International Journal of Science and Research Archive

eISSN: 2582-8185 CODEN (USA): IJSRO2

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(REVIEW ARTICLE)

Check for updates

A review on various medicinal applications of kiwi fruit

Sarita Ramesh Khutare [1,*] and Amol Sampat Deshmukh [2]

[1] *Department of Pharmaceutics Student of S. M. B. T. College of Pharmacy, Dhamangaon, Nashik, India.*
[2] *Department of Pharmaceutics, S.M.B.T. College of Pharmacy, Dhamangaon, Nashik, India.*

International Journal of Science and Research Archive, 2023, 08(02), 193–206

Publication history: Received on 02 January 2023; revised on 18 March 2023; accepted on 21 March 2023

Article DOI: https://doi.org/10.30574/ijsra.2023.8.2.0112

Abstract

A kiwi fruit commonly known as 'Green kiwi' traced under the family *Actinidiaceae* having *Actinidia* genus and species *deliciosa.* Kiwi fruits are the superior as compared with other commonly consumed fruit for their nutrient density, health benefits and consumer's appeal. It is crammed with wide variety of nutrients such as vitamins, minerals and phytoconstituents. A range of phytochemicals are found in kiwi which include the triterpenoids, saponins, amino acids, carotenoids, carbohydrates and sugars, phenolic compounds such as flavonoids, polyphenols, anthraquinones and coumarins. These constituents render the wide variety of pharmacological activities. Immense amount of vitamin C pointed for a promising treatment of catastrophic disease involving cancer and heart diseases. Other activity includes antibacterial activity, anti-oxidant, anti-diabetic, anti-inflammatory, anti-hypertensive, anti-thrombin, anti-asthmatic, hepatoprotective, anti-platelet, anti-constipation, anti-carcinogenic, anti-fungal, antiviral and anti-tumour. This review provides a brief knowledge about botanical aspects, chemical constituents and recent biological or pharmacological activities of kiwi fruit.

Keywords: *Actinidia deliciosa;* Kiwi; Vitamin C; Flavonoids

1. Introduction

Fruits are the natural source of antimicrobial agents and antioxidants which can be added into diet for prevention of diseases caused by pathogenic organisms. In order to carry out these reactions and proper functioning of body we need ample of nutrients which are supplied by the fruits such as apple, pomegranate, guava, and orange. Kiwi fruit or Chinese gooseberries are the edible berries of several species of woody wines and nutrient dense fruit [1, 2]. Kiwi fruit is originating from the Yangtze Valley in China, was initially cultured in New Zealand in the 1900s as a fruit tree. It is mainly produced in temperate areas located between the latitudes 25 °C and 45 °C. Presently, kiwi fruit contains various vitamins and proteinases [3]. Hence the demand for kiwi fruit is increasing because of its delicious refreshing taste, nutritive values, health benefits and economic viability [4]. Kiwi fruit is widely cultivated in 'Hayward' about 90–95% of kiwifruit is being traded throughout the world from Hayward. The genus *Actinidia* and family *Actinidiaceae* are where the kiwifruit originated. *Actinidia deliciosa*, a botanical name of kiwi that was given to the kiwi plant in 1984. The term *Actinidia* comes from the Greek word Akinos, which means "ray," and was used to characterise the female fruit's radial appearance, which resembles a wheel's spokes. Due to the juicy flavour of kiwi, the word *deliciosa* was derived from the Latin word "deliciosus," which means "delicious." [5]. Kiwi fruit is oval in shape, greenish brown in colour, it has little sweet and bitter taste. The male and female flower are borne on different individuals. Therefore they called as dioecious. The ellipsoidal kiwi is a true berry and has a green brownish skin colour with furry appearance. The mesocarp has green flesh with numerous purple-black seeds enclosed around a white centre. There are various species of kiwi fruit like *A. chinensis* (golden kiwi), *A. kolomikta* and *A. argyta* (cold-hardy species), *A. melanandra*(red kiwi), *A. polygama* (silver kiwi), *A. purpurea*(purple kiwi) [6]. The major flavonoid and phenolic content include caffeic acid, gallic acid, syringic acid, salicylic acid, ferulic acid, and protocatechuic acid and also include triterpenoid , saponins , anthraquinonones [7].

* Corresponding author: Sarita Ramesh Khutare

The extract of kiwi fruit shows various activities like antitumor activity, antioxidant activity, antibacterial activity, anti-inflammatory activity, immunoregulatory activity, hypolipidemic activity, antidiabetic activity, cardiovascular protective effect, dermatological effect such as abscesses, furancles, cellulitis, blisters also decreases the frequency and symptoms of the common cold and flu, Kiwifruit supports Iron nutrition, aids digestion, Hypnotic Effects, Ace Inhibitory activity, Cytochrome P450 Enzyme Inhibitory Activities[7, 8]. Regular consumption of kiwifruit have been associated with enhancement in mood. The high content of vitamin C of the kiwi is not the only parameter for its pharmacological activity but also the other nutrients and phytochemicals that work co-ordinately in the food matrix. For health promotion and prevention of numerous diseases the daily intake of kiwifruit can be effective strategy [9, 10].

The each part kiwi fruit shows the pharmacological activities. Flesh, peel and seed provide some parameters to improve economic profits. Various kiwifruit-derived ingredients have been developed in nutraceutical, pharmaceutical, cosmetic, detergent and textile industries (Supplementary materials). In the fruit industry, an increase in fruit pulp consumption generates greater production of residues of fruit skin or seed kernel [11]. In our daily life we directly consumed the mesocarp and endocarp of gooseberry while the exsocarp that is peel was discarded. However, since the peel is so intimately connected to the edible part hence has many pharmacological activities because of high content of phenols, terpenoids and tannins [3]. Kiwifruit production is processed into a variety of products including fruit juices, either natural or clarified, juice concentrates, jams, fruit preserved either whole or sliced in syrup, dried fruits, soft drinks, and wine and spirits, also used to prepare jams. Riper fruit squeezed for juice or used for wine; and poorer grade fruit used to manufacture spirits. The vitamin C present in flesh is helpful in boosting immune system and improve the function of white blood cells. Hence the objective of present data was to evaluate the various medicinal application of kiwi fruit and its pharmacological action [7].

2. Botanical aspects

2.1. Taxonomical Classification:

Botanical Name: *Actinidia deliciosa*

Synonyms*:* Chinese gooseberries, woody vine, green kiwi

Table 1 Taxonomical classification of kiwi [12]

Classification	Name
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Magnoliidae
Order	Ericales
Superorder	Asteranae
Family	Actinidiaceae
Genus	*Actinidia*
Species	*Deliciosa*

2.2. Morpholgy

Actinidia deliciosa is a woody, vigorous, climbing shrub reaching approximately 9 m, being a perennial climber it require strong support for its growth. Its leaves are long petioled, alternate, deciduous, heart-shaped at the bottom, and have 8–13 cm length. Young leaves are coated with red-colored hairs; mature leaves are dark-green in colour and smooth appearance on the upper side, and downy-white with distinguished, light-colored veins beneath. The scented, dioecious or sexual flowers are borne singly or in groups of three among the leaf axils. Each sex has a centre tuft of numerous stamens, and the petals are originally white before becoming buff-yellow [13, 14]. Honey bees (*Apis mellifera L.)* and wind are regarded as essential pollinators in kiwi fruit. Some floral characteristics of kiwifruit, such as the pendulous nature of flowers, absence of pollenkit and high ovule: pollen ratio. The plant is characterized by fleshy roots, very

branched and with a tendency to distribute in the upper substrate of the soil. It has flexible stem. The kiwi is a berry, gathered in clusters of ovoid shape, spherical or elongated, depending on the cultivation of species. It has brownish green colour on outside surface and outside layer is so intact with the flesh. Its flesh is green and small black seeds are arranged in a circle about the centre [6]. The oblongated fruit is upto 7-8 cm long [13].

