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A comprehensive review of phytochemical and pharmacological properties of *Actinidia deliciosa*

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Abstract
Actinidia deliciosa is a fruiting vine. It is deciduous and woody. It consists of different species and cultivars with diverse traits and sensory properties. Various extracts of the plant have been utilized in traditional Chinese medicine to alleviate symptoms of many conditions. As *Actinidia deliciosa* becomes more popular, researchers focus on its health benefits such as increased antioxidant levels, improved gastrointestinal health, lower blood lipid levels, and relief from skin diseases. It can cause allergy symptoms in some individuals, prompting an investigation into its allergenicity across different groups. It also contains high levels of vitamin C, folate, potassium, and fiber. This fruit's minerals and phytochemicals have led to research on its antioxidant and anti-inflammatory properties, potentially preventing cardiovascular disease, cancer, and other chronic diseases.

Keywords: *Actinidia deliciosa*, extracts, health benefits, phytochemicals

Introduction
Phytomedicine and herbal medications have been employed in the healthcare system since ancient times. Throughout history, medicinal plants have been used by various societies, ethnic groups, and cultures. They can provide therapeutic compounds with great pharmacological value and significant utility for healthcare development. Herbal medicines offer substantial potential for treating various diseases in developing and developed countries. Ethnomedicinal herbs offer protection against serious ailments. Plant secondary metabolites are increasingly important in the nutraceutical and pharmaceutical industries. Ethnomedicinal plant products are cost-effective and have little side effects or toxicity. Indian ethnomedicinal plants provide therapeutic characteristics that can reduce the danger of life-threatening disorders. Phytochemicals can defend against illnesses and improve the immune system. The study of traditional medicinal plants contributes to a better knowledge of their biological functions, which can benefit future human welfare and healthcare. Proper cultivation of medicinal and aromatic plant species requires special care. Various studies have explored the potential of pharmacology through experimental and observational therapies for complementary and alternative medicine. These plants can be utilized as a functional food to boost health because of their high content of fiber, minerals, and vitamins, as well as essential metabolites (primary and secondary). Plant species have significant potential for medicinal and nutraceutical applications, taking into account pharmacology, phytotherapy, and phytochemistry [1].

Synonyms: *Actinidia chinensis deliciosa, Actinidia chinensis hispida, Actinidia deliciosa chlorocarpa, Actinidia deliciosa coloris, Actinidia deliciosa longipila. Actinidia latifolia deliciosa.* [3, 4].

Classification
Kingdom: Plantae.
Division: Magnoliophyta.
Class: Magnoliopsida.
Order: Ericales.
Family: Actinidiaceae.
Genus: *Actinidia*.
Species: *deliciosa* [5].

Plant profile

Fig 1: Kiwi

Common name: Kiwifruit, Chinese gooseberry [2]

Distribution

Actinidia deliciosa is native to China, primarily in the south and central regions, where it grows in mountain forests at elevations ranging from 800 to 1400 meters. It is also widely grown in several countries, including New Zealand, Brazil, Chile, and Italy. In India, cultivation has grown to the mid-hills of Jammu Kashmir, Himachal Pradesh, and Arunachal Pradesh [6, 7].

Description

Kiwifruit is typically oval, measuring 5-8 cm long and 4.5-5.5 cm in diameter, similar to a giant hen's egg. The plant has alternating, long petioled, deciduous leaves that are oval to almost round and cordate at the base, measuring 7.5-12.5 cm in length. Young leaves have red hairs, whereas mature leaves are dark green, hairless on top, and downy-white with noticeable light-colored veins below. Flowers are fragrant, dioecious, or bisexual, and can be borne individually or in clusters in leaf axils. They are 5- to 6-petalled, white at first, turning to buff-yellow, and 2.5-5 cm wide. Both sexes have central tufts of numerous stamens, but female flowers lack viable pollen. The flowers also lack nectar. It blooms in November. The fruit has a fibrous, dull brown-green exterior and bright green or golden flesh. It contains rows of tiny, black edible seeds. The fruit has a delicate texture and distinctive flavor [5].

Traditional uses

Kiwi is a good source of potassium, fiber, and omega-3 fatty acids. Fibre may help lower elevated cholesterol levels. As a result, it may aid in the prevention of cardiovascular disorders such as stroke and coronary heart disease. Fruit also includes magnesium, phosphorus, and zinc, which may improve blood circulation and hence affect hair development. Some civilizations have traditionally utilized kiwi fruit juice to tenderize meat [8, 9].

