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Nutritional and health importance of *Hibiscus sabdariffa*: a review and indication for research needs

Abstract

Hibiscus sabdariffa commonly named as "red sorrel" or "roselle" is a member of malvaceae family. It is a medicinal plant with a worldwide fame and has more than three hundred species which are distributed in tropical and subtropical regions around the world. Roselle can adapt to a variety of soil in a warmer and more humid climate. Roselle is rich in organic acids including citric, malic, tartaric and allo-hydroxycitric acids. The plant is also known for its Beta carotene, vitamin C, protein and total sugar. Roselle, having various medically important compounds called photochemical, is well known for its nutritional and medicinal properties. Many parts of Roselle including seeds, leaves, fruits and roots are used in various foods as well as in herbal medicine as a potential non-pharmacological treatment. Different extracts from Roselle plays a crucial role in treating different medical problems including many cardiovascular disorders, helmenthic disease and cancer. The plant also act as an anti oxidant and used in obesity management

Keywords: roselle, medicinal plant, photochemical

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Introduction

Description of *Hibiscus sabdariffa*

Hibiscus has more than three hundred species distributed in tropical and subtropical regions around the world and are used as ornamental plants. Research on have shown that some species of Hibiscus possess certain medicinal properties of which *Hibiscus sabdariffa* is one.[1] *Hibiscus sabdariffa* is commonly named as "red sorrel" or "roselle". Even though permeable soil is the best, Roselle can adapt to a variety of soil in a warmer and more humid climate.[2,3]

Hibiscus sabdariffa, a member of Malvaceae family, is a known medicinal plant with a worldwide fame[4] and the plant can be found in almost all warm countries such as India, Saudi Arabia, Malaysia, Indonesia, Thailand, Philippines, Vietnam, Sudan, Egypt and Mexico.[5,6] Roselle is mainly cultivated to be consumed and the main producers of Roselle blossoms are Egypt, Sudan, Mexico, Thailand and China. Other hibiscus varieties are planted for their fibers they produce.[7]

Origin of *Hibiscus sabdariffa*

There is a big argument about the origin of Roselle among different scholars. Cobley[8] suggested Roselle is a native plant of West Africa and from there it was carried to other parts of the world such as Asia and America, whereas in others opinion, Roselle was originated from India[9] and Saudi Arabia.[10]

Varieties of *Hibiscus sabdariffa*

Among numerous verities of Hibiscus, *Hibiscus altissima* and *Hibiscus sabdariffa* are the commonest and better introduced. *Hibiscus altissima* is branchless plant with yellow flowers and red or green colored calyxes. Though this species is not used for food, this plant is more economically important than *Hibiscus sabdariffa* because of its high fiber content. The other distinct type *Hibiscus sabdariffa* or "Roselle" grows in a bush with many branches. The flowers of Roselle are axillaries or in terminal racemes, the petals are white with reddish center at the base of the stamina column and this species is widely used as food.[10,11]

Composition of *Hibiscus sabdariffa*

Roselle is mainly cultivated for its calyx, which is of three types: green, red and dark red. The red calyxes are the most used are characterized by their concentration anthocyanin. Delphinidin 3-Sambubioside and Cyanidin3-Sambubioside are the major anthocyanin. Roselle is also rich in organic acids, minerals, amino acids, carotene, vitamin C and total sugar in its calyx, leaves and seeds at variable levels depending on the variety and geographical area.[12] According to Manita–mishra[13] a number of compounds have also been isolated and characterized from Roselle including flavonoids, anthocyanidins, triterpernoids, steroids and alkaloids. Nutrient contents of different part of *Hibiscus sabdariffa* per 100 gram are clearly stated in Table 1.

