World Journal of Science and Research. 9 (2): 26-44 (2024)

ISSN: 2455 2208

SJIF: 4.622

SJIF: 4.622

Available online at http://www.harmanpublications.com

World Journal of Science and Research

Article **Chemistry**

IMPACT OF DIFFERENT CONCENTRATION OF AQUEOUS EXTRACT OF FRUITS PEEL AND SILVER NANOPARTICLES ON SEED GERMINATION, GROWTH PERFORMANCE AND BIOCHEMICAL CONTENT IN GREEN GRAM

A. John Britto and Dr. P. Sahaya Amutha
PG & Research Department of Chemistry, Government Arts College (Affiliated to Bharathidasan University), Tiruchirappalli – 620022, Tamil Nadu, India

Received on 15th May. 2024; Revised on 29th May. 2024 Online 18th June. 2024

ABSTRACT

The phytochemical screening of extract showed that the presence of tannin, saponins, flavonoids, steroids, polyphenol, anthroquinones, glycosides, terpenoids, alkaloids and coumarins was presence in fruit peels aqueous extract. Significant amount of total content of phenols and flavonoids were present in the fruit peels. Aqueous fruit peels extract was used to synthesis silver nanoparticles. The silver nitrate solution was incubated with fruit peels extract to formation of brown colour after 5 hrs whereas silver nitrate solution without fruit peels extract showed no colour change was observed. These environmentally benign silver nanoparticles were further confirmed by UV visible and FTIR spectrum. The size of the nanoparticle range 12 to 56nm with spherical shape was confirmed by SEM studies. A significant effect of aqueous fruit peels extract and AgNPs showed throughout the growing period in green gram. Green gram found to be maximum seed germination, growth performance and biochemical content with the treatment of 2% of aqueous fruit peels extract and AgNPs while in case of 1% and 3% were significantly decreased compare with 2%, Overall, 2% AgNPs treatment ware significantly increased compared with fruit peels extract. Among the aqueous extract of fruit peels and AgNPs treatment, silver nanoparticles treated crop has potential seed germination, growth performance and biochemical content were observed than fruit peels extract treated and control group. Overall, It can be demonstrated the different concentrations silver nanoparticles using fruit peels extract showed the. Significant effects on seed germination, growth performance and biochemical content. Among various concentrations used in the study, 2% AgNPs was the most effective treatment for the improvement in seed germination, growth and biochemical parameters studied. The impacts of ecofriendly and bio-based AgNPs is the alternative for synthetic fertilizer.

Keywords: Fruit peel, Phytochemicals, Silver nanoparticles, Green gram, Seed germination, Growth performance and Biochemical content.

Citation: A. John Britto and P. Sahaya Amutha. (2024) Impact of different concentration of aqueous extract of fruits peel and silver nanoparticles on seed germination, growth performance and biochemical content in green gram. World Journal of Science and Research. 9 (2): 26-44.

INTRODUCTION

Agriculture was practiced for thousands of years without using any artificial chemicals. Soil management practices have recently increased the use of chemical fertilizers to help crop yields by improving nutrient supply. Use of these agrochemicals not only causes the degradation of cultivable land but also increases agricultural pollution. In order to overcome this situation, organic farming is the only solution in which only natural resources such as organic matter, plant and animal wastes and microbes are implied. Use of organic manures has improved soil fertility and helps in combating pest and disease problems. The awareness of environment and food safety issues is responsible for the development of organic farming in the recent years Over the last few years, agricultural waste has been used as organic fertilizer. (Masarirambi *et al.*, 2010; Wazir *et al.*, 2018).

Fertilizers are used in agriculture to enhance the natural fertility of soil. The high concentrations of organic matter and nutrient contents of food waste can be used as organic fertilizer for agricultural purpose. Natural fertilizer possesses little to no risk of toxic build ups while chemical fertilizers are hazardous. The method was developed due to fact that chemical fertilizers are hazardous for plant growth, human health and environment. Organic fertilizers are natural fertilizers that are made up from animals, plants and minerals. They are crucial in agricultural sector because they have positive effect on soil without damaging plants. Plant wastes can be converted to compost, which is a rich source of nutrient-rich organic material, and then absorbed by plants for fertilization, obtaining natural organic components.

Nanotechnology is the most advanced field in agriculture and is tremendous scientific interest globally. The definition of nanotechnology states that the nanoscale is the smallest particle ranging from 1 to 100 nm in size. The significance of metallic nanoparticles is very high in several fields. AgNPs have been a primary focus for researchers due to their unique biological, chemical, and physical properties. AgNPs are crucial in the bio-system that are well studied and utilized. It has a broad spectrum of anti-microbial activities and strong bactericidal/inhibitory effects. AgNPs are the most important in agriculture that involves in enhancing seeds germination and plant growth. Several applications of AgNPs including: Nano-pesticides, Nano-fertilizers, food packaging, pest management, crops, and food protection (nano-antibacterial, nano-antifungal, and nano-antiviral agents) (Salama *et al.*, 2021; Khan *et al.*, 2023). In the present study was to undertaken to investigate the effects of different concentration of (1%, 2% and 3%) aqueous extract of fruits peel (Pineapple (*Ananas comosus*), Orange (*Citrus sinensis*), Pomegranate (*Punica granatum*) and Banana *(Musa acuminata*) and AgNPs on seed germination, growth performance and biochemical content in green gram.

MATERIALS AND METHODS

Collection of plant materials

The Peel of fruit such as Pineapple *(Ananas comosus),* Orange *(Citrus × sinensis),* Pomegranate *(Punica granatum),* Banana *(Musa acuminata)* were collected in December 2024 from Tirchy, Tamil Nadu, India (Plate 1).

Preparation of nutrient supplementation

Pineapple, Orange, Pomegranate, Banana peels nutrient supplementation was preparation ratio as (1:1:1:1 w/w). The prepared nutrient supplementation where further experiment study was used.

Pineapple peel

Orange peel

Pomegranate peel Banana peel

Plate.1: Preparation of Nutrient supplementation raw materials

Preparation for extract

Take one gram of nutrient supplementation peels powder in the extract prepared in 50 ml of aqueous solvent, the extract shake it well for 30 minutes by free hand and wait for 24 hours. After extracts were filtered using whatman filter paper No.1 and filtrate used for further analysis.

Phytochemical screening

Chemical tests were carried out on the extract using standard procedures to identify the constituents as described by Sofowara (1993), Trease and Evans (1989) and Harborne (1973 and 1984). Determination of total phenols by spectrophotometric method by Edeoga *et al.*, (2005). Flavonoid determine by the method of Boham and Kocipai-Abyazan (1994)

Synthesis of silver nanoparticles from nutrient supplementation peels

Preparation of extract

The dried powder of Pineapple, Orange, Pomegranate, Banana peels (1:1:1:1 w/w) were well with mortar and pestle to make a powder. Twenty grams of peels powder was mixed into one hundred mille liter of deionized water and therefore the mixture was boiled for ten minutes. Once cooling the peels extract was filtered with Whatman No. one paper. The filtrate was hold on at 4◦C for synthesis of nanoparticles.