Phytochemistry

HPLC analysis of acetone extract of kiwi peels revealed the primary phenolic constituents were syringic, chrysin, and quercetin [10]. There are 40 polyphenols in the peel. Flavones present are apigenin, acacetin (8-O-glucoside), chrysoeriol (6-C-glucoside), and apigenin O-glucoside. Other constituents include malonylated apigenin 7-[galactosyl-(1-4)-mannoside], flavanols (kaempferol, dihydrokaempferol, quercetin, quercitrin, taxifolin-O-pentoside, dihydrokaempferol-O-hexoside, kaempferol dipentoside, rutin), flavan-3-ol (epi) catechin), phenolic acids (4-hydroxybenzoic acid, 3-O-methyl gallic acid), and citric acid. There are 36 polyphenols in berry pulp. Flavones: apigenin, acacetin, luteolin, diosmetin, and acacetin 8-C-glucoside. 7-O-glucoside, Linarin, and Genistein Flavanols: kaempferol, quercetin, quercitrin, afzelin; flavan-3-ols (epi) afzelechin, (epi) catechin; phenolic acids: Resveratrol, stilbenes, 3-hydroxyresveratrol, cis-epsilon-Viniferin, resveratrol-piceatannol, and resveratrol dihexoside, as well as anthocyanins such as petunidin and cyanidin, are present [11].

Reported Activities

Shadab Ahmed *et al.* (2021)

Reported the analgesic, anti-inflammatory, and antipyretic potential of *Fragaria ananassa* and *Actinidia deliciosa* fruit extract. The study aimed to determine the *in-vivo* analgesic, anti-inflammatory, and antipyretic effects of ethanol extracts of Fragaria ananassa (EEFA), *Actinidia deliciosa* (EEDA), and their 1:1 combination with reference standards (aspirin and paracetamol 100 mg/kg/day), EEFA (800 mg/kg/day), EEAD (800 mg/kg/day), and a 1:1 combination of EEFA and EEAD (400 + 400 mg/kg/day). The results demonstrated that EEAD and their combination had a substantial anti-inflammatory capability, with 79.35% and 82.03% inhibition in carrageenan-induced paw edema, respectively, whereas EEFA produced 52.54% inhibition vs control [12].

Véronique Delcenserie *et al.* (2023)

Investigated the Butyrogenic, bifidogenic, and slight anti-inflammatory effects of a green kiwifruit powder (Kiwi FFG®) in a human gastrointestinal model simulating mild constipation. Reporter gene tests using human intestinal cells (HT-29) revealed that kiwifruit fermentation products activate the aryl hydrocarbon receptor (AhR) transcriptional pathway, a key regulator of intestinal homeostasis and inflammation. Furthermore, regulation of human interleukin (IL-6 and IL-10) production in Caco-2 cells revealed a modest anti-inflammatory impact of kiwifruit powder and gut microbiota-derived metabolites. These findings suggested that Kiwi FFG® may help the gut microbiota, particularly in constipated persons [13].

Geetha N B *et al.* (2024)

Evaluated the *In vitro* Anti-cancer Activity of Methanol Extracts of *Actinidia deliciosa* in HCT-119 Cells. The biological activity was assessed using MTT and COMET tests. The kiwi extract was cytotoxic to these cells, with an IC_{50} value of 30.038 mg/ml. The microscopic investigation demonstrated cell membrane damage, decreased adhesion, and limited growth. Fluorescence labeling revealed alterations in cell nuclei, suggesting apoptosis. Furthermore, the extract inhibited HCT-119 cell growth by activating particular cell death mechanisms [14].

Abdul Qadir *et al.* (2022)

Investigated the GC-MS analysis of phytoconstituents present in the methanolic extract of *Actinidia deliciosa* fruits and its antioxidant activity determined by the DPPH

method. Methanolic extract of kiwi fruit (MEKF) contains several key components, including 2-cyclohexylpiperidin, phenol, 2, 4-bis(1,1-dimethylethyl), 1,6-anhydro-β-d-glucopyranose, dodecanoic acid, 2-heptenoic acid, trimethylsilyl ester, tetradecanoic acid, n-hexadecanoic acid, ethyl hexadecanoate, and n-hexadecanoic acid. Phytol, α-linolenic acid, ethyl (9z,12z)-9,12-octadecadienoate, octadecanoic acid, 17-methyl, methyl ester, Phytol, Acetate 2-Methylhexacosane, Ethyl 9,12,15-octadecatrienoate, Tetracontane, α-tocospiro A, α-tocospiro B, 3.β-Acetoxystigmasta-4,6,22-triene, Octacosane, 1-iodo, 4,6-cholestadien-3.β-ol, benzoate, γ.-Sitosterol, and Tigogenin. The findings of the investigation of MEKF's antioxidant activity revealed considerable free radical scavenging potential against DPPH-generated free radicals due to the presence of alkaloids, glycosides, terpenoids, vitamins, and other known substances [15].

