Comparative study on the effect of gold nanoparticles for immunosensing techniques by using OWLS- and QCM detection

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Introduction

Immunoanalytical techniques are widely used for detecting food contaminants and other undesired substances in food or feed products. The advantage of the immunoanalytical methods relies in their cost-effectiveness, rapidity, high selectivity and sensitivity.

In this study the effect of chemically and biologically produced gold nanoparticles (AuNPs) were investigated to enhance the sensitivity of optical waveguide lightmode spectroscopy (OWLS) and quartz crystal microbalance (QCM) measurements. The AuNPs were used of different size and with different functionalization for the sensitization of the sensor surface for immunosensing methods in the food analytics.

Instrumentation

Materials and methods

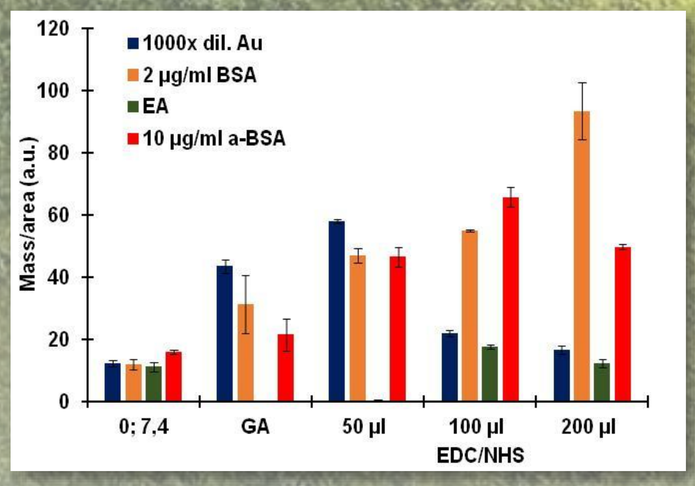
First we demonstrated the results and the applicability of the AuNPs – especially, which were produced by green technology – by a model measurement of BSA - anti-BSA. BioAuNPs were produced by biosynthesis with the supernatants after shaken flask cultivation and centrifugation of the fermentation broth. The antigen-protein conjugates were immobilized on the surface of a silicon titanium oxide (STO) sensor by using γ-aminopropyl triethoxysilane (APTES) for providing amino groups to facilitate the immobilization by glutaraldehyde cross linker or 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide (EDC) / n-hydroxysuccinimide (NHS) reagents. The gold coated quartz crystals for QCM analysis were activated by cysteine for the immobilization of AuNPs using EDC/NHS chemistry.

BSA protein molecules were immobilized in both technologies on the AuNPs enhanced sensor surface. For both measurements the anti-BSA solution was injected in a flow injection system.

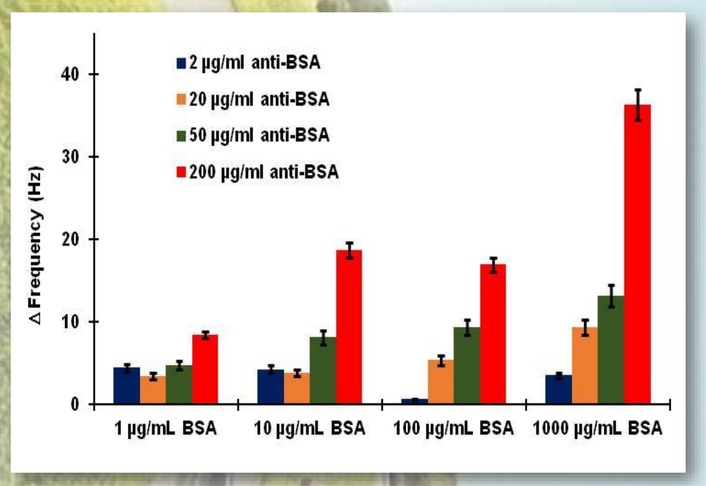
	Origin of AuNP	Median size
A	Without AuNP	-
B	Sigma 765430	5 nm
C	Sigma 765538	15 nm
D	Sigma 765473	30 nm
E	*Humicola insolens* CBS 147.64	76.5 nm
F	*Rhizopus pusillus* WFPL 267A (ATCC 16458)	60.1 nm
G	*Thermoascus aurantiacus* TUB F-43 (ATCC 58156)	54.2 nm
H	*Thermomucor indicae-seudaticae* NRRL 6429 (ATCC 28404)	69.5 nm
I	*Thielavia terrestris* NRRL 8126 (ATCC 38088)	124.0 nm

