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Nutritional and Therapeutic uses of Hibiscus Rosasinensis

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Abstract
Hibiscus rosa sinensis is a common flower found in many parts of the world. Yet only a few people are aware of its health benefits. Indian Ayurvedic medicine has recognized the medicinal effects of this flower long ago and recommends its use in treating many ailments. Chinese herbology also considers medicinal value of this plant. Various parts of the plant are rich in phytonutrients which can be attributed for its medicinal properties. It contains polysaccharides, anthocyanins, flavonoids, pectin and organic acids such as malic acid, citric acid, and tartaric acid. The leaves and flowers of Hibiscus rosa-sinensis Linn. (Family Malvaceae) have been used in ethnomedicine for the treatment of various human diseases such as aphrodisiac, hypertension, wound healing, skin disease, hair disease, diabetes mellitus and cancer.

Keywords: hibiscus, ailments, herbology, attributed

1. Introduction
Hibiscus rosa-sinensis are native to Tropical Asia. A native of Southeastern Asia (China), the plant is commonly found throughout the tropics and as a house plant throughout the world [41]. Hibiscus rosa-sinensis, commonly known as Hawaiian hibiscus or Chinese hibiscus, is an evergreen, glabrous shrub, belonging to the Malvaceae family [18]. The edible flower is defined as non-toxic, innocuous flowers with health benefits consumed in human diet [24]. Edible flowers impart unique and powerful color, flavor and aroma to the food, and therefore have gained popularity in the culinary world as an innovative ingredient [18]. Traditionally The plant Hibiscus rosasinensis is a perennial shrub with tap root. The leaves at 3.5-12 cm. In length and 2-5.5 cm wide. Leaves are simple ovate or ovate-lanceolate. Leaves are entire at the base and coarsely toothed at the apex. Taste is mucilaginous. Flowers are pedicillate, Actinomorphic, pentamerous and complete. Corolla consists of 5 petals, red in colour and about 3 inches in diameter, generally available in many areas within its hardiness range [21]., several plants and their products have been used in foods (as herbs or spices) as a mode of natural preservative, flavoring agent as well as a remedy to treat some of the common ailments in humans [44]. This property of curing is attributed mainly to their antimicrobial activities. Use of natural plant derived antimicrobials can be highly effective in reducing the dependence on antibiotics, minimize the chances of antibiotic resistance in food borne pathogenic microorganisms as well as help in controlling cross-contaminations by food-borne pathogens [44]. In addition to the antioxidant and antimicrobial activities exhibited by plants or their extracts, they can also be used as natural colorants of foodstuffs; as in most of the cases, they are believed to be safe, and non-toxic to humans [32, 9,16]. Of late, many reports are available wherein flowers or their extracts have been shown to exhibit rich antioxidant and antimicrobial properties [36, 20, 44]. Hibiscus rosa-sinensis L. (family; Malvaceae) is a profusely flowering, perennial, woody ornamental shrub distributed widely in the tropical regions. Previous studies have indicated H. rosa-sinensis to possess bioactive properties and is recommended to be used as an herbal alternative to cure many diseases [30].

2. Nutritional analysis
Fresh flowers
It was found that fresh Hibiscus rosa-sinensis flowers had 83.00 per cent moisture, 1.54 g protein and 0.35 g fat. Total ash was 1.40 g / 100 g, crude fibre was 1.50 g and carbohydrate was 13.71 g per 100 g. Among vitamins the flowers had β-carotene (54.02 µg) and vitamin C (7.502 mg). The results of mineral analysis showed that fresh flowers had 4.32 mg of calcium, 236.45 mg potassium, 1.48 mg of iron and 0.82 mg zinc. These results are comparable with the findings of 18. who reported that the edible part of fresh Hibiscus rosa- sinensis flower contains 89.80 g of moisture, 0.064 g of nitrogen, 0.36 g of fat, 1.56 g of crude fibre, 4.04 mg of calcium, 26.68 mg of phosphorus, and 1.69 mg of iron, 4.90 mg ascorbic acid per 100 g of flowers [4].