Das Saumya *et al.* (2024)
Evaluated the immunomodulatory and anti-asthmatic activity of the ethanolic extract of *Actinidia deliciosa* fruit on Swiss albino mice. They were tested for immunomodulatory and anti-asthmatic activity using various models, including delayed-type hypersensitivity, neutrophil adhesion test, milk-induced neutrophil leucocytes, clonidine-induced catalepsy activity, and mast cell degranulation method. Microscopic and histopathological visuals were also obtained during the experiment to improve the analysis of the results. Milk (4 mL/kg) administered subcutaneously leads to a considerable rise in leukocyte count within 24 hours. Pre-treatment with the extract at 50 and 100 mg/kg doses resulted in considerable suppression of leukocytes and eosinophilia in mice, equivalent to Dexamethasone (50mg/kg i.p). The extract also significantly inhibited clonidine-induced catalepsy in mice administered for 30, 60, 90, and 120 minutes, equivalent to Chlorpheniramine maleate (10 mg/kg, p.o.) at 120 minutes. The ethanolic extract suppressed the DTH response in mice treated with OVA, resulting in delayed-type hypersensitivity. The high dosage of 100 mg/kg extract significantly improved neutrophil adhesion [16].

Kapa Bhargavi Preeti *et al.* (2021)
Reported the antibacterial activity of *Actinidia deliciosa* extract against periodontopathogenic bacteria. To evaluate the extract's antibacterial effectiveness against periodontopathogenic bacteria, the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were measured using serial dilution and colony-forming units, respectively. The extract had MIC values ranging from 12.5-100µg/ml for *Porphyromonas gingivalis, Prevotella intermedia, Fusobacterium nucleatum,* and *Aggregatibacter actinomycetemcomitans.* At the maximum concentration (100 µg/ml), no colony-forming units were found in the extract's MBC value for any periodontopathogenic bacteria tested. Further research is needed to assess the *in-vivo* effectiveness of this compound in various formulations (e.g. gels, mouthwashes) for managing Periodontal disease [17].

Fatma M. El-Demerdash *et al.* (2023): Evaluated the anti-hyperglycemic and antioxidant role of *Actinidia deliciosa* aqueous extract in streptozotocin-treated rats. The aqueous extract demonstrated a significant antioxidant and radical scavenging activity. Diabetic rats showed elevated blood sugar levels, lipid peroxidation, renal function biomarkers, and hematological indicators. Meanwhile, enzymatic and non-enzymatic antioxidants, protein content, and alkaline phosphatase activity decreased. Additionally, rat kidneys showed changes in collagen, total protein, DNA, and RNA, as well as α-SMA immunoreactivity. STZ upregulated inflammatory genes (TNF-α and TGF-β1) and triggered apoptosis by upregulating apoptotic genes (Bcl2-associated X protein (Bax)) and downregulating anti-apoptotic genes (Bcl-2) based on real-time PCR data. Furthermore, diabetic rats treated with ADAE demonstrated considerable restoration in LPO, antioxidant status, and biochemical indices, as well as improvements in tissue architecture and gene expression compared to the STZ group. In conclusion, *A. deliciosa* has a beneficial effect on diabetic rats' glucose levels and renal function [18].

Eman Fawzy El Azab *et al.* (2023)
Investigated *in vivo* and in silico-based studies of *Actinidia deliciosa* Extract as a Promising Supplemental Agent for Hepatic and Renal Complication-Associated Type 2 Diabetes in a high-fat diet (HFD) and streptozotocin (STZ)-induced T2D in rats. Diabetic rats showed an increase in hepatic and renal lipid peroxidation, as well as a reduction in antioxidant status. Diabetes-related inflammatory and apoptotic responses were observed in the liver and kidneys of rats, as well as dysregulation of phosphorylation levels of mTOR, Akt, and PI3K signaling proteins. However, administering kiwi extract to diabetic rats reduced hepatorenal dysfunction, inflammatory processes, oxidative stress, and apoptotic events by activating the insulin signaling system. Molecular docking and dynamic modeling studies identified quercetin, chlorogenic acid, and melezitose in kiwi extract as possible natural compounds that activate the SIRT-1 pathway. Kiwi extract contains phenolic acids such as syringic acid, P-coumaric acid, caffeic acid, and ferulic acid, which can block the PTEN active site. In conclusion, kiwi extract may be an effective supplementary therapy for treating diabetic hepatorenal problems [19].

Mauro Commisso *et al.* (2021)
Investigated the Undifferentiated *In vitro* Cultured *Actinidia deliciosa* as a Cell Factory for the Production of Quercetin Glycosides. Plant cell and tissue culture (PCTC) is a promising platform for biotechnological synthesis of plant metabolites. This method saves a significant quantity of water and agricultural area, and because the process is free of pollutants, it is suited for scaling up production in bioreactors. In a project to generate and screen *in vitro* plant cells for the production of valuable specialized metabolites for commercial production, various cell lines from *Actinidia deliciosa* and *Actinidia chinensis* that could produce significant amounts of quercetin derivatives, primarily quercetin glycosides. Metabolomics was used to describe three *A. deliciosa* cell lines, both targeted and untargeted. Under normal growth circumstances, they generate and accumulate up to 13.26 mg/100 g fresh weight (419.76 mg/100 g dry weight) of quercetin derivatives. To prepare for future commercial uses, these cell lines should be put through an acceleration program to enhance the quantity of

these metabolites by improving growth conditions and elicitation [20].

