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Phytochemical analysis of crude extract and carotenoid pigments from fruits, vegetables and flowers

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Abstract

The well-documented health benefit of a diet high in fruits and vegetables has led to a growing interest in so-called "functional foods" and their application in health and disease. Nature has been providing medicines to treat our diseases and relieve our suffering for many thousands of years. Despite great advances in rational drug design, in which new medicines are synthesized based on knowledge of specific molecular targets, most prescribed medicines used in industrialized countries today still are derived from, or patterned after, natural compounds from plants, animals, and microbes. This is particularly true for drugs that treat infections and cancers. Thus Traditional medicine has a long history of serving peoples all over the world. India is without doubt a herbal hub. Medicinal plants that are native to India and their use in various traditional systems of medicine are indeed awe-inspiring. The Ethnobotany of ubiquitous plants provides a rich resource for natural drug research and development. Thus natural sources make a very significant contribution to the health care system. The present study is a first initiative to study the Phytochemical properties of selected Fruits, Vegetables and Flowers of Medicinal Importance.

Keywords: Functional Foods, Nature, Traditional Medicine, Ethnobotany and Health Care System.

Introduction

Natural products have been the basis of treatment of human diseases for a long period of time. Modern medicine or allopathy has gradually developed over the years due to the scientific and observational efforts of scientists. However the basis for its development remains in the roots of traditional medicine and therapies. Herbal medicinal preparations and their proprietary products are also being used more and more widely throughout the world.

Fruits and their health benefits

Fruits have been recognized as good sources of vitamins and minerals, and for their role in preventing vitamin C and vitamin A deficiencies. Fruits are important sources of many nutrients, including potassium, fiber, vitamin C and folate (folic acid). People who eat fruit as part of an overall healthy diet generally have a reduced risk of chronic diseases. United States Department of Agriculture (USDA's) My Plate organization encourages making half your plate with fruits and vegetables for healthy eating. They insist on incorporating fruits rich in vitamin C which contain phytochemicals for added health benefits (**Figure 1**).

Figure 1: Dried Fruit samples

The nutrients in fruits are vital for health and maintenance of our body. The potassium in fruit reduces the risk of heart disease and stroke. Potassium may also reduce the risk of developing kidney stones and also helps to decrease bone loss as one age. Folate (folic acid) helps the body in the formation of red blood cells. Women of childbearing age who become pregnant and those in the first trimester of pregnancy need adequate folate. Folate helps prevent neural tube birth defects, such as spina bifida. Eating a diet rich in fruit may reduce the risk for stroke, other cardiovascular diseases and type-2 diabetes and provides protection against certain cancers. Fruits help to maintain optimum health due to the health promoting phytochemicals it contains – many of which are still being identified. One to 2-1/2 cups of fruits are recommended each day; depending on how many calories one needs (www.healthyeating.org).

Ananas comosus (L.) Merrill belonging to the family Bromeliaceae is an important tropical and subtropical plant widely cultivated in the tropical areas of the world. Its fruit is consumed fresh or canned as a commercial product in many countries. Pineapple has also been known for a number of beneficial biological activities such as antioxidative, anti-browning, anti-inflammatory and anti-platelet activities. The enzyme complex of *A. comosus* called bromelain is known for its clinical applications particularly modulation of tumor growth, blood coagulation and anti-inflammatory effect (**Tripoli *et. al.*, 2007**).

Oranges contain very good amount of vitamin A, and other flavonoid antioxidants such as alpha and beta carotenes, beta-cryptoxanthin, zeaxanthin and lutein, compounds that have antioxidant properties. Vitamin A is necessary for maintaining healthy mucus membranes, skin and essential for vision. It is also a very good source of B-complex vitamins such as thiamin, pyridoxine and folates. These vitamins are essential in the sense that body requires them from external sources to replenish. Orange fruit also contains a very good amount of minerals like potassium and calcium. Potassium in an important component of cell and body fluids helps control heart rate and blood pressure. Vitamin A is also required for maintaining healthy mucus membranes and skin and is also essential for vision (**Tsuda *et al*, 2004**).

Banana is the common name for herbaceous plants of the genus *Musa* and for the fruit they produce. It is one of the oldest cultivated plants. All parts of the banana plant have medicinal applications: the flowers in bronchitis and dysentery and on ulcers; cooked flowers are given to diabetics; the astringent plant sap in cases of hysteria, epilepsy, leprosy, fevers, hemorrhages, acute dysentery and diarrhea, and it is applied on hemorrhoids, insect and other stings and bites; young leaves are placed as poultices on burns and other skin afflictions; the astringent ashes of the unripe peel and of the leaves are taken in dysentery and diarrhea and used for treating malignant ulcers; the roots are administered in digestive disorders, dysentery and other ailments; banana seed mucilage is given in cases of diarrhea in India.

