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A review of medicinal and nutritional values and mutation breeding of *Hibiscus sabdariffa* L.

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Abstract
The main objective of the study is the review of medicinal, nutritional values and mutation breeding of *Hibiscus sabdariffa* L. This plant comes under the Malvaceae family. It is one of the biggest family in the plant kingdom. Commonly called as a Roselle, *Hibiscus sabdariffa* is native from sub-tropical regions. Roselle is an important medicinal and nutritional valuable plant. Roselle is rich in fiber content. It is mostly cultivated in warm countries. This review provides valuable and informative knowledge about *Hibiscus sabdariffa*. The plant extract is used to cure different kinds of diseases like a cancer, hypertension and cardiovascular diseases. All the parts of the roselle are edible, example leaf, seeds, flower and calyx. The calyx extracts are used as a juice and tea. The leaves are sour in taste. The plant is economically very important in in medicinal, nutritional and dye industries.Through mutation breeding *Hibiscus sabdariffa* plant produced a lot of mutants in a genetic and morphological level. The Roselle is useful for human and the society in a various ways.

Keywords: Cancer, *Hibiscus sabdriffa* L., Medicinal, Mutation breeding, Nutritional value, Roselle

1. Introduction
Hibiscus sabdariffa L. is commonly known as Roselle or Red Sorrel. It is an annual herb, belongs to the family Malvaceae. Roselle grows from seed and stem cuttings [1]. Under the Hibiscus genus more than 300 species are distributed in the tropical and subtropical region all over the world [2]. *Hibiscus sabdariffa* is one of the crop plants in tropical regions. The stem is cylindrical in shape, green and red in colour. The leaves are alternatively arranged in the stem. They are three to five lobed and the leaf veins are green with reddish colour [3]. The flowers are attractive in colour. It is born from the leaf axils. Flowers are having five petals and are arranged in the twisted aestivation. The fruit of the Roselle is called Calyx and it is fleshy in nature. The seeds are kidney shaped and brown in colour. For maturation Roselle plants take five to six months. The chromosome number of Roselle is 4n=72, tetraploid. The *Hibiscus sabdariffa* are rich in nutritional medicinal value [4]. It is an edible plant. In this plant lots of works are done in the field of biochemical, biomedicine, food chemistry and mutation. In this review I am particularly focused on the field of mutation breeding, medicinal and nutritional values. There are two main varieties of *Hibiscus sabdariffa* which are *Hisbiscus sabdariffa* var. *sabdariffa* and *Hisbiscus sabdariffa* var. *altissma*. *Hisbiscus sabdariffa* var. *altissma* is a branchless plant and it is not used for food, *Hisbiscus sabdariffa* var. *sabdariffa* is a bushy plant with many branches and it is edible [5]. Roselle is mostly found in all warm countries like India and it is spread to Malaysia. Roselle is known in different vernacular names in different places. The vernacular names used in different states of India are shown in Table 1. Roselle is called Ambasthika in Sanskrit.

Table 1: Vernacular names of Roselle in different states of India.

State	Vernacular name
Tamil Nadu	Shimai kasarai, Chimapulicha Keerai, Cem-pulichai
Kerala	Puli Cheera, Pulechi
Andra Pradesh	Shimagongura, Ettagomgura
Karnataka	Plachakiri, Mathipuli
Maharastra	Lal ambadi
West Bengal	Chukar
Assam	Tengamora

Taxonomical classification of *Hibiscus sabdarif* L. (APG. IV)
Kingdom: Plantae
Subkindom: Tracheobionta
Division: Magnoliophyta
Class: Magnoliopsita
Order: Malvels
Family: Malvaceae
Genus: *Hibiscus*
Species: *Hibiscus sabdariffa* L

Hibiscus sabdariffa Habit

Hibiscus sabdariffa L. Flower

Medicinal value of *Hibiscus sabdariffa* L.

