Synthesis of molecularly imprinted polymer nanoparticles for α-casein detection using surface plasmon resonance as a milk allergen sensor

ABSTRACT

Food recalls due to undeclared allergens or contamination are costly to the food manufacturing industry worldwide. As the industry strives for better manufacturing efficiencies over a diverse range of food products, there is a need for the development of new analytical techniques to improve monitoring of the presence of unintended food allergens during the food manufacturing process. In particular, the monitoring of wash samples from cleaning in place systems (CIP), used in the cleaning of food processing equipment, would allow for the effective removal of allergen containing ingredients in between food batches. Casein proteins constitute the biggest group of proteins in milk and hence are the most common milk protein allergen in food ingredients. As such, these proteins could present an ideal analyte for cleaning validation. In this work, molecularly imprinted polymer nanoparticles (nanoMIPs) with high affinity toward bovine α-casein were synthesized using a solid-phase imprinting method. The nanoMIPs were then characterized and incorporated into label free surface plasmon resonance (SPR) based sensor. The nanoMIPs demonstrated good binding affinity and selectivity toward α-casein ($KD \sim 10 \times 10^{-9}$ M). This simple affinity sensor demonstrated the quantitative detection of α-casein achieving a detection limit of 127 ± 97.6 ng mL^{-1} (0.127 ppm) which is far superior to existing commercially available ELISA kits. Recoveries from spiked CIP wastewater samples were within the acceptable range (87–120%). The reported sensor could allow food manufacturers to adequately monitor and manage food allergen risk in food processing environments while ensuring that the food produced is safe for the consumer.