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Hibiscus sabdariffa - uses, nutritional and therapeutic benefits - A review

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ABSTRACT: *Hibiscus sabdariffa* is a shrub that belongs to the family Malvaceae. Over 200 different species of *Hibiscus* exist worldwide. *Hibiscus sabdariffa* has been noted to have a high nutritional potential, particularly in the leaves, calyces, and seeds. The Roselle calyx, which is used to make a variety of beverages, has been said to contain a significant amount of vitamins, minerals, flavonoids, protein, lipids, carbs, and other nutrients. There are reports on the plants' antioxidant, antihypertensive, hepatoprotective, nutritive, and antihyperlipemic qualities. Reviewing the uses, the nutritional worth and therapeutic benefits of *Hibiscus sabdariffa* is the goal of this paper.

Keywords: *Hibiscus sabdariffa*, roselle, beverages, calyces, antioxidants.

INTRODUCTION

Hibiscus sabdariffa, also known as roselle, is a nutritive and medicinal herb from the Malvaceae family. It is an annual summer shrub with a deep penetrating taproot that grows upright and generally branches. Its leaves range in colour from green to red, and its enormous, short-peduncled blooms have a dark centre (Abou-Sreya *et al.*, 2022). Roselle is consumed by humans and animals as an important vegetable. Roselle young herbage are eaten fresh in a salad recipe, while the immature fruit, luscious calyces, and sensitive shoots are all chopped and added to the sauce. Its calyces, which are red, green, or dark green, are the part of the plant that is most commonly exploited (Salami and Afolayan, 2021). *Hibiscus sabdariffa*'s dried reddish-brown petals (calyces) are used to make the aqueous extract known as zobo. The plant is indigenous to Malaysia and India, where it is grown extensively in many tropical nations in both hemispheres (Ogundapo *et al.*, 2014). It is a dicotyledonous plant that is widely grown in Nigeria's middle belt states, such as Plateau, Nasarawa, and Benue, as well as its south-western states, such as Ondo and Osun (Aganbi *et al.*, 2017). Evidence has shown that Roselle contains phytochemicals such as anthraquinones, glycosides, alkaloids, tannins, polyphenols, and saponins (Ogundapo

et al., 2014; Aganbi *et al.*, 2017; Teye *et al.*, 2019). The plant is allegedly an effective treatment for cancer, abscesses, cough, debility, dysuria, scurvy, and fever, as well as an antihypertensive, antiseptic, strict diuretic, and purgative (Olawale, 2011). The extract is typically sweetened to taste with sugar and occasionally flavoured with spices such as ginger hot pepper, as well as natural flavours such as pineapple juice and lime juice or artificial flavours such as strawberry vanilla, etc. The sweetness of the extract is usually determined by personal preferences (Ogundapo *et al.*, 2014).

Reports from earlier studies said that *Hibiscus sabdariffa* has a high concentration of ascorbic acid (Aganbi *et al.* 2017). According to Builders *et al.* (2010) and Teye *et al.* (2019), *H. sabdariffa* is high in calcium, iron, riboflavin, niacin, and calcium while being low in sugar. The presence of anthocyanins, a coloured byproduct of the flavonoid pathway, is thought to be responsible for *H. sabdariffa*'s purported medical benefits. Antioxidant activity has been discovered in the anthocyanins present in *H. sabdariffa*, which provide defense against cancer and atherosclerosis. Additionally, they are related to liver protection and improved cholesterol action. There is evidence that the antioxidant potential is far more active than that of typical

antioxidants like ascorbate. The calyces of the red-colored species of *H. sabdariffa* have been found to contain the anthocyanins delphinidin-3-sambubioside, cyaniding-3-sambubioside, and delphinidin-3-glucose (Builders *et al.*, 2010; Ellis *et al.*, 2021). There have been reports of *H. sabdariffa*'s hypoglycemic and hypolipidemic effects (Sini *et al.*, 2011).

