CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
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Project Number
S0622

Project Title
Developing Spectrophotometric & Colorimetric Field Tests to Measure Beta-Carotene Concentration of Biofortified Cassava

Abstract

Objectives/Goals
In an effort to fight vitamin A deficiency, a leading cause of morbidity and mortality in Africa, South America, and Southeast Asia, HarvestPlus and BioCassavaPlus have biofortified cassava to increase its beta-carotene concentration. Because carotenoid concentration is affected by climate and growing conditions, field tests are needed to maintain the integrity of these biofortification programs. Current HPLC methods are timely and expensive, making spectrophotometric and colorimetric assays more desirable for field tests.

Methods/Materials
Samples were prepared in two ways: beta-carotene was extracted and then reconstituted to 1:2 dilutions to be measured on the spectrophotometer and colorimeter; and dry samples were homogenized and measured on the colorimeter. Linear regressions were plotted to depict the correlation between the known concentrations and the values obtained using the spectrophotometer and colorimeter.

Results
Spectrophotometric assays were reasonably effective, with $R^2 = 0.7284$. For wet colorimetric assays, there was a strong correlation between the a*, b*, C*, and h values and the concentration of beta-carotene, with $R^2=0.82$, $R^2=0.89$. $R^2=0.90$, $R^2=0.74$,respectively. Both wet assays were more effective than dry colorimetric tests. It is important to note that for actual field tests, standard curves must first be created for each individual spectrophotometer and colorimeter.

Conclusions/Discussion
Excitingly, both spectrophotometric and colorimetric assays have much potential to be used as field tests, saving nonprofit organizations like HarvestPlus and BioCassavaPlus time and money, resources they can use to further their impact preventing vitamin A deficiency and saving lives doing so. This study also suggests that carotenoid concentration determines the color values of extracted samples. More broadly this suggests that higher concentrations of beta-carotene results in a color shift to a more vivid yellow-green, away from being a white-yellow color. More research should be done to evaluate the limitations of spectrophotometric and colorimetric assays as field tests and their potential applications to other biofortified foods.

Summary Statement
The purpose of this project was to evaluate the potential use of expeditious and cost-efficient methods of beta-carotene measurement of biofortified cassava such as spectrophotometry and colorimetry in place of timely and costly HPLC.

Help Received
Used lab equipment at University of California, Davis; I was supported by Dr. Betty Burri who gave me the freedom to conduct this investigation; HPLC results were provided by Dr. Michael La Frano at the University of California, Davis