensis are β-sitosterol, stigmasterol.

Liebermann-Burchard test: Add few drops of acetic anhydride to the extract, bring to a boil, and then let it cool. Next, pour concentrated sulfuric acid from the test tube's side until a brown ring form at the intersection. Steroids are indicated by the layer turning green, and triterpenoids are indicated by the occurrence of a deep red tint.

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Carbohydrates

Examples of carbohydrates present in hibiscus rosa sinensis are glucose, fructose, sucrose.

Molisch's test: Molisch's reagent and the plant extract were carefully mixed. Next, two milliliters of concentrated sulfuric acid was added along the walls of the test tube. The presence of carbohydrates was verified by the development of a purple ring at the interface.

Benedicts test: The plant extract and two milliliters of Benedict's reagent were combined in a test tube and heated for ten minutes in a water bath. The presence of carbohydrates was verified by the presence of a reddish-brown precipitate.

Phenols

Examples of phenols present in hibiscus rosa sinensis are chlorogenic acid, ferulic acid, caffeic acid.

Ferric chloride test: 1ml of water is added to dissolve a tiny quantity of ethanolic plant extract. When few drops of ferric chloride were added, phenols were detected by the appearance of a bluish-green tint.

Proteins

Millon's test: 2ml of Millon's reagent was combined with the plant extract. The presence of proteins is verified by appearance of a white precipitate.

Biuret test: A few drops of copper sulphate and 40% sodium hydroxide were added to the plant extract. The appearance of proteins was indicated by the appearance of a violet hue.

Amino acids

Examples of amino acids present in hibiscus rosa sinensis are lysine, leucine, valine, Alanine, glutamic acid.

Ninhydrin test: Ninhydrin solution is added to the extract, and boiledappearance of violet color the presence of amino acids.

Glycosides

Examples of glycosides present in hibiscus rosa sinensis are quercetin-3-o-rutinoside, cyanidin-3-glucoside.

Keller-Killiani test: Use chloroform to extract the drug, then evaporate it until it is completely dry. Add 0.4 ml of glacial acetic acid with small amount of ferric chloride. Transfer into a tiny test tube, and then carefully pour 0.5 ml of concentrated sulfuric acid to the test tube's side. The layer of acetic acid is blue in color.

Extraction of Phytochemicals

Extraction is known as a method of addressing plant or animal tissues mixed with a solvent to ensure that the medicinally active components dissolve; as the most of the inactive materials remains undissolved in the solvent used for extraction is referred to as "menstruum". "Marc" refers to the inactive, non-soluble residue remaining after extraction. Hexane, chloroform, ethyl acetate, methanol, and aqueous solvents were used in serial solvent extraction of the dried whole plant material of hibiscus rosa sinensis. The leaves of Hibiscus rosa sinensis were shade dried and grounded into a coarse powdered substances was subsequently exposed to consecutive extraction through the maceration extraction technique utilizing petroleum ether, methanol, ethyl acetate, diethyl ether, chloroform, acetone, and DMSO as solvents. The extract was allowed to evaporate at room temperature to obtain a solid residue. The obtained extract was analyzed through phytochemical screening and utilized for subsequent research.

