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Hibiscus Tea: A Natural Tea to Dwindle Hypercholesterolemia

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ABSTRACT

Nowadays, there are many natural plant products that are widely used to reduce the increasing burden of diseases. Hibiscus rosa-sinensis Linn, which belongs to the family Malvaceae, is a plant distributed widely throughout the world. Its leaves, roots, barks, roots, and flowers are being used by the Indian traditional system as medicine to cure several diseases. Many research studies have proved that the different parts of the Hibiscus rosa-sinensis plant exhibit antioxidant, antimicrobial, anti-diabetic, anti-ulcer, hepatoprotective, anti-fertility, anti-genotoxic, anti-hypertensive, anti-hypercholesterolemia, and anti-inflammatory activities, which grab the scientific attention due to various biological activities. Hibiscus rosa-sinensis has been used in many herbal mixes and drinks. Various research studies have been conducted in animal models to evaluate Hibiscus rosa-sinensis flowers and leaves as anti-diabetic and antioxidant compounds. The present study is to mainly illuminate the antihypercholesterolemic effects of Hibiscus rosa-sinensis.

Keywords: Hibiscus rosa-sinensis, hypercholesterolemia, blood pressure

INTRODUCTION

The trend of the herbal remedies is rapidly growing globally.

^[1] Based on 2002 data, almost four billion people in the world relied on herbal remedies for primary health issues. ^[2] Although the Beneficial effects of these herbal remedies on health problems have been observed and experienced by humans for thousands of years, yet minimum scientific data are available on these treatments. Lack of data on the mode of action, potential adverse reactions, contraindications and interactions with existing Western medical treatments has restricted these products from being competitive leading supplements in the market. ^[3]

Hibiscus is a family of flowering plants which the leaves and red flower's petals are used as herbal remedies by most people in the world. Yet data are scarce on the effects of

different varieties. Consumption of tea made of flower petals of hibiscus family is being practiced by a large number of patients in the world to control hyperlipidemia ^[4] thus Hibiscus tea is commercially available in international markets. To prepare hibiscus tea, a variety of flowers which are belonged to hibiscus family is used. Hibiscus sabdariffa is the mostly consuming variety which also has scientifically proven hypolipidemic effects. However, hibiscus rosa-sinensis is the most common, easily cultivated plant which is accessible to most people in the world as it is grown massively in tropics and sub-tropical (it can be cultivated in glass chambers in cold weathers as it does not tolerate temperatures below 10°C) Aqueous extract of hibiscus rosa-sinensis red flower petals are a common herbal home-remedy consumed by people in Asian countries however, has minimum scientific data to prove the effects on humans. This plant is a globous shrub

cultivated as an ornamental plant. Among the different colors, red flowered variety is mostly used as an herbal remedy.^[5] Due to universal availability and good palatability, herbal home-made tea could be prepared with the petals of *Hibiscus rosa-sinensis* with a minimum preparation time. Prior a study on the effect of *Hibiscus rosa-sinensis* tea on humans, the present review mainly focuses on the effects of this flower on hypercholesterolemic humans. The herb *Hibiscus rosa-sinensis* L. (Malvaceae) is native to China. Many species of *Hibiscus* are grown for their showy flowers. It is a shrub widely

cultivated in the tropics as an ornamental plant and has several forms with varying colors of flowers. *Hibiscus* has also medicinal properties and takes part as a primary ingredient in many herbal teas. The red flowered variety is preferred in medicine. The taxonomy and the name of *Hibiscus* flowers in different regions were depicted in Table 1. There were various studies reported that variety of *Hibiscus* plants have different medicinal properties. This review mainly focused on the therapeutic potential of the *Hibiscus rosa-sinensis* plant and its applications.

