*Indian Journal of Hill Farming 27(1): 81-90*

# Medicinal Uses of Roselle Plant (*Hibiscus sabdariffa* L.): A Mini Review

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Received 8.6. 2014, Revised 28.6.2014, Accepted 30.6.2016

## ABSTRACT

The use of herbal extracts and nutritional supplements either as alternative or complementary medicine for treatment of diseases is well documented in various cultures such as Ayurveda in India and traditional Chinese medicine system. Medicinal plants as natural antimicrobial agents are gaining popularity. Roselle plant (*Hibiscus sabdariffa*) Linne (Malvaceae) has been used in folk medicine as a diuretic, mild laxative, and treatment for cardiac and nerve diseases. Herein we discussed some of the recent studies on its various activities.

**Keywords:** Antioxidant, Antihypertensive, Antimicrobial, Anticancerous

## INTRODUCTION

Roselle plant, with an attractive flower believed to be native to Africa, is cultivated in Sudan, India, Malaysia and Taiwan. It is an annual or perennial herb or woody-based sub-shrub, growing to 2-2.5 m tall. The leaves are deeply 3-5 lobed, 8-15 cm long, arranged alternately on the stems. The flowers are 8–10 cm in diameter, white to pale yellow with a dark red spot at the base of each petal, and have a stout fleshy calyx at the base, 1-2 cm wide, enlarging to 3-3.5 cm, fleshy and bright red as the fruit matures. It takes about six months to mature. In some places, the plant is primarily cultivated for the production of bast fibre from the stem of the plant. The fibre may be used as a substitute for jute in making burlap. The red calyces of the plant are used as food colourings and dyes. Today, roselle is attracting the attention of food and beverage manufacturers and pharmaceutical concerns who feel it may have exploitable possibilities as a natural food product for herbal medicine and as a colorant to replace some synthetic dyes.

*Nutritive value*

The nutritional analysis of roselle plant by proximate method (Luvonga et al. 2010) found the carbohydrate content (68.7%) was highest followed by crude fibre (14.6%) and ash content (12.2%) and others. The plant is also found to be rich in minerals especially potassium and magnesium. Vitamins (ascorbic acid, niacin and pyridoxine) were also present in appreciable amounts. Various workers (Nnam and Onyeke 2003; Ojokoh 2006; Falade et al. 2005; Adanlawo and Ajibade 2006) reported variable content suggesting that the type of soil influences its ash and mineral content causing variations within the same species (Carvajal et al. 2012). It has long been used in herbal tea to treat hypertension, pyrexia and liver damage although the pharmaceutical components are poorly defined (Hou et al. 2005). Nutritional studies have indicated that low consumption of fruits and vegetables is consistently related to an increased incidence of cancer (Choi and Mason, 2000) reflecting dietary habits. The component in fruits and vegetables like polyphenol and anthocyanin may be responsible for the reduced risk of cancer (Weisburger and Chung 2002; Mei et al. 2005; Lin et al. 1999; Wang et al. 2003; Gao et al. 2002; Briviba et al. 2001). Plants have the capacity of producing secondary metabolites like proteins, steroids, alkaloids, etc (Sharaniah et al. 2013) that will enhance its nutritive value.

*Antimicrobial properties*

Roselle is widely used for the treatment of diseases. Olaleye (2007) used the aqueous-methanolic extract of roselle to investigate its phytochemical constituents, antimicrobial activity and cytotoxicity, and reported that the extract contained cardiac glycosides, flavonoids, saponins and alkaloids. It exhibited antibacterial activities against *Staphylococcus aureus, Bacillus stearothermophilus, Micrococcus luteus, Serratia mascences, Clostridium sporogenes, Escherichia coli, Klebsiella, pneumoniae, Bacillus cereus, Pseudomonas fluorescence.* The results support the use of this plant in the treatment of diseases like abscesses, bilious conditions, cancer and coughs in traditional medicine, and also suggest the possibility of isolating antibacterial and anticancer agents while the antimicrobial activity on Escherichia coli O157:H7, *Salmonella enterica* and *Listeria monocytogenes* isolates from food, veterinary, and clinical samples by Fullerton (2011) indicated that roselle extract was effective and suggest the

application of extracts as potential antimicrobials in foods. The antibacterial effects of roselle calyx aqueous and ethanol extracts and protocatechuic acid against food spoilage bacteria Salmonella Typhimurium DT104, *Escherichia coli* O157:H7, *Listeria monocytogenes*, *Staphylococcus aureus* and *Bacillus cereus* were examined by Chau et al. (2008) and shown the inhibitory activity in dose-dependent manner against test bacteria in ground beef and apple juice and suggested that it might be potent agents as food additives to prevent contamination from these bacteria.

*Antioxidant properties*

Roselle - Hibiscus anthocyanins (HAs) which are a group of natural pigments existing in the dried calyx exhibited antioxidant activity and liver protection. HA antioxidant bioactivity in rat primary hepatocytes and hepatotoxicity was studied by Wang et al. (2000). The results demonstrated that HAs, at the concentrations of 0.10 and 0.20mg/ml, significantly decreased the leakage of lactate dehydrogenase and the formation of malondialdehyde and significantly lowered the serum levels of hepatic enzyme markers (alanine and aspartate aminotransferase) and reduced oxidative liver damage. The histopathological evaluation of the liver revealed that roselle pigments reduced the incidence of liver lesions including inflammatory leucocyte infiltration, and necrosis induced by tert-butyl hydroperoxide (t-BHP) in rats. An antioxidative activity was also reported in cancerous cell lines (Akim et al. 2011). In animal models (McKay et al. 2011), extracts of its calyces have demonstrated hypocholesterolemic and antihypertensive properties irrespective of age, gender or dietary supplement used. The antioxidant potential of three fractions of the ethanol crude extract (HS-C: chloroform-soluble fraction; HS-E: ethylacetate soluble fraction; HS-R: residual fraction) obtained from the dried flowers were evaluated by Tseng et al. (1997) for their capacity to quench free radicals and inhibiting xanthine oxidase (XO) activity. HS-E showed the greatest capacity of scavenging free radical, and HS-C showed the strongest inhibitory effect on XO activity. Furthermore, antioxidant bioactivities of these crude extracts were investigated in rat primary hepatocytes. All fractions were found to inhibit significantly the unscheduled DNA synthesis (UDS). These results indicated that the dried flower extracts (HS-C and HS-E) protect rat hepatocytes from t-BHP-induced cytotoxicity and

