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Evaluation of Nanoparticles Based Gels from Extraction of Different Fruit Peels

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ABSTRACT

Nanoparticles are particles ranging in size from 1 nm to 100 nm. Triangles, spheres, irregular shapes, etc. They come in different sizes such as. In recent years, the synthesis of nanoparticles has received widespread attention due to their unique properties and potential applications. The powder sample (100gm) was extracted with 800ml ethanol using Soxhlet extraction method for 6 hours. The resulting extract is used in the preparation of nanoparticles. The main objective of the present work was to prepare green apple and orange peel extract based nano particles by chemical complexation method. Ethanol extracts of green apple and orange peel were prepared using Soxhlet extractor and analyzed for their phytochemical composition. qualitative analysis of green apple peel showed positive results for alkaloids, anthraquinones, saponins and terpenoids, while orange peel showed positive. Good results for alkaloids, tannins and saponins. The moisture percentage of two fruits (green apple and orange) is 72% and 96.12% respectively. Green apples and oranges have a pH of 3.6 and 3.8 respectively. The zeta potential of green apple extract nanoparticles is -24.6 mV to -34.5 mV (P20 and P50), and the zeta potential of orange extract is -21.4 mV to 32.0 mV (O20 and O50). For nanoparticles these values are higher, indicating less potential for aggregation. The size of the apple extract varies from 118.6 nm to 231.7 nm (P20 and P30), while the size of the orange extract varies from 178.8 nm to 191.6 nm (O20 and O50). This line confirms that the obtained particles are in the nanometer range, i.e. <500 nm in size. SEM results show the formation of nanoparticles and their shape is spherical. Energy dispersive spectroscopy (EDS) analysis confirmed the presence of silver nanoparticles. Silver nanoparticles were prepared using green and orange juice peels. Computability studies FT-IR showed that there was no change in the functional group of the shell in the prepared nanoparticles. Zeta potential indicates higher efficiency and therefore less particle aggregation. The prepared nanoparticles are spherical in shape and have a particle size of approximately 200 ± 20nm. Further the study will be extended for anti- microbial and wound healing activities.

Key words: Orange peel extract, Qualitative analysis, Nano particles, Zeta potential, Particle Size.

1. INTRODUCTION

Nanoparticles are particles ranging in size from 1 nm to 100 nm. Triangles, spheres, irregular shapes, etc. They come in different sizes such as. In recent years, the synthesis of nanoparticles has attracted great attention due to their unique properties and potential applications.[1] Nanoparticles offer new or improved properties compared to others. The size of these large new materials is achieved by changes in certain properties. Such as the size, distribution and morphology of the material. As particle size increases, nanoparticles show higher surface to volume ratio.[2]

Nanoparticles can be produced using various methods such as chemical, physical and biological processes. Although the chemical synthesis process requires the synthesis of large amounts of nanoparticles in a short time, this method requires capping agents to stabilize the size of nanoparticles. The chemicals used for nanoparticle synthesis and stabilization are toxic and made from environmentally unfriendly materials. The need for environmentally friendly options for nanoparticle synthesis has led to increased interest in biological processes that do not use chemical byproducts. Therefore, the demand for green nanotechnology is increasing. Plants provide a better platform for nanoparticle synthesis as they are non-toxic and provide natural capping agents.[3]

Green apple peel contains tannins, flavonoids, polyphenols and delphinidin, anthocyanins etc. It is rich in some anthocyanins such as. Antibacterial activity of apple peel has been reported in in vitro models. It is reported that all of the compounds in green apple peel have therapeutic properties. Green juice peel extract has antibacterial properties against species of Escherichia coli, Pseudomonas aeruginosa and Staphylococcus aureus.[4]

Orange peels are beneficial for the skin as they have antibacterial, anti-inflammatory and antifungal properties. The dried bark can be ground into powder and used for scrubbing and exfoliating. It is an effective cleanser that helps treat acne and pimples, removes blackheads, dark spots and pigmentation.[5] The aim of this study is to create nanoparticles based on green apple and orange peel extracts.

2. MATERIALS AND METHODS

2.1 Material Used

Green apple and orange peels were collected from local market, Jaipur. Chemicals like Silver nitrate and Sodium borohydride were obtained from S.D Fine chemicals, Mumbai, India. All others chemical used were analytical grade. Milli Q water was used throughout the experiment.

2.2 Methods

2.2.1 Nanoparticles Preparation

Fruits of green apple and orange were collected, peels were separated and washed thoroughly with tap water. Cut the washed peel into small (1-5 cm) pieces and dry them in the sun for 20 days. Mix the dry husk well with mortar and pestle and then grind it with a grinder until powder and then pass it through sieve No. 40 Obtain a homogeneous powder and store at room temperature. The powder sample (100gm) was extracted with 800ml ethanol using Soxhlet extraction method for 6 hours. Filter the mixture through Whatman filter paper (No. 2) to remove the husk. The extract was filtered and evaporated to dryness in a field evaporator (Buchi, Singapore) under reduced pressure at 60°C. The extract was placed in a dark bottle and stored in the refrigerator at 4°C.[6] Add 5 ml of 0.002 M sodium borohydride solution to 50 ml of 0.001 M silver nitrate solution, stirring constantly, let stand for 15 minutes, then pour into a clean 250 ml beaker until a clear and slightly thick solution is possible. Additionally, this solution was heated in a 45°C water bath for 30 min (solution A). Dissolve 200 mg (P20) and 500 mg (P50) of apple peel extract at different concentrations in 4 ml of Milli Q water in a test tube and heat gently to obtain a yellow-brown solution. Add this solution dropwise to solution A with constant stirring using a glass rod for 30-45 minutes until a clear brown tea is obtained. The solution was cooled to room temperature, 0.5 ml of 0.5 mcg/ml PVP solution was added as a stabilizer, and filtered to obtain a clear brown nanoparticle solution. Store this medication in a closed container in a dark place until next use. The same method was followed with orange peel extract to obtain pure orange juice containing silver nanoparticles. FTIR, size, zeta potential and surface morphology of the prepared nanoparticles were evaluated by SEM, X-ray diffraction and energy dispersive spectroscopy.[7]