Table 1: Taxonomy and common name of *Hibiscus rosa-sinensis*

Taxonomy	
Name	<i>Hibiscus rosa-sinensis</i>
family	Malvaceae
Common Names in India	
Andhra Pradesh	Susanna
Assamese	Jiwa, Joba
Bengali	Our
Gujarati	Java, Jaunt
Hindi	Gather, Jason, Jasum, Jeva
Malayalam	Vasavada
Kansas	Vasavada
Manipuri	Java Kusum
Marathi	Dasindachaphula, Jasvand
Mizoram	China pangpar, Midumpangpar

In history, the medicinal plants are widely used for the various purposes. The plants have identified as medicinal plants because of the ability to synthesize chemical compounds which play major role to prevent different diseases like cancer, diabetes, etc. A wide variety of chemical compounds also has important biological functions, and to defend against attack from predators' compounds have been isolated so far; a number estimated to be less than 10% of the total.

Medicinal plants can be considered and divided in three important sectors: (a) modern medicines that utilize about 30 to 35 medicinal plants; (b) organized and codified traditional medicines that are with written treatise texts such as Ayurveda, Siddha, Unani, Amchi and Tibetan systems of medicine that use about 1,200 to 2,000 medicinal plant species, and (c) local health traditions that are based on traditions practiced by villagers, folk healers, vaidyas, and tribal people who use more than 8,000 species of medicinal plants for primary health care purposes^[6]

History of herbal tea

The *Hibiscus rosa-sinensis* flower is most widely found in tropical climates around the world, including Africa, Central and South America, Mexico, and the Caribbean. It has a long history of use in both cuisine and healing, particularly in a number of African countries where it was first cultivated.

Hibiscus tea has been used in Egypt and Sudan for hundreds of years, where it is called "Karkare." In ancient Egypt, the tea was served cold and used primarily by Pharaohs to cool off in the desert heat. *Hibiscus* tea performed an important role in several religious and healing ceremonies in the Nile Valley during this time. *Hibiscus* tea residues as a very popular drink throughout Africa, especially in northern and western African countries like Nigeria. Today, traditional

Egyptian and Sudanese weddings still typically contain a toast using *hibiscus* tea.

Importance of *Hibiscus* tea

Hibiscus tea, also called as Sorrell tea or "sour tea" is a fragrant tea assemble from the dried calyxes of the tropical *Hibiscus rosa-sinensis* flowers.

The US and Food Drug Administration (FDA) contemplates *hibiscus* safe when consumed in food. You can certainly add *hibiscus* into your diet safely.

Hibiscus tea has a fruity, refreshing flavor that many enjoy hot or iced. Many people drink it for its potential health benefits. While research shows that there may be some truth to these claims, there may also be potential risks. More research is required to attain this.

Nutrition Information

One small iced *hibiscus* breeze tea cooler contains:

- Calories: 79
- Protein: 0 grams
- Fat: 0 grams
- 654rrCarbohydrates: 20 grams
- Fibber: 0 grams
- Sugars: 20 grams

Hibiscus tea contains vitamin C - a nutrient that plays multiple essential roles in the body. These include: Tissue growth and repair, the maintenance of cartilage, bones, and teeth, wound healing, the formation of collagen and iron absorption.

Vitamin C - aka ascorbic acid is also an antioxidant. It can help boost your immune system and helps to prevent cell damage caused by free radicals in the body. This can minimize your risk of developing many significant health complications such as heart disease, diabetes, and cancer.

Applications of hibiscus tea in medicinal Industry

The leaves stem and flowers of the hibiscus rosa-sinensis plant are mainly used to treat a variety of ailments. In particular, many research results have demonstrated that tea made by hibiscus flowers offers numerous health benefits. Here you can see how this plant produces exotic flowers, promotes physical health and its several medicinal benefits.

It assists liver health by protecting the liver from a variety of toxins and also opposes against bacteria.

It acts against inflammation and also plays a role in the betterment of many illnesses including cancer, asthma, Alzheimer's disease, heart failure and rheumatoid arthritis. It Provides anti fertility properties, lowers the elevated blood pressure, promotes cardiovascular health and exhibits potential to fight against cancer antioxidants.

