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Review Article

Use of *Hibiscus Sabdariffa* as a Potential Colorant in Paediatric Drug Formulations

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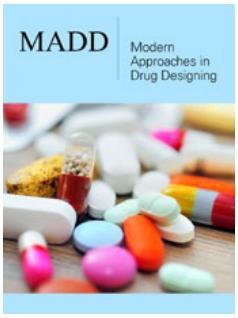

Abstract

Decoctions of H*ibiscus Sabdariffa L.* (Family *Malvaceae*) are very popular for the preparation of homemade refreshing drinks and are also used medicinally for a variety of ailments. Particularly remarkable are its red shinning petals of the flowers that have serious potential as colourants in various tablets and pediatric preparations. When sweetened with honey or sucrose it may also be used as flavor in children's pediatrics preparations such as syrups. This possibility necessitated this review of the potential uses of this plant and the suggestion of using the colour from its flower petals in colouring pediatric syrup preparations.

Keywords: *Hibiscus sabdariffa;* Colourant; Pharmaceutical dosage forms; Paediatric formulations

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Introduction

Extracts of *Hibiscus Sabdariffa* (Family *Malvaceae*) are very popular for the preparation of homemade refreshing beverages and are also used medicinally for a variety of ailments. *Hibiscus Sabdariffa* is native to central and West Africa and grows to 1.5m or higher and produces elegant red flowers. The flowers (calyx and bract portions) are collected when slightly immature. *Hibiscus* has a long history of use in Africa and other tropical countries for many conditions, including hypertension, liver diseases, cancer, constipation and fever [1]. The fleshy red calyx is used in the preparation of jams, jellies, drinks and cold and warm teas. The plant is also widely used in Egypt, Iran and Thailand, as well as in Western countries, and is often found as a component of herbal tea mixtures [2]. The use of beverages and teas containing *Hibiscus Sabdariffa* Extracts (HSEs) among hypertensive patients is growing because of some scientific reports showing that the extract of the plant possesses useful diuretic and hypotensive properties that could be beneficial to them [3].

Description of *Hibiscus Sabdariffa*

Hibiscus has more than three hundred species distributed in tropical and subtropical regions around the world and are used as ornamental plants. Research has shown that some species of *Hibiscus* possess certain medicinal properties of which *Hibiscus Sabdariffa* is one [4]. *Hibiscus Sabdariffa* is commonly named Roselle. The plant can adapt to a variety of soil in a warm and humid climate. As mentioned above, the plant is a known medicinal plant with a worldwide fame [5] and the plant can be found in almost all warm countries such as India, Saudi Arabia, Malaysia, Indonesia, Thailand, Philippines, Vietnam, Sudan, Egypt and Mexico [6,7]. Roselle is mainly cultivated to be consumed, and the main producers of Roselle blossoms are Egypt, Sudan, Mexico, Thailand and China. Other *Hibiscus* varieties are planted for the fibers they produce [8].

Origin of *Hibiscus sabdariffa*

There is a big argument about the origin of Roselle among different scholars. Cobley [9] suggested Roselle is a native plant of West Africa. According to him, from there it was carried to other parts of the world such as Asia and America. Whereas in others' opinion, Roselle originated from India [10] and Saudi Arabia [11].

Varieties of *Hibiscus sabdariffa*

Among numerous varieties of *Hibiscus, Hibiscus* altissima and *Hibiscus Sabdariffa* are the commonest. *Hibiscus* altissima is a branchless plant with yellow flowers and red or green coloured calyxes. Though this species is not used for food, the plant is more economically important than *Hibiscus Sabdariffa* because of its high fiber content. The other distinct type of *Hibiscus Sabdariffa* or Roselle grows in the bush with many branches. The flowers of Roselle are axillaries or in terminal racemes; the petals are white with reddish center at the base of the stamina column, and this species is widely used as food [11,12].

Composition of *Hibiscus sabdariffa*

Roselle is mainly cultivated for its calyx, which is of three types: Green, red and dark red. The red calyxes are the most used and are characterized by their concentration of anthocyanin. Delphinidin 3-Sambubioside and Cyanidin-3-Sambubioside are the major anthocyanins. Roselle is also rich in organic acids, minerals, amino acids, carotene, vitamin C and total sugar in its calyx, leaves and seeds at variable levels depending on the variety and geographical area [13]. A number of compounds have also been isolated and characterized from Roselle including flavonoids, anthocyanidins, triterpenoids, steroids and alkaloids [14].