ZOBO (*Hibiscus sabdariffa*)

Morphology of the plant

Hibiscus sabdariffa is a shrub belonging to the family—*Malvaceae* and genus *Hibiscus*. It is an annual erect shrub with a reddish or green stem that is essentially unbranched or has branches at the base. The stem is glabrous or slightly hairy and has tiny tubercles. The leaves are serrated, with the lower ones being ovate and undivided and the upper ones being palmately 3-5 lobed (Figure 1) (Qi *et al.*, 2005). The flowers are a large yellow colour with a dark crimson eye, and the epicalyx is united at the base with dark red to purple calyx; fleshy capsules have many seeds and are ovoid-shaped (Juhi and Ela, 2014).

Uses

Roselle is a versatile plant whose outer leaves, or calyx, are widely used to make jelly, jam, juice, wine, syrup, gelatin, pudding, cake, ice cream, and flavouring. Calyx is also known as natal sorrel. Its distinctive flavour and beautiful red colour make it a valued food item (Mohamed *et al.*, 2012).

An annual crop called roselle is utilised in pharmaceuticals, nutraceuticals, cosmeceuticals, food, and animal feed. Acidic flavour can be found in the calyces, stems, and leaves. Due to the calyces' high concentration of vitamin C, anthocyanins, and other antioxidants, the juice is advertised as a beverage that improves health (Mohamed *et al.*, 2012).

The dried calyx is used to make a tasty and nutritious beverage (Figure 2), and it is also used to make tea, jelly, marmalade, ice cream, sorbets, butter, pies, sauces, tarts, and other desserts. Alternatively to coffee, the seeds have been utilized as a stimulant (Mohamed *et al.*, 2012).

Nutritive value

According to Luvonga *et al.* (2010) in their study, observed that roselle plant contain 68.7% carbohydrate, 14.6% crude fibre, 12.2% ash and other nutrients. The plant is shown to be abundant in minerals, particularly magnesium and potassium. A notable amount of vitamins, including ascorbic acid, niacin, and pyridoxine, were also detected. Nmahadevan and Pradeep (2009) reported the physicochemical constituents of the fresh calyces and leaves of *H. sabdariffa* (Table 1). Variable content



Figure 1. *Hibiscus sabdariffa* plant: A shrub belonging to the family—*Malvaceae* and genus *Hibiscus* with reddish or green stem and green leaves. The flowers are trumpet shaped and are either red, orange, yellow pink or purple in colour with dark to purple calyx (Source: Qi *et al.*, 2005).



Figure 2. Beverage prepared from the extract of the dried calyces of *Hibiscus sabdariffa* (Source: Mohamed *et al.*, 2012).

Table 1. Physicochemical constituents of the fresh calyces and leaves of *H. sabdariffa*.

Constituents	Calyces fresh (per 1000ml)	Leaves fresh (%)
Moisture	9.2 g	86.2%
Protein	1.14 g	1.7-3.2%
Fat	2.161 g	1.1%
Fibre	12.0 g	10%
Ash	6.90 g	1%
Calcium	12.63 g	0.18%
Phosphorus	273.2 mg	0.04%
Iron	8.98 mg	0.0054%
Carotene	0.029 mg	
Thiamine	0.117 mg	
Riboflavin	0.277 mg	
Niacin	3.765 mg	
Ascorbic acid	6.7 mg	

The fresh leaves has higher moisture, protein, fat, fibre, ash, calcium, Phosphorus, and iron content compared to the fresh calyces. Carotene, thiamine, riboflavin, niacin and ascorbic acid were detected in the fresh calyces. Units in gram and milligram are value per 1000 ml while % is value per 100ml (Source: (Nmahadevan and Pradeep, 2009).

suggests that variations within the same species are caused by the kind of soil's influence on its ash and mineral content (Carvajal-Zarrabal *et al.*, 2012). Although the pharmacological components are not clearly identified, it has long been used in herbal tea to treat hypertension, pyrexia, and liver damage. Nutritional studies have shown that poor dietary habits are regularly linked to a higher incidence of cancer. This includes eating less fruits and vegetables (Puro *et al.*, 2014). The lower risk of cancer may be due to a component found in fruits and vegetables called polyphenol and anthocyanin. Proteins, steroids, alkaloids, and other secondary metabolites can be produced by plants to increase their nutritional value (Sharanaiah *et al.*, 2013).

