

## **A Comprehensive Review of Hibiscus, Classification, Therapeutic Activity, Extraction, and Medicinal Application**

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### **ABSTRACT**

Hibiscus sabdariffa It is a member of the Malvaceae family and is often referred to as "red sorrel" or "roselle. These are the kind of plants that are used for a long time in Taiwan as a herbal remedy and soft drink that decreases animal blood cholesterol levels.[10] acetaminophen, a popular over-the-counter antipyretic-analgesic, is frequently used orally with water or other liquids at any time of day. A sweetened water extract of the dried calyx of Hibiscus Sabdariffa is called zobo drink[11]. The COVID-19 pandemic and a sedentary lifestyle can exacerbate metabolic syndrome, a complex and multifaceted illness linked to an increased risk of heart disease and type 2 diabetes. Eating foods that are high in polyphenols has been demonstrated in recent research to have a preventive impact, lowering the risk of cardiovascular illness. Because of its potential to treat metabolic syndrome, scientists have recently focused on Hibiscus sabdariffa (HS) in conjunction with other plant extracts. The effects of HS in conjunction with additional plant extracts on the prevention of metabolic syndrome are investigated in this systematic review and meta-analysis, along with their potential as therapeutic agents and synergistic effects.[12]. Infusion of Hibiscus sabdariffa (H. sabdariffa) is a very popular drink in many parts of the world. Its phytochemical composition is associated to antioxidant, hypotensive, and antiatherosclerotic effects. However, the molecular mechanisms involved in these processes are not well known. The aim of this review was to report the scientific evidence supporting that regular use of H. sabdariffa decreases oxidative stress, atherosclerosis, lipid profile, and blood pressure. Further more no unfavorable incidents or adverse effects were documented.[13]

**Keywords-** Hibiscus Sabdariffa, cardiovascular

## INTRODUCTION

Plants play a crucial role in human life, providing food, clothing, shelter, and medicine. They have been the foundation of several ancient medical systems, including Unani and Ayurvedic practices [1]. One such plant is *Hibiscus sabdariffa*, commonly included in herbal tea blends due to its antioxidant and antihypertensive properties [2].



Fig -1 Representation of Hibiscus

Known locally as "karkade," roselle (\*\**Hibiscus sabdariffa* L.\*\*), a member of the Malvaceae family, is a significant annual crop, thriving in tropical and subtropical climates [3]. The plant is also known for its therapeutic qualities [4], and its seeds are occasionally used as animal feed [5], containing 17.8–21% non-edible oil [6] and 20% protein. Roselle is a versatile and adaptable plant, often grown along field edges or interplanted with staple crops like sesame and sorghum, requiring minimal attention. Its leaves, seeds, capsules, and stems are traditionally used for medicinal purposes [7].

*Hibiscus sabdariffa* is a well-known medicinal plant recognized worldwide, and it is found in nearly all warm countries, including Mexico, Vietnam, Egypt, Saudi Arabia, India, Malaysia, Indonesia, Thailand, and the Philippines [8, 9].

For optimal growth, the plant requires a nurturing period of 4 to 8 months, with nighttime temperatures maintained at 20°C and exposure to 13 hours of sunlight each day. High humidity levels and rainfall can significantly impact the overall yield and quality of the calyces. This crop is particularly advantageous as it shows resistance to various threats, including viruses, insects, bacteria, and fungi. The leaves can produce a yield of about 10 tons per hectare, while the fruits yield between 1 to 5 kilograms, resulting in an approximate total yield of 8 tons per hectare [4].

## Classification of hibiscus sabdariffa

Kingdom : Plantae (Plants)

Subkingdom : Tracheobionta (Vascular plants)

Superdivision : Spermatophyta (Seed plants) Division :

Magnoliophyta (Flowering plants) Class :

Magnoliopsida (Dicotyledons) Subclass : Dilleniidae

Order : Malvales

Family: Mavaceae (Mallow family) Genus :

Hibiscus L. (Rosemallow) Species :

Hibiscus sabdariffa L



## TYPES OF HIBISCUS

Among the various species of Hibiscus, Hibiscus altissima var. and Hibiscus sabdariffa var. are the most prevalent and widely cultivated. Hibiscus altissima is characterized by its lack of branches, featuring yellow flowers and calyxes that are either red or green. Although this species is not utilized for culinary purposes, it holds greater economic significance than Hibiscus sabdariffa due to its high fiber content. In contrast, Hibiscus sabdariffa, commonly known as "Roselle," is a bushy plant with numerous branches. Its flowers are either axillary or arranged in terminal racemes, displaying white petals with a reddish center at the base of the stamina column, and this species is extensively used for food. [14,15].

