Detection of environmental toxins by aptamers, as alternative recognition elements to antibodies

Jaytry Mehta*[1,2], Bieke Van Dorst[1,2], Elsa Rouah-Martin[1,2], Ronny Blust[1] and Johan Robbens[1,2].

[1]University Antwerp, Department of biology, Laboratory for Ecophysiology, Biochemistry and Toxicology, Groenenborgerlaan 171, B-2020 Antwerp, Belgium
[2] Institute for agricultural and fisheries research (ILVO), Ankerstraat 1, B-8400, Oostende, Belgium

*Presenting author: Jaytry Mehta, e-mail contact: Jaytry.Mehta@ua.ac.be

Veterinary drugs, such as chloramphenicol (Cam) are often administered to farm animals for therapeutic and prophylactic purposes. A significant percentage of them are excreted and released into the environment promoting antibiotic resistance and raising food safety issues. Moreover, although Cam is an effective antimicrobial drug, it has lost favour due to its toxic effects which can cause diseases such as aplastic anemia, bone marrow suppression, leukaemia and gray baby syndrome. Therefore, according to European Union regulation, a zero-tolerance policy is applied for Cam calling urgently for a sensitive, rapid and cost-effective detection technique.

The health and environmental concerns of Cam are a result of their physicochemical and toxic properties which are directly derived from their structures. Thus, in order, to detect these tridimensional structures, we engineered specific DNA aptamers that bind Cam with high affinity and hence the name, 'aptus', which means 'to fit'. Aptamers, which are synthetic oligonucleotides offer advantages over antibodies due to their animal-friendliness, chemical stability and cost effectiveness, making them promising recognition elements for analytical applications.

Our aptamers are single stranded DNA ligands which have been selected for Cam, starting from a library of molecules containing randomly created sequences. We employed a stringent iterative selection protocol, in order to get highly specific and sensitive aptamers. The final potential aptamer candidates were sequenced and revealed a high amount of diversity amongst each aptamer; this was evident in their varied secondary structures. Their specificity was checked via competition assays with other antibiotics occurring in the same matrices as Cam. The aptamers had been further characterized for their binding constants and three aptamers have shown high selectivity and affinity (nanomolar range) towards Cam. The highest binding aptamer will be used to develop a fast detection system to measure Cam. In view of the unprecedented advantages brought by aptamers, we expect aptamer-based biosensors to find broad applications in environmental and food monitoring.

Keywords: aptamers, antibiotics, chloramphenicol, sensitive, selective, recognition