Nutritional and medical importance of *Hibiscus sabradiffa*

Roselle, the safe medicinal plant,[4] having various medically important compounds called phytochemicalsis well known for delicacy and also for its nutritional and medicinal properties.[14] The application of the plant in managing different medical problems including cancer, inflammatory diseases, different cardiovascular problems has been well investigated by different scholars in different settings.[15]

Domestic applications

Even though, the uses of different parts of Roselle are many and varied both in food and in traditional medicine, all parts of Roselle including seeds, leaves, fruits and roots are used as a food in different parts of the world. Fleshy red calyxes of Roselle are commonly used for the production of soft drinks and tonic without alcohol like wine, juice, jam, jelly, syrupand also dried and brewed into tea and spice.

These are rich in carotene, riboflavin, anthocyanins, ascorbic acid, niacin, calcium, iron and vitamin C. The young leaves and tender stems of Roselle are consumed raw as green vegetable. The Roselle seeds are good source of protein, fat, total sugars and are widely used in the diet in many African countries.[1–18]

Table 1 Adopted from: Naturlan[7]

Nutrients	Calyxes	Seeds	Leaves
Protein [g]	2	28.9	3.5
Carbohydrates[g]	10.2	25.5	8.7
Fat [g]	0.1	21.4	0.3
Vitamin A [I.E.]	-	-	1000
Thiamine [mg]	0.05	0.1	0.2
Riboflavin [mg]	0.07	0.15	0.4
Niacin [mg]	0.06	1.5	1.4
Vitamin C [mg]	17	9	2.3
Calcium [mg]	150	350	240
Iron [mg]	3	9	5

Herbal medicine applications

Roselle is used in many folk medicines. It is valued for its mild laxative effect, ability to increase urination, relief during hot weather and treatment of cracks in the feet, bilious, sores and wounds.[1] Traditionally in Sudan, Roselle has been used for relief of sour throat and healing wounds.[17] In African folk medicine, Roselle leaves are used for their, antimicrobial, emollient, antipyretic, diuretic, anti-helmentic, sedative properties and as a soothing cough remedy, whereas in India, leaves are poultice on abscesses.[16,19]

Hypo- lipidemic effects: According to a study conducted among hyper-cholesterolemic patients, two capsules of Roselle extract (1g), given three times a day (for a total of 3g/day), significantly lowered serum cholesterol.[20] Another scientific study also confirmed that ethanolic extract from the leaves of Roselle significantly exhibit hypo-lipidemic effect.[21] Roselle extract was also studied among subjects, some with and some without metabolic syndrome. Subjects with metabolic syndrome receiving ethanolic extract of Roselle had significantly reduced glucose, total cholesterol and low density lipoprotein, while increasing high density lipoprotein.[22,23]

Blood pressure lowering effect: The effectiveness of an aqueous extract of Roselle on mild to moderate hypertension was investigated in many researches. Aqueous extract of Rosellewas as effective as captopril in treating mild to moderate hypertension and there is no adverse effect with the treatment, confirming the effectiveness and safety of the extract.[24,25] Even though the possible mechanism(s) of action of Roselle extract is not investigated, daily consumptionof an aqueous Roselle extract resulted in decrease in systolic and diastolic blood pressure.[26]

Anti diabetic activity:[27] Extracted the polyphenolic components of Roselle and studied their effect in a type II diabetic rat model (high fat diet model). Studied revealed anti-insulin resistance properties of extract at a dose level of 200mg/kg, and reduction in hyper glycaemia and hyper insulinemia. The extract was found effective in lowering serum cholesterol, triacylglycerol, the ratio of low density lipoprotein/high-density protein (LDL/HDL), and also (AGE) formation and lipid per oxidation. Intestinal α-glycosidase and pancreatic α-amylase help in digestion of complex carbohydrates present in the food into bioavailable monosaccharide and plays an important role in postprandial hyperglycaemia; therefore inhibition of these enzymes has been reported as an effective mechanism for the control of postprandial hyperglycaemia. Hibiscus acid (hibiscus-type (2S,3R)-hydroxycitric acid lactone) have been shown as a potent inhibitor of pancreatic α-amylase and intestinal α-glucosidase and pancreatic α-amylase activity.[28,29] In another study, Adisakwattanaet al.,[30] conducted an *in vitro* study and reported Roselle extracts as an effective inhibitor of pancreatic α-amylase.

