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Synthesis Colloidal Platinum Nanoparticles With Variance Silver Ion and Characterization With UV-Vissible Spectrophotometer and TEM Analysis.

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ABSTRACT

Colloidal Platinum nanoparticles have been synthesized with glycerin as matrix and present of silver ions. Thermal oxidation-reduction process used in this synthesis with 10 minutes controlling time at 100^{o}C. Volume of Glycerin controlled 3 ml in 100 ml of solution. Ag present on the surface of platinum clusters. In this research, clusters form and clusters diameter have correlated with the concentrate of silver ions, than as independent variable. These concentrate of silver ions are dependent with clusters form and clusters diameter, than used independent variable in this research. Concentrate of silver ions are 0.3, 0.4, 0.5, 0.6, 0.7, and 0.8 M. Characterization of colloidal platinum nanoparticles used UV-Visible spectrophotometer. The λ maximum absorption of platinum nanoparticles is in the range 200-216 nm. The move of the cluster size can see by the change of the λ maximum absorption at periodical measure. This phenomena show the stability of the colloidal platinum. The form of cluster nanoparticle observed in Transmission Electron Microscopy (TEM) figure. Future prospects of platinum nanoparticle as healthy drink, that is important to study the stability this colloidal. The constant of λ maximum absorption and absorbance inform of the colloidal stability. The conclusion that Ag present have not correlation with stability of colloidal, but correlation with the octahedral form of the cluster.

Keywords: colloidal, platinum, clusters, nanoparticles, stability and absorbance.

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INTRODUCTION

The commonly of the used of nanotechnology in medicine as specifically drug delivery. Today, nanoparticle can reduce toxicity and side effect of drugs in pharmaceutical science. The carrier systems my impose risks to the patient was not realized recently. Nanoparticle used as drug delivery introduce of typical hazards that imposed by only chemicals matrices. The basic interaction of nanoparticle with living cell, organs and organisms have not understanding all, but the reactivity of nanoparticle is be possible. That is new scientific paradigm. A conceptual understanding of biological responses to nanomaterial is needed to develop and apply safe nanomaterial in drug delivery in the future [1].

Platinum black used as catalyst in any chemical reactions. The most important of platinum nanoparticle as a catalytic inverter in automobile. This catalytic inverter allows complete combustion with low concentration. The combustion process give carbon dioxide, water vapor and limit unburned hydrocarbon. Platinum is also used in the petroleum industry as a catalyst in a number of separate processes, but especially in catalytic reforming of straight run naphthalene has into higher-octane gasoline which becomes rich in aromatic compounds [2].

In recent year, interest at platinum nanoparticles increase. That is correlation with the fact that unique properties of this material. The catalytic reactivity dependent on size and shape of platinum nanoparticles and therefore synthesis of controlled shapes and size of these colloidal could be critical in this research and applications. Nanostructured platinum promises unique properties with potential applications [3]. The specific used in healthy drinks and medicines. Colloidal platinum in aqueous solution has been known for many decades. In most methods of preparation ions of platinum are reduced. The most popular synthesis method by reduction of H_2PtCl_6 with citrate solution [3].

Anticancer drugs with platinum compounds used in chemotherapy and so have anti tumors activity. The manufacture of the silicone rubber used platinum as catalyst. That is doing too in many process organs form: breast implants, joint replacement prosthetics, artificial lumbar discs, vascular access ports, etc. Platinum compounds are possible in human body, that adverse effect has been study. [4]. Platinum compounds have not toxicity in vivo and recommended by Food and Drug Administration and other institutions. [5]. Chemotherapeutic agent of cancer drugs including antineoplastic drugs with platinum compounds. They are coordination complexes of platinum. The side effect of platinum compounds that use in cancer treatment can be limited by the main dose. The side effects are neurotoxicity that causes peripheral and neuropathies that polyneuropathy including [6]. Platinum-based antineoplastic agents causes crosslinking of DNA as mono adduct, inter strand crosslinks, intra strand crosslinks or DNA protein crosslinks. DNA repair process and DNA synthesis in cancer cell inhibited by resultant of crosslinking bond of platinum compounds. Sometimes, antineoplastic agent with platinum-based compounds described as "alkylating-like" due to similar effects as alkylating antineoplastic agents, although they do not have an alkyl group [7].

Antioxidant effect of platinum nanoparticles have shown extension significantly. Pt nanoparticles significantly reduced the accumulation of ROS indicating that Pt nanoparticles have more potent SOD/catalase. Pt nanoparticle has interesting anti-ageing properties [8].