## THERAPUETIC ACTIVITY

Roselle is known as a plant that provides many health benefits, particularly as a source of antioxidants, and can serve as an alternative treatment for various diseases.it includes-



*Anti-Hypertensive      Anti-  
hyperlipidemicAntioxidant  
Anti-Inflammatory      Anti-  
Hyperglycemic*

## ANTI-HYPERTENSIVE

Hypertension is a significant contributor to heart disease, which can ultimately result in mortality. Research indicates that administering 100, 200, and 400 mg/kg of aqueous extract from roselle leaves, rich in saponins, tannins, flavonoids, alkaloids, phenols, and steroids, over a period of six weeks effectively lowered systolic and diastolic blood pressure, mean arterial pressure, and heart rate in rats with salt-induced hypertension[16]. Furthermore, a polyphenol-rich extract of roselle has been proposed to reduce both systolic and diastolic blood pressure through mechanisms involving enhanced diuresis and the inhibition of angiotensin-converting enzyme (ACE) activity in diabetic rat models treated with 100 mg/kg for eight weeks, likely mediated by compounds such as delphinidin-3-O-sambubioside and cyanidin-3-O-sambubioside[17]. Additionally, another study demonstrated that a polyphenol-rich extract of roselle, characterized by high levels of flavonoids and phenolic acids, normalized systolic function, decreased heart rate, and improved coronary bloodflow, effects that were linked to the modulation of L-type  $\text{Ca}^{2+}$  channels, ryanodine receptors,  $\beta$ -adrenergic receptors, and the sarcoendoplasmic reticulum calcium transport ATPase (SERCA) blocker, all of which were negated by the roselle extract in isolated rat hearts[18].

## ANTI-HYPERLIPIDIMIC

Most of the studies have shown that anti-hyperlipidemic treatment by roselle to reduce the level of cholesterol, mainly by targeting LDL cholesterol, which effectively lower the risk of heart disease[19]. The administration of a 100 mg/kg aqueous extract of roselle over a period of 28 days resulted in a notable decrease in the concentrations of LDL cholesterol, plasma leptin, total cholesterol, and triacylglycerol in rat models that were subjected to diet-induced obesity [20].

Research conducted by Farombi and Ige [21] indicated that administering ethanolic extracts of roselle at doses of 100 and 200 mg/kg over a four-week period resulted in a more pronounced anti-hyperlipidemic effect than the conventional dyslipidemia treatment, Lovastatin, in rats induced with diabetes through alloxan. The majority of the research assumed that the reduction in LDL cholesterol observed with a daily intake of 500 mg/kg of ethanolic extract of roselle over a 30-day period is attributed to its ability to inhibit cholesterol absorption in the intestine, disrupt lipoprotein synthesis, and enhance the expression of hepatic LDL receptors, potentially facilitating the removal of LDL cholesterol from the bloodstream and promoting the breakdown and metabolism of cholesterol within the body. In a similar vein, the intake of a polyphenol-rich extract of roselle resulted in a notable decrease in serum levels of LDL, triglycerides, and total cholesterol, while also increasing HDL cholesterol levels in diabetic rat models[22].

Conversely, the combination of polyphenol extract and aqueous extract of roselle with a high-fat diet administered to hamsters resulted in reduced cholesterol and triglyceride levels, while also inhibiting the expression of fatty acid synthesis and lipid synthesis in hepatocytes[23].

## ANTI-OXIDANT

Roselle is widely recognized for its impressive antioxidant benefits[24]. According to a study by Morales-Luna and colleagues[25], both red and white varieties of roselle are rich in a range of phytochemical compounds. These include organic acids like hibiscus acid, as well as phenolic acids, anthocyanins, and flavonoids, all of which

have the ability to counteract the harmful effects caused by oxidative stress. The reason for this is that compounds like anthocyanins, phenolic acids, and flavonoids can help reduce oxidative stress by neutralizing harmful free radicals, including reactive oxygen species (ROS) and reactive nitrogen species (RNS). These substances work by targeting and eliminating these unstable molecules, which can cause damage to cells and contribute to various health issues. [26,27].