Therapeutic properties

According to Pegu *et al.* (2021), infusions of the leaves or calyces of *H. sabdariffa* are traditionally used for their diuretic, cholerectic, febrifugal, and antihypertensive properties, as well as to lessen blood viscosity and induce intestinal peristalsis. Calyces formulations are used in Egypt to treat heart and nervous system disorders, promote urination, and act as a cooling agent. Calyces of *H. sabdariffa* are used in Sudan to treat high blood pressure, cold symptoms, and flu (Issa *et al.*, 2018). People in Zimbabwe utilise the plant's calyces, which are edible, to treat cancer. According to a survey on ethnomedicinal plants used by traditional healers in Zimbabwe, *H. sabdariffa* has been utilised to treat all cancer kinds (Matowa *et al.*, 2020). *H. sabdariffa* is used to treat type 2 diabetes mellitus in Mauritius, an island

nation in East Africa, where the prevalence of diabetes is high. In order to prepare juices, they use the fruits of *H. sabdariffa*. The fruit's seeds must be taken out and cooked for 10 minutes in 1 litre of water to prepare the juice. Thereafter, it is filtered and consumed one cup twice a day (Mootosamy and Fawzi, 2014). In Nigeria, a traditional therapeutic for low milk production, poor letdown, and maternal mortality involves a decoction of the seeds. This therapy is designed to boost lactation (Gay *et al.*, 2009).

According to Suresh and Ammaan (2017), the calcium in Roselle protects teeth by ensuring tight-fitting teeth where germs cannot flourish and by maintaining a robust and powerful jaw bone throughout your life. Roselle contains vitamin C, which strengthens the body's immune system and shields us against colds and coughs. Roselle's magnesium content offers prompt relief from constipation. By relaxing the intestinal muscles, this vitamin's laxative effects assist create a smoother rhythm for bowel movements. Phosphorous, which is present in roselle, has the potential to alleviate minor health issues including weariness, numbness, and other conditions of a similar nature. Bioactive compounds of *Hibiscus sabdariffa* which contribute to the therapeutic potentials are anthocyanins, flavonoids, organic and phenolic acids (Mohd Suhaili, and Manshoor, 2022).

The following therapeutic properties of *Hibiscus sabdariffa* are discussed: antimicrobial, antioxidant and hepatoprotective, effect on lipid metabolism, antihypertensive properties and antidiabetic activity

Antimicrobial properties

Roselle is frequently used to treat illnesses. In order to explore the phytochemical components, antibacterial activity, and cytotoxicity of roselle, Olaleye (2007) utilised an aqueous-methanolic extract of the plant. He found that the extract contains cardiac glycosides, flavonoids, saponins, and alkaloids. *Staphylococcus aureus*, *Bacillus stearothermophilus*, *Micrococcus luteus*, *Serratia marscescens*, *Clostridium sporogenes*, *Escherichia coli*, *Klebsiella pneumoniae*, *Bacillus cereus*, and *Pseudomonas fluorescens* were among the microorganisms it showed antibacterial activity against. While the antimicrobial activity on *Escherichia coli* O157:H7, *Salmonella enterica*, and *Listeria monocytogenes* isolates from food, veterinary, and clinical samples by Fullerton *et al.* (2011) indicated that roselle extract was effective and suggested that it might be possible to isolate antibacterial and anticancer agents, the results support the use of this plant in the treatment of diseases like abscesses, bilious conditions, cancer, and coughs in traditional medicine. Protocatechuic acid and roselle calyx extracts were tested for their antibacterial properties against the food spoilage bacteria *Salmonella Typhimurium* DT104, *Escherichia coli* O157:H7, *Listeria monocytogenes*, *Staphylococcus aureus*, and *Bacillus cereus*. The results showed inhibitory activity in a dose-

dependent manner against the test bacteria in ground beef and apple juice, and it was suggested that these substances might be effective food additives (Puro *et al.*, 2014).