Dehydrated flowers
Hibiscus rosa-sinensis flowers had 13.0 per cent moisture, 6.23 g protein and 1.8 g fat. Total ash was 16.00 g / 100 g, crude fibre was 5.88 g and carbohydrate content was 62.97g per 100 g. Among vitamins the dehydrated flowers had 2359.33 µg of β-carotene and 17.84 mg of vitamin C per 100 g. The analysis of the mineral content showed that the dehydrated powder consisted of calcium (1224 mg), potassium (1112.60 mg), sodium (14.95 mg), phosphorous (156.30 mg), zinc (3.16 mg) and iron (12.28 mg) [3].

Leaves
The proximate composition of the leaves shows that the carbohydrate (CHO) of the plant is (31.66%). The moisture content is 2.63% and it has a high fibre content of 3.99% while the protein value is 7.01%. The leaves are riched in calcium (772.57mg/g-1) followed by potassium (181.00 mg/g-1). The sodium content (0.38mg/g-1) is comparably lower than the other minerals [9].

3. Domestic applications

Domestic applications Even though, the uses of different parts of Hibiscus are many and varied both in food and in traditional medicine, all parts of hibiscus including leaves, flower and roots are used as a food in different parts of the world. Fleshy red flowers are used for the production of juice , wine , cake , chocolate ect. These are rich in carotene, riboflavin, anthocyanins, ascorbic acid, niacin, calcium, iron and vitamin C [4].

4. Traditional uses:

In medicine, the red flowered variety was preferred. Roots and leaves, were anodyne and emmenagogue. They were used to regulate menstruation and stimulate blood circulation. Leaves were also used as abortifacient and to stimulate expulsion of placenta after childbirth. Flower were used for regulation of menstrual cycle, for liver disorders, high blood pressure as antitussive, in stomach pain, for eye problems, as abortifacient and as an aphrodisiac. Young leaves and flowers were used in headache. Decoction of leaves, root and fruits were helpful in treatments of arthritis, boils and coughs. Fruits were employed externally in cases of sprains, wounds and ulcers [10, 19]. The leaves of Hibiscus rosa-sinensis were used for the treatment of dysentery and diarrhea, to promote draining of abscesses and as analgesic in the traditional medicine of Cook Islands, Haiti, Japan and Mexico [28]. Flowers of the plant were used in diabetes, epilepsy, bronchial catarrh and leprosy [31, 33]. The flowers have been reported in the ancient Indian medicinal literature with beneficial effects in heart diseases. They were refrigerant, emollient, demulcent, aphrodisiac and emmenagogue. Petals were used to stimulate thicker hair growth and to prevent premature graying, hair loss and scalp disorders. It considered as a natural emollient hair conditioner and was used in hair washes, treatments and vinegar rinses for the hair [15, 40].

5. Therapeutic uses

Antibacterial effect

Hibiscus is known for its antibacterial activity. Hibiscus plants can be sources of compounds that can potentiate the activity of antibiotics against resistant bacterial pathogens [34]. The ethanol extract of these medicinal plant was subjected to evaluate their antibacterial properties against four gram negative (that is, Escherichia coli, Klebsiella pneumoniae, Salmonella typhi, Proteus mirabilis) and two gram positive bacteria (that is, Staphylococcus aureus, Bacillus subtilis) by agar well-diffusion method. The ethanol extracts of the plant prevented the growth of both gram-positive and gram-negative bacteria [8]. Aqueous and solvent extract of Red flowers was also investigated antibacterial activity. The aqueous and solvent extracts of flowers of H. rosa-sinensis were screened for antibacterial activity by using disc diffusion method. The study was concluded these extract could inhibit human pathogens growth [13]. The flower of Hibiscus rosa sinensis Linn. possess various activity such as anti - convulsents, antidiabetic, antipyretic, antioxidant, antifertility and antidiarrheal. IR spectroscopy of ethanolic flower extract shows the presence of functional groups like diallyl sulfoxide, sulfonamide, carbonyl, amide, gem dimethyl and flavonoids such as NaQSA [Sodium Salts of Quercetin 5' Sulfonic Acid], quercetin, flavone, myricetin and fisetin. This proves its correlation with antimicrobial activity [35].