Flower

Leaf

Kiwi fruit

kiwi's on vine

Figure 1 Parts of kiwi *Actinidia deliciosa*

Table 2 Morphology of *Actinidia deliciosa* [15]

Parts	**Description**
Fruit shape	Long cylindrical or elongated
Fruit weight	30-200 gm.
Fruit skin colour	Brown
Skin hair	Dense, yellow brown, coarse hairs
Flesh colour	Green
Leaves	Long petioled, alternate, deciduous, heart shape at bottom(8-12 cm length)
Flowers	Aromatic, dioecious, 4-6 petioled, white initially changing to yellow
Roots	Fleshy and branched

2.3. Origin, Geographical source and Distribution

Actinidia is a broad genus located around cool temperate forests to the tropics. The kiwi fruit is native to china as it first found along the border of "Yangtze river valley" that is in the mountain range of south western in china in 1947. As it is first found in china hence kiwi also called as 'Chinese gooseberry' and 'China's miracle fruit'. Actinidia fruits are known as "mihoutao" or "monkey peaches" in China because wild monkeys have been seen to eat them. Because of the fruit's brownish colour and hairy appearance resembling the flightless "kiwi bird" and hence from New Zealand, the fruit was nicknamed as "kiwifruit" by the United States importer. Around 1900 and 1910, the fruit was brought from China to the United Kingdom, Europe, United States and New Zealand. In New Zealand, commercial planting first started in 1937. The first nation to employ its commercial production was New Zealand. In Bangalore, India, kiwifruit was first cultivated, but it failed to produce any fruit. It was then introduced in Shimla, Himachal Pradesh, where it became successful immediately. Its commercial cultivation has been expanded to the mid hills of Himachal Pradesh, Uttar Pradesh, Jammu & Kashmir, the Darjeeling hills and Kalimpong in West Bengal, the North-eastern hill region, and the Nilgiri hills in Tamil Nadu with considerable research and development funding [6, 9].

Alexander Allison, a nurseryman from Wanganui, transplanted the seed in New Zealand (1906), and the first harvest occurred in 1910. The expansion of this species throughout the world began to take place in the 1960s with the export of New Zealand plants and seeds to destinations such as Germany, Italy, Spain, India, South America, Morocco, Israel and South Africa. Italy represents 90% of the international kiwifruit production. Kiwi fruit is now consumed worldwide and traded internationally as the sixth most significant fruit crop after citrus, apple, pears, and peaches. The brand name of kiwi is Zespri [4, 5, 9, 13].

2.4. Phytochemistry

A range of phytochemicals are found in kiwi which include the triterpenoids, saponins, phenolic compounds (flavonoids, polyphenols, anthraquinones and coumarins), vitamins and minerals [7].

2.4.1. Nutritional composition

Kiwifruit also known as the "king of fruits". Because of its high-pulp juices, thick flesh, delicious taste and abundant nutrition has a higher commercial and economic value [8]. It is a good source of various nutrients including fatty acids, protein, minerals, amino acids, vitamins, carbohydrate, sugar, carotenoid and also it is rich in minerals and vitamins [11].

Vitamins

Fruits contain a number of vitamins that strengthen the body's defences against infection and inflammation. The kiwifruit is a great source of the antioxidant vitamins A, vitamin C, and vitamin E as well as the B complex vitamins. The concentration of vitamin C is primarily high in kiwifruit, often in both commercial species, and is nearly three times that of strawberries and oranges. L-dehydroascorbic acid and L-ascorbic acid are the two parameters used for the estimation of Vitamin C content in the fruit. Due to its diverse variety of biological functions, vitamin C is primarily engaged in the normal functioning of our body's metabolism. Vitamin C controls the enzymes necessary for the manufacture of neurotransmitters, collagen, catecholamine, l-peptide, and carnitine. Vitamin C is also thought to strengthen the immune system. Green kiwi is one of the most nutrient-dense fruit and they are particularly rich in vitamins C, E, K as compared to other commonly consumed fruits [4, 14, 16, 17].

Table 3 Vitamin content of kiwi fruit [4, 18]

Type of Vitamin	Name of Vitamin	Amount (mg)
Vitamin C	Ascorbic acid	92.7
Vitamin E	Tocopherol	1.46
Vitamin K	Phylloquinone	40.3
Vitamin B1	Thiamine	0.027
Vitamin B2	Riboflavin	0.025
Vitamin B5	Pantothenic acid	0.183
Vitamin B12	Cobalamin	7.80

Minerals

Potential scientific studies demonstrate the importance of minerals for the human body's formation of bones and teeth. Minerals found in kiwifruits aid in electrolyte balancing in humans as well as hormone production, metabolic catalysis, and oxygen binding. Minerals including potassium, phosphorus, magnesium, manganese, calcium, iron, copper, and sodium are also abundant in kiwi [17, 18].

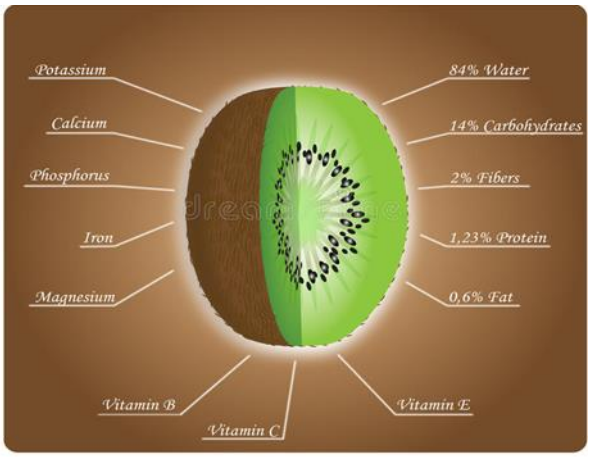
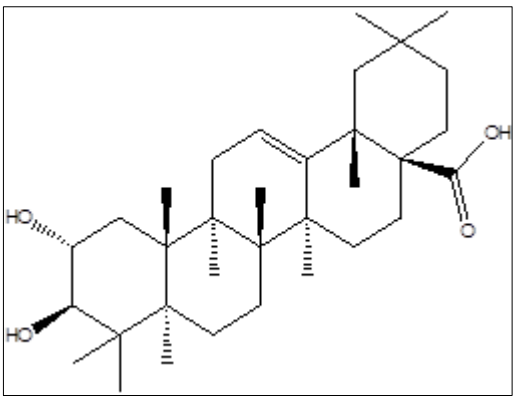