## ANTI-INFLAMMATORY

Inflammation is a significant factor in the development, advancement, and symptoms of heart disease. However, finding safe ways to control inflammation with specific treatments is still difficult. Despite this challenge, previous research that has explored the use of roselle as a natural remedy suggests that focusing on inflammation could help lower the chances of developing heart disease.

A new study has carried out by Sun and colleagues[28] found that adding delphinidin-3-O- glucoside, which is a beneficial substance found in the calyx of roselle, can help lower inflammation. This effect was observed through the decrease of mRNA levels for interleukin-6 (IL-6), vascular cell adhesion molecule 1 (VCAM-1), and NF- $\kappa$ B in rabbits that had atherosclerosis. The study highlights the potential of this compound in managing inflammatory responses related to cardiovascular issues.

In earlier studies, a methanolic leaf extract from roselle, administered at a dosage of 500 mg/kg to rats with inflammation induced by carrageenan, effectively reduced the swelling associated with inflammation, as evidenced by a decrease in the size of the inflamed paw[29].

As a result, roselle has the ability to suppress proinflammatory cytokines like interleukin-6 (IL-6) and tumor necrosis factor alpha (TNF $\alpha$ ) [30,31]. This means that roselle is rich in antioxidants, which can help reduce inflammation in the cardiovascular system and offer protective benefits for the heart.

## ANTI-HYPERGLYCEMIC

Roselle is known to have strong effects in lowering high blood sugar levels. Research has shown that both red and white varieties of roselle can help decrease hyperglycemia by blocking the activity of two important enzymes,  $\alpha$ -amylase and  $\alpha$ -glucosidase, which are crucial for breaking down carbohydrates. This action can potentially reduce the risk of developing long-term health issues, particularly diabetes mellitus and heart disease[32].

The extract of roselle seeds, which is dissolved in methanol, was found to lower the levels of glucose in the blood plasma just one week after diabetes was induced. This indicates that roselle may play a role in promoting the regeneration of  $\beta$  pancreatic cells, which are crucial for insulin production and blood sugar regulation.[33]

Research conducted by Ajani and colleagues[34] demonstrated that an aqueous extract of roselle effectively lowered blood glucose levels in type I diabetic models. In their study, the subjects were administered doses of 200 and 500 mg/kg of the extract over a period of 28 days, showing promising results in managing diabetes.

## ISOLATION

The fresh leaves of *Hibiscus rosasinensis* Linn were picked and then washed with water to get rid of any dirt and debris. After, they were dried out. Next, the powdered leaves got soaked in water for about 5 to 6 hours. Then, they were boiled for half an hour and left aside an hour. This helps to fully release the mucilage into the water. Then came the fun part! The mixture was squeezed through an eight-fold muslin cloth bag to separate the marc from the solution. To make it even better, acetone was added to the filtrate. This caused the mucilage to settle out at three times the volume of the total filtrate. The mucilage was taken out, dried in an oven at a temperature below 50 degrees Celsius, and then collected. After drying, it was powdered up and passed through a sieve. On another note,

about 1 kg of fresh, immature Okra fruits was bought from a local market. The seeds were removed first, and then the fresh fruits were sliced up nicely. They were homogenized and mixed with cold water that had 1% sodium metabisulphate in it. This crude mucilage was then spun in a centrifuge at 3,000 rpm for around 5 minutes. The gum formed in the supernatant was made to precipitate using acetone. After that, the precipitated gum was washed several times with acetone until it looked clean. What came out was a lovely cream-colored product that got dried under vacuum inside desiccators. Once all moisture was gone, a light brown powder remained! This dried gum was then pulverized using an end runner mill and screened with a fine 0.25 mm stainless steel sieve. Finally, it was stored carefully in a tightly closed amber-colored specimen bottle until it's needed for use.[35]

## EXTRACTION METHOD

### Determination of RSO tocopherols

RSO Samples went saponification, like described in [36]. For the PLC analysis, we used an Agilent Technologies 1100 series chromatograph. This cool has an auto-sampler & a diode-array. We chose a Chrospher RP Select B column which is 250 4.0 mm with a C18 guard column from Phenomenex out of Torrance CA.