3. RESULTS AND DISCUSSION

Green apple and orange peel extracts were subjected to various tests to confirm the presence of photochemical constituents. The UV-spectroscopic analysis showed that green apple peel extract, a colored solution showed maximum absorbance at 461 nm wave length.[8] This result is in agreement with Nisha MH et al. studies, where they reported maximum absorbance of at green apple peel 472 nm.[9] Whereas orange peel extract showed absorbance at 280 nm wave length (figure 2). Hence same wave length will be used for further studies. Results of qualitative analysis reviled that green apple peel extract showed positive results for Alkaloids, Anthraquinones, Saponins, tannins, and Terpenoids[10], whereas orange peel showed positive results for Alkaloids, Tannin and Saponins.[11] The results were tabulated in table 1. Quantitative analysis reviled that equivalent weight in mg/ml found to be 345.14 and 500.10 respectively. The percentage moisture content obtained from the 2 fruits (green apple and orange) was 72% and 96.12% respectively. The pH was found to be 3.6 and 3.8 for green apple and orange respectively. The results were tabulated in table 2.

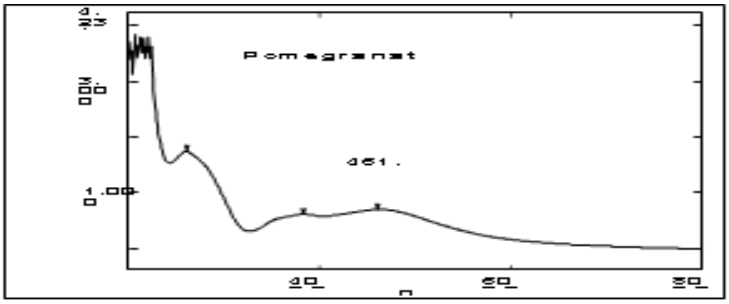

Figure 1: UV-Spectrum of green apple peel extract

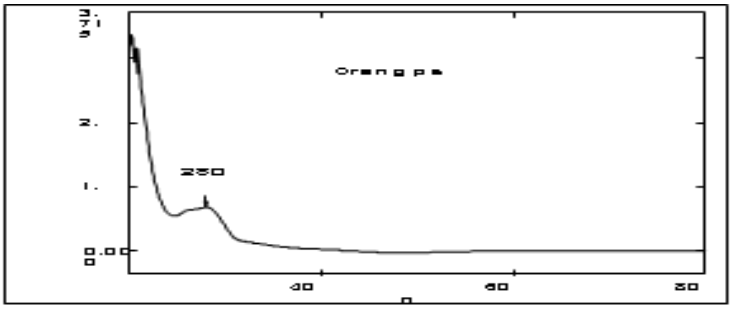

Figure 2: UV-Spectrum of orange peel extract

Table 1: Phyto-chemical analysis of ethanolic extract of green apple and orange peel

Phytochemicals	Green Apple	Orange
Alkaloids	+	+
Amino acids	_	_
Tannin	+	+
Anthraquinones	+	_
Saponins	+	+
Protein	-	-
Terpenoids	+	_
Cardiac glycosides	-	-

Note: + = Present, - = Absent

Table 2: Quantitative analysis of green apple and orange peel extract

Parameters	Green apple	Orange
Equivalent weight (mg/ml)	345.14	500.10
Ash content	30%	40%
Moisture content	72%	96.12%
pH	3.6	3.8

The FT-IR spectrum of green apple peel extract showed the distinct peak in the range of 3036, 2928, 1734, 1102 and 713. The absorption peaks located mainly at 3036 cm−1 are generally attributed to aromatic or aliphatic C–H stretching, 2928 cm−1 are generally assigned to the alkyl C–H stretching, whereas peaks at 1734, 1375 and 1332 cm−1 are due to C–O–O stretching bands, 1102 and 1050 cm−1are due to C–C stretching vibrations, 713 and 624 cm−1are due to acetylenic C–H bending vibrations in the region of 40–4000 cm−1. All the spectrum of green apple peel extract is present in the green apple peel extract nanoparticles. Hence there was no any shift of functional groups are seen in green apple peel extract nanoparticles (Figure 3 & 4).