Lemon is an important medicinal plant of the family Rutaceae. It is cultivated mainly for its alkaloids, which are having anticancer activities and the antibacterial potential in crude extracts of different parts (viz., leaves, stem, root and flower) of Lemon against clinically significant bacterial strains has been reported (**Kawaii *et. al*., 2000**). Citrus flavonoids have a large spectrum of biological activity including antibacterial, antifungal, antidiabetic, anticancer and antiviral activities (**Burt, 2004**). Flavonoids can function as direct antioxidants and free radical scavengers, and have the capacity to modulate enzymatic activities and inhibit cell proliferation (**Duthie and Crozier, 2000**). In plants, they appear to play a defensive role against invading pathogens, including bacteria, fungi and viruses (**Sohn *et. al*., 2004**). The peel of *Citrus* fruits is a rich source of flavonoid glycosides, coumarins, and volatile oils

(**Shahnah *et. al*., 2007**). Many polymethoxylated flavones have several important bioactivities, which are very rare in other plants (**Ahmad *et. al*., 2006**). In addition, the fiber of citrus fruit also contains bioactive compounds, such as polyphenols, the most important being vitamin C (or ascorbic acid), and they certainly prevent and cure vitamin C deficiency-the cause of scurvy (**Aronson, 2001**).

Vegetables and their health benefits

Vegetables can be eaten either raw or cooked and play an important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and fiber. Particularly important are the antioxidant vitamins A, C and E. When vegetables are included in the diet, there is found to be a reduction in the incidence of cancer, stroke, cardiovascular disease and other chronic ailments. Research has shown that compared with individuals who eat less than three servings of fruits and vegetables each day, those that eat more than five servings have an approximately twenty percent lower risk of developing coronary heart disease or stroke (**Figure 2**). Vegetables contain a great variety of other phytochemicals (bioactive non-nutrient plant compounds), some of which have been claimed to have antioxidant, antibacterial, antifungal, antiviral and anticarcinogenic properties (www.encyclopedia.com).

Figure 2: Dried Vegetable samples

Natural antioxidants such as vitamin C, tocopherols, flavonoids and other phenolic compounds are known to be present in certain plants **(Pakade V, *et. al*., 2013).** Recent studies have shown the importance of vegetables in a healthy diet in preventing degenerative diseases caused by oxidative stress. Vitamins and phytochemicals, such as ascorbic acid, carotenoids, polyphenols, and fiber have been regarded as the bioactive substances responsible for these effects and as spinach shows all these qualities it is highly recommended to add a daily intake of it **(Ana P. Tiveron *et. al*., 2012).**

Carrot (*Daucus carota* L.) is the most important crop of *Apiaceae* family. It is a root vegetable that has worldwide distribution. Carrots were first used for medical purposes and gradually went on to be used as food. Carotenoids and anthocyanins are the major antioxidant pigments found in carrots. Carotenoids are the yellow, orange, or red colored phytochemicals found in most yellow and orange fleshed cultivars. The widely used orange carrot is high in α- and β-carotene and is a rich source of provitamin A. Yellow carrot color is due to lutein which plays an important role in prevention of macular degeneration **(Dias, J.S, 2012)**. Anti-diabetic, cholesterol and cardiovascular disease lowering, anti-hypertensive, hepatoprotective, renoprotective, and wound healing benefits of carrot have also been reported. The cardio- and hepatoprotective, anti-bacterial, anti-fungal, anti-inflammatory, and analgesic effects of carrot seed extracts are also noteworthy (**Silva Dias, J.C, 2014).**

There are two kind of spinach (*Amaranthus* sp), the wild spinach and cultivated spinach. Spinach that is often consumed is cultivated spinach that comprises of green and red spinach (*Amaranthus tricolor* L.) **(Rukmana 1994)**.The nutritional value of spinach indicates it to be a **very nutrient-dense food**. It is low in calories yet very high in vitamins, minerals and other phytonutrients. When we consume this healthy food, we don't need to worry about our weight-loss diet as we take it in abundance this good-nutrients. This leafy green vegetable is an excellent source of vitamin K, vitamin A, magnesium, folate, manganese, iron, calcium, vitamin C, vitamin B2, potassium, and vitamin B6. It's a very good source of protein, phosphorus, vitamin E, zinc, dietary fiber, and copper and it is also a good source of selenium, niacin, and omega-3 fatty acids. Spinach is **loaded with flavonoids** which act as antioxidants, protecting the body from free radicals. Researchers have discovered at least 13 different flavonoid compounds that act as anticancer substances. The various nutrients offer much in the way of disease protection.

Another of the health benefits of spinach is that this is **a heart-healthy food**. It's an outstanding source of vitamins C and A which are antioxidants that help reduce free radical amounts in the body.

