Development of aptasensors for antibiotic monitoring

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From lab to in-field detection

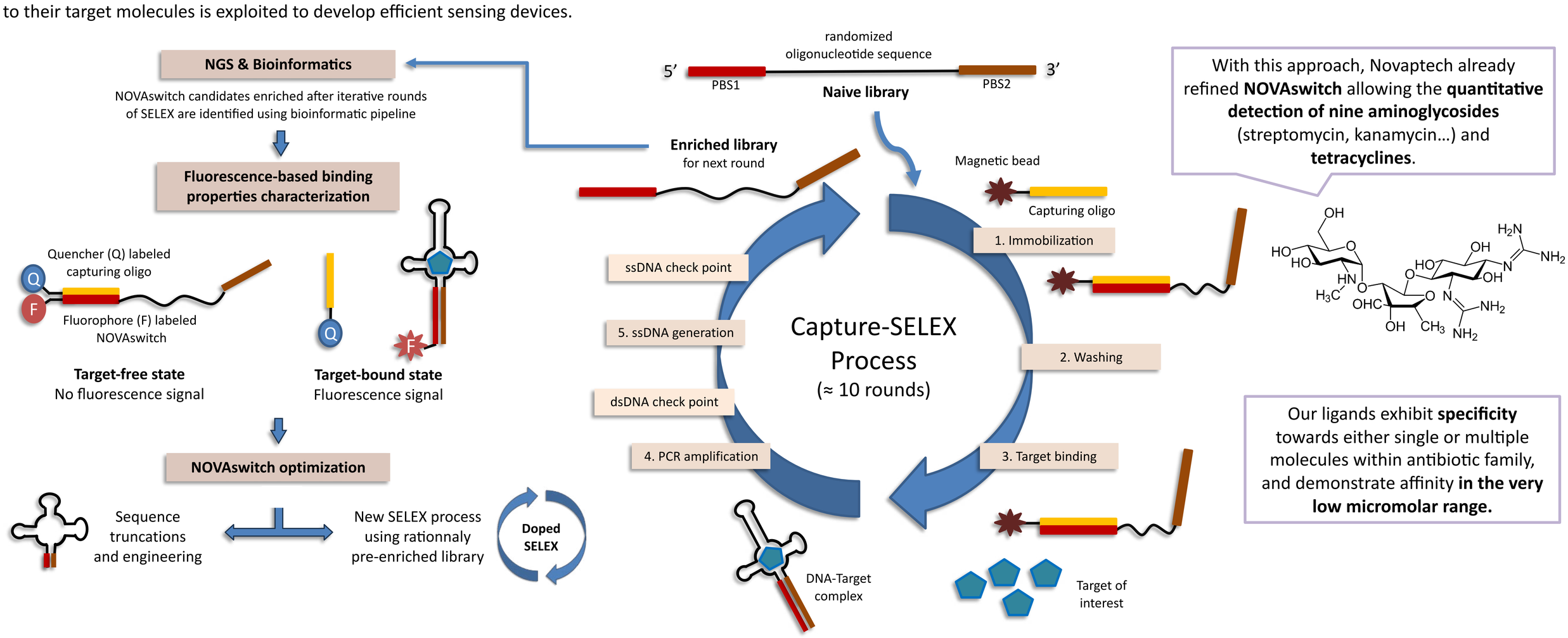
Antibiotics are extensively used in agri-food industry and healthcare for their broad-spectrum antibacterial properties. However, their uncontrolled use has led to significant environmental **pollution and food safety risks**. Among these, the rise of antibiotic resistance and its direct threat to human health has emerged as a pressing concern. Hence, there is a growing need for **on-site antibiotic detection** in both environmental and food assessments. **Aptamer-based biosensors**, offering a practical and cost-effective solution, have garnered significant attention in addressing this demand.

Aptamers are single-stranded nucleic acid molecules that fold into unique three-dimensional structures capable of **specifically binding to target molecules with high affinity**. They serve as recognition element in various applications, mimicking the properties of antibodies but with unique advantages such as **stability and ease of synthesis and modification**.

