**South Indian leafy vegetable Gongura (Hibiscus sabdariffa L.) as an important medicinal herb: a review**

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**Abstract**

*Hibiscus sabdariffa* L. is an herbaceous plant well known to be a South Indian leafy vegetable commonly used for various food products, beverages and have many more medicinal properties like anti-scorbutic, emollient, diuretic, refrigerant, sedative, anti-hypersensitive, anti-atherosclerotic, anti-oxidant etc. Because of the innovation, crop improvement and extension work carried by many researchers there is evaluation in the information regarding the properties of this plant. The research during 2000-2017 presented a lot of medicinal, industrial uses of this plant. This review is a small overview covering the therapeutic uses of *Hibiscus sabdariffa* L.

**Keywords:** *Hibiscus sabdariffa* L., Phytochemicals, Medicinal properties, Gongura, Leafy vegetable, Rosella and its medicinal uses.

**Introduction**

*Hibiscus sabdariffa* L. is an annual herbaceous plant that has many industrial, pharmaceutical uses in many countries all over the world. It is commonly called as Rosella or Roselle and belongs to family Malvaceae (Husseina et al. 2010). More than 300 tropical and subtropical Rosella species are there. It is cultivated in warm countries particularly like India, Indonesia, Philippines, Malaysia, Tropical Africa, Brazil, Australia, Hawaii, Florida etc. (Mahadevan et al. 2009). Nowadays, it is cultivated in both tropical and subtropical regions including India, Saudi Arabia, China, Malaysia, Indonesia, The Philippines, Vietnam, Sudan, Egypt, Nigeria and Mexico. There are many coloured types of Rosella depending on sepals’ colours (Husseina et al. 2010). *Hibiscus sabdariffa* L. is cultivated for its stem, leaves, calyces and seeds as all parts have industrial, medicinal and other applications. Fresh juicy and dried calyces are used in the preparation of beverages, jams, jellies, sauces, cakes, puddings, syrup and wine. Tender leaves and stalks are used in food items like sauces, curries and chutneys. This herb is also used in traditional medicine.

There are more than 300 species of hibiscus around the world among them *Hibiscus sabdariffa* L. (Roselle) is best known for its sour test (Ansari et al. 2013). Its native distribution is uncertain; some believe that, it is from India or Saudi Arabia. *Hibiscus sabdariffa* L. is commonly known as Roselle, hibiscus, Jamaica sorrel, Indian sorrel or red sorrel (English), karkadeh (Arabic) and in Indian language Gongura, Lal-ambari or Patwa (Hindi), Lal-mista or Chukar (Bengali), Lal-ambadi (Marathi), Yerra gogu (Telugu), Pulichchaikerai (Tamil), Pulachakiri or Pundibija (Kamada), Polechi or Pulichchai (Malayalam), Mesta (Odia) and Chukiar (Assam). Roselle (*H. sabdariffa* L.) is an edible plant used for various activities including foods, Fibre, medicinal purpose etc. The fleshy red calyces are used for making wine, juice, jam, syrup, pudding cakes, pickle, ice cream or herbal tea. Roselle flowers and calyces are also known for their antiseptic, diuretic, antioxidant and anti-mutagenic properties. The traditional medicine use the aqueous extract of this plants as diuretic, for treating gastrointestinal disorders, liver diseases, fever, hypercholesterolemia, and hypertension. Leaves of Gongura are being used for skin ailments by Yanadi tribe in Chittoor district of Andhra Pradesh, India (Sudha et al. 2016). So there is a need to assess the potential effects of this plant. Keeping this in view, the present study has been undertaken to compile the research results regarding the medicinal properties of this herb.

Two varieties among *Hibiscus sabdariffa* L. one is variety subdariffa, cultivated for its red or pale yellow inflated edible calyces, and the other is altissima cultivated for its fibre. It is an erect and mostly branched shrub of about 3.5 metres tall. The stems are cylindrical and typically dark green to red in colour with a deep penetrating tap root system. Leaves are alternate, green to red in colour and are petiolate, palmately lobed (3-7) with serrated margins. Flowers are white pale to yellow in colour with fleshy red calyces.

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**Phytochemicals in different part of Hibiscus sabdariffa L.**

Phytochemicals refer to the natural non-nutritive bioactive compounds found in almost all parts of plant like flowers, leaves, stem, root, bark and seeds which acts in a protective manner in humans by preventing many degenerative diseases and harmful processes by showing anti-oxidant activities. Pioneer works conducted by many scientists and researchers expanded the information regarding the phytochemical composition of *Hibiscus sabdariffa* L.

Research findings shows that alkaloids, anthocyanins, flavonoids, saponins, and tannins were present in the dried petals of *Hibiscus sabdariffa* L. while quinones, steroids and terpenoids were absent. Anthocyanins are the abundant compound, followed by the phenols and flavonoids. They identified 18 compounds namely phenolic acids (chlorogenic acid and protocatechuic acid), flavonoids (gossypetin, sabdaretin, gossypetin, and luteolin), glycosides, hibiscin, hibiscitrin, sabdaretin, fibre, resins which are having many more importance in the life cycle of human (Ali et al. 2005; Orwa et al. 2009; Mungole and Chaturvedi 2011; Ijehomah et al. 2012; Kumar et al. 2012; Ansari et al. 2013; Pacome et al. 2014).

