ABSTRACT

Roselle (Hibiscus sabdariffa L.) belonging to family Malvaceae is a very important herbaceous crop can be consumed for improvement in health condition due to its excellent nutritional value. It is a good source of vitamins like A, C, B1, B2, B3. It contains minerals like Potassium, Phosphorous, Sodium, and Calcium, Magnesium as Macro element and Copper, Manganese, Zinc, Iron, Nickel, Cobalt as Microelement. It is also a good source for antosianin, Protein and Flavonoid substance, Hibiscetine and Sabdaretine (Antioxidant). It has lots of medicinal as well as commercial importance. Medicinal uses include its uses as antioxidant, anticancerous, antihypertensive and antimicrobial. It can also be used for curing anemia, diuretic.

Consumption of Roselle juice in different concentrations may help in the treatment and prevention of renal stone disease and decrease creatine, uric acid, citrate, tartrate, calcium, sodium potassium but not oxalate in urinary excretion. Commercially it can be used for the production of natural food color, in bakery as a substitute for normal flour. Fiber of this crop plant is also used in preparation of biodegradable fibre [Burlap].

KEYWORDS: Taxonomy, Malvaceae, Antioxidant, Antihypertensive, Antimicrobial, Burlap.

INTRODUCTION

Rosella (Hibiscus sabdariffa L.) is an annual or perennial herb or woody- based subshrub. The height of the plant is up to 2-2.5m tall. The plant root is slightly thin and branched with tap root system. The stem is glabrous, pale rosy in appearance. The leaves are palmately,
triangular shaped arranged alternatively on the stem with leaf petiole length of about 2-8cm while the main veins are black and rib are glandular with linear stipules.

![Image](image_url)

**Figure: Showing the Growing Plant of *Hibiscus sabdariffa* L.**

The flowers are solitary and axillary, erect, nearly sessile with bracteoles 8-12. The calyx is red colored, fleshy, lanceolate shaped. The fruit is capsular, ovoid, densely hirsute 5 mericarp while seeds are reniform and glabrous.[1] It is probably a native of West Africa and is cultivated throughout the tropics and subtropics e.g. Sudan, China, Thailand, Egypt, Mexico and the West India.[2] Plants normally begin to crop when about 3 months old and cropping may continue for 9 months or until the first frost. The fruit ready to pick about 3 weeks after flowering. Sharaniah et al reported that Plants have the capacity of producing secondary metabolites like proteins, steroids, alkaloids, etc that enhances its nutritive value.[3]

**Taxonomy**

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae</th>
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<tr>
<td>(Unranked)</td>
<td>Angiosperms</td>
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<tr>
<td>(Unranked)</td>
<td>Eudicots</td>
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<tr>
<td>(Unranked)</td>
<td>Rosids</td>
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<tr>
<td>Order</td>
<td>Malvales</td>
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<tr>
<td>Family</td>
<td>Malvacae</td>
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<tr>
<td>Genus</td>
<td><em>Hibiscus</em></td>
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<td>Species</td>
<td><em>sabdariffa</em></td>
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Roselle plant is cultivated in some places for the production of blast fibre from the stem of the plant which can be used as a substitute for jute in making Burlap. It is also attracting attention of food and beverage manufacturer due to its characteristics natural red colored
calyx. Roselle juice, which is conventionally made from water extraction of fresh or dried Roselle calyces, a popular soft drink with daily consumption in many countries including Egypt, Sudan, Mexico, Nigeria and Thailand as reported by Aurelia et al.\cite{5}

![Figure: Showing the Leaves of and Stems of Hibiscus sabdariffa L.](image)

The mineral content in Roselle include maximum amount of K, Ca and Mg, while medium concentration of Fe and P, low concentration of minerals include Na, Zn, Cu and Mn. While Ni and Co are not detected as reported by Azza et al in 2011.\cite{6}

Calyces extract have been reported to have organic acids which include tartaric acid, oxalic acid, malic acid as well as succinic acid; glucose, ascorbic acid, β-carotene and lycopene. In addition anthocyanin pigments (Delphinidin-3-sambubioside and cyaniding-3-Sambubioside are used in conjunction with natural base for coloring syrups and liquors.\cite{7-9}

As color are used exclusively worldwide by food industries in many different varieties including juices, jam, jelly etc so it is a tendency for consumption of natural products. Calyces are exported to Americas and Europe where they used these calyces as food coloring agent. The leaves are used in preparing spices and as a flavoring agent.\cite{10-12} Other health benefit of Roselle plant includes diuretic and choloractic properties, intestinal antiseptic and mild laxative actions. It is also used in treating high blood pressure and calcified arteries.\cite{13}
Nutritional Importance

