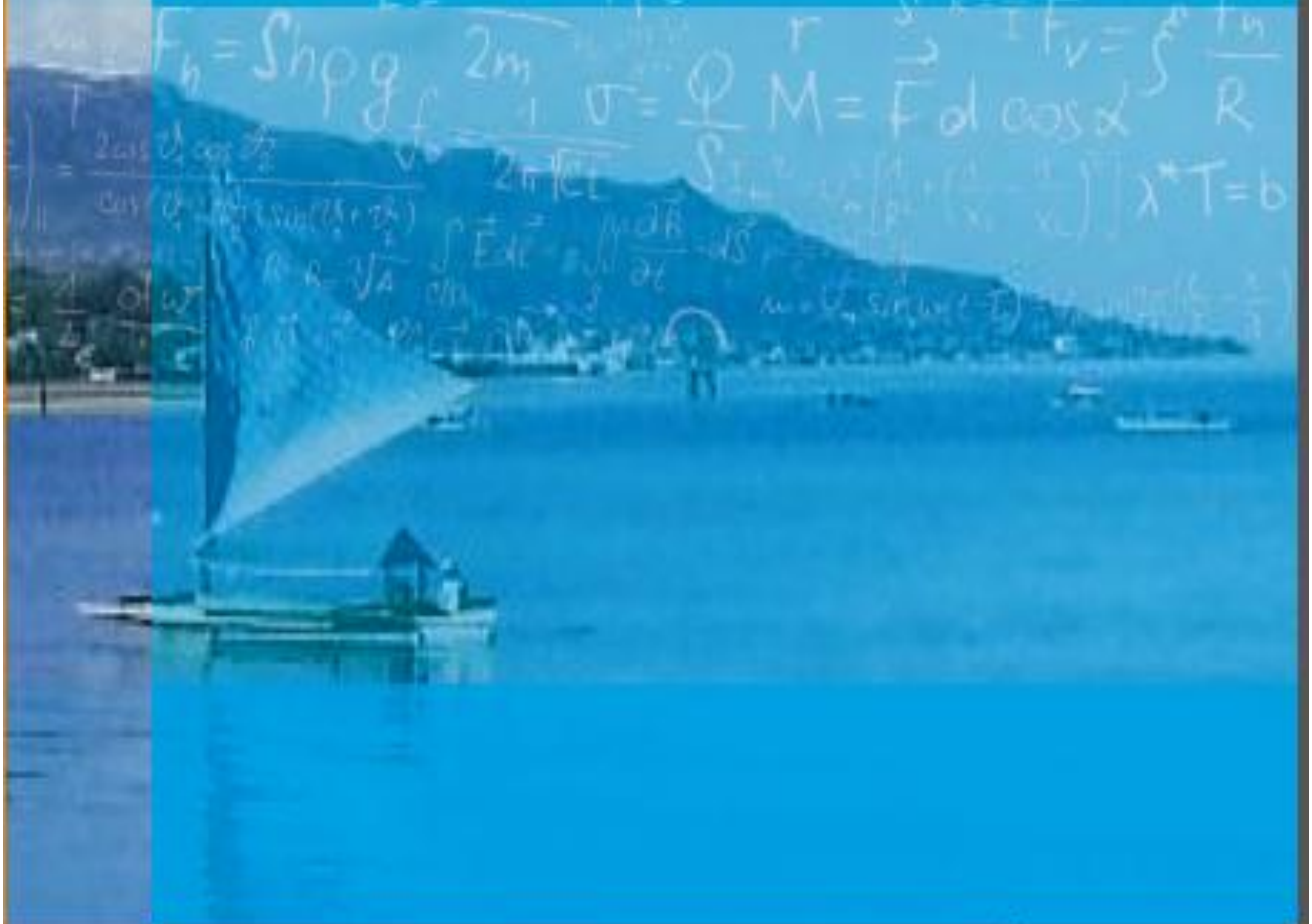
Basic Science
for Sustainable Marine Development

PROCEEDING
INTERNATIONAL SEMINAR 2015

Ambon, 3-4 June 2015



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Pattimura University

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Welcoming Address by The Organizing Committee

The honorable, the rector of Pattimura University
The honorable, the vice rector of academic affair, Pattimura University
The honorable, the vice rector of administration and financial affair, Pattimura University
The honorable, the vice rector of planning, cooperation and information affair, Pattimura University
The honorable, all the deans in Pattimura University
The honorable, the key note speakers and other guests.

