The AptaReport™

Newsletter

WINTER 2016

Diabetes Mellitus AptaSensor

Diabetes Mellitus is one of the leading causes of death worldwide. Insulin, an important hormone that allows glucose to enter the cells, functions ineffectively in diabetics, leading to a buildup of glucose in the bloodstream. Over time elevated blood sugar levels can be very damaging to the body, contributing to kidney disease, blindness, strokes and heart disease. Hemoglobin A1C is a biomarker used to monitor blood glucose levels in diabetics over time to gauge the efficacy of treatment. Due to the relatively long life cycle of hemoglobin A1C and difficulties in monitoring its levels in patients with anemia, an alternative indicator is desirable.

Human serum albumin (HSA) is the most abundant protein in human plasma and reacts with glucose present in the bloodstream to become glycated HSA (GHSA). GHSA levels can be 2-5 times higher in diabetic patients than in healthy counterparts, and levels change more rapidly than A1C levels making GHSA an adequate indicator of disease management. An aptasensor was developed using a fluorescently labeled aptamer for GHSA. By binding the aptamer to fluorescence quenching graphene oxide, Deanpen Japrung's lab from the National Science and Technology Development Agency in Thailand created a biosensor that releases the fluorescently labeled aptamer in the presence of GHSA. The GHSA biosensor is a promising tool that could one day offer an alternative to traditional blood glucose monitoring in diabetics.

-K.C.

*Reference: Apta-Index™ ID #615

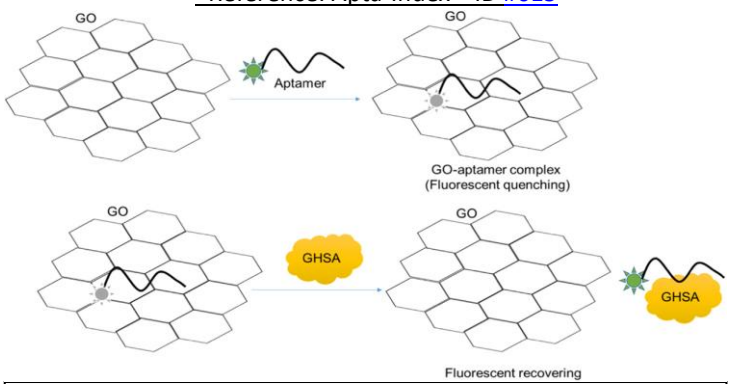

Figure (adapted) Graphene-aptamer complex approach for GHSA detection. Fluorescent labeled aptamer binds graphene oxide(GO) to form GO-aptamer complex and fluorescent quenching. In the presence of GHSA, which is aptamer target, fluorescent labeled aptamer leaves the GO and bind to GHSA, leading to fluorescent recovering.*

NEW PUBLICATION featuring Aptagen

Recently, Aptagen scientists Albert Liao and Dr. G. Thomas Caltagirone were co-authors on a collaborative paper titled, **"Ribozyme-based RNA Aptamer that Specifically Binds to Mycolactone and Serves as a Diagnostic Tool for Early Diagnosis of Buruli Ulcer"** which has been accepted and will be published by PLOS Neglected Tropical Diseases journal. This publication and the related research was led by Samuel A. Sakyi, who traveled to Jacobus, PA to work with the Aptagen team to develop the aptamer used. The abstract for the publication can be found in AACC Annual Meeting Abstract Archive. It is noteworthy to mention, that a poster outlining the research was also presented at the conference.