NOVAswitch cutting-edge technology capitalizes on the many benefits provided by aptamers in pollutants biosensing. Novaptech identified aptamers for the **specific and quantitative detection** of aminoglycosides and tetracyclines. Exploiting their intrinsic switching and binding properties within fluorescence-based optical biosensors, **in-field detection devices** are currently in development, while other valuable classes of antibiotics are under investigation.

NOVAswitch identification and optimization

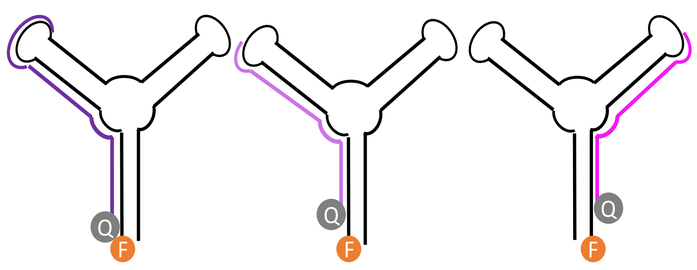
Aptamers are selected *in vitro* from large libraries of randomized oligonucleotide sequences by a process known as **SELEX** (Systematic Evolution of Ligands by EXponential enrichment). Capture-SELEX is a variation of the traditional SELEX process that allows the selection of aptamers with intrinsic **structural switching capabilities** (**NOVAswitch**). This ability to undergo conformational changes upon binding to their target molecules is exploited to develop efficient sensing devices.



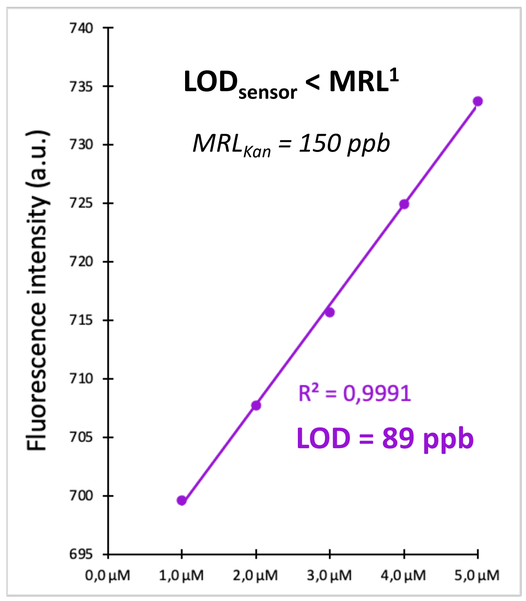
With this approach, Novaptech already refined **NOVAswitch** allowing the **quantitative detection of nine aminoglycosides** (streptomycin, kanamycin…) and **tetracyclines**.

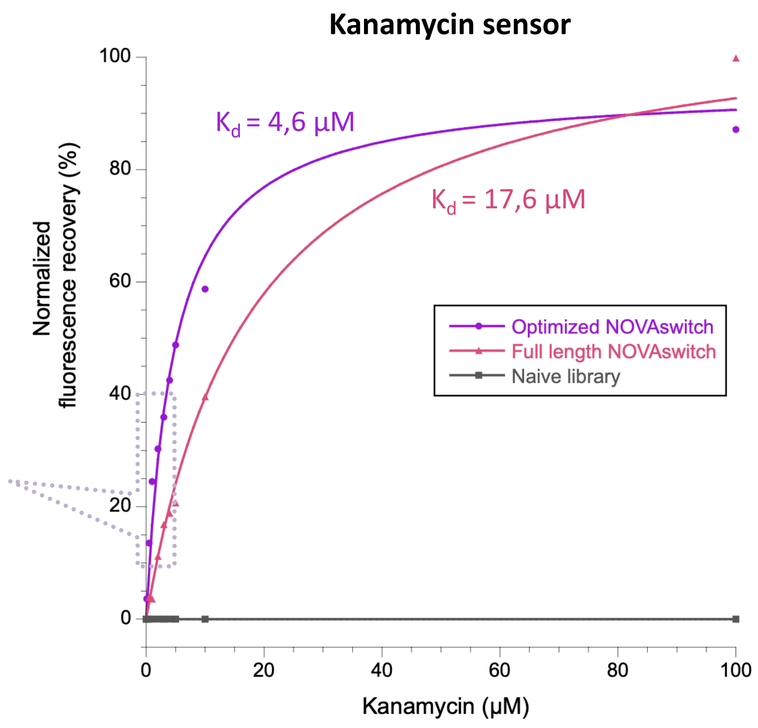
Our ligands exhibit **specificity** towards either single or multiple molecules within antibiotic family, and demonstrate affinity **in the very low micromolar range.**