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METHODS OF EXTRACTION

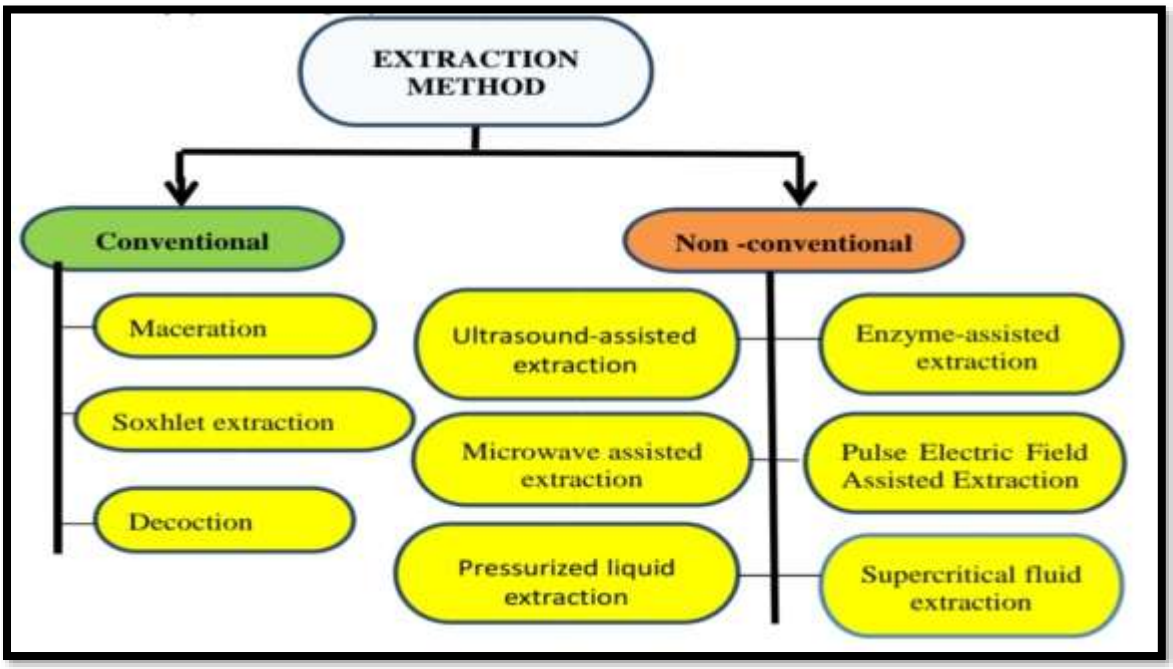

Fig 3: Extraction methods

Conventional extraction techniques

Conventional or traditional techniques, which frequently need basic equipment, rely on the solubility of plant elements at different temperatures and times.

Maceration:
The plant medication, either whole or coarsely powdered, is kept in contact with the solvent in a closed container for a predetermined period of time during maceration (for fluid extract), and it is regularly stirred to dissolve any soluble ingredients. This method is effective for thermolabile medicines.

Infusion:
This is a diluted combination of the readily soluble components of the crude drugs. Fresh infusions are made by briefly macerating the ingredients in either hot or cold water.

Percolation:
A percolator with a narrow, cone-shaped vessel that is open at both ends has used in this process. Then the plant material has been wet with the solvent, it is put in a percolation chamber. The active component is then extracted by repeatedly washing the plant material with the solvent. The solvent is used up to the point of saturation.

Decoction:
A crude medication is boiled in water for fifteen minutes, allowed to cool, strained, and then pass through the cold water to extract the desired amount. This method removes the drug's water-soluble and heat-soluble components.

Soxhlet extraction

Only when an impurity is insoluble in a solvent and the target component has limited solubility in that solvent is the Soxhlet extraction technique required. If the target compound is highly soluble in a solvent, it can be separated from the insoluble material using a simple filtering procedure. The advantage of this approach is that, instead of passing many portions of heated solvent through the sample, only one batch of solvent is

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recycled. This method cannot be used with thermolabile compounds since extended heating may result in compound degradation.

Non-conventional advanced methods

Modern techniques boost yield and reduce processing times by breaking down plant cell walls with physical forces.

Microwave-assisted extraction

This method employs microwave energy to help separate the active compounds from the plant material into the solvent. The electric and magnetic fields seen in microwaves are perpendicular to one another. Heat is produced by the electric field by ionic conduction and dipolar rotation. The ensuing heating is as rapid as the solvent's dielectric constant. Microwave aided extraction heats the entire sample at once, in contrast to traditional procedures. Heat breaks weak hydrogen bonds during extraction because of molecules' dipole rotation, and the migration of dissolved ions increases the solvent's penetration into the sample or matrix.

Ultrasound-assisted extraction

This is an advanced method to quickly extract a large number of bioactive compounds. Because the cell walls are broken down by the acoustical cavitations, this method's main advantage is the greater solvent penetration into the matrix. Additionally, it is more appropriate for extracting thermally unstable compounds due to its low operating temperature.