Flowers and their health benefits

Plants have been used in traditional medicine since prehistoric period and play a significant role to heal human diseases and disorders. According to World Health Organization (WHO), more than 80% of the world's population relies on traditional medicines for their primary health care needs. The medicinal value of plants lies in some chemical substances that produce a definite physiologic action on the human body. The most important of these bioactive compounds of plants are alkaloids, flavonoids, tannins and phenolic compounds. The phytochemical research based on ethno pharmacological information is generally considered as an effective approach in the discovery of new antioxidant and ant-infective agents from higher plants. Many medicinal plants contain large amounts of antioxidants other than vitamin C and carotenoids (**Figure 3**). In recent years, in order to discover novel antioxidant and antimicrobial drugs, screening of plants has been accelerated **(Rajamurugan R, *et. al*., 2013).**

Figure 3: Dried Flowers samples

Medicinal plants have been of age long remedies for human diseases because they contain components of therapeutic value. Plants are used in modern medicine where they occupy a very significant place as raw material for important drugs. Plants are considerably useful and economically essential. They contain active constituents that are used in the treatment of many human diseases. Plants are rich sources of ecologically developed secondary metabolites, which are potential remedies for different ailments **(Elumalai, 2012).**

Peltophorum pterocarpum is a very common deciduous tree grown in tropical countries and known by a variety of names such as Yellow Poinciana, Golden Flame, Copper pod, Rusty shield bearer and Yellow flamboyant. Different parts of this tree are used to treat many diseases like stomatitis, insomnia, skin troubles, constipation and ringworm. Its flower extract is known to be a good sleep inducer and used in insomnia treatment. Its bark is used as medicine for dysentery, as eye lotion, embrocation for pains and sores. The traditional healers use the leaves in the form of decoction for treating skin disorders. Stem infusion of *P. pterocarpum* is used in dysentery, for gargles, tooth powder and muscular pain. Flowers are used as an astringent to cure or relieve intestinal disorders after pain at childbirth, sprains, bruises and swelling or as a lotion for eye troubles, muscular pains and sores. It is also assumed that the flowers of *P. pterocarpum* contain a rich content of carotenoids. There are so many chemical constituents isolated from different parts of the tree and these chemical constituents are known to exhibit several biological activities such as antimicrobial activity, antioxidant activity, cytotoxic activity, antiglycemic activity, aldose reductase inhibition activity, cardiotonic activity, choline esterase inhibitory activity, etc **(Dilip Gorai, 2016).**

Hibiscus rosa sinensis (Malvaceae) is widely cultivated in the tropics as an ornamental plant. Chinese hibiscus is the English name of *Hibiscus rosa sinensis*. It is an evergreen woody glabrous showy shrub of 1.5-2.4m in height. Flowers are axillary, solitary, campanulate, red, blue, yellow or white, 10.2-15.2 cm diameter. Capsules are rotund; many seeded **(Upadhyay *et. al*., 2011)**. Previous studies show that its extract affects male fertility **(Singh and Udupa, 1882)**, *the treatment of inflammatory disease* and spermatogensis **(Reddy *et. al.*, 1997)**. The anti-diabetic activity of *H. rosa sinensis* in rural populations and in hyperglycemic rats are also reported **(Sachdewa *et. al*., 2001; Sachdewa and Khemani, 2003)**. Moreover, there is very important evidence of the anticancer action of *H. rosa sinensis* extract against the tumor promotion stage of cancer

development, in mouse skin with ultraviolet radiation **(Sharma *et. al*., 2004)**. The crude extract of aerial parts of *H. rosa sinensis*, and its subsequent fractions, clearly shows the presence of two components that have cholinomimetic and calcium antagonist activities. So, the possible pharmacological rationale use of the plant for constipation and diarrhea are suggested **(Gilani *et. al*., 2005)**. On the other hand, the ancient Indian medicinal literature reported that the flowers of *H. rosasinensis* have beneficial effects in heart diseases, mainly in myocardial ischemic disease, due to its enhancement of the myocardial endogenous antioxidants by an adaptative response and without producing any cytotoxic effects **(Gauthaman *et. al*., 2006)**. Recently, **Nade *et. al*. (2011)** suggested that *Hibiscus rosa* had a protective role against age and scopolamine- induced amnesia, indicating its utility in management of cognitive disorders.

