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An Outline on the Roselle (*Hibiscus sabdariffa L.*): A Functional Food with High Nutritional and Medicinal Competency

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Abstract

The main objective of this study is to substitute the amount of medicine intake with herbal remedies to minimize the hazards of medicines to some extent. Hibiscus sabdariffa L, also known as roselleis native to Asia and Africa.It has extensive commercial and nutritional properties which makes it a folk medicine and a highly significant functional food. The calyces of the plant can be dried and used to make tea and other beverages like wine and juice, and spices which is used as seasoning in desserts and confectionaries. Other commercial purposes where it can be used as a flavouring and colouring agent are jam, jellies, marmalade, syrup, gelatin and pudding. The seeds of this plant are used as a substitute for coffee. The presence of anthocyanins, polyphenols, gossypetin, flavonoids and antioxidants make it a potent anti-diabetic, anti-inflammatory, cholagogue, diuretic, anti-hyperlipidemic, anti-hypertensive, anti-bacterial, anti-cancerous, aphrodisiac, astringent agent. The content of vitamins and minerals is also very high which helps to treat scurvy, fever, dysuria, abscesses and bilious conditions. Hence, due to the wide range of applications of roselle, itcan be considered a nutraceutical and if consumed regularly, it can help to boost health and minimize lifestyle hazards.

KEYWORDS: Roselle, anti-hyperlipidemia, anti-hypertension, antioxidant, anti-inflammatory, polyphenol, antibacterial, aphrodisiac

INTRODUCTION

The Roselle plant (*Hibiscus sabdariffa L.*) plant, also known as red sorrel or Indian sorrel (in different parts of the world), is a truly remarkable plant with versatile uses. It is highly regarded for its abundant levels of antioxidants and vitamins, making it a common ingredient in cooking and in herbal medicine. Its resilient nature makes it easy to cultivate as it thrives in various soil and climate conditions. The plant's vibrant red flowers and distinct flavour add a unique touch to numerous dishes and teas. Moreover, the Roselle plant's leaves and stems are perfect for creating natural dyes for fabrics. It is a highly traded flower native to Africa that is mainly cultivated in parts of Sudan and Malaysia. Taxonomically it is placed in the genus Rosids, family Malvaceae and widely placed in the Kingdom Plantae. Roselle is grown as an annual or perennial tropical herb or shrub and is consumed in tropical countries as a processed food in the pharmaceutical industry and as an herbal remedy for hyperlipidaemia and hypertension. This plant possesses several medicinal properties, such as being anti-

inflammatory, antiviral, antibacterial, cytotoxic, hepato-protective, and a potent antioxidant, as evidenced by studies. Different parts of the roselleplant have different biological importance. [1,2] The calyces of the roselle plant are brilliant red and are rich in polyphenols, minerals, and Vitamin C. For optimal growth, roselle plants require a humid tropical and subtropical climate with full access to sunlight in sandy or loamy well-drained soil. However, it is important to note that this plant is susceptible to frost. All in all, the roselle plant is an exceptional addition to any garden or kitchen, with its diverse range of uses.

Fig-1: Roselle calyces and its application

AIMS AND OBJECTIVES

The study aims to perform a systematic review of the significance of roselle and its medicinal and nutritional benefits.The objective is to find out the shreds of evidence that prove roselle plant can be used as folk medicine to treat cardiac and nerve diseases and also proliferative diseases like cancer and considerably reduce hypertension. It has diuretic and mildly laxative effects and also acts as an antioxidant. The objective is also to find out whether Roselle's protein fractions and isolates can be used for protein biofortification in a variety of food products that can be consumed by consumers who are protein deficient. The roselle plant is commercially available in several forms either as a flavouring agent like as jam, jelly, juice, wine syrup, gelatin, pudding, bakery products, spices, pies, sauces, tarts and other dessert items or brewed into tea.

METHODOLOGY

This paper focuses on the review work with the fact-finding types by using scientific techniques. Most of the articles are reviewed from various literature studies derived from different sources of secondary data. The effectiveness of different parts of the roselle under various conditions needs to be proved by controlled studies in future.

USES OF ROSELLE IN COMMERCIAL AND PHARMACEUTICAL INDUSTRIES

Roselle is a valuable ingredient in the commercial and pharmaceutical industries. With its unique characteristics, Roselle is used in various applications, including food, cosmetics, and medicine. Its high nutritional value and medicinal properties make it popular in the food and medicinal industries, while its antioxidants and anti-inflammatory properties make it an ideal component in skincare products. Therefore, Roselle is an essential and versatile ingredient with limitless potential.