Antiulcer

The aqueous and alcohol extracts of H. rosa sinensis roots possessed significant antiulcer activity in pylorus ligated rats at the dose of 250 and 500 mg/kg/p.o, which was well compared with lansoperazole (8 mg/kg/p.o.). Thus it had been scientifically proven that these extracts possess enough potential as an anti ulcerogenic agent [1].

Hypo- lipidemic effects

According to a study conducted on lipid profile of streptozotocin diabetic rats The extract was administered to the diabetic models for 21 days. The extract of Hibiscus rosa sinensis found to have hypolipidemic potential. Elevated serum phospholipids and triglyceridemia are common findings in patients with diabetes mellitus. Administration of the extract to the STZ induced diabetic rats significantly ($p < 0.05$) improved these param- eters. Significant lowering of total cholesterol and raise in HDL cholesterol is a very desirable biochemical state for prevention of atherosclerosis and ischaemic conditions. The study proved extract of Hibiscus rosa sinensis to have a hypolipidemic potential [7]. Another study was also investigated antihyperlipidemic effect of Hibiscus rosa‐sinensis Linn. (Malvaceae) ethanolic extract in rats. Oral administration of 500 mg/ kg body weight of ethanolic extract residual fraction of Hibiscus rosa‐sinensis Linn. flowers exhibited a significant reduction ($P < 0.01$) in serum lipid parameters such as triglycerides, total cholesterol, low density lipoprotein (LDL), very LDL and increase in high density lipoprotein in hyperlipidemic rats [27].

Inflammation

Inflammation is a localized reaction that produces redness, warmth, swelling and pain as a result of infection, irritation or injury. In the treatment of carrageenan induced paw edema in rats, there was highly significant decreased paw volume when treated with Diclofenac and high dose of Hibiscus Rosa Sinensis Linn leaves extract. This activity may be due to presence of flavonoids, phytosterols and tannins in extract [42]. Another study was also determined and compared the anti- inflammatory activities of ethanol extract of flower and leaf of Hibiscus rosa-sinensis var alba (white Hibiscus) and Hibiscus rosa-sinensis L. (red Hibiscus). Dosing of 50 and 100 mg/kg of flower and leaf estracts of Hibiscus rosa-sinensis L. caused significant inhibition ($p<0.05$) of edema. Flower and leaf of Hibiscus rosa-sinensis var alba significantly inhibited ($p<0.05$) edema in all range of testing dose [39]. The methanolic extract of Hibiscus rosa- sinensis leaves (250 and 500 mg/kg body weight orally) have anti-nociceptive and anti-inflammatory activities. The anti- inflammatory activity was studied in carrageenin and dextran induced rat paw edema using Indomethacine as standard which showed significant anti-inflammatory activity. The peripheral analgesic activity was studied in rats using acetic acid-induced writhing response and tail flick method by using Pethedine (5mg/kg body weight, intraperitonially) as standard. The extract showed significant dose-dependent analgesic activity in both the models [43].

Wound healing

Hibiscus rosa-sinensis L. Wound healing properties was evaluated using excision, incision, dead space and burn wound model. In the evaluation of wound healing

properties, ELEHR treated group showed an enhanced wound contraction rate and epithelisation period in both excision and burn wound models, whereas in incision wound model wound breaking strength was significantly increased in extract treated group compared to control [38] The wound-healing potency of the ethanolic extract of the flowers of Hibiscus rosa sinensis.The wound-healing activity of H. rosa sinensis (5 and 10% w/w) on Wistar albino rats was studied using three different models viz., excision, incision and dead space wound. The extract increased cellular proliferation and collagen synthesis at the wound site, as evidenced by increase in DNA, total protein and total collagen content of granulation tissues. The extract of H. rosa sinensis significantly ($P < 0.001$) increased the wound-breaking strength in the incision wound model compared to controls [6].