Characteristics of *Hibiscus sabdariffa*

This plant has a wide distribution which is not only due to its extensive uses, but also because of its unique appearance. The attractive *Hibiscus Sabdariffa* plant is generally branched and erect, growing between 7 to 8 feet (2 to 2.5m) in height. The leaves that grow along their branches range in color from green to red, are alternate, and bear three to seven lobes.

Morphological characteristics of *Hibiscus sabdariffa*

i. Leaf: The leaves are simple, having petioles, blade 3-5 lobed or parted, the lobes serrated or obtusely toothed.

ii. Flowers: The flowers are solitary, axially, nearly sessile, 5-7cm in diameter, consisting of epicalyx segments B-12 distinct, lanceolate or linear adnate at base of the calyx.

iii. Calyx: It is thick, red and fleshy, cup-like, deeply parted, prominently 10-nerved; petal 5, red, twice as long as calyx, stamens are numerous.

iv. Fruit: The fruit is capsule, ovoid, pointed, 1-2cm long, shorter than calyx, having densely sharp and stiff hairs (Figure 1 & 2).

Figure 1: Stem of *Hibiscus sabdariffa* plant.

Figure 2: Flowers of *Hibiscus sabdariffa.*

Classification of *Hibiscus sabdariffa*

Kingdom - *Plantae* (Plants)

Sub-kingdom - *Tracheobionta* (Vascular plants)

Super-division - *Spermatophyta* (Seed plants)

Division - *Magnoliophyta* (Flowering plants)

Class - *Magnoliopsida* (Dicotyledons)

Subclass - *Dilleniidae*

Order - *Malvales*

Family - *Malvaceae* (Mallow family)

Genus - *Hibiscus L.* (rose mallow)

Species - *Hibiscus Sabdariffa L.* (Roselle)

Sources: Wikipedia, retrieved in 2025

Harvesting *Hibiscus sabdariffa*

Hibiscus Sabdariffa flower is harvested from late December onwards. The harvest is timed according to the ripeness of the seed. The fleshy calyces are harvested after the flower has dropped but before the seedpod has dried and opened. The more time the capsule remains on the plant after the seeds begin to ripen, the more susceptible the calyx is to sores, sun cracking and general deterioration in quality.

General Use of *Hibiscus Sabdariffa*

Food uses

Hibiscus Sabdariffa fruits are best prepared for use by washing; then making an incision around the tough base of the calyx below the bracts to free and remove it with the seed capsule attached. The calyxes are then ready for immediate use. They may be merely chopped and added to fruit salads. In Africa, they are frequently cooked as a side dish eaten with pulverized peanuts. For stewing as sauce or filling for tarts or pies, they may be left intact, if tender and cooked with sugar [15]. The product will be almost indistinguishable from cranberry sauce in taste and appearance. For making a finer-textured sauce or juice, syrup, jam, marmalade, relish, chutney or jelly, the calyces may be first chopped in a wooden bowl or passed through a meat chopper. Or the calyces, after cooking, may be pressed through a sieve. Some cook-steam the roselle with a little water until soft before adding the sugar, then boiled for 15 minutes. Roselle sauce or syrup may be added to puddings, frosting cake, gelatins and salad dressings. It can also be poured over gingerbread, pancakes, waffles or ice cream. It is not necessary to add pectin to make a firm jelly. In fact, the calyxes possess 3.19 % pectin. In Pakistan, *Hibiscus Sabdariffa* has been recommended as a source of pectin for the fruit-preserving industry. Juice made by cooking a quantity of calyxes with ¼ water in ratio to the number of calyces, is used for cold drinks and may be frozen or bottled if not for immediate needs. In sterilized, sealed bottles or jars, it keeps well providing no sugar has been added [16].

In the West Indies and tropical America, *Hibiscus Sabdariffa* is used primarily for the cooling, lemonade-like beverage made from the calyces. This is still "one of the most popular summer drinks of Mexico." In Egypt, *Hibiscus Sabdariffa* is consumed cold in the summer, and hot in winter. In Jamaica, a traditional Christmas drink is prepared by putting *Hibiscus Sabdariffa* into an earthenware jug with a little grated ginger and sugar as desired, pouring boiling water over it and letting it stand overnight [16,17]. The liquid is drained off and served with ice and a dash of rum. A similar spiced drink has long been made by natives of West Tropical Africa.