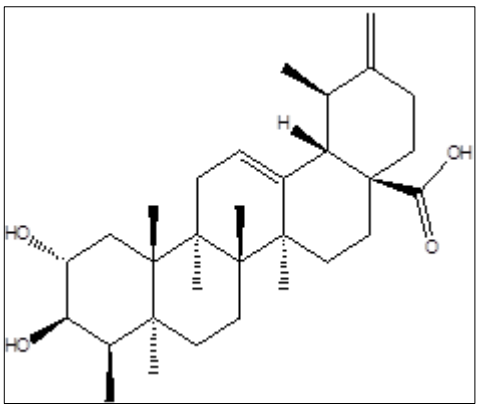
Figure 2 Nutritional composition of kiwi fruit

2.4.2. Triterpenoids

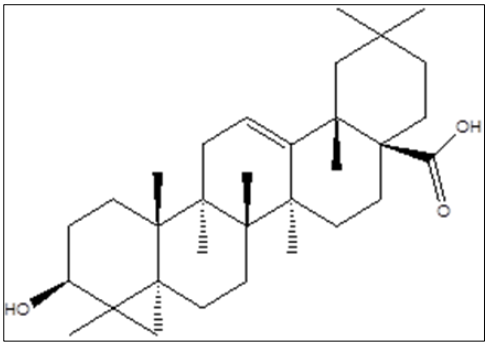
Triterpenoids have been the important components due to their promising antitumor properties. Till now, there are about 42 triterpenoids are investigated in roots. The triterpenoid 12-en-28-oic acids of oleanane and ursane are most commonly found in roots. Actinidic acid is the main triterpenoids found in unripe kiwi fruit [8].



MASLINIC ACID



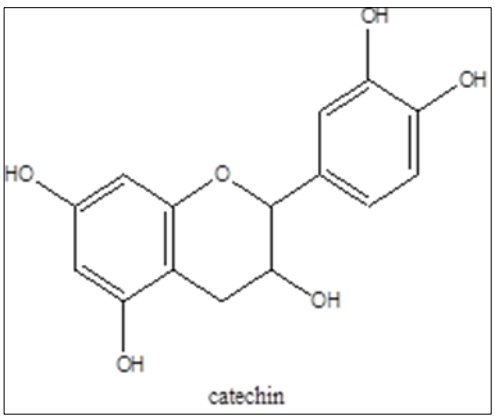
ACTINIDIC ACID



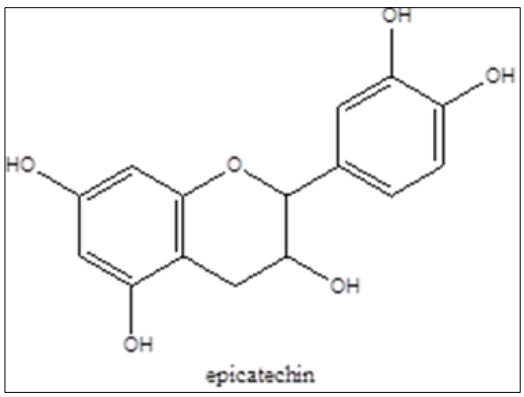
OLEANOLIC ACID

2.4.3. Phenol and flavonoids

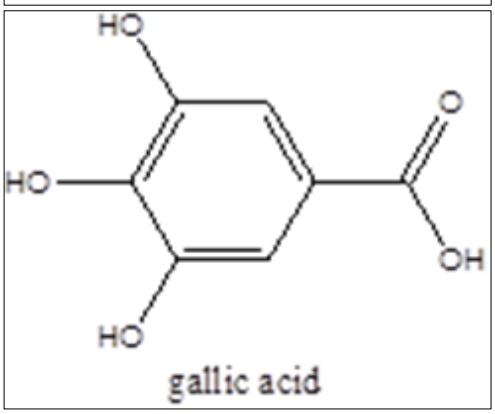
Phenolic acids, including two hydroxybenzoic acids (gallic acid and protocatechuic acid) and three hydroxycinnamic acids (chlorogenic acid, neochlorogenic acid and caffeic acid) and three flavonols, including quercetin-3-rhamnoside, quercetin-3-O-glucoside and rutin were identified. Syringic acid, ferrulic acid, salicylic acid, catechin, epicatechin, quercetin 3-O-glucoside, and cyanidin-3-O-glucoside are also some of the phenolic chemicals found in kiwi fruit. Previous research has demonstrated that the major phenolic compounds in kiwifruits include flavan-3-ols such as epicatechin, catechin, procyanidin B1 and procyanidin B2, hydroxybenzoic acids include gallic acid and protocatechuic acid, hydroxycinnamic acids involving chlorogenic acid, neochlorogenic acid, and caffeic acid and flavonols. Researchers have identified a total of fifteen commercially available phenolic compounds, including (+)-catechin, epicatechin, procyanidin B1, procyanidin B2, quercetin, rutin, kaempferol, quercetin-3-O-glucoside, and quercetin-3-rhamnoside. Kiwi has a total phenolic acid concentration of 26.58 g/g DW [11, 19, 20, 21].



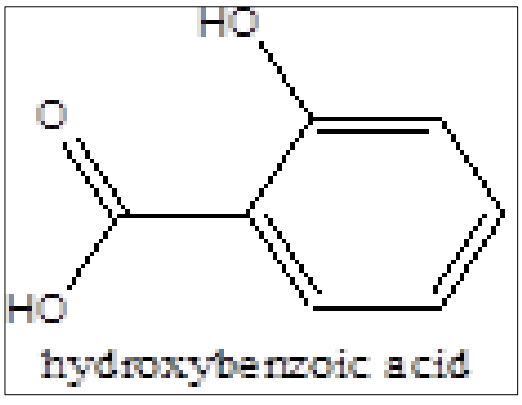
catechin



epicatechin



gallic acid

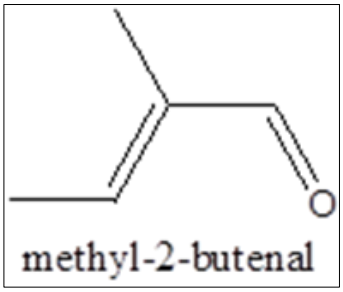


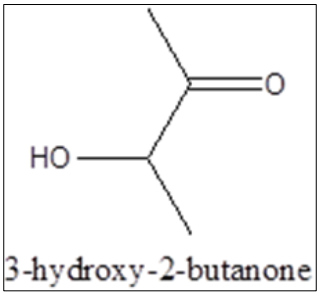
hydroxybenzoic acid

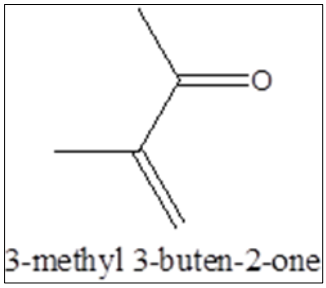
2.4.4. Volatile oils

In ripe fruit straight chain aldehydes, alcohol, ester such as decanal, hexanal, octanal, benzaldehyde, acetaldehydes are present. The essence in kiwi is due to contribution of 35 total components which include; methyl-butanol, ethyl furan,

cyclohexanone, hexanal, methyl-2-butenal, 3-methyl-2-butanone, 2-methyl-1-butanol, 2,6-nonadienal ,3-methyl 3-buten-2-one, and octane, hexyl hexanoate, 3-methyl-1-butanol, diethyl succinate, 3-hydroxy-2-butanone ,3-penton-2-ol [11, 22].