The high antioxidant effect of platinum cause the platinum is very good to application in healthy drink. It is necessary to get stability of the platinum colloidal. This research designed to synthesis and characterization of platinum colloidal or platinum nanoparticles. The platinum colloidal stability got by measure λ maximum absorption and absorbance with UV-Visible spectrophotometer at periodical time. The changes λ maximum absorption and absorbance every week were correlation with stabile value of colloidal. The change λ maximum absorption was correlation with the size of cluster, when the cluster to be bigger the λ maximum absorption go to little value. If the size of cluster changes periodical time from little to bigger and little again show that colloidal condition was stability. The changes absorbance correlated with cluster concentrate in the colloidal system. When the absorbance changes (decrease or increase) at periodical time was showed that the cluster is in the dynamic equilibrium. This condition was care the stability of colloidal platinum. TEM analysis used to get size and form of the authentic cluster platinum nanoparticle.

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MATERIAL AND METHOD

Material

Platinum ions (H_2PtCl_6), silver ions ($AgNO_3$), glycerin and sodium citrate were obtained from Sigma (www.sigmaaldrich.com,USA). 1,000 ml of water, All chemicals and solvents used were of analytical grade and were used as received. All solutions were made up with twice-distilled water. Platinum colloids were prepared according to the literature by adding 3 g sodium citrate solution to 100 ml boiling solution of H_2PtCl_6 20 ppm. The size of the prepared Platinum colloids or Platinum Nanoparticles was about 6-10 nm, which was estimated from transmission electron microscopy (TEM) JEOL/E0 version 1.0 JEM-1400.

Method

Glycerin (3 ml) dissolved in 95 ml of water was prepared in double distilled water. The solution boiled at temperature of 100^{o}C. Sodium citrate about 3 g is added in boiling solution and then exposed to a solution of H_2PtCl_6 about 20 ml 1000 ppm. The specific concentrate of the silver ions are 0.3, 0.4, 0.5, 0.6, 0.7 and 0.8 M. The synthesis was carried out for 10 minutes. Characterization synthesis result with UV-Vis Spectrophotometer and transmission electron microscopy TEM[3].

RESULTS

Data from UV-Vis Spectrophotometer are λ maximum absorption and absorbance of the colloidal platinum. The λ maximum absorption was correlation with size of the cluster diameter platinum nanoparticle, that absorbance was correlation with clusters concentration in the colloidal system. The changes of λ maximum absorption confirm that the clusters were to be change too. If λ maximum change to bigger value, the clusters change to be bigger too. The absorbance was correlation with clusters concentrate in the colloidal system. If the absorbance was decrease, concentration of clusters in the colloidal system was decrease too. This condition was occur that any clusters were aggregation to big clusters. Big clusters were falling down in the base colloidal system, then colloidal system will be transparent or colorless.

Table 1: The date of λ maximum absorption and absorbance Platinum Nanoparticles every weeks at ions silver 0.3 M.

Week	λ maximum	Absorbance
Week 1	201.80	3.647
Week 2	212.60	3.592
Week 3	211.40	3.749
Week 4	204.20	3.712
Week 5	214.87	3.998
Week 6	214.80	3.449

The present ions silver 0.3 M in synthesis process give λ maximum and absorbance platinum nanoparticle every week in Table 1. Clusters diameter was change bigger at week 2 and relative stabile in week 3, than in week4 the diameter of colloidal platinum was smallest. Clusters diameter was change to be big again at week 5 and relative stabile in week 6. This Phenomena that show if the stability of colloidal in the dynamic equilibrium and not be stopped. Clusters aggregation was being occur in week 2 and week 6, its can see that absorbance decrease in these weeks, and then that cluster smaller in other weeks.

Table 2: The date of λ maximum absorption and absorbance Platinum Nanoparticles every weeks at ions silver 0.4 M.

Week	λ maximum	Absorbance
Week 1	201.80	3.571
Week 2	212.60	3.592
Week 3	204.20	3.703
Week 4	202.80	3.619
Week 5	202.40	3.980
Week 6	215.00	3.387

The present ions silver 0.4M in synthesis process give λ maximum and absorbance platinum nanoparticle every week in Table 2. Clusters diameter was change bigger at week 2, than in week 3 the diameter of colloidal platinum was to be small again and relative stabile in week 4 and week 5. Clusters diameter was change to be bigger at week 6. Clusters aggregation was being occur in week 2 and week 6, its can see that absorbance decrease in these weeks. At the bigger of the cluster, the concentration of cluster in colloidal system decrease.