We have to thank The Almighty God for the blessings that allow this International seminar can be held today. This is the first seminar about MIPA Science in which the Faculty of MIPA Pattimura University becomes the host. The seminar under the title Basic Science for Sustainable Marine Development will be carried out on 3 June 2015 at Rectorate Building, the second floor. There are 250 participants from lecturers, research institute, students, and also there are 34 papers will be presented.

This International seminar is supported by the amazing people who always give financial as well as moral supports. My special thanks refer to the rector of Pattimura University, Prof. Dr. Thomas Pentury, M.Si, and the Dean of MIPA Faculty, Prof. Dr. Pieter Kakissina, M. Si. I also would like to express my deepest gratitude to Dr. Kotaro Ichikawa, the director of CSEAS Kyoto University, Prof. Bohari M. Yamin, University of Kebangsaan Malaysia, Prof. Dr. Budi Nurani Ruchjana (Prisident of Indonesian Mathematical Society/Indo-MS), Dr. Ir. A. Syailatua, M.Sc (Director of LIPI Ambon), and Hendry Ishak Elim, PhD as the key note speakers. We expect that this international seminar can give valuable information and contribution especially in developing basic science for sustainable marine development in the future.

Last but not least, we realize that as human we have weaknesses in holding this seminar, but personally I believe that there are pearls behind this seminar. Thank you very much.

Chairman
Dr. Netty Siahaya, M.Si.

Opening Remarks
By Dean of Mathematic and Natural Science Faculty

I express my deepest gratitude to The Almighty God for every single blessing He provides us especially in the process of holding the seminar until publishing the proceeding of International Seminar in celebrating the 17th anniversary of MIPA Faculty, Pattimura University. The theme of the anniversary is under the title Basic Science for Sustainable Marine Development. The reason of choosing this theme is that Maluku is one of five areas in Techno Park Marine in Indonesia. Furthermore, it is expected that this development can be means where the process of innovation, it is the conversion of science and technology into economic value can be worthwhile for public welfare especially coastal communities.

Having the second big variety of biological resources in the world, Indonesia is rich of its marine flora and fauna. These potential resources can be treated as high value products that demand by international market. Basic science of MIPA plays important role in developing the management of sustainable marine biological resources.

The scientific articles in this proceeding are the results of research and they are analyzed scientifically. It is expected that this proceeding can be valuable information in terms of developing science and technology for public welfare, especially people in Maluku.

My special thanks refer to all researchers and reviewers for your brilliant ideas in completing and publishing this proceeding. I also would like to express my gratefulness to the dies committee-anniversary of MIPA Faculty for your creativity and hard working in finishing this proceeding, God Bless you all.

Dean of Mathematic and Natural Science Faculty

Prof. Dr. Pieter Kakisina, M.Si.