Silver nanoparticles synthesis using peels extract

For the Ag nanoparticles synthesis, 5 ml of peels extract was added to 45 ml of 1 mM aqueous $AgNO_3$ solution in a 250 ml Erlenmeyer flask. The flask was then incubated in the dark at 5hrs (to minimize the photo activation of silver nitrate), at room temperature. A control setup was also maintained without flower extract. The Ag nanoparticle solution thus obtained was purified by repeated centrifugation at 10,000 rpm for 15 min followed by re-dispersion of the pellet in de-ionized water. Then the Ag nanoparticles were freeze dried using SEM analysis (Arunachalam *et al.*, 2012).

Characterization of silver nanoparticles from peels extract

UV-Visible and FTIR Spectroscopic analysis

The silver nanoparticles were examined under UV and visible spectrophotometer analysis, The silver nanoparticles were scanned in the wavelength ranging from 200-800 nm using Perkin Elmer Spectrophotometer and the characteristic peaks were detected. FTIR analysis was performed using Spectrophotometer system, which was used to detect the characteristic peaks in ranging from 400-4000 cm^{-1} and their functional groups. The peak values of the UV and FTIR were recorded. Each and every analysis was repeated twice for the spectrum confirmation.

Scanning Electron Microscope (SEM)

In this research work, Jeol JSM-6480 LV SEM machine was used to characterize mean particle size and morphology of nanoparticles. The freeze dried sample of AgNPs solution was sonicated with distilled water and small drop of this sample was placed on glass slide and allowed to dry. A thin layer of platinum was coated to make the samples conductive. Jeol JSM-6480 LV SEM machine was operated at a vacuum of the order of 10-5torr. The accelerating voltage of the microscope was kept in the range 10-20kV.

Experimental design

Group I : Control (Without extract)

Group II : Prepare 1% of aqueous extract and AgNPs separately

Group III : Prepare 2% of aqueous extract and AgNPs separately

Group IV : Prepare 3% of aqueous extract and AgNPs separately

Set up for the Investigation of green gram

For each treatment, 10 seeds of green gram (*Vigna radiata*) of each selected grams were placed separately in different pots containing equal amount of dried, well mixed sandy loam soil. Then 20 ml of different concentrations (1%, 2% and 3%) (Plate 2) of each aqueous extracts and AgNPs were applied in each pot in morning and evening respectively while only distilled water was used as control treatment (Plate 4). Before seeding the green gram seeds were activated by water soaking for better growth (Plate 3). All the treatments were replicated for three times. 20 ml of distilled water was applied in each pot per day as irrigation. (Talukder *et al.*, 2015).

1% 2% 3%

AgNPs

1% 2% 3%

Aqueous extract

Plate 2 Preparation of different concentration of fruit peels aqueous extract and AgNPs

Plate 3 Many species of dormant seeds benefit from 1 to 4 hours of water soaking before sowing to fully imbibe seeds and remove any chemical inhibitors within the seeds or on the seed coats

Group I **Group II** **Group III** **Group IV**

Before seeding

Plate 1: Experimental design

Growth Parameters

The growth parameters of the green gram (*Vigna radiata*) were assessed by taking their total height of plant, leaf length, leaf width, stem length at measured every 5 days upto 15 days.

Proximate composition estimation

Plant homogenate

The 1g of plant materials (Leaves and Stem) was weighed and homogenized using a Teflon homogenizer. homogenate was prepared in 0.1 M Tris Hcl buffer (pH 7.4) and used for the estimation of various biochemical parameters.

Proximate composition

Protein was estimated by the method of Lowry *et al.* (1951). Carbohydrate present in fish tissues was quantified using Anthrone method. Amino acid in tissues were estimated by the method of Rosen (1957).

Statistical Analysis

Tests were carried out in triplicate for 3 separate experiments. The result was graphically determined by a linear regression method using Ms- Windows based graphpad Instat (version 3) software. Results were expressed as graphically and mean ± standard deviation.

RESULTS AND DISCUSSION

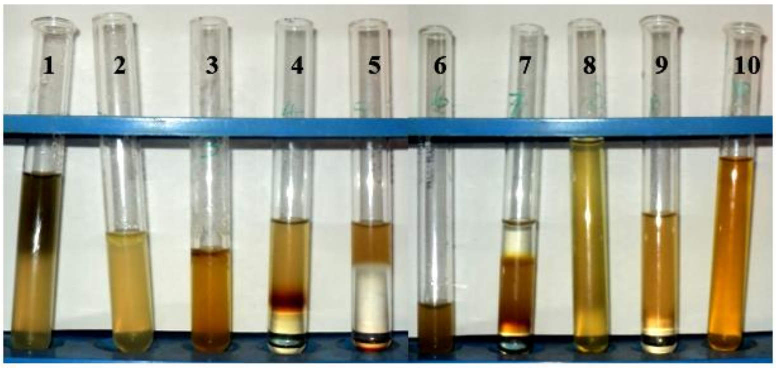
Qualitative analysis of prepared nutrient supplementation extract

The phytochemical characters of the prepared fruit peels extract investigated and summarized in Table 1 and Plate 2. The phytochemical screening of extract showed that the presence of tannin, saponins, flavonoids, steroids, polyphenol, anthroquinones, glycosides, terpenoids, alkaloids and coumarins was presence in aqueous extract following on table 1.

Table.1: Qualitative analysis of phytochemicals in nutrient supplementation peels extract

S. No	Phytochemicals	Results
1	Tannin	+
2	Saponin	+
3	Flavonoids	++
4	Steroids	+
5	Terpenoids	+
6	Alkaloids	+
7	Antroquinone	+
8	Polyphenol	++
9	Glycoside	+
10	Coumarins	++

(+) Presence, (++) High concentrations and (–) Absences



(1. Tannin, 2. Saponin, 3. Flavonoids, 4. Steroids, 5. Terpenoids, 6. Alkaloids, 7. Anthroquinone, 8. Polyphenol, 9. Glycoside and 10. Coumarins)

Plate 2: Qualitative analysis of phytochemicals in nutrient supplementation peels extract

Quantitative phytochemical analysis

The present study was performed to evaluate the total content of phenols and flavonoids in nutrient supplementation peels extract. The highest amount present in the phenol followed by flavonoids. Table 2 represent the quantitative analysis of phytochemicals in fruit peels extract.

Table 2: Quantitative phytochemical analysis of nutrient supplementation peels extract

S. No	Phytochemicals	Results (mg/gm)
1	Flavonoids	10.00±0.07
2	Total phenol	272.30±1.90

Values are expressed as mean ± SD for triplicates

Hassain *et al.*, (2011) screened phytochemical constituents from methanol leaf extract of *Bombax malabaricum*. Various organic 11 solvent extracts of *Pedalium murex* were subjected to preliminary phytochemical screenings by Thamizh mozhi *et al.* (2011). Selected 53 traditionally used medicinal plants from western region of India for their qualitative phytochemical screenings, total phenol and flavonoids contents. Jeruto *et al.*, (2011) screened phytochemical constituents of some medicinal plants used by the Nandis of South Nandi District, Kenya.

Kumar *et al*., (2013) investigated the preliminary phytochemical screening of the leaves of the plant *Lasia spinosa* (Lour) Thwaites. The phytochemical screening showed that the methanol and aqueous extracts contained alkaloid, the carbohydrates and the phenolic compounds were present in all of the solvent extract except petroleum ether extract. The chloroform, ethyl acetate and the aqueous extract contained glycosides whereas the saponins present in methanol and aqueous extract. The ethyl acetate extract contain only the flavonoids.