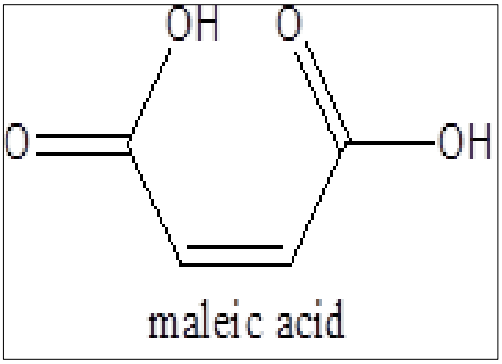


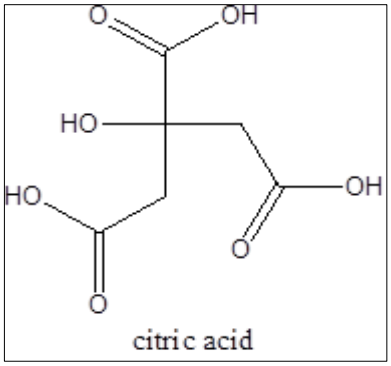




2.4.5. Anthocyanins

Anthocyanins are also colored pigments that act as powerful antioxidants and are widely distributed in fruits. They are a subtypes of flavonoids that are commonly found in nature. These colored pigments are associated with lower risk for certain chronic diseases such as urinary tract infection, cancers, improved memory, and normal aging. Carotenoids, beta-carotene, and lutein are present. Organic acids include citric acid, quinic acid, and maleic acid [5].



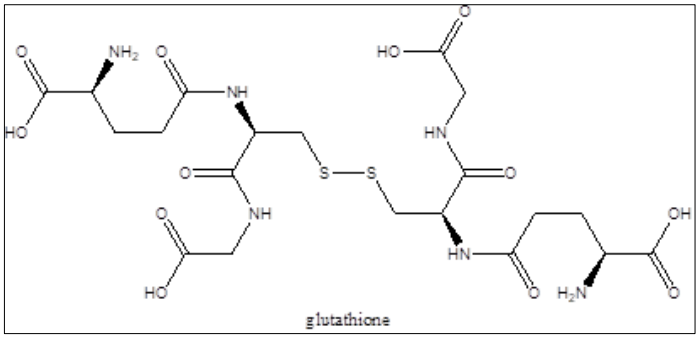


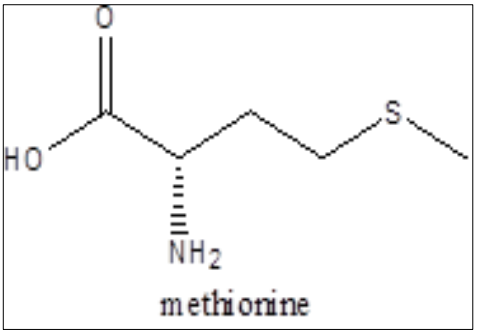
2.4.6. Proteins

Kiwi fruit soluble protein is mostly accounted for proteolytic enzyme actinidin and its inactive form, so called thaumatin-like protein and another called kiwellin. Actinidin is the predominant enzyme containing up to 40% of soluble fruit protein and it is primarily found in the flesh of the fruit. A cysteine protease enzyme called actinidin hydrolyse the gluten proteins and digestion-resistant gluten peptides aiding the digestive process and it is also able to increase digestion of beef, dairy, and wheat. Actinidin accelerate the gastric emptying and it is theorized it may modulate pain reception and anti-inflammatory activity. Kirola is also one of the protein found in kiwi. Kiwellin accounts for 20–30% of the soluble protein in kiwifruit. Kiwellin is a single polypeptide chain protein of 189 amino acid residues and an apparent 28 kDa molecular mass [23, 24, 25].

2.4.7. Amino acids

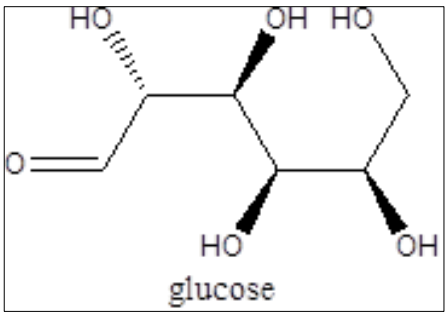
There are number of amino acids present in kiwi fruit including tryptophan, threonine, isoleucine, glutamic acid, glycine, proline, leucine, glutathione, serine and methionine [7].

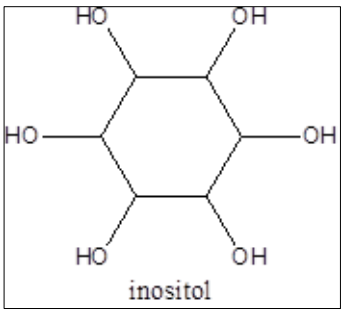




2.4.8. Carbohydrates and sugars

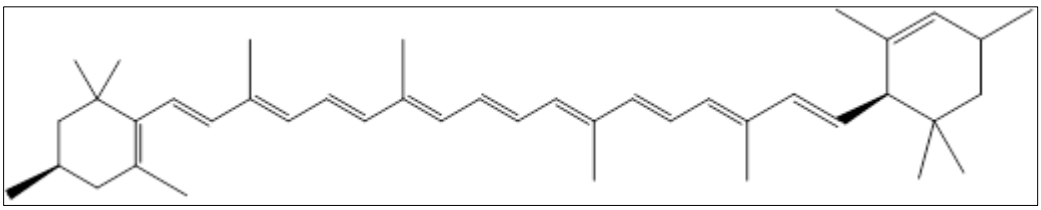
One typical-sized green kiwi contains 10 g of carbohydrates. Out of which 6.2 g of the total 10.1 g of carbohydrates come from sugars that occur naturally and 2.1 g come from fibre. Kiwis are a low-glycaemic acid fruit. When kiwis are ripe and ready to eat, the main carbohydrates they contain are glucose and fructose, with small traces of sucrose. Fruit ripening causes a quick rise in the concentration of fructose and glucose while a fall in the amount of starch. Even though the tissues of kiwis are quite tough, as they grow older, their flesh becomes less firm. For optimal digestive health and to lessen gastrointestinal discomforts such bloating brought on by intestinal fermentation, the ratio of fructose to glucose should be close to 1:1 [18, 22].





2.4.9. Carotenoids and chlorophyll

A range of carotenoid compounds has been identified in kiwifruit and include lutein, α-carotene, β-carotene, violaxanthin, zeaxanthin, and 9'cis-neoxanthin [15, 26]. Among the different cultivars, lutein and β-carotene are the compounds with the highest concentration. The carotenoids can be separated by using HPLC. Kiwifruit contain both chlorophyll a and b in concentrations and ratios that vary among species and cultivars. During ripening chlorophyll content is decreased and carotenoids and anthocyanin become dominant. As kiwifruit mature and ripen, chlorophyll containing chloroplasts are retained in the flesh of green-colored kiwifruit but are transformed into chromoplasts with a loss of chlorophyll in the flesh of gold-colored kiwifruit. Hence the difference in colour between green and gold fruit is due to the absence of chlorophyll and not the concentration of carotenoids in the flesh [26].