Ixora coccinea is cultivated for ornamental purpose and reported for diverse pharmacological properties including antitumor, hepatoprotective, chemo protective anti-inflammatory cytotoxic, antidiarrheal, antimicrobial, wound healing and antimitotic activities. Leaves and flower extracts *Ixora coccinea* are reported to possess antimicrobial activities. Flower extracts of these plants contains ursolic acid and triterpenoids and have shown protective effect against systemic toxicity induced by cyclophosphamide and cisplastin. They are useful in dysentery, dysmenorrheal, leucorrhoea, haemoptysis, catarrhal bronchitis and opthalmopathy. Beyond these, phytochemicals present in these flower extracts acts as bioreducing and capping agent in the chemical reduction of metal nanoparticles like silver nanoparticles.

Tecoma stans (Bignoniaceae) known as yellow elder is an erect shrub or small tree. The plant has been used for a variety of purposes in herbal medicine, treating diabetes and digestive problems. Extracts from *Tecoma stans* leaves have been found to inhibit the growth of the yeast infection. **Marzouk *et. al*., (2006)** have studied the anticancer activity of *Tecoma stans* and antioxidant constituents. **Alanso-Castro *et. al*., (2010)** have reported that the *Tecoma stans* extracts exhibited antidiabetic activity. **Senthilkumar *et. al*., (2010)** have reported that the extracts have antibacterial activity on human pathogenic bacteria.

Carotenoids

Carotenoids are an abundant group of naturally occurring pigments. They occur ubiquitously in all organisms which conduct photosynthesis**.** They are found in photosynthetic membranes of phototropic bacteria and cyanobacteria. More than 600 different carotenoids from natural sources have been isolated and characterized **(www.upb.pitt.edu)**. Carotenoids play a very important role in human health. They are known to be very efficient physical and chemical quenchers of singlet oxygen (O_2), as well as potent scavengers of other reactive oxygen species (ROS), thus acting as very important natural antioxidants. Thus it is of special significance because the uncontrolled generation and concomitant increase of ROS level in the body results in “oxidative stress”, an essential contributor to the pathogenic processes of many diseases **(Joanna Fiedor and Kvetoslava Burda, 2014, Nengguo Tao *et. al*., 2010)**. The present study is a pioneer work aimed at analysing the phytochemicals present in **Fruits** such as Orange, Lemon, Pineapple and Banana, **Vegetables** such as Carrot, Beet root, Red spinach and Green spinach and **Flowers** such as Copper pod, Yellow bell, Hibiscus and Red jungle flame which are rich in vitamin A, vitamin C and beta carotene.

Materials and Methods

Samples used in the present study are as follows

Orange (*Citrus reticulate* Blanco)
Lemon (*Citrus limon* (L.)Brum.f.)
Pineapple (*Ananas comosus* (L.)Merr.)
Banana (*Musa acuminate* Colla.)
Green spinach (*Sauropus androgynus* (L.)Merr.)
Beetroot (*Beta vulgaris* L.)
Red spinach (*Amaranthus dubius* Mart.ex Thell.)
Carrot (*Daucus carota* L.)
Yellow bell (*Tecoma stans* (L.) Juss.ex Kunth.)
Red jungle flame (*Ixora Coccinea* L.)
Copper pod (*Peltophorum pterocarpum* (DC.) K.Heyne.)
Hibiscus (*Hibiscus rosasinensis* L.)

Preparation of extracts

The Fruits, vegetables and flowers were collected and dried in shade for few weeks. The dried samples were ground into powder. 5gm of the dried sample powder was weighed and immersed in 50 ml of the solvents – Ethanol, Ethyl acetate and Chloroform for 48 hours. After 48 hours, the extracts were filtered. The filtrates were used for further phytochemical analysis which includes Test for Carbohydrates, Proteins, Glycosides, Tannins, Alkaloids, Flavonoids, Terpenoids, Saponins, Resins, Quinones, Cardiac Glycosides, Coumarins,

Steroids, Phytosteroids, Phenols, Anthraquinones and Phlobotannins. The carotenoid pigments were isolated using Column Chromatography and was quantified using the formula

Total carotenoid content (µg/g) = A x V (ml) x 10^4 / $A^{1\%}$cm x W (g)

Where A is the absorbance of the carotenoid pigment at 450 nm, V is the total extract volume, $A^{1\%}$cm is the absorption coefficient of β carotene in hexane (2600), W is the sample weight. The samples were further subjected to Thin Layer Chromatography.

Results and Discussion

Qualitative phytochemical analysis

The following results were obtained for the phytochemical analysis of Fruits **(Orange, Lemon, Pineapple and Banana),** Vegetables **(Carrot, Beetroot, Red Spinach and Green spinach)** and Flower **(Copper pod, Yellow Bells, Red Jungle Flame and Hibiscus)** extract.

