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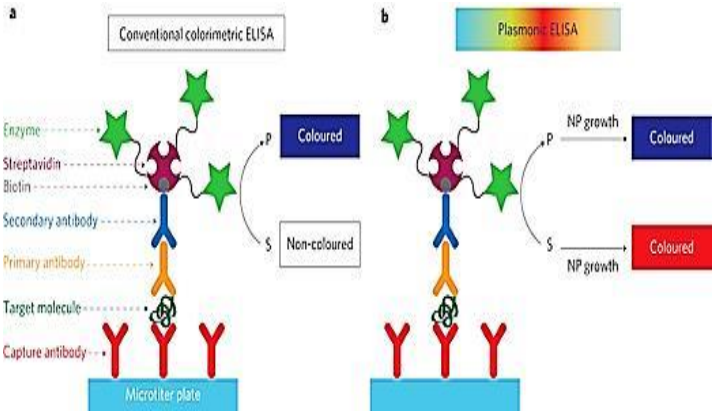
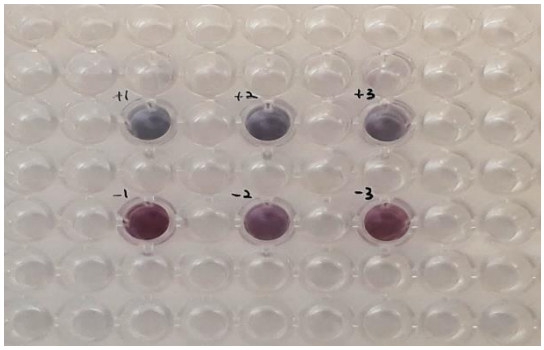
RESEARCH HIGHLIGHTS

Tuberculosis (TB) has become one of the most serious infectious diseases, causing death globally. Failure to control the spread of TB is largely due to inability to detect and treat all infectious cases of pulmonary TB in a timely fashion, allowing continued Mycobacterium tuberculosis transmission within communities. The global TB epidemic results in nearly two million deaths and nine million new cases of the disease a year. In fact, this resurgent disease has become a significant public health concern in Malaysia, with approximately 234,160 new TB cases every year and is largely related to immigration from countries with a high prevalence of TB. Currently, recommended gold-standard diagnostic tests for TB are laboratory based, and multiple investigations may be necessary over a period of weeks or months before a diagnosis is made. Delayed diagnosis has serious consequences for both the prognosis of the patient and onward transmission of M. tuberculosis.

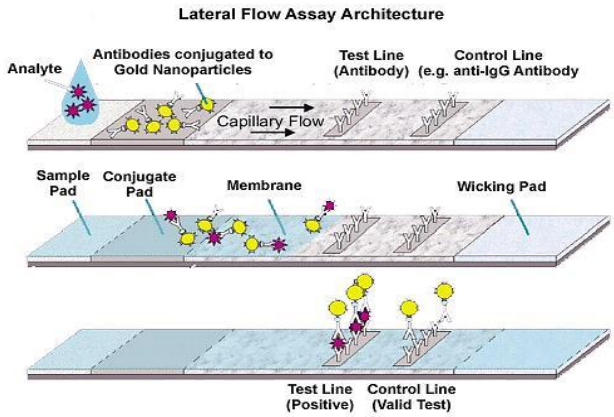
We have developed three techniques with features that suits the TB diagnosis based on nanotechnology. The first one is on Plasmonic ELISA which has proven to be very sensitive and selective in TB patient's sputum sample analysis. Graphical representation can be viewed below.

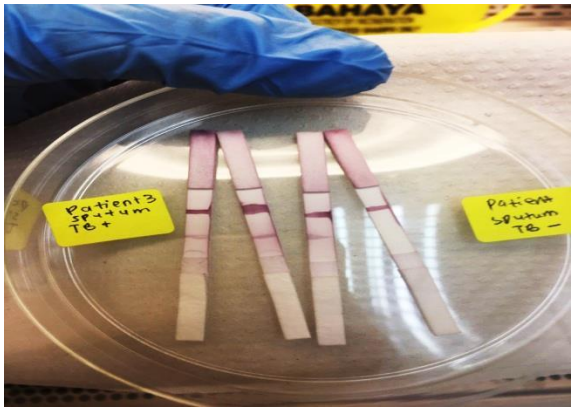
Left Figure showing the graphical representation of the sensing principal and the the right Figure showing the actual result obtained when tested with TB positive and negative patient's sputum sample.



