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Chemotaxonomic Study Based on Flavonoid as Taxonomic Markers in the Roots of the Selected Species Belonged to Family Solanaceae

Asaad Ahmed*

Department of Chemistry, Imperial University College, Khartoum, Sudan

***Corresponding author:** Asaad Ahmed, Department of Chemistry, Imperial University College, Khartoum, Sudan, E-mail: asaadalsiddig@yahoo.com

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Major Groups of Flavonoids

Chalcones

These are aromatic ketones that occur in some fruits such as citrus and apple, and some vegetables such as tomatoes and potatoes.

Flavones

These are trimethoxy flavones (TMF). These are natural flavones isolated from *Andrograhpis viscula* and used in the treatment of dyspepsia, influenza, malaria, respiratory infections, and anti-dote for stings of some poisonous insects.

Flavanols (Catechins or Proanthocyanidins)

These generally occur in woody angiosperms. They act as anti-oxidants and are found in dark chocolate, fruits, and beverages. They act against viruses, anti-tumors and anti-flammatory compounds.

Flavanones

These occur in fruits like orange and grapefruit. They reduce the risk of ischemic stroke in women.

Anthocyanidins

These are versatile and plentiful flavonoid pigments found in red purplish fruits and vegetables including purple cabbage, beets, blue berries and cherries.

Isoflavonoids

These are compounds that reduce the effect of oestrogen on cells and skin layers when the hormone levels are high. It also essentially reduces the risk of oestrogen linkage cancer. It occurs in soybeans which are regarded as a good source for these compounds.

Significance of Flavonoids

The flavonoids mostly emit brilliant fluorescence with excited by UV light and they were ubiquitous to green plant cell, they regulate plant growth by the inhibition of the auxin indolyl acid as well as induction of gene expression. Flavonoids were functional components of many herbal and insect's preparation for medicinal use [1].

The capacity of the flavonoids to modify membrane-dependant process such as free radical membrane lipoperoxidation related to their ability to interact with and penetrate bilayers [2].

Low cardiovascular mortality rate observed in Mediterranean populations in association with the red wine consumption in a high saturate fat intake, several other potential benefit properties of flavonoids had since been as curtained [3].

Flavonoids were responsible for the major organoleptic characteristics of plant-derived foods and beverages, owing to their importance in food organoleptic properties; a better understanding of their structures and biological activities indicates their potential as therapeutic agents and also for predicting and controlling food quality. Due to their variety of pharmacological activities in the mammalian bodies [4].

These compounds appeared to play vital roles in defense against pathogens and predators; they contributed to physiological functions such as seed maturation and dormancy. Some sub classes of the flavonoids such as proanthocyanidins regulative impacted the usage of the seeds and grains animal feed and could be added undesirable quantities to food products for human consumption [5].

Flavonoids contained 30% dry weight from the green tea leaves, the potent antioxidant activity of the flavonoids related to their ability to scavenging hydroxyl radicals, superoxide anion and lipid peroxy radicals, many sub classes of flavonoids such as catechins and its derivatives and quercetin could be utilized in preventative and treatment protocols for cardiovascular diseases, cancer and many other diseases [6].

These compounds were low molecular weight and this characteristic appeared in order to be required for the best

activity, especially, antioxidant and antiproliferative. The particular hydroxylation of flavonol was increased their activities, especially, in inhibition of mast cellsecretion, certain plants and species which contained flavonoids have been used for thousands of years in traditional eastern medicine. In spite of the voluminous literature available, however, western medicine has not yet used flavonoids therapeutically, even though their safety record was exceptional [7].

The importance of this study occurs from the importance of the flavonoid compounds in the medicinal and industrial field, so that if we know their usefulness and the parts of its presence in the plants and the families which contained, therefore, there will be biological studies in the future related to these information's.

This study also interested to identify a certain mechanism according to the chemotaxonomic as a criterion for the classification, for example in families Malvaceae and Solanaceae, especially, roots and leaves of them, we also while we counting chemotaxonomic for the flavonoids we rely on numbers of flavonoids which will definitely be varied as well as the type of flavonoids in their varieties, then this step in the future will reduce the effort and time in determining the plant designed parts required of it which contains phenolic compounds, then this study could be utilized in economic field from where we could grew plants which contained flavonoids in large quantities to take advantages medically and industrially.

The Roots of The Selected Plant Species Related to Family Solanaceae

Figure 1: Roots of *Solanum melongena* L.

Figure 2: Roots of *Lycopersicum esculentum* Mill.

Figure 3: Roots of *Solanum tuberosum* L.

Table 1: Classification and Description of Family Solanaceae [8].

Classification	
Kingdom:	Plantae
Subkingdom:	Trachaeobiontae (Vascular plants)
Super division:	Spermatophyta (Seed plants)
Division:	Magnoliophyta (Flowering plants)
Class:	Magnoliopsida (Dicotyledons)
Sub class:	Asteridae
Order:	Solanales
Family:	Solanaceae

Family Description

This is an angiospermic family, called nightshade **(Table 1)**. The species of this family are distributed around the whole world and many species contain some compounds such as: exudate flavonoid compounds, alkaloids and high toxic compounds, although some species are edible **(Figure 1)**. The species selected for study were: *Solanum melongena, Lycopersicum esculentum and Solanum tuberosum*. These species have many economic, industrial and medicinal benefits and uses.

Several species of *Solanum* and other members of Solanaceae have been examined for their exudate chemical groups; most of the aglycones were widespread but flavonols are rare **(Figure 2)**. The flavonoid compounds isolated from *Solanum melongena* showed potent antioxidant activity, and the activity of catalase was found to be significantly enhanced in tissues of normal and cholesterol fed rats which were administrated (1 mg) of flavonoid compounds. Flavonoid compounds elevated levels of glutathione which significantly stimulated the activity of catalase **(Figure 3)**. This may be responsible for the antioxidant effect of flavonoids [9].