Acts as a diuretic by relieving different conditions such as kidney disease, heart disease, high blood pressure, liver cirrhosis. Ameliorates liver health as they are high in antioxidants that play a prominent role in the healthy functioning of the liver. Controls blood sugar level by lowering lipid and blood sugar levels. In particular, the flowers of this plant are famous for treating diabetes.

Relieves all hair problems, Supports skin enrichment and aids in weight loss. Slows down the premature aging, treats various respiratory ailments, boosts the immune system and helps to induce quality of sleep. Accelerates wound healing process, maintains healthy digestive system and benefits for women in multiple ways.

Phytochemicals in flower on serum cholesterol

Scientific data reveals that the edible parts of the H. rosa-sinensis flowers contain 89.8% moisture, 0.064% nitrogen, 0.36% fat, 1.56% crude fiber. Moreover, flower extract contains tannins (7.5±0.20 %), phenols (0.678±0.14%) and alkaloids (0.51±0.16 %) while the total phenol content in flowers was 735±46 mg Gallic acid equivalent /100g. The four main types of flavonoids in petals are rutin, quercetin, kaempferol and myricetin⁽¹¹⁾. Petals contain various flavones such as quercetin-3-di-0-beta-D-glucoside, quercetin-3-7-di0-beta-D-glucoside, cholesterol, campesterol, quercetin3-0-beta-D-sophorotrioxide, β-sitosterol10, kaempferol3-0-beta-D-xylosyl-glucoside19, catalase13. Red and magenta color flower petals possessed dark- purplish dye, anthocyanin pigment and cyanidin diglycosidic^[12] along with proanthocyanins^[13]. Another study reveals the presence of terpenoids in flower petals⁽¹⁴⁾. All these compounds elicit antioxidant properties; thus, the antioxidant capacity of the petals was significantly high [ascorbic acid equivalent antioxidant capacity (AEAC): 640 ± 56 mg ascorbic acid /100g; total anthocyanin content (TAC): 284 ± 17 mg cyanidin-3-glucoside equivalent/100g; ferric-reducing power (FRP): 4.0 ± 0.3 mg Gallic acid equivalent /100g⁽¹⁵⁾]. In another study, aqueous extract of Hibiscus elicited high tannin and anthocyanin contents, and possessed high ferric reducing antioxidant power^[16]. Further, fresh flowers of Hibiscus rosa-sinensis possess 0.30-0.50 v/w % of essential oils.

Most of the beneficial effects of this flower variety could be due to the presence of antioxidants, which play a key role in controlling diabetes and hypercholesterolemia. Phenolic compounds in tea inhibit α amylase and α glucosidase enzymes. The key enzymes of carbohydrate digestion^[17]. Furthermore, polyphenolics in tea inhibit glucose uptake by

Intestinal Caco-2 cells^[18]. Tannic acid, a major compound of tannins and alkaloids, stimulates the translocation of glucose transporters (GLUT 4) and increase phosphorylation of insulin receptors thus increasing glucose clearance from blood and activating insulin action respectively^[19]. The whole plant of Hibiscus rosa-sinensis increase insulin secretion from the pancreatic beta cells, probably by the actions exerted by alkaloids, flavonoids and terpenoids^[20]

Owing to the above actions on GLUT 4 receptors and insulin receptors, polyphenolic compounds might increase deposition of excess glucose in adipose tissues as fat, increase uptake of triglycerides from adipose tissues by activating lipoprotein lipase and inhibit hormone sensitive lipase which involve in adipolysis. Summative action will be the decrease of circulatory triglycerides and phospholipids. Further, Anthocyanins in Hibiscus sabdariffa inhibit Angiotensin Converting Enzyme (ACE) by competing with the substrate of the enzyme, thereby controls hypertension^[21]

Terpenoids are present in many herbal plants which can modulate activities of ligand- dependent transcription factors [peroxisome proliferator-activated receptors (PPARs)] and thus can prevent obesity-induced metabolic disorders, such as type 2 diabetes, hyperlipidemia, insulin resistance, and cardiovascular diseases.^[22]

Quantitative analyses have revealed that the aqueous extract of Hibiscus rosa-sinensis flower petals have high amounts of tannins and anthocyanin. Thus show high ferric reducing antioxidant power. Among the phenols, flavonoids, tannins, flavanol and Anthocyanins are the most potent antioxidants in Hibiscus⁽¹⁶⁾ thus it can be hypothesized that the above beneficial health effects also could be obtained by Hibiscus tea.