Leo Stanley *et al.* (2011) reported that leaves of *C. pedata* showed the presence of alkaloids, carbohydrates, steroids, tannin, phenolic compounds, flavonoids and terpenoids. Dinesh kumar *et al.,* (2011) has been reported to terpenoids, flavonoids and tannin are present in *C. trifolia.* Rajmohanan *et al.,* (2014) investigated the preliminary phytochemical analysis of various extracts of leaves of *C. pedata* and showed the presence of carbohydrates, flavonoids, tannins and phenolic compounds and terpenes.

Synthesis of Silver nanoparticles

Nanoparticle research is currently an area of intense scientific interest due to a wide variety of potential applications in electronics, energy, medicine and life sciences. Nanoparticles of noble metals, such as gold, silver, and platinum, are widely applied in products that directly come in contact with the human body. Therefore, there is a growing need to develop ecofriendly processes for nanoparticle synthesis without using toxic chemicals. The medicinal value of the chosen fruit peels such as Pineapple, Orange, Pomegranate, Banana (1:1:1:1 w/w) has not been extensively worked out. Therefore, the present study was to investigate the synthesis, characterization and evaluation of biological activities of silver nanoparticles from peels extract.

Aqueous peels extract was used to synthesis silver nanoparticles. The silver nitrate solution was incubated with fruit peels extract to formation of brown colour after 5 hrs. whereas silver nitrate solution without fruit peels extract showed no colour change was observed. The presence of brown colour in fruit peels extract is a clear indication for silver nanoparticles formation (Plate 3).

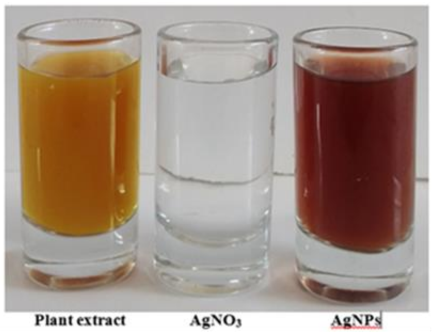


Plate 3 Synthesis of sllver nanoparticles confirmed by brown colour formation

Nanotechnology is a broad interdisciplinary area of research, development and industrial activity which has grown very rapidly all over the world for the past decade. It plays a vital role in technologies of new millennium. Nanomaterials may provide solutions to technological and environmental challenges in the areas of solar energy conversion, catalysis, medicine and water treatment (Reza Ghorbani *et al*., 2011).

In the present study, silver nitrate incubated with leaf extract showed a color change from yellow to brown after 5 hrs. The appearance of brown color in peels extract treated flask is clear indication for the formation of Ag nanoparticles. Our findings are in concordance with Rafi Shaik *et al.*, (2018) which have been reported that the formation of brown colour when the reaction mixture of 1mM silver nitrate solution with *Origanum vulgare* extract.

Characterization of AgNPs

Characterization of nanoparticles is important to understand and control nanoparticles synthesis and applications. Characterization is performed using a variety of different techniques such as Fourier transform infrared spectroscopy (FTIR), UV–Vis spectroscopy and scanning electron microscopy (SEM) (Michael Ndikau *et al*., 2017; Kero Jemal *et al*., 2017).

Ultra violet and visible spectrometric analysis

It is generally recognized that UV–Vis spectroscopy could be used to examine size and shape-controlled nanoparticles in aqueous suspensions. Figure 1 shows the UV-Vis spectra recorded from the reaction medium after 5 hours. In the UV–Vis spectra of the reaction mixture of silver nitrate solution with peels extract the peak was observed at 420nm indicating the presence of silver nanoparticles which is synthesized by peels extract. The peak was raised due to the effect of surface plasmon resonance of electrons in the reaction mixture and the broadening of peak indicated that the particles are polydispersed. Appearance of this peak indicated that the surface plasmon is well-documented for numerous metal nanoparticles with size starting from 2nm to a 100nm (Henglein, 1993).

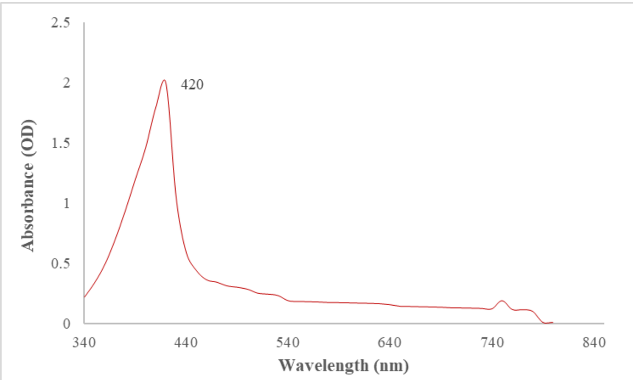


Figure 1: UV-Vis. analysis of AgNPs synthesis using peels extract

It is generally doc umented that UV–Visible spectroscopy might be used to analyze size and shape of nanoparticles in aqueous suspensions. In order to verify the synthesis of AgNPs, the test samples were subjected to UV–Vis spectrophotometric analysis. Spectrophotometric absorption measurement in the wavelength ranging from 400 to 450 nm is used to characterize AgNPs (Mittal *et al*., 2013; Mittal *et al*., 2014). In the present study the analysis of AgNPs showed the sharp absorbance at around 420nm, which was specific for AgNPs. The UV–Vis absorption band in the current visible light region (380–460 nm) is an evidence for the presence of surface plasmon resonance (SPR) of silver nanoparticles and is well-documented for various metal nanoparticles with size within 100 nm (Bonde *et al*., 2012).

Fourier Transform Infra-Red spectral analysis of AgNPs

FTIR spectrum of silver nanoparticles was scanned to identify the probable biomolecules responsible for efficient stabilization and capping of the silver nanoparticles synthesized by peels extract. The peaks observed (Figure 2) for phytochemicals capped silver nanoparticles formed through reduction by silver nanoparticles at 3227.92cm^{-1} indicates alcohol and phenol group, 1641.61cm^{-1} indicates alkenes group, 1263.68cm $^{-1}$ indicates aromatic amines group, 1187.09cm $^{-1}$ indicates aliphatic amines, 705.63cm $^{-1}$

indicates aromatics group and 598.87cm $^{-1}$ indicates alkyl halides suggest the presence of flavonoids and phenols adsorbed on the surface of silver nanoparticles. The results of FTIR analysis evidenced the presence of phenol, alcohol, alkenes, carboxylic acid, aromatics and aliphatic amines compounds.