Botanical Description of *Solanum melongena* L.

Common vernacular English names are: eggplant and aubergines.

Herb or shrub. Leaves alternate, simple, spiral. Inflorescence cymose; flowers bisexual, white to purple, solitary, radial; sepals (5), giant, united; petals (5), lobbed; ovary superior; placentation axile; stamens (5), free; gynoecium syncarpous. Fruit purple to black, depressed, ovate.

This plant is perennial in the tropical area which has a warm-season. The fruit of this plant in the first phase of the growth looks like an egg, and because of that it was called eggplant. This plant requires a temperature of (10°C-20°C) and high humidity. The diseases of eggplant included damping off and spider mites during hot weather [10].

The infusion of the powdered preparation of the fruit may reduce cholesterol levels which may prevent the primary risk factors for cardiovascular disease and LDL levels. The flavonoid compounds extracted from the fruit (1 mg/100 g) showed significant hypolipidemicaction in normal cholesterol fed rats, the activity of lipoprotein lipase and plasma showed significant enhancement, but a significant increase in the concentration of hepatic and fecal bile acids was observed which indicated a high rate degradation of cholesterol [11,12]

Botanical Description of *Lycopersicum esculentum* L

Common vernacular English name is tomato. Syn.: *Solanum lycopersicum* L.

Herb. Leaves simple, alternate, spiral. Inflorescences racemose; flowers bisexual, bright yellow to red, radial; sepals lobbed and narrow; petals yellowish, rotate; ovary superior; placentation axile; stamens (5), free; gynoecium of (2) carpels, syncarpous. Fruit berry.

It is an edible angiosperm plant which can be consumed in many ways such as sauces, salads and drink. The fruit is rich in lycopene which may have beneficial health effects. Tomato requires sunlight, deep watering and (69-120 days) for growth; most modern tomato cultivars require smooth surface, but some elder tomato cultivars may be curly. There are considerable differences between the commercial and home garden cultivars; home cultivars are always bred for flavor, while the commercial species are bred for many factors for consistence of size and shape. The plant may suffer from some diseases such as tobacco mosaic virus (T.M.V) and *Fusarium* fungi. Tomato had been shown as protected against oxidative damage in many epidemiological cases because of its antioxidant activity; other metabolomic effects of lycopene have also been demonstrated. Tomato consumption has been associated with the decrease of the risk of breast cancer and also head and neck cancer. It might give a strong protection against neuro-degenerative disease and may reduce cardiovascular risk associated with type (2) diabetes. This species is an important source of flavonoid compounds, and includes the most significant flavonoid compounds such as: dihydrochalcone phlorentin-3,5-di-C-β-glycopyranoside, flavonol qurecetin-3-O, chalcone naringenin, kaempferol and qurecetin-3-rutinoside. There are also phenolic compounds in the fruits. This was particularly connected to its antioxidant properties as well as possible health effects of cultivars [13].

Botanical Description of *Solanum tuberosum* L.

Common vernacular English name is potato.

Herb or sub-shrub. Leaves lobbed, alternate. Inflorescence cymose; flowers bisexual, radial; sepals (5); petals (5), rotate; ovary superior; placentation axile; stamens (5), free; gynoecium syncarpous. Fruit berry or capsule.

This plant is starchy tuberous crop and it is a perennial that occurs throughout America to southern China and requires sandy soil, fullsunlight with cool climate and moisture, and a temperature of below (4°C). Potato contains toxic compounds known as glycoalkaloids, and other useful flavonoid compounds for mankind. The plant significantly suffers from some pests such as: rhizoctonia, powdery mildew and leaves viruses [14].

The major anthocyanin and phenolic acids occur in the tubers, flowers and leaves of cultivars. The major anthocyanins found in the flowers and leaves of cultivars are rutinosides, other glycosides such as pelargonidin, petunidin and some phenolic acids are found in the tubers. The common flavonoid compounds are kaempferol-3-rutinoside and 2-qurecetin rhamnose glycosides. The flowers and leaves of some cultivars contain a higher concentration of flavonoid compounds [15].

The following flavonoid compounds were found only in the roots of the selected species of family Solanaceae:

Cycloheptasiloxane, tetradecamethyl.

Hexadecanoic acid methyl ester.

9-octadecenal, (Z).

Summary

Only one flavonoid was identified as taxonomic marker in the roots of S. melongena. This is: cyclohexanol-5-methyl-2- (1-methylene),{1R-1.alpha,2.beta,5.alpha}.

Four taxonomic markers were detected in the roots of L. esculentum. These are: cis-1,2-diphenyl cyclohexane, 7-tetradecenal, (Z), syn/anti-5,5-dimethyl-6-oxobicyclo {2.2.2} octane-2-carbaldehyde and 1,2-dihydro-1-methyl-2-trifluoroacetyl methylene quinoline.

Ten taxonomic markers were identified in the roots of S. tuberosum. These are: omega undecylinc acid chloride, ricinoleic acid, methyl-9-10-didutero-9-octadecanoate, delta-2-carene, 1-decene-2,4-dimethyl, 2,5,5-trimethyl bicyclo{4.1.0}heptanol, 1-heptanol-2,4-dimethyl, 13-hexyl oxa-cyclotridec-10-en-2-0ne, 2-chlorobicyclo{8.2.0}dodecane-11-one and 8-hexadecenal-14-methyl, (Z).

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