Table 3: The date of λ maximum absorption and absorbance Platinum Nanoparticles every weeks at ions silver 0.5 M.

Week	λ maximum	Absorbance
Week 1	201.20	3.599
Week 2	214.40	3.625
Week 3	203.20	3.927
Week 4	202.60	3.627
Week 5	209.80	3.998
Week 6	215.40	3.426

The present ions silver 0.5 M in synthesis process give λ maximum and absorbance platinum nanoparticle every week in Table 3. Clusters diameter was change bigger at week 2, than in week 3 the cluster be small and week 4 and 5 the diameter of colloidal platinum was relative stabile. Clusters diameter was change to be big again at week 6. Clusters aggregation was being occur in week 2 and week 6, its can see that absorbance decrease in these weeks and in the small cluster in other weeks.

Table 4: The date of λ maximum absorption and absorbance Platinum Nanoparticles every weeks at ions silver 0.6 M.

Week	λ maximum	Absorbance
Week 1	207.00	3.775
Week 2	212.60	3.592
Week 3	209.20	3.790
Week 4	204.40	3.558
Week 5	204.40	3.997
Week 6	214.60	3.371

The present ions silver 0.6 M in synthesis process give λ maximum and absorbance platinum nanoparticle every week in Table 4. Clusters diameter was change bigger at week 2 and in week 3 the cluster to be small, than in week 4 and 5 diameter of colloidal platinum was relative stabile. Clusters diameter was change to be big again at week 6. Clusters aggregation was being occur in week 2 and week 6, its can see that absorbance decrease in these weeks.

Table 5: The date of λ maximum absorption and absorbance Platinum Nanoparticles every weeks at ions silver 0.7 M.

Week	λ maximum	Absorbance
Week 1	212.80	3.516
Week 2	212.60	3.592
Week 3	202.80	3.890
Week 4	202.60	3.488
Week 5	204.00	3.984
Week 6	215.00	3.263

The present ions silver 0.7 M in synthesis process give λ maximum and absorbance platinum nanoparticle every week in Table 5. Clusters diameter relative stabile in week 2 and it was change smaller at week 3 then in week 4 and 5 relative stabile. The diameter of colloidal platinum was bigger in week 6. Clusters aggregation was being occur in week 2 and week 6, its can see that absorbance decrease in these weeks.

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Table 6: The date of λ maximum absorption and absorbance Platinum Nanoparticles every weeks at ions silver 0.8 M.

Week	λ maximum	Absorbance
Week 1	205.20	3.858
Week 2	204.20	3.403
Week 3	201.80	3.777
Week 4	208.20	3.703
Week 5	205.80	3.999
Week 6	216.40	3.402

The present ions silver 0.8M in synthesis process give λ maximum and absorbance platinum nanoparticle every week in Table 6. Clusters diameter was stabile in week 2 and change smaller at week 3, than in week 4 the diameter of colloidal platinum was bigger again. Clusters diameter was change to be small at week 5 and bigger again at week 6. Clusters aggregation was being occur in week 2 and week 6, its can see that absorbance decrease in these weeks.

DISCUSSION

The same phenomena that occur in the variance of Ag present in the synthesis result. The stability of colloidal platinum show that in the dynamic equilibrium for every weeks. The change of the size of the cluster occur in every weeks and the same phenomena at week 2 and week 6 always in the big cluster. In these weeks aggregation of any cluster that occur and the activity of big cluster not good. The optimum activity of nanomaterial is in the small cluster. In this research the variance of Ag present not correlation with the stability of colloidal platinum that resulted. The size of the cluster change every weeks and occur at every concentrate of Ag.