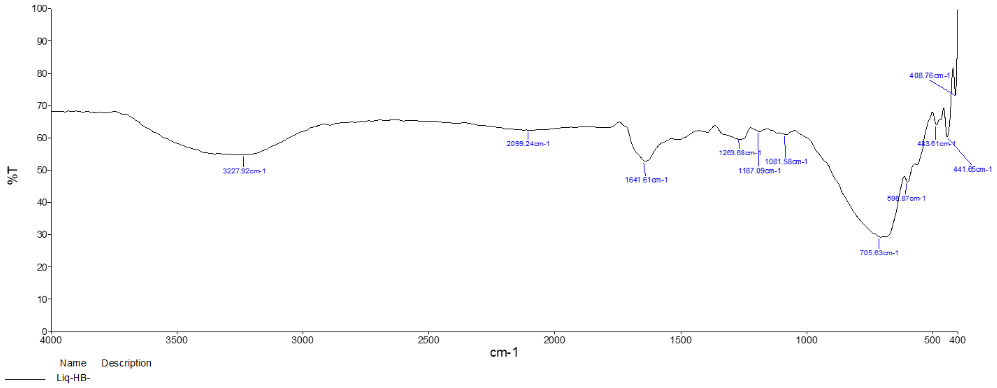


Figure 2: FTIR analysis of AgNPs synthesis from *fruit* peels extract

FTIR measurements are carried out to identify the possible biomolecules responsible for reduction, capping and efficient stabilization of AgNPs and the local molecular environment of the capping agents on the nanoparticle (Chanda, 2013). The analysis of IR spectrum also provided an idea about biomolecules bearing different functionalities which are present in the underlying system. The peaks observed for Ag nanoparticles formed through reduction by *Leucas aspera* suggest the presence of flavonoids and phenols adsorbed on the surface of Ag nanoparticles. FTIR analysis of AgNPs showed the presence of alcohols, phenols, alkenes, alcohols, carboxylic acids, aliphatic amines and aromatics compounds. This suggests the attachment of some polyphenolic components on to silver nanoparticles.

The studies reveals that extracellular synthesis using plant extracts has been considered better as compared to intracellular synthesis (Makarov *et al*., 2014) because it eliminates the extraction and purification procedures. Biosynthesis of AgNPs by plant extracts such as neem (Tripathy *et al*., 2010).

Scanning Electron Microscope (SEM) analysis of AgNPs

SEM analysis was carried out to understand the topology and the size of AgNPs, which showed the synthesis of higher density polydispersed spherical AgNPs of various sizes that ranged from 12.65 to 56.47nm respectively as well cubic and crystalline nature of the nanoparticles. Most of the nanoparticles gathered and only a little of them were dispersed, when observed under SEM (Plate 4). Overall Particle size of AgNPs were highly distributed between 20nm to 80nm range which is the evidence that the NPs synthesized less than 100nm (NPs < 100nm).

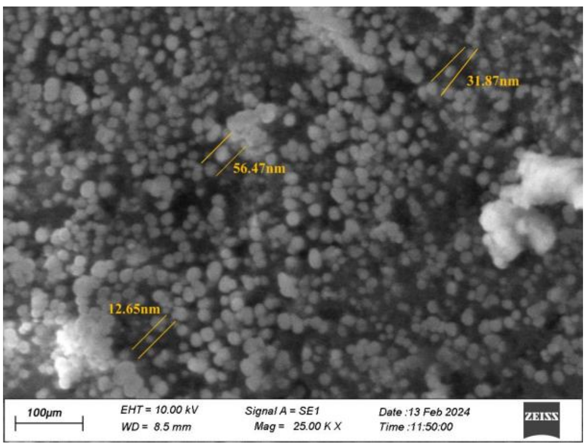


Plate 4: Scanning Electron Microscope (SEM) analysis of AgNPs

The presences of biomolecules in the leaf extract has resulted in the synthesis of spherical silver nanoparticles and the aggregation may be due to the presence of secondary metabolites in the leaf extract. SEM analysis of the AgNPs showed the synthesis of higher density polydispersed AgNPs of various sizes. One should note that SEM images were made by attaching a single drop of the nanoparticle solution onto a carbon film. Hence the single drop used for each sample cannot fully represent the entire solution. It is observed that most of the AgNPs were of various spherical shapes, which fall closer to many of the silver nanoparticles produced by other plant materials (Shankar *et al*., 2004; Huang *et al*., 2007).

Effects of aqueous extracts and AgNPs on growth performance of green gram (*Vigna radiata*)

Plants are reservoir of different types of natural occurring bio-organic compounds having a wide range of biological activities. Different parts of plants and their extracts have been used for various purposes since long time ago due to their chemical properties, availability, and simple use without side effects. Certain plant extracts found to have cytotoxic effects (Asadujjaman *et al.*, 2004), some showed antioxidant properties (Shah *et al.,* 2014) while a group of plant species effectively showed biological activities (Tekwu *et al.,* 2012) and reduced plant diseases like damping-off and wilt (Abdel-Monaim *et al.,* 2011). Some investigations have also reported Bio-insecticidal effects of plant extracts from certain species (Jbilou *et al.,* 2008). Organic fertilizers are naturally available mineral sources that contain moderate amount of plant essential nutrients. They are capable of mitigating problems associated with synthetic fertilizers. They reduce the necessity of repeated application of synthetic fertilizers to maintain soil fertility.

Spraying different concentrations (1%, 2% and 3%) of aqueous extract and AgNPs to green gram showed that increased seed germination of green gram compared with the control plant. Table 3 represent the effect of different concentrations of prepared fruit peels aqueous extract, AgNPs and control on seed germination in green gram (*Vigna radiata*).

The higher seed germination was observed in 2% concentration of treatment of fruit peels aqueous extract and AgNPs as compared to 1 and 3% treated and control groups. The overall present study of fruit peels extract and AgNPs were stimulate the seed germination in green gram (*Vigna radiata*) based on the concentration-dependent and high concentration was a negative effect on seed germination compared with low dose. Among the different concentrations (1%, 2% and 3%) of aqueous extract and AgNPs treatment, 2% concentration of aqueous extract and AgNPs treated crop has probable seed germination was observed than fruit peels extract treated and control group. Among the aqueous extract of fruit peels and AgNPs treatment, silver nanoparticles treated crop has potential seed germination was observed than fruit peels extract treated and control group.

Seed germination provides a suitable foundation for plant growth, development, and yield (Siddiqui and Al-Whaibi 2014). AgNPs are currently the most produced engineered nanomaterials found in a wide range of commercial products (Davies 2009). AgNPs have been implicated in agriculture for improving crops. There are several reports indicating that appropriate concentrations of AgNPs play an important role in enhancing seed germination (Shelar and Chavan 2015). Recently, Krishnaraj et al. (2012) found that biosynthesized AgNPs showed a significant effect on seed germination

Table 3: Influence of nutrient supplementation fruit peels extract and AgNPs concentrations on seed germination for green gram (*Vigna radiata*) plants

Concentration	Seed germination (n = 10) / Day									
	Nutrient Supplementation Peels Extract					Fruit peels mediated AgNPs				
	3rd Day	4th Day	5th Day	6th Day	7th Day	3rd Day	4th Day	5th Day	6th Day	7th Day
Control	Nil	Nil	4	5	8	Nil	Nil	4	5	8
1%	Nil	Nil	4	7	8	Nil	3	7	7	9
2%	Nil	Nil	**5**	**9**	**9**	**2**	**6**	**8**	**9**	**10**
3%	Nil	Nil	1	3	5	Nil	2	4	5	7

Present study was undertaken to observe the effects of aqueous extracts of fruit peel viz. Peel of fruit such as Pineapple *(Ananas comosus)*, Orange *(Citrus × sinensis)*, Pomegranate *(Punica granatum)*, Banana *(Musa acuminata)* and fruit peels mediated AgNPs on the effect of growth (Table 4), and proximate content (Table 5a to 5c) of green gram (*Vigna radiata*). They gradually release nutrients into the soil solution and maintain nutrient balance for healthy growth of crop plants.

Spraying different concentrations (1%, 2% and 3%) of aqueous extract and AgNPs to green gram showed that increased leaf length, width, stem length and plant height in green gram compared with the control plant. Table 4 represent the effect of different concentrations of prepared fruit peels aqueous extract, AgNPs and control on leaf length, width, stem length and plant height in green gram (*Vigna radiata*).

