E-ISSN: 2706-8927
P-ISSN: 2706-8919
www.allstudyjournal.com
IJAAS 2024; 6(7): 154-157
Received: 17-05-2024
Accepted: 22-06-2024

Aradhana Goswami
Research Scholar, Department of Botany, S.G.S. Govt. P.G. College, Sidhi, Madhya Pradesh, India

IP Kumhar
Professor, Department of Botany, S.G.S. Govt. P.G. College, Sidhi, Madhya Pradesh, India

M Salim
Retd. Professor and Head, Department of Botany, S.G.S. Govt. P.G. College, Sidhi, Madhya Pradesh, India

Corresponding Author:
Aradhana Goswami
Research Scholar, Department of Botany, S.G.S. Govt. P.G. College, Sidhi, Madhya Pradesh, India

Medicinal use of *Hibiscus sabdariffa* L.

Aradhana Goswami, IP Kumhar and M Salim

DOI: https://doi.org/10.33545/27068919.2024.v6.i7a.1234

Abstract
The utilization of herbal extracts and dietary supplements for treating diseases is well-documented in different cultures like Ayurveda in India and traditional Chinese medicine system. There is a growing trend in using medicinal plants as natural antimicrobial agents. *Hibiscus sabdariffa* L. (Malvaceae) has been traditionally used for its diuretic, mild laxative, and therapeutic properties for cardiac and nervous system disorders in folk medicine. In this article, we have highlighted some recent research on the diverse benefits of this plant.

Keywords: Antioxidant, antihypertensive, antimicrobial, anticancerous

Introductions
Hibiscus sabdariffa, also known as the Ambari plant, is a plant with a beautiful flower that is thought to originate from Africa. It is grown in various countries including Sudan, India, Malaysia, and Taiwan. The plant can be either an annual or perennial herb, or a woody-based sub-shrub, reaching heights of 2-2.5 meters. Its leaves are deeply 3-5 lobed, measuring 8-15 cm long, and are 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 thick fleshy calyx that is 1-2 cm wide at the base, expanding to 3-3.5 cm, becoming fleshy and bright red as the fruit ripens. The plant takes approximately six months to reach maturity. In certain regions, the primary cultivation of the plant is for the production of bast fiber from the stem, which can be used as a replacement for jute in burlap production. The red calyces of the plant are utilized as food colorings and dyes. Presently, Ambari is gaining interest from food and beverage manufacturers as well as pharmaceutical companies who believe it has potential as a natural food product for herbal medicine and as a coloring agent to substitute some synthetic dyes.

Nutritive value
The proximate method was used to conduct a nutritional analysis (Luvonga *et al.* 2010) [1] of the Ambari plant, revealing that it had the highest carbohydrate content at 68.7%. Following closely behind were crude fiber at 14.6% and ash content at 12.2%, among others. The plant was noted for its high mineral content, particularly potassium and magnesium. Additionally, significant amounts of vitamins such as ascorbic acid, niacin, and pyridoxine were also found in the plant. Various workers (Nnam and Onyeke 2003; Falade *et al.* 2005; Adanlawo and Ajibade 2006 and Ojokoh 2006) [2-5] 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) [6]. 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) [7]. Nutritional studies have indicated that low consumption of fruits and vegetables is consistently related to an increased incidence of cancer (Choi and Mason, 2000)[8] 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) [9-13]. Plants have the capacity of producing secondary metabolites like proteins, steroids, alkaloids, etc. (Sharaniah *et al.* 2013) [14] that will enhance its nutritive value.

Antimicrobial properties
Ambari is widely used for the treatment of diseases. Olaleye (2007) [15] used the researchers

used an aqueous-methanolic extract of Ambari to study its phytochemical components, antimicrobial effects, and cytotoxicity. They found 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) [16] indicated that Ambari extract was effective and suggest the application of extracts as potential antimicrobials in foods. The antibacterial effects of Ambari 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) [17] 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