The major parameter to control particle shape of metal nanoparticle in solution phase synthesis can be added foreign ions. Xia et al. told that the present foreign ions give morphology changes of noble metal nanoparticles in synthesis process. The noble metal including Ag, Pa and Pt. [9]. They observed that chloride ions and oxygen in the reaction mixture preferentially dissolved twinned particles initially formed during reduction and led to selective formation of single crystalline products such as truncated tetrahedral and cubic octahedral [10]. In another study, trace amounts of iron chloride slowed the reduction of Pt(II) species, inducing optimal anisotropic growth condition during a poly-OH process to form agglomerates of single-crystalline Pt nanowires rather than small (<5 nm) Pt crystallites which formed The synthesis of 9 nm Pt nanoparticles of well-defined shape with the use of silver ions and surface template polymers in protect solvents has been demonstrated. Addition of increasing amounts of $AgNO_3$ to refluxing EG followed by slow introduction of $H_2PtCl_6.6H_2O$ led to the formation of cubes, cubic octahedral and octahedral with shape uniformity greater than eighty percent. The Pt nanoparticles are incorporated into a miso porous silica matrix by hydro-thermal growth and encapsulation in aqueous solution [11].

Table 7: The date of λ maximum Platinum Nanoparticles at any concentrate ions silver every weeks

Week	Ions silver 0.3M	Ions silver 0.4M	Ions silver 0.5M	Ions silver 0.6M	Ions silver 0.7M	Ions silver 0.8M
Week 1	201.80	201.80	201.20	207.00	212.80	205.20
Week 2	212.60	212.60	214.40	212.60	212.60	204.20
Week 3	211.40	204.20	203.20	209.20	202.80	201.80
Week 4	204.20	202.80	202.60	204.40	202.60	208.20
Week 5	214.87	202.40	209.80	204.40	204.00	205.80
Week 6	214.80	215.00	215.40	214.60	215.00	216.40

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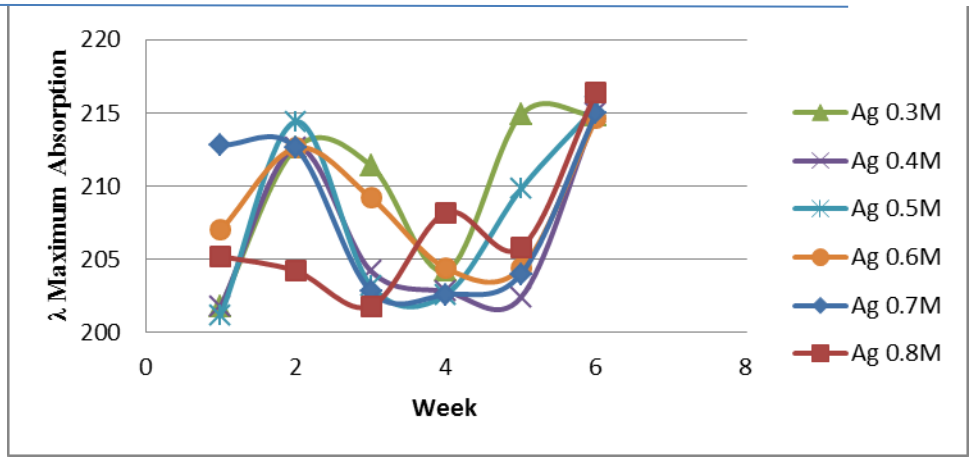

Figure 1: The changes λ maximum absorption Pt nanoparticles every week at different ions Ag concentrate.

The present of silver ions at variation concentrate in this synthesis process was not yet clear. The λ maximum absorption and absorbance of platinum nanoparticle was being changes every week. It is give information that the present ions silver at different concentration was not significant correlation. The stability of colloidal system was secure at all variation concentrate. It is can see from changes of diameter cluster bigger, smaller and bigger again every week. The clusters concentrate of colloidal system in the dynamic equilibrium. It is can see from the change absorbance of colloidal. It was decrease, than increase and decrease again. The condition of all colloidal system can see at Table 7 and to be clear can see at Figure 1.

The date week 1, the variation of ions silver concentrate was not correlation with λ maximum absorbance. The same condition was being occur in week 2, week 3 and others weeks. The clusters diameters change from big to small and change to be big again. It was give information that the clusters diameter in the dynamic equilibrium every week or every time. Aggregation process was being occur any time and after that the cluster move on small again. The stability of cluster diameter secure in the colloidal system of platinum nanoparticle at week 1 until week 6. It is to be able in the pharmaceutical formulation include healthy drink.

Table 8: The date of Absorbance Platinum Nanoparticles at any concentrate ions silver every week.