Anti helmentic and anti microbial effects

Roselle is known for its antibacterial, antifungal and anti-parasitic actions. Oil extracted from seeds of Roselle has been shown to have an *in vitro* inhibitory effect on *Bacillus anthracis* and *Staphylococcus albus*.[31] Aqueous and ethanol extracts were also found to be effective against *Schistosoma mansoni* and other microorganisms.[32,33] Afolabi et al.,[34] demonstrated the antibacterial effect of hibiscus extract on *Streptococcus mutans*, a bacterium from oral cavity. In a similar study, antibacterial potential of hibiscus was also observed on *Campylobacter* species.[35] An ethanol extract of the dried leaves of Roselle reduce aflatoxin formation and have *in vitro* inhibitory effect against some fungi.[36,37]

Anti-oxidant effect: Protective property of a compound to inhibit the oxidative mechanisms by scavenging reactive oxygen and free radicals is known as antioxidative activity. It protects lining organelles from premature cell damage and reduces ageing. A large number of *invitro* and *invivo* studies have shown that Roselle calyxes contain potent antioxidant. According to Augustine,[38] both the whole aqueous and anthocyanin-rich extracts of Roselle are effective antioxidant. Studies have also highlighted that poly-phenolic acid, flavonoids and anthocyanins which are found in Roselle are potent antioxidants.[39]

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Other pharmacological effects: Roselle has been reported to possess a lactogenic activity. Okasha et al.,[40] observed enhancement in the serum prolactin level of lactating female Albino Rats on administration of seed extract of Roselle. Bako et al.,[41] studied the lactogenic effect of ethyl acetate fraction of *Hibiscus sabdariffa*, from 3-17days of lactation. The results showed an increase in serum prolactin level and milk production in lactating female albino rats, which confirms the lactogenic property of *Hibiscus sabdariffa.* Studies have shown that Roselle tea contains an enzyme inhibitor which blocks production of amylase and it is possible that drinking a cup of hibiscus tea after meals can reduce the absorption of dietary carbohydrates and assist in weight loss.[42] It was also reported that Roselle is considered as a possible anti-obesity agent.[43] Extracts from Roselle are also known to have effect on inflammatory disease[43] and cancer.[6]

Hibiscus tea

Hibiscus tea is caffeine free herbal tea from a special type of hibiscus, called *Hibiscus sabdarrifa* specifically, the tea is made out of the dried fruit part of Roselle, called calyx. It is in red color and tastes like berries.[44]

Steps in preparation of hibiscus tea

i. First, collect the hibiscus fruits and wash them clean, and air dry or dry them in an oven at 70 degree C for 3days.

ii. Peel off the calyx and store them in air-tight containers.

iii. To make tea, simply take 2grams of the dried calyx, and crash them into small pieces using a wooden roller.

iv. Put them in a tea bag or a net, bring out your favourite mug, add 8 oz of boiling water, steep it for 2-4minutes, add sugar if desired, or add other flavours of your choice such as few drops of lemon juice.

v. You can also refrigerate it and make hibiscus iced tea.[43]

Conclusion

Hibiscus sabdariffa or "Roselle" is medicinal plant with a worldwide fame. Roselle, having various medically important compounds called phytochemicals, is well known for its nutritional and medicinal properties. Seeds, leaves, fruits and roots of the plant are used as food and herbal medicine. Extracts from Roselle plays a crucial role in treating different medical problems including many cardiovascular disorders and cancer but further researches are required to know its exact mechanism of action and to formulate food products using Roselle with locally grown food items. Obesity is a growing problem, affecting not only adults but also children. The effectiveness of Roselle extract for metabolic disorders like type II diabetes should be examined further, as previous clinical studies have shown encouraging effects on hyperlipidemia and hypertension, conditions strongly correlated with type II diabetes or metabolic syndrome.[41]

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Conflict of interest

Author declares that there is no conflict of interest.

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