Anti diabetic

H. rosa-sinensis could have great importance as a safe therapeutic agent in diabetes mellitus. Aqueous extract and ethanolic extract of the flowers and leaves have anti diabetic effect. Phytochemical study reveals that alkaloids, tannins, saponins, triterpenoids, coumarins, steroids, flavonoids were present in the extract.The antidiabetic activity was performed by enzyme inhibition (α-glycosidase) in in vitro method on extract and extract showed significant inhibition. [21] The oral administration of aqueous methanolic extract of Hibiscus rosa-sinensis leaves (400 mg/Kg) on streptozotocin (STZ) induced diabetic rats and alteration in liver and kidney functions. The treatment of diabetic rats with hibiscus leaves extract reduced levels of plasma glucose, cholesterol, aspartate aminotransferase (AST), alanine aminotransferase (ALT), uric acid and creatinine and hepatic malondialdehyde that was elevated in diabetic rats. Moreover, the Hibiscus leaves extract mitigates the decrease in hepatic superoxide dismutase and plasma protein levels due to STZ injection. The treatment of diabetic rats with Hibiscus extract was shown to had hepatic and renal protective effects in diabetic rats induced experimentally. These results clearly indicate that aqueous leaves extract of H. rosa-sinensis possess antidiabetic and hypolipidemic effects in diabetic rats which may be due to antioxidant properties of the hibiscus extract [23].

The research was to evaluated various biological activities of Hibiscus Rosa Sinensis flower extract in alloxan induced diabetes in rabbits. The hydroalcoholic extract of Hibiscus Rosa Sinensis flowers (HEFHR) was used as test extract. Glibenclamide was administered as drug for comparison. HEFHR was found to be more effective in antidiabetic activity than glibenclamide, as flower extract produced a gradual fall in blood sugar level in 72 hour [26]. The Hibiscus rosa-sinensisethanolic leaves extract was evaluated the Anti diabetic, Hypo lipidemic and histopathological effect in Alloxan mono hydrate induced diabetic wistar rat by administering graded oral doses (350 and 700 mg/kg body weight) for 14 days. The extract showed significant anti diabetic activity with significant improvement in body weight. The study was concluded that Hibiscus rosa sinensis leaves extract has significant antidiabetic effects [11]. The ethanolic Hibiscus flower extract in diabetes induced Wister rats which had been made hyperlipidaemic by feeding them with high fat diet. The serum blood glucose levels and lipid profile was found to be significantly increased in the hyperlipidaemic diabetic rat models while the level of plasma insulin was lowered [2].

Hair growth

Hibiscus rosasinensis flower is known as hair growth promoter in traditional and folklore medicines. In the hair growth study, the various parameters like hair length, hair density, total serum protein, testosterone and histology, were performed in stress induced alopecia albino rat model. To concluded it could be affirmed that hydrolcholic extract of H. rosa-sinensis, C. gigantea and Polyherbal formulation of H. rosa-sinensis (Hr) + C. gigantea (Cg) showed reflective results.. Presence of active constituents like flavonoids, tannins, may be responsible for hair growth activity [12].

Anti lithiatic

The aqueous extract of flowers of Hibiscus rosa-sinensis was evaluated for its antilithatic potential in vitro. Hibiscus rosa-sinensis is a good remedy for leucorrhoea, chronic cough, urinary diseases and psychiatric ailments, without any side effects and is less expensive. The presence of calcium oxalate crystals was evaluated immediately and after 24 hrs of stone induction. Crystal aggregation after 24 hrs was inhibited by Hibiscus rosa-sinensis extract. The study showed that the extract interfere with early stages of stone formation and may represent an alternative form of treatment and prevention for urolithiasis. The in vitro assays performed in the study revealed that the flower extract of Hibiscus rosa-sinensis at various concentrations exhibited a very good inhibitory effect against crystal nucleation, growth and aggregation. It was clearly evident that the components present in the flower extract might be responsible for its preventive action against kidney stone formation [29].