Week	Ions silver 0.3M	Ions silver 0.4M	Ions silver 0.5M	Ions silver 0.6M	Ions silver 0.7M	Ions silver 0.8M
Week 1	3.647	3.571	3.599	3.775	3.516	3.858
Week 2	3.592	3.592	3.625	3.592	3.592	3.403
Week 3	3.749	3.703	3.927	3.790	3.890	3.777
Week 4	3.712	3.619	3.627	3.558	3.488	3.703
Week 5	3.998	3.980	3.998	3.997	3.984	3.999
Week 6	3.449	3.387	3.426	3.371	3.263	3.402

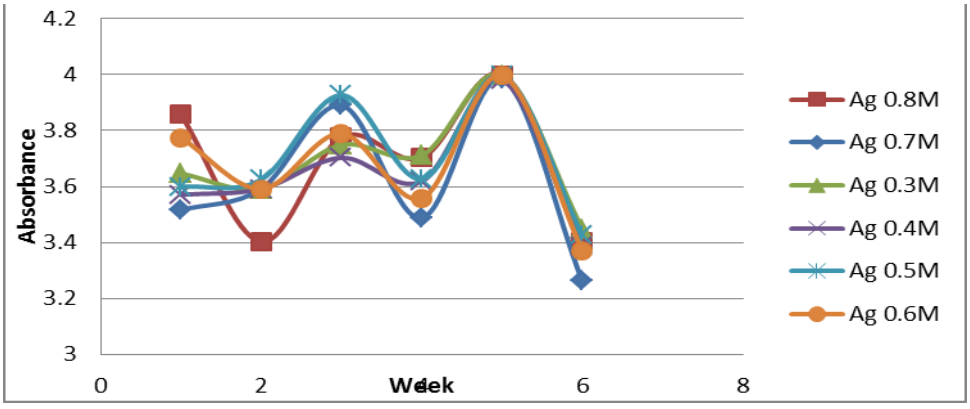

Figure 2: The Changes Absorbance Pt nanoparticles every week at different ions Ag concentrate.

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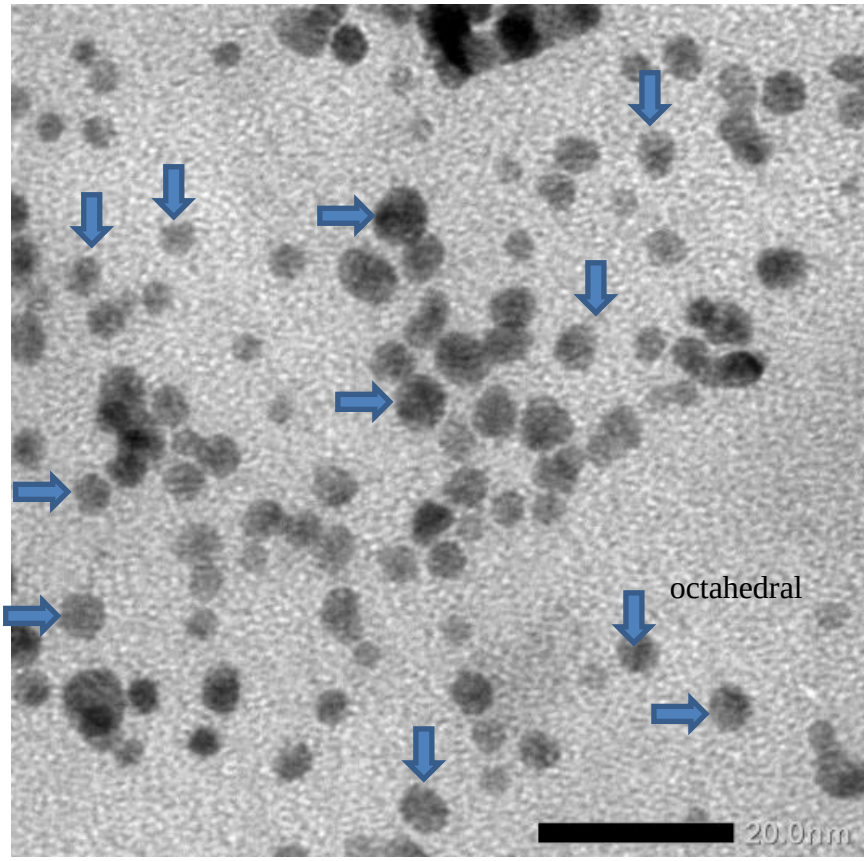

Figure 3: TEM picture of platinum nanoparticles (octahedral)