Medicinal Uses

Herbal medicine applications

Roselle is used in many folk medicines. It is valued for its mild laxative effect, ability to increase urination, relief during hot weather and treatment of cracks in the feet, bilious, sores and wounds [4]. Traditionally in Sudan, Roselle has been used for relief of sour throat and healing wounds [18]. In African folk medicine, roselle leaves are used for their antimicrobial, emollient, antipyretic, diuretic, anti-helminthic, sedative properties and as a soothing cough remedy, whereas in India, the leaves are used as poultice on abscesses [19,20].

Hypo-lipidemic effects

According to a study conducted among hyper-cholesterolemic patients, two capsules of Roselle extract (1g), given three times a day (for a total of 3g/day), significantly lowered serum cholesterol [21]. Another scientific study also confirmed that ethanolic extract from the leaves of Roselle significantly exhibits hypo-lipidemic effect [22]. Roselle extract was also studied among subjects, some with and some without metabolic syndrome. Subjects with metabolic syndrome receiving ethanolic extract of Roselle had significantly reduced glucose, total cholesterol and low-density lipoprotein, while increasing high density lipoprotein [23,24].

Blood pressure lowering effect

The effectiveness of an aqueous extract of Roselle on mild to moderate hypertension has been investigated in many researches. Aqueous extract of roselle was as effective as captopril in treating mild to moderate hypertension and there is no adverse effect with the treatment, confirming the effectiveness and safety of the extract [25,26]. Even though the possible mechanism(s) of action of Roselle extract was not investigated, daily consumption of an aqueous Roselle extract resulted in decrease in systolic and diastolic blood pressure [27].

Antidiabetic activity

The polyphenolic components of Roselle were extracted, and their effect was studied in a type II diabetic rat model (high fat diet model). Studies revealed anti-insulin resistance properties of extract at a dose level of 200mg/kg, and reduction in hyper glycaemia and hyper insulinemia [28]. The extract was found effective in lowering serum cholesterol, triacylglycerol, the ratio of low-density Lipoprotein/High-Density Protein (LDL/HDL), and (AGE) formation and lipid per oxidation. Intestinal α-glycosidase and pancreatic α-amylase help in digestion of complex carbohydrates present in the food into bioavailable monosaccharide and it plays an important role in postprandial hyperglycaemia; therefore, inhibition of these enzymes has been reported as an effective mechanism for the control of postprandial hyperglycemia. *Hibiscus* acid (*Hibiscus*-type (2S,3R)-hydroxycitric acid lactone) have been shown as a potent inhibitor of pancreatic α-amylase and intestinal α-glucosidase and pancreatic α-amylase activity [29,30]. Roselle extracts are an effective inhibitor of pancreatic α-amylase [31].

Anthelminthic and antimicrobial effects

Roselle is known for its antibacterial, antifungal and anti-parasitic actions. Oil extracted from seeds of Roselle has been shown to have an *in vitro* inhibitory effect on *Bacillus* anthracis and *Staphylococcus* albus [32]. Aqueous and ethanol extracts were also found to be effective against Schistosoma mansoni and other microorganisms [33,34]. A study demonstrated the antibacterial effect of *hibiscus* extract on Streptococcus mutans, a bacterium from oral cavity [35]. In a similar study, antibacterial potential of *hibiscus* was also observed on *Campylobacter* species [36]. An ethanol extract of the dried leaves of Roselle reduced aflatoxin formation and have *in vitro* inhibitory effect against some fungi [37,38].

Antioxidant effect

Protective property of a compound to inhibit the oxidative mechanisms by scavenging reactive oxygen and free radicals is known as antioxidative activity. It protects lining organelles from premature cell damage and reduces ageing. A large number of *in vitro* and *in vivo* studies have shown that Roselle calyxes contain potent antioxidants. Both the whole aqueous and anthocyanin-rich extracts of Roselle are effective antioxidants [39]. Studies have also highlighted that poly-phenolic acid, flavonoids and anthocyanins which are found in Roselle are potent antioxidants [40].

Other pharmacological effects

Roselle has been reported to possess a lactogenic activity [41] observed enhancement in the serum prolactin level of lactating female albino rats on administration of seed extract of Roselle [42] studied the lactogenic effect of ethyl acetate fraction of *Hibiscus Sabdariffa,* from 3-17 days of lactation. The results showed an increase in serum prolactin level and milk production in lactating female albino rats, which confirms the lactogenic property of *Hibiscus Sabdariffa*. Studies have shown that Roselle tea contains an enzyme inhibitor which blocks production of amylase, and it is possible that drinking a cup of *Hibiscus* tea after meals can reduce the absorption of dietary carbohydrates and assist in weight loss. It was also reported that Roselle is considered as a possible anti-obesity agent [43]. Extracts from Roselle are also known to have effect on inflammatory disease [44] and cancer [6].