Beta-carotene

3. Pharmacological activities of kiwi fruit

Many studies have been carried out to investigate the pharmacological profile and health advantages of kiwi. Numerous biological effects, including anti-oxidant, anti-diabetic, anti-inflammatory, and anti-hypertensive, anti-thrombin, anti-asthmatic, hepatoprotective, anti-platelet, anti-nociceptive, anti-microbial, anti-constipation, anti-carcinogenic, anti-fungal, antiviral, anti-tumour, and have been observed. It has a rich pharmacological profile, which confers a variety of

health benefits. It guards against HIV/AIDS, cancer and cardiovascular issues, too. It significantly contributes to improvement anomalies in metabolism such dyslipidaemia and low-density lipoprotein, vascular inflammation, improper glucose metabolism, hypertension, and hemostatic disorder [7, 27].

3.1. Antibacterial activity

Streptococcus pyogenic, a gram-positive bacteria causes infections of the skin and mucosal surfaces. The kiwi fruit, which has antimicrobial properties, were tested as potential alternatives to conventional antibacterial agents causing necrotizing fasciitis, pharyngitis, sore throat, and streptococcal toxic shock syndrome. It is also active against different bacterial species include gram positive bacteria (*Staphylococcus aureus , Bacillus cereus*) and gram negative bacteria (*Escherichia coli , Vibrio cholerae*) determine by using agar diffusion and well diffusion methods. The multiple drug resistance of bacteria and improper administration of antibiotics are generally the major drawback of antibiotics. The chemical detection was made for the plants extract and revealed that the plants extract were positive for flavonoids and phenols. The percentage growth inhibition of vancomycin and the kiwi extract did not differ significantly. kiwi fruit extract has antimicrobial activity similar to vancomycin and is a powerful antibacterial agent against *S. aureus* [27, 28, 29].

3.2. Antitumor activity

An anti-mutagenic component found in *A. deliciosa* helps to prevent mutations of genes which can originate the cancer process. Glutathione is also present in *A. deliciosa* which may help in the reduction process. Numerous facts were discovered during the research appears to confirm that kiwifruit may show a positive prevention of cancer. Kiwifruit or its extracts have the ability to: permanent DNA damage, potentially lowering the chance of cancer development, or exerting direct cytotoxic effects by decreasing the viability of many cells. It has potential impact on cancer cell lines and has direct cancer-fighting ability. When compared to a placebo (i.e., water), kiwifruit supplementation was related with increased resistance to H2O2-induced DNA injury (i.e., a significantly lower number of DNA breaks), but no significant difference could be seen for endogenous DNA damage [2, 7, 30].

3.3. Antioxidant effect

Antioxidants are now a popular issue in modern science because they are not generated by the human body naturally and must be acquired from artificial sources or foods like kiwi fruit. Antioxidants are therefore chemicals that, at low concentrations, inhibit or prolong the oxidation of the substrate that occurs during chain reactions. Kiwifruits ability to act as antioxidants is linked to their ability to improve health. Varying amounts of phenolic compounds and ascorbic acid in the studied kiwifruits may, at least in part, account for the variations in antioxidant capacity. According to reports, chlorogenic acid has a stronger relationship with antioxidant activity. Others constituents other than vitamin C and E responsible for activity including polyphenols, polysaccharide, triterpenoids, unsaturated fatty acid, flavones and flavonones; the carotenoids zeaxanthin, lutein, and beta carotene, chlorophylls, quinic acid, caffeic acid, glucosyl derivatives and β-sitosterol. The role of antioxidant is to scavenge, delay, or retard the cell damage by free radicals that are generated by the normal metabolism of the human body. Consumption of fruit decreases oxidative DNA damage in human cells and led to an increased resistance of DNA to oxidative damage induced by H2O2. This susceptibility depends on the state of the DNA [3, 5, 19, 31, 32].

3.4. Anti-inflammatory activity

Living systems naturally contain reactive oxygen species (ROS), which are continuously synthesized through regular biological mechanisms. Hydroxyl radical, hydrogen peroxide, singlet oxygen and superoxide this are the some examples of reactive oxygen species. Numerous situations and elements, including inflammation, infection, UV exposure, and drug consumption, can boost cellular ROS generation and start a series of inflammatory processes. Excessive ROS induced oxidative damage to vital biomolecules in the human body, which leads to degenerative conditions like atherosclerosis, chronic inflammation, and neurological diseases. The primary polyphenols in the extract of kiwi peel as well as fruit accounting for 92% w/w of the total, are procyanidin. Interleukin-6 (IL-6) and tumour necrosis factor-a (TNF-a), which are controlled by transcription factors including c-fos and signal transducer and activator of transcription 3 in lipopolysaccharide-stimulated cells, are inhibited by the flavonoid cirsimaritin. The chlorogenic acid and phenolic acid was discovered to lower the pro-inflammatory levels of IL-1b, TNF-a, and IL-6 cytokines, and to prevent the nuclear factor jB translocation. Kiwifruit Hayward boosted cytokine production while suppressing antioxidant stress [3, 33].

3.5. Antidiabetic effect

Chronic hyperglycaemia and/or hyperinsulinemia are caused by insulin resistance, which is characterised by a diminished capacity of cells or tissues to respond to physiological insulin concentrations. Obesity, metabolic syndrome,

and type 2 diabetes (T2D) mellitus are all conditions influenced by these factors. Chronic insulin secretions may directly or indirectly alter peripheral tissues, causing insulin resistance, by altering blood levels of glucose, insulin, or fatty acids. An extensively cultivated and major crop, kiwis (*Actinidia deliciosa*) are harvested throughout China. Previous research has demonstrated that kiwifruit is high in vitamin C, flavonoids, and trace elements. Many studies indicate that kiwifruit soluble dietary fibre (KSDF) and kiwifruit insoluble dietary fibre (KIDF) differ in their monosaccharide composition. Numerous in vitro investigations have demonstrated that both KSDF and KIDF have beneficial functional characteristics, such as the capacity to bind glucose. These findings suggest the hypoglycaemic potential of KSDF and KIDF*. A. deliciosa* contains a natural sugar alcohol that is inositol that aids in controlling diabetes. Supplemental inositol can increase the speed of nerve conduction in diabetic neuropathy. In intracellular responses to hormones and neurotransmitters, kiwi has a notable role. A second messenger, inositol participates in the cell signalling pathway [13, 34].

3.6. Antiplatelet activity

Dietary factors have a significant impact on a range of cardiovascular disease (CVD) risk factors, including platelet hyperactivity, high blood cholesterol, triglycerides, obesity, and diabetes. The stability of atherosclerotic plaque as well as its formation may be significantly influenced by platelet activity. Two or three kiwi fruit consumed daily for 28 days greatly diminished platelet aggregation, indicating that eating kiwi fruit is a beneficial method for preventing platelet aggregation brought on by collagen and ADP. The consumption of kiwi fruit may improve the efficacy of thrombosis prevention. Platelet inhibitory action of the extract may be mediated in part by reducing TxA2 synthesis. Platelet reactivity to collagen, ADP, and plasma triglyceride levels is modified. The extract of kiwi pulp containing the flavonoid and polyphenolic compounds shows modulated antiplatelet activity [35].

