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Health benefits of *Hibiscus rosa sinensis* and its role in removing heavy metals- Review

Venkata Kanaka Srivani Maddala
Associate Professor, Department of Science and Humanities, Environmental Science division, Vignans Foundation for Science Technology and Research deemed to be University Deemed to be University, Vadlamudi, Guntur, Andhra Pradesh, India

Abstract
Hibiscus rosa sinensis is called China hibiscus belong to the family Malvaceae. It is an ornamental plant with many medicinal properties and treats many diseases. Leaves, twigs, roots, stem and flowers are useful and reduce cough, menstrual pain, fever, prevents hair fall, labor pain in women, many bacterial and viral diseases. Many researchers explained about the health benefits of *Hibiscus rosa sinensis.* Today heavy metal pollution is more and many methods were developed to prevent the impacts of it. Biosorption methods play a vital role to remove the heavy metals. Using flower wastes are ecofriendly, cheap and curb the problems on earth. This paper reviews about the benefits of *Hibiscus rosa sinensis* and also highlight the flower waste of *Hibiscus rosa sinensis* to remove heavy metal pollutants in water and soil by biosorption.

Keywords: *hibiscus rosa sinensis*, benefits of *hibiscus rosa sinensis*, heavy metals, biosorption

Introduction
There are 200 different species of *Hibiscus* plants are there. *Hibiscus rosa sinensis* is distributed in India, Srilanka, China, Thailand, South Africa, Myanmar and Pakistan. It's an ever-green shrub and consists of approximately 300 species. It is known as china rose and medicinal plant and grows to a height of 2-8 meters tall. It is cultivated in both tropical and sub-tropical regions. The characteristic features of this plant consist of single auxillary bell shaped flowers with red color. The propagation of this plant can be done by cutting, layering, budding, grafting. Its flowers are attractive and used in Hindu devotional ceremony. *Hibiscus rosa sinensis* consists of quercetin, hentriacontane, cyanidin chloride (Jadhav, 2009) [1]. The flowers of *Hibiscus rosa sinensis* consists of flavonoids, thiamine, niacin and ascorbic acid and niacin. Carbohydrates, sterols, phenolic compounds, saponins, glycosides are present in the roots of it (Kumari *et al.*, 2010) [2]. Approximately there are 3000 plant speies recorded in India with medicinal properties (Prakasha *et al.*, 2010) [3]. In this review information on health benefits of Hibiscus rosa sinensis and role of its flowers in removal of heavy metals were highlighted.

Benefits
Many studies revealed that Hibiscus shows antidiarrheic, anticomplementary, antiphlogectic activities Shimizu *et al.*, 1993) [4]. It has many antidiabetic, anti-inflammatory, antipyretic properties and even shows anti spermatogenic and androgenic properties (Sachdewa, Khemani, 2003) [5] and anti asthmatic activity (Zhao *et al.*, 2010) [6] It has bioactive properties and can cure many diseases (Obi Usenu Osayande, 1998; Arullappan *et al.*, 2009) [7, 8]. The flowers shows antibacterial activity against gram negative and gram positive food borne bacterial pathogens (Mak, Yin Wei, *et al.*, 2013) [9] and its extract also induces labor pain in women. The flowers, leaves, twigs, stem almost all the parts of this plants are useful. Decoction of this flower maintain menstrual pain in women. Leaf juice of this plants play an important role in digestion and control diarrhoea (Singh, 1986) [10]. Flower decoction also used to control stomach pain, flu and cough, and even eye problems (Kobayashi, 1976) [11]. It also prevents sexually transmitted diseases like Gonorrhea (Whistler, 1985) [12]. Roots and flowers extract of *Hibiscus rosa sinensis* cures fever and stimulate menstrual flow (Steenis krusemen Van, 1953) [13]. Root paste controls sexual disease. and flower powder helps in sexual desire. Flower extracts prevents ultra violet radiations. The various parts of this plant and its benefits are mentioned in Table-1. In India we are using the flowers and stem extract for antifertility, reduction of cough, reduce menstrual pain, increase production of urine (Maheswari,Singh and Saha 1980) [14]. prevention of bronchitis (Jain and Tarafder 1970). [15]. The drug from this plant also helps to control cholesterol, triglycerides and phospholipids. Its leaves are used in Ayurveda treatment. Leaves and flowers of Hibiscus increase hair growth and cure ulcers. Flowers play an important role in treating arterial hyper tension (Dwivedi *et al.*, 1977) [16]. It consists of terpenoids, Saponoids, flavonoids and glycosides. The flowers of Hibiscus helps to treat heart diseases. The decoction treats mucus in the air way that treats the throat or sinuses. It is anticonvulsant that prevents the seizure in the brain (Sachdeva, Nigam and Khemani 1997) [17]. and also treats diabetics (Kasture, Chopde and Deshmukh 2000) [18]. The flower extracts of *Hibiscus rosa synesis* are also used for synthesis of silver nano scaffold formation and its reduction by flowers (Shabana, Muzammil and Parsana 2013) [19]. The stem and leaves of Hibiscus rosa sinensis also used to remove heavy metals by adsorption process (Krishnaveni and Ravindranath, 2021) [20]. The flowers and leaves of Hibiscus rosa sinensis can be used to prepare cosmetics and contains antidiabetic activity. Mucilage can be extracted from the powdered leaves of Hibiscus rosa sinensis used to increase the efficiency of some drugs. This plant consists of multifunctional medicinal properties and many research findings revealed that it can be recommended to use in society to benefit the health