Pharmacological Actions

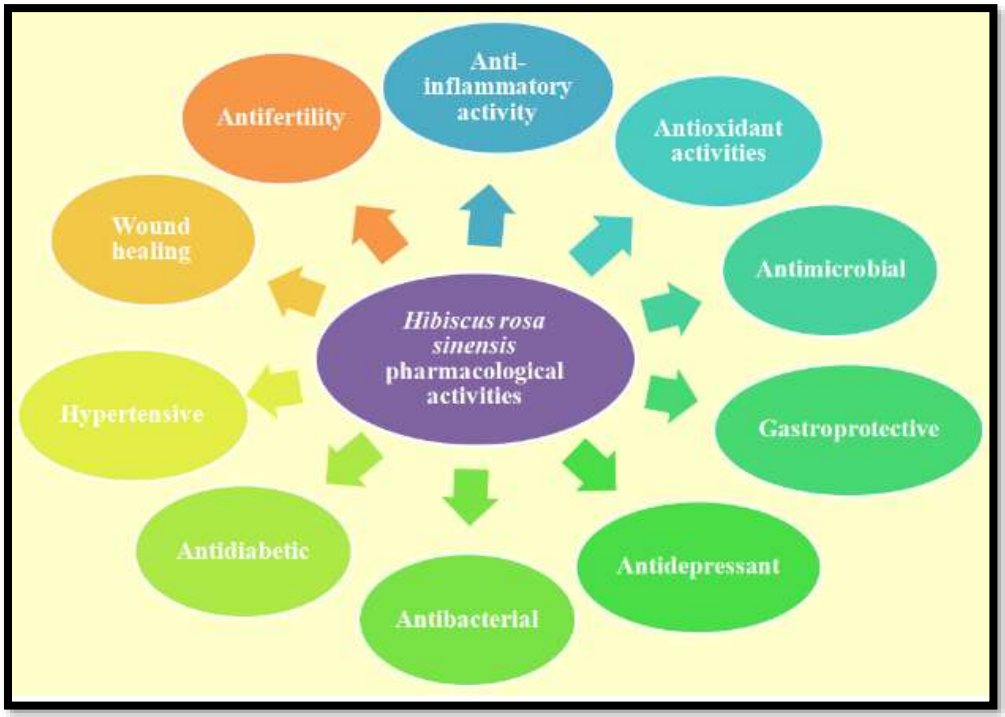

Fig 4: Pharmacological actions

Anti-oxidant activity

Research on hibiscus flower, stem, root, and leaf extracts has demonstrated that the plant's phenolic components exhibit antioxidant activity and scavenge free radicals that can damage DNA, have an impact on human health. H. rosa sinensis showed phenolic and flavonoid contents as well as enhanced antioxidant activity. Plants have the capacity to scavenge and neutralize reactive oxygen species (ROS), which helps to

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lower the oxidative stress and inflammation while preserving the body's homeostasis. The harmful effects of free radicals in dietary and biological systems make radical scavenging activities crucial. Unsaturated lipids in meals are known to auto-oxidize due to free radicals. Conversely, antioxidants are thought to stop the free radical chain of oxidation and donate hydrogen from the phenolic hydroxyl groups, creating a stable end product that doesn't start or spread additional lipid oxidation. Natural antioxidants found in hibiscus extracts include oxalic acid, tartaric acid, and ascorbic acid. H. rosa-sinensis is considered as a natural antioxidant because of its ability to scavenge and neutralize ROS. The DPPH assay revealed antioxidant activity, which was confirmed in several studies. The presence of phenolic compounds in the Hibiscus rosa-sinensis plant may have an effect on antioxidant chemicals. DPPH is a stable free radical that transforms into a stable diamagnetic molecule by absorbing an electron or hydrogen radical. Because of their capacity to donate hydrogen, aqueous leaf extract demonstrated more potent DPPH radical scavenging capabilities than methanolic leaf extract. The phytochemicals reported in H. rosa sinensis may contribute to protection against oxidative damage through their antioxidant activity.