Sadia Rafique *et al.* (2022)
Evaluated the effect of *Actinidia deliciosa* fruit extract on skin revitalization. The O/W emulgels prepared formulation contained 5% extract and base was applied to the cheeks of thirteen healthy female volunteers over three months. Skin measurements were taken at baseline and then at 14-day intervals throughout the experimental period. The results of the prepared formulation were compared to base gel for skin composition and showed a significant effect. The prepared formulation was declared to be an appropriate anti-wrinkle, anti-aging, and skin-whitening agent and used for the treatment of many different dermatological preparations, including acne [21].

Ilhami Gulcin *et al.* (2023)
Investigated the Antioxidant, Antiglaucoma, Anticholinergic, and Antidiabetic Effects of *Actinidia deliciosa* Oil. The LC-HRMS results show that apigenin, epigallocatechin, caryophyllene oxide, and luteolin are all abundant in kiwifruit oil. In addition, the amount and chemical makeup of the essential oils of kiwifruit oil were determined using GC-MS and GC-FID analyses. The most prevalent substances in kiwifruit oil were squalene, linoleoyl chloride, linoleic acid, and palmitic acid. The effects of DPPH and ABTS radical scavenging procedures on the radical scavenging activities of kiwifruit oil were also investigated. These techniques successfully illustrated the powerful radical scavenging abilities of kiwifruit oil (IC_{50}: 77.00 µg/mL for ABTS scavenging, and 48.55 µg/mL for DPPH). Additionally, studies were conducted on the reducing abilities of iron (Fe^{3+}), copper (Cu^{2+}), and Fe^{3+}-2, 4, 6-tri(2-pyridyl)-S-triazine (TPTZ). Furthermore, kiwifruit oil showed a significant inhibitory impact on α-amylase (IC_{50}: 421.02 µg/mL), AChE (IC_{50}: 12.80 µg/mL), and hCA II (IC_{50}: 505.83 µg/mL). The findings showed that because kiwifruit oil possesses anti-glaucoma, anti-Alzheimer, antidiabetic, and antioxidant properties, using it in a pharmaceutical technique has significant benefits [22].

Ali Reza Khosravi *et al.* (2022)
Evaluated the chemical composition of *Sambucus ebulus* and *Actinidia deliciosa* ethanolic extracts as well as their *in vitro* antifungal activity on *Saprolegnia parasitica*. The HeMP technique was used to calculate the initial minimum inhibitory concentration (MIC) and minimum lethal concentration (MLC). An agar dilution procedure was then used to create quantities of each extract ranging from 1 to 10% to quantitatively test the *in vitro* antifungal activity. *In vitro*, *Saprolegnia* hyphae growth was suppressed by both herbal extracts. *S. ebulus* was reported to exhibit complete *in vitro* growth suppression at a concentration of ≥5%, but *A. deliciosa* did not exhibit any growth inhibition, not even at a 10% concentration. According to a study using GC/MS, the primary components of *S. ebulus* include phytol, fatty acids, monophthalate, and acetic acid. *A. deliciosa* was found to have phenolic levels of 162 mg gallic acid (GAE)/g DW and flavonoid values of 2.31 mg quercetin (QE)/g DW using colorimetric tests. The study's findings, taken together, suggested that S. ebulus and *A. deliciosa* had some antifungal action against S. parasitica, with the former showing more activity [23].

Dhiman *et al.* (2021)
Reported the Purification and characterization of actinidin from *Actinidia deliciosa* and its utilization in the inactivation of α-amylase. SDS-PAGE examination of protease revealed a molecular mass of 27 kDa. By optimizing the procedure one element at a time, the actinidin yield was raised to 176.03 U/mg. The enzyme was most active and stable at pH 7.5, but it was stable throughout a broad pH range. The enzyme had half-lives of 5.5 hours at 35 °C, 4.5 hours at 40 °C, 2.5 hours at 45 °C, and 1 hour at 50 °C. The maximal velocity (V_{max}: 1.428 mmol/ml/min) and Michaelis-Menten constant (K_m: 3.14 mg/ml) were displayed using a Lineweaver-Burk plot using casein. Ca^{2+} ions increased actinidin activity, but Cd^{2+} and Hg^{2+} ions decreased it [24].