However, all above beneficial effects have been observed with isolated polyphenolic compounds. Therefore, it is not clear whether a tea made from the herbal plant or flower will exert the same effect. Although data on animal studies are available to prove the anti-hyperglycemic and anti-hyperlipidemic effects of Hibiscus rosa-sinensis extracts, human studies to observe the activity of these compounds in human body, are yet to be carried out.

MATERIALS AND METHODS

Mainly three materials are used in the hibiscus tea preparation and their benefits were exhibited in Table 2. They are

- Hibiscus flowers
- Cinnamon
- Lemon

METHODOLOGY

Hibiscus tea making process

Now you know all the benefits that come with the simple act of boiling water and adding hibiscus flowers, there's plenty of reasons to brew up this floral delight. While a warm cup is always welcome, we love the sour tang of a tropical tea made with hibiscus. Not only is it a visual thirst quencher but the aroma and gorgeous coloring just scream. Take a look at this easy to make hibiscus tea recipe.

Take 2 cups of water, four fresh hibiscus flowers, little amount of cinnamon and 2 table spoons of fresh lemon juice and steps as follows

1. Pick fresh hibiscus flowers; pull all the petals from the flowers. Rinse well in water to remove any dust, bugs or impurities.
2. Take a bowl and add 2 cups of water for boiling and then add little amount of cinnamon pieces into the boiling water.
3. Add boiling water over the fresh petals of hibiscus flowers. Let it steep for few minutes. The petals will change from red to yellow.
4. Remove all the yellow petals. Don't steep the flowers for longer time or else the tea becomes quite bitter.
5. Tea can be drunk hot or cold. If you want an ice-tea add some ice cubes to it.
6. Add freshly squeezed lemon and see how the color magically changes to a beautiful cranberry.
7. Now the tea is ready to serve.

Hibiscus tea is an herbal tea made as an infusion from the sepals of the hibiscus *rosa-sinensis* flower. It has a tart, cranberry like flavor, and sugar or honey is often added to sweeten it. Hibiscus tea is a very popular drink throughout the world, and is often used as a medical tea. Hibiscus tea is ruby red in color, and is also colloquially known as sour tea. It is widely available all over the world, and can be consumed either hot or cold, depending on your preference. This tea is low in calories and is caffeine-free.

Nutritional values of hibiscus tea

Let's check out nutritional information hibiscus tea, this tea is one of the healthiest beverages out there, as it contains no fats and no carbohydrates, but is filled with a plethora of essential nutrients. Hibiscus tea is rich in calcium and iron as well as other material such as potassium and manganese it has very impressive antioxidant properties, which help treat many diseases and ailments.

Hibiscus tea for cholesterol level management

Hibiscus tea helps lower bad cholesterol levels from the body, thereby helping to protect against heart diseases and protecting blood vessels from damage. The Hypolipidemic

and hypoglycemic properties of hibiscus tea can be beneficial for those who suffer from blood sugar disorders like diabetes. Over the years, hibiscus tea has been used to aid in weight loss efforts. When you consumed food that is rich in carbohydrates, that food contains sugar and starch as well, which makes you likely to gain weight this is where hibiscus comes in.

Hibiscus extract lowers the absorption of starch and glucose, and also inhibits the production of amylase, which helps in the absorption of carbohydrates and starch, which means that drinking hibiscus tea prevents the absorption from occurring. Therefore, hibiscus tea is found in many weight loss products.

Uses of hibiscus tea

Hibiscus is a large genus of flowering plants, growing primarily in tropical and subtropical regions, whose flowers used for a wide range of medicinal purposes and edible products ranging from making gums and jellies to lowering blood pressure aiding in weight loss, reducing cholesterol and, in some case treating cancer.