Analgesic activity

The plant Hibiscus rosa sinensis Linn. belongs to family “Malvacecae” and Considering various medicinal properties of this plant, the leaves were collected and studied for Extractability percent- age, analgesic. The extract showed marked analgesic activity in a dose dependent manner. Aqueous and alco- holic extracts produced significant results at both doses ($P<0.01$), the findings indicated the anal- gesic activity of the leaves of the plant.This may be due to presence of alkaloids which produce narcotic analgesic activity mediated through opiodergic receptors [5].

Anti-oxidant

An attempt had been made to study the comparative antioxidant activity, using HPLC-DPPH method, and total phenolic as well as total flavonoid contents of four cultivars i.e. plants with red, pink, white and yellow coloured flowers of Hibiscus rosa-sinensis. The methanolic extract of the defatted samples was used for the study. The Total Phenolic content was determined by spectrophotometric method using Folin-Ciocalteu reagent whereas the total flavonoid content was estimated by colorimetric method using aluminium chloride. DPPH free radicals scavenging activity was assessed by HPLC-DPPH method. All the cultivars showed presence of considerable amount of phenolic compounds, flavonoids and significant antioxidant activity. The red cultivar revealed highest antioxidant activity, total phenolic and total flavonoid content. Conclusion: The study indicated the potential of Hibiscus rosa-sinensis flowers as a

natural antioxidant. The data revealed significant variations in phytochemical content among its different cultivars and these variations contribute to their studied bioactivity, i.e. in vitro antioxidant activity [14].

Antioxidant potential of different solvent extracts of Hibiscus rosa-sinensis was evaluated by estimation of total flavonoids contents, total phenolic contents, DPPH free radical scavenging activity and percentage inhibition of linoleic acid oxidation capacity. Methanol and ethanol extract of Hibiscus rosa-sinensis showed total phenolics 61.45 ± 3.23 and 59.31 ± 4.31 mg/100g as gallic acid equivalent, total flavonoids 53.28 ± 1.93 and 32.25±1.21 mg/100g as catechine equivalent. DPPH free radical scavenging activity was 75.46±4.67 and 64.98 ± 2.11% and inhibition of linoleic acid oxidation potential 75.8 ±3.22 and 61.6 ± 2.01% respectively [39].

Wound healing

Ethanolic leaves extract of Hibiscus rosa-sinensis L. (ELEHR). In-vitro antioxidant properties were assessed using DPPH radical scavenging activity, Nitric oxide scavenging activity, and superoxide radical scavenging activity. Wound healing properties was evaluated using excision, incision, dead space and burn wound model. In the evaluation of wound healing properties, ELEHR treated group showed an enhanced wound contraction rate and epithelisation period in both excision and burn wound models, whereas in incision wound model wound breaking strength was significantly increased in extract treated group compared to control. Histology of the skin of healed excised wound also showed restoration to normal architecture in extract treated group [38].

7. Conclusion

Hibiscus rosa sinensis is a common flower found in many parts of the world. Yet only a few people are aware of its health benefits. Indian Ayurvedic medicine has recognized the medicinal effects of this flower long ago and recommends its use in treating many ailments. Chinese herbology also considers medicinal value of this plant. Various parts of the plant are rich in phytonutrients which can be attributed for its medicinal properties. It contains polysaccharides, anthocyanins, flavonoids, pectin and organic acids such as malic acid, citric acid, and tartaric acid. The leaves and flowers of Hibiscus rosa-sinensis Linn. (Family Malvaceae) have been used in ethnomedicine for the treatment of various human diseases such as aphrodisiac, hypertension, wound healing, skin disease, hair disease, diabetes mellitus and cancer