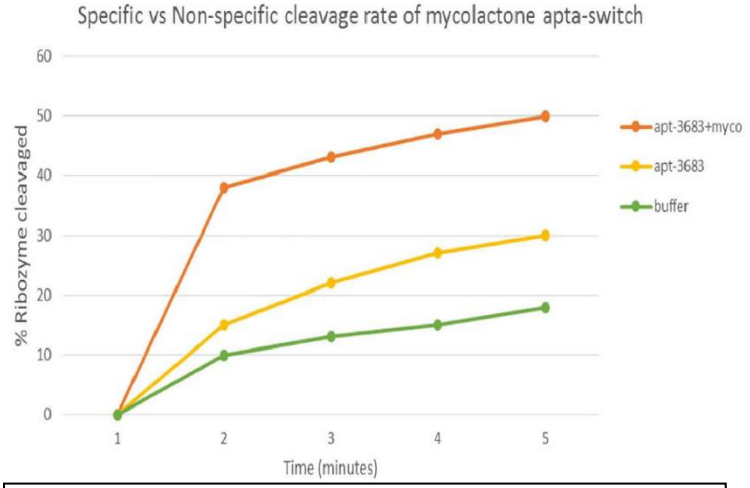

Figure (adapted) Specific versus non-specific cleavage rate of apt-3683 in the presence and absence of mycolactone*

Published research focused on mycolactone, a biomarker of the Buruli Ulcer Disease (BUD), which ranks third among the most common mycobacterial diseases. Because mycolactone can be detected at every stage of the BUD, an aptamer detection method was implemented in the study. The research developed an aptamer with nanomolar affinity to mycolactone and is able to correctly diagnose samples with high sensitivity and specificity.

Aptagen would like to congratulate all of the co-authors, Samuel Yaw Aboagye, Isaac Darko Otchere and Dorothy Yeboah-Manu, for their excellent work and achievements.

-E.G.

CLICK HERE TO REVIEW THE FULL ARTICLE

*Reference: Apta-Index™ ID #620

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Microfluid Chip Assay for Diabetes Mellitus

Gwo-Bin Lee's lab from The National Cheng Kung University in Taiwan has developed an assay for diagnosing diabetes mellitus using aptamers conjugated to magnetic beads loaded onto a chip. This method reduces the amount of reagent consumed by 75%, reduces the analysis time from 3 hours to 30 minutes, and can be fully automated. The average amount of glucose in an individual's blood over the past few months can be determined by measuring the ratio of glycated hemoglobin (HbA1c) to hemoglobin (Hb). Individuals with diabetes have an increased level of blood glucose and the presence of glucose in the blood can lead to the permanent glycation of Hb into HbA1c. This means that it is possible to diagnose diabetes by comparing the levels of HbA1c and Hb. This method is superior to measuring blood glucose directly as a fasting blood sample is not required and it is less susceptible to biological variation.

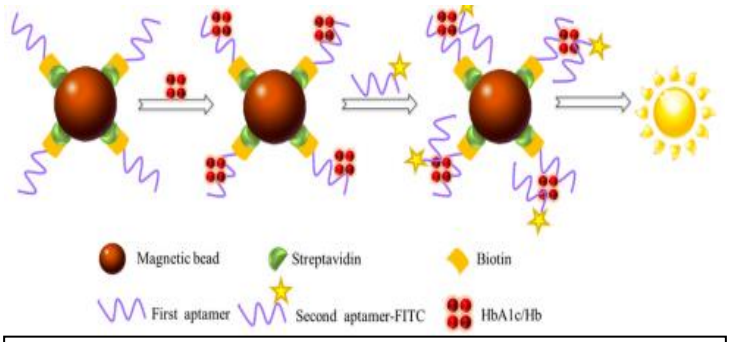

Figure (adapted)* Illustration of the experimental procedure for measuring both Hb and HbA1c in Human Blood.

The assay works by conjugating either Hb or HbA1c aptamers to biotin and binding that biotin to streptavidin coated magnetic beads. The magnetic bead complexes are then attached to a microfluid chip which can be used is the assay. First, the blood to be tested is incubated with the magnetic beads. During this time the aptamers conjugated to the beads bind onto either Hb or HbA1c depending on their sequence, but only one type is on each individual chip. The beads are then washed to remove any unbound material. Next, fluorescently labeled aptamers to either Hb or HbA1c are added depending on the type of chip. The amount of fluorescence produced by these labels is directly proportional to the amount of Hb or AbA1c. This procedure and the binding of molecules therein is shown in the figure above.

