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Review

# Immunochromatographic methods in food analysis ☆

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ABSTRACT

In this review, we describe the current state of development of immunochromatographic tests to detect toxic contaminants (e.g., mycotoxins, pesticides, and veterinary drugs) in agricultural products and foodstuffs. We consider the place of these tests among other methods used for food quality/safety assurance, as well as the specific requirements for immunochromatographic analyses of compounds in different food matrices. We discuss strategies to decrease the limit of detection and to conduct multi-parametric and quantitative analyses. We highlight some successfully commercialized analytical techniques and priorities for further research.



**Contents**



## 1. The principle of immunochromatography and its main benefits

The concept of immunochromatography as a combination of chromatography (separation of components of a sample based on differences in their movement through a sorbent) and immunochemical reactions emerged a long time ago, and it has been implemented in many different ways. Today, the most widespread immunochromatographic system is the test strip – an assembly of several plain porous carriers impregnated with immunoreagents. On contact with the test strip, a liquid sample flows along the carriers, and detectable immune complexes are formed in certain zones of the test strip [1]. Test strips are widely used for the early detection of pregnancy, for drug screening, to identify markers for various diseases, and for a number of other analytical tasks. However, a few decades ago, the term "immunochromatography" was used to describe a different type of analysis (i.e., separation of samples on a column containing a sorbent with covalently-bound antibodies specific to a target substance) [2–4]. This approach is

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used in modern analytical practice to separate and to concentrate various substances [5,6].

These two types of immunoassay systems are very different. However, it is difficult to consider them as fundamentally different methods when they share the same analytical components and the same name. In the broad sense of the term, 'immunochromatography' analytical systems combine longitudinal or transverse liquid flow through a carrier with immunochemical reactions. Fig. 1 illustrates the main kinds of immunochromatographic systems in six sectors. One shows the most widely used lateral-flow test strips designed to detect immune complexes in the binding areas (sector I-α), another shows the immunoaffinity columns used to concentrate analytes prior to detection in the binding areas (sector II-α) [7,8], while the other four can be summarized as follows:

- lateral-flow test strips designed to detect washed-out compound (as described in [9], e.g.,) – sector I-β;
- immunoaffinity columns designed to detect washed-out compound (see [10]) – sector II-β;
- cross-flow membranes designed to detect bound immune complexes (see [11,12]) – sector III-α; and,
- cross-flow membranes designed to detect washed-out compound [13] – sector III-β.

What distinguishes immunochromatography assays from other types of immunoassays? Regardless of the format, all immunochromatography systems consist of immunoreagents immobilized on a carrier and fluid flow through that carrier. This approach allows for:

- adjustable and rapid formation of immune complexes;
- removal of unreacted compounds from the binding zone during the analysis; and,
- the use of special zones to concentrate and to detect target complexes.

Immunochromatography combines advantages of homogeneous and heterogeneous analytical methods. It combines the speed of a homogeneous immunoassay with the separation of reacted and unreacted compounds by a variety of heterogeneous methods. Another advantage of immunochromatography is that the fluid flow through the carrier (e.g., sorbent and membrane,) enables separation of reacted from unreacted products without the need for additional precipitation or washing steps.

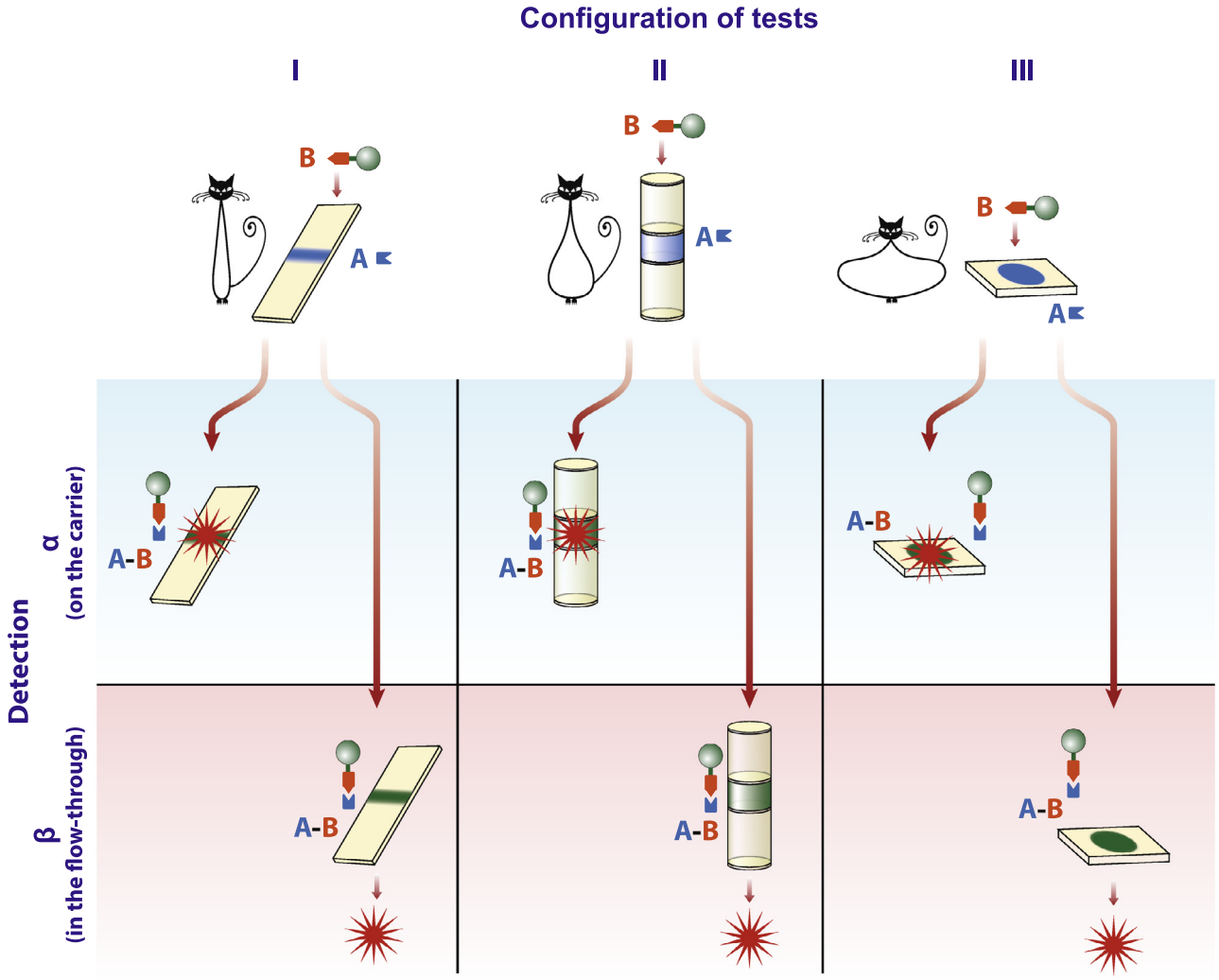


**Fig. 1.** Test systems for immunochromatographic assays (see text for full descriptions of systems). A and B are interacting immunoreagents and their derivatives; compounds detected when recording the results of the assay are marked by red stars. Lateral-flow test strips designed to detect bound immune complexes (I-α); lateral-flow test strips designed to detect in the flow-through (I-β); immunoaffinity columns designed to detect bound immune complexes (II-α); immunoaffinity columns designed to detect in the flow-through (II-β); cross-flow membranes designed to detect bound immune complexes (III-α); cross-flow membranes designed to detect in the flow-through (III-β).