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CHARACTERIZATION OF PVP AND GELATIN BLENDS FILMS DOPED WITH BARIUM OXIDES NANOPARTICLES

Sonam Ahuja * and Ajay M. Padhiyar

Department of Chemistry, Faculty of Applied Sciences, Parul Institute of Applied Science (PIAS), Parul University, Limda, Waghodiya, Vadodara - 391760, Gujarat, India.

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Correspondence to Author:
Dr. Sonam Ahuja

Assistant Professor,
Department of Chemistry, Faculty of Applied Sciences, Parul Institute of Applied Science (PIAS), Parul University, Limda, Waghodiya, Vadodara - 391760, Gujarat, India.

E-mail: sonam.ahuja82106@paruluniversity.ac.in

ABSTRACT: Polymeric films of pure PVP/ gelatin mixture contain different measures of Barium oxide Nanoparticles to be arranged for projecting. The arranged films' underlying and associated actual properties are concentrated on utilizing various methods. The acquired information uncovered the present expansion of gelatin and Barium oxide Nanoparticles causes underlying variety in the Poly (vinyl pyrrolidone) organization. The X-ray diffraction (XRD) designs uncover the formless character of the mixture increments along the centralization of Barium oxide Nanoparticles. Composite arrangements exist, affirmed by XRD and FT-IR investigation. The results show that the current expansion of gelatin and Barium Oxides Nanoparticles to Poly (vinyl pyrrolidone) changes the warm way of behaving, such as the mirror progress temperature and warm soundness. Also, the expansion of gelatin and Barium Oxides Nanoparticles produce work on the electrical properties of Poly (vinyl pyrrolidone) film. The visual what's more, electrical outcomes recommended the appropriateness of these substances in the Optical or potentially electrical detector.

INTRODUCTION: The water-soluble poly (vinyl pyrrolidone) PVP, known as polyvidone or povidone, is created from the monomer N-vinyl pyrrolidone. PVP can be chosen based on the desired application qualities and is offered in various molecular weights and associated viscosities [1, 2]. Gelatin is an essential amino acid-rich protein generated from collagen found in animal skin and bones. Gelatin is mostly used in food as a gelling agent for ready-to-eat items kept in the refrigerator [3].

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Polymer science has shown a propensity in the last ten years to make mixes of various polymers rather than to faster new polymers. Mixing polymers is one of the most straightforward means to get an assortment of fleshly and fabricated properties from the constituent polymers [4]. The addition of fresher properties depends upon the similarity or miscibility of the polymers at a sub-atomic level. Mostly, the polymer-polymer miscibility is because of a few explicit communications like dipole powers, hydrogen holding, and charge move building's synthetic resin sections [5].

Water-dissolvable polymers are significant from a modern viewpoint. Polyvinyl pyrrolidone (PVP) has fantastic attributes like high-dielectric constant, insoluble, stability, similarity, and obstruction, what's more, enormous scope screen printing of PVP films for a minimal price is doable.

Poly (vinyl pyrrolidone) is profoundly dissolvable in polar solvents such as liquor, so keeping away from stage separation is best in the response. One more benefit of utilizing PVP is that PVP can be thermally cross-linked and that makes the composites have remarkable warm security and high mechanical strength. Besides, the undefined construction of PVP likewise gives a low dissipating misfortune, which makes it an optimal polymer for composite materials for the visual application [6]. Poly (vinyl pyrrolidone) thermally breaks down before arriving at its liquid state. This ends the utilization of this polymer. PVP is picked as a framework for the composites as a result of the two significant attributes. One is that PVP has great film-framing and cement conduct on a large number of strong substrates and its films display great visual quality and mechanical strength. Another is just the pyrrolidone gathering of PVP likes to composite with numerous inorganic salts bringing about fine scattering and surface passivation of them [7].