Table 3: FTIR peaks of Green apple peel extract and peel extract nanoparticles

Absorption peaks (cm-1)		
Functional group	**Green apple peel extract**	**Green apple peel extract nanoparticles**
aromatic or aliphatic C–H stretching	3036	3038.31
alkyl C–H stretching	2928	2926.48
C–O–O stretching bands,	1734, 1375 and 1332	1338.23
C–C stretching vibrations	1102 and 1050	1008.1
acetylenic C–H bending	713 and 624	896.06

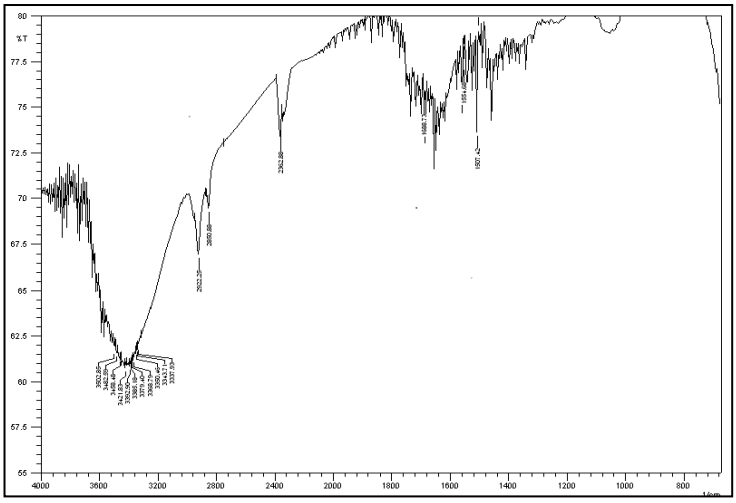

Figure 3: FTIR spectra for green apple peel extract

The FT-IR spectrum of orange peel extract showed the distinct peak in the range of 3390, 2355, 1649, 771, 677, and 424 cm-1 (Fig. 2a). Intense absorption is observed at 1649 cm-1 and is characteristic of the C=C stretching aromatic ring. The peak at 3390 and 3388 cm-1 reveals water and OH absorption frequency. The weak bands at 2355 and 2357 cm-1 indicates carbonyl specific absorption. The peak at 771 and 769 cm−1 corresponds to C–H stretching of aromatic compounds. The peak at 677 and 671 cm-1 could be assigned to the C=O stretching of carbonyl group. The broad peaks around 424 and 422 cm−1 are related to oxygen from hydroxyl groups. Further the comparison of FT-IR spectrum

between the orange peel extract and peel-AgNPs will be done to find out any changes in the position as well as the absorption bands. All the spectrum of orange peel extract is present in the orange peel extract nanoparticles. Hence there was no any shift of functional groups are seen in orange peel extract nanoparticles (Figure 5 & 6).

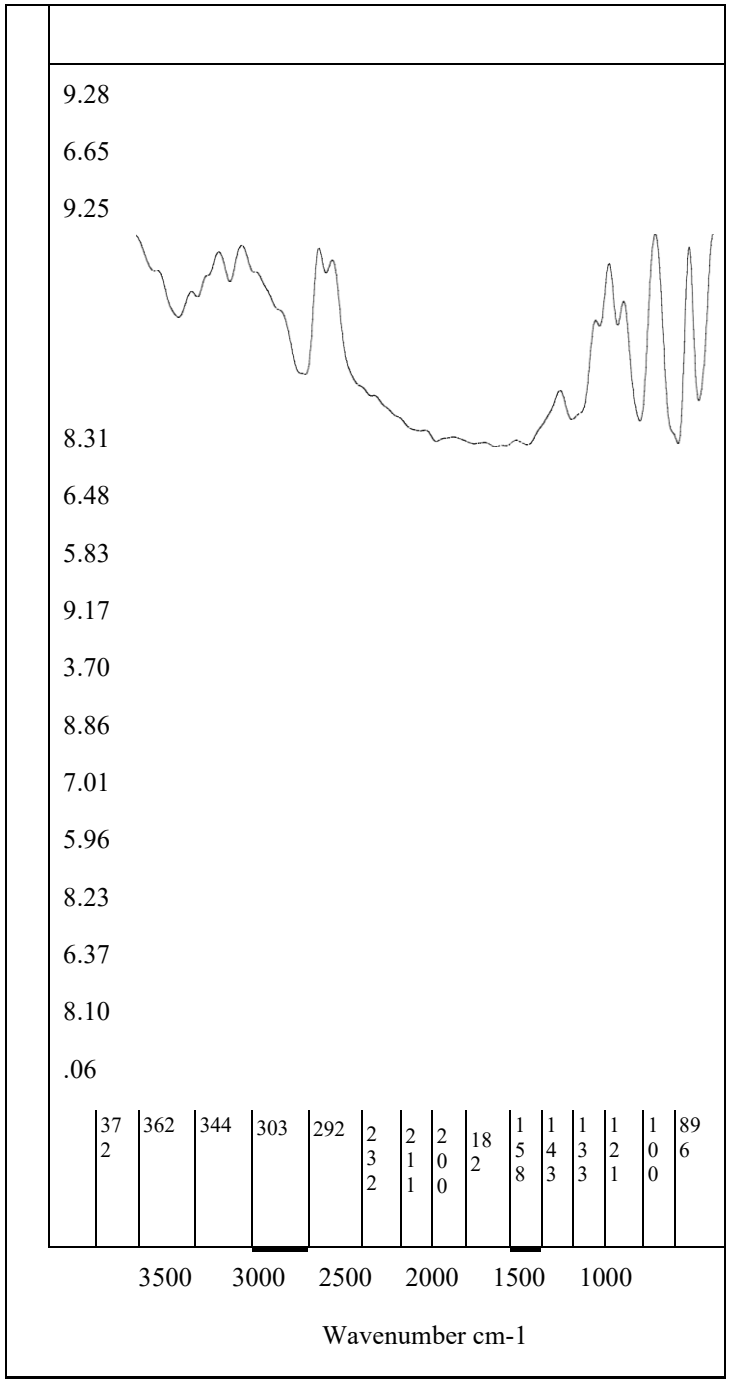

Figure 4: FTIR spectra for green apple peel extract nanoparticles

Table 4: FTIR peaks of orange peel extract and orange peel extract nanoparticles

Absorption peaks (cm-1)		
Functional group	**Orange peel extract**	**Orange peel extract nanoparticles**
C=C stretching aromatic ring	1649	1588.62
OH absorption	3390 and 3388	3388.62
Carbonyl group	2355 and 2357	2256.18
C–H stretching of aromatic	771 and 769	889.11