Ambari - 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) [18]. 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 Ambari 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) [19]. In animal models (McKay *et al.* 2010) [20], 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) [21] 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) [22] provided evidence of potential use as a medicine for curing liver diseases in aquaculture as Ambari 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 Ambari juice were evaluated by Akim *et al.* (2011) [19] 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 antiproliferative potency towards the MCF-7 cancer cells. The effects on human cancer cells (HL-60) studied by Chang *et al.* (2005) [23] using Ambari - 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) [7] 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 (HL60) in a concentration and time dependent manner (Tseng *et al.* 1997) [21], and apoptosis is induced via reduction of retinoblastoma phosphorylation and down regulation of Bcl-2 protein expression (Tseng *et al.* 2000) [24]. 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) [25]. The methanolic extract of Ambari on seven cancer lines (Lin *et al.* 2005) [26] 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 Ambari on lipid profile, creatinine and serum electrolytes has been studied by Abbas *et al.* (2011) [27] 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) [28] evaluated the changes of urine in normal patients after consuming Ambari 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

Hypertension is connected to the occurrence of cerebrovascular diseases, heart ischemia, and heart and kidney failure, resulting in it being recognized as a worldwide health issue. The studies on the efficacy of aqueous extract in hypertensive human (Haji-Faraji and Haji-Tarkhani, 1999) [29] showed significant reduced pressure difference in both systolic and diastolic compared

to control group, while Mckay *et al.* (2010) [20] 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) [30-32], and findings support the popular belief that Ambari 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) [33], lisinopril (Herrera-Arellano *et al.* 2007) [34] 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. Ambari extract as acidifiers has been shown by Aphirakchatsakun *et al.* (2007) [35] in post weaning pig with the ability to increase trypsin activity, fat digestibility and improve feed conversion ratio (FCR). In poultry, the effect of Ambari 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) [36] 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

Its impact on lipid metabolism, antihypertensive properties, and induction of apoptosis have been extensively investigated among the properties reported so far. There have also been some research findings on its antimicrobial properties. As a result, future research studies utilizing plant extracts on animal and human models have the potential to provide valuable chemical-biological insights. These studies can help in establishing safe and effective herbal formulations for treating various health conditions and promoting overall well-being, provided that there is a focus on standardizing dosage levels to ensure efficacy, safety, and tolerability.

Acknowledgement

Authors are thankful to authority of colleges for providing necessary facilities to carryout this work.

References