Contents

ANALYSIS THE MATURITY LEVEL OF PLANTAIN FRUIT (*Musa paradisiaca*) BY USING NIR SPECTROSCOPY

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ABSTRACT

In recent years, there have been a number of reported studies on the use of conventional methods with non-destructive techniques to assess the predictability and determine the maturity levels of banana. Most of these reported works were conducted using the expensive techniques and other measurements. But at this time, some instrumentation techniques have been developed to determine the maturity levels of banana fruit, an example the measurement technique using the NIR spectroscopy. The research by NIR spectroscopy to determine the maturity levels of banana (Musa paradisiaca) has been done. The results of maturity level of banana fruit can be analyzed with reference to the spectra patterns of water and carbohydrates. NIRS value increased with increasing fruit maturity. The best calibration equations, obtained from the second derivative spectra and wave numbers around 5200 cm^{-1}, with the correlation coefficient =0.99, SEC = 0.36, SEP = 1.23, and RPD = 4.27. Indications of water absorption of banana fruit, are the wave number 5200 cm^{-1}. While of indication carbohydrate absorption of banana fruit (such as; fructose, sucrose and glucose) are the wave number 4644 cm^{-1}. The maturity level of banana fruit are closely related with to the content of water and carbohydrates.
Keywords: *NIR spectroscopy, maturity, banana, second derivative*

INTRODUCTION

In recent years, there have been a number of reported studies use the conventional methods with non-destructive techniques to assess the predictability and determine the chemical content and maturity levels of fruit. Most of these reported works were conducted using the expensive technics and other non-destructive measurements (Suhandy, 2009). One of the measurement technique is spectroscopes NIR (near infrared) that was emitted to the materials or samples and has been proven capable of measuring a wide range of good quality fittings (Bull, 1991).

The NIR spectroscopy has proven capable of measuring a wide range of good quality fittings (Bull, 1991). It is not in spite of the various advantages of this technique when compared to conventional measurement techniques. Excellence of quality or quality measurement techniques using NIR spectroscopy, which is free of chemicals, quickly, without damaging the samples tested, and can be easily integrated in a continuous quality assessment system (Suhandy, 2009). Saputra, et al., (1995), has been applied by NIR to classify the sweet and sour taste of mango. The relationship between the NIR with sugar and acid on the research studied by calibration using multiple linear regression (MLR). The regression equation of the calibration results used to suspect the sugar and acid content of mango. Through the regression equation to estimated, that mean assuming the relationship between NIR chemical content is linear.

According to Osborne, et al., (1993), the advantages of near infrared in the analysis of food ingredients is achieve a combination of speed, level of accuracy, and ease of experiments performed. With the method of near infrared can be measured internal and external quality of a product, for example, the sugar content of dried tissue apples (Giangiacomo, et al., 1981), the acidity and total dissolved solids in Jonagold apples (Lammertyn, et al., 1988), sucrose and citric acid in oranges Mandarin (Citrus unshiu MARC) (Miyamoto, Kawauchi, and Fukuda, 1998), and measurement of hardness on wheat seeds (Delwiche, 1993). The suitability reflection of near infrared to evaluate the taste of rice, have been studied by Kawamura, et al., (1997). In the liquid foodstuffs such as estimation of total dissolved solids in the juice of orange, apple, papaya, pears, and bananas so that it can develop a general algorithm for the determination of total dissolved solids fruit juice (Chang, et al., 1998). For online application of measurement using NIR, has been done by Purwadaria, et al., (1995), on levels of sucrose and malate acid in mango, and produce a level of accuracy about 75%.

It is interesting to be assessed, if the NIR spectroscopic methods used to view the maturity level of fruit.

MATERIALS AND METHODS

Experiment laboratory

First of all, cut the 18 samples of banana into small pieces and blend until smooth. Each samples of banana was blended separately and then, put into a different petri dish (18 petri dish). After that, the pulp of banana in each petri is compacted to the size of the sample surface about 0.5 cm. And the last step is analyze the maturity level of each samples banana (plantain) by using NIR spectroscopy.

NIR Spectroscopy

The first step before making measurements by using NIR spectroscopy, is measures the reference spectra. After that, each samples of banana (plantain) that have been placed in a petri dish, and measured pattern of spectra using NIR spectroscopy.

