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Effects of gold nanoparticles on SKBR3 breast cancer and CRL-4010 non cancer cells

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ABSTRACT

The newly synthesized gold nanoparticles have been getting extraordinary medical and social interests because of their potential physico-synthetic properties as higher affinity, low molecular weight, and larger surface area. In this work, a drug capped gold nanoparticles (Au-NPs) were synthesized to check the effects of these nanoparticles (50µg/mL) on SKBR3 breast cancer and CRL-4010 non cancer cells. The biological properties of these AuNPs were excellent in the SKBR3 human breast cancer cells. In brief, we conclude that these gold nanoparticles have anticancer potentiality and can be an alternative for the treatment of SKBR3 breast cancer cells; further studies are mandatory to confirm our preliminary findings.

Keywords: Gold nanoparticles, p53, NFkB, Caspases, SKBR3 cells, Apoptosis

1. Introduction

AuNPs has various industrial, nano-biotechnological and medical applications these days. We can see the advancement of nanoparticle synthesis and their methods. As their characteristics always change from bulk to nanoscale level and by using these changes, they have many shapes such as rod, oval, nanostructures etc. which can enhance their features, especially tensile strength, resistance in conductivity, characteristics of nano-magnetic and optic properties (Duncan, 2011).

Some methods include the chloroauric acid (HAuCl4) for reduction of gold with the help of citrate solutions to synthesis of gold nanoparticles. As these methods need help from capping and stabilizing agents, which should be optimized before use in experiment. In some methods, gold precursors were used as a metallic salt of chloroauric acid of different concentrations to make nanoparticles with different shapes such as nanorods, nanostructures, nanowires, spherical, triangular etc (Arshad et al., 2019; Safdar et al., 2021a; Safdar et al., 2021b; Ahiwale et al., 2017).

Some authors also explained CTAB method for the synthesis of gold nanoparticles. It worked slowly at initial level but after capping of gold metal it reacted fastly. This method has one disadvantage such as low stability of newly synthesized nanoparticles (Bayahia et al., 2017).

Recently, a unique approach consisting oxidation-reduction reaction at room temperature was used to synthesize zero dimensional, hollow and nanoporous gold nanoparticles (Francis et al., 2017). This novel and zero-dimensional method for the synthesis of gold nanoparticles was included large density with extremely active surface sites, mass diffusivity and specific electro-active area. The size-dependent behavior of gold nanoparticles and their nano-related property have tremendous potential of AuNPs in rodent brain cancer treatment; because the experimental studies have shown great potential for AuNPs. They are being used as labeling material in medical specialty and they could be used as medicine tool for various diseases (Agnihotri et al., 2014) such as peste des petits ruminants (PPR). This disease protein could be used with the mixture of AuNPs for the preparation of PPR diagnostic strips.

Cancers of the breast, colon, rectum, anal canal and anus, and leukemia were the second and third most frequently seen cancers, respectively. Cancer progression and malignant growth is related to activation of caspases (CASPs) in Fig. 1.

Fig. 1. Mechanisms of AuNPs on breast cancer cells

In our hypothesis, effect of gold nanoparticles (AuNPs) can be effective on the expression levels of p53 in breast cancer line (SKBR3) and mammary epithelial cell line (CRL-4010).

2. Material and Methods

2.1. Preparation of AuNPs

AuNPs has been synthesized with the help of antibiotic drug and then has been characterized by various techniques such as UV Visible, FTIR, SEM, TEM and XRD. At the end we had application of it on SKBR3 breast cancer and breast normal cells.

2.2. Cell culture

Breast cancer cell line (SKBR3) and immortal breast epithelial cell line (CRL-4010) (LGC Promochem, Teddington, UK) were cultivated. At the end of 24 hours, the cells were harvested for total RNA isolation.

2.4 Gene expression analysis

cDNA was collected using reverse transcription assay kit (Qiagen, Germany). Gene expression levels of TLRs, p53, NFkB and the GAPDH (housekeeping gene).

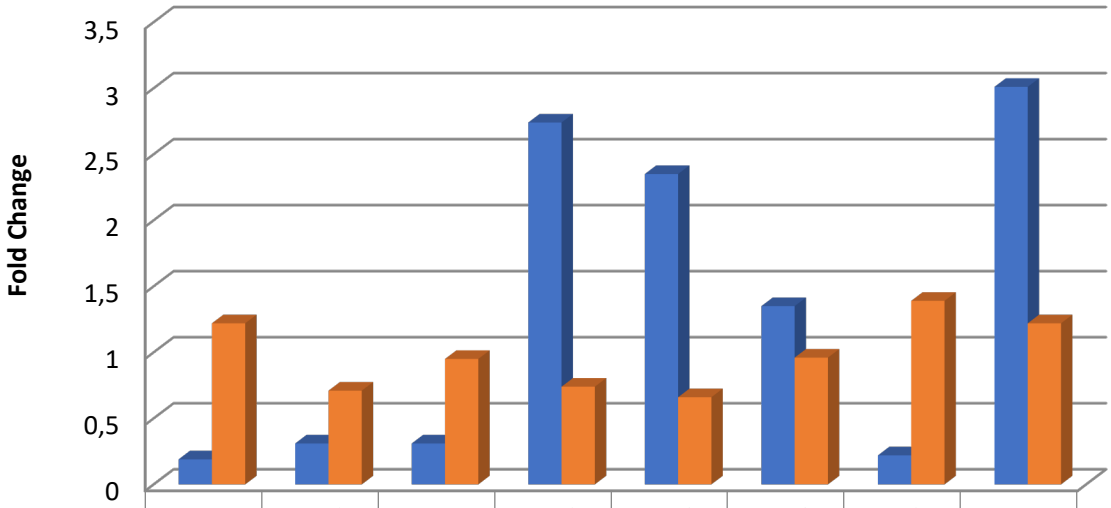
2.5 Statistical study

Collected data were analyzed using Corbet Rotor-Gene software. Fold change ($2^{-\Delta\Delta Ct}$) values among 0.1 to 0.5 were measured as significant downregulation while >2.0 was measured significant upregulation.