Results

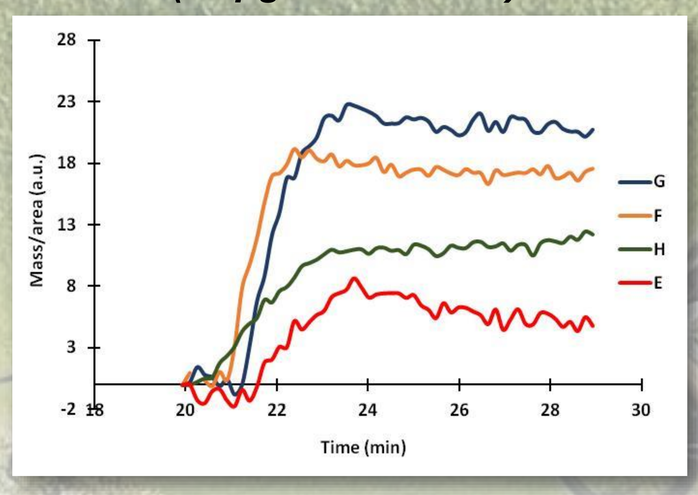
Effect of the different immobilization methods



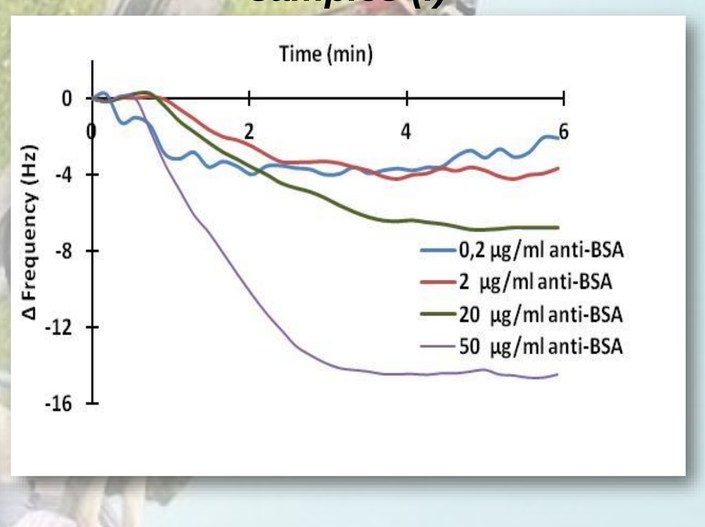
Effect of the concentrations of the immobilized BSA



Effect of the different bioAuNPs (10 µg/ml anti-BSA)



QCM signals for the anti-BSA samples (I)



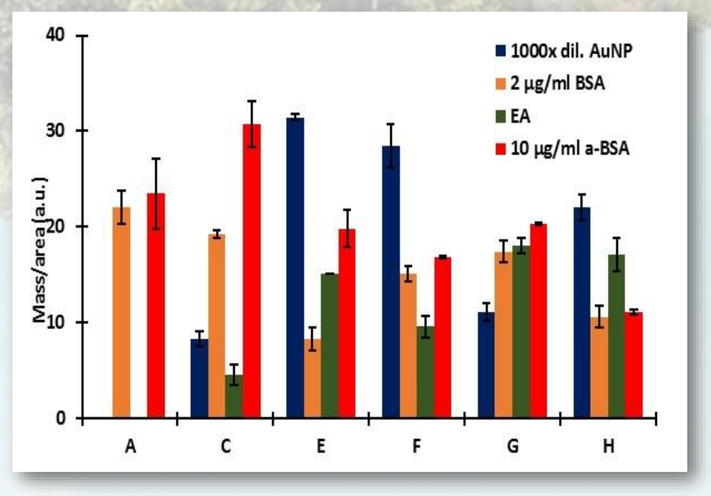
Conclusion

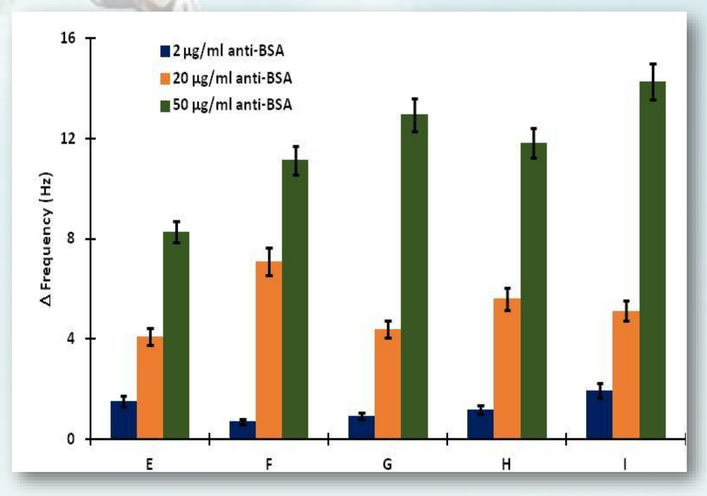
Novel measuring methods were investigated by using bioAuNPs for optical waveguide lightmode spectroscopy (OWLS) and quartz crystal microbalance (QCM) measurements.

For the optimization of the OWLS measurement the effect of the different AuNPs and the biochemical parameters were optimized and it was found, that the AuNPs used effectively enhanced the signal and improved the repeatability of the measurement.

In the case of QCM measurement, the signals increased with the particle size of the AuNPs, and despite of the relatively small concentration of the antibody solution the signals were well defined and the deviation decreased.

Effect of different bioAuNPs on anti-BSA measurement





Acknowledgment

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