Rosella has an important source of vitamins and minerals. Vitamins include Vitamin C, Niacin B3, Riboflavin B2, Thiamine and pyridoxine. It has a higher content of vitamin C as compared to Guava, Orange and Mango.\textsuperscript{[14]} It is a good source of many minerals including K, Mg, Ca, Fe, P, Co, Mn, Na and Zn. Potassium is required to maintain osmotic balance of the body fluid and the pH of the body, muscle regulation in nerve irritability.\textsuperscript{[15]} Mg is activator of many enzymes systems to maintain the electrical potential in nerves.\textsuperscript{[16]} Its content in Rosella is very high as 315.21mg/100g.\textsuperscript{[17]} Ca acts as a coordinator among inorganic elements. Excess amount of K, Mg, or Na in the body can be corrected by Ca and adequate quantity in diet assist in Fe utilization. As reported by Fleck et al in 1976,\textsuperscript{[18]} it has high content of 912.15mg/100g. Iron is required for development of infants and young children.\textsuperscript{[19]} Zn help to overcome retarded growth, delayed sexual maturation. Cu daily requirement is only 2 mg while rosella has copper content as 4.32mg/100g. Na is required to maintain osmotic balance of the body fluid and the pH of the body, muscle regulation in nerve irritability.

Uses of Plant Parts

Calyces

They are rich in anthocyanin, ascorbic acid and hibiscus acid. It is a rich source of dietary fibre, vitamins, minerals and bioactive compounds such as organic acids, phytosterols and polyphenols and antioxidant properties.\textsuperscript{[20]} The calyces contain 7.51%, 0.46% and 11.17% of Protein, Fat and Fiber respectively.\textsuperscript{[6]} They are used to decrease blood viscosity and reduce hypertension\textsuperscript{[21]} and good for healthy Bone and Teeth formation. It is also useful in blood formation.\textsuperscript{[6]}
Juice of it having high content of Vitamin C. It is used in treating Leukemia. In dried form, it is used as colorant in Jelly, marmalade ices, ice cream, sorbets, butter, pies, sauces, tarts and other desert. It is also used in soft drink with daily consumption in many countries including Egypt, Sudan, Mexico, Nigeria and Thailand.\(^{[20]}\)

**Petals**
It is a good source of antioxidants such as anthocyanin and ascorbic acid.\(^{[22]}\) Dried petals are used to prepare sweet herbal tea.\(^{[20]}\)

**Seeds**
Good source of lipid soluble antioxidant particularly gamma-tocopherol. Vegetable oil is extracted content low cholesterol and rich in other type of sterol and tocopherols, particularly \(\beta\)-sitosterol and \(\gamma\)-tocopherol.\(^{[17]}\)

**Stems**
Used to produce bast fibre which can be used as a substitute for jute in making Burlap (Biodegradable Fibre).\(^{[4]}\)

**Flowers**
It contains anthocyanins, flavonoids and polyphenols.\(^{[23]}\)

**Medicinal Uses**
Herbal tea helps in soothing colds, clearing blocked nose, clearing mucous, as an anstringent, promoting kidney function, aiding digestion, as a general tonics, as diuretic, and help to reduce fever.\(^{[24]}\)

**High Phenolic Compounds and Antioxidant Properties**
The amount of Phenolic compounds in the raw Roselle was 37.42mg/g dry weight which is similar to that found by Mazza et al. in various fruits such as strawberries and currants.\(^{[25]}\) The petals are potentially a good source of antioxidant agents as anthocyanins and ascorbic acid as reported by Prenesti et al. 2007.\(^{[22]}\)

The Phenolic content in the plant consists mainly of anthocyanins like delphinidin 3-glucoside, sambubioside and cyaniding-3-sambubioside mainly contributing to their antioxidant properties reported by Aurelia et al., 2007.\(^{[5]}\) The antioxidant activity of Roselle extract is pH dependent (pH 2 to 7) by Sukhapat et al., 2004.\(^{[26]}\)
To Fight Leukemia
Sepal extract has been used as an effective treatment against leukemia due to its high content in polyphenols, particularly protocatechuic acid by Tseng et al.[27]

Source of Vitamin C
The calyces are rich in Vitamin C (141mg/100g).[28] Roselle has a high content of Ascorbic acid than Guave, Orange and Mango by Tee et al.[29]

High Blood Pressure
Extracts of calyces are used to reduce hypertension and to decrease the viscosity of blood (Christian et al., 2006).[21] Faraji et al in 1999 showed significant reduction in pressure difference in both systolic and diastolic as compared to control group, but Mckap et al in 2010 found only reduction in systolic pressure was significant while diastolic pressure remained unchanged.[30,31]