The anthocyanins present in roselle caused apoptosis of leukaemia cells through reactive species of oxygen-mediated mitochondrial pathways. A phenolic compound called Protocatechuic Acid (PCA) which was isolated from dried roselle flower was responsible for the inhibition of the proliferation of human promyelocytic leukemia (HL- 60). This pathway was induced via the reduction of retinoblastoma phosphorylation and downregulation of Bcl-2 protein expression. Roselle juice contains an anti-proliferative mechanism which was evaluated by using different cancer cell lines of the ovary (Caov-3), breast *(MCF-7, MDA-MB-231)* and cervix (HeLa). It was found that the roselle juice exhibited very strong anti-proliferative potential against MCF-7 cancer cells. Roselle helps to check the uncontrolled degeneration of tumour cells hence making it a potent anti-cancerous agent. Studies showed that *H. sabdariffa* can be used as a cancer chemo-preventive agent on estrogen-responsive breast cancer cells. The extracts from roselle are enriched with phytoestrogens like quercetin and daidzein, unlike other plants that diligently help to fight cancer. [1]

Extensive documents prove the fact that the calyces of *H.sabdariffa* can be used as a natural food colourant substitute for various artificial food colours.It was found that the water-soluble brilliant red colour of the calyces that are extracted from the aqueous extract of roselle is due to the presence of anthocyanins. The anthocyanins that were identified in calyces of roselle were delphinidin-3 sambubioside, cyanidin-3-sambubioside, and delphinidin-3-monoglucoside. [2]

The most beneficial effect of roselle is in the beverage industry where it is used to brew hold and old beverages like tea. The herbal tea that is made from roselle has a lot of qualities that boost our health. Moreover, it also has an ample number of uses in fermented drinks, jam, jellies, wine, confectionaries, chocolates, desserts and ice creams. It enhances the characteristic flavour and also nullifies the hazards of using artificial flavouring and colouring effects. [3]

Several secondary data and reports have shown the biochemical and molecular characterization of *Hibiscus sabdariffa L* and have identified the antioxidant effect and phenolic compounds of the plant. The test was performed using Folin-Ciocalteu reagent and DPPH assay. Roselle was found to have high phenolic content and is a potent antioxidant. Hence it can be considered of high economic value as it could be widely used in the food and pharmaceutical industry.The anthocyanins found showed thermal

resistance to some extent and they maintained good stability in colour even in acidic conditions when tested in different pH conditions. The amount of anti-oxidant capacity that was found was *(DPPH IC50 = 4.06 mg/ml and ABTS 1C50 = 3.7 mg/ml)*. The anti-oxidant helps to scavenge free radicals from our body and keep us healthy. [3]

In an article, when two distinct groups were taken, one as an experimental group containing hypertensive humans and one as the control group and an aqueous extract of roselle was administered to both groups. It was found that the hypertensive group showed a significant reduction in blood pressure difference in both systole and diastole than the control group. In another document,it was found that salt-induced hypertensive albino rats when treated with an aqueous extract of roselle and also with a hypertensive drug showed no significant differences in the result. Both reduced the blood pressure almost to equal levels which again proves the strong antihypertensive property of roselle. [4]In an investigation conducted by Nabil Elkafrawy on the lowering of blood pressure efficacy and safety of two doses of an herbal product of *Olea Europaea* leaves and calyces of *Hibiscus sabdariffa* in 134 patients of Egypt having grade 1 hypertension. After eight weeks the study showed that there was a visible decrease in the blood pressure of the patients [4].

The aqueous-methanolic extract of *H. sabdariffa* was investigated for its antimicrobial activity and cytotoxicity with the help of brine shrimp's lethality assay. The extract consisted of cardiac glycosides, flavonoids, saponins and alkaloids. It exhibited antibacterial activities *(MIC 0.30 ± 0.2- 1.30 ± 0.2 mg/ml)* against *Staphylococcus aureus*, *Bacillus stearothermophilus, Micrococcus luteus, Serratia mascences, Clostridium sporogenes, Escherichia coli, Klebsiella pneumoniae, Bacillus cereus, Pseudomonas* fluorescence. Its efficacy was also found against brine shrimps with an LC50 value of 55.1 ppm.[5].The anti-microbial activity of water extracted roselle strongly retarded the growth of *E.coli*whereas the ethanol extract of roselle functioned best against *Bacillus subtilis* and *Staphylococcus aureus*. Divya Jaroni concluded in his study that 4.6g extract of dry acetonic extract that was obtained from 100g of dehydrated roselle calyces showed potent anti-microbial activity against eight multidrug-resistant strains of *Salmonella* and *E.coli* hence proving roselle quite effective against pathogenic micro-organisms. [5]

The crude extract of roselle calyx showed anti-hyperlipidemic activity by following the mechanism of inhibiting the absorption of cholesterol in the intestine, disrupting lipoprotein production and enhancing the expression of hepatic LDL receptors which causes faster removal of LDL from the blood. It also increases the HDL levels in the blood which is considered good cholesterol and helps in preventing atherosclerosis or coronary heart disease.The lipid profile and creatininecan be maintained at optimum levels with the consumption of roselle products due to their anti-atherosclerotic and anti-hyperlipidemic action. [6]

