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ΕΡΕΥΝΗΤΙΚΗ ΕΡΓΑΣΙΑ

The protein bonding effect of gold nanoparticles in milk
Implication for possible risk of nanoparticle exposure

OBJECTIVE **In medicine, there is limited knowledge on the toxicity of nanoparticles particularly concerning the effect of nanoparticles in milk. Here, the authors reported the effect of gold nanoparticles in milk specimens.** METHOD **This study was performed as an experimental study. A mixture of gold nanoparticle solution and milk sample was prepared and analyzed.** RESULTS **According to this study, after mixing the milk sample with gold nanoparticle solution, fine aggregated particles were observed.** CONCLUSIONS **It was demonstrated that gold nanoparticles can cause bonding of the protein in the milk. This could lead to further toxicity in infants ingesting contaminated milk.**

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ΑΡΧΕΙΑ ΕΛΛΗΝΙΚΗΣ ΙΑΤΡΙΚΗΣ 2008, 25(5):631–633

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Δεσμευτική δράση πρωτεΐνης των υπομικροσκοπικών σωματιδίων χρυσού στο γάλα: Εμπλοκή στον πιθανό κίνδυνο έκθεσης σε νανοσωματίδια

Περίληψη στο τέλος του άρθρου

Key words

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Nanotechnology is now widely used biotechnology. Nanoparticles differ from the same materials at a larger scale in their chemical and physical properties.[1] The rapidly developing field of nanotechnology is likely to become yet another exposure source, through inhalation, ingestion, skin uptake and injection of engineered nanomaterials.[2] In medicine, there is limited knowledge on the toxicity of nanoparticles. Recently, Wiwanitkit et al reported that the gold nanoparticles can be detected intracellularly into red blood cells and can be a cause of future toxicity.[3] Since foreign micrometer-sized particle can be detected in the milk, the nanoparticles can be expected to pass from the blood stream into the milk. Here, the authors report the effect of gold nanoparticles (AuNP) on milk specimens.

MATERIAL AND METHOD

Milk samples were collected for this study and transferred according to the standard procedure of the medical laboratory. Following the classical Turkevich citrate reduction method,[4] 9 nanometer-sized AuNPs were established and AuNP concentration was prepared at 44 ppm. The AuNPs can be stored in the dark under 4 °C for over a month. Firstly, the mixture between equal amounts (500 microliter) of gold nanoparticle solution and milk sample was prepared. After being left for 15 minutes, the morphological changes of the milk were studied by clinical microscopy technique under the high power field. All of the laboratory analysis was performed in a reference ISO 15189 accredited laboratory of the Department of Laboratory Medicine, Faculty of Medicine, Chulalongkorn University.

RESULTS

It was revealed that after mixing the milk sample with gold nanoparticle solution, fine aggregated particles can be observed (fig. 1).

A. Milk B. Goldnano solution C. Mixture

Figure 1. Appearance of milk sample with gold nanoparticle solution.

DISCUSSION

Colloidal nanometer-sized gold suspension appears to be red in color, whereas aggregation of AuNP, from any precipitating factors, changes the color into purple-grey; the aggregation shifts surface plasmon band.[5,6] This naked eye detection can be demonstrated *in vitro*. In liquids with high protein such as urine samples with proteinuria,[7] prevention of aggregation by protein bonding is proposed.

Gold can be seen in breast milk in exposed cases. A level of 2.1 μg/L in breast milk was reported to be attributed to gold dental fillings.[8] Here, it was demonstrated that the gold nanoparticle can cause the bonding of the protein in milk. The mechanism of entry needs to be further studied. The possible mechanisms might be direct bonding between the nanoparticle and the protein as that of the urine sample with proteinuria.[7] This knowledge can be useful for future applications.

ΠΕΡΙΛΗΨΗ

Δεσμευτική δράση πρωτεΐνης των υπομικροσκοπικών σωματιδίων χρυσού στο γάλα: Εμπλοκή στον πιθανό κίνδυνο έκθεσης σε νανοσωματίδια

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ΣΚΟΠΟΣ Υπάρχουν περιορισμένα στοιχεία γύρω από την πιθανή τοξική επίδραση των νανομορίων. Οι γνώσεις για τη δράση των νανομορίων στο γάλα είναι πολύ περιορισμένες. Περιγράφεται η δράση των νανομορίων χρυσού σε δείγμα γάλακτος. **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Πρόκειται για πειραματική μελέτη με ανάλυση μείγματος διαλύματος νανομορίων χρυσού και γάλακτος. **ΑΠΟΤΕΛΕΣΜΑΤΑ** Παρατηρήθηκαν λεπτά συγκρίμματα. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Τα νανομόρια χρυσού μπορεί να προκαλέσουν δέσμευση της πρωτεΐνης στο γάλα, η οποία ενδέχεται να οδηγήσει σε τοξικότητα στα παιδιά που λαμβάνουν γάλα μολυσμένο με τέτοια νανομόρια.

Λέξεις ευρετηρίου: Γάλα, Νανομόρια χρυσού, Τοξικότητα

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