A novel low cost approach for tuberculosis diagnosis using coconut water and silicon solar cell cum biosensor

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Tuberculosis (TB) still causes around two million deaths per year. Mycobacterial culture and identification provide a definitive diagnosis of TB and it is now often required that a unit of a liquid medium be used, along with solid media, for any attempt of mycobacterial culture isolation to expedite the laboratory diagnosis of TB.

We present a low-cost natural culturing medium and an easy set up capable of rapidly indicating tubercular growth. Mature coconut water was utilized as the culture medium and a silicon solar cell *cum* biosensor as detector of mycobacterium growth. Autoclaved mature coconut water was formulated by adding penicillin and amphotericin B. The prototype biosensor comprised a light source (LED 600 nm), tube holder 1.44 cm^2, silicon solar cell (0.05 W, 0.5 V, 0.25 cm^2 effective area) and a multimeter. The set up could detect turbidity and provides the reading as a variation of photocurrent, which is inversely proportional to turbidity. The study was conducted in two batches, three bacterial suspensions equivalent to McFarland Standards-No.0.5, 1 and 2 were prepared using a standard strain of MTB. Each suspension (3 ml) was incubated for 24 days at 37^0C in a CO_2 (10%) incubator. Growth was measured using biosensor at three day intervals and for comparison, readings were also taken using a multi-mode plate reader. Increase in bacterial number was confirmed with microscopy using ZN staining. Biosensor readings decreased as turbidity increased and seemed more sensitive to the initial increase in bacterial number ($1x10^6$-$1x10^8$ CFU/ml); day3-day14, than the spectrophotometer. MTB propagates in coconut water with clump and cords formation; and results indicate that generation time varies with initial inoculum size.

Composition of coconut water is sufficient allows propagation of MTB. However, competition for nutrients seems to affect their growth rate. The readings of the prototype biosensor were correlative to the spectrophotometer (R2=0.5202), with a minimum time to detection (TTD) of: 7-10 days. This approach using coconut water as culture medium and silicon solar cell *cum* biosensor is a potentially useful MTB diagnostic method in resource limited environments.