Now, talking about the mobile phase—it was a mix of acetonitrile (that solvent A) & methanol (solvent). The flow rate? Well, it stayed at .0 mL for 30 minutes total. gradient program looked like this: starting at 100% B, going down to 85 B over 30, dropping to 50% B in the next 20 minutes, and then all the way down to 0% B in just 5 minutes. Finally, we switched back from 0% B to 100% B over another 5 minutes.

For each injection, we used a volume of 50L. While doing this, we kept an eye on the peaks at both 280 and 320 nm to spot benzoic acid & its friend cinnamic acid derivatives. Before we injected anything, we made sure all samples were filtered through a little 0.45 µm Acrodisc syringe filter from Gelman Laboratory in MI. The peaks were identified by checking their retention times alongside UV spectra & comparing to our standard samples.

### Total phenolic content (TPC)

The Folin-Ciocalteu method [37] is a neat way to the Total Phenolic Content, or PC. It's based on reported earlier by researchers. First, we take 2.5g of RSO dissolve it in 5L of hexane. Then, we use an 80:20 mix of methanol and for extraction. This mix helps separate the good part.

mixing, we spin it all in a centrifuge for about 5 minutes 3500 rpm. The liquid part gets collected, and then we let it dry in a vacuum at room temperature. Once it's dry, we combine it with 5 mL of methanol solution. We also add 2.5mL of Folin reagent and 10mL of sodium carbonate solution into a 50 mL flask[38].

We then fill up the flask with deionized water to reach the right volume. After waiting for about half an hour, we measure the absorbance at a wavelength of 765 nm. Oh, and just so you know, gallic acid is what we use for calibration! Finally, this is all expressed as milligrams of gallic acid equivalent (GAE) per 100 grams of oil samples.

## MEDICINAL USES

In various countries such as those in Africa, India, and Mexico, people traditionally use a blend of calyces or leaves for their beneficial properties, including acting as a diuretic, reducing fever, thinning the blood, and alleviating issues related to bile production[38]. In North Africa specifically, the calyx is commonly employed to treat ailments like sore throats, genital issues, and coughs.

Additionally, the soft pulp of the leaves is known to aid in the healing of external wounds and abscesses, showcasing the diverse medicinal uses of these plant parts[39].

## Cosmetics uses

In Malaysia different kind of soaps, hair powders and scrubs are prepared by hibiscus sabdariffa oil(40).



Fig 3-Soap



Fig 4-Scrub



Fig 5-Powder

## Traditional Uses:-

Different parts of the roselle plant are commonly used in traditional medicine and various food products. In Sudan, the dried calyx of Hibiscus sabdariffa is transformed into a nutritious beverage, which can be made into non-alcoholic drinks like wine and soft drinks, as well as being a source of flavonoids. Additionally, this dried calyx is a key ingredient in many desserts, including ice cream, jelly, sour tea, pies, butter, and tarts. Around the globe[41] the leaves, roots, seeds, and fruits of the plant are utilized in cooking. Roselle is particularly rich in riboflavin, ascorbic acid, calcium, vitamin C, carotene, and anthocyanins, making it a valuable addition to diets. The young leaves can also be consumed as a green vegetable[42]. This versatile crop is used to create a variety of foods such as pudding, jam, cake, flavoring, syrup, ice cream, wine, and jelly. Furthermore, its vibrant reddish color not only makes dishes visually appealing but also boosts their overall productivity[43].

## CONCLUSION

The risk factors of CVD, especially hyperglycemia, hypertension, and hyperlipidemia, are the main culprits that induce the development of CVD via oxidative stress, inflammation, fibrosis, and apoptosis mechanisms. Roselle has been studied for decades due to its promising effects in limiting the CVD progression by exhibiting anti-hyperglycemic, anti-hyperlipidemic, anti-hypertensive, antioxidative, anti-inflammatory, effects in preclinical studies and clinical studies. And other kind of beverage drinks and cosmetic uses. However, most of the studies that were conducted do not highlight which compound found from each type of extract shows potent results in alleviating CVD risk factors. Hence, future studies should consider this matter so that the biological properties of roselle can be fully utilized. Furthermore, limited studies have been conducted to develop roselle as a nutraceutical product. Therefore, this review can provide knowledge about roselle for developing nutraceuticals in the future, mainly targeting CVDs.

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