3.7. Cardioprotective activity

Atherosclerosis is a complicated, multifactorial process that includes platelet aggregation, increased blood pressure, and the oxidation of cholesterol and intracellular build-up of oxidised cholesterol. Kiwi fruit has cardiovascular health benefits such as fibrinolytic or ACE, HMG-CoA reductase, and angiotensin I-converting enzyme (ACE) inhibition activity. Kiwifruit is probably able to alter the course of atherosclerosis due to a variety of components such dietary fibre, phenolic antioxidants, and minerals. Vitamin C, carotenoids and flavonoids provides a preventive effect against cardiovascular disease. Kiwi fruit contains plenty of vitamins E, fructose, galactose and minerals, it contains isoflavones and flavonoids which are important phytochemical represent the major class of phytoestrogen which has an important cardioprotective activity. In addition, a many compounds such as diosgenin, resveratrol, quercetin, catechin, sulforaphane, tocotrienols, and carotenoids are also absorbed during the digestion of fruit and vegetables. These nutrients, which are abundant in fruits and vegetables, may responsible for the inverse association of the intake of these foods with the risks of stroke and mortality from CVD [32, 36].

3.8. Hypolipidemic activity

Major factors that contribute to the onset of cardiovascular disease include hypercholesterolemia and hypertriglyceridemia. The most effective method for treating atherosclerosis is to lower the serum levels of total cholesterol (TC) and triglycerides (TG). In the blood, dyslipidaemia is defined as an elevation in TC and TG, low-density lipoprotein cholesterol (LDL-C), and a reduction in HDL-C. Dyslipidaemia is a major risk factor that can interact individually or in combination to promote the progression of atherosclerotic plaques and coronary artery disease. Several plants flavonoids ameliorate dyslipidaemia. The consumption of food is one way for the body to obtain cholesterol. The other is biological synthesis, which constitutes between 70 – 80 % of all the serum cholesterol. Therefore, preventing the biological synthesis of cholesterol is an effective way to lower cholesterol levels. The HMG-CoA reductase is an important enzyme which catalysed the first step in cholesterol biosynthesis, which reduces HMG-CoA to mevalonate in a NADPH-dependent manner. Kiwi lowers the action of the liver enzyme HMG-CoA, triglyceride and total cholesterol levels significantly decreases [7, 32, 37].

3.9. Dietary fiber and Laxative effect

Constipation is a common issue that affects both children and adults, and its symptoms frequently include difficulties, discomfort, infrequent urination, and the sense that an evacuation is not complete. Long-term faecal retention in the colon and a deficiency of moisture in the lumen are defining features of constipation. The regular use of fresh kiwifruit in the diet of the elderly have been shown to enhance the frequency and ease of bowel movements. Kiwifruit consumption alleviates the symptoms of gastrointestinal (GI) diseases such as indigestion, bloating, and constipation. Kiwifruit has long been utilised as a functional food to treat intestinal conditions like constipation since it is rich in vitamins, minerals, dietary fibre, and other beneficial nutrients. Kiwi fruit contains the actinidin (proteolytic enzyme) and its inactive form, so called thaumatin-like protein and another called kiwellin. This enzymes aiding the digestion

process. Numerous research proved that kiwifruit peel is beneficial and contains large amounts of dietary fiber (DF), which benefits the physiological activities of humans by maintaining gastrointestinal health [23, 24, 38].

3.10. Immunoregulator

Kiwi fruit might improve innate and adaptive immune response of human blood cells. Research studies have revealed that supplementation of kiwi fruit resulted in elevation in the rate of process of phagocytosis and immunoglobulin's levels (IgA, IgG and IgM). It is proven that individuals who consume less vitamin C have higher bronchitis and wheezing symptoms, which are more severe in asthmatic and bronchitis susceptible patients. In older and younger people as well as children, kiwis boost the immune system and lessen the severity of cold and flu-like illnesses. The little kiwi fruit contains vitamin B6 and B12, vitamin C, vitamin K, zinc, fibre, folate, and other elements that work together to promote immunity. Vitamin C increases immunity, produces collagen-like elastic material, and accelerates the body's production of connective tissues, which helps pregnant women's bodies heal more quickly. Spina Bifida is a birth defect caused by a B9 deficiency in babies. Due to its increased proportion of folate content, kiwi fruit offers protection from such problems [7, 22].

3.11. Support Iron nutrition

Consumption of kiwi helps to overcome the iron deficiency. It has a significant amount of carotenoids, ascorbic acid and citric acid which improves a person's iron status. Blood flow from both inside and outside of your body is abnormally increased by bleeding disorders. Low levels of iron in the body cause iron deficiency anaemia, which can leave you feeling weak, exhausted, and lightheaded. Ascorbic acid and more recently the carotenoids; lutein and zeaxanthin has been shown to enhance Fe absorption. This components are abundantly found in kiwi fruit [7, 17, 22].

3.12. Use of active constituents in bone, teeth and nails

The most prominent metabolic bone disease, which is characterised by a loss of bone mineral density, is osteoporosis and bone tissue degradation on a microstructural level. It assists in preventing BMD (bone mineral density) decline brought on by overiectomy. Postmenopausal osteoporosis leads to increase risk of bone fracture. Hence consumption of kiwi conserved a minerals such as calcium, phosphorous and magnesium. It also support the growth of stronger bones because it contains vitamin K. When these fruits mixed with fermented permeates to make a fermented beverage, can be utilised as a diet for humans suffered from osteoporosis. It contains biotin, which may promote growth of nails. The kiwi-flavoured nail polish remover for strong nails. Kiwis contains abundant amount of fibre and calcium, a powerful dental mineral that helps to strengthen enamel defences and neutralises harmful acids [7, 22, 39, 40].

3.13. Dermatological activity

A protein called collagen improves skin's smoothness, reduces wrinkles and accelerates the healing of wounds. Kiwi's vitamin C promotes the production of collagen. The main form of vitamin E that is tocopherol is also present in kiwi. The vitamin C an antioxidant can protects skin from UV rays, pollution, and smoke while also enhancing skin health in general. It contains a lot of vitamin K, which is necessary for healthy, radiant skin. It is used to treat the skin infections like abscesses, furancles, cellulitis, blisters and redness in topical dosage form. High amounts of polysaccharides it seems worth to investigate a potential use of kiwi polysaccharides as pharmacological active entities in the dermatological skin treatment [6, 20, 28].

3.14. Use of kiwi in kidney problems

The clinical problem of acute kidney injury (AKI) is a critical condition. A sudden reduction of renal function or AKI, is a condition which is linked to a higher risk of death and more instances of chronic renal disease that is becoming worse. AKI is characterised by a substantial reduction and ongoing loss in kidney function. Nephron depletion, waste build-up, and electrolyte imbalance occurs as a result of it. Most of the time, this form of renal failure can be reversed, but if the patient is not sensitive to treatment, it can develop to chronic kidney disease (CKD). Vitamin C present in kiwi can boost the amounts of nitric oxide, which prevents free radical-induced cellular transformation, and by inducing antioxidant enzyme activities as a defence against decreasing reactive oxygen species, vitamin C exhibits protection against nephrotoxicity. The concurrent administration of kiwifruit and glycerol resulted in a substantial decrease in nephrotoxicity by reducing the NGAL levels. NGAL is a protein expressed in convoluted renal proximal tubules, and is also regulated after renal ischemia and injury [41, 42].