The presence of steroids and tocopherols were observed in seed oil. Rosella seed oil have low-cholesterol and are rich in other phytosterols and tocopherols, particularly β-sitosterol and γ–tocopherol. Linoleic, oleic, palmitic acids are in higher percentages among the fatty acids of seed oil (Mohamed et al. 2007). The seed of Roselle comprises of 9.9 % moisture, 33.5 g of protein, 18.3 g of total dietary fibre, 13 g of carbohydrate and 22.1 g of Fat. Seeds are enriched with minerals like calcium, phosphorus and magnesium. Seventeen types of essential and non-essential amino acids were identified in the seeds of Rosella. The seeds are rich in lysine, arginine, leucine, glutamic acid and phenyl alanine (Haimida et al. 2008). Flavanoids, steroids, saponins, tannins, alkaloids, and phenolic compounds were also observed in seeds (Mungole and Chaturvedi 2011).

In fruits the major phytochemicals are α- Terpinyl acetate, anisaldehyde, caprylic acid, citric acid, acetic acid, formic acid, pelargonic acid, propionic acid, ethanol, isopropanol, methanol, benzyl alcohol, 3-methyl-1-butanol, benzaldehyde, ascorbic acid and different minerals (Mahadevan et al. 2009).

**Medicinal properties of Hibiscus sabdariffa L.**

Rosella or Mesta is used in traditional medicine as well as a leafy vegetable. It was proved by many researchers that it shows anti-hypersensitive, anti-hyper-lipidimic, hepatoprotective, diuretic, anticancer, anti-oxidant and having many other properties. It also contains vitamnins E and Vitamins C which fulfil the daily requirement of human body. Leaves of Gongura can be used as potential sources of vitamins, minerals, phenolics with antioxidant activity and as antimicrobial agents with potential medicinal value (Zhang et al. 2011).

**Anti-hypersensitive**

By the studies with standardized extract of *Hibiscus sabdariffa* L. it was proved to reduce the systolic and diastolic blood pressure by an infusion prepared with 10 mg of dry calyx (Arellanoa et al. 2004). Another experiment with Rosella suggests that the daily consumption of hibiscus tea, in an amount readily incorporated into the diet, lowers blood pressure in pre hypertensive and mild hypertensive adults (McKay et al. 2009).

**Hepatoprotection**

*Hibiscus sabdariffa* L. leaf extract offers hepatoprotection by influencing the levels of lipid peroxidation products and liver markers in experimental hyperammonemia and this could be due to its free radical scavenging property and the presence of natural antioxidants (Essa et al. 2006).

**Anti-anaemic activity**

Dry fermented calyces of *Hibiscus sabdariffa* L. exhibited a very low pH value which enhanced mineral (iron, zinc, calcium and magnesium) availability and can be used as an alternative source of iron for the treatment of anaemia and some other mineral deficiency diseases. It has high concentration of ascorbic acid (Falade et al. 2005). Comparatively higher dose (in the range of 200 to 400 mg/kg) of the extract had a beneficial effect on the red cells, while further increase in dose is not beneficial (Adigun et al. 2006).
Apoptosis

Protecatechuic acid of Rosella found to induce apoptosis or cell death in leukaemia cells through reduction of Retinoblastoma phosphorylation and Bcl-2 Expression and inhibiting the survival of human Promyelocytic Leukemia HL-60 cells in a concentration and time dependent manner (Tseng et al. 2000).

Anti-atherosclerotic

Rosella shows anti-atherosclerosis activity which was tested by inducing the extract of Rosella in rabbits along with high cholesterol diet and the results showed the levels of triglyceride, cholesterol, and low-density lipoprotein cholesterol were lower in the serum of rabbits fed high cholesterol diet plus Hibiscus sabdariffa L. extract than in the serum of rabbits fed high cholesterol diet (Chen et al. 2003). Aqueous extracts of petals of Rosella decreases total plasma concentration in rats indicating the cardio vascular protective properties (Mahadevan et al. 2009).

Anti-oxidant properties

Roselle contains three times more vitamin C than Black currants and that of nine times more than Citrus (Emmy 2006). By chronic administration of NaNO₃, toxicity was induced in Wistar rats and it seems to be alleviated by the antioxidant effect of ethanolic seed extract of Roselle, mainly by tocopherol (Vitamin E) and ascorbic acid (Vitamin C) which are present in substantial amount in seed oil of Hibiscus sabdariffa L. (Bako et al. 2009). The two Fractions (chlo roform soluble fraction and ethyl acetate soluble fraction) from ethanolic extract of Roselle dried flowers showed antioxidant and free radical scavenging properties against hydrogen peroxide (79-94%) at the dose of 500 μg (Mahadevan et al. 2009). Due to the anti-oxidative properties of aqueous extract of Rosella, nephro toxicity induced by organo-phosphorus pesticide like Malathion in albino rats was inhibited as it effectively reduce the oxidative stress on the kidneys (Mossalam et al. 2011). The antioxidant property of Roselle seed oil showed the inhibition of DPPH at 5g per litre was 65% (Zoue et al. 2012).

