Utilization of miswak silver nanoparticles biology essay

Science, Biology

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Abstract

Nanotechnology can be regarded as one of the most wanted field of research in the present scientific world. Even though the synthesis of nano particles can be done by means of physical as well as chemical methods , the method of green synthesis is the most demanding. It can be used to treat a wide variety of diseases. Here in the current study, the synthesis of silver nanoparticles from the extracts of miswak(Salvadora persica) that can be used to treat peridontitis has been developed. Periodontitis is a severe oral problem that is currently treated using surgical methods and antibiotics which is mediocre and painful. The production of silver nanoparticles from miswak is done at first. The antimicrobial activity is also checked and the results are analysed.

Keywords

Peridontitis, Porphyromonas gingivalis , Silver nanoparticles , Salvadora persica (miswak)

Introduction

Nanotechnology is one of the most emerging fields in modern science. It is defined as the science which deals with th nano sized particles). It affects the human life in a number of ways (Singh et al 2010). It has a large number of applications in industrial as well as medical sectors. The applications in

industrial sector ranges from electronic and computer chips development, cosmetics, foot wear etc . In the field of medicine, nanotechnology has been employed in delivering drugs, heat, light or other substances to specific types of cells especially cancer cells. Particles are engineered in such a way that the diseased cells attracts them allowing direct treatment of those cells. The damage to healthy cells while using nanoparticles is minimal or nil making them a good option for tumor treatment. Moreover nanoparticles have been employed in diagnostic techniques, treating pathogenic diseases , repairing of damaged cells etc. The conventional methods of synthesising nanoparticles include physical and chemical methods . This includes micelle formation, sol process, chemical precipitation, hydrothermal method, chemical vapour deposition and pyrolysis (Leela and Vivekanathan 2008) . Nanoparticles are produced from elements like gold, silver , bismuth and many other metals (Roy and Barik 2010), . Some of these methods are very easy to perform but the general stability of the product is sometimes compromised. Moreover it is energy inefficient and needs more capital support for the research purposes (Klaus et al 2001). To overcome these defects , biosynthesis or green synthesis of nanoparticles have been employed. It is more or less affordable process . Besides this it is environmental friendly and biocompatible (Govindraju et al 2010). For the biosynthesis of nanoparticles, both plants and microbes(bacteria and fungi mostly) can be used. In bacteria and fungi, the development of nanoparticles take place intracellularly (Mandal et al 2006). In the case of plants, their extracts are used for the production of nanoparticles. Here the time used for the development is very less when compared to those from microbial origin.

moreover they can be easily scaled up(Shankar et al 2004)This can be considered an advantage. As aresult of this a large number of traditionally used medicinal plants have been used up in the industries to develop nanoparticles out of it and produce more efficient medicines. Periodontitis is a group of inflammatory diseases which affects the tissues surrounding and supporting the teeth. It is caused by the organism Porphyromonas gingivalis. This organism is seen in the gingival region of the mouth as well as the gastrointestinal tract , respiratory tract and colon.. It cannot form biofilms as such. in the oral partsIt needs the support of yet another group of colony forming bacteria called Streptococcus gordonii . At first the Streptococcus gordonii establishes itself on the surface of teeth and the gingival areas. Then the pathogen for periodontitis comes and attaches to the surface with the help of its fimbriae and forms the biofilm. It leads to the deposition of metabolites leadin to dental plaques and finally tooth decay (Savage et al 2009). Later it leads to peridontitis condition and if left untreated it leads to the degradation of the alveolar bone , loosening of the teeth and finally their fall out . It also leads to many other disorders in the body including heart failure(Pussinen et al 2004), stroke(Pussinen et al 2007), artheroscleroris (Ford et al 2007 , Beck et al 2007 Scannapieco et al 2003, Wu et al 2000, Beck 2001, Elter et al 2004 , Humphrey , 2008) and rheumatoid arthritis. The common treatments for the problem of periodontitis includes administration of antibiotics like doxycyclin and in severe cases surgical methods. The main consideration is that the development of biofims or individual colony development is seen within 6 to 7 hours after the periodontal surgery also which means it is a tedious process to remove this pathogen completely and

also their treatment in some way or the other is quite tough. Moreover the current methods of treatment are painful and stress generating. So the scope of using traditional medicines for this are to be considered in the present scenario. A large number of traditional medicines and practices exist all around the world for the treatment of oral related problems. The most commonly used natural products include Neem (Azadirachta indica), Cloves(Syzygium aromaticum) and Miswak (Salvadora persica). Miswak is infact the tooth cleaning twig developed from the twigs of Salvadora persica tree. The usage of these twigs have been practised over centuries for the purpose of cleaning teeth. World Health Organization has approved the usage of its fibrous branches for maintaining the oral health. It is found to have Carbohydrates , Trimethylamine-an alkaloid, Salvadorine, Chlorides, Terpenes, Sulphur, VitaminC, Tannins, Saponins, Flavanoids and Sterols also fluorides(Almas and Khalid 2002, Amro et al 2007 , Batwa et al 2006 , Araya and Yoseph 2008 , Spina and Mary 1994).. These chemicals aid in their antimicrobial properties. The activity of Miswak twigs are found to be almost similar to that of tricolsan and chlorhexidine (Almas 2002, Almas et al 2005). . The activity of these can be improved by the introduction of nanoparticles to it. Silver nanoparticles can be produced from a large number of plant species (Arshad et al) In the present study the development of Silver nanoparticles from miswak extracts is done. The characterisation of the silver nanoparticles is performed . The antimicrobial activity of these silver nano particles on the Porphyromonas species is also determined.