Hibiscus Sabdariffa as potential drug formulations colorant

The calyces of *Hibiscuss* sabdariffa produces very elegant, red colour that is very appealing to children. As a result, many children drink the beverage produced from these Rosselle flowers in large quantities. Thus, it has been suggested that the colour from these flowers should be used as colorant in paediatric preparations such as syrups [45]. Colouring agents or colorants are pharmaceutical excipients employed to impart specific colour to a pharmaceutical formulation. Colouring agents are also extensively used in the food, cosmetics and textile industries to provide the preferred colouration for the products. They are employed as excipients in the manufacture of liquid (emulsions, suspensions, syrups), semi-solid (creams, lotions, ointments) and solid (sugar and film coated tablets, soft and hard gelatine capsules) pharmaceutical dosage forms. Colouring agents are added to pharmaceutical products for a variety of reasons. They enhance product appearance, aesthetic appeal and product elegance, leading to improved product acceptability by patients [45].

Colorants improve product identification for the manufacturer, healthcare professional and patients. They enhance the stability of photosensitive compounds by providing protection from light [46]. Colouring agents also provide a measure of protection against product counterfeiting [47]. The colour of a product also provides an indication of product quality and freshness. Colours are obtained from either natural or synthetic sources. Natural colours are obtained from plant or animal sources. Plant colour contains flavonoids which act as pigments, imparting colour, often yellow or red to flowers, fruits and at times calyces. The suitability of a natural colourant for pharmaceutical preparations depends on factors such as colour value, stability to light, heat and pH. Colouring agents form a chemically diverse group of compounds with wide- ranging stability properties. Compared to synthetic colorants, natural colorants are less stable due to rapid breakdown, especially when formulated in liquid dosage forms. Natural colours are, however, less toxic and more biocompatible and readily biodegradable compared to synthetic colours. It is for this reason that I am presenting the colourant from *Hibiscuss* sabdariffa as a colourant to replace any artificial colourants that are currently in use.

This has earlier been scietitifiaccly evaluated by Frimpong et al. [45]. From their studies, all the three formulations coloured with H. sabdariffa extract showed better colour stability when stored in amber bottles than in plain bottles. Other studies have also supported this claim [48]. Absorbance values over time remained steady when amber bottles were used whereas fluctuations in absorbance values were noted when plain bottles were used. With these studies, it is hoped that H. sabdariffa will become the colourant of choice in pediatric formulations. Although various researches have pointed out this but the colourant from this plant is yet to be officially recognized. In other words, it should be included in the standard pharmacopeia.

Concerns about toxicity and drug interactions

Tahir et al. [49] have stated that the worldwide use of herbal medicines and the growing possible toxicity and herb-drug interactions have been the subject of increased interest in current decades. Thus, *Hibiscus Sabdariffa*, when utilized to cure various diseases, as it is often efficacious, needs its safety to be assessed by health practitioners. The major safety concerns that are of most utmost importance are the risk of toxicity and interactions with drugs, which might sometimes cause toxicity and/or drug therapeutic failure [49]. According to them, several studies have indicated that high doses of Hibiscus tea for relatively long term might have a diverse influence on reproductive systems, kidney, and liver functions. Thus, it is necessary that health specialists must advise and inform their patients about potential interactions that might arise between the related ingestion of *Hibiscus* and drugs. These potential interactions might be from other chemical components of the *Hibiscus* plant which might be different from the colorant. Generally, there is a silent need for more well-designed

controlled clinical studies in humans on the kinetics of *Hibiscus* extracts and their ingredients and related effects of their long-term consumption [49]. It should be noted, however, that the low amount of the *Hibiscus* extract that might be used as colorant in pediatric preparations might not be able, at that level, to cause toxicity. It should, however, be really evaluated for toxicity and drug interactions when used in syrup preparations for adult patients because a higher amount of the extract will be used.

Conclusion

This minireview points out the various properties of *Hibiscuss* sabdariffa plant and its usefulness particularly its flowers. Many studies have been carried out on the plant and the use of its flower extracts as colourants. The flower extract is highly recommended as a colourant in paediatric preparations, although it may be suggested other studies should be carried out on it to establish various compatibility and stability issues. It should be noted that with the various properties such as antioxidant and antibacterial properties, it might also impact some level of preservation of the paediatric preparations reducing the need for other artificial preservatives.

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