Eman F El Azab (2021)
Investigated the Ameliorative Effect of *Actinidia deliciosa* against Lead-Induced Oxidative Stress in the hepatic, renal, brain, and blood tissues in Wistar Albino Rats. The improvement of antioxidant enzyme activity [Catalase (CAT), Superoxide Dismutase (SOD), Glutathione Peroxidase (GPx), and Glutathione Reductase (GR)] was noted as a protective effect of kiwifruit extract (250 and 500 mg kg) and lower liver, brain, and kidney tissue levels of lipid peroxidation. It also significantly improves the blood's delta-aminolevulinic acid dehydratase activity and increases the activity of acetylcholine esterase in the brain [25].

Evelyn Sharon Sukumaran *et al.* (2017)
Reported Comparative Study of *Actinidia deliciosa* and *Garcinia mangostana* in Ovariectomy-Induced Osteoporosis in Female Wistar Rats. Bone loss caused by ovariectomy was avoided by administering fresh juice combinations of *Actinidia deliciosa* and Garcinia mangostana fruits. The fresh juice combinations were administered, and the femur length and weight increased. This was followed by an increase in body weight and the amount of calcium that was derived from the femur bone's ash. It is clear that the fresh juice combinations have dual benefits for preventing postmenopausal osteoporosis: They may be used as a preventative and a therapeutic [26].

Ravindra R. Kamble *et al.* (2023)
Evaluated the Adept green synthesis of Cu_2O nanoparticles using *Actinidia deliciosa* juice and Studies on their cytotoxic activity and antimicrobial activities. The green synthesis of Cu_2O NPs using kiwi fruit juice is the methodology's first step. XRD, SEM, UV-visible, FT-IR, particle size, and zeta potential methods are then used for characterization. By subjecting HEK-293 and MCF-7 cell lines to Cu2O NPs, the toxicity of the particles was assessed. Additionally, the potency of the nanoparticles against *S. aureus, E. coli, A. niger*, and *C. albicans* was tested. According to the SEM-EDX investigation, Cu_2O NPs are pure and spherical. The size of half of the Cu_2O NPs particles was around 100 nm. The IC_{50} values for MCF-7 and HEK-293 cells were 6.25±0.27 µg mL^{-1} and 20.51±0.52 µg mL^{-1}, respectively. The Cu_2O NPS was shown to have a specific selectivity index (3.28) against MCF-7 human breast cancer cells. The zones of inhibition for *S. aureus, E. coli, A. niger*, and *C.*

albicans in the antimicrobial test were 20, 18, 14, and 15 mm, respectively [27].

Lovedeep Kaur *et al.* (2022)
Reported the effectiveness of actinidin in Hayward and SunGold kiwifruit in digesting alternative proteins, including pea protein, almonds, tofu, and quinoa. A three-stage *in vitro* oral-gastro-small intestinal digestion model was used to digest the protein sources. The results demonstrated that, presumably as a result of increased actinidin activity at stomach pH, both kiwifruit extracts improved the breakdown (as shown by SDS-PAGE) for all the protein sources under study, especially during gastric digestion. Actinidin's greater specificity than pepsin's most likely contributed to the rise in the rate of protein degradation. When kiwifruit extract was added to many protein sources, the majority of the intact proteins vanished during the first few minutes of stomach digestion. The green kiwifruit extract was more effective than the SunGold extract in breaking down proteins because of its increased actinidin activity. However, SunGold extract led to increased levels of protein breakdown for specific proteins and under specific digesting circumstances. Unlike the green kiwifruit extract, the latter also caused some protein breakdown during the small intestine digestion phase in the absence of any digestive enzymes. The main allergen in almonds, Pru-du 6, had its polypeptide chains broken down more by the green kiwifruit extract. The results for the first time indicate that both SunGold and Hayward kiwifruit can improve the breakdown and digestion of other proteins when eaten as part of a meal. As a result, they have the potential to be used as a digestive aid in populations like athletes, the elderly, and those with impaired digestive systems who want to achieve faster and greater protein digestion [28].

Kartheeswari *et al.* (2024)
Reported *In vitro* Cytotoxicity and Apoptotic Activity of Aqueous (AQU), Chloroform (CHL), and Methanol (METH) extract of *Actinidia deliciosa* Fruit in MCF-7 Cells. The MTT cytotoxicity test was employed to ascertain the fruit extracts' anti-cancer properties. Additionally, DAPI was utilized to assess the imaging of apoptotic cells. The METH extract exhibited the greatest potency, with an IC50 value of 70.984 µg/ml after 24 hours of incubation, among the dose-dependent cytotoxic effects reported by the MTT tests. The extract-induced apoptotic cell death was verified by DAPI staining. These results point to the possibility of using METH extract as a natural source for the creation of cancer medications. To determine the active substances causing these effects and their apoptotic routes, more research is required [29].