Materials and Methods

Miswak twigs were purchased from the local market of Trivandrum. The media to be used including nutreint broth, Luria Broth (LB) , MH agar and Agar agar were purchased from Himedia. Besides this the silver nanoparticles for the preparation of silver nanoparticles were also purchased.

Preparation of Miswak extracts

The miswak twigs were ground into fine powder using mortar and pestle. 5g of it was weighed and dissolved in 20ml of distilled water. It was kept for cooling for 1 hour at 4°C. Later it was taken and subjected to centrifugation at 2500rpm for10 minutes. The supernatant wer e collected and again the pellet was subjected to centrifugation. Extract was kept for further use.

Development of silver nanoparticles from miswak extract

For synthesis of silver nanoparticles , 50ml of 0. 03 M AgNO3 was prepared at first. It was made sure that the water is double distilled inorder to prevent the precipitation of silver. Moreover the flasks in which silver nitrate is prepared is wrapped with aluminium foil paper. Different volumes of the miswak extracts were allowed to react with the silver nitrate solution and is shaken well. The flasks were kept for incubation. The development of silver nanoparticles is determined by the change in colour of the solution from colourless to brown. They are used for the testing of the antimicrobial activity.

Bacterial sample preparation

The bacteria Porphyromonas gingivalis was isolated from the gingival and palatal region using cottom swabs and inoculated in LB broth and incubated for 24hours. This is done inorder to develop bacterial population to large numbers.

Development of colonies

The developed bacterial population in the Luria broth was tansferred into the prepared luria agar plates. It was subjected to streaking . The agar plates were kept at 37°C and 24 hours incubation so that individual colonies were developed . The individual colonies were subjected to subculturing in freshly prepared media.

Antimicrobial activity testing

The antimicrobial activity of miswak silver nanoparticles was identified using Kirby Bauer’s Disc Diffusion method (Bauer et al 1966).. Here bacterial population developed from Luria broth was inoculated by means cotton swabs into the freshly prepared 4mm thick MH agar . The filter paper discs impregnated with known concentrations of silver nanoparticles, meswak extracts and silver nitrate solution were kept on the MH agar plates and incubated at 37°C. A dics soaked with sterile distilled water acts as the control . Results were analysed only after 24hours incubations inorder to avoid the misleading results.

Results and Discussion

The formation of silver nitrate particles was obtained after5 hours of incubation. There was a considerable change in the colour of the solution from colourless to pale brown colour(Fig 1). This change in colour is attributed to the excitation of the surface plasmons. The formation of the silver nanoparticles is attributed to the fact that the formation of nanometric sized silver particles have evolved from silver nitrate solution by the reduction of the silver ions which means the presence of reduction entities are present in the medium. The colour change indicates the presence of silver nanoparticles and reduction reactions in the medium. This reduction reactions are due to the presence of reducing sugars present (Shankar et al)plates were found to have remarkable zone of clearance. The silver nanoparticles were showing the maximum zone of clearance. However there was a difference in the antimicrobial activity in the silver nanoparticles produced from freshly prepared extracts than 1month old extracts. The silver nanoparticles from the newly prepared extracts had more zone of clearance than the latter. The silver particles as such doesn’t have a profound effect on the bacterial species Porphyromonas gingivalis. Miswak extracts has a moderate effect on the bacteria. Zones of 12 nm and 10 nm were obtained for silver nanoparticles produced from new and old extracts. The bioreduced silver particles are thus playing a very important role in generating antimicrobial properties. The control and the silver nitrate solution as such showed no zone of clearance. But there was a mild antibacterial activity exhibited by the miswak extract. But this was quite less when compared to that formed by the silver nanoparticles of the extract. Value of zones of

inhibition obtained from disc diffusion method(table 1)ComponentsDiameter of the zone of inhibtion(mm)Distilled waterSilver nitrate solutionMiswak extractSilver nanoparticles (from old extract)Silver nanoparticles (from new extract)0071012

Conclusion

In the present study, the antibacterial activities of the silver nano particles produced from twigs of the plant , Salvadora persica were used. Even though the silver nanoparticles are showing very good antimicrobial activity, their activity seems to be decreasing after a while. However it is to considered that the development of much durable nanoparticles would help in medical field especially peridontal surgery.

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