Data Analysis

After the measurement pattern of spectra by using spektorskopi NIR, the results obtained can be analyzed by using the program Origin 6.1 and Microsoft Excel 2007. In first, create a calibration equation the maturity level of banana fruit using polynomial method (order = 4). Before making the calibration equation, the first step that must been done is measure the height of the second derivative spectra of samples banana (plantain) around wavenumber 5200 cm^{-1} of each phase of maturity levels. A good calibration equation can be seen through high correlation coefficient (r), low standard error of calibration (SEC) and low standard error of prediction (SEP). In addition, the calibration equations with the high ratio prediction to deviation (RPD), it is a requirement acceptable calibration equation (Williams, 1987). A good calibration equations obtained on the value of SEP > 1 and accompanied by high RPD value. Determination to high or low value of SEP will be more objective when referring to the RPD value obtained. Therefore, the value of RPD should be as large as possible. The next step after making the calibration equations is measure the validity of the calibration equation by comparing the results of valid data and predictions data of maturity level.

RESULTS AND DISCUSSION

Results

This research is conducted in order to determine the maturity level of plantain using NIR spectroscopy, obtained the following results:

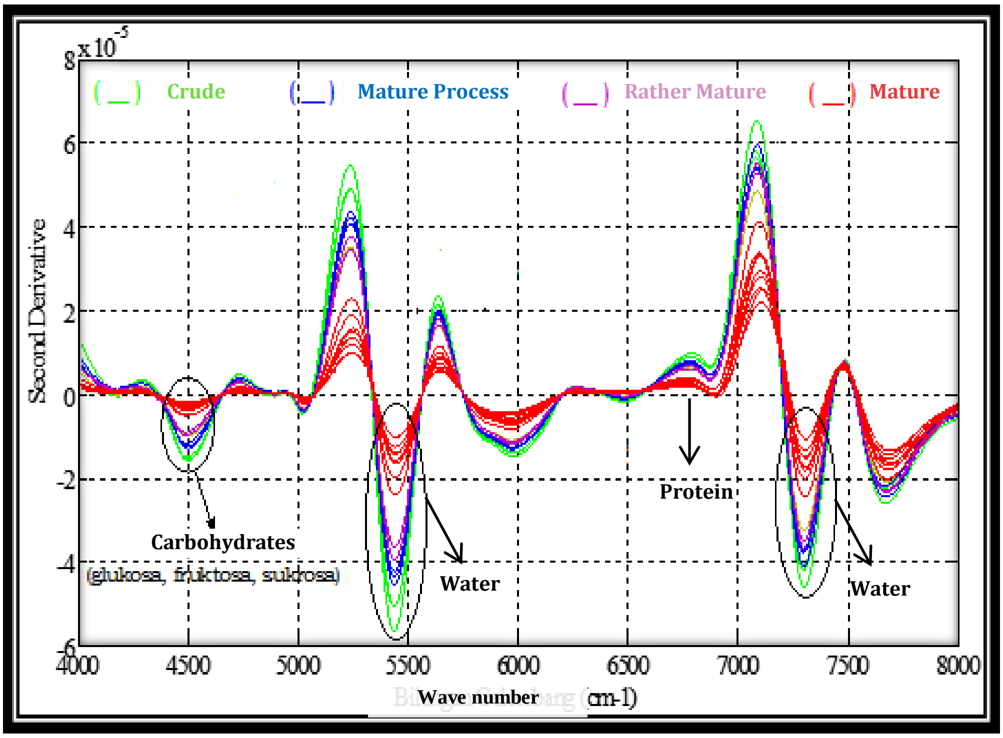

Figure 1. NIR Spectra of Plantain Fruit for *Second Derivative* Spectra

In figure 1, can be seen plantain fruit NIR spectra for the second derivative, which is divided into four phases of maturity level, namely crude phase, a phase of maturation process, rather mature phase, and mature phase. Differences in patterns of spectra, as a result of differences in the value of the maturity level. The differences are quite obvious, visible at wave number 5200 cm^{-1}; 7000 cm^{-1}; 4644 cm^{-1}; and 5600 cm^{-1}. Reach area of the NIR spectrum being around at wave number 5000 cm^{-1} and 7000 cm^{-1}, is highly correlated with water, while reach area of the NIR spectrum being around at wave number 4600 cm^{-1} and 5600 cm^{-1}, is highly correlated with carbohydrates (Workman, et al., 2007; Novita and Trihandaru, 2010).