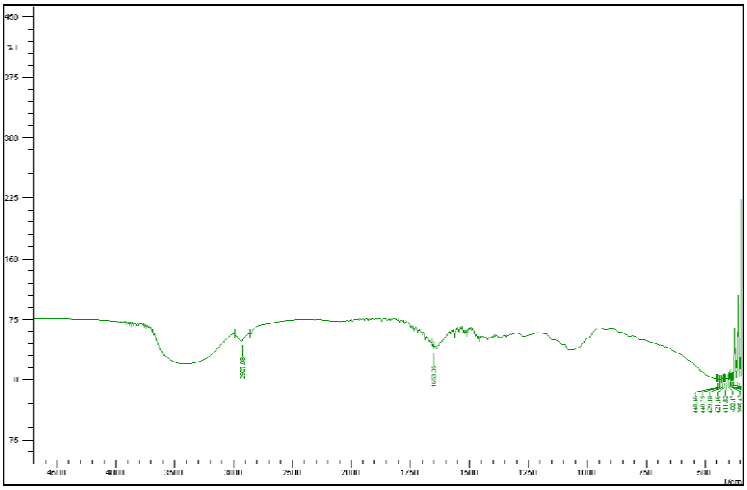

Figure 5: FTIR spectra for orange peel extract

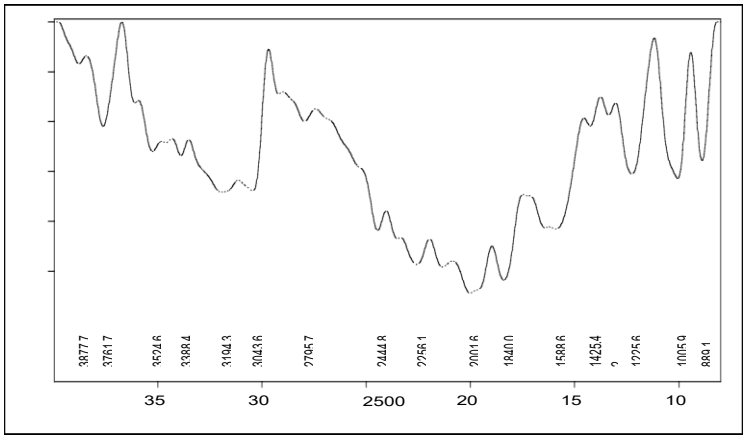

Figure 6: FTIR spectra for orange peel extract nanoparticle

The green apple and orange peel extracts silver nanoparticles were subjected to Zeta Potential analysis to determine the surface charge of the nanoparticles and to find out the aggregation behavior. The values of zeta potential for green apple peel extract silver nanoparticles were found in the range of – 34.5 mV to -24.6 mV for green apple P50 and green apple P20, respectively. Whereas, in case of orange peel extract nanoparticles showed zeta potential value range from – 32.0 mV to -21.4 mV for orange O50 and orange O20, respectively. Hence all batches of nanoparticles having higher surface charge which indicates there is least chance of aggregation.