Reference

1. AV Anita Gnana Kumari, A Palavesam, J, *et al*..Preliminary phytochemical and antiulcer studies of Hibiscus rosa sinensis Linn. root extracts, 2013.
2. Abhijeet Ghosh, Dr. Abhijit Dutta. Antidiabetic effects of ethanolic flower extract of Hibiscus Rosa sinensis (L) on alloxan induced diabetes in hyperlipidaemic experimental Wister rats (WNIN), 2017, 5(4). | ISSN: 2321-9939
3. Aishwarya Bahuguna, Dr. KG Vijayalaxmi. Formulation and evaluation of dehydrated red Hawaiian hibiscus (Hibiscus rosa-sinensis) incorporated valued added products.International Journal of Food Science and Nutrition ISSN: 2455-4898. 2018; 3(4):194-199.
4. Aishwarya Bahuguna KG, Vijayalaxmi, VC. Suvarna. Formulation and Evaluation of Fresh Red Hawaiian Hibiscus (Hibiscus rosa-sinensis) Incorporated Valued Added Products. International Journal of Current Microbiology and Applied Sciences ISSN: 2319-7706, 2018.
5. Alka Sawarkar C R *et al*. Analgesic Activity of Hibiscus rosa sinensis Linn in Rat. Veterinary World. 2009; 2(9):353-354.
6. Anusha Bhaskar, V Nithya. Evaluation of the wound-healing activity of Hibiscus rosa sinensis L (Malvaceae) in Wistar albino rats, 2018.
7. Anusha Bhaskar. Evaluation of hypolipidaemic activity of Hibiscus rosa sinensis L.Journal of Pharmacy Research. 2011; 4(10):3293-3294, 3293-3294. Research Article ISSN: 0974-6943 Available online through www.jpronline.info.
8. Bimala Subba, Anjana Sharma, Anupa Budhathoki. Assessment of phytochemical content, antioxidant and antibacterial activities of three medicinal plants of Nepal. Journal of Medicinal Plants Research. 2016; 10(45):829-837.
9. Boo, H.-O., Hwang, S.-J., Bae, C.-S., Park, S.-H., Heo, B.-G., Gorienstein, S., 2012. Extraction and characterization of some natural plant pigments. Industrial Crops and Products 40, 129–135
10. Chopra RN, Chopra IC, Varma BS. Supplement to Glossary of Indian Medicinal Plants. New Delhi, India 1969:39.
11. D.Peer Basha and Subbarao M. 2012.Antidiabetic, hypolipidemic and histopathological studies of ethanolic leaves extract of hibiscus rosa- sinensis in alloxan mono hydrate induced diabetic rats. World journal of pharmacy.
12. Dr. Namrata Singh, Dr. Mukul Tailang and Dr. Anupam K. Pathak.2017.Evaluation of hair growth activity of hibiscus rosa- sinensis and calotropis gigantea leaves on stress induced alopecia. World Journal of Pharmaceutical Research Volume 6, Issue 17, 477-484.ISSN 2277– 7105.
13. Dr. Shashi Agarwal, Dr. Rachna Prakash. Evaluation of Antibacterial activity of Hibiscus rosa-sinensis flower extract against E. coli and B. Biological Forum – An International Journal.ISSN No. (Print): 0975-1130 ISSN No. (Online),. 2014, 2249-3239
14. Falguni Sheth. Evaluation of comparative antioxidant potential of four cultivars of Hibiscus rosa-sinensis L. by HPLC-DPPH method. Free Radicals and Antioxidants, 20122(4).
15. Gaur K, Kori ML, Nema RK. Investigation of immunomodulatory potential of hydro-alcoholic extracts of Euphorbia neriifolia Linn. and Hibiscus rosa-sinensis Linn. International Journal of Medical Sciences. 2009; 2(1):61-65.
16. Gupta V, Nair J. Application of botanicals as natural preservatives in food. In: Bhat, R., Karim, A.A., Paliyath, G. (Eds.), Progress in Food Preservation. Wiley Blackwell Publishers, UK, 2012, 513-524.
17. Inyang John Udo, Mayen Godwin Ben, Christiana Utibe Etuk, Adenugba Imaobong Tiomthy. Phytochemical, proximate and antibacterial properties of Hibiscus Rosa-Sinensis L. Leaf. Journal of Medicinal Plants Studies. ISSN 2320-3862 JMPS. 2016; 4(5):193-195