Preliminary phytochemical screening of the Fruits (Orange, Lemon, Pineapple and Banana) extracts showed the presence of Carbohydrate, Glycosides, Tannins, Alkaloids, Flavonoids, Terpenoids, Saponin, resins, Quinones, Cardiac glycosides, Coumarins, Steroids and Phenols **(Table 1).**

Table 1: Phytochemicals present in Fruit extracts

Phytochemical tests	Orange			Lemon			Pineapple			Banana		
	E	EA	C	E	EA	C	E	EA	C	E	EA	C
Carbohydrate	+	+	-	+	-	-	+	+	-	-	+	-
Carbohydrate	-	-	+							-	+	+
Protein	-	-	-	-	-	-	-	-	-	-	-	-
Protein	-	-	-							-	-	-
Glycoside	+	+	+	+	-	-	+	+	+	+	+	+
Tannins	+	-	-	-	-	-	-	+	-	-	-	-
Alkaloides	+	+	+	+	+	+	+	+	+	+	+	+
Alkaloides	+	+	+	+	+	-	+	-	-	-	-	-
Flavonoides	+	+	+	+	-	-	+	+	+	-	+	-
Terpenoides	+	+	+	-	-	-	+	+	+	-	+	+
Saponins	+	-	-	-	-	-	+	+	+	-	-	-
Resins	+	-	-	-	-	-	+	-	-	-	+	-
Quinones	+	+	+	+	+	+	+	+	+	+	+	+
Cardiac glycosides	+	+	+	+	+	+	+	-	-	+	+	-
Coumarines	+	+	+	+	+	+	+	+	+	+	+	-
Steroids	+	+	+	+	+	+	+	+	+	+	+	+
Phenols	+	-	-	+	-	-	-	-	-	-	-	-
Phytosteroids	-	-	-	-	-	-	-	-	-	-	-	-
Antraquinones	-	-	-	-	-	-	-	-	-	-	-	-
Phlobatannins	-	-	-	-	-	-	-	-	-	-	-	-

Preliminary phytochemical screening of the Vegetables (Carrot, Red spinach, Green spinach and Beet root) extracts showed the presence of Carbohydrate, Glycosides, Alkaloids, Flavonoids, Terpenoids, Saponin, Resins, Quinones, Cardiac glycosides, Coumarins and Steroids (**Table 2).**

Table 2: Phytochemicals present in Vegetable extracts.

Test	Carrot			Red spinach			Green spinach			Beet root		
	E	EA	C	E	EA	C	E	EA	C	E	EA	C
Carbohydrate	+	+	+	-	-	+	+	-	-	-	+	+
Carbohydrate	-	-	-	-	-	-	-	-	-	-	-	-
Protein	-	-	-	-	-	-	-	-	-	-	-	-
Protein	-	-	-	-	-	-	-	-	-	-	-	-
Glycoside	+	+	-	+	-	-	+	+	+	+	+	-
Tannins	-	-	-	+	+	+	+	+	+	-	-	-
Alkaloides	+	+	+	-	+	+	-	+	+	+	+	+
Alkaloides	+	+	+	-	+	-	+	+	-	-	-	+
Flavonoides	+	+	+	-	+	+	-	-	+	+	-	-
Terpenoides	+	+	+	+	+	+	+	+	+	+	+	+
Saponins	+	-	-	+	+	-	-	-	-	-	-	-
Resins	+	-	+	+	-	-	-	-	-	-	-	+
Quinones	+	+	+	+	-	-	-	-	-	+	+	+
Cardiac glycosides	+	+	-	+	+	+	+	+	+	+	+	+
Coumarines	+	+	+	-	-	-	-	-	-	+	+	-
Steroids	+	+	+	+	+	+	+	+	+	+	+	+
Phenols	-	-	-	+	-	+	+	-	-	-	+	+
Phytosteroids	-	-	-	-	-	-	-	-	-	-	-	-
Antraquinones	-	-	-	-	-	-	-	-	-	-	-	-
Phlobatannins	-	-	-	-	-	-	-	-	-	-	+	+

Preliminary phytochemical screening of the Flowers (Copper pod, Yellow bell, Hibiscus and Red jungle flame) extracts showed the presence of Carbohydrate, Glycosides, Tannins, Alkaloids, Flavonoids, Terpenoids, Saponin, Resins, Quinones, Cardiac glycosides, Steroids and Phenols (**Table 3).**

Table 3: Phytochemicals present in Flower extracts.