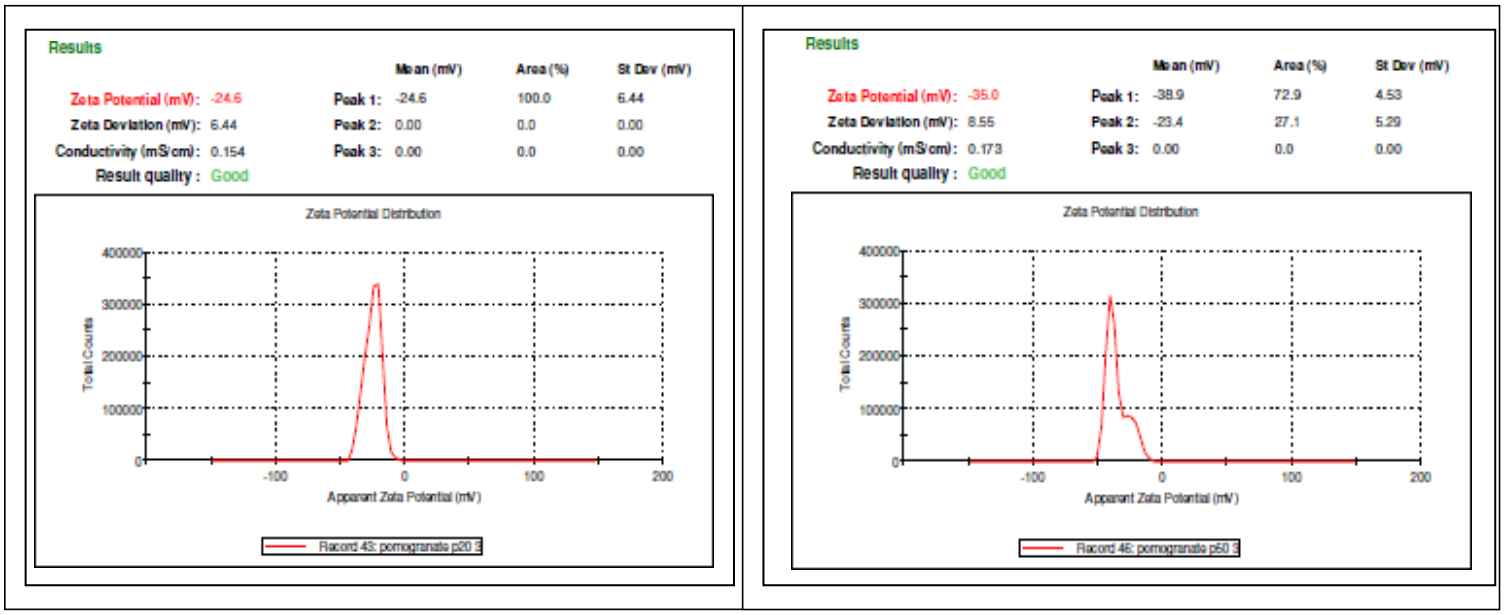

Figure 7: Zeta potential of green apple extract silver nanoparticles (P20, P50)

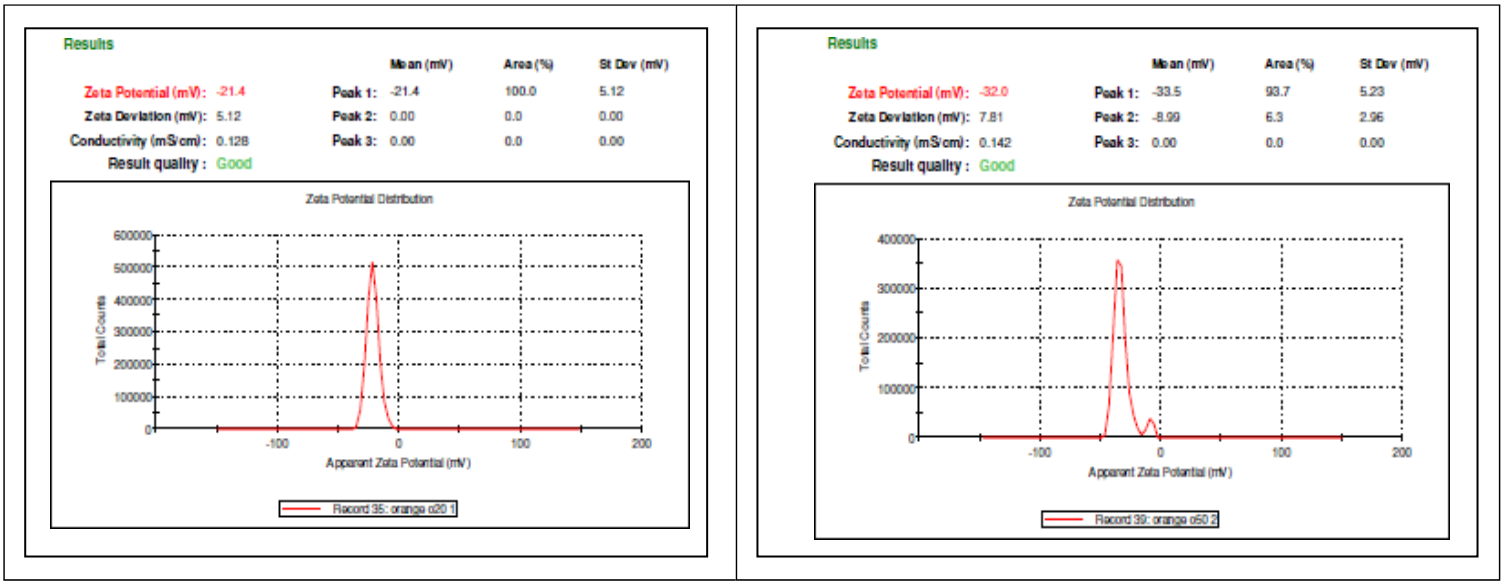

Figure 8: Zeta potential of orange extract silver nanoparticles (O20, O50)

The particle sizes of prepared nanoparticles were determined by using Malvern particle size analyzer. The values of particle size for green apple peel extract silver nanoparticles were found in the range of 118.6 nm to 231.7 nm for green apple P20 and green apple P30, respectively. Whereas, in case of orange peel extract nanoparticles showed particle size in the range of 178.8 nm to 191.6 nm for orange O20 and orange O50, respectively.