18. Jadhav VM, Thorat RM, Kadam VJ, Sathe NS. Traditional medicinal uses of Hibiscus rosa-sinensis. Journal of Pharmacy Research. 2009; 2(8):1220-1222.
19. Jadhav VM, Thorat RM, Kadam VJ, Sathe NS. Hibiscus rosa-sinensis Linn–'Rudrapuspa': A Review. J Pharm. Res. 2009; 2(7):1168-1173
20. Jo YH, Seo GU, Yuk HG, Lee SC. Antioxidant and tyrosinase inhibitory activities of methanol extracts from Magnolia denudata and Magnolia denudata var. purpurascens flowers. Food Research International. 2012; 47:197-200.
21. KNV Rao, Geetha K, Alagar Raja M, David Banji. Quality control study and standardization of Hibiscus rosasinensis l. flowers and leaves as per WHO guidelines. Journal of Pharmacognosy and Phytochemistry. E-ISSN: 2278-4136 P-ISSN: 2349-8234 JPP. 2014; 3(4):29-37.
22. Khan ZA, Naqvi SA, Mukhtar A, Hussain Z, Shahzad SA, M, *et al*. Antioxidant and antibacterial activities of Hibiscus rosa- sinensis Linn flower extracts. Pak J Pharm Sci. 2014; 27(3):469-474.
23. Lina H Zaki, Samy M Mohamed, Samir AE. Bashandy, Fatma A. Morsy, Kawther M. Tawfik1 and Abdelaaty A. Shahat.2017.Hypoglycemic and antioxidant effects of Hibiscus rosa- sinensis L. leaves extract on liver and kidney damage in streptozotocin induced diabetic rats. African Journal of Pharmacy and Pharmacology. ISSN 1996-0816.
24. Lu TM, Lee CC, Mau JL, Lin SD. Quality and antioxidant property of green tea sponge cake. Food Chem. 2010; 119(3):1090-1095.
25. Mirunalini Sankaran.2011. Antioxidant and Antidiabetic Effect of Hibiscus rosasinensis Flower Extract on Streptozotocin Induced Experimental Rats-a Dose Response Study. Available online at www.notulaebiologicae.ro.Not Sci Biol. 2011; 3(4):13-21 Print ISSN 2067-3205; Electronic 2067-3264 Notulae Scientia Biologicae
26. Mohan Pethe, Samir Yelwatkar, Vijay Gujar, Sushil Varma and Smita Manchalwar. Antidiabetic, Hypolipidimic and Antioxidant Activities of Hibiscus Rosa Sinensis Flower Extract in Alloxan Induced Diabetes in Rabbits, 2011.
27. Mukesh Singh Sikarwar, MB Patil.. Antihyperlipidemic activity of Hibiscus rosa‑sinensis Linn. ethanolic extract fractions, 2012.
28. Nath P, Yadav AK. Acute and sub-acute oral toxicity assessment of the methanolic extract from leaves of Hibiscus rosa-sinensis L. in mice. J Intercult Ethnopharmacol. 2015; 4(1):70-73.
29. Nirmaladevi, R, Kalpana S, Kavitha D, Padma PR. Evaluation of antilithiatic potential of Hibiscus rosa-sinensis Linn, in vitro. Journal of Pharmacy Research. ISSN: 0974-6943, 2012.
30. Obi FO, Usenu IA, Osayande JO. Prevention of carbon tetrachloride-induced hepatotoxicity in the rat by H. rosasinensis anthocyanin extract administered in ethanol. Toxicology. 1998; 131:93-98
31. Pekamwar SS, Kalyankar TM, Jadhav AC. Hibiscus rosa-sinensis: A review on ornamental plant. World Journal of Pharmacy and Pharmaceutical Sciences 2013; 2(6):4719-4727.