3.15. Hepatoprotective activity

Due to the liver's vital roles in the detoxification of the majority of environmental toxins that enter the body, liver damage has grown because of exposure to larger levels of environmental pollutants. Studies on both humans and

animals have indicated that a few medications and chemical substances may have hepatotoxic effects. According to reports, the production of reactive oxygen species (ROS) and lipid peroxidation in the liver are linked to the hepatotoxic effects. Vitamin C serves as an electron donor or reducing agent and is a crucial co-factor in numerous metabolic processes. Through antioxidant and anti-lipid peroxidation processes, vitamin C protects the liver. Additionally, ascorbic acid was able to maintain 100% of cell integrity, regulate alanine and aspartate aminotransferases and lessen the cytotoxicity caused by cypermethrin in hepatocytes by recovering 60% of glutathione and decreasing gamma glutamyl transpeptidase by 54%. Several cancers, including stomach, lung, and liver cancer, are treated with kiwi fruits because they are rich in vitamins, polyphenols, and lipophilic components. Kiwi fruits show cell protection against oxidative DNA damage and suppress the formation of cancerous cells [43, 44].

4. Conclusion

Kiwi fruit is becoming popular throughout the world because of its nutrient dense property and health benefits. Due to its important chemical constituents like vitamins, phenolic compounds, proteolytic enzymes, amino acids etc. it shows numerous pharmacological activities. Daily intake of kiwi were shown to reduce the various incidence of disease. Hence, day by day the demand of kiwi fruit increases.

Compliance with ethical standards

Disclosure of conflict of interest

The author declare that there is no conflict of interest.

References

[1] S. S. Mulye et al., "Medicinal and Phytochemical Analysis of Alcoholic Whole Fruit Extracts of *Actinidia deliciosa*," J. Sci. Res., vol. 64, no. 01, pp. 179–185, 2020, doi: 10.37398/jsr.2020.640126.

[2] B. Poojar et al., "Methodology Used in the Study," Asian J. Pharm. Clin. Res., vol. 7, no. 10, pp. 1–5, 2017, doi: 10.4103/jpbs.JPBS.

[3] Barnkob L; Argyraki A; Jakobsen J, "In vitro studies on anti-inflammatory activities of kiwifruit peel extract in human THP-1 monocytes" DAFNE DIPARTIMENTO DISCIENZE AGRARIE E FORESTALI,2020.

[4] M. Yazawa, T. Matsuyama, and T. Akihama, "Transgenic Kiwi Fruit (*Actinidia deliciosa*)," vol. 47, pp. 1–12, 2001, doi: 10.1007/978-3-642-56901-2_1.

[5] B. A. Kehinde, G. A. Nayik, and S. Rafiq, Muntingia calabura. 2020. doi: 10.1007/978-981-15-7285-2_13.

[6] T. Pinto, "Kiwifruit, a botany, chemical and sensory approach a review," Adv. Plants Agric. Res., vol. 8, no. 6, pp. 383–390, 2018, doi: 10.15406/apar.2018.08.00355.

[7] D. Satpal, J. Kaur, V. Bhadariya, and K. Sharma, "*Actinidia deliciosa* (Kiwi fruit): A comprehensive review on the nutritional composition, health benefits, traditional utilization, and commercialization," J. Food Process. Preserv., vol. 45, no. 6, 2021, doi: 10.1111/jfpp.15588.

[8] X. He et al., "Actinidia chinensis Planch.: A review of chemistry and pharmacology," Front. Pharmacol., vol. 10, no. OCT, pp. 1–18, 2019, doi: 10.3389/fphar.2019.01236.

[9] W. Stonehouse, C. S. Gammon, K. L. Beck, C. A. Conlon, P. R. von Hurst, and R. Kruger, "Kiwifruit: Our daily prescription for health1," Can. J. Physiol. Pharmacol., vol. 91, no. 6, pp. 442–447, 2013, doi: 10.1139/cjpp-2012-0303.

[10] T. O. Pediatría and C. Martínez-costa, "Nutrición Hospitalaria," vol. 33, pp. 21–25, 2019.

[11] Z. A. Salama et al., "Active constituents of Kiwi (*Actinidia deliciosa* Planch) peels and their biological activities as antioxidant, antimicrobial and anticancer," Res. J. Chem. Environ., vol. 22, no. 9, pp. 52–59, 2018.

[12] A. R. Ferguson, "Botanical Description," pp. 1–13, 2016, doi: 10.1007/978-3-319-32274-2_1.

[13] V. K. Raman, S. K. Chauhan, and A. Chaudhuri, "*Actinidia deliciosa*: A Nature's Boon to Modern Pharmacotherapeutics," Appl. Pharm. Sci. Microbiol., no. October, pp. 83–94, 2020, doi: 10.1201/9781003019565-5.

[14] B.N. Hazarika, Thejangulie Angami and V.A. Parthasarathy,"Fruits: tropical and subtropical Vol-3" fourth revised and illustated edition, Astral publication, page no. 389-450.

[15] S. J. Henare, The Nutritional Composition of Kiwifruit (Actinidia spp.). Elsevier Inc., 2015. doi: 10.1016/B978-0-12-408117-8.00015-5.

[16] I. Nishiyama, Y. Yamashita, M. Yamanaka, A. Shimohashi, T. Fukuda, and T. Oota, "Varietal difference in vitamin C content in the fruit of kiwifruit and other Actinidia species," Journal of Agricultural and Food Chemistry, vol. 52, no. 17. pp. 5472–5475, 2004. doi: 10.1021/jf049398z.

[17] K. Beck, C. A. Conlon, R. Kruger, J. Coad, and W. Stonehouse, "Gold kiwifruit consumed with an iron-fortified breakfast cereal meal improves iron status in women with low iron stores : a 16-week randomised controlled trial," pp. 101–109, 2011, doi: 10.1017/S0007114510003144.

[18] D. P. Richardson, J. Ansell, and L. N. Drummond, "The nutritional and health attributes of kiwifruit: a review," Eur. J. Nutr., vol. 57, no. 8, pp. 2659–2676, 2018, doi: 10.1007/s00394-018-1627-z.

[19] H. Y. Li et al., "Phenolic profiles, antioxidant capacities, and inhibitory effects on digestive enzymes of different kiwifruits," Molecules, vol. 23, no. 11, pp. 1–16, 2018, doi: 10.3390/molecules23112957.

[20] M. Dias et al., "Chemical composition and bioactive properties of byproducts from two different kiwi varieties," Food Res. Int., vol. 127, p. 108753, 2020, doi: 10.1016/j.foodres.2019.108753.

[21] S. K. Hettihewa, Y. Hemar, and H. P. Vasantha Rupasinghe, "Flavonoid-rich extract of actinidia macrosperma (a wild kiwifruit) inhibits angiotensin-converting enzyme in vitro," Foods, vol. 7, no. 9, pp. 4–11, 2018, doi: 10.3390/foods7090146.