B. Discussion

1. Equation Calibration

In Figure 2, shows the results of calibration for the determination maturity level of banana (plantain).

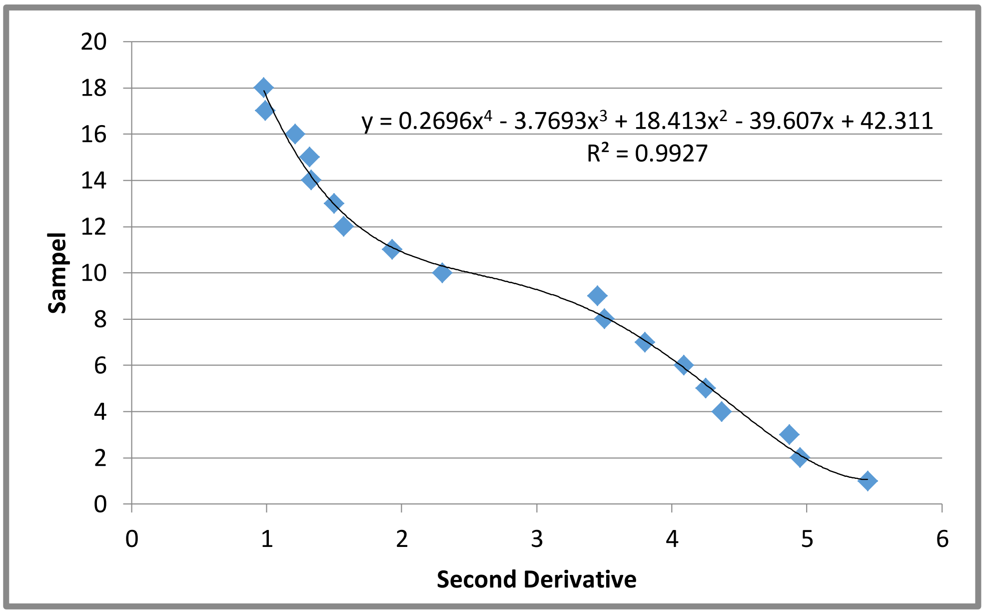

Figure 2. Calibration for Determination Maturity Level of Banana

This picture showing the results of the calibration range of the spectrum being around at wave number 5200 cm^{-1} for the second derivative spectra, produce a good calibration equation with a correlation coefficient of 0.99, while the value of SEC = 0:36; SEP = 1.23; and RPD = 4.27.

From the NIR spectra of plantain fruit for *Second Derivative* spectra and results of calibration for determination maturity level of plantain fruit (Figures 1 and 2), it seems clearly that the water is a dominant component in especially of ripe bananas. According to Mikasari, (2004), the main constituent component of ripe bananas is water, with a total content of about 75%. Increased water levels in line with the maturity level of fruit. Increased of moisture content during fruit maturation process, caused by the presence of formation water from the respiration process of fruit and the results are retained in the space between cells. Although the fruit has been plucked from the tree, but the metabolic activity of the tissue is still running and it is a complete process of respiration.

In addition, the figure 1 shows that the protein levels did not show obvious changes during the stages of ripeness of the fruit when compared to carbohydrates. Carbohydrates are the second largest component of water, which is about 20-25% (Mikasari, 2004). Carbohydrates in plantain is energy reserves that are used to carry out metabolic activity during the maturity process. Fruit carbohydrates content of raw plantain higher than ripe plantain, because to produce energy for continue the process of metabolism (hydrolyzed starch into sugar). Increased sugar content in conjunction with reduced starch content. Carbohydrates in raw banana (plantain) is starch, while the ripe banana (plantain) shaped is glucose, fructose, and sucrose.