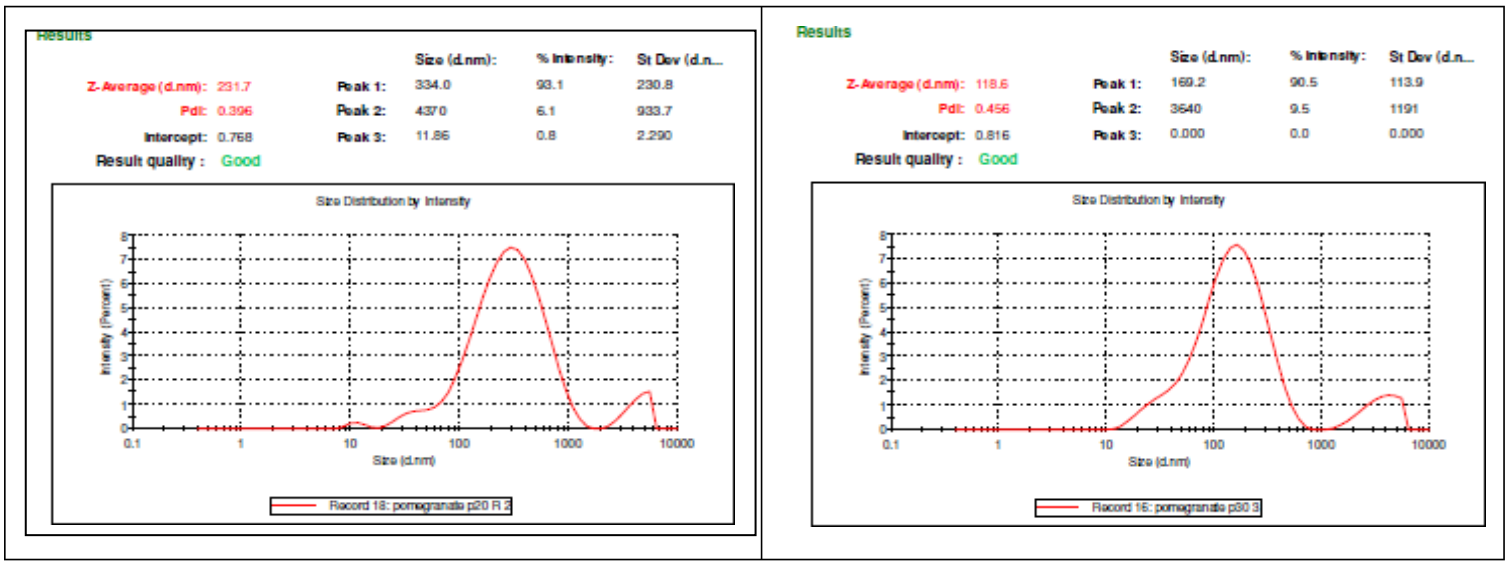

Figure 9: Particle size distribution of green apple extract silver nanoparticles (P20, P30)

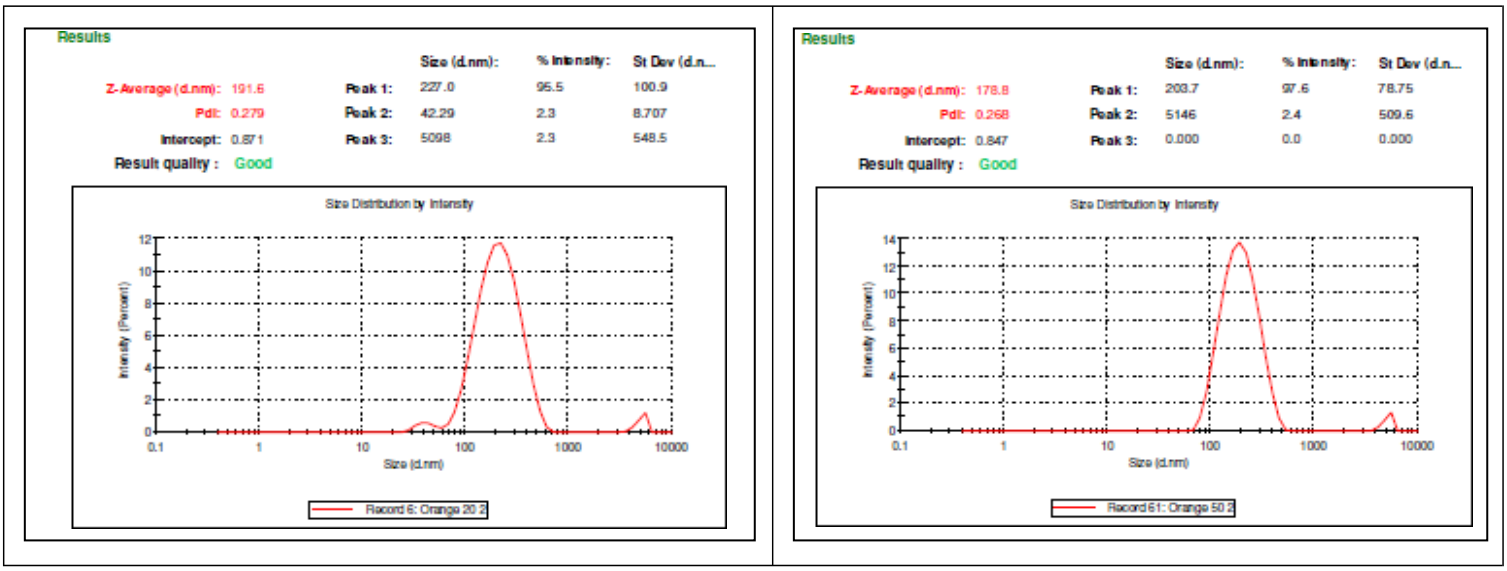

Figure 10: Particle size distribution of orange extract silver nanoparticles (O20, O50)

To confirm the crystalline nature of orange peel extract, X-ray diffraction (XRD) patterns were obtained (Figure 11). The peaks assigned to the diffraction pattern clearly showed peaks corresponding to 2θ = 9.21°, 11.36°, 19.42°, 38.10°, and 67.44^0.

To confirm the crystalline nature of green apple peel extract, X-ray diffraction (XRD)patterns were obtained (Figure 11). The peaks assigned to the diffraction pattern clearly showed peaks corresponding to 2θ = 11.36°, 16.26°, 19.04°, 27.48°, 49.26°, 59.56° and 64.07^0 c.

