JIPF (JURNAL ILMU PENDIDIKAN FISIKA)
p-ISSN: 2477-5959 | e-ISSN: 2477-8451 *Vol. 4 No. 1, March 2019, Page 33-38*

The Effect of Noni Leaves' Age Variation On the Value of Absorbance and Wavelength In Certain Color Spectrums

Kasyfi Rifqi Mouromadhoni [1], Heru Kuswanto [2], Andi Asmar [3]
Science Education Study Program, Postgraduate Program, Yogyakarta State University[1,3],
Physics Education Study Program, Postgraduate Program, Yogyakarta State University[2]
kasyfirm@gmail.com[1], herukus61@uny.ac.id[2], asmarandi14@gmail.com[3]

Received: January 30th, 2019. Revised: March 7th, 2019. Accepted: March 8th, 2019

Keywords :
Optical Properties of Leaves; Absorbance; Wavelength; Age of Noni Leaf

ABSTRACT
This research is experimental research. The research aims to analyze the absorbance and wavelength values on the certain color spectrum based on the age of noni leaf sample. Variation in absorption and wavelength occurs in the red spectrum ranges between 650 to 700 nm. Maximum absorption occurs in the middle of noni leaf followed by the tip of noni leaf sample but the yellow leaf sample results poor absorption. Chlorophyll a has main leaf pigment the most which occurs in the light reaction of photosynthesis. The maximum absorption which ranges between 3,5 to 4,0 A occurs in the blue spectrum ranges between 400 to 450 nm. Chlorophyll b absorbs photon energy in sun light. A wavelength ranges between 500 to 600 nm occurs in the green spectrum which has low absorption of three samples ranges 0,5 to 1,5 A. The chlorophyll reflects light of the green spectrum; therefore, it causes low absorption.

INTRODUCTION

Noni tree (*Morinda Citrifolia* L.) is one of wild plants which usually used in traditional medicine that many interested people consume it. Noni plants can grow well not only in fertile land but also in infertile land. Besides, noni plants can grow in the seashore until 1.500 m above sea level. Noni plant is well spread in Asia, particularly in South East Asia and South Asia, South Africa and the regions of Pacific island [1]. Scientific classification or taxonomy of noni tree is as follows in table 1.

Table 1. Taxonomy of Noni Tree

Kingdom	Division	Subdivision	Class	Subclass	Order	Family	Genus	Species
Plantae	Spermatophyte	Angiospermae	Dicotyledonae	Sympetalae	Rubiales	Rubiaceae	Morinda	*Morinda Citrifolia, L*

Noni has oval shape, rather rough surface, shiny green, and narrow leaf base. The size of noni leaf becomes the indicator of the size of noni fruit. In general, long and wide noni leaf has bigger size of the fruit, conversely, small and short noni leaf has smaller size of the fruit [2] [3]. Leaf of green plant

contains a pigment called chlorophyll. Chlorophyll absorbs the certain light wavelength of the visible light spectrum. Theoretically, chlorophyll absorbs light in the long wavelength region of red spectrum and the short wavelength in blue of visible light spectrum [4]. Green spectrum is not absorbed but reflected, so it makes plants look green. In photosynthesis, chlorophyll absorbs energy to convert carbon dioxide and water into carbohydrate and oxygen. Moreover, in reduction process, electron is transferred from water to carbon dioxide. In this process, chlorophyll assists in trapping energy of sunlight. When chlorophyll absorbs the energy from sunlight, an electron of chlorophyll molecule is pulled from lower energy to higher energy. Excited electron is easier to move to other molecule. An electron transfer chain ends when electron is transferred to carbon dioxide molecule. This is a process of converting photon energy from which energy of sunlight becomes an object that the plants can use it and animals can eat it in order to form the food chain foundation [5].

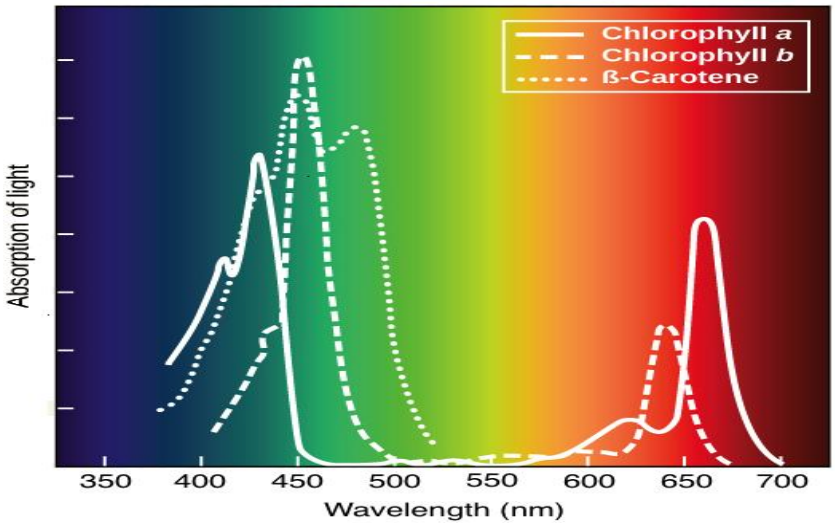

Fig 1. *Absorbance and Wavelength of Chlorophyll a, Chlorophyll b and Carotenoid in the Leaf* [5]