Hibiscus tea has many proven to help manage blood pressure in hypertensive adults, and this is due to its anti-inflammatory properties, which reduce blood pressure drastically with daily consumption. Hibiscus tea has antioxidant properties which helps protect the liver as well as lower bad cholesterol levels in the blood, thus keeping the heart functioning properly. Hibiscus tea contains vitamins and minerals like flavonoids which have anti-depressant properties, so this tea is often used to treat anxiety issues.

Benefits of hibiscus tea on overall heart health

Hibiscus does more than lower blood pressure, blood sugar, and cholesterol. If kept at constant low levels, these benefits will lead to better heart health. It's important to keep your blood pressure at a stable level because over time high blood pressure can put unnecessary strain on your heart. This weakens it and increases your chances of heart disease. High blood sugar and fat levels can also lead to stroke and heart disease. So once again, it's important to regulate.

Table 2: Chemical constituents and medicinal uses of ingredients used in hibiscus tea

Sl. No	Ingredients	Parts	Chemical Constituents	Medicinal Uses
1.	Hibiscus Flowers	Flowers	Protein Free amino acids Reducing sugars Saponins	It helps to maintain weight loss. Maintain healthy weight. Reduce cholesterol. Decrease blood lipids.
2.	Lemon	Lemon juice	Chitral Limonene	Reduce body weight. Reduce obesity.
3.	Cinnamon	Bark	Cinnamaldehyde Cinnamic acid	Reduce some of the bad effects of eating high fat food. Anti-obesity effect.

Photochemistry

Hibiscus *rosa-sinensis* is well studied plant. The report suggested that it contains Tannins, Flavonoids, Steroids, Alkaloids, Saponins, Total phenols, Total flavonoids, Total proanthocyanins. It has been also reported that it contains majorly Anthocyanins and flavonoids; cyanidin-3,5-diglucoside, cyanidin-3-sophoroside-5-glucoside, quercetin-3,7-diglucoside, quercetin-3-diglycosidic. The other compounds are also present like cyclopeptide alkaloid [23].

Cyanidin chloride, quercetin, hentriacontane [24] and vitamins: riboflavin, ascorbic acid and thiamine. The leaves and stems contain β -sitosterol, stigmasterol, tracery acetate and three cyclopropane compounds and their derivatives. The Hibiscus flowers contain cyanidin Di glucoside, flavonoids and vitamins, thiamine, riboflavin, niacin and ascorbic acid. H. *rosa-sinensis* extract is a source of many potentially active antioxidants and anticancer constituents such as quercetin, glycosides, riboflavin, niacin, carotene, malvalic acid gentilic

acid, margaric acid and laurie acid [25-30]. The Phytocompounds of the ethanolic extract of the flowers of *H. rosa sinensis* also analysed by GC-MS and they reported Propanol, 3,3'-dithiobis(2,2-dimethyl- SS)- or (RR)-2,3-hexanediol, 2-Hydroxy-2-methylbutyric acid, n-Hexadecenoic acid, Heptanoic acid, 2-ethyl- Trans-(2-Ethylcyclopentyl) methanol, 3-N-Hexylthiolane, SS-dioxide Hexane dioic acid, bis(2-ethylexyl) ester, 1,2-

Benzenedicarboxylic acid, dioctyl ester, 1,3-Benzodioxole, 5,5'- (tetrahydro-1H,3H-furo(3,4-c)furan1,4-diyl)bis-, (1S-(1 α ,3 α α ,4 β ,6 α α)-Squalene, 2R- Acetoxymethyl-1,3,3-trimethyl-4t-(3-methyk-2-buten-1-yl)-1cyclohexanol^[31]. The roots of *H. sinensis* contains sterols, carbohydrates and glycosides, Phenolic compounds and tannins, triterpenoids, saponins, mucilage and flavonoids. ^[32]