The greater leaf length and width were observed in 2% concentration of treatment of fruit peels aqueous extract and AgNPs as compared to 1 and 3% treated and control groups. The higher stem length was observed in 2% concentration of treatment of fruit peels aqueous extract and AgNPs as compared to 1 and 3% treated and control groups. The better plant height was observed in 2% concentration of treatment of fruit peels aqueous extract and AgNPs as compared to 1 and 3% treated and control groups. The overall present study of fruit peels extract and AgNPs were stimulate the green gram (*Vigna radiata*) plants' growth with concentration-dependent and high concentration was a negative effect on plant growth compared with low dose. Among the different concentrations (1%, 2% and 3%) of aqueous extract and AgNPs treatment, 2% concentration of aqueous extract and AgNPs treated crop has probable growth performance was observed than fruit peels extract treated and control group. Among the aqueous extract of fruit peels and AgNPs treatment, silver nanoparticles treated crop has potential growth performance was observed than fruit peels extract treated and control group.

Silver is an excellent growth simulator (Sharon *et al*. 2010). Similar results of improving the role of AgNP treatments were obtained on mung bean by Najafi and Jamei (2014) and Razzaq et al. (2016) on wheat plant. These increases in growth parameters of AgNPs treated to green gram plant is observed in this study.

Secondary metabolites, commonly referred to as natural products, are produced by living organisms and usually have pharmacological or biological activities. Secondary metabolites are the primary source for the discovery of new drugs. Although secondary metabolites are mainly used by their beneficial biological activity, the toxicity of some of them may limit their use **(**Madariaga *et al.*, 2019**)**. They also act as an effective energy source of soil microbes which in turn improve soil structure and crop growth. Organic fertilizers are generally thought to be slow releasing fertilizers and they contain many trace elements. They are safer alternatives to chemical fertilizers.

Table 4: Effect of different concentrations of nutrient supplementation fruit peels extract and AgNPs on leaf length, width, stem length plant height in green gram (*Vigna radiata*).

Concentration	5th Day							
	Nutrient Supplementation Peels Extract				Fruit peels mediated AgNPs			
	Stem length (mm)	Leaf length (mm)	Leaf width (mm)	Plant height (mm)	Stem length (mm)	Leaf length (mm)	Leaf width (mm)	Plant height (mm)
Control	0.22±0.01	0.25±0.01	0.10±0.01	0.33±0.02	0.22±0.01	0.25±0.01	0.10±0.01	0.33±0.02
1%	1.30±0.02	0.47±0.03	0.13±0.01	1.48±0.02	9.58±0.06	2.50±0.03	0.69±0.02	10.08±0.07
2%	**2.65±0.03**	**1.31±0.02**	**0.15±0.02**	**2.91±0.03**	**9.92±0.06**	**3.25±0.03**	**0.85±0.03**	**10.60±0.07**
3%	0.58±0.01	0.33±0.02	0.11±0.01	0.66±0.04	8.03±0.05	2.11±0.02	0.67±0.02	8.02±0.05
	10th Day							
	Nutrient Supplementation Peels Extract				Fruit peels mediated AgNPs			
Control	5.27±0.03	2.80±0.01	0.69±0.01	5.43±0.03	5.27±0.03	2.80±0.01	0.69±0.01	5.43±0.03
1%	6.60±0.04	2.40±0.01	0.83±0.02	6.23±0.04	12.10±0.08	2.90±0.01	1.10±0.01	12.48±0.08
2%	**8.31±0.05**	**3.48±0.02**	**0.98±0.02**	**8.49±0.05**	**13.90±0.09**	**4.00±0.02**	**1.60±0.02**	**13.50±0.09**
3%	5.10±0.03	1.69±0.01	0.57±0.01	5.26±0.03	10.19±0.07	2.69±0.01	0.80±0.01	11.02±0.07
	15th Day							
	Nutrient Supplementation Peels Extract				Fruit peels mediated AgNPs			
Control	9.60±0.06	3.20±0.02	1.01±0.01	10.90±0.08	9.60±0.06	3.20±0.02	1.01±0.01	10.90±0.08
1%	11.40±0.08	2.85±0.01	1.03±0.01	11.70±0.08	14.80±0.10	4.34±0.02	2.46±0.01	14.30±0.10
2%	**12.90±0.09**	**4.40±0.03**	**1.19±0.02**	**13.10±0.09**	**15.10±0.11**	**5.15±0.03**	**3.96±0.02**	**15.17±0.11**
3%	12.02±0.08	3.10±0.02	0.97±0.01	12.10±0.09	13.93±0.09	3.98±0.02	1.08±0.01	13.36±0.06

Values were expressed as mean ± SD

5th day 10th day 15th day

5th day

1% 2% 3%

10th day

1% 2% 3%

15th day

1% 2% 3%

Plate 5: Effects of aqueous extract of fruit peel on growth performance in green gram