Yi Li *et al.* (2021)
Investigated the Facile synthesis of ZnO nanoparticles by *Actinidia deliciosa* fruit peel extract with Bactericidal, anticancer and detoxification properties. UV visible spectroscopy, X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and energy-dispersive X-ray spectroscopy (EDAX) were used to thoroughly analyze the produced nanoparticles. Staphylococcus aureus was used to test the ZnO nanoparticles' bactericidal activity, and SEM pictures were used to investigate the process of cell death. ZnO nanoparticles were also shown to have a superior anticancer effect when it came to suppressing colon cancer cells (HCT116). Furthermore, ZnO nanoparticles demonstrated effective photocatalytic activity in the 120-minute time frame, degrading p-bromophenol by around 96.3%. Furthermore, using Vigna radiata (V. radiata) as a model plant, the phytotoxicity of the intermediate products was examined. After 120 minutes of degradation, the germination index (GI) increased to 82.3% from 8.0% in pure p-BP, indicating that detoxification of the compound had been achieved. Therefore, the current study shows that ZnO nanoparticles made using an easy, quick, affordable, environmentally friendly, and effective green technology provide an alternative foundation for biomedicine and wastewater treatment technologies [30].

Yi Li *et al.* (2017)
Investigated the catalytic, antioxidant, anticancer, and bactericidal activity of green synthesized silver and gold nanoparticles using *Actinidia deliciosa*. The produced nanoparticles were effectively employed as green catalysts in the reduction of methylene blue and 4-nitrophenol. The highly effective antioxidant, anticancer, and bactericidal activities of the developed nanoparticles were the basis for investigating their improved biological activity. The gold nanoparticles (AuNPs) displayed particle sizes ranging from 7 to 20 nm, whereas the silver nanoparticles (AgNPs) generated were mostly spherical with diameters ranging from 25 to 40 nm, according to TEM micrographs. The existence of elemental silver and gold was verified by the results of XPS and EDAX. The X-ray diffraction (XRD) pattern showed that AgNPs and AuNPs formed a face-centered cubic structure. The biomolecule that was responsible for capping the nanoparticles may have contained functional groups, as seen by the Fourier-transform infrared (FTIR) spectrum. Using the MTT test, the AgNP-treated HCT116 cells demonstrated 78% vitality at the maximum concentration (350 µg/mL), whereas the AuNP-treated cells demonstrated 71% viability at the same dose (350 µg/mL). These results suggest a possible avenue for the creation of alternative nano-drugs. TEM images were used to test the antibacterial activity of the nanoparticles against Pseudomonas aeruginosa, showing damage to the cell membrane. The findings showed that the green synthesis approach is simple, quick, affordable, environmentally friendly, and effective in producing multifunctional nanoparticles soon for use in nanobiotechnology, biomedicine, and water treatment [31].

Heba Sayed Mostafa *et al.* (2021)
Evaluated the Phytochemical analysis and antioxidant defense of *Actinidia deliciosa* against pancreatic cancer and AAPH-induced RBC hemolysis. The most prevalent phenolic chemicals found in each extract were p-coumaric acid and ferulic acid (found in the peel), syringic acid, and cinnamic acid (found in the meat), as determined by HPLC analysis. In terms of its anti-cancer potential, meat extract was shown to have a more cytotoxic effect based on the decrease of PANC-1 cell line viability (IC_{50} = 232.89 µg/ml) as compared to the IC_{50} of peel extract (556.60 µg/ml). Both kiwi extracts have demonstrated significant efficacy in reducing hemolysis, thiobarbituric acid reactive substances (TBARS), and GSH levels in AAPH-induced RBCs in

comparison to ascorbic acid. Remarkably, the ethanol peel extract at 80 µg/ml brought the TBARS and GSH levels back to the standard range for red blood cells (0.022 and 2.86 nmole/mg hemoglobin, respectively) [32].

Sneha R. Chandani *et al.* (2019)
Evaluated the data on the docking of phytoconstituents of *Actinidia deliciosa* on dengue viral targets. Four non-structural proteins (NS2B-NS3, NS3 helicase, NS5 methyltransferase, and NS5 RdRp domain) and three potential target locations in the dengue virus's envelope protein were docked. The Schrodinger Maestro Protein Preparation Wizard was used to prepare the receptor. Avogadro software was used to minimize energy use, and structures were stored in sdf format. Using FlexX Lead IT 2.3.2 software, the reduced structures were converted to 3D structures and refined before being docked to the prepared protein targets. Based on its ability to bind energy and interact with amino acid residues crucial for viral replication, the optimal phytoconstituent was found. Docking of these phytoconstituents was carried out on seven viral targets: three DENV structural proteins (Envelope protein-β-OD domain, stem domain, and Domain III) and four DENV non-structural proteins (NS5-SAM binding domain, NS5 RdRp domain, NS3 helicase, and NS2B-NS3 protease). Based on binding affinity, interactions (kind and distance of bonds), and interactions with amino acids important for viral replication, the study was conducted. There has been reporting of the top 5 phytoconstituents with the best docking score [33].