Test	Copper pod			Yellow bell			Hibiscus			Red jungle flame		
	E	EA	C	E	EA	C	E	EA	C	E	EA	C
Carbohydrate	+	+	-	+	+	-	+	-	-	+	-	+
Carbohydrate				+	+	+	-	-	-			
Protein	-	-	-	-	-	-	-	-	-	-	-	-
Protein	-	-	-	-	-	-	-	-	-	-	-	-
Glycoside	+	+	-	+	+	+	+	+	-	+	+	+
Tannins	+	-	-	-	-	-	+	-	-	+	-	-
Alkaloides	+	+	+	+	+	+	-	+	+	-	+	+
Alkaloides	-	-	+	+	+	+	-	-	+	-	+	-
Flavonoides	+	+	-	+	-	+	-	+	+	-	+	+

Terpenoides	+	+	+	+	+	+	+	+	-	+	+	+
Saponins	+	-	-	-	-	+	-	-	-	+	-	-
Resins	+	-	-	+	-	-	+	-	-	+	-	-
Quinones	+	+	+	+	+	+	+	+	+	+	+	+
Cardiac glycosides	+	+	-	+	+	+	+	+	-	+	+	+
Coumarines	-	+	+	-	+	+	-	+	+	-	+	-
Steroids	+	+	+	+	+	+	+	+	+	+	+	+
Phenols	+	-	-	+	-	-	+	-	-	+	-	-
Phytosteroids	-	-	-	-	-	-	-	-	-	-	-	-
Antraquinones	-	-	-	-	-	-	-	-	-	-	-	-
Phlobatannins	-	-	-	-	-	-	-	-	-	+	-	-

Over all, the samples Orange, Lemon, Pineapple, Carrot, Red spinach, Green spinach, Copper pod, Yellow bell, Hibiscus and Red jungle flame showed the presence of maximum phytochemicals in the Ethanolic extract. Banana and Beet root samples showed the presence of maximum phytochemicals in the Ethyl acetate extract and all the fruits, vegetables and flowers samples showed the minimum phytochemicals in Chloroform extract compared to Ethanolic and Ethyl acetate extracts.

Isolation of carotenoid pigments by column chromatography

Carotenoid pigments were effectively separated from the sample extracts separately in a silica gel column with 100% hexane. The yellow colour band which gets separated when eluted with 100% hexane is identified to be carotenoid pigments **(Figure 4)**.The carotenoid pigments eluted with hexane was collected and stored in vials at -20ºC.

Figure 4: Isolation of Carotenoid pigment

Quantification of carotenoids

The extracted carotenoids were quantified and the following results were obtained.
Total carotenoid content in orange = $0.245 \times 10 \times 10^4$ / **2600x10 = 0.94 µg/g.**
Total carotenoid content in lemon = $0.220 \times 10 \times 10^4$ / **2600x10 = 0.84 µg/g.**
Total carotenoid content in pineapple = $0.251 \times 10 \times 10^4$ / **2600x10 = 0.96 µg/g.**
Total carotenoid content in banana = $0.254 \times 10 \times 10^4$ / **2600x10 = 0.97 µg/g.**
Total carotenoid content in carrot = $0.252 \times 10 \times 10^4$ / **2600x10 = 0.96 µg/g.**
Total carotenoid content in red spinach = $0.231 \times 10 \times 10^4$ / **2600x10 = 0.88 µg/g.**
Total carotenoid content in green spinach = $0.252 \times 10 \times 10^4$ / **2600x10 = 0.96 µg/g.**
Total carotenoid content in beet root = $0.145 \times 10 \times 10^4$ / **2600x10 = 0.56 µg/g.**
Total carotenoid content in copper pod = $0.232 \times 10 \times 10^4$ / **2600x10 = 0.89 µg/g.**
Total carotenoid content in yellow bell = $0.258 \times 10 \times 10^4$ / **2600x10 = 0.99 µg/g.**
Total carotenoid content in hibiscus = $0.237 \times 10 \times 10^4$ / **2600x10 = 0.91 µg/g.**
Total carotenoid content in red jungle flame = $0.242 \times 10 \times 10^4$ / **2600x10 = 0.93 µg/g.**

Thin Layer Chromatography

The crude extracts and the purified carotenoid pigments and the standard were subjected to thin layer chromatography **(Figures 5 - 7).** The standard used was beta carotene. The mobile phase used was hexane and acetone in the ratio 6:4. The respective Rf values for the Fruits, Vegetables and Flowers were calculated **(Table 4).**