- A.P.

*Reference: Apta-Index™ ID #616, #617

Community Sewage Drug AptaSensors

With drug use rising over the past few decades, communities are in need to monitor the drug activity with new technology that can remove the need of surveys. Barbara Kasprzyk-Horden of the University of Bath, UK used wastewater-based epidemiology, or WBE for short, is a novel and cost-efficient way to monitor illegal drug, such as cocaine, use in communities' drug use of sewage sensors that use aptamers. DNA-directed immobilization of aptamer sensors, or DDIAS, is a next step in quantitative community drug sensor technology that will allow for quick and cheap way to monitor drug problems. DDIAS uses a new approach in substance detection by immobilized aptamers on gold electrode surfaces for electrochemical detection of cocaine in wastewater.

The results of the sensor were able to find that the drug use increased during the weekends, while during the weekdays it remained unchanging. These results were also compared against mass-spectrometry tests done before and were found that both of the tests conclusions were in agreement. It also provided a proof-of-concept to the DDIAS, since it is the first aptasensor that is able to monitor cocaine levels in wastewater on a community-wide level. The team seeks to develop a real-time, portable device that could be able used on-site by anyone to monitor the cocaine levels in the community.

- E.G.

*Reference: Apta-Index™ ID #614

Date	Flow (m^3/day)	C (ng/L) with sensors	Load (g/day) with sensors	C (ng/L) with MS	Load (g/day) with LC-MS/MS
Monday 16th	197493.3	455.3 ± 49.6	96.3 ± 15.8	533.5 ± 23.9	112.9 ± 7.1
Tuesday 10th	204490.8	533.5 ± 72.4	116.9 ± 18.5	560.0 ± 30.6	122.7 ± 9.5
Wednesday 11th	198950.4	485.2 ± 50.7	103.4 ± 15.9	546.5 ± 27.4	116.5 ± 8.3
Thursday 12th	197523	413.6 ± 49.4	87.5 ± 15.3	562.0 ± 18.6	118.9 ± 5.6
Friday 13th	252682.2	550.6 ± 98.9	149.1 ± 28.5	688.5 ± 14.0	186.4 ± 5.4
Saturday 14th	220687.2	1023.4 ± 99.2	242.1 ± 29.1	1051.0 ± 36.0	248.5 ± 12.0
Sunday 15th	193194	624.3 ± 82.6	129.2 ± 24.4	771.0 ± 44.5	159.6 ± 13.0

Figure (adapted)* Concentrations and daily loads of cocaine in sewage determined with sensors and liquid chromatography coupled with tandem triple quadrupole mass spectrometry during sampling period from 3/10-3/16, 2015.

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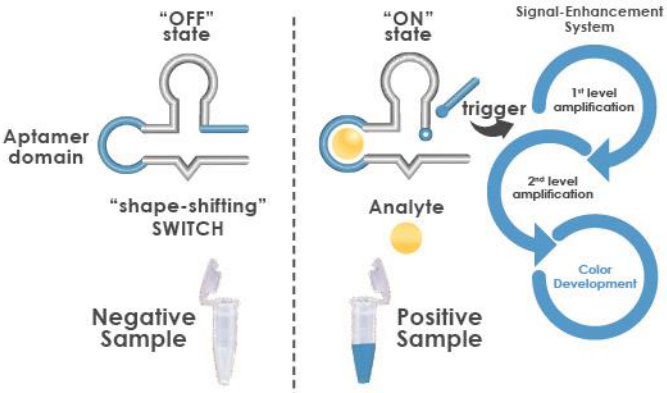

Distinguish just a few atoms, free in-solution!

Technology Comparison Chart

	Antibodies	Aptamers	Apta-Beacons™
Stability/ Refolding		++++	++++
HIGH Affinity	++++	++++	++++
HIGH Selectivity	+	++++	++++
Unknown Biomarkers		++++	++++
Small Target Selectivity	+	++++	++++
Difficult Target Selectivity		++++	++++
One-Step Detection			++++
In-Solution Detection			++++

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