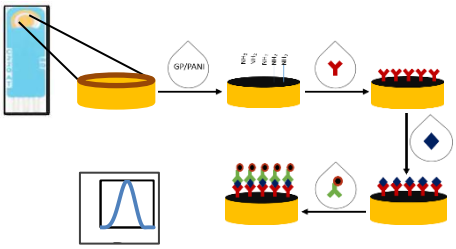


The second detection system is using Lateral Flow system which utilize gold nanoparticle. The advantages in using Lateral Flow system or commonly known as strip test is the low cost and the user friendly feature. However the sensitivity is a bit low compared to Plasmonic ELISA method. The test strip method has been tested with TB patient's sputum sample and the strip manage to show acceptable selectivity between negative and positive samples. Figures below are showing the result and the principle of the developed test strip.



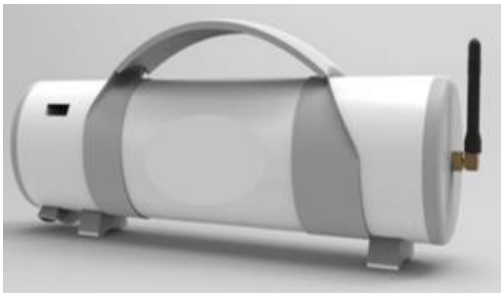


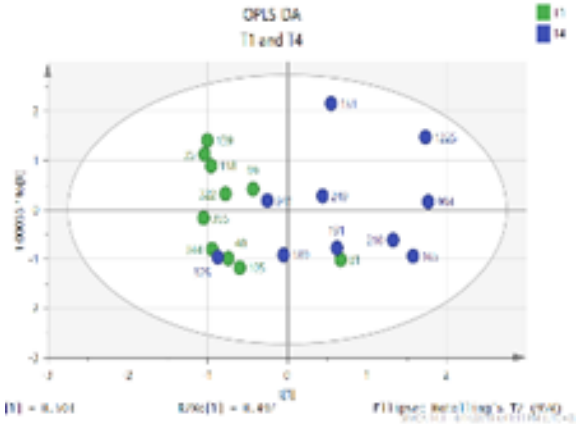
The third technique is using electrochemical reader. The reader was developed using Differential Pulse Voltammetry technique where the usage of nanomaterial has proven to enhance the current signal. This technique is very sensitive and manage to detect down to picomolar level. Figures below describe the sensing principle, the electrode modification technique and the applicability of the method on TB patient's sputum sample.



Bil	Reader Sensor						Culture method	AFB direct smear
	Trial 1	Trial 2	Trial 3	Average	SD	Conclusion		
1	58.12	64.06	56.62	59.60	3.93	Positive	Positive	Positive
2	74.88	52.77	53.29	53.03	0.37	Negative	Negative	Negative
3	55.81	56.13	70.95	60.96	8.65	Positive	Positive	Negative
4	59.82	57.53	57.43	58.26	1.35	Negative	Negative	Negative
5	53.78	57.18	44.5	51.82	6.56	Negative	Negative	Negative
6	53.37	60	63.09	58.82	4.97	Negative	Negative	Negative
7	48.39	50.54	51.94	51.24	1.79	Negative	Negative	Negative
8	55.46	47.43	59.13	54.01	5.98	Negative	Negative	Negative
9	74.61	71.98	60.52	69.04	7.49	Positive	Positive	Negative

Another highlight of our research is on our E-nose detection system for oil palm tree disease. Malaysia is currently the second main producer of palm oil in the world after Indonesia. Malaysia export palm oil of 39% of world palm oil production and 44% of world exports. But the planters of oil palm in Malaysia are facing a devastated crop disease infection called Basal Stem Rot (BSR) that mostly caused by Ganoderma boninense which is a basidiomycete white rot fungus that will disrupt the water and nutrient transport to the upper part of the palm thus causing frond wilting, yellowing of fronds, unopened spear leafs, reduce and "one sided mottling" canopy and emergence of basidiocarps on the lower stem. We have developed an E-nose system to detect an increase level of secondary metabolite when the tree is infected by Ganoderma boninense at early stage. The e-nose developed is equipped with semiconductor based sensors where it will give out changes in signal/pattern upon exposure to the leaves of the infected tree. The E-nose system is equipped with Bluetooth system and can be operated using mobile apps. The current e-nose system is currently being tested with Sime Darby plantation (one of the major producer of Malaysian palm oil) and Malaysian Palm Oil Board (MPOB) plantation.





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