3. Results and Discussion

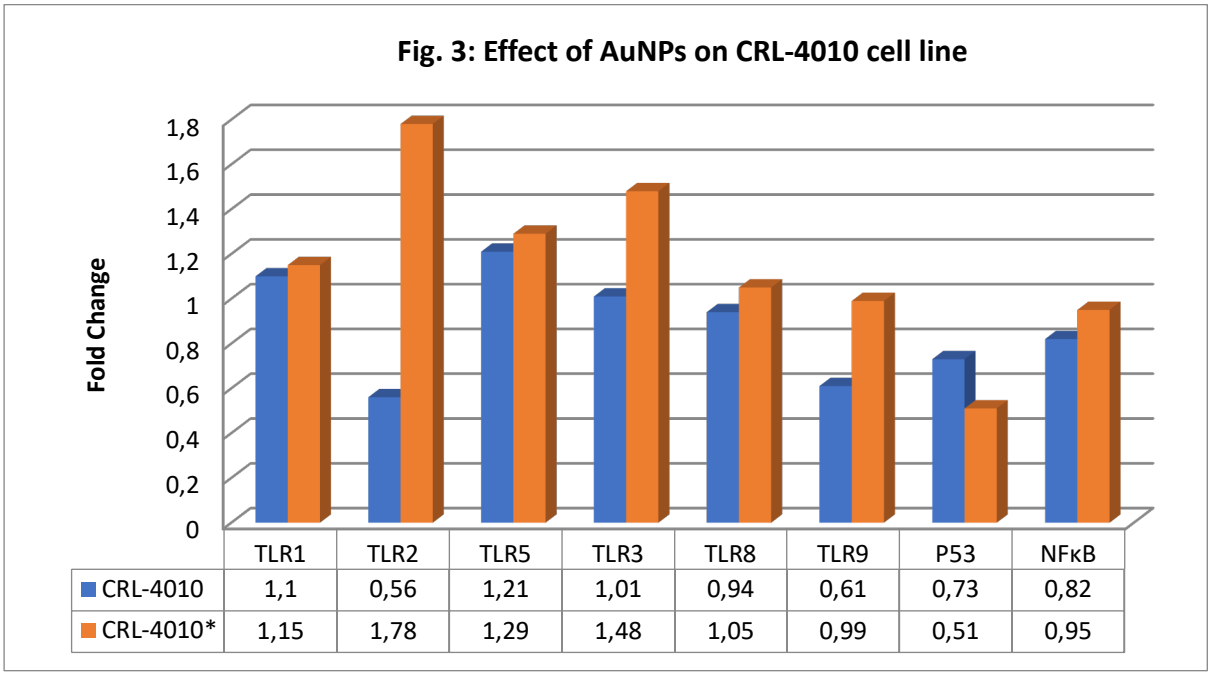
Real-time PCR (qRT-PCR) was used to measure the expression level of TLRs after the treatment of AuNPs. We observed that TLRs expression levels in SKBR3 breast cancer cell line was decreased due to AuNPs. While on the other hand expression levels of TLRs in SKBR3 breast cancer cell line was increased. In addition, the upregulation of p53 and simultaneous downregulation of NF-kB after AuNPs treatment suggested the presence of a crosstalk between these two important cellular pathways. This is one of the pioneer studies in its uniqueness and it depicts an association between the NFκB, p53 and TLRs after the treatment of AuNPs (Fig. 2&3).

Fig. 2: Effect of AuNPs on SKBR3 cell line



	TLR1	TLR2	TLR5	TLR3	TLR8	TLR9	P53	NFκB
SKBR3	0,19	0,31	0,31	2,74	2,35	1,35	0,22	3,01
SKBR3*	1,22	0,71	0,95	0,74	0,66	0,96	1,39	1,22

Fig. 2. Effects of AuNPs on TLRs of SKBR3 cell line with (Red) and without (blue) AuNPs by qRT-PCR.



	TLR1	TLR2	TLR5	TLR3	TLR8	TLR9	P53	NFκB
CRL-4010	1,1	0,56	1,21	1,01	0,94	0,61	0,73	0,82
CRL-4010*	1,15	1,78	1,29	1,48	1,05	0,99	0,51	0,95

Fig. 3. Effects of AuNPs on TLRs of CRL-4010 cell line with (Red) and without (blue) AuNPs by qRT-PCR

4. Conclusion

The expression levels of TLRs in breast cancer cell lines were increased/decreased on a particular concentration (50µg/mL) of gold nanoparticles. In addition, the upregulation of p53 and downregulation of NF-kB after AuNPs treatment displayed a pathway. Our results demonstrated that expression levels of NFκB, p53 and TLRs genes were changed following the treatment of particular AuNPs**.**

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Conflict of interest

Authors do not have conflict of interest.

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