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Overview article

An overview for the application of multispectral device for determination of alkaloid level in *dioscorea hispida*

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ABSTRACT

Recently with development of computer imaging, the application field of near infrared image processing becomes much wider. The potential of machine vision application in the determination of alkaloid in *Dioscorea hispida* rhizome was explored. A camera vision system used in this research is TETRACAM multispectral camera, which consists of three bands, namely red band (R), green band (G) and near infrared band (NIR). The first component is the hardware component that functions as an image acquisitioned for the system. The second component is the software part which converts data obtained from the hardware. From the design review, the images from a variety of harvested of *Dioscorea hispida* will be captured and the readings in multispectral wavelength index were tabulated. The statistical relationship between multispectral wavelength and alkaloid level in the fruit were determined. The development on this study is grouped as non destructive method to determine the dioscorine content which is one of the alkaloid components in the rhizome of *Dioscorea hispida.*

1. Introduction

The development of computer information technology in 1960's, near infrared (NIR) analysis technique has been rapidly urbanized. Today, modern NIR analysis has become the fastest growing and most notable technology. It is mainly applied in some fields as follows: food science, Nondestructive quality inspecting of agricultural products, detection of insects inside wheat kernels, identification of weed and application of precision chemicals in agricultural management, etc. (Ming *et al.* 2009). *Dioscorea hispida* is a poisonous plant where scientific study has shown that its rhizome contains toxic alkaloid constituents, dioscorine. The rhizomes can only be consumed after the poisonous dioscorine is removed. This plant is commonly found in secondary forest and grows under shaded areas or near streams. *D.hispida* is one of the *Dioscorea* (Yam) species with glabrous leaves and twinning stems. *D.hispida* is one of the most economically important yam species, which serves as a staple food for millions of people in tropical and subtropical countries (Hanh, 1995; Udensi et al., 2008) and the only species of which most of the leaves have 3 leaflets and have no aerial rhizomes (Jill and Linda (1998). This plant is classified as a wild creeping and climbing plant which can grow up to 20 meters in height (Hudzari *et al.,* 2011). Traditionally, the stem of *D.hispida* has been used to treat sinus. The rhizomes have been reported to be rich in essential dietary nutrients (Megh and Jun, 2005). This plant is also known by the local with names such as *Tuba Ubi*, *Ubi Nasi, Ubi Cerok, Ubi Kendudok* and *Ubi Kipas* (Nashriyah *et al. 2010*). Figure 1 shows the operation of collecting the rhizome of *D.hispida at* Ajil, Terengganu, Malaysia. Mohd. Hudzari *et al.* (2011), Ishak and Hudzari (2009) mentioned that the advancement of technology should be introduced for agriculture research in *D. hispida* within the area of harvesting process, dioscorine removal and dioscorine detection devices. The essentialness of agriculture shown within the righteous book of Al-Quran which is there are about eighty three sentences mentioning about agriculture as indicated as benefit of mankind (Mohd. Hudzari *et al*. 2010).

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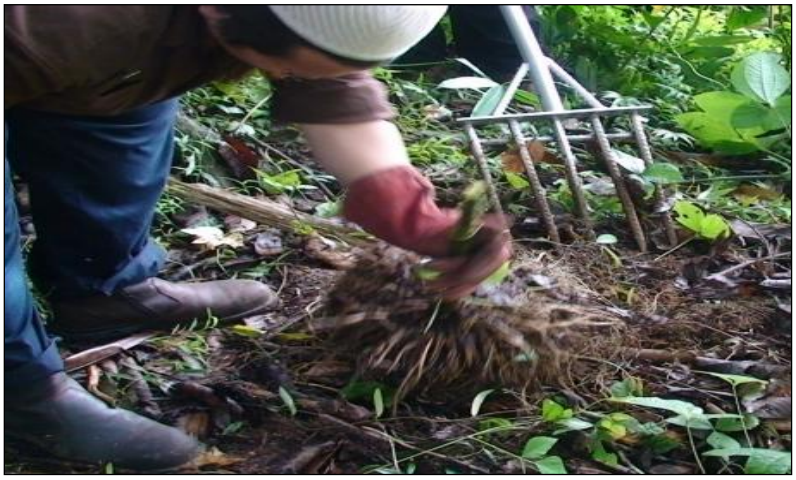


Fig. 1. Collecting the rhizome of *D.hispida*

The method used is a non-destructive practice which is possible to be use for determination of alkaloid level for this project. Advantages of using non-destructive method for sensing are that it can be fairly accurate, and yields consistent results thereby reducing costs and making agricultural operations and processing safer for farmers and processing-line workers (Tang *et al. 2009*). It holds great potential and benefits for the agricultural industry because of its simplicity, rapid inspection rate, and broad range of applications.