Other types of carbohydrates in bananas are fiber and pectin. During the stage of maturity, the fiber in bananas will decrease, so the bananas shape on display is looks hard, it would seem soft when ripe. This is because the hydrolysis of starch in bananas, produce the same concentrations of glucose and fructose. Can be concluded that the maturity of plantain is very closely related to the water content and carbohydrates. Furthermore, increased weight of fruit from raw to cooked can be occur because the sugar content in the pulp is higher than the rind. It's trigger to osmotic pressure so that the pulp of fruit absorbs water from the rind and eventually lead to weight differences pulp and rind.

The stages of maturity level of fruit can be clearly through a color change. The change color from the crude stage of fruit to mature stage, caused the chlorophyll content decreased when the fruit enters the maturity stage, while the carotenoid content is relatively constant even experiencing an increase. The formation of carotenoids, marked by a color change from green to yellow fruit.

2. Validation Calibration Equation

In figure 3, shows the scatter plot between the valid data and the prediction data of the maturity level on plantain at wave number 5200 cm^{-1}. From the results obtained, it appears are not significantly different, and through the calibration equations can be concluded that the determination level maturity of plantain using NIR spectroscopy, is well done.

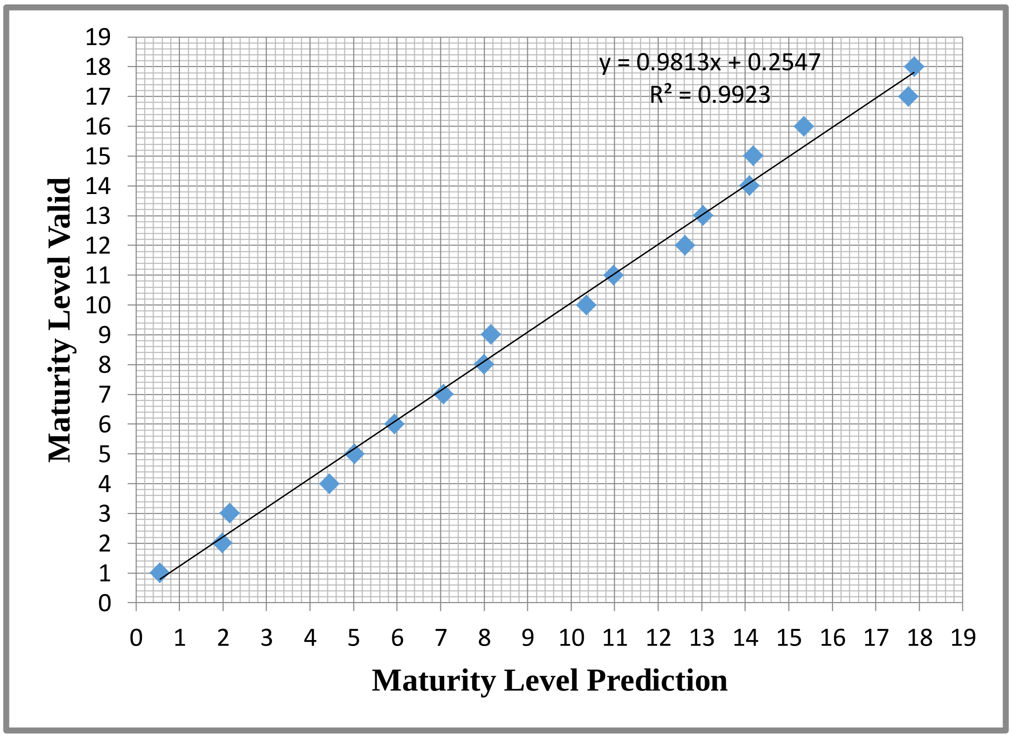

Figure 3. ***Scatter plot between the valid data and prediction data***

CONCLUSIONS

From this research it can be concluded that :

1. Analysis of the level of ripeness of plantain can be done using NIR spectroscopy.
2. The best calibration equations derived from second derivative spectra around wave number 5200 cm^{-1}, with a correlation coefficient = 0.99, SEC = 0:36, SEP = 1.23, and RPD = 4.27.
3. Maturity level of plantain is very closely related to the water content and carbohydrates content.

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