Conclusion
Humans have been eating fruits and vegetables since prehistoric times. Research has demonstrated that eating more fruits and vegetables is known to lower the risk of several ailments. One of the most well-liked and tasty foods with many health benefits is kiwis. It may be needed for academics or pharmaceutical companies to create new herbal formulations. *Actinidia deliciosa* is one of the most well-liked fruits in the Western Hemisphere and is native to China. It is a sensible dietary supplement since it is a great combination of nutrients, minerals, and bioactive substances. In addition to its useful therapeutic qualities as an energy booster, it also possesses anti-oxidant, anti-inflammatory, anti-HIV, anti-microbial, anti-proliferative, anti-asthmatic, anti-platelet, and anti-hypertensive qualities.

References

1. Poddar S, Sarkar T, Choudhury S, Chatterjee S, Ghosh P. Indian traditional medicinal plants: A concise review. Int J Bot Stud. 2020;5(5):174-190.
2. Kiwifruit. New World Encyclopedia. Available from: https://www.newworldencyclopedia.org/entry/Kiwifruit. Accessed April 26, 2024.
3. *Actinidia deliciosa*. Wikipedia. Available from: https://en.wikipedia.org/wiki/Actinidia_deliciosa. Accessed April 26, 2024.
4. *Actinidia chinensis* var. deliciosa. Wikispecies. Available from: https://species.wikimedia.org/wiki/Actinidia_chinensis_var._deliciosa. Accessed April 26, 2024.
5. Shastri KV, Bhatia V, Parikh PR, Chaphekar VN. *Actinidia deliciosa*: A Review. IJPSR. 2012;3(10):3543-3549.
6. *Actinidia deliciosa* (A. Chev.) C.F. Liang & A.R. Ferguson. Plants of the World Online. Available from: https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:60458895-2/general-information. Accessed April 26, 2024.
7. Raman VK, Chauhan SK, Chaudhuri A. *Actinidia deliciosa*: A Nature's Boon to Modern Pharmacotherapeutics. In: Applied Pharmaceutical Science and Microbiology. 1st ed. Apple Academic Press; c2020. p. 12.
8. Ayurveda: Uses, Benefits, Side Effects of Kiwi. Pharm Easy. Available from: https://pharmeasy.in/blog/ayurveda-uses-benefits-side-effects-of-kiwi/#Potential_Uses_of_Kiwi. Accessed April 26, 2024.
9. Tyagi S, Nanher AH, Sahay S, Kumar V, Bhamini K, Nishad SK, *et al*. Kiwifruit: Health benefits and medicinal importance. Rashtriya Krishi. 2015;10(2):98-100.
10. Zeinab AS, Aboul-Enein AM, Gaafar AA, Abou-Elella F, Aly HF, Asker MS, *et al*. Active Constituents of Kiwi (*Actinidia deliciosa* Planch) Peels and Their Biological Activities as Antioxidant, Antimicrobial and Anticancer. Res J Chem Environ. 2018;22(9):52-59.
11. Razgonova MP, Boiko AP, Zinchenko Y, Tikhonova NG, Sabitov AS, Zakharenko AM, *et al. Actinidia deliciosa*: a high-resolution mass spectrometric approach for the comprehensive characterization of bioactive compounds. Turk J Agric For. 2023;47:155-169.
12. Ahmed S, Maalik S, Zehra T, Baig SG, Zehra S, Hassan MMU, *et al*. Preclinical assessment of analgesic, anti-inflammatory and antipyretic potential of Fragaria ananassa and *Actinidia deliciosa* fruit extract. Pak J Pharm Sci. 2021 Mar;34(2):521-527.
13. Goya-Jorge E, Bondue P, Gonza I, Laforêt F, Antoine C, Boutaleb S, *et al.* Butyrogenic, bifidogenic and slight anti-inflammatory effects of a green kiwifruit powder (Kiwi FFG®) in a human gastrointestinal model simulating mild constipation. Food Res Int. 2023;173(2):113348.
14. Geetha NB, Priya R, Weslin D, Christus ATA, *et al. In vitro* Anti-cancer Activity of Methanol Extracts of Kiwi Fruit, *Actinidia deliciosa* in HCT-119 Cells. J Angiother. 2024;8(2):1-6.
15. Qadir A, Khan N, Nasar S, Ullah MN, Ali A, Gupta DK, *et al*. GC-MS analysis of phytoconstituents present in methanolic extract of *Actinidia deliciosa* L. fruits and its antioxidant activity. J Indian Chem Soc. 2022;99(7):100566.
16. Das S, Das S, Pal S. Anti-Asthmatic and Immunomodulatory Effect of *Actinidia deliciosa* Fruit on Swiss Albino Mice. Ind. J Pharm Edu. Res. 2024;58(1):162-171.
17. Preeti KB, Sowmya NK, Gayathri GV, Mehta DS. Antibacterial Activity of *Actinidia deliciosa* (Kiwi Fruit) Extract against Periodontopathogenic Bacteria: An In-Vitro Study. World J Pharm Pharm Sci. 2021;10(1):1212-1220.
18. Naoom AY, Kang W, Ghanem NF, Abdel-Daim MM, El-Demerdash FM. *Actinidia deliciosa* as a complemental therapy against nephropathy and oxidative stress in diabetic rats. Food Sci. Hum Wellness. 2023;12(6):1981-1990.