Mixing PVP with a possibly valuable regular biopolymer like gelatin is an intriguing approach to setting up a polymeric composite [8]. Gelatin not just keeps up with the intrinsic natural exercises of PVP, but also gains new properties and capabilities. Such a composite detailed better warm strength and absorbability when utilized as lattices for barium oxide nanoparticles. As previously mentioned, a few scientists have revealed PVP and its mixes with different polymers. Notwithstanding, a little examination covers the planning and actual portrayal of Poly (vinyl pyrrolidone) and gelatin mix doped with metal oxide nanoparticles.

The current work is completed to research the impact of doping gelatin and Barium Oxide Nanoparticles on the design of PVP utilizing XRD, FT-IR, and DSC methods [9]. Postulations composites got would offer chances to investigate their original visual, warm what's more and electronic properties.

MATERIALS AND METHODS:

Materials: Poly (vinyl pyrrolidone) was purchased from Oxford Lab Fine Chem. LLP. The molecular weight of PVP is 40,000. $BaCl_2.2H_2O$ (Dehydrate) was purchased from Oxford Lab Fine Chem. LLP and its molecular weight 244.28

Film Preparation: The poly (vinyl pyrrolidone) and gelatin composite films were blended at various ratios. The PVP and Gelatin ratios used were (60/40, 50/50, and 80/20). All the synthesized films were obtained using the casting technique. 3 gm of PVP and 2 gm of gelatin were dissolved in 25ml double distilled water at 100 °C with stirring for 30 minutes. Keep the homogeneous solution in a clean and dry Petri dish for 24 hours at 70 °C. Then the dried film was stored in a vacuum for analysis. Also, the same methods for the different amount ratio of PVP and Gelatin (60/40, 50/50, 80/20) was prepared [1].

BaO Nanoparticles Preparation: The preparation and presentation of barium oxide nanoparticles integrated by the thermo-compound approach have been the focus of the examination. The arrangement comprising Ba^{+2} was made by adding 20ml alkali drop by drop over about 30 minutes to 2g of anhydrous bacl2 powder while vigorously blending (at 550–700 rpm). Alkali needs to be progressively added to the antecedent due to the exothermic reaction of bacl2 with smelling salts. 33 degrees Celsius was chosen as the arrangement temperature, while a pH range of 10 was chosen for the pH [10].

As the arrangement continued to be thoroughly blended until white accelerated framed, refined water was added as a precipitant specialist. The following accelerator was separated and given two separate washes with deionized water. It has dried the white accelerator. To create BaO nanoparticles, the white accelerate is dried at 100 °C for 1hour in an oven. The dried accelerate is then calcinated at 500 °C for 2 hours in a heater [10].

Nano-loaded Film: 3 gm of PVP and 2 gm gelatin (60/40) ratio was dissolved in 25ml double distilled water at 100 ^{0}C temperature with stirring the solution for 30 minutes. The quantity of BaO oxide nanoparticles was doping to the polymeric solution. Then the solution was poured onto clean Petri dishes and dried in a heater at 70 ^{0}C temperature for 24 hours. After, then the dried film was stored in a vacuum for analysis.

Measuring Techniques:

XRD Analysis: In materials science, X-beam diffraction analysis (XRD) is a technique used to

determine a material's crystallographic structure. To estimate the powers and dissipation points of the X-beams that leave the material, XRD illuminates the material with incident X-rays. A seimens type f diffractometer with Cu Ka radiation and a LiF monochromator was used to obtain the X-beam diffraction (XRD) measurements [11].

FT-IR Analysis: The Fourier change infrared spectroscopy (FTIR) technique determines the retention, outflow, and photoconductivity of gases, fluids, and solids in the infrared region. PHB makes use of differentiating between distinct utilitarian groups. The FTIR range has been measured between 4000 and 400 cm^{-1}. Utilizing a single pillar Fourier change infrared spectrometer, FT-IR assimilation spectra of the examples were obtained in the spectral range of 4000-400 cm^{-1} [12].