1. Luvonga WAL, Njorge MS, Makokha A, Ngunjiri PW. Chemical characterization of *Hibiscus sabdariffa* (Roselle) calyces and evaluation of its functional potential in the food industry. Proceeding of JKUAT Scientific and Industrial Conference. Kenya; c2010. p. 631-638.
2. Nnam NM, Onyeke NG. Chemical compositions of two varieties of sorrel (*Hibiscus sabdariffa* L.), calyces and the drinks made from them. Plant Foods Hum Nutr. 2003;58:1-7.
3. Falade OS, Otemuyiwa IO, Oladipo A. The chemical composition and membrane stability activity of some herbs used in local therapy for anemia. J Ethnopharmacol. 2005;102:15-22.
4. Adanlawo IG, Ajibade VA. Nutritive value of the two varieties of roselle (*Hibiscus sabdariffa*) calyces soaked with wood ash. Pak J Nutr. 2006;5:555-557.
5. Ojokoh AO. Roselle (*Hibiscus sabdariffa*) calyx diet and histopathological changes in liver of albino rats. Pak J Nutr. 2006;5:110-113.
6. Carvajal O, Maria D, Dremitriz B, Flores ZO, Margaret P, Jones H. *Hibiscus sabdariffa* L., roselle calyx, from ethnobotany to pharmacology. J Expt Pharmacol. 2012;4:25-39.
7. Hou D, Tong X, Terahara N, Luo D, Fujii M. Dephinidin 3-sambubioside, a *Hibiscus* anthocyanin, induces apoptosis in human leukemia cells through reactive oxygen species-mediated mitochondrial pathway. Arch Biochem Biophys. 2005;440:101-109.
8. Choi SW, Mason JB. Folate and carcinogenesis: an integrated scheme. J Nutr. 2000;130:129-132.
9. Weisburger JH, Chung FL. Mechanisms of chronic disease causation by nutritional factors and tobacco products and their prevention by tea polyphenols. Food Chem Toxicol. 2002;40:1145-1154.
10. Mei Y, Wei D, Liu J. Modulation effect of tea polyphenol toward N-methyl-N-nitro-N-nitrosoguanidine-induced precancerous gastric lesion in rats. J Nutr Biochem. 2005;16:172-177.
11. Lin JK, Liang YC, Lin-Shiau SY. Cancer chemoprevention by tea polyphenols through mitotic signal transduction blockade. Biochem Pharmacol. 1999;58:911-915.
12. Wang S, DeGroff VL, Clinton SK. Tomato and soy polyphenols reduce insulin-like growth factor-I-stimulated rat prostate cancer cell proliferation and apoptotic resistance *in vitro* via inhibition of intracellular signaling pathways involving tyrosine kinase. J Nutr. 2003;133:2367-2376.
13. Gao X, Xu YX, Divine G, Janakiraman N, Chapman RA, Gautam SC. Disparate *in vitro* and *in vivo* antileukemic effects of resveratrol, a natural polyphenolic compound found in grapes. J Nutr. 2002;132:2076-2081.
14. Sharanaiah U, Shirin M, Mohammed A. Antioxidant and antidiabetic activities of medicinal plants: a short review. J Res Phytochem Pharmacol. 2013;3(1):40-53.
15. Olaleye MT. Cytotoxicity and antibacterial activity of methanolic extract of *Hibiscus sabdariffa*. J Med Plant Res. 2007;1:9-13.
16. Fullerton M, Khatiwada J, Johnson JU, David S, William LL. Determination of antimicrobial activity of sorrel (*Hibiscus sabdariffa*) on *E. coli* O157 isolated from food, veterinary and clinical samples. J Med Food. 2011;14(9):950-956.
17. Chau C, Yin M. Antibacterial Effects of Roselle Calyx Extracts and protocatechuic Acid in Ground Beef and Apple Juice. Foodborne Pathogen Dis. 2008;6(2):201-206.
18. Wang CJ, Wang JM, Lin WL, Chu CY, Chou FP, Tseng TH. Protective effects of Hibiscus anthocyanins against tert-butyl hydroperoxide-induced hepatic toxicity in rats. Food Chem Toxicol. 2000;38:411-416.
19. Akim A, Lim CH, Asmah R, Zanainaul AZ. Antioxidant and anti-proliferative activities of Roselle juice on Caov-3, MCF-7, MDA-MB-231 and Hela cancer cell lines. Afri J Pharma Pharmacol. 2011;5(7):957-965.
20. Mckay DL, Chen CY, Saltzman E, Blumberg JB. *Hibiscus sabdariffa* L. tea (tisane) lowers blood