Fluorescence-based optical biosensors



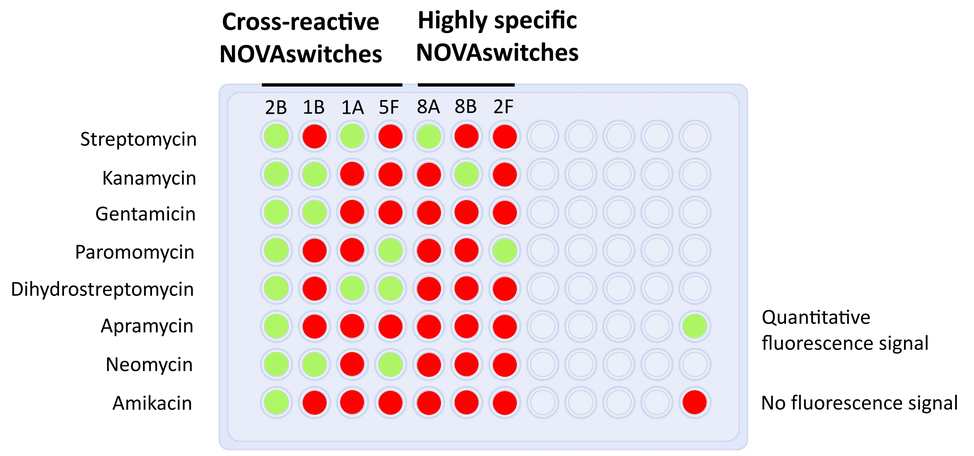
We screened several pairs of **optimized aptamers** and quenching beacons with varying sizes and hybridation sites, selecting the ones that demonstrated the **best sensing characteristics**.





Most of our NOVAswitches sensors exhibit **LOD within 50-1000 ppb range**. These performances allow **relevant on-site detection**. For some of them, a modest gain in sensivity must be achieved to fully satisfy European commission requirements on **maximum residue limits[1] (MRL)** in food.

Detection demonstrator in process

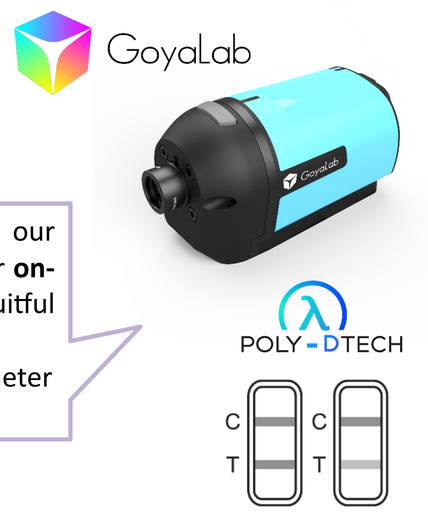


Using our **NOVAswitch repertoire**, we are developping in-plate assays to accurately **detect, quantify and discriminate** members of the aminoglycosides and tetracyclines families. In designing these **in-lab demonstrators**, we harness the inherent affinities and specificities properties of our optimized ligands.

We demonstrated that our NOVAswitch sensors are still effective in **complex samples** like milk

We are currently adapting our aptamer-based biosensors for **on-site detection** through fruitful collaborations:

- ✓ IndiGo handheld spectrometer
- ✓ Lateral flow rapid test



Conclusion & perspectives

A valuable collection of NOVAswitches has been developed through Capture-SELEX process. Those ligands, within refined in-lab fluorescence-based biosensors, allow the detection of aminoglycosides and tetracyclines at relevant levels, even within complex matrices like milk.

Currently, an in-lab demonstrator is undergoing validation while on-site detection devices relying on the developed aptamers are being explored through collaborations.

Furthermore, our repertoire is now expanding to include other antibiotic classes of interest such as ß-lactam, quinolones and macrolides.

Visit our website
http://novaptech.com

If you have any questions, contact us!
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