Molecularly imprinted nanosensors for porcine serum albumin detection in Halal food control

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Various analytical methods for detecting pork contamination in meat extract were rapidly developed in last ten years in order to contribute for expanding Halal food market segments in the world [1]. However, the developed sensors such as immunosensor and DNA sensor need cumbersome procedures and high costs due to the use of natural antibodies and specific primers. Molecularly imprinted polymers (MIPs) have been attracted a great attention as alternative artificial materials of natural antibodies to recognize protein targets [2, 3].

In this study, we have prepared molecularly imprinted polymer nanogels (MIP-NGs) capable of highly specific recognition for porcine serum albumin (PSA) by emulsifier-free precipitation polymerization with pyrrolidyl acrylate as a functional monomer. MIP-NGs were then immobilized on quartz crystal microbalance (QCM) sensors for sensitive detection of PSA in halal raw meat extract. After the polymerization, the obtained MIP-NGs were purified by anion exchange chromatography to remove the template PSA, resulting in the high removal rate of template PSA from the materials (approximately 92%).

The immobilization of MIP-NGs on the carboxyl functionalized surface of QCM sensor chips was conducted by an amine coupling reaction. The binding interaction between PSA and MIP-NGs was evaluated by the MIP-NGs-immobilized QCM-D. The adsorption of PSA increased gradually with increasing PSA concentrations in the samples and observed concentration-dependent binding of the immobilized MIP-NGs on the QCM sensor chip. The binding affinity of MIP-NGs (K_a = 6.7 × 10^7 M^{-1}) was higher than that of NIP-NGs (K_a = 3.0 × 10^7 M^{-1}). Moreover, the MIP-NGs showed the higher binding affinity for PSA than the other serum albumins from human, bovine, goat, rabbit, and sheep. For meat extract samples, the MIP-NGs immobilized QCM sensors gave the high recovery rates (83%-128%) with acceptable relative standard deviations (2.5-3.9 %). In addition, a limit of detection appeared to be as low as 1.2 wt% pork contamination in raw meat extract. Thus, the MIP-NGs based QCM sensor provides a simple approach to detect pork contamination in halal raw meat samples with high selectivity and reliability, suggesting that MIP-NGs is to be a new candidate for use in halal food control.

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