UV/VIS Analysis: The instantaneous flow electrical resistivity was calculated using an auto-range multimeter with an accuracy of ±3, and UV-VIS assimilation spectra were estimated in the frequency range of 200-900 nm.

TGA Analysis: TGA is a strong method for the estimation of warm solidness of materials including polymers. In this strategy, changes in the heaviness of an example are estimated while its temperature is being expanded. TGA can estimate dampness and unstable items in an example.

RESULTS AND DISCUSSION:

XRD (X-Ray Diffraction): Full precision X-ray diffraction analysis tests were carried out at PNP Analytical Solutions, Vadodara (Gujarat, India). The deliberate XRD profiles of unadulterated PVP, PVP/gelatin mix films are shown in **Fig. 1**. There was an observable change in the power of XRD pinnacles of the PVP and Gelatin tests in option to appearance of extra pinnacles. The pure PVP check shows an exceptionally wide diffraction top around $2\theta = 22.3$, which affirms the formless idea of the pre-arranged polymer film that is similar to either announced in writing at the point when gelatin was added into PVP, making PVP/gelatin mix, the power of this pinnacle expanded and became more acute. An increment in the force and reduction in the width of PVP/gelatin mix are noticed, demonstrating a semi-crystalline structure, which prompts their benefit similarity [13].

The comparable outcome was accounted for by Nagahama *et al.* For the expansion of BaO nanoparticles to the mix network, there is a change in the diffraction top towards lower diffraction points, affirming a complex development. Besides, a dispersing top at $2\theta = 9.5^{o}$ was noticed for doping levels 10 and 20 wt%. This pinnacle has a place neither to PVP nor PVP/gelatin. This pinnacle might demonstrate the new glasslike period of the mix grid.

Moreover, the tops for $2\theta = 23^{o}$, 25^{o}, 29^{o} what's more, 40^{o}, relating to BaO nanoparticles, vanished in the buildings demonstrating the total separation of the Oxide in the polymer network. This perception affirms that complexation has occurred in the shapeless stage. The abatement in the powers of the tops on doping are envisioned in that the reduction in the crystalline and synchronous expansion in the amorphous of the complexes films. This indistinct nature is answerable for more prominent ionic diffusivity bringing about high ionic conductivity [1].

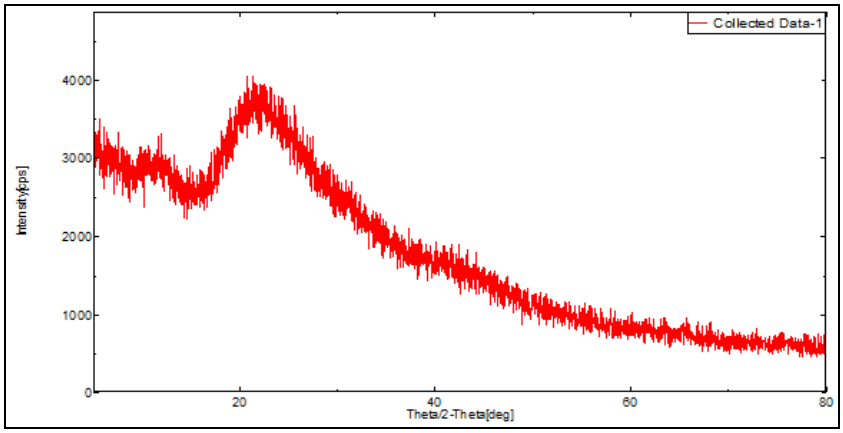

FIG. 1: XRD SPECTRUM OF PVP/GELATIN COMPOSITE FILM

FT-IR (Fourier Transforms Infrared) Analysis: These FTIR tests were meticulously carried out by PNP Analytical Solutions in Baroda, Gujarat (India).