The surface morphology of prepared nanoparticles was determined by using SEM (Hitachi. SEM results clearly showed the formation of nanoparticles and were relatively spherical in shape and also showed there was only a small degree of agglomeration. The largest size of orange peel extract nanoparticles was 94.5 nm in size whereas green apple-based nanoparticles had 74.9 nm. The SEM results were shown in figure 12 a (orange peel extract), 12 b (green apple peel extract) and 12 c, morphology of peel extract based AgNPs respectively.

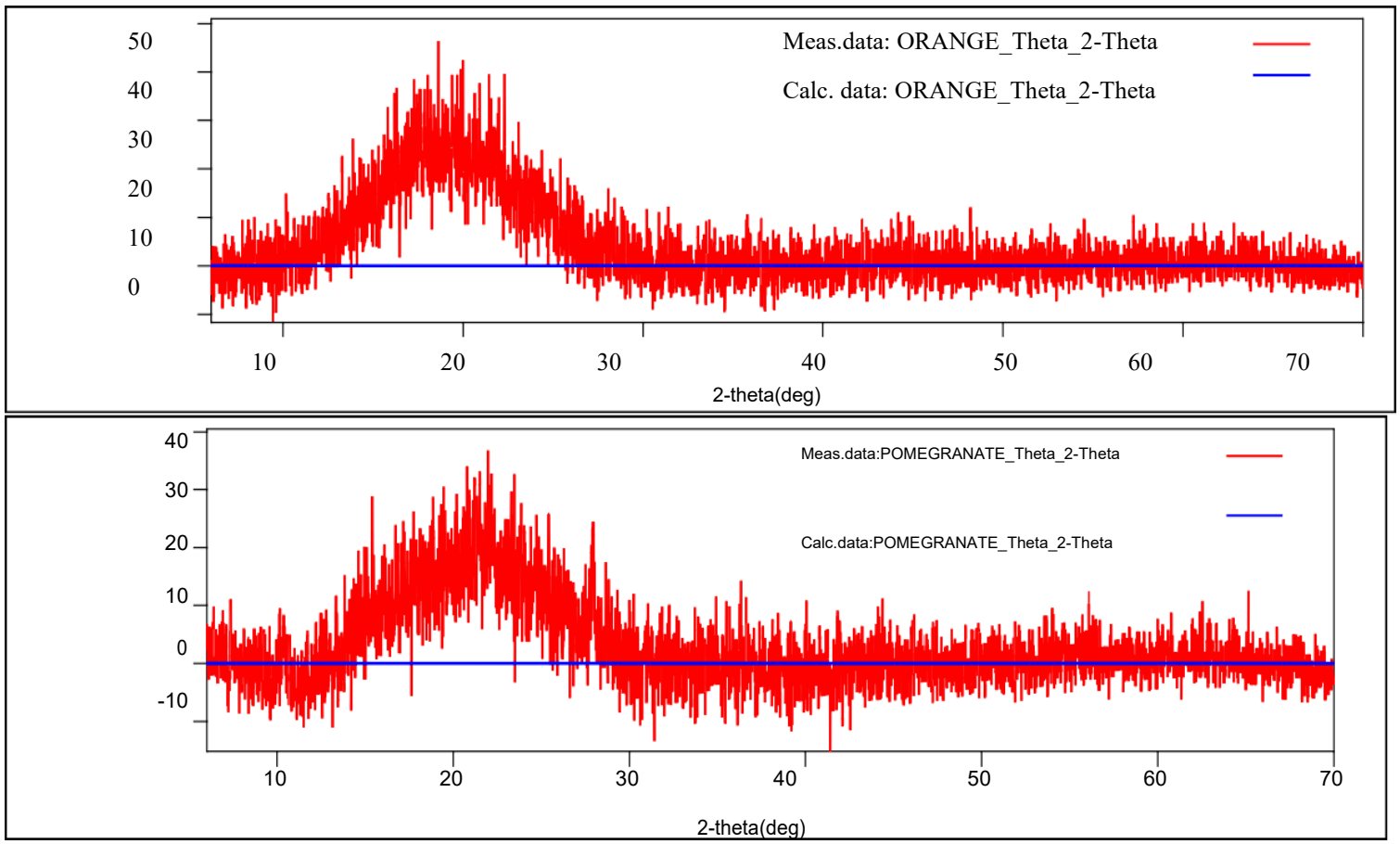

Figure 11: XRD pattern of green apple peel extract and orange peel extract

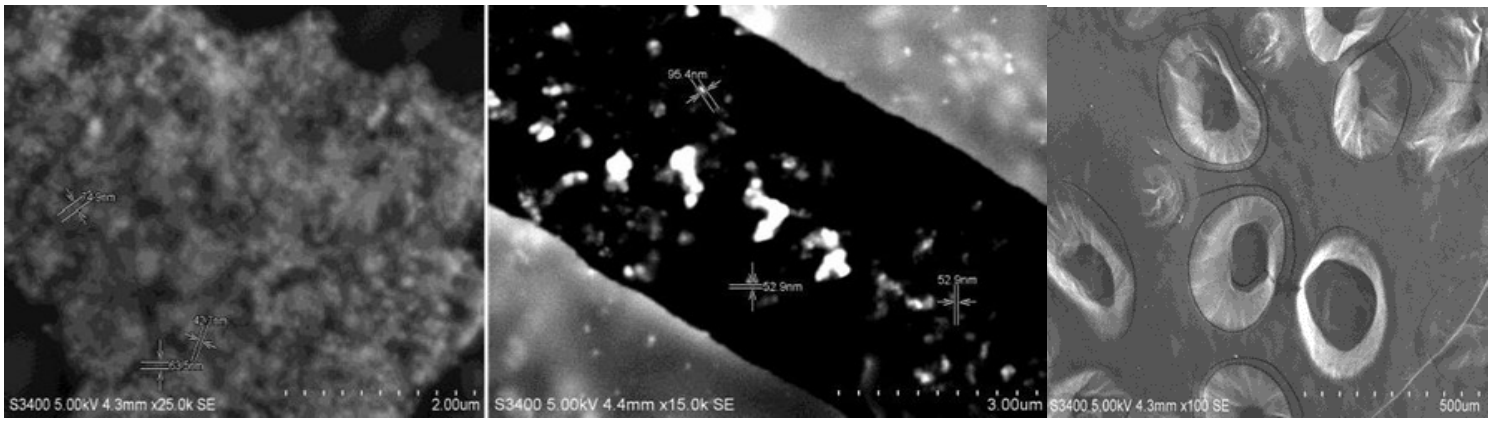

Figure 12: (a) SEM images of AgNPs by orange peel extract, (b) green apple peel extract and (c) AgNPs morphology respectively.

Energy dispersive spectrometer (EDS) analysis for the confirmation of elemental silver was carried out for the detection of elemental silver. The EDS microanalysis confirms the presence of AgNPs which is known to provide information on the chemical analysis of the elements or the composition at specific locations. The spectrum analysis reveals signal in the silver region and then confirms the formation of AgNPs. Metallic silver nanocrystals generally show a typical optical absorption peak at approximately 2 keV due to the surface plasmon resonance. The EDS results were shown in figure 13 a for green apple peel nanoparticles and 13 b for orange peel nanoparticles, respectively.