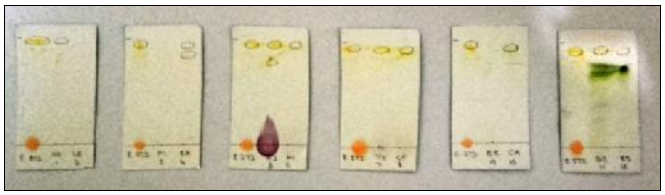

Figure 5: Thin Layer Chromatography of Ethanol Crude Samples

Figure 6: Thin Layer Chromatography of Ethyl acetate Crude Samples

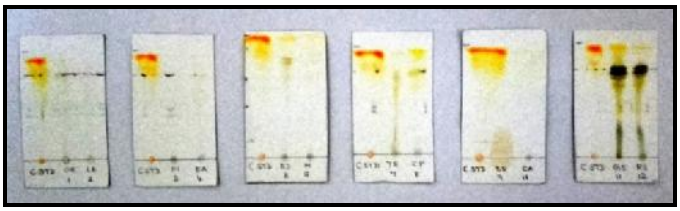

Figure 7: Thin Layer Chromatography of Chloroform Crude Samples

Table 4 : Rf values of crude extract and carotenoid

Sample	Ethanol crude	Ethyl acetate crude	Chloroform crude	Carotenoide pigment
Orange	0.95	0.94	0.94	0.94
Lemon	0.92	0.92	0.92	0.92
Pineapple	0.92	0.92	0.92	0.92
Banana	0.94	0.91	0.95	0.94
Carrot	0.94	0.91	0.94	0.94
Red spinach	0.95	0.95	0.94	0.94
Green spinach	0.95	0.95	0.94	0.94
Beet root	0.92	0.91	0.94	0.92
Copper pod	0.91	0.95	0.94	0.94
Yellow bell	0.91	0.95	0.94	0.94
Hibiscus	0.97	0.97	0.95	0.94
Red jungle flame	0.97	0.95	0.95	0.94

Conclusion

The solvent (ethanol, ethyl acetate and chloroform) crude extracts of various fruits **(Orange, Lemon, Pineapple and Banana),** Vegetables **(Carrot, Beetroot, Red Spinach and Green spinach)** and Flowers **(Copper pod, Yellow Bells, Red Jungle Flame and Hibiscus)** were subjected to phytochemical analysis. Over all, the samples **Orange, Lemon, Pineapple, Carrot, Red spinach, Green spinach, Copper pod, Yellow bell, Hibiscus** and **Red jungle flame** showed the presence of maximum phytochemicals in the Ethanolic extract. **Banana** and **Beet root** samples showed the presence of maximum phytochemicals in the Ethyl acetate extract and **all the fruits, vegetables** and **flowers samples** showed the minimum phytochemicals in Chloroform extract compared to Ethanolic and Ethyl acetate extracts. Phytochemicals plays an important role in a plant's metabolic activities. Based on the phytochemicals present the antimicrobial, antioxidant and anticancer activities of these plant extracts can be taken up for future studies.

References

Ahmad, M.M., Z. Salim-ur-Rehman, F.M. Iqbal-Anjum and J.I. Sultan, (2006),"Genetic Variability to Essential Oil Composition in Four Citrus Fruit Species", Pak. J. Bot., 38(2): 319-324.

Ana P. Tiveron, Priscilla S. Melo, Keityane B. Bergamaschi, Thais M. F. S. Vieira, Marisa A. B. Regitano-d'Arce and Severino M. Alencar (2012) "Antioxidant Activity of Brazilian Vegetables and Its Relation with Phenolic Composition" *International Journal of Molecular Science* 13: 8943-8957.

Aronson, J.K., (2001), Nature Publishing Group. Retrieved from: http://medicine.nature.com.

Burt, S.A., (2004), "Essential oils: Their antibacterial properties and potential applications in foods: Av review", Inter. J. Food Microbiol., 94: 223-253.

Dias, J.S. (2012) "Nutritional Quality and Health Benefits of Vegetables: A Review" *Food and Nutrition Sciences*, **3**, 1354-1374.

Dilip Gorai (2016) "Antimicrobial Activity of the Leaf and Flower Extracts of Peltophorum" *Universal Journal of Chemistry*, Volume 1, Number 1.

Duthie, G. and A. Crozier (2000) "Plant-derived phenolic antioxidants. Curr. Opin. Lipidol", 11: 43-47.

Elumalai (2012) "Phytochemical and pharmacological profile Of *Ixora coccinea* Linn" *International Journal of Pharmacy & Life Sciences* 3(3).

Gauthaman K.K., Saleem M.T., Thanislas P.T., Prabhu V.V., Krishnamoorthy K.K., Devaraj N.S. and Somasundaram J.S (2006) "Cardioprotective effect of the *Hibiscus rosa-sinensis* flowers in an oxidative stress model of myocardial ischemic reperfusion injury in rat" *BMC Complementary and Alternative Medicine*, 6: 32.

Gilani A.H., Bashir S., Janbaz K.H. and Shah A.J (2005) "Presence of cholinergic and calcium channel blocking activities explains the traditional use of *Hibiscus rosa sinensis* in constipation and diarrhea" *Ethnopharmacol*, 102: 94–289.

Govindappa M, Sadananda TS, Channabasava R, Jeevitha MK, Pooja KS and Vinay B. Raghavendra (2011) "Antimicrobial, Antioxidant Activity and Phytochemical Screening of *Tecoma stans* (L.) Juss. ex Kunth" *Journal of Phytology* 3(3): 68-76.