PVP/ Gelatin Composite Film: Fig. 2 shows the FT-IR spectra of PVP/gelatin mix film as in the scope of 2000 - 400 cm^{-1}. The PVP range not shown, and PVP/gelatin films have almost comparative trademark FTIR groups. Range of the mix film shows extreme tops at 1650, 1400 and 1100 cm^{-1} comparing to C=O, C=C and C=N individually. A wide pinnacle situated at 850 cm^{-1} is because of the external face vibration wavering of the hydroxyl bunch (δ O-H). Different pinnacles focused at 1350 and 1100 cm^{-1} are allotted to the internal face-bowing vibrations of the hydroxyl bunch [14].

The spectra of PVP/gelatin films show some distinctions: The rising in the force and moving towards higher wave number of the retention top at around 683 cm^{-1}, relegated to PVP/gelatin extending, compared areas of strength for polymer network [1]. New retention at 775 cm^{-1} to1035 cm^{-1} is noticed. The new groups might be connected similarly to abandon instigated by the charge move response between the polymer chains [1]. The shift of top from 1677 cm^{-1} to 1700 cm^{-1}, showed solid columbic cooperation among PVP and Gelatin. A few scientists have recommended that the moving of the C = O bunch in PVP can be ascribed to the charge of p-π formation related with the amide gathering of PVP emerging from the separation of PVP binds because of the fuse of different species.

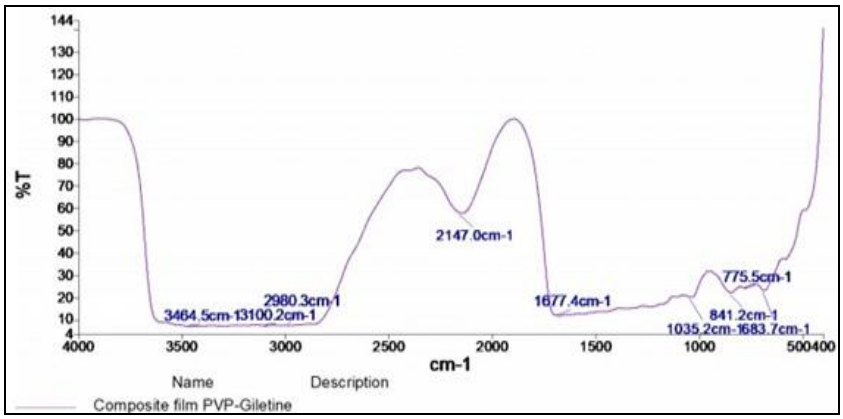

FIG. 2: 60/40 PVP AND GELATIN COMPOSITES FILM

Sample Details 1

Analyst	X-Axis Units	X-Axis start value	X-Axis end value	Number of points	Y-Axis Units
Analyst	cm-1	4000	400	3601	%T

Single Peak Table 1

Peak Number	1	2	3	4	5	6
X (cm-1)	3464.48	3100.22	2980.28	2146.96	1677.45	1035.24
Y (%T)	6.94	7.19	7.27	57.61	11.73	19.91

Single Peak Table 1

7	8	9
841.24	775.46	683.72
21.96	24.03	23.08

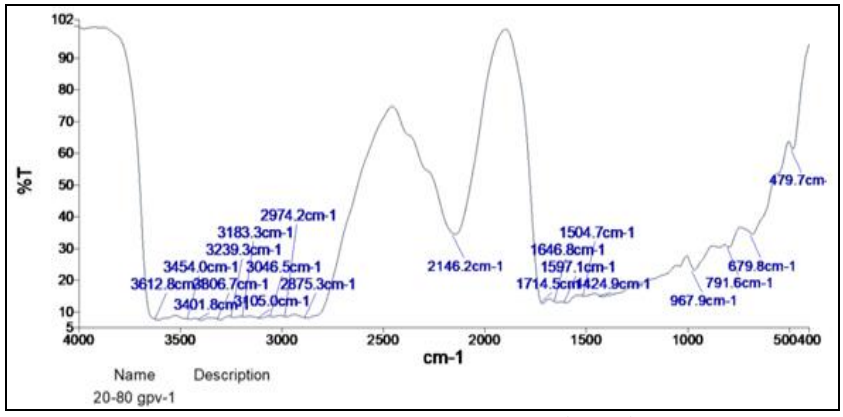

FIG. 3: PVP/GELATIN FILM (20/80)

It is conceivable that the connection between the gelatin and PVP prompts the separations of the collected PVP chains, moving the C=O vibration band. From the summed up spectra highlights recorded above, it very well may be seen that more grounded atomic collaboration exists between polymers [1].