Diameter of cluster platinum nanoparticle can see from TEM picture. The small cluster has 2 nm in the diameter and the big one has 6 nm in the diameter. The form of clusters were any kind, there is cubic, octahedral and combination of both (cubic-octahedral). Cubic-octahedral can formed if 2 clusters (cubic form and octahedral form) were aggregation. The little cluster has octahedral form. It is important form and size because has biggest antioxidant effect and catalyst effect. The present octahedral form was increase at the concentration of silver ions increase too. Octahedral form has biggest area and give contribution and very good as catalyst. Future prospect of platinum nanoparticle was as healthy drink. Platinum nanoparticles with high antioxidant effect can secure healthy of body by helping antioxidant endogen. It was necessary to synthesis this colloidal in octahedral form and small in diameter. In this research octahedral form of these clusters relative so many to be resulted than others form. The present of Ag caused octahedral form and small cluster get optimal in the synthesis process. The Glycerin caused that the cluster is in the uniform size (2-6 nm).

CONCLUSION

The stability of colloidal platinum show that in the dynamic equilibrium for every weeks. The change of the size of the cluster occur in every weeks and the same phenomena at week 2 and week 6 always in the big cluster. In this research the variance of Ag present not correlation with the stability of colloidal platinum that resulted. The size of the cluster change every weeks and occur at every concentrate of Ag.

TEM analysis conclusion that the clusters diameter of platinum nanoparticle was synthesized in the range 2-6 nm. In this research octahedral form of these clusters relative so many to be resulted than others form. The present of Ag caused octahedral form and small cluster get optimal in the synthesis process. The Glycerin caused that the cluster is in the uniform size (2-6 nm).

It is important to synthesis platinum nanoparticle in the little size and in the octahedral form because has biggest antioxidant effect and catalyst effect. This form is very good to used healthy drink.

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REFERENCES

[1] Wim H, D. J., & Paul JA, B., *Drug delivery and nanoparticles Applications and hazards*., Int J Nanomedicine , **3**(2), pp.133-149, 2008.

[2] Krebs, R. E, *"Platinum", the History and Use of our Earth's Chemical Elements*. Greenwood Press ISBN 0-313-30123-9, pp.124-127, 1998.

[3] Sarala, D., & VJ, R., *Room temperature synthesis of colloidal platinum nanoparticles*. Bull. Mater. Sci **23**(6) Indian Academy of Sciences, 467-470, 2000.

[4] Brook, M. (2006). *Platinum in silicone breast implants. Biomaterials,* J. Biomaterials, **27**(17), pp. 3274-3286, 2006.

[5] FDA, *Backgrounder on Platinum in Silicone Breast Implants.*(2008-09-09)*U.S*:Http://web.archive.org/web/20080724070851/http://www.fda.gov/cdrh/breastimplants/platinum.html. *U.S. Food and Drug Administration Archived from the original* (http://www.fda.gov/cdrh/breastimplants/ platinum.html) on 2008-07-24.

[6] Donzelli, E., Carfi, M., Miloso, M., Strada, A., Galbiati, S., Bayssas, M., Tredici, G., *Neurotoxicity of platinum compounds: Comparison of the effects of cisplatin and oxaliplatin on the human neuroblastoma cell line SH-SY5Y*. Journal of neuro-oncology, **10**(23), pp. 67-73, 2004.

[7] Cruet, H. S., Glynn, M., Murillo, L., Coyne, S., & Carty, M., *Enhanced DNA-PK-mediated RPA2 hyperphorylation in DNA polymerase eta-deficient human cells treated with cisplatin and pxaliplatin*, DNA Repair (Amst.) **7**(4), pp. 582-596, 2007.

[8] Kim j, T., Shimizu, T., Shirasawa, T., Kajita, M., Kanayama, A., & Miyamoto, *Effects of a potent antioxidant, platinum nanoparticle, on the lifespan of Caenorhabdities elegans*, Mech Ageing Dev, PubMed-NCBI, **129**(6), pp. 322-331, 2008.

[9] B. Wiley., Y. Sun., B. Mayers, Y.Xia, *Introduction of foreign ion in synthesis platinum nanoparticle*. Chem.Eur.J 11, pp 454, 2005.

[10] J. Chen., T. Herrics., M. Geissler., & Xia Y., *The Chloride ions and oxygen effect in synthesis platinum nanoparticle*. J Am. Chem.Soc 126, 10854, 2004.

[11] R.M'Riouxa, & H, Songa., *Monodisperse platinum nanoparticles of well-defined shape : Synthesis, characterization, catalytic properties and future prospects*, Topics in Catalysis Vol.39, pp. 3-4, 2006.