Anti-inflammatory activity

Inflammation is a localized response that causes redness, heat, swelling, and pain, typically due to infection, irritation, or injury its trigger is chemical mediators released from the injured tissue and migratory cells. Inflammatory illnesses are frequently treated with non-steroidal anti-inflammatory drugs (NSAIDs). These drugs prevent prostaglandin production by COX-1 and COX-2 enzymes. Among the most dangerous adverse effects of NSAIDs are stomach inflammation and the consequent development of gastric ulcers. Long-term use of these drugs can harm the liver, digestive system, and other human biological systems. Hibiscus rosa sinensis is effective in addressing various inflammatory conditions, such as blenorrhea, asthmatic bronchitis, and inflammation of the oral mucosa. The anti-inflammatory properties were investigated using a methanolic leaf extract of hibiscus rosa sinensis . A previous invitro study reported Ethanolic leaf extract was shown to protect RBC from hypotonic-induced hemolysis (91.09% protection) and protein denaturation (89.45% inhibition).The leaf extract can inhibit the protein denaturation and reduce the inflammation. These findings support further investigation of H. rosa-sinensis as a potential source for anti-inflammatory bioactive compounds. Flavonoids like quercetin and cyanidin plays important role in the processes, which include inhibition of the COX and LOX pathways, decreased generation of histamine and prostaglandins, and suppression of neutrophil migration. The anti-inflammatory strategy involves inhibiting pro-inflammatory cytokines (TNF-α, IL1β, IL-6), suppressing COX-2 and LOX enzymes, reducing nitric oxide generation, and modulating the NF-κBsignalling pathway. H. rosa-sinensis contains luteolin and quercetin, which are both known COX-2 inhibitors .

Other Pharmacological Actions

Hibiscus rosa-sinensis had been shown to have other potentials in addition to its antioxidant, anti-inflammatory, and antibacterial qualities.

Anti diabetic activity

Diabetes is a deadly and incurable illness that is becoming more common in worldwide. Diabetes is a stable condition Insulin is the key component that regulates blood sugar. The body is unable to produce or use enough insulin on its own when a person has diabetes mellitus. This results in blood sugar. Diabetes can result in serious health problems such kidney failure, heart disease, amputations, and blindness. Through processes such as pancreatic β-cell regeneration, blood glucose decrease, lipid profile improvement, and anti-inflammatory activity, Hibiscus rosa-sinensis (HRS) demonstrates strong antidiabetic effects. Models have demonstrated the hypoglycemic potential of both ethanolic and aqueous extracts from its flowers and leaves. According to in vitro research, leaf extracts decreases postprandial blood glucose levels and the digestion of carbohydrates by inhibiting the enzymes α-amylase and α-glucosidase. Significant enzyme inhibitory action has been demonstrated by ethyl acetate leaf extracts, indicating that the plant may have potential as a natural antidiabetic drug .

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Anti-cancer activity

The anticancer efficacy of ethanolic leaf extract of H. rosa-sinensis was assessed using the MTT (3- [4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide) test, which revealed a concentration-dependent decrease in cell proliferation and growth. The extract showed promising anticancer properties, which could help cure cancer progression. Its extract has excellent antioxidant and antiproliferative properties and can be potent enough to delay the promotion of carcinogenesis. Hibiscus rosa-sinensis has strong anticancer activity in numerous human cancer cell lines via cytotoxic, antioxidant, and pro-apoptotic mechanisms. The plant's pharmacological efficacy is ascribed to its diverse phytochemical composition, which includes flavonoids, phenolics, triterpenoids, and saponins that affect redox balance, apoptosis, and mitochondrial integrity. That methanolic leaf extract had the maximum cytotoxicity against K-562 chronic myeloid leukaemia cells while causing low harm to normal cells. It has anticancer properties through several routes, including ROS-mediated apoptosis, mitochondrial malfunction, and synergistic effects with chemotherapeutic drugs. Its bioactive chemicals show potential for further research in cancer therapy.