TGA (Thermal Gravimetric Analysis): PNP Analytical Solutions meticulously carried out these TGA tests in Baroda, Gujarat (India). TGA was used to evaluate the thermal behaviour of the gelatin and PVP electrical characteristics. TGA is the most important method for evaluating the thermal stability of polymers. The gelatin TGA curve in **Fig. 4** shows two weight decreases. The evaporation of fluid is what causes weight loss between 50 and 150 ^{o}C. The gelatin molecule degrades around 200–300 0C, resulting in additional weight loss. Water loss is the primary cause of weight loss for nanocomposites with electrical characteristics between 85 and 130 ^{o}C and a weight loss of 18%. The second stage begins at 250–400 °C and results in a weight loss of 48% due to the thermal and oxidative degradation of PVP and gelatin. The third stage begins at 500–700 ^{o}C with a weight loss of 11% due to the incorporation of barium oxide nanoparticles into the matrix of gelatin and PVP [15].

TABLE 1: TGA ANALYSIS

Temperature (^{o}C)	25.59	105.59	215.59	345.59	405.59	445.59	525.59	605.59	735.59
Weight (%)	99.508	90.207	83.873	67.098	54.605	31.844	15.815	13.879	10.463

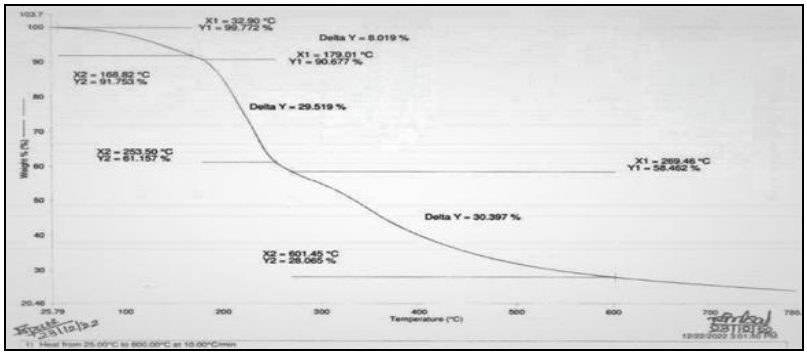

FIG. 4: TGA GRAPH

Sem (Scanning Electron Microscopy): At PNP Analytical Solutions in Vadodara, SEM analytical tests were conducted (Gujarat, India). The films' morphology was investigated using field emission scanning electron microscopy (FESEM). FESEM provides information on the homogeneity of the continuous matrix, the existence of aggregate, the presence of voids, the distribution of nanoparticles within it, and the potential direction of those particles. Surface observations were done on the PVP/Gelatin film after the synthesis [16].