Now a day, medicines are very important for humans like food. Every plant is naturally having medicinal components that can cure many diseases. Diseases are the biggest problem in the world. Many new diseases are appearing every year due to climatic changes and food styles. In ancient days our ancestors used *Hibiscus sabdariffa* plant as a traditional medicine in Ayurveda, Siddha and Unani treatments. Every plant is having specific medicinal characters. Lots of medicinal plants are present in the world. In a way *Hibiscus sabdariffa* is one of the wonderful medicinal plants. *Hibiscus sabdariffa* shows a various medicinal properties due to the presence of Phytochemicals [6]. The plant is a cure against different diseases like hypertension, cancer, inflammatory diseases, cardiovascular problems and obesity [7]. Roselle is used as a folk medicine. It has the ability to increase urination, bilious and relief during hot weather. Roselle extracts can significantly lower the serum cholesterol [8]. The *Hibiscus sabdariffa* calyx tea reduces 11.02 % systolic blood pressure and 10.07 % diastolic pressure [9]. The *Hibisscus sabdariffa* teas are caffeine free. Intravenous injection of aqueous extracts of Roselle calyx to anaesthelized rats for the studies in the effect of blood pressure. It lowered the blood pressure depend on the dose [10]. The effect of aqueous extract of Roselle on mild to moderate hypertension was recently investigated involving 3 Mexican patients [11]. The dried Roselle calyx contains anthocyanins which are natural pigment and it is secreted by the Roselle plant. It exhibited antioxidant activity and liver protection. The antioxidative activity was also reported in the cancerous cell lines. The herbal tea of Roselle is used for sooth colds, clear blocked nose, fever and kidney problems [12]. The herbal tea is sour in taste. The Roselle decoction was prepared from the seeds. It is useful for relieving pain in urination and digestion problems [13]. The Roselle tea is one of the immune boosters. The extracts of *Hibiscus sabdariffa* were tested against some pathogenic bacteria of human, the crude extract induced endothelium dependent relaxant effects [14]. Traditionally the infusions of the calyx and leaves are used for curing hypertension and other diseases [15]. The Hibiscus sabdaariffa extract significantly reduced the deposition of kidney stone [16]. Extracts of *Hibiscus sabdariffa* can induce apoptosis in cancer cells [17]. The *Hibiscus* extracts which were rich in polyphenol was used to induce cell death in a human gastric carcinoma. Anticlastogenic effects from Roselle has been demonstrated against Sodium arsenite [18]. Roselle protocatechuic acid inhibits the survival of human promyeloctic HL-60 cells. It is dependent on the concentration and time [19]. Roselle has relaxation effects on the smooth muscles and it is partially responsible for the hypertensive action [20]. The early studies showed the direct smooth muscle activation non-endothelium dependent relaxation [21]. Aqueous–methanol extract of dried *Hibiscus sabdariffa* showed *in vitro* inhibitory effects in bacterial strains [22]. The Roselle seed crude extracts showed antimicrobial effects against gram negative bacteria [23]. The Roselle plant has hepatoprotective activity. It reduces the oxidative stress by attenuating mitochondrial dysfunction [24]. Phenolic components are rich in Roselle plants. It was demonstrated *in vitro* in protective effects against the cytotoxicity genotoxicity of hepatocytes induced by the tert-butyl hydroperoxide [25]. The Roselle leaf extracts have anti-cancer activity and it is assessed against the human prostate cancer cell *in vitro* and *in vivo* [26]. The Roselle extracts have a lowering lipid activity. It prevents the hypelipidemia and cardiovascular diseases [27]. Calyx are useful for the treatment in hypertension and Ceylon mouth diseases [28].

Nutritional value of *Hibiscus sabdariffa* L.

Nutrition is very important for the survival of living beings. The *Hibiscus sabdariffa* is used a leafy vegetable. The plant has nutritional value. In the tropical and subtropical region people frequently take the Roselle plant as food. In this plant leaf, calyx, seed and flower are edible cooked or raw. Calyx is an important part of the plant. Jams, tea, cold drinks, herbal drinks and beverages are prepared from the calyx [29]. The early researchers reported nutritional components of Roselle calyx contain 49 calories from 100g of fresh Roselle calyces [30]. Roselle calyces are used to make cake buddings. In village people are using the leaf for making curry, sauce and the dried calyces are used to prepare a sour tea which is good for headache.

The previous studies showed that the dried Roselle calyces contain a high level of ascorbic acid 360-280mg/100g [31]. The Roselle seeds are rich in proteins and fibers. The amino acids Lysine, arginine, leucine, phenylalanine and glutamic acids are rich in Roselle seeds [32]. Indian women make chutney from tender leaves and stem [33]. In West Indies,

during Christmas time they make lemon added beverages from the Roselle calyces [34].

Mutation Breeding of *Hibiscus sabdariffa* L.

Father of mutation breeding is Ake Gustafsson. Mutation is the sudden heritable change. In other worsds mutation is the changes occuring in the nucleotide sequence. Mutations can be induced in a plant in the form of physical and chemical mutagens. The mutagens which change the plant character are called mutants. The production of new varities from some of the varities of a plant is called mutation breeding. It is a type of plant breeding method. In mutation breeding in Roselle plant it changes the flower colour, seed colour, and randomly increases the leaf and seed quality. Some mutants also occur like chlorophyll and morphological mutants. They cause the genetical changes to the plant. The highest concentration of Gamma rays decrease the plant height, root and shoot lengths and delay the flowering and the lowest concentration of gamma rays significantly increase the plant height, root and shoot lengths. Higher concentrations of gamma rays give a negative in morphological characters [35]. In gamma rays irradiated *Hibiscus sabdariffa* plant calyces, anthocyanin components are increased compared to the control plant.

Future Research:

My research field is mutation breeding. The *Hibiscus sabdaiffa* plant seeds are irradiated in physical and chemical mutagens. Physical mutagens are Gamma rays and the Chemical mutagens are EMS they are taken in the following concentrations like 05, 10, 15, 20, 25, 30, 35, 40, 45 and 50 (Gamma rays KR and EMS mM). The aim of the further research is to analyze the phytochemicals present by the method of High performance liquid chromatography HPLC.

Conclusion

The review paper shows that the Roselle is a popular medicinal and economical plant. This plant is rich in medicinal and nutritional values and it is having a lot of health benefits.

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