pressure in prehypertensive and mildly hypertensive adults. J Nutr. 2010;140:298-303.
21. Tseng TH, Kao ES, Chu CY, Chou FP, Lin WHW, Wang CJ. Protective effects of dried flower extracts of *Hibiscus sabdariffa* L. against oxidative stress in rat primary hepatocytes. Food Chem Toxicol. 1997;35:1159-1164.
22. Yin G, Cao I, Xu P, Jenny G, Nakao M. Hepatoprotective and antioxidant effects of *Hibiscus sabdariffa* extract against carbon tetrachloride-induced hepatocyte damage in Cyprinus carpio. *In vitro* Cellular Develop Biol Animal. 2011;47:10-15.
23. Chang YC, Huang HP, Hsu JD, Wang CJ. Hibiscus anthocyanins rich extract-induced apoptotic cell death in human promyelocytic leukemia cells. Toxicol Appl Pharm. 2005;205:201-212.
24. Tseng T, Kao T, Chu C, Chou F, Lin W, Wang C. Induction of apoptosis by *Hibiscus* protocatechuic acid in human leukemia cells via reduction of retinoblastoma (RB) phosphorylation and Bcl-2 expression. Biochem Pharmacol. 2000;60:307-315.
25. Lin H, Chen J, Kuo W, Wang C. Chemopreventive properties of *Hibiscus sabdariffa* L. on human gastric carcinoma cells through apoptosis induction and JNK/p38 MAPK signaling activation. Chemico-Biol Interact. 2007;165:59-75.
26. Lin H, Huang H, Huang C, Chen J, Wang C. Hibiscus poylphenol rich extract induces apoptosis in human gastric carcinoma cells via p53 phosphorylation and p38 MAPK/ FasL cascade pathway. Mol Carcinog. 2005;43:86-99.
27. Abbas M, Shirin M, Patricia K, Mohammad GK. The effect of *Hibiscus sabdariffa* on lipid profile, creatinine and serum electrolytes: A randomized clinical trial. ISRN Gastroenterol. 2011:1-4.
28. Kirdpon S. Changes in urinary chemical composition in healthy volunteers after consuming roselle (*Hibiscus sabdariffa*) juice. J Med Assoc Thai. 1994;77(6):314-21.
29. Haji-Faraji MH, Haji-Tarkhani AH. The effect of sour tea (*Hibiscus sabdariffa*) on essential hypertension. J Ethnopharmacol. 1999;65:231-236.
30. Onyenekwe PC, Ajani EO, Ameh DA. Antihypertensive effect of roselle (*Hibiscus sabdariffa*) calyx infusion in spontaneously hypertensive rats and a comparison of its toxicity with that in Wistar rats. Cell Biochem Funct. 1999;17:199-206.
31. Odigie IP, Ettarh RR, Adigun SA. Chronic administration of aqueous extract of *Hibiscus sabdariffa* attenuates hypertension and reverses cardiac hypertrophy in 2K-1 hypertensive rats. J Ethnopharmacol. 2003;86:181-185.
32. Ajay M, Chai HJ, Mustafa AM. Mechanisms of the anti-hypertensive effect of *Hibiscus sabdariffa* L. calyces. J Ethnopharmacol. 2007;109:338-393.
33. Herrera-Arellano A, Flores-Romero S, Chávez-Soto MA. Effectiveness and tolerability of a standardized extract from *Hibiscus sabdariffa* in patients with mild moderate hypertension: a controlled and randomized clinical trial. Phytomed. 2004;11:375-382.
34. Herrera-Arellano A, Miranda-Sanchez J, Avila-Castro P, *et al*. Clinical effects produced by a standardized herbal medical product of *Hibiscus sabdariffa* on patients with hypertension. A randomized, double-blind, lisinopril-controlled clinical trial. Planta Med. 2007;73:6-12.
35. Aphirakchatsakun W, Kris A, Suwanna K. The effect of Roselle (*Hibiscus sabdariffa* Linn.) calyx as antioxidant and antihyperlipidemic activities in rats. Proceedings of the 41st Kasetsart University Annual Conference. Bangkok. 2003;171-179.
36. Hirunpanich V, Utaipat A, Morales NP, *et al*. Hypocholesterolemic and antioxidant effects of aqueous extracts from the dried calyx of *Hibiscus sabdariffa* L. in hypercholesterolemic rats. J Ethnopharmacol. 2006;103:252-260.
37. Nwachukwu U. Impact of *Hibiscus sabdariffa* calyx infusion on lipids and lipoproteins in adults with metabolic syndrome. J Nutr. 2012;42:238-245.
38. Okereke CE, Ijeoma EU. Hypocholesterolemic effects of *Hibiscus sabdariffa* Linn. and *Zingiber officinale* Roscoe in rats. Afr J Biotechnol. 2006;5:1-9.
39. Ubaoji KI, Eze EO, Achi OK. An evaluation of the hypolipidemic property of aqueous extract of *Hibiscus sabdariffa* calyx in albino rats. J Med Plant Res. 2008;2:370-373.
40. Chiu TH, Chen K, Yu B, Ko T, Lin T, Chen HY. *Hibiscus sabdariffa* extract reduces serum cholesterol in men and women. Nutr Res. 2004;24:575-581.
41. Chen CC, Hsu JD, Wang SF, *et al*. *Hibiscus sabdariffa* extract inhibits the development of atherosclerosis in cholesterol-fed rabbits. J Agric Food Chem. 2003;51:5472-5477.
42. Ali BH, Mousa HM, El-Mougy S. The effect of a water extract and anthocyanins of *Hibiscus sabdariffa* L. on paracetamol-induced hepatotoxicity in rats. Phytother Res. 2003;17:56-59.
43. Mohamed R, Fernandez J, Pineda M. Roselle (*Hibiscus sabdariffa*) seed oil is a rich source of gamma-tocopherol. J Food Sci. 2007;72:207-211.
44. Alarcon-Aguilara FJ, Roman-Ramos R, Perez-Gutierrez S, *et al*. Study of the antihyperglycemic effect of plants used as antidiabetics. J Ethnopharmacol. 1998;61:101-110.
45. Faraji MH, Tarkhani AH. The effect of sour tea (*Hibiscus sabdariffa*) on essential hypertension. J Ethnopharmacol. 1999;65:231-236.