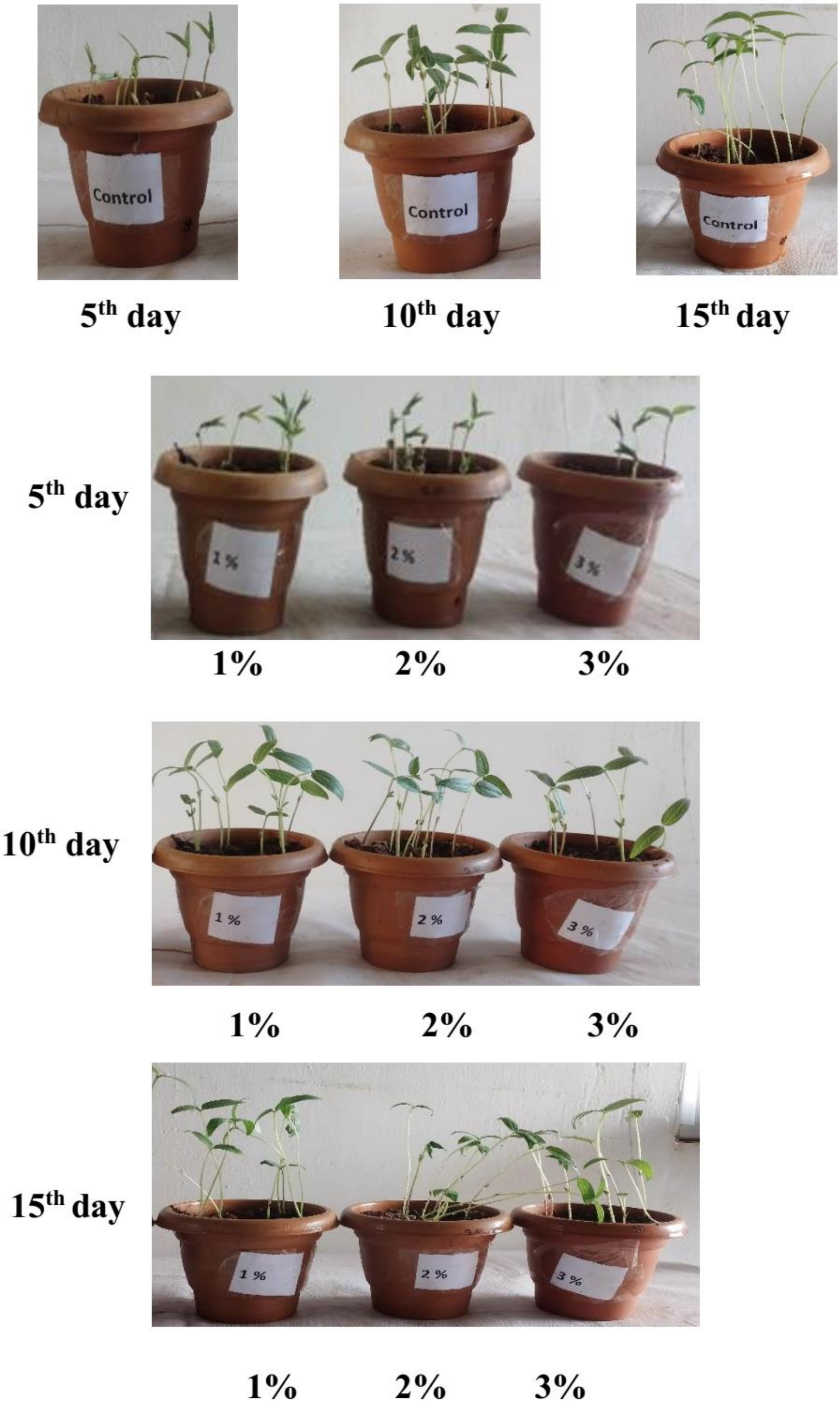


Plate 6: Effects of AgNPs on growth performance in green gram

Carbohydrates are a group of organic compounds including sugars, starches and fiber which is a major source of energy for animals. The protein of crab has a high biological value with its growth promoting capability. Table 5a to 5a shows Proximate content of aqueous fruit peels extract and AgNPs on green gram (*Vigna radiata*).

In the present study was to investigate the proximate content of different concentrations (1, 2 and 3%) of fruit peels extract and AgNPs treated to green gram. The increased biochemical content in 5th, 10th and 15th days as compared with control. Among the various concentrations, 2% of fruit peels extract and AgNPs treated group has significant biochemical content was observed as compared with 1 and 3% of concentration. The overall present study of fruit peels extract and AgNPs were stimulate the green gram (*Vigna radiata*) plants' growth with concentration-dependent and high concentration was a negative effect on proximate content compared with low dose. The Fruit peels mediated AgNPs has potential proximate content than fruit peels aqueous extract. Table 5s, b and c demonstrates that AgNP treatment of green gram plant led to marked increases in total carbohydrates, protein and amino acids when compared with control plants; these increases reached maximum levels at 2% AgNPs treatment group. Among the aqueous extract of fruit peels and AgNPs treatment, silver nanoparticles treated crop has increased biochemical content was observed than fruit peels extract treated and control group.

Recently, Krishnaraj *et al*. (2012) found that biosynthesized AgNPs showed a significant induced the synthesis of protein and carbohydrate and protein contents of *Bacopa monnieri*. AgNPs increased plants' growth profile and biochemical attributes (chlorophyll, carbohydrate and protein contents, antioxidant enzymes) of *Brassica juncea*, common bean, and corn (Sharma *et al*. 2012). The impact of AgNPs on the morphology and physiology of plants depends on the size and shape of NPs.

Table 5a: Proximate content analysis of effects of aqueous fruit peels extract and AgNPs on green gram (*Vigna radiata*)

Concentration	Protein(mg/gm)	
	Fruit peels extract	AgNPs
Control	206.09±1.44	206.09±1.44
1%	236.17±1.65	391.80±2.74
2%	277.52±1.94	436.92±3.05
3%	194.81±1.36	200.13±1.40

Values were expressed as mean ± SD

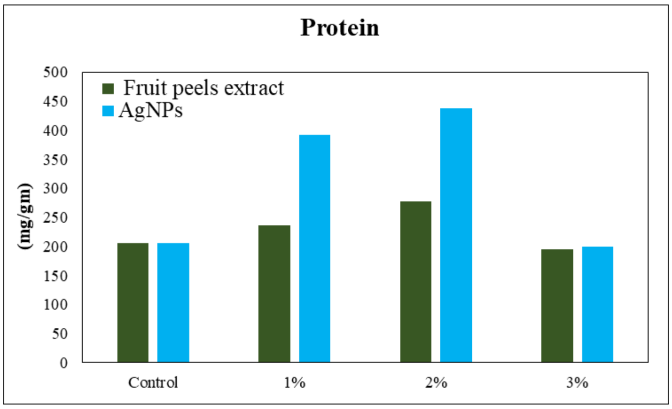


Figure 3a: Proximate content analysis of effects of aqueous fruit peels extract and AgNPs on green gram (*Vigna radiata*)

Table 5b: Proximate content analysis of effects of aqueous fruit peels extract and AgNPs on green gram (*Vigna radiata*)

Concentration	Carbohydrate (mg/gm)	
	Fruit peels extract	**AgNPs**
Control	3.74±0.02	3.74±0.02
1%	7.22±0.05	7.55±0.05
2%	8.60±0.06	9.63±0.06
3%	3.82±0.02	6.34±0.04

Values were expressed as mean ± SD

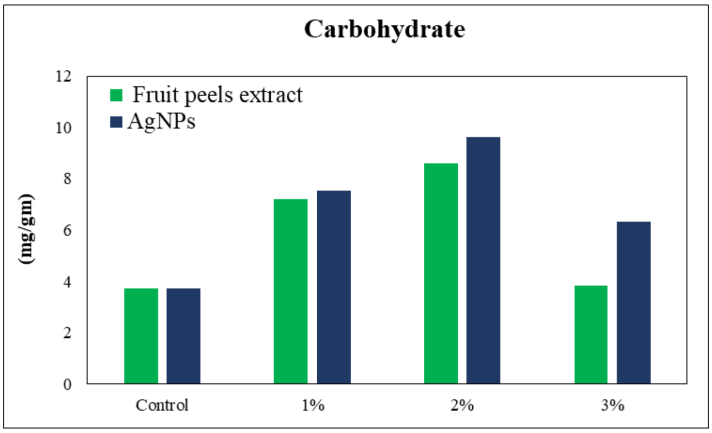


Figure 3b: Proximate content analysis of effects of aqueous fruit peels extract and AgNPs on green gram (*Vigna radiata*)

Table 5c: Proximate content analysis of effects of aqueous fruit peels extract and AgNPs on green gram (*Vigna radiata*)

Concentration	Amino acid (mg/gm)	
	Fruit peels extract	**AgNPs**
Control	368.64±2.58	368.64±2.58
1%	550.45±3.85	216.36±1.51
2%	748.18±5.23	239.09±1.67
3%	316.36±2.21	143.64±1.00

Values were expressed as mean ± SD

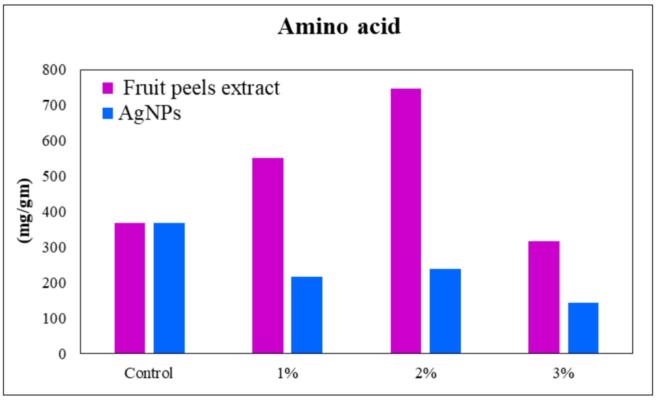


Figure 3c: Proximate content analysis of effects of aqueous fruit peels extract and AgNPs on green gram (*Vigna radiata*)

Organic fertilizers are effective in promoting environmental sustainability and plant growth after long-term use. Specialized horticultural production has fostered the emergence of new liquid organic fertilizers (Pichyangkura and Chadchawan, 2015), which have usually been derived from natural products and their biological activities occur at limited doses. Compared with conventional organic fertilizer, the abundant organic matter and soluble nutrients in the liquid organic fertilizers could maintain soil sustainability and plant health (Hou *et al.*, 2007). In addition, the integration of watering and fertilization patterns could improve the nutrient use efficiency and decrease the risk of nutrient loss (Ceretta *et al.*, 2010).