Heavy metals

Heavy metals are the major pollutants and they persist in the environment for long time. Application of fertilizers and pesticides consist of heavy metals like Zinc, Iron, Copper, Magnesium, Manganese, Iron, Nickel. Some of the metals are nutrients essential for the plant growth. Metals like Cadmium, Lead, Copper, Chromium and Arsenic are highly toxic and effects the environment. Application of the fertilizers and pesticides consists of Cadmium, Lead and Mercury that degrades the quality of soil and affects the food chain. The metals percolate deep in to the soil and degrades or contaminate the soil quality. High levels of Cadmium, Arsenic, Chromium, Mercury, Nickel, Copper also enters the leaves and fruits through soil solution and effects human. According to Wunna 2011 soil may be contaminated due to accumulation of heavy metals and metalloids through industrial areas, mine tailings, paints, irrigation, atmospheric deposition, land application of fertilizers and animal manures sewage sludge and pesticides etc (Wuana *et al.*,2011) [21]. Fertilizers like NPK are added to increase the fertility of soil but these have little quantities of impurities like cadmium and lead. Phosphate fertilizers add Cadmium, Mercury and Lead to the soil and degrades it quality. So removal of heavy metals is required. There are many methods developed to remove the heavy metals in the soil but they are not recommended as they cause harm to the environment. It is better to use eco-friendly methods for sustainable development.

Biosorption

Biosorption is the passive adsorption of toxic substances by using biological materials. The main aim of biosorption is the removal of heavy metals form the industrial waste water or removal of soil contaminants. Flower waste biomass can be used as adsorbent to remove heavy metals. It is low cost and ecofriendly method. Various flowers like *Musa paradisiacal, Rosacentifolia, Borassus aethiopum, Saffron flower, Tithonia diversifolia* and *Helianthus annus*, Marigold flowers, *Alstonia scholaria, Chrysanthemum indicum* locally available flowers and weeds can be used to remove Chromium, Cadmium, Arsenic, Lead and Nickel in soil. Different methods were adopted to remove these metals. Adsorption, chemical precipitation, membrane processes, ion exchange, electro coagulation solvent extraction. Physical remediation includes soil replacement method and thermal desorption. Chemical remediation and biological remediation includes Phyto remediation, Bioremediation and Combining remediation were used to treat heavy metals. Some of these methods are expensive and have many disadvantages. So in this review *Hibiscus rosa sinensis* flower waste used as biosorbent to remove the heavy metals. Application of flower waste makes biosorption the recent alternative technology and increase value to the waste. *Hibiscus rosa synesis* play an important role in adsorption of pollutants. The purpose of flower dry residue of *Hibiscus rosa synesis* removed arsenic from aqueous solution. Herbal dry waste can be used as biosorbent and significant in removal of arsenic from aqueous solution and ecofriendly (Nigam *et al.*,2013) [22]. Herbal dye wastes, used as biosorbent, exhibited significant (85–98 %) removal of arsenic from aqueous solution. Hence, these biosorbents are cost-effective, easily available, eco-friendly, and comparatively more effective than other bio sorbents already in use. According to Padma *et al* 2010 cadmium and lead ions can be extracted from wate water using natural dry waste of *Hibiscus rosa sinensis* flower and the lead and cadmium concentrations also increased with increasing pH and adsorbent doses (Venkar *et al.*,2010) [23] and uptake of heavy metals by using natural non living biomass gained importance in recent years (Veglio and Beolcini 1997) [24] The leaf powder of *Hibiscus rosa sinensis* on treating with acid can be used as an adsorbent to remove cu (II), Ni(II) and Fe(II) from solution. Removal of zinc ions from aqueous solutions by using natural dye waste. *Hibiscus rosa sinensis* and adsorption increased by decreasing the adsorbent particle size and increasing adsorbent doses. Zinc adsorption also increases with rising its temperature showing endothermic nature (Venkar, 2012)[25]. Shuba nigam *et al* 2012 revealed that four flower dye residues like *Hibiscus rosa sinensis, Rosa rosa, Tagetes erecta* and *Canna indica* play an important role in removing arsenic from aqueous solutions. They used Scanning electron microscopy, energy dispersive X ray spectroscopy, Fourier transform infra-red were used for analysis (Nigam *et al.*, 2013) [26]. *Canna indica, Portulaca olecera, Hibiscus Rosa sinensis* and *Trapa natans* fruit skin can be used for removal of Chromium (VI) from stimulated waste water. Four plant materials were used to remove the chromium and compared and hibiscus flower has shown 63% of chromium V1 reduction by sorption process (Venkar and Padma 2013) [27]. Copper iodide nanoparticle is prepared using Hibiscus rosa sinensis flower extract which consist of anthocyanin, cyanidin-3-sophorocide that play a vital role in removing Cr(VI) and Mn(VII) ions (Archana and Yogalakshmi 2019) [28].According Sarvaman 2017 Hibiscus rosa sinensis can be used in coagulation and flocculation process of waste water treatment (Saravaman, 2017) [29].