Table 3: Nutritional composition of Hibiscus flowers on fresh weight bases

Major components		Minerals		Vitamin	
Water	89.8%	Calcium	4mg	Thiamine(B1)	0.03mg
Protein	0.06g	Phosphorus	27mg	Riboflavin(B2)	0.05mg
Fat	0.4g	Iron	1.7	Niacin	0.6mg
Fiber	1.56g			Ascorbic acid	4.2mg
Nutritional composition of Hibiscus flowers on dry weight bases					
Calories	353g	Minerals	Vitamins	Calories	353g
Protein	3.9g	Calcium	39mg	Protein	3.9g
Fat	3.9g	Phosphorus	265mg	Fat	3.9g
Carbohydrate	86.3g	Iron	1.7mg	Carbohydrate	86.3g
Fiber	15.7g	Ash	5.9mg	Fiber	15.7g

RESULTS & DISCUSSION

Lipid profile parameter of the volunteer before using hibiscus tea

Table 4: Lipid profile parameter of the volunteer before using hibiscus tea

Parameter Lipid Profile	Result	Reference range
Total cholesterol	198mg/dl	Normal:<200 Boarderline:200 -240 High :>200
Triglycerides	154mg/dl	Normal:<150 Boarderline:150-200High :>200
HDL cholesterol	43mg/dl	Low risk :>60 Normal risk :40-60High risk:<40
LDL cholesterol	125mg/dl	Normal:<130 Boarderline:130-160High :>160
VLDL cholesterol	32mg/dl	Normal:<40 High :>40
LDL HDL Ratio	2.84mg/dl	Normal :<3.5

Table 5: Lipid profile parameter of the volunteer after using hibiscus tea

Parameter Lipid Profile	Result	Reference range
Total cholesterol	159mg/dl	Normal:<200 Boarderline:200 -240 High :>200
Triglycerides	130mg/dl	Normal:<150 Boarderline:150-200 High :>200
HDL cholesterol	39.75mg/dl	Low risk :>60 Normal risk :40-60High risk:<40
LDL cholesterol	94mg/dl	Normal:<130 Boarderline:130-160 High :>160
VLDL cholesterol	26mg/dl	Normal:<40 High :>40
LDL HDL Ratio	2.36mg/dl	Normal :<3.5

Lipid profile parameter of the volunteer shows that the result of *Hibiscus rosa-sinensis* tea has anticholesteremic effect. The present data shows effects of *Hibiscus rosa-sinensis* tea on controlling hypercholesterolemia. *Hibiscus* tea used to increase in 'good cholesterol' (high density lipoproteins) and decreased in 'bad cholesterol' (low density lipoproteins). It used an anticholesteremic agent. The *Hibiscus rosa-sinensis*

tea can be used as a home remedy to control hypercholesterolemia.

CONCLUSION

The majority of the population pursues drugs derived from plants for their health care. Several medicinal plants and their derived components are used directly or indirectly for

therapeutic applications. The antioxidant properties of *Hibiscus rosa-sinensis* plants are of particular interest in view of oxidative modification. *Hibiscus rosa-sinensis* plants can also reduce diabetes-related complications like hyperglycemia, hypercholesterolemia, and hyperlipidemia in both humans and animals. With time, we can expect to see a greater body of scientific evidence supporting the benefits of *Hibiscus rosa-sinensis* in the overall maintenance of health and protection from disease. The present research study

focuses on the available scientific data on the effects of *H. rosa-sinensis* on controlling hypercholesterolemia. The endeavor was to identify whether *H. rosa-sinensis* flower petals as tea are effective for hypercholesterolemic patients. *H. rosa-sinensis* petals present in a home-made *Hibiscus* tea are sufficient to elicit anti-hyperlipidemic effects. Homemade *Hibiscus* tea is effective in controlling hypercholesterolemia without causing acute toxicity.