Moreover, the special compounds in liquid organic fertilizers, such as chitin, humic and fulvic acids, and other biopolymers, can be biostimulants to plants (Tang *et al.*, 2013). Canfora *et al.*, (2015) reported that liquid organic fertilizers containing stillage and vermicompost promoted the root growth of tomato and improved the soil microbial communities Eubacterial and Archaeal diversity, and this was in accordance with the results of liquid residues from lipopeptide production that could promote tomato growth and increase the diversity of the soil's microbial community, as well as the related enzyme activities and nutrient cycles (Zhu *et al.*, 2013). Given the ecological and economic benefits of liquid organic fertilizer, evaluating plant growth under organic versus chemical fertilizer use and studying the possible mechanisms of action are promising steps in developing an effective alternative fertilizer for chrysanthemum production (Martinez-Alcantara *et al.*, 2016). Similarly our study green gram (*Vigna radiata*) plant increase of AgNPs exposed plant while increase of biochemical contents.

Crushed eggshell fertilizer is simply made by crushing eggshell and put them on the soil. The eggshell under soil would be degraded in the purpose of releasing nutrients for plants. These nutrients in liquid form can be sprayed on leaves. This way, the nutrients can be absorbed directly by plants through leaves. The advantage of using eggshell fertilizer relies on its application. The spraying process makes it easier for plants to absorb the nutrients (Ji *et al.*, 2017).

CONCLUSION

Nanotechnology is an emerging field of science that mainly deals with nanomaterials to overcome size limitations and change the world perspective on science. It has revolutionized agriculture sectors and played essential roles in various fields like agricultural, food security, and crop production. AgNPs have distinct characteristics and broad range of applications, particularly in agriculture. In the present study to investigate the effects of different concentration of (1%, 2% and 3%) aqueous extract of fruits peel (Pineapple (*Ananas comosus*), Orange (*Citrus sinensis*), Pomegranate (*Punica granatum*) and Banana *(Musa acuminata*) and AgNPs on seed germination, growth performance and biochemical content.Overall, It can be demonstrated the different concentrations silver nanoparticles using fruit peels extract showed the. Significant effects on seed germination, growth performance and biochemical content. Among various concentrations used in the study, 2% AgNPs was the most effective treatment for the improvement in seed germination, growth and biochemical parameters studied. The impacts of ecofriendly and bio-based AgNPs is the alternative for synthetic fertilizer.

REFERENCES

Abdel-Monaim, M.F., Abo-Elyousr, K.A.M. and Morsy, K.M. (2011) Effectiveness of plant extracts on suppression of damping-off and wilt diseases of lupine (*Lupinus termis* Forsik). Crop Protection, 30(2): p. 185-191.

Arunachalam R, Dhanasingh S, Kalimuthu B, Uthirappan M, Rose C, Asit Baran M. (2012) .Phytosynthesis of silver nanoparticles using *Coccinia grandis* leaf extract and its application in the photocatalytic degradation. Colloids and Surfaces B: Biointerfaces 94 226– 230

Asadujjaman, M., Mishuk, A.U., Hossain, M.A. and Karmakar, U.K. (2004) Medicinal potential of Passiflora foetida L. plant extracts: biological and pharmacological activities. Journal of Integrative Medicine,12(2): p. 121-126.

Boham B.A and Kocipai-Abyazan R., (1974). Flavonoids and condensed tannins from leaves of *Vaccinium vaticulatum* and *V. calycinium*. Journal of Pacific Science., 48: 458-463.

Bonde, S. R., Rathod, D. P., Ingle, A. P., Ade, R. B., Gade, A. K., and Rai, M. K. (2012). *Murraya koenigii* mediated synthesis of silver nanoparticles and its activity against three human pathogenic bacteria. *Nanosci Methods, 1,* 25–36.

Canfora, L.; Malusa, E.; Salvati, L.; Renzi, G.; Petrarulo, M.; Benedetti, A. Short-term impact of two liquid organic fertilizers on *Solanum lycopersicum* l. Rhizosphere eubacteria and archaea diversity. Appl. Soil Ecol. 2015, 88, 50–59.

Ceretta, C.A.; Girotto, E.; Lourenzi, C.R.; Trentin, G.; Vieira, R.C.B.; Brunetto, G. Nutrient transfer by runoff under no tillage in a soil treated with successive applications of pig slurry. Agric. Ecosyst. Environ. 2010, 139, 689–699.

Chanda, S. (2013). Silver nanoparticles (medicinal plants mediated) : A new generation of antimicrobials to combat microbial pathogens- a review. In Méndez-Vilas, A. (Ed). Microbial pathogens and strategies for combating them: science, technology and education.. *Spain*: *Formatex*. p. 1314-1323.

Dinesh Kumar, Sunil Kumar, Jyoti Gupta, Renu Arya and Ankit Gupta. (2011) A review on chemical and biological properties of *Cayratia trifolia* Linn.(Vitaceae).Pharmacognosy, 5(10): 184–188.

Edeoga H.O., D. E. Okwu and B.O Mbaebie. 2005 Phytochemical constituents of some Nigerian medicinal plants. African Journal of Biotechnology Vol. 4 (7), pp. 685-688

Harborne JB. (1973) Phytochemical Methods; A guide to modern techniques of plant Analysis.2nd Edition, London New York.

Harborne, J. B. (1984). Phytochemical Methods: A guide to modern techniques of plant analysis, 2nd ed: Chapman and Hall Ltd., London, New York.

Hassain E, Mandal SC and Gupta JK. (2011) Phytochemical screening and in vitro antipyretic activity of the methnol leaf-extract of *Bombax malabaricum* DC (Bombacaceae). Trop. J. Pharmaceut. Res, 10: 55-60.

Henglein A. (1993) Physicochemical properties of small metal particles in solution: “microelectrode” reactions, chemisorption, composite metal particles, and the atom-to-metal transitionJ. Phys. Chem., 97 (21), pp. 5457-5471

Hou, J.Q.; Li, M.X.; Mao, X.H.; Hao, Y.; Ding, J.; Liu, D.M.; Xi, B.D.; Liu, H.L. Response of microbial community of organic-matter-impoverished arable soil to long-term application of soil conditioner derived from dynamic rapid fermentation of food waste. PLoS ONE 2017, 12, e0175715.

Huang C.C., Yang Z., Lee K.H. and Chang H.T. (2007). Synthesis of highly fluorescent gold NPs for sensing mercury (II). Angew Chem Int Ed, 46: 6824–6828.

