CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
S0499

Project Title
The Ferrometer: A Device to Detect Iron Deficient Anemia via Non-Invasive Optical Measurement of Zinc Protoporphyrin

Abstract

Objectives/Goals
To build an inexpensive, non-invasive device that detects iron deficient anemia. Hopefully, it will pass WHO field trials later this year in Africa (Dakar, Senegal).

Methods/Materials
Using current technology (primarily high intensity LEDs and a spectrometer), I modified the design parameters (see results) of a 1977 device that invasively detected "Lead poisoning" to create a device that non-invasively detects "Iron Deficient Anemia". Parma Ham was used as the initial subject to verify the approach. I then obtained informed consent from several individuals, optically excited several points on their bodies and measured the resulting spectra.

Results
Parma Ham test results were consistent with those from a Japanese Food Laboratory. Human testing showed that male and female test subject spectra differ and supported previous knowledge about ZPP. Both tests help determine the best values for key design parameters, such as angular geometry (90 ° or 180 ° source detector separation), illumination technology (LEDs), illumination intensity (Automatic Gain Control is needed), excitation wavelengths (400, 425 and 470 nm), use of a collimating lens vs built in LED Optics (built in optics are better), effectiveness of a reflectance versus a transmittance approach (transmittance is better), and the best measurement points (webbing between thumb and forefinger).

Conclusions/Discussion
The results are promising enough that UC Davis has kindly offered to provide test subjects for the initial stage of a clinical trial. The goal is to perfect the current prototype and eventually use it to test subjects in Senegal, Africa. The next technical step is to add a microcontroller to control LED intensity and fluorescence measurement.

Summary Statement
I am creating an optical device that would non-invasively detect iron deficient anemia by measuring the florescence of Zinc Protoporphyrin.

Help Received
UC Davis' Dr Frank Chuang and Xiaoyan Chen referred me to a 1979 invasive ZPP measurement patent; Harker and Oceanoptics guided me to spectrometer equipment; I discussed project ideas with my father, who also retrofitted a colorimeter control box built by Dr Howard Johnson.