Roselle can be used as a natural antioxidative supplement in the prevention of oxidative damage in diabetic patients (Mohamed et al. 2013). The results observed by Pacome et al. (2014) revealed that the antioxidant activity of the investigated extract has a scavenging ability of DPPH radical scavenging activity (around 97%). The IC50 values of Hibiscus sabdariffa L. extract was 0.24 mg per ml while that of ascorbic acid used as the reference control was 0.35 mg per ml. This indicated that the compounds constituting mainly petals of Hibiscus sabdariffa L., such as anthocyanins, flavonoids and phenolic acid contribute to the antioxidative activity. The extracts from Hibiscus sabdariffa L. shows antibacterial, anti-oxidant, nephro- and hepato-protective, renal or diuretic effect, effects on lipid metabolism (anti-cholesterol), anti-diabetic and anti-hypertensive effects and is popularly used in traditional medicines. This might be linked to strong antioxidant activities, inhibition of α-glucosidase and α-amylase, inhibition of angiotensin converting enzymes (ACE), and direct vaso-relaxant effect or calcium channel modulation. Phenolic acids (especially protocatechuic acid), organic acid (hydroxy citric acid and hibiscus acid) and anthocyanins (delphinidin-3-sambubioside and cyanidin-3-sambubioside) are also contributing to the above mentioned problems (Rocha et al. 2014). Instant Gongura spice mix is a convenient and economical product which is rich in protein and bioactive components and possessed good antioxidant activity, due to the presence of bioactive components such as polyphenols and ascorbic acid (Rao et al. 2017).

Anticancer

Topical application of protocatechuic acid extracted from Hibiscus sabdariffa L. prior to treatment with 12 Otetradecanoylphorbol-13-acetate to female mice inhibited the incidence of tumours (Ali et al. 2005). The glycoside derivative in Rosella may play a role in the treatment of cancer (Chen et al. 2006). It was recorded by many experts that it inhibits mutagenicity, exhibits cytotoxicity and also has inhibitory effect of protocatechuic acid of Roselle on tumour promotion in mouse skin, hence proves as a potential source against tumour promotion (Mahadevan et al. 2009). Hibiscus sabdariffa L. is a potential source for anticancer activity (Padmaja et al. 2014; Solowe et al. 2014). Roselle flowers and calyces are reported to be good sources of anti-mutagenic compounds (Prabhakaran et al. 2017).

Antibacterial, antifungal, anti-inflammatory and anti-cholesterol activities

It was reported to change the composition of urine as well have beneficial renal effects on consumption of Hibiscus sabdariffa L. extract (Ali et al. 2005). It shows antibacterial, antifungal, anti-inflammatory and anti-cholesterol properties. Aqueous methanolic extract of Roselle exhibited antibacterial activities against Staphylococcus aureus, Bacillus stearothermophilus, Bacillus cereus, Micrococcus luteus, Serratia marnescens, Clostridium sporogenes, Escherichia coli, Klebsiella pneumonia and Pseudomonas fluorescense (Olaeye 2007). Its seeds are good source of antioxidants and their effect increases when combined with other antioxidants (Ismail 2008). It also acts as anti septic, aphrodisiac, astringent, chologogue, demulcent, digestive, diuretic, emollient, purgative, refrigerant, resolvent, sedative, stomachic, laxative, and tonic. Rosella is commonly used as a folk remedy for abscesses, bilious conditions, cancer, cough, debility, dyspepsia, dysuria, fever, hangover, heart ailments, hypertension, neurosis, scurvy, and strangury (Orwa et al. 2009). Animals kept on a diet supplemented with Hibiscus sabdariffa L. calyx ethanol extract showed significant C16:0 excretions in faeces and can be considered as the possible anti-obesity agents, through their tendency to inhibit α-amylase (Zarrabal et al. 2009). Roselle protein fractions and its isolates have good nutritional quality and could be a good source of protein fortification for a variety of food products for protein deficient consumers as well as a potential food ingredient (Tounkara et al. 2013). Roselle flowers and calyces are also known for their anti septic, diuretic and antioxidant properties. The traditional medicine use the aqueous extract of this plant for diuretic, treating gastrointestinal disorders, liver diseases, fever, hyper-cholesterolemia and hypertension (Padmaja et al. 2014; Prabhakaran et al. 2017).

Conclusion

Hibiscus sabdariffa L. is an excellent source of dietary phytochemicals such as anthocyanins, flavonoids, phenolic acids, vitamins and various minerals. The use of Roselle petals as natural antioxidants, natural colorants, anticancerous drugs, antibacterial, antifungal, anti-inflammatory, anti-cholesterol and an ingredient of functional foods seem to be promising and health security enhancing.