Hepatoprotective

The liver performs a variety of functions, including detoxification of toxins, drugs, and other harmful metabolites; nutrient metabolism; digestion and absorption via bile production; storage of glucose, vitamins, and minerals; and hormone regulation in the body to modulate the homeostatic environment. Medicinal herbs, such as H. rosa-sinensis, being studied for improving liver function .The aqueous leaf extract was found to lower glucose, cholesterol, and liver enzymes while increasing antioxidant levels, providing hepatoprotective and nephroprotective effects by reducing organ damage. Orientin and verbascoside, two key phytochemicals, helped to achieve these advantages [38]. The plant's anti-inflammatory components, which lessen hepatic inflammation, and antioxidant substances, especially flavonoids and polyphenols, which diminish lipid peroxidation in hepatocytes, are responsible for the hepatoprotection. Among the main phytoconstituents found to have hepato-protective properties are quercetin and gallic acid.

Cardioprotective

Phytochemicals obtained from natural sources have reduced the risk of heart disease by preventing the generation of free radicals, and they have become essential components of contemporary pharmaceutical systems. "All mechanisms and means that contribute to the preservation of the heart by reducing or even preventing myocardial damage" are referred to as cardio-protection. One possible antioxidant mechanism is shielding the heart's tissues from oxidative damage.

Hibiscus rosa-sinensis has cardio protective properties, specifically against oxidative damage in cardiac ischemia-reperfusion injury, principally by boosting antioxidant defences and regulating lipid peroxidation. It also possesses major cardio protective activity because of its rich flavonoid contents. The antioxidant properties of the chemical compounds contained in Hibiscus rosa sinensis may be responsible for its cardio protective characteristics, and it can be used as a good source to manufacture a herbal treatment.

IN-Vitro Model for Antioxidant Activity

DPPH Assay

Previous studies have evaluated the antioxidant activity of hibiscus rosa sinensis extracts using The 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay. Free radical scavenging activity was evaluated using McCune and Johns' technique with 2, 2-diphenyl-1-picryl-hydrazyl or 1, 1-diphenyl-2-picrylhydrazyl. The reaction mixture included 1.0 ml of DPPH in methanol (0.3 mm) and 1.0 ml of the extract. After 10 minutes of incubation in the dark, absorbance is measured at 517 nm. DPPH scavenging activity is measured using ascorbic acid equivalent (mg/g).

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$$\text{DPPH radical scavenging activity (\%)} = \left(\frac{A_c - A_s}{A_c}\right) \times 100$$

Ferric-reducing antioxidant power (FRAP) assay

To measure absorbance at 593 nm, 0.2 ml of extract (1:20 dilution) is added to 3.8 ml of FRAP reagent (10 parts 300 mm, sodium acetate buffer at pH 3.6, 1 part 10.0 mM TPTZ solution, and 1 part 20 mm $Fecl_3$ 6 H_2o solution). This mixture is incubated at 37°C for 30 minutes. The antioxidant capacity of the sample was measured by its ability to reduce ferric ions and expressed in mg/g of ascorbic acid.

Hydrogen peroxide (H_2O_2) radical scavenging assay

Plant extracts' ability to scavenge hydrogen peroxide is measured using the Ruch method. Prepare a 40 mM hydrogen peroxide solution in phosphate buffer (50 mM, pH 7.4), then add 2 ml to 1 ml of extract (1:20 dilution). The absorbance at 230 nm is measured after 10 minutes. **H_2O_2** radical scavenging activity was measured in mg per gram of ascorbic acid.

Radical scavenging using superoxide anion (SO) assay

The superoxide anion scavenging activity was tested by following Robak and Gryglewski's protocol. To create superoxide anion radicals, mix 3.0 ml of Tris-HCl buffer with 0.5 ml of nitroblue tetrazolium (0.3 mM), 0.5 ml of nicotinamide adenine dinucleotide solution (0.936 mM), 1.0 ml of extract (1:100 dilution), and 0.5 ml of Tris-HCl buffer (16 mM, pH 8). To begin the reaction, add 0.5 ml of phenazine methosulfate solution to the mixture. Incubate for 5 minutes at 25°C before measuring absorbance at 560 nm. Ascorbic acid was employed as a standard (0.1-0.5 mg/mL). Super oxide anion scavenging activity was reported in mg/g.