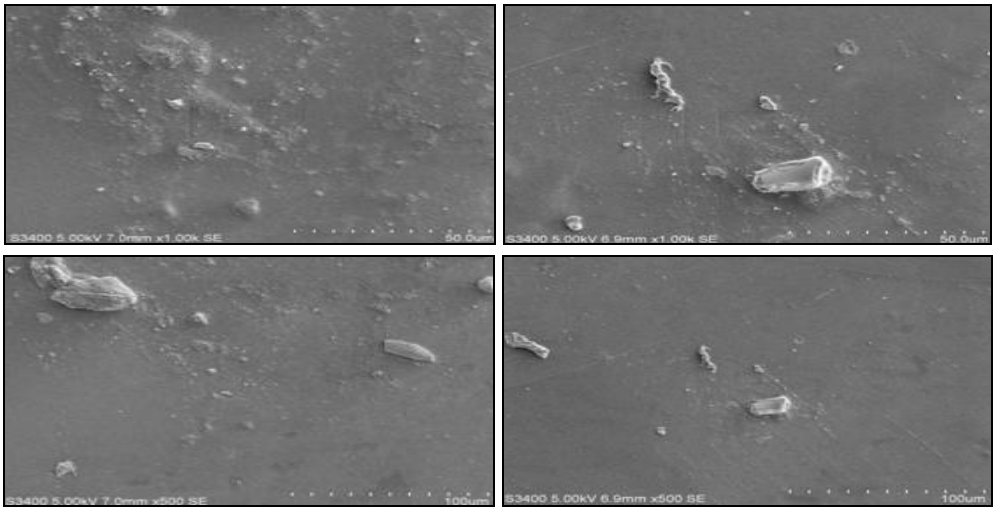

FIG. 5: FESEM IMAGES OF THE SURFACE OF PVP/GELATIN FILM

UV/Vis BaO Nanoparticles: PNP Analytical Solutions, Vadodara, performed UV-Visible analysis testing (Gujarat, India). **Fig. 5** shows the absorbance range obtained at room temperature after UV-Vis spectroscopy was used to examine the optical characteristics of blended BaO-NPs. The writing described the estimating method used. At 341 nm, referred to as the distinctive edge or peak of BaO as disclosed in several literary works, the highest light ingestion was seen. No other retention top that could have been seen in the spectra could have supported the combined BaO-NPs' ownership of solid optical characteristics [17].

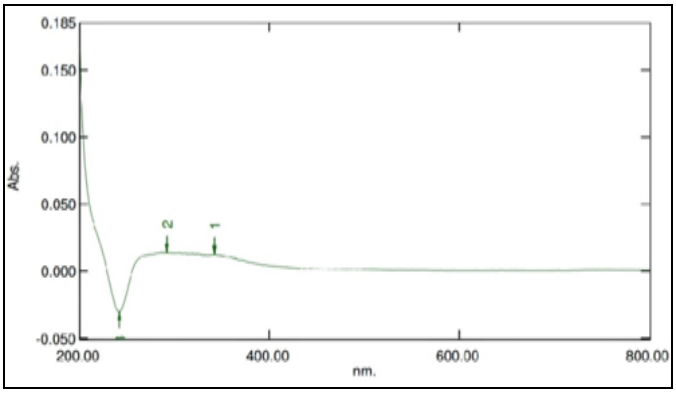

FIG. 6: BAO UV/VIS

CONCLUSION: PVP/gelatin mix and its complex films were arranged to utilize a dissolvable projecting strategy. The XRD study uncovers the indistinct idea of the mixes and their intricate films. Both XRD and FT-IR investigations affirmed the complex arrangement between the polymeric frameworks. Fusing BaO nanoparticles in PVP/gelatin mix expands the charge transporters, which causes a reduction of both the optical band hole and electrical resistivity of the pre-arranged films. The decline in optical band holes on doping levels was relegated to developing the charge move complex in the host cross-section.

The decreased upsides of the optical holes work on their optical reaction. These films can be utilized as microwave sensors. The conductivity study shows that the polymer mix can be doped with BaO nanoparticles to work on its conductivity. The expansion in conductivity is credited to the arrangement of charge move edifices. The workout optical band hole upsides of these materials and the extent of their electrical conductivities of the films propose the chance to consider them for use in the readiness of electronic gadgets [18].

