

## Electrochemical immunosensing of folic acid based on improved nanostructured transducer

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Enzyme-linked immunosorbent assays (ELISAs) today represent an important percentage of the tests performed in clinical diagnostics or quality control of foods and pharmaceuticals. For some substances they represent the most reliable quantification method [1-4]. Furthermore such tests represent a good alternative to microbiological tests, which often take days to perform and do not always show high specificity, and are often used as a complementary method to HPLC [5].

Recent advances allow the immunoassays to be performed on magnetic beads as a support. The magnetic beads are known to be a powerful and versatile tool in a variety of analytical and biotechnology applications. The use of non-porous magnetic beads greatly improves the performance of the immunological reaction, due to: (i) an increase in the surface area, as well as (ii) the fast assay kinetics achieved because the beads are in suspension and the analytical target does not have to migrate very far. According to their properties as well as the improved washing and separation steps, the matrix effect is minimized despite this increased surface area. Additionally, the magnetic beads can be easily magnetically manipulated by using permanent magnets or electromagnets. Therefore, the analysis of samples performed on magnetic beads can be easily achieved without any pre-enrichment, purification or pre-treatment steps, which are normally necessary for standard methods [6-8]. All these advantageous properties of magnetic beads are improved when they are nano-sized.

Most immunoassays are designed for the quantification of proteins or peptides. However, small organic molecules can also be quantified by the same technique. Hormones, antibiotics, small peptides, amino acids or vitamins are popular targets for such tests. However, the assays have to be designed in the competitive or inhibition mode rather than a sandwich-type mode, as most of these small molecules have only one functional site, which can be recognized by an antibody. Folic acid, a water-soluble compound of the vitamin B group, is added to many food products to prevent folate deficiency in individuals [9]. Supplementation with folic acid is particularly important with pregnant women, as insufficient folic acid can cause neural tube defects in the developing foetus. Moreover, folate deficiency is the most common cause of anaemia after iron deficiency [10].

In this work, we present the development of a novel magneto-ELISA with optical detection for the quantification of folic acid. The immunological reaction for this strategy detection was performed on nanostructured magnetic beads and is based on a direct competitive assay using a tracer with HRP peroxidase for the enzymatic labelling. The magnetic nanobeads are then attached to improved nanostructured magnetic transducer for the electrochemical detection, based on bamboo structured CNT.

Moreover, we present preliminary results of a novel electrochemical immunosensing strategy based on magneto sensors for folic acid detection in milk. This strategy combines the

advantages taken from immunochemical assays, nano-sized magnetic beads separation and electrochemical transduction based on bamboo structured CNT.

Future work will be focused on the application of this method for the detection of folic acid on food, and clinical samples, with the electrochemical immunosensing strategy.

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