Theanti-diabetic propertyof probiotic goatmilk supplemented with roselle extract was evaluated and the result revealed 87.72% inhibition of diabetes at 25%

concentration.From this, it can be concluded that the yoghurt milk biofortified with roselle extract is a highly potent anti-diabetic treatment among all other diabetes treatments. The anti-diabetic property is due to the presence of anthocyanins, flavonoids and phenolic acids. Roselle plant ethanol extract possesses inhibitory activity against α-glucosidase, β-glucosidase and α-amylase which are responsible for the increase of glucose concentration in the blood. [7]

The diuresiscaused by roselle plant extract acts on the renal hemodynamics which is the effect of increased glomerular filtration rate.The aqueous extract of *Hibiscus sabdariffa* contains a compound known as quercetin which acts on vascular endothelium and releases nitric oxide which increases kidney infiltration resulting in renal vasorelaxation. The nitric oxide mediates the diuretic effect of the roselle plant.The roselle plant has its unique composition which comprises gossypetin, glycoside hibiscin and anthocyanin which promotes its choleretic and diuretic effects. They stimulate intestinal peristalsis and reduce hypertension. [8]

The immunomodulatory function of alcoholic aqueous extract from the dried calyces of roselle showed that they increased the secretion of IL-10 and reduced the tumour necrosis factor TNF- alpha.The polyphenols that are present in *Hibiscus sabdariffa* namely catechins, protocatechuic acid and caffeic acid induced cyclo-oxygenase-2 by negative regulation of JNK and protein 38 nitrogen-activated kinases paths(p38 MAPK) hence making an anti-inflammatory property more effective.They retard the production of proinflammatory cytokines and help reduce inflammation. [9]

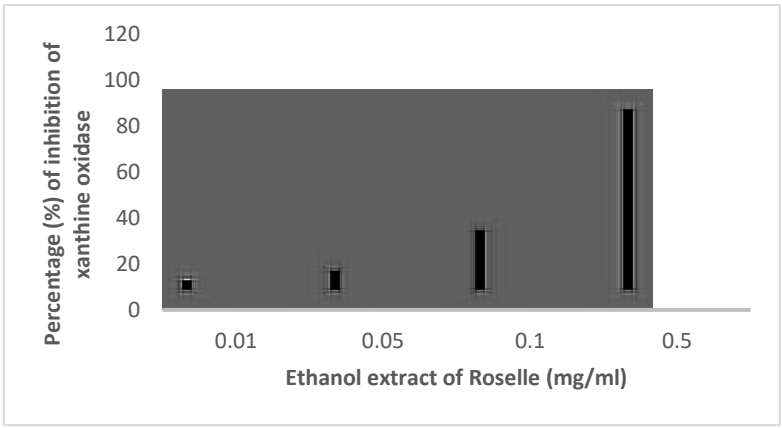

Fig-2: Effect of different dosages of ethanol extract of Roselle in the inhibition of xanthine oxidase

In the Fig-2 Assay on Xanthine oxidase inhibition is performed on ethanol extracts and their fraction using various variants of concentration of Roselle, which aims atsupervising theeffects of inhibition on xanthine oxidase enzyme. The x-axis shows the amount of Roselle extract taken in (mg/ml) and the y-axis implies the percentage of xanthine oxidase that is decreased by the effect of treatment with roselle extract. Excessive production of xanthine oxidase causes an increase in the level of uric acid in

our body. This causes gout and acute inflammatory problems. The above figure states that an optimum amount of roselle plant extract of 0.5 mg/ml can cause upto 96% decrease in the concentration of xanthine oxidase which further reduces the risks of gout.

H. sabdariffa is enriched with vitamins, natural carbohydrates, protein, tannins, gums, minerals and other antioxidants. It is used as a recovery aid for abscesses, bilious conditions, cough, sores, wounds, dysuria and scurvy. Roselle plant extracts give relief from pancreatic disturbances and cholecystitis by discharging bile from the system.[10]. It has various other applications such as aphrodisiac, astringent, cholagogue**,** demulcent, purgative, resolvent, antiseptic, demulcent, resolvent and digestive. The cholerectic property of roselle is due to the presence of gossypetin, anthocyanin glycoside, hibiscin and citric acid in its calyces. [11]

CONCLUSION

After studying the literature review in details, it is evident that the roselle plant offers an abundance of versatility, boasting both commercial and medicinal qualities. Its fleshy red calyces are especially valuable, as they can be transformed into a diverse range of products, including wine, juice, jam, jelly, and even ice cream. Furthermore, the plant's roasted seeds are an excellent alternative to coffee, and although its young root is fibrous, it is still edible. This herb is renowned for its cooling, aromatic properties, and its leaves offer a variety of potential health benefits, including their antiscorbutic, emollient, and diuretic properties. The plant's flowers also contain several compounds that possess diuretic and choleretic effects, which can contribute to reducing blood pressure and stimulating intestinal peristalsis. Roselle is an exceptional natural colouring and flavouring agent, as well as a traditional remedy for heart ailments, scurvy, and fever due to its high antioxidant and antimicrobial properties.Overall, roselle holds tremendous potential not just for human nutrition and healthcare, but also for use in the pharmaceutical and food industries.

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