32. Rymbai, H, Sharma RR, Srivasta M. Bio-colorants and its implications in health and food industry – a review. International Journal of PharmaTech Research. 2011; 3:2228-2244.
33. Sharma K, Pareek A, Chauhan ES. Evaluation of hyperglycemic and hyperlipidemic mitigating impact of Hibiscus rosa-sinensis (Gudhal) flower in type II diabetes mellitus subjects. International Journal of Applied Biology and Pharmaceutical Technology. 2016; 7(2):223-228.
34. Shaymaa Khudhr, Al Alak, RashaMohamed Saj*et al*-Oqaili, *et al*. Antibacterial Activity of Hibiscus rosa-sinensis Extract and Synergistic Effect with Amoxicillin against some Human Pathogens. American Journal of Phytomedicine and Clinical Therapeutics. ISSN 2321 – 2748, 2011.
35. Shilpi Patel, Madhvi Adhav. IR spectroscopy and antimicrobial activity of ethanolic flower extract of Hibiscus rosa sinensis Linn. (HIBISCUS Red). International Journal of Botany Studies ISSN: 2455-541X. 2018; 3(2):161-163
36. Shyu YS, Lin JT, Chang YT, *et al*. Evaluation of antioxidant ability of ethanolic extract from dill (Anethum graveolens L.) flower. Food Chemistry 115, 515–521. Silhavy, T.J., Kahne, D., Walker, S., 2010. The bacterial cell envelope, 2009.
37. Sukirti Misra Upadhyay,Prashant Upadhyay, Ashoke K Ghosh, 1 Vijayender Singh and Vinod K Dixit. Effect of ethanolic extract of Hibiscus rosa sinensis L., flowers on hair growth in female wistar rats.
38. Sumanta Mondal, Debjit Ghosh, Nuni Sagar.. Evaluation of Antioxidant, Toxicological and wound healing Properties of Hibiscus rosa-sinensis L. (Malvaceae) ethanolic leaves extract on different Experimental animal models, 2016.
39. Sz raduan, Mwh abdul aziz, Ah roslida, *et al*. Anti-inflammatory effects of hibiscus rosa-sinensis l. And hibiscus rosa-sinensis var. Alba ethanol extracts, 2013.
40. Upadhyay SM, Upadhyay P, Ghosh AK, Singh V, Dixit VK. Effect of ethanolic extract of Hibiscus rosa-sinensis L., flowers on hair growth in female wistar rats. Der Pharmacia Lettre. 2011; 3 (4): 258- 263.
41. V Kumar, P Singh, R Chander , F Mahdi, S Singh, R Singh, *et al*. Indian Journal of Biochemistry & Biophysics. 2009; 46:507-510.
42. Venkateswarlu Guddeti, D Madhu Babu, B Nagamani, *et al*. Evaluation of anti inflammatory activity of Hibiscus rosa sinensis linn. Flower extract in rats.International journal of pharmaceutical, chemical and biological sciences. IJPCBS. 2015; 5(3):532-536. ISSN: 2249-9504
43. Vivek Tomar, Kannojia P, Jain KN, Dubey KS. Anti-noceceptive and anti -inflammatory activity of leaves of hibiscus - rosa sinensis, 2010.
44. Voon HC, Bhat R, Gulam R. Flower extracts and their essential oils as potential antimicrobial agents. Comprehensive Reviews in Food Science and Food Safety. 2012; 11:34–55
45. Yin Wei Mak, Li Oon Chuah, Rosma Ahmad, Rajeev Bhat,. Antioxidant and antibacterial activities of hibiscus (Hibiscus rosa-sinensis L.) and Cassia (Senna bicapsularis L.) flower extracts, 2012.