Joanna Fiedor and Kvetoslava Burda (2014) "Potential Role of Carotenoids as Antioxidants in Human Health and Disease" *Nutrients* 6, 466-488.

Kawaii, S., T. Yasuhiko, K. Eriko, O. Kazunori, Y. Masamichi, K. Meisaku, ChihiroIto and F. Hiroshi, (2000), "Quantitative study of flavonoids in leaves of *Citrus* plants", J. Agric. Food Chem., 48: 3865-3871.

Nade V.S., Kanhere S.V., Kawale L. A. and Yadav A.V (2011) "Cognitive enhancing and antioxidant activity of ethyl acetate soluble fraction of the methanol extract of *Hibiscus rosa sinensis* in scopolamineinduced amnesia" *Indian Pharmacol*, 43(2): 137–142.

Nengguo Tao, Yumei Gao, Yuejin Liu and Fei Ge (2010) "Carotenoids from the peel of Shatian Pummelo (*Citrus grandis* Osbeck) and its antimicrobial activity" *American-Eurasian J. Agric &Environ. Sci*., 7(1):110-115.

Pakade V, Cukrowska E, Chimuka L (2013) "Comparison of antioxidant activity of *Moringa oleifera* and selected vegetables in South Africa" *South African Journal of Science* 109(3/4).

Rajamurugan R, Thirunavukkarasu C , Sakthivel V , Sivashanmugam M and Raghavan C M (2013) "Phytochemical Screening, Antioxidant and Antimicrobial Activities of Ethanolic Extract of *Tecoma Stans* flowers" *International Journal of Pharmaceutical Bio science* apr; 4(2): (p) 124 – 130.

Reddy C.M., Murthy D.R.K. and Patil S.B (1997) "Antispermatogenic and androgenic activities of various extracts of *Hibiscus rosasinensis* in albino mice" *Indian Experimental Biol*, 35: 1170–1174.

Rukmana R (1994). Bertanam Bayam dan pengelolaan pascapanen. Kanisius. Yogyakarta.

Sachdewa A. and Khemani L.D (2003) "Effect of Hibiscus rosa-sinensis ethanol flower extract on blood glucose and lipid profile in streptozotocin induced diabetes in rats" *Ethnopharmaco*, 89: 61–66.

Sachdewa A., Raina D., Srivastava A.K., and Khemani L.D (2001) "Effect of Aegle marmelos and *Hibiscus rosa sinensis* leaf extract on glucose tolerance in glucose induced hyperglycemic rats" *Environment. Biol*, 22: 7–53.

Shahnah, S.M., S. Ali, H. Ansari and P. Bagri, 2007. "New sequiterpene derivative from fruit peel of citrus limon (Linn) Burn" *F. Sci. Pharm*, 75: 165-170.

Sharma S., Khan N. and Sultana S (2004) "Effect of *Onosma echioides* on DMBA/croton oil mediated carcinogenic response, hyperproliferation and oxidative damage in murine skin" *Europ. Cancer Prevention*, 13: 40–53.

Silva Dias, J.C. (2014) Nutritional and Health Benefits of Carrots and Their Seed Extracts. *Food and Nutrition Sciences*, **5**, 2147-2156.

Singh M.P., Singh R.H. and Udupa K. N (1882) "Anti-fertility activity of a benzene extract of *Hibiscus rosa-sinensis* flowers on female albino rats" *Planta Medica*, 44:171–174.

Sohn, H.Y., K.H. Son, C.S. Know and S.S. Kang, (2004), "Antimicrobial and cytotoxic activity of 18 prenylated flavonoids isolated from medicinal plants: *Morusvalba* L., *Morus mongolica* Schneider, *Broussnetiavpapyrifera* (L.) Vent, *Sophora flavescens* Ait and *Echinosophora koreensis"*, Nakai. Phytomedicine, 11: 666-672. Staphylococci" *Lett. Appl. Microbiol*, 41: 52-55.

Tripoli, E., La Guardia, M., Giammanco, S., Di Majo, D. Giammanco, M. (2007) "Citrus flavonoids: Molecular structure, biological activity and nutritional properties: A review", *Food Chemistry*, vol. pp. 104 466–479.

Tsuda, H., Ohshima, Y., Nomoto, H. et al. (2004) "Cancer prevention by natural compounds" *Drug Metabolism and Pharmacokinetics* vol.19, no. 44, pp. 245–263.

Upadhyay S.M., Upadhyay P., Ghosh A.K., Singh V. and Dixit V.K (2011) "Effect of ethanolic extract of *Hibiscus rosa sinensis* L., flowers on hair growth in female wistar rats. Dermatol" *Pharmacia Lettre*, 3 (4): 258-263.

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www.healthyeating.org
www.upb.pitt.edu

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