Conclusion

There are many properties are present in this plant and play a vital role in curing diseases. There are so many research papers regarding its medicinal properties. The parts of this plants can be used by common man as it treats many diseases and found everywhere. Presence of many compounds in *Hibiscus rosa sinensis* can have good priority in the coming years and many new drugs can prepared from this plant in the future by increasing research.. Many research findings revealed that flower extracts consists of antioxidant and anti-hemolytic activities and they have excellent benefits so they can be used as ingredient of foods that are currently in demand. It has many health benefits in addition to that flowers of *Hibiscus rosa sinensis* are used in treatment of removing heavy metals. Its flowers are low cost and can found year-round. It is cheap and ecofriendly and biodegradable. So this can be used in treating many pollutants in water and soils.

Table 1: Benefits of Hibiscus Rosa sinensis

Parts of the plants	Benefits
Leaves and flowers	Increases hair growth and treats ulcers
Flowers of Hibiscus	Treat heart diseases and arterial hypertension (Dwivedi *et al.*, 1977) [16].
Hibiscus rosa sinensis decoction	Treats the throat or sinuses Prevents the seizure in the brain (Sachdeva, Nigam and Khemani 1997) [17]. Treats diabetics (Kasture, Chopde and Deshmukh 2000) [18]. Maintains menstrual pain Flower decoction also used to control stomach pain, flu and cough, and even eye problems (Kobayashi, 1976) [11]. Controls Gonorrhea (Whistler, 1985) [12].
Flower extracts	Synthesis of silver nano scaffold formation and its reduction by flowers (Shabana, Muzammil and Parsana 2013) [19].
Flowers	Prevents Staphylococcus aureus infection Arullappan *et al.*, 2009) [7]. Shows antimicrobial activity (prevents microbes) (Ruben and Gajalakshmi 2012) [30]. Flowers are edible and used in preparation of salads. Used as pH indicator Prevent dandruff Shows anti asthmatic properties (Sikarwar, Mukesh and Patil 2011; Zhao *et al.*, 2010 [31, 6].
	The flowers shows antibacterial activity against gram negative and gram positive food borne bacterial pathogens (Mak, Yin Wei, *et al.*, 2013) [9]
Leaf juice	Hepls in digestion and control diarrhoea (Singh, 1986) [10].
Roots and flowers exract	Cure's fever and stimulate menstrual flow (Steenis krusemen Van, 1953) [13]. Flower extract also induces labor pain in women. Flower extract also induces labor pain in women. Extract from the flowers used to absorb ultraviolet radiation and acts as anti-solar agent.
Extracts of roots stems and leaves	Shows antioxidant activity and the phytochemicals produced from the hibiscus rosa sinensis can prevent the cell system and components from cytotoxic damage (Ghosh and Dutta 2017) [32].
Root extracts	Prevents the growth of S.*aureus, E.coli and B.Subtilis* Prevents tongue deformations and restores antioxidant enzyme (Nade *et al.*, 2009) [33].
Methanol extracts of Hibiscus rosa sinensis	Prevents the growth of *C.albicans, A. flavus and C.glabreta* (Sanjesh, Kanu and Vaidhun) [34]. The crude protein from these flowers also prevents the growth of *Salmonella* sps and E.coli
Hibiscus tea	Increases immunity, prevents cold and flu Kills flu virus (Baatartsogt, Tugsbaatar *et al.*, 2016) [35].
Petals	Protects Pancreatic- β cells in experimental diabetes mellitus (Pillai, Sneha and Mini 2017) [36]. Prevention of tongue deformation
Flower and leaf paste	Applied on cancerous swellings and mumps
Root paste	Venereal diseases(sexual disease)
Flower powder	Increases sexual desire
Mucilage	Used as pharmaceutical adjuvant and ingredient in food (Gupta *et al*., 2015) [37]. Mouth dissolved tablets like Famotidine can be prepared from the mucilage of hibiscus and treated agar (Prabhu *et al.*, 2010) [38].

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