REFERENCES

1. Ekor M, Pistelli L. Frontiers The growing use of herbal medicines issues relating to adverse reactions and challenges in monitoring safety Pharmacology. Vol. 177; 2013. Front pharmacol. doi: 10.3389/fphar.2013.0017.
2. Subramanian SS, Nair AGR. Flavonoids of four Malvaceae plants. Phytochemistry. 1972;11(4):1518-9. doi: 10.1016/S0031-9422(00)90132-8.
3. Nakamura Y, Hidaka M, Masaki H, Seto H, Uozumi T. Major anthocyanin of the flowers of hibiscus (*Hibiscus rosa-sinensis* L. Agric Biol Chem. 1990;54(12):3345-6. doi: 10.1080/00021369.1990.10870458.
4. Patel S, Adhav M. Comparative phytochemical screening of ethanolic extracts (flower and leaf) of morphotypes of *Hibiscus rosa-sinensis* Linn. J Pharmacogn Phytochem. 2016;5(3):93.
5. SK, W. Lim, Y, & Chan, E. J Trop Forest Sci. 2009. Antioxidant properties of hibiscus: Species variation, altitudinal change, coastal influence and floral colour change;21(4):307-15.
6. Mak YW, Chuah LO, Ahmad R, Bhat R. Antioxidant and antibacterial activities of hibiscus (*Hibiscus rosa-sinensis* L.) and Cassia (*Senna Capsularis* L.) flower extracts. J King Saud Univ Sci. 2013;25(4):275-82. doi: 10.1016/j.jksus.2012.12.003.
7. Hara Y, Honda M. The inhibition of α -amylase by tea polyphenols. Agricultural and Biological Chemistry. 1990;54(8):1939-45. doi: 10.1080/00021369.1990.10870239.
8. control obesity or diabetes by diminishing the absorption of glucose decomposed from starch obtained E.g.) were 2 times more inhibitory than pyro- catechins (Gigg and Egg) respective-, 54(8), 1939–1945.
9. Johnston JJ. Evaluation of cocoa- and coffee-derived methylxanthines as toxicants for the control of pest coyotes. J Agric Food Chem. 2005;53(10):4069-75. doi: 10.1021/jf050166p, PMID 15884841.
10. Li Y, Kim J, Li J, Liu F, Liu X, Himmeldirk K et al. Natural anti- diabetic compound 1,2,3,4,6-penta-Ogalloyl-d-glucopyranose binds to insulin receptor and activates insulin-mediated glucose transport signalling pathway. Biochem Biophys Res Commun. 2005;336(2):430-7. doi: 10.1016/j.bbrc.2005.08.103, PMID 16137651.
11. Mishra M. an Analytical Review of Plants for Anti Diabetic Activity with Their Phytoconstituent & Mechanism of Action. Int J Pharm Sci Res. 2009;1(1):29-46.
12. Ojeda D, Jiménez-Ferrer E, Zamilpa A, Herrera-Arellano A, Tortoriello J, Alvarez.
13. Ojeda D, Jiménez-Ferrer E, Zamilpa A, Herrera-Arellano A, Tortoriello J, Alvarez L. Inhibition of angiotensin converting enzyme (ACE) activity by the anthocyanins delphinidin- and cyanidin-3-O-sambubiosides from *Hibiscus sabdariffa*. J Ethnopharmacol. 2010;127(1):7-10. doi: 10.1016/j.jep.2009.09.059, PMID 19808084.
14. Goto T, Takahashi N, Hirai S, Kawada T. Various terpenoids derived from herbal and dietary plants function as PPAR modulators and regulate carbohydrate and lipid metabolism. PPAR Res. 2010;2010:483958. doi: 10.1155/2010/483958, PMID 20613991.
15. Khokhar I, Ahmad I. Studies in medicinal plants of Pakistan: a new cyclopeptide alkaloids from the flowers of *Hibiscus rosa sinensis*. Sci Int (Lahore). 1992;4(2):147-50.
16. Jadhav VM, Thorat RM, Kadam VJ, Sathe NS. Traditional medicinal uses of *Hibiscus rosa-sinensis*. J Pharm Res. 2009;2(8):1220-2.
17. Hennekens CHH, Stampfer MJ, Willett W. Micronutrients and cancer chemoprevention. Cancer Detect Prev. 1984;7(3):147-58. PMID 6467250.
18. H. Weis burger, Nutritional approach to cancer prevention with emphasis on vitamins, antioxidants, and carotenoids, Am. J Clin Nutra. 1991;53(1):226S-37S.
19. Block G, Patterson B, A, Subaru. Fruit, vegetables, and cancer prevention: a review of the epidemiological evidence, Nutrition and Cancer 18(1). 1992;118 Vincenta Khristi and V. H. Patel:1-29.
20. Makita H, Tanaka T, Fujitsuka H, Tatematsu N, Satoh K, Hara A et al. Chemoprevention of 4-nitroquinoline 1-oxide-induced rat oral carcinogenesis by the dietary flavonoids chalcone, 2-hydroxychalcone, and quercetin. Cancer Res. 1996;56(21):4904-9. PMID 8895742.
21. Ross IA. Medicinal plants of the world: chemical constituents, traditional and modern medicinal uses; 2001.
22. Woutersen RA, Appel MJ, Van Garderen-Hoetmer A. Modulation of pancreatic carcinogenesis by antioxidants. Food Chem Toxicol. 1999;37(9-10):981-4. doi: 10.1016/S0278-6915(99)00093-9.
23. Bhaskar A, Nithya V, Vidhya VG. Phytochemical screening and in vitro antioxidant activities of the ethanolic extract of *Hibiscus rosa sinensis* L. Annals Biol Res. 2011;2(5):653-61.