[22] P. Biologii and K. Tom, "Phytochemistry, Nutritional and Medicinal Value of Kiwi Fruit," Postep. Biol. Komorki, vol. 2, no. 2, pp. 147–166, 2021, [Online]. Available: https://plantinstructions.com/tropical-fruit/how-to-grow-kiwi-in-a-pot/

[23] I. A. Jayawardana et al., "The kiwifruit enzyme actinidin enhances the hydrolysis of gluten proteins during simulated gastrointestinal digestion," Food Chem., vol. 341, p. 128239, 2021, doi: 10.1016/j.foodchem.2020.128239.

[24] S. B. Bayer, C. M. Frampton, R. B. Gearry, and G. Barbara, "Habitual Green Kiwifruit Consumption Is Associated with a Reduction in Upper Gastrointestinal Symptoms: A Systematic Scoping Review," Adv. Nutr., vol. 13, no. 3, pp. 846–856, 2022, doi: 10.1093/advances/nmac025.

[25] M. Boland, Kiwifruit Proteins and Enzymes. Actinidin and Other Significant Proteins., 1st ed., vol. 68. Elsevier Inc., 2013. doi: 10.1016/B978-0-12-394294-4.00004-3.

[26] P. Latocha, T. Krupa, R. Wołosiak, E. Worobiej, and J. Wilczak, "Antioxidant activity and chemical difference in fruit of different Actinidia sp.," Int. J. Food Sci. Nutr., vol. 61, no. 4, pp. 381–394, 2010, doi: 10.3109/09637480903517788.

[27] Ebtehal H. Al-Naimy, Raghad K. Al-Lihaibi, Suad M. Majeed, Rafal S," ANTIBACTERIAL AND CYTOTOXIC EFFECTS OF THE KIWI FRUIT AND POMEGRANATE ACTIVE COMPOUNDS ON TUMOR CELL LINE (L20B, RD)", The Iraqi Journal of Agricultural Sciences 43 (1): 157-167,2012.

[28] J. David et al., "Antibacterial Effect of Kiwi Fruit Extract (Actinidia chinensis) to Streptococcus pyogenes and Staphylococcus aureus," Cabrini J. Allied Med., vol. 3, no. 2, pp. 1–6, 2019.

[29] M. Popovic, U. Andjelkovic, M. Grozdanovic, I. Aleksic, and M. Gavrovic-Jankulovic, "In Vitro Antibacterial Activity of Cysteine Protease Inhibitor from Kiwifruit (*Actinidia deliciosa*)," Indian J. Microbiol., vol. 53, no. 1, pp. 100–105, 2013, doi: 10.1007/s12088-012-0319-2.

[30] G. Lippi and C. Mattiuzzi, "Kiwifruit and Cancer: An Overview of Biological Evidence," Nutr. Cancer, vol. 72, no. 4, pp. 547–553, 2020, doi: 10.1080/01635581.2019.1650190.

[31] A. Siddique et al., "Antibacterial and Antioxidant Activity of Kiwi Fruit," Biol. Clin. Sci. Res. J., vol. 2021, no. 1, pp. 1–8, 2021, doi: 10.54112/bcsrj.v2021i1.76.

[32] S. S. Soltan and M. MSM Shehata, "Effects of Bioactive Component of Kiwi Fruit and Avocado (Fruit and Seed) on Hypercholesterolemic Rats," World J. Dairy Food Sci., vol. 8, no. 1, pp. 82–93, 2013, doi: 10.5829/idosi.wjdfs.2013.8.1.1121.

[33] Y. E. Kim, C. H. Cho, H. Kang, H. J. Heo, Y. S. Cho, and D. O. Kim, "Kiwifruit of Actinidia eriantha cv. Bidan has in vitro antioxidative, anti-inflammatory and immunomodulatory effects on macrophages and splenocytes isolated from male BALB/c mice," Food Sci. Biotechnol., vol. 27, no. 5, pp. 1503–1511, 2018, doi: 10.1007/s10068-018-0321-5.

[34] G. Microbiota, "Insoluble and Soluble Dietary Fibers from Kiwifruit (Actinidia and Streptozotocin-Induced TYPE 2 Diabetes in Rats," 2022.

[35] A. K. Duttaroy and A. Jørgensen, "Effects of kiwi fruit consumption on platelet aggregation and plasma lipids in healthy human volunteers," vol. 15, no. August, pp. 287–292, 2004, doi: 10.1080/09537100410001710290.

[36] A. K. Duttaroy, Cardioprotective Properties of Kiwifruit, 1st ed., vol. 68. Elsevier Inc., 2013. doi: 10.1016/B978-0-12-394294-4.00015-8.

[37] X. Zhao, X. Li, Y. Jin, X. Yu, S. Qu, and D. Sui, "Hypolipidemic effects of kaempferide-7-O- (4 ' ' -O-acetylrhamnosyl) -3-O-rutinoside in hyperlipidemic rats induced by a high-fat diet," no. June 2008, pp. 837–841, 2012, doi: 10.3892/mmr.2011.714.

[38] Z. Zhuang et al., "The manufacturing process of kiwifruit fruit powder with high dietary fiber and its laxative effect," Molecules, vol. 24, no. 21, 2019, doi: 10.3390/molecules24213813.

[39] H. A. El, S. Doaa, and F. H. Ayat, "Effect of natural sources rich in calcium on treated rats induced osteoporosis," Discov. Food, 2022, doi: 10.1007/s44187-022-00023-7.

[40] S. Katsumata, F. M. Wolber, M. Tadaishi, Y. Tousen, Y. Ishimi, and M. C. Kruger, "Effect of kiwifruit on bone resorption in ovariectomized mice," J. Nutr. Sci. Vitaminol. (Tokyo)., vol. 61, no. 4, pp. 332–337, 2015, doi: 10.3177/jnsv.61.332.

[41] F. Khalifa and A. A. Alharbi, "Protective Effects of Alcoholic and Aqueous Extracts of Lyophilized Kiwifruit on Acute Kidney Injury (AKI) Induced by Glycerol in Male Albino Rat Protective Effects of Alcoholic and Aqueous Extracts of Lyophilized Kiwifruit on Acute Kidney Injury (AKI ," no. May, 2021, doi: 10.9734/jpri/2021/v33i27B31499.

[42] Y. I. Mahmoud, "nephrotoxicity in albino mice via the activation of Nrf2 and the inhibition of NF- k B (Kiwi & gentamicin-induced nephrotoxicity)," Biomed. Pharmacother., vol. 94, pp. 206–218, 2017, doi: 10.1016/j.biopha.2017.07.079.

[43] A. M. A. Foda, E. I. E. Ibrahim, and M. S. Gouida, "Hepato-Protective Effect of Vitamin C Extract from Kiwifruit on Hepatic Injury Induced by Monosodium Glutamate," no. 1, 2019.

[44] W. Kang, H. Yang, H. J. Hong, C. H. Han, and Y. J. Lee, "Anti-oxidant activities of kiwi fruit extract on carbon tetrachloride-induced liver injury in mice," vol. 52, pp. 275–280, 2012.