genotoxicity. The study on hepatoprotective and antioxidant effects on the carbon tetrachloride ($CCl_4$)-induced hepatocyte damage in fish by Yin et al. (2011) provided evidence of potential use as a medicine for curing liver diseases in aquaculture as roselle extract significantly elevated levels of lactate dehydrogenase (LDH), glutamate oxalate transaminase (GOT), glutamate pyruvate transaminase (GPT), and malondialdehyde (MDA) and significantly reduced levels of superoxide dismutase (SOD) and glutathione peroxidase (GSH-Px).

*Anticancerous properties*

The antiproliferative activities of roselle juice were evaluated by Akim et al. (2011) using different cell lines like ovarian (Caov-3), breast (MCF-7, MDA-MB-231) and cervical (HeLa) cancer cell lines and found that it exhibited the strongest anti-proliferative potency towards the MCF-7 cancer cells. The effects on human cancer cells (HL-60) studied by Chang et al. (2005) using roselle-anthocyanins (HA) showed apoptosis of cells in a dose- and time-dependent manner. It also revealed increased phosphorylation in p38, c-Jun and cytochrome c release, and expression of tBid, Fas, and FasL genes indicating that it could be developed as chemopreventive agents. However, Hou et al. (2005) reported the apoptosis of leukemia cells induced by anthocyanin is through reactive oxygen species mediated mitochondrial pathways. Protocatechuic acid (PCA), a phenolic compound isolated from the dried flower, was found to inhibit the survival of human promyelocytic leukemia (HL-60) in a concentration and time dependent manner (Tseng et al. 1997), and apoptosis is induced via reduction of retinoblastoma phosphorylation and down regulation of Bcl-2 protein expression (Tseng et al. 2000). The study revealed that cells underwent intranucleosomal DNA fragmentation and morphological changes characteristics of apoptosis while the action against gastric carcinoma cells by inducing apoptosis is through JNK/MAPK signaling pathways (Lin et al. 2007). The methanolic extract of roselle on seven cancer lines (Lin et al. 2005) implied the AGS cancer cells being most susceptible in concentration-dependant form affecting both the intrinsic and extrinsic apoptotic routes.

*Effect on lipid metabolism*

The effect of roselle on lipid profile, creatinine and serum electrolytes has been studied by Abbas et al. (2011) in hypertensive patients and reported the upward trend of total cholesterol and high density lipid (HDL) which is significant since HDL-Cholesterol is a protective factor for coronary heart diseases. Kirdpon (1994) evaluated the changes of urine in normal patients after consuming roselle juice in different concentrations and durations which may help the treatment and prevention of renal stone disease, and reported a decrease of creatinine, uric acid, citrate, tartrate, calcium, sodium, potassium and phosphate but not oxalate in urinary excretion.

*Antihypertensive effect*

The consequence of hypertension is implicated in the development of cerebrovascular diseases, cardiac ischemia as well as cardiac and renal failure, and is now considered a global health problem. The studies on the efficacy of aqueous extract in hypertensive human (Faraji et al. 1999) showed significant reduced pressure difference in both systolic and diastolic compared to control group, while Mckay et al. (2010) found the decrease in systolic pressure significant, the diastolic pressure remained unchanged. Studies were also conducted in rats (Onyenekwe et al. 1999; Odigie et al. 2003; Ajay et al. 2007), and findings support the popular belief that roselle extract contains antihypertensive constituents. The anthocyanins extract investigated for its therapeutic efficacy, safety and tolerability along with antihypertensive drug captopril (Herrera-Arellano et al. 2004), lisinopril (Herrera-Arellano et al. 2007) in humans found the results comparable and suggest the synergistic mechanism of diuretic and ACE inhibition results in exerting hypotensive effects.

*Effect on domestic animal studies*

Few studies in animals have been reported. Roselle extract as acidifiers has been shown by Aphirakchatsakun et al. (2008) in post weaning pig with the ability to increase trypsin activity, fat digestibility and improve feed conversion ratio (FCR). In poultry, the effect of roselle calyx in layer diets on egg production performance, egg quality and Thiobarbituric acid reactive substances (TBARS) value in plasma and yolk was studied by Piyaphon et al. (2011) to check the lipid peroxidation as a result of degradation of fats.

Storage time of extract was found to be an important factor to decrease egg quality and increase TBARS value in yolk.

*Future approach*

Among the properties reported to date, its effect on lipid metabolism, antihypertensive action and apoptosis are largely studied. Some studies on its antimicrobial effects were also documented. Therefore, with many enriching chemical-biological knowledge from animal and human models using plant extracts, future studies with greater scientific robustness in terms of standardization of dose for its effectiveness, safety and tolerability will permit the formulation of safe, effective therapeutic herbal formulations which can be used as an acceptable source for curing many health issues and restoring general health.

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