IN-Vitro Model for Anti-Inflammatory Activity

Inhibition of Protein Denaturation

The method was used to determine the inhibition of protein denaturation with a few minor modifications. The reaction mixture contains different concentrations of the test extract together with 1% BSA-Bovine serum albumin (aqueous solution). The reaction mixture's pH was adjusted using 1 N HCl. After heating the sample for 20 minutes at 37 °C and another 20 minutes at 57 °C, they were left to cool. The turbidity of the samples was measured at 660 nm. The experiment was conducted in three duplicates.
The percentage inhibition of protein denaturation was calculated by using the following formula:

$$\text{Percentage inhibition} = \frac{A_c - A_s}{A_c} \times 100$$

Where, A_c and A_s stand for the control and sample's respective absorbances at 660 nm.

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Proteinase Inhibitory Assay

Previous studies have evaluated proteinase inhibitory activity using a method modified from oyedepo and Femurewa. The test plant extract sample at different quantities,0.006 mg of trypsin, and 1ml of Tris -HCL buffer(2ml). After five minutes of incubation at 37c,1ml of 0.8% (w/v) casein was added to the reaction mixture. The mixture was incubated for a further twenty minutes. Two millilitres of 70% perchloric acid were added to stop the reaction. After centrifuging the hazy solution, the absorbance of supernatant at 210nm was determined using a Tris-HCL buffer as a reference. The experiment was conducted three times .

HRBC membrane stabilization

The ethyl acetate fraction in varying concentrations (10, 25, 50, 75, 100, 150, 200 µg/mL), 0.5 ml of 2% RBC, 1 ml of phosphate buffer (0.15M, pH 7.4), 2 ml of hyposaline (0.25%), and the suspensions were taken in separate tubes. As a control, two milliliters of distilled water was used in place of the medication. At 37°C, both test tubes were incubated for 30 minutes. Following incubation, the samples were centrifuged, and a digital photoelectric colorimeter (Type 115 Systronics) calibrated to 560 nm was used to measure the amount of hemoglobin in the supernatants. Membrane stabilization or percentage inhibition of hemolysis was determined using the following formula.

$$\text{Hemolysis inhibition percentage} = 100 \times \left(\frac{OD1 + OD2}{OD1} \right)$$

where, OD1 is the optical density of the hypotonic + buffered saline solution alone. OD2 is the optical density of the test sample test in a hypotonic solution.

Therapeutic Uses

Hibiscus Rosa-sinensis, popularly known as hibiscus, is a plant with a variety of uses and medical applications. While preclinical studies have reported activities include antioxidant, anti-inflammatory, antidiabetic anticancer, hepatoprotective and cardioprotective effects. It aids the cardiovascular system by regulating blood pressure, lowering cholesterol levels, and improving heart health. Because of its high antioxidant content, hibiscus helps to neutralize free radicals, lowering the risk of oxidative stress and chronic diseases. The use of hibiscus-based hair care products promotes new hair production, reduces dandruff, and improves the natural texture of the hair. Hibiscus can be used for therapeutic reasons in a variety of ways, including tea, topical therapies, and extracts.

Fig 5: Therapeutic uses

CONCLUSION

The available literature indicates that Hibiscus Rosa sinenis leaves possess promising antioxidant and anti-inflammatory potential and may represent a potential source of biologically active phytoconstituents, Reported invitro studies have demonstrated their free radical scavenging ability and potential to inhibit inflammatory processes, which may be associated with the presence of flavonoids, phenolic compounds, tannins, alkaloids, and terpenoids. Collectively, these findings provide scientific support for the traditional medicinal use of Hibiscus Rosa Sinensis leaves and highlight their potential for further pharmacological investigation. However, further well designed experimental and clinical studies are required to validate their safety and efficacy elucidate their mechanisms of action, and deterime their potential therapetic applications.

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