19. El Azab EF, Alakilli SYM, Saleh AM, Alhassan HH, Alanazi HH, Ghanem HB, *et al.* *Actinidia deliciosa* Extract as a Promising Supplemental Agent for Hepatic and Renal Complication Associated Type 2 Diabetes (*In Vivo* and In Silico-Based Studies). Int. J Mol. Sci. 2023;24:13759.
20. Negri S, Gambini S, Ceoldo S, Avesani L, Commisso M, Guzzo F, *et al*. Undifferentiated *In vitro* Cultured *Actinidia deliciosa* as Cell Factory for the Production of Quercetin Glycosides. Plants (Basel). 2021;10(11):2499.
21. Rafique S, Irshad K, Afsheen N, Riaz R, Meer S, Kausar R, *et al.* Exploring the Effect of *Actinidia deliciosa* Extract for Skin Revitalization. Plant Cell Biotechnol. Mol. Biol. 2022;23(29&30):20-31.
22. Ozden EM, Bingol Z, Mutlu M, Karagecili H, Köksal E, Goren AC, *et al.* Antioxidant, Antiglaucoma, Anticholinergic, and Antidiabetic Effects of Kiwifruit (*Actinidia deliciosa*) Oil: Metabolite Profile Analysis Using LC-HR/MS, GC/MS and GC-FID. Life. 2023;13:1939.
23. Mirmazloomi S, Ghiasi M, Khosravi AR. Chemical composition and *in vitro* antifungal activity of Sambucus ebulus and *Actinidia deliciosa* on the fish pathogenic fungus, *Saprolegnia parasitica*. Aquac. Int. 2022;30:1037-1046.
24. Dhiman VK, Chauhan V, Kanwar SS, Singh D, Pandey H. Purification and characterization of actinidin from *Actinidia deliciosa* and its utilization in inactivation of α-amylase. Bull Natl. Res Cent. 2021;45:213.
25. El Azab EF. Ameliorative Effect of Kiwifruit (*Actinidia deliciosa*) against Lead-Induced Oxidative Stress in Wistar Albino Rats. Pak J Biol. Sci. 2021;24(5):599-611.
26. Vellapandian C, Sukumaran ES, Sivasubramanian LR, Vetrivelan VR. A Comparative Study of *Actinidia deliciosa* and Garcinia mangostana in Ovariectomy-Induced Osteoporosis in Female Wistar Rats. Biomed Res Int. 2017;2017:5349520.
27. Kodasi B, Kamble RR, Manjanna J, Hoolageri SR, Bheemayya L, Nadoni VB, *et al.* Adept green synthesis of Cu2O nanoparticles using Kiwi fruit (*Actinidia deliciosa*) juice and Studies on their cytotoxic activity and antimicrobial evaluation. J Trace Elem Min. 2023;3:100044.
28. Kaur L, Mao B, Bailly J, Oladeji O, Blatchford P, McNabb WC, *et al*. Actinidin in Green and SunGold Kiwifruit Improves Digestion of Alternative Proteins-An *In vitro* Investigation. Foods. 2022;11:2739.
29. Kartheeswari AC, Anupreyaa K, *et al. In vitro* Cytotoxicity and Apoptotic Activity of Aquous, Chloroform and Methanol Extracts of Kiwi Fruit *Actinidia deliciosa* in MCF-7 Cells. J Angiother. 2024;8(2):1-5.
30. Li J, Li Y, Wu H, Naraginti S, Wu Y. Facile synthesis of ZnO nanoparticles by *Actinidia deliciosa* fruit peel extract: Bactericidal, anticancer and detoxification properties. Environ Res. 2021;200:111433.
31. Naraginti S, Li Y. Preliminary investigation of catalytic, antioxidant, anticancer and bactericidal activity of green synthesized silver and gold nanoparticles using *Actinidia deliciosa*. J Photochem. Photobiol. B. 2017;170:225-234.
32. El Azab EF, Mostafa HS. Phytochemical analysis and antioxidant defense of kiwifruit (*Actinidia deliciosa*) against pancreatic cancer and AAPH-induced RBCs hemolysis. Food Sci. Technol. 2021;42(1):1-10.
33. Chandani SR, Lokhande KB, Swamy KV, Nanda RK, Chitlange SS. Data on docking of phytoconstituents of *Actinidia deliciosa* on dengue viral targets. Data Brief. 2019;25:103996.