24. Kumari AAG, Polavaram A, J. A. J. Sunil's son, K. Ananda Rajagopal, M. Vignesh and J. Parkavi, Preliminary phytochemical and antiulcer studies of *Hibiscus rosa sinensis* Linn. Root extracts. *Int J Green Pharm (IJGP)*. 2010;4(1).
25. Yashaswini S, Hegde RV, Venugopal CK. Health and nutrition from ornamentals.
26. *Int J Res Ayur Pharm*. 2011;2(2):375-38.
27. Jadhav VM, Thorat RM, Kadam VJ, Sathe NS. Traditional medicinal uses of *Hibiscus rosa-sinensis*. *J Pharm Res*. 2009;2(8):1220-2.
28. Hennekens CHH, Stampfer MJ, Willett W. Micronutrients and cancer chemoprevention. *Cancer Detect Prev*. 1984;7(3):147-58. PMID 6467250.
29. H. Weis burger, Nutritional approach to cancer prevention with emphasis on vitamins, antioxidants, and carotenoids, *Am. J Clin Nutra*. 1991;53(1):226S-37S.
30. Block G, Patterson B, A, Subaru. Fruit, vegetables, and cancer prevention: a review of the epidemiological evidence, *Nutrition and Cancer* 18(1). 1992;118 Vincenta Khristi and V. H. Patel:1-29.
31. Makita H, Tanaka T, Fujitsuka H, Tatematsu N, Satoh K, Hara A et al. Chemoprevention of 4-nitroquinoline 1-oxide-induced rat oral carcinogenesis by the dietary flavonoids chalcone, 2-hydroxychalcone, and quercetin. *Cancer Res*. 1996;56(21):4904-9. PMID 8895742.
32. Ross IA. Medicinal plants of the world: chemical constituents, traditional and modern medicinal uses; 2001.
33. Woutersen RA, Appel MJ, Van Garderen-Hoetmer A. Modulation of pancreatic carcinogenesis by antioxidants. *Food Chem Toxicol*. 1999;37(9-10):981-4. doi: 10.1016/S0278-6915(99)00093-9.
34. Bhaskar A, Nithya V, Vidhya VG. Phytochemical screening and in vitro antioxidant activities of the ethanolic extract of *Hibiscus rosa sinensis* L. *Annals Biol Res*. 2011;2(5):653-61.
35. Kumari AAG, Polavaram A, J. A. J. Sunil's son, K. Ananda Rajagopal, M. Vignesh and J. Parkavi, Preliminary phytochemical and antiulcer studies of *Hibiscus rosa sinensis* Linn. Root extracts. *Int J Green Pharm (IJGP)*. 2010;4(1).