Good for Bone and Teeth Formation
The consumption of Roselle calyces will took an active role in good bone and teeth formation and could be useful in blood formation.[18]

For Anemic Patients
Though the concentration of Fe and Zn were 37.80 and 6.51 mg/100g, the quantities are available for biochemical function. The daily recommended Fe requirements for humans are 10-15mg for children, 18mg for women and 12 mg for men by Oluwaniyi et al., 2009).[32]

High Phenolic Compounds and Antioxidant Properties
The amount of Phenolic compounds in the raw Roselle was found to be as same as that found in strawberries and currantas reported by Mazza et al., 1999.[25] The petals are potentially a good source of antioxidant agents as anthocyanins and ascorbic acid (Preneisti et al., 2007).[22]

Aurelia et al reported that the phenolic content in the plant consists mainly of anthocyanins like delphinidin 3-glucoside, sambubioside and cyaniding-3-sambubioside contribute mainly to its antioxidant properties. The antioxidant activity of Roselle extract is pH dependent (pH 2 to 7) is also stated by (Sukhapat et al., 2004).[26]
Lipid Metabolism
Abbas et al in 2011 studied the effect of roselle on lipid profile, creatinine and serum electrolytes in hypertensive patients and reported that total cholesterol and high density lipid (HDL) is high which is a significant as HDL-Cholesterol protect from coronary heart diseases.\cite{33} Consumption of roselle juice in different concentrations may help in the treatment and prevention of renal stone disease and decrease creatine, uric acid, citrate, tartrate, calcium, sodium potassium but not oxalate in urinary excretion as stated by Kridpon in 1994.\cite{34}

Anticancerous Properties
The dried flower of Rosella contains a phenolic compound named Protocatechuic acid (PCA) which was found to have an inhibitory activity against Human promyelocytic leukemia (HL-60) as stated by Tseng et al 1997. Tseng et al in 2000 also reported that apoptosis is induced via reduction in the phosphorylation of retinoblastoma and by down regulation of Bcl2 protein expression. Lin et al added that the cells undergo intranucleosomal DNA fragmentation and morphological changes during apoptosis while in gastric carcinoma apoptosis is induced through JNK/MAPK signaling pathways.\cite{35}

Anti Microbial Effect
Methanolic extracts of rosella contained cardiac glycosides, flavonoids, saponins and alkaloid as reported by Olaleye 2007.\cite{36} It also has antibacterial activities against *Staphylococcus aureus*, *Bacillus stearothermophilus*, *Micrococcus luteus*, *Serratia mascences*, *Clostridium porogenes*, *Escherichia coli*, *Klebsiella pneumoniae*, *Bacillus cereus*, *Pseudomonas fluorescence*. Chau et al in 2008 reported that aqueous and ethanol extracts and protocatechuic acid of rosella can be used against spoilage of food against the bacteria Salmonella Typhimurium DT104, *Escherichia coli* O157:H7, *Listeria monocytogenes*, *Staphylococcus aureus* and *Bacillus cereus*.\cite{37}

Commercial Uses
Food Colourant
Calyses are used as food colourants for food industries and are rich in anthocyanin, ascorbic acid and hibiscus acid. Roselle calyces extract is water soluble with brilliant and attractive red colour and with sour and agreeable acidic taste which aid digestion, thus utilized by food industries for obtaining natural color. The stability of color depends on a combination of
factors which include the structure of anthocyanin, pH level, temperature of extraction, temperature, oxygen, light and water activity as stated by Jackman et al 1996[38].

**Bakery Products**

Cookie consumed worldwide has high sugar content which has less physiological benefits. The addition of dietary fibre from Rosella Seeds to bakery products will reduce the fat content without loss of quality (Martin 1999).[39]

**On Poultry Animals**

Piyaphon et al. (2011) showed that if Roselle calyx was used in diets increased the egg production performance, egg quality and Thio Barbituric Acid Reactive Substances (TBARS) value in plasma and yolk.[40]

**CONCLUSION**

Roselle (*Hibiscus sabdariffa* L.) crop which is characterized by its sour taste has high pH value contains many important chemicals very much essential for medical reasons. It can be thus be consider as a miracle dish to be consumed for treating many diseases including high blood pressure, leukemia, maintaining HDL-cholesterol and also contain high amount of Calcium as well as vitamin C, B1, B2 etc. It is also rich in many Phenolic compounds as well. Considering it as a rich source of macroelements and microelement, dosage can be standardized for securing effective result.

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