Jbilou, R., Amri, H., Bouayad, N., Ghailani, N., Ennabili, A. and Sayah, F. (2008) Insecticidal effects of extracts of seven plant species on larval development, α-amylase activity and offspring production of *Tribolium castaneum* (Herbst) (Insecta: Coleoptera: Tenebrionidae). Bioresource Technology, 99(5): p. 959-964.

Ji, R., G. Dong, W. Shi and J. Min, 2017. Effects of liquid organic fertilizers on plant growth and rhizosphere soil characteristics of chrysanthemum. Sustainability, 9(5): 841-856.

Kero Jemal, B., Sandeep, V., and Sudhakar Pola. (2017). Synthesis, Characterization and Evaluation of the Antibacterial Activity of *Allophylus serratus* Leaf and Leaf Derived Callus Extracts Mediated Silver Nanoparticles. Journal of Nanomaterials, 1-11.

Khan, S., Zahoor, M., Khan, R. S., Ikram, M., & Islam, N. U. (2023). The impact of silver nanoparticles on the growth of plants: The agriculture applications. *Heliyon*.

Krishnaraj C, Jagan EG, Ramachandran R, Abirami SM, Mohan N, Kalaichelvan PT (2012) Effect of biologically synthesized silver nanoparticles on Bacopa monnieri (Linn.) Wettst. Plant growth metabolism. Process Biochem 47(4):51–658

Kumar M, Mondal P, Borah S and Mahato K. (2013) Physico- chemical evaluation, preliminary phytochemical investigation, fluorescence and TLC analysis of leaves of the plant *Lasia spinosa* (Lour) Thwaites. *Int J Pharm Pharm Sci*, 5 (2):306-310.

Leo Stanley, A., Alex Ramani, V., and Ramachandran, A. (2011). Phytochemical Screening and GC-MS Studies on the Ethanolic Extract of *Cayratiapedata*. *J. Pharm. Phytopharmacol, Res*, *1*(3), 112-116.

Lowry O.H, Rosenbrough N.J, Farr A.L and Randall R.J., (1951). Protein measurement with the Folin's reagent. Journal of Biological Chemistry., 193: 265-276.

Madariaga, Abraham & Hernández-Alvarado, Ricardo & Noriega-Colima, Karla & Osnaya-Hernández, Adriana & Martínez, Karina. (2019). Toxicity of secondary metabolites. Physical Sciences Reviews. 4. 10.1515/psr-2018-0116.

Martinez-Alcantara, B.; Martinez-Cuenca, M.R.; Bermejo, A.; Legaz, F.; Quinones, A. Liquid organic fertilizers for sustainable agriculture: Nutrient uptake of organic versus mineral fertilizers in citrus trees. PLoS ONE 2016, 11, e0161619.

Masarirambi, M.T., Mduduzi, M.H., Olusegun, T.O. and Thokozile, E.S. (2010) Effects of Organic Fertilizers on Growth, Yield, Quality and Sensory Evaluation of Red Lettuce (Lactuca sativa L.) "Veneza Roxa". Agriculture and Biology Journal of North America, 1, 1319-1324.

Michael Ndikau., Naumih, M., Noah Dickson, M., and Andala Eric Masika. (2017). Green Synthesis and Characterization of Silver Nanoparticles Using *Citrullus lanatus* Fruit Rind Extract. International Journal of Analytical Chemistry, 1-9.

Najafi S, Jamei R (2014) Effect of silver nanoparticles and Pb(NO3)2 on the yield and chemical composition of mung bean (*Vigna radiata*). J. Stress Physiol. Biochem. 10:316–325.

Pichyangkura, R.; Chadchawan, S. Biostimulant activity of chitosan in horticulture. Sci. Hortic. 2015, 196, 49–65.

Rajmohanan TP, Sudhakaran Nair C R and Padmaja V. (2014) Pharmacognostical and phytochemical studies on *Cayratia pedata* (Lam). International Journal of Pharmacognosy and Phytochemical Research, 6(2); 227-233.

Razzaq A, Ammara R, Jhanzab HM, Mahmood T, Hafeez A, Hussain S (2016) Anoval nanomaterial to enhance growth and yield of wheat. J of Nanoscience & Technology 2(1):55–58

Reza Ghorbani, H., Akbar Safekordi, A., Attar, H., and Rezayat Sorkhabadi, S. M. (2011). Biological and Non-biological Methods for Silver Nanoparticles Synthesis. *Chem. Biochem. Eng*, 317-326.

Rosen, H. 1957. A modified ninhydrin colorimetric analysis for amino acids. Arch. Biochem. Biophys., 67, 10-15.

Salama, M.E. Abd El-Aziz, F.A. Rizk, M.S.A. Abd Elwahed, Applications of nanotechnology on vegetable crops, Chemosphere 266 (2021), 129026,

Shah, M.A., Bosco, S.J.D. and Mir, S.A. (2014) Plant extracts as natural antioxidants in meat and meat products. Meat Science, 98(1): p. 21-33.

Shankar,S.S., Ahmad,A., Rai, A & Sastry, M. (2004).Rapid synthesis of Au, Ag and bimetallic Au core-Ag shell nanoparticles by using *neem (Azadirachta indica*) leaf broth. *J Colloid Interface Sci*, (275),496–502.

Sharon K, Choudhry A, Kumar R (2010) Nanotechnology in agricultural disease and food safety. J. Phytol. 2:83–92.

Shelar GB, Chavan AM (2015) Myco-synthesis of silver nanoparticles from Trichoderma harzianum and its impact on germination status of oil seed. Biolife 3:109–113

Siddiqui MH, Al-Whaibi MH (2014) Role of nano-SiO2 in germination of tomato (Lycopersicum esculentum seeds. Mill.). Saudian J. Biol Sci 21:13–17

Sofowara A (1993). Medicinal plants and Traditional medicine in Africa. Spectrum Books Ltd, Ibadan, Nigeria. p:289.

Tang, H.; Zhang, L.Y.; Hu, L.Y.; Zhang, L.N. Application of chitin hydrogels for seed germination, seedling growth of rapeseed. J. Plant Growth Regul. 2013, 33, 195–201.

Tekwu, E.M., Pieme, A.C. and Beng, V.P. (2012) Investigations of antimicrobial activity of some Cameroonian medicinal plant extracts against bacteria and yeast with gastrointestinal relevance. Journal of Ethnopharmacology, 142(1): p. 265-273.

Trease GE and Evans WC. (1989) Phenols and Phenolic glycosides. In:Textbook of Pharmacognosy. (12th ed.). Balliese, Tindall and Co Publishers, London pp. 343-383.

Tripathy, A., Raichur, A.M., Chandrasekaran, N., Prathna, T.C & Mukherjee, A. (2010). Process variables in biomimetic synthesis of silver nanoparticles by aqueous extract of *Azadirachta indica (Neem)* leaves. *J. Nanopart. Res*, (12), 237–246.

Wazir, A., Gul, Z., & Hussain, M. (2018). Comparative study of various organic fertilizers effect on growth and yield of two economically important crops, potato and pea. *Agricultural Sciences*, *9*(06), 703.

Zhu, Z.; Zhang, F.G.; Wang, C.; Ran, W.; Shen, Q.R. Treating fermentative residues as liquid fertilizer and its efficacy on the tomato growth. Sci. Hortic. 201.