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SYNTHESIS AND CHARACTERIZATION OF QUERCETIN-CONJUGATED GOLD NANOPARTICLES

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ABSTRACT
Gold nanoparticles and quercetin-conjugated gold nanoparticles complex were synthesized using trisodium citrate as reducing agent. Both kinds of nanoparticles were characterized using spectrophotometry, dynamic light scattering and zeta potential measurements. Comparison of the results confirmed successful synthesis of quercetin-conjugated gold nanoparticles complex.

INTRODUCTION
In recent years, considerable attention has been paid to the synthesis and characterization of gold nanoparticles (GNPs). Gold nanoparticles are renowned for their promising therapeutic possibilities, due to their significant properties such as biocompatibility, high surface reactivity, resistance to oxidation and plasmon resonance [1].

Quercetin (Q) (Fig.1) is the most abundantly consumed bioflavonoid with high concentrations in tea, apple, and onion. This flavonoid exhibits antioxidant, anti-inflammatory, antiglycating, anti-allergic properties.

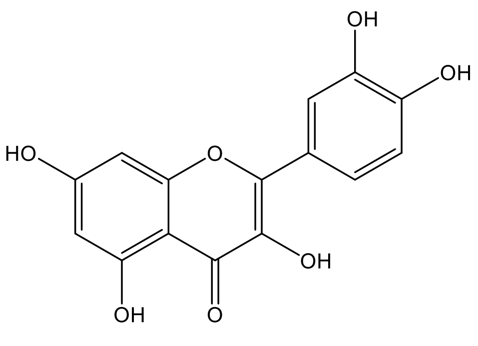

Figure 1. Quercetin structure

Although the mechanism of action is not fully known, quercetin is considered as a drug which helps protecting against various kinds of heart diseases and cancer [2]. Since flavonoids are easily metabolized and removed from the biological systems, nanoparticle-mediated delivery may enhance their activities by decelerating their metabolism [3]. To enhance the efficacy of a therapeutic agent, use of nanoparticle-based drug formulation is an important aspect of nanomedicine, for which the first step is the preparation of a stable nanoparticle-drug complex.

Previously, stable quercetin-gold nanoparticle complex (QGNP) was synthesized and characterized [4]. We have undertaken the present study to synthesize different quercetin-gold nanoparticle formulation and to characterize the complex for further study of its antioxidant effect.

EXPERIMENTAL

Gold nanoparticles were synthesized by reducing chloroauric acid by trisodium citrate in the boiling condition according to the method of Turkvitch [5]. To synthesize free gold nanoparticles, 1 mL of 1% trisodium citrate was added to 15 ml of 0.025 % (6 x 10^{-4} M) tetrachloroauric acid under boiling condition. After few minutes the color changed to wine red. The solution was boiled for 15 min. Quercetin was coated onto the nanoparticles during synthesis of GNP [4]. For preparation of quercetin-conjugated gold nanoparticle, 2 mg/ml of quercetin in DMSO was added to the chloroauric acid and trisodium citrate mixture to get 6 x 10^{-4} M quercetin, at the boiling condition prior to the formation of the wine red color. Absorption spectra were recorded by Lambda 35 UV-Vis Spectrometer, Perkin Elmer, Inc., Waltham, MA, USA). The measurements of particles size and zeta potential measurements were performed using a Zeta-sizer Nano ZS with 633 nm He-Ne laser (Malvern, UK), and the data were analyzed by the Zetasizer Software Version 6.20 (Malvern, UK).

RESULTS AND DISCUSSION

GNP and QGNP were synthesized and their absorption spectra were recorded and presented in Fig. 2. As can be seen from the spectra, surface plasmon resonance (SPR) band of citrate-capped gold nanospheres (bare) showed absorption maximum at 522 nm (Fig. 2A) while the absorption maximum of QGNP (quercetin coated) was red-shifted to 554 nm (Fig. 2B). The values of absorption maxima of GNP and QGNP suggest that the

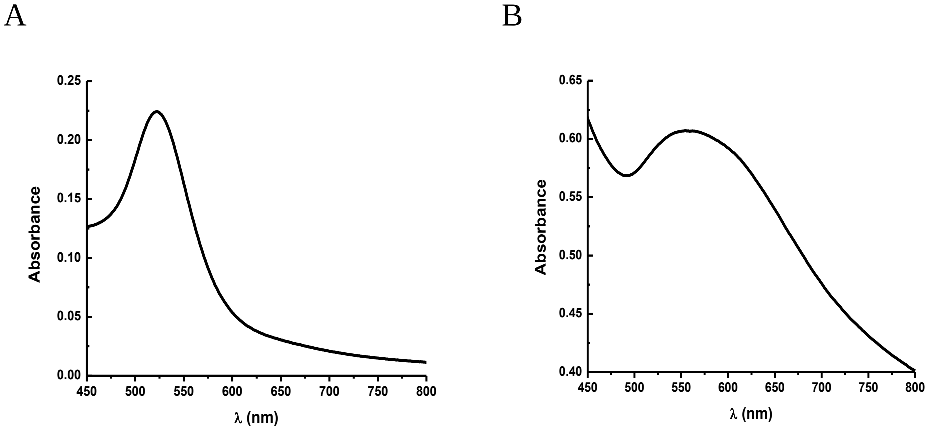

Figure 2. UV-Vis absorption spectra of A) GNP and B) QGNP.

diameters of the particles are around 20 nm and 80 nm, respectively. The diameter of GNPs measured by dynamic light scattering (DLS) was found to be approximately 30 nm, while QGNP appeared to be approximately 94 nm. The size appeared larger in DLS studies because of hydrodynamic factor also contributed to the observed diameter by this method. Also, one gold nanoparticle may attach with several molecules of quercetin. Enlarged size of flavonoid-coated GNP in comparison with bare NP was also reported by other authors [4,6].

We observed that surface charge present on GNP was -45 mV, as measured by zeta potential. Since gold atoms should not contain any negative charge on their surface, the presence of negative surface charge suggests a citrate capping on the surface of the particle. The reduction of surface charge to -13 mV in case of QGNP further indicates the attachment of quercetin on the citrate coated GNP surface [4,6].

CONCLUSION

In this work, results obtained from different experiments suggested successful formation of quercetin-conjugated gold nanoparticles. These conjugates can be proposed as potential therapeutic for an emerging nanomedicine application.

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