Antioxidant and Hepatoprotective properties

Hibiscus anthocyanins (HAs), a class of naturally occurring pigments found in the dried calyx, showed antioxidant activity and liver protection according to the research by Puro *et al.* (2014). Hepatotoxicity and HA antioxidant bioactivity were investigated in rat primary hepatocytes (Puro *et al.*, 2014). The findings showed that HAs, at concentrations of 0.10 and 0.20 mg/ml, significantly reduced the leakage of lactate dehydrogenase and the production of malondialdehyde, and significantly decreased the serum levels of hepatic enzyme markers (alanine and aspartate aminotransferase), which in turn reduced oxidative liver damage. The liver's histological analysis showed that roselle pigments decreased the frequency of liver lesions in rats, including necrosis brought on by tert-butyl hydroperoxide (t-BHP) and inflammatory leucocyte infiltration. In malignant cell lines, an antioxidative activity was also identified (Akim *et al.*, 2011). Regardless of age, gender, or dietary supplement use, extracts of its calyces have shown hypocholesterolemic and antihypertensive effects in animal models (McKay *et al.* 2011). Evidence of potential use as a medication for treating liver diseases in aquaculture was presented by the study of Yin *et al.* (2011) on the hepatoprotective and antioxidant effects on the carbon tetrachloride (CCl₄)-induced hepatocyte damage in fish. Roselle extract significantly increased levels of lactate dehydrogenase (LDH), glutamate oxalate transaminase (GOT), glutamate pyruvate transaminase (GSH- Px) (Yin *et al.*, 2011).

Effect on lipid metabolism

In a study of hypertensive patients, Mohagheghi *et al.* (2011) examined the impact of roselle on lipid profiles, creatinine levels, and serum electrolytes. They found an upward trend in total cholesterol and high density lipid (HDL), which is significant because HDL-Cholesterol is a protective factor for coronary heart disease. According to Kirdpon (1994), urinary excretion of creatinine, uric acid, citrate, tartrate, calcium, sodium, potassium, and phosphate decreased in normal patients after consuming roselle juice at various concentrations and durations, but not that of oxalate, which may aid in the treatment and prevention of renal stone disease.

Antihypertensive

It is now recognised as a global health issue that the effect of hypertension is linked to the emergence of cerebrova-

scular illnesses, cardiac ischemia, as well as cardiac and renal failure. In research on the effectiveness of aqueous extract in hypertensive humans, Puro *et al.* (2014) reported a substantial reduction in the difference between systolic and diastolic pressures compared to the control group; however, McKay *et al.* (2011) only identified a significant reduction in systolic pressure. The results of studies done on rats (Ajay *et al.*, 2007) corroborate the notion that roselle extract includes components that lower blood pressure.

Anti-diabetic activity

To control postprandial hyperglycemia, a therapeutic procedure based on the inhibition of α -amylase and α -glucosidase is used. It demonstrates the potential of the intestinal α -glycosidase and pancreatic α -amylase inhibitors to block both enzymes. According to the investigation, roselle polyphenolic extract has the ability to reduce hyperinsulinemia and hyperglycemia when used at a dose level of 200mg/kg (Penq *et al.*, 2011).

Conclusion

H. sabdariffa has a wide range of applications in food preparation, such as jelly, jam, juice, wine, syrup, gelatin, pudding, cake, ice cream, and flavouring, as well as in the treatment of diabetes, hypertension, microbial infection, liver diseases, renal diseases, and other illnesses. These diverse uses are due to its great nutritional and therapeutic properties. *H. sabdariffa* extracts decrease lipid levels by raising total cholesterol and high density lipid levels, both of which are preventive factors in coronary heart disease. The plant contains bioactive substances such as anthocyanins, flavonoids, organic acids, and phenolic acids that support the plant's therapeutic properties.

Recommendation

1. Commercial *H. sabdariffa* cultivation is recommended.
2. Its mode of action should be investigated.
3. Consumption of *H. sabdariffa* juices or beverages over commercially produced beverages as it's a natural beverage that can provide natural nutrients for people.

CONFLICT OF INTEREST

The authors do not declare any conflict of interest.

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