2. Objective

The objectives of this study are to investigate the alkaloid level from the different variety of *D.hispida* using the Tetracam multispectral camera. The relationship between the levels of alkaloid with the color of *D.hispida* also will investigate and lastly this study is to generate the simulation model based on alkaloid content in *Dioscorea hispida*.

3. Review materials and method suggestion

Two plants of *D.hispida* were collected from Kampung Kudat, Ajil, Terengganu, Malaysia. There were three levels of each plant. Three rhizomes were chosen from each level.

3.1. Analysis of pictures from multispectral camera (image processing)

The acquired 50 pictures were then processed by using two softwares namely TETRACAM Pixel Wrech 2 (TPW2) and MATLAB. The Tetracam Multispectral camera (Fig. 2) captures the images in RAW format. By using Pixel wrench (TPW2) the RAW images were processed and store in BMP format. The BMP images with RGB color index was processed and transformed into BMP HSV color index by using MATLAB.

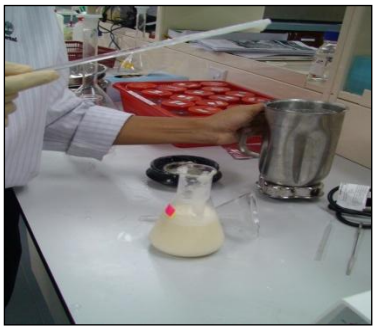
Fig. 2. Tetracam multispectral camera

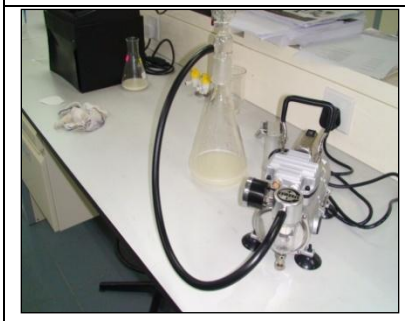
3.2. Chemical experiment for alkaloid determination

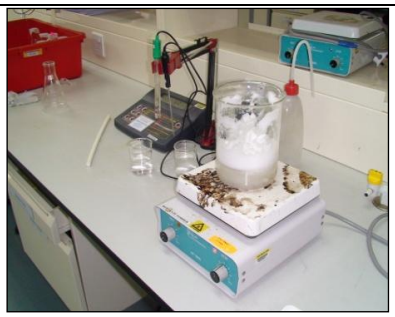
The experimental method was adopted from the chemical analysis method (Megh and Jun [6]). After the rhizome was peeled, they were weighed (40 grams) and sliced. Each sample was blended with 200mL of 0.5426 M hydrogen chloride (HCl) (specific molarity of HCl obtained from Titrant/Acid Standardisation) using an electric blender. For HCl preparation, 42mL of HCl was dissolved with distill water. The mixtures of sample were transferred into conical flask covered with parafilm and stand at room temperature for 2 days. After that, the samples were filtered using muslin cloth followed by filter paper; (Whatman Cat No 1001 150). The pH of the samples was checked using pH meter. The mixtures were made alkaline (pH 10-11) by adding K_2CO_3 and extracted with 3 portion (600-200mL x 3) of ether using the separating funnel. All of the extracts were combined and dried overnight with Na_2SO_4. Dried extract was filtered and concentrated under reduced pressure using rotor evaporator. The concentrated extract was spotted on a 20 x 20 cm TLC plate (Silica gel G, 60 F_{254}, 0.5 mm thickness, Merck). The compounds were separated by an ascending method with a solvent mixture of chloroform:ethanol:ammonia (100:10:0.5). The plates were air-dried and were sprayed with Dragendorff reagent. The calculated R_f value compared with literature R_f value (Leete and Pinder, 2009). Fig. 3 shows overall process flow and pictures taken during experiment.


A


B


C


D


E


F

Fig. 3. The process flow for determination of alkaloid level in *D. hispida*; A: cutting roots of rhizomes; B: slicing rhizomes ; C: blending with 200mL of 0.5M HCl ;D: filtering ; ; E: made alkaline of pH 10-11 ; F: concentrating under pressure by rotor evaporator.

4. Expected result

A relationship between the readings of multispectral wavelength and the percentage of dioscorine content in *D.hispida* was obtained. The linear graphs were plotted and get the regression, R^2. If R^2>0.8 means multispectral wavelength index has strong correlation with the percentage of dioscorine content in *D.hispida.* Similar researches were conducted with the potential on application of technology advance in *D. hispida* research (Mohd *et al.*, 2011a,b). Therefore this study will be proceeding.

5. Conclusion

The model using the mathematical equation developed to predict the level of alkaloid of the *D.hispida* rhizome. Therefore, the amount of water was needed to remove the toxic compound and the time consuming in the process can be determined. InshaAllah the sensory device to determine the alkaloid level for *D.hispida* will be realised.

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