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CONFLICTS OF INTEREST: Declared None

REFERENCES:

1. Anuradha C, Veerabadrarao K and Aravind G: Investigation of Electrical Properties of Pure and Thallium Chloride Doped Poly Vinyl Alcohol Polymer Electrolyte Films. Journal of Engineering Research and Application 2019; 9(6): 13-15.
2. Mallesh Kurakula and Koteswara Rao GSN: Pharmaceutical assessment of polyvinylpyrrolidone (PVP): As excipient from conventional to controlled delivery systems with a spotlight on COVID-19 inhibition. J Drug Deliv Sci Technol 2020; 60(5): 102046.
3. Harris P and Norton IT: Gelatin. Science directs 2nd edition 2003; 60(2):10-15.
4. Hitesh C: Preparation and Evaluation of Chitosan/PVA Based Hydrogel Films Loaded with Honey for Wound Healing Application 2022; 8(2): 111-116.
5. Menazea AA: Physical characterization and antibacterial activity of PVA/Chitosan matrix doped by selenium nanoparticles prepared *via* one-pot laser ablation route 2020; 9(5): 9598-9606.
6. Saeed Adel MN, Al-Gunaid MQA, Nithin Kundachira S, Madhukar BS and Siddaramaiah B: Effect of Cesium Aluminate Nanofiller on Optical Properties of Polyvinyl Pyrrolidone Nanocomposite Films. Polymer-Plastics Technology and Engineering 2017; 57(12): 1188-1196.
7. Jianghao Y: Preparation and property studies of chitosan-PVA biodegradable antibacterial multilayer films doped with Cu2O and nano-chitosan composites. Food Control 2021; 126(10): 1080-85.
8. Alipal J: A review of gelatin: Properties, sources, process, applications, and commercialization 2021; 42(1): 240-250.
9. Karuppusamy T, Velmurugan C and Thirumalaimuthukumaran M: Experimental study on the mechanical properties of heat treated aluminium composites. Materials Research Express 2019; 6(4): 9-10.
10. Bazeera AZ and Amrina MI: Synthesis and Characterization of Barium Oxide Nanoparticles. IOSR Journal of Applied Physics (IOSR-JAP) 2017; 1(5): 76-80.
11. Qi Gu: Hybrid Gelatin Hydrogels in Nanomedicine Applications. ACS Publication 2021; 4(4): 2886–2906.
12. Elashmaw IS, Abdelrazek EM, Hezma AM and Asmaa ME: Multi-walled carbon nanotubes (MWCNTs) filler effects on some physical properties of PCL/PMMA blend films. Research Square 2022; 1(5): 1-5.
13. Sharma D: Development and Validation of Stability Indicating UV-Visible Spectrophotometric Method for Simultaneous Estimation of Neem (Azadirachtin) and Curcumin in Pharmaceutical Tablet Dosage Form. Analytical Chemistry Letters 2019; 9(4): 564-581.
14. Sudha Kamath MK, Harish Kumar HG, Chandramani R and Radhakrishna MC: PVP Influence on PVA crystallinity and optical band gap. Archives of Physics Research 2015; 6(5): 18-21.
15. Archana D, Brijesh KS, Joydeep D and Dutta PK: *In-vivo* evaluation of Chitosan–PVP–titanium dioxide

nanocomposite as wound dressing material. Carbohydrate Polymers 2013; 95(1): 530-539.
16. Kaiwen C, Yern Chee C, Cheng H C, Sabariah J and Nai-Shang L: Preparation and Characterization of Polyvinyl Alcohol-Chitosan Composite Films Reinforced with Cellulose Nanofiber. Advances in Functionalization of Lignocellulosic Materials 2016; 9(8): 644-645.
17. Ansari M A and Jahan N: Structural and Optical Properties of BaO Nanoparticles Synthesized by Facile Co-precipitation Method. Atlantis Press 2021; 1(2): 10-12.
18. Abdelrazek EM, Ragab HM and Abdelaziz M: Physical characterization of poly (vinyl pyrrolidone) and gelatin blend films doped with magnesium chloride. Plastic and Polymer Technology 2013; 2(1): 1-8.

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