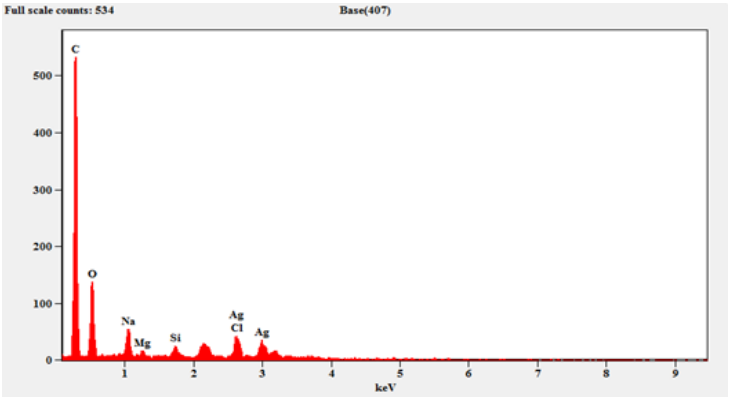

Figure 13 (a): EDS pattern of spherical green apple peel extract AgNPs prepared

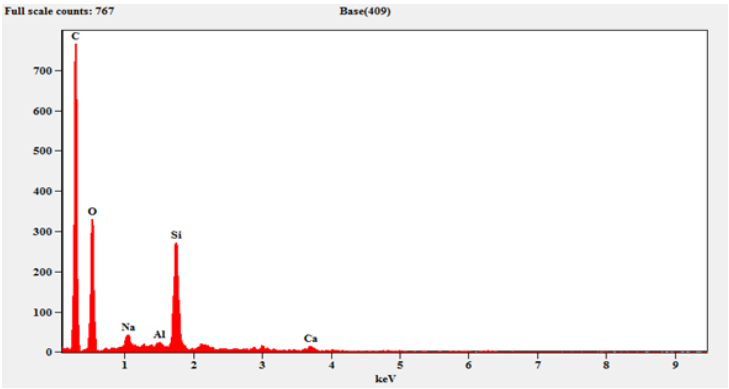

Figure 13 (b): EDS pattern of spherical orange peel extract AgNPs prepared

Table 5: Quantitative Results for Base (407)

Element Line	Weight %	Weight % Error	Atom %
C K	56.12	± 3.15	67.25
O K	30.86	± 1.38	27.76
Na K	3.94	± 0.47	2.46
Mg K	0.61	± 0.13	0.36
Si K	1.08	± 0.18	0.55
Si L	---	---	---
Cl K	2.29	± 0.29	0.93
Cl L	---	---	---
Ag L	5.11	± 0.92	0.68
Ag M	---	---	---
Total	100.00		100.00

Table 6: Quantitative Results for Base (409)

Element Line	Weight %	Weight % Error	Atom %
C K	45.26	± 5.94	55.60
O K	38.92	± 2.13	35.88
Na K	3.18	± 0.45	2.04
Al K	0.43	± 0.13	0.24
Si K	11.10	± 0.30	5.83
Si L	---	---	---
Ca K	1.10	± 0.15	0.41
Ca L	---	---	---
Total	100.00		100.00

4. CONCLUSION

Nanoparticles based on green apple and orange peel extracts were prepared using the silver nitrate chemical complexation method. Particle size, surface morphology and content analysis showed that the prepared formulations were nanoparticles based on silver particles. Further studies on antibiotic use and wound healing will be expanded using appropriate animal models. This plant-based nanoparticle may be safe, cost-effective and effective.

ACKNOWLEDGEMENT

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