Green plants use photon energy from sunlight to produce the form of glucose molecule ($C_6H_{12}O_6$) from the compound of CO_2 and H_2O through photosynthesis. This causes green plants to have ability to form the food for themselves through anabolism process which is a photosynthesis [6]. Green plant is one of photoautotroph organisms because it uses light for glucose molecule synthesis. Photosynthesis occurs to all parts of plant, for instance, they are stick, leaf and immature fruit. However, the main photosynthesis occurs in the leaf. The part of leaf where the photosynthesis occurs is chloroplast. Four main pigments in the chloroplast cause changes of color. Chlorophyll a and b make chloroplast have green, while xanthophyll and carotenoid cause the chloroplast to have yellow-orange. Moreover, chloroplast has a smaller section which is green substance of chlorophyll [5]. The chlorophyll content in adult leaves is greater than the chlorophyll content in young leaves. The age of leaves is an important factor in determining chlorophyll content levels in leaves [7]. Moreover, chlorophyll and stomata contribute a direct role in the process of photosynthesis as they produce organic compounds from inorganic compounds with the help of sunlight. Organic compounds are used by plants to grow and develop in maintaining their growth. Furthermore, the amount of light absorbed by leaves also determines photosynthetic activity, which in turn will determine the amount of carbohydrates produced [8].

Electron is transferred from water to carbon dioxide in reduction process of photosynthesis. In that process, chlorophyll has an essential task to absorb the energy of ultraviolet (UV) light. The ultraviolet is absorbed by chlorophyll in that lower electron in chlorophyll molecule is pulled into the condition when the energy is higher. It makes the energy easy to excite, moving to other molecule. Hence, sunlight hold a key in photosynthesis [6]. Photosynthesis occurring in high temperature and light intensity condition results in heavier leaves [9].

Light is polychromatic in which the refracted polychromatic light produces monochromatic light to assist in photosynthesis [10]. Sunlight has several color spectrums which have a wavelength (λ). The color spectrum has different influences to photosynthesis. Further, each pigment of photosynthesis (chlorophyll and carotenoid) has different light absorption energy (absorbance) [5]. The light spectrum has an important role in the process of photosynthesis as in this process, the chlorophyll will transmit several specific colors of light, i.e. the color of blue light with the wavelength ranging from 450 to 475 nm and the color of red light ranging from 630 to 675 nm. The more light absorbed, the higher the energy for photosynthesis [11] [12].

When sunlight passes the leaf, the light will be absorbed by a pigment in chlorophyll. The pigment in chlorophyll absorbs the visible light in blue ranges between 400 to 450 nm more than in red ranges between 650 to 700 nm, and it reflects the visible light in green ranges between 500 to 600 nm. Absorption spectrum of chlorophyll a is effective in absorbing short wave [4]. Chlorophyll a has the largest amount of main pigment that has a function in light reaction of photosynthesis. Furthermore, chlorophyll b has a function to absorb photon energy of sunlight, while carotenoid absorbs and releases excessive energy of sunlight [13].

The ability of leaf to photosynthesize also increases until the leaf completely grows and decreases slow when the leaf turns yellow. The yellow and dying leaf are not able to photosynthesize because the function of chloroplast is vanished and the chlorophyll is broken [14]. The age of trees and leaves also affect the chlorophyll content. Leaves at a young age have higher light absorbance than the yellowed old leaves that have low light absorbance [15]. Based on this description, the researchers determine the result of "The Effect of Age Variation of Noni Leaves on the Value of Absorbance and Wavelength in Certain Color Spectrums.

METHOD

This research is an experimental research, while the tools and materials used in this study are as follows in table 2.

Table 2. Tools and materials

Tools	Materials
3 pounders	80% Acetone
3 petri dishes	3 filter papers
3 pipettes	Aquades
3 magnifying glass	Noni leaf (tip of noni leaf, middle of noni leaf, and yellow noni leaf)
3 beakers	
3 test tubes	
1 shelf of test tubes	
1 digital scale	
3 stirrers	
UV-VIS Spectrophotometer	

Procedures

1. Prepare tools and materials by taking different ages of noni leaves (young leaf, old leaf and yellow leaf) needed during research.
2. Pound the leaf using mortar until it is smooth.
3. Calibrate the digital balance that has been placed on the digital balance petri dish and then weigh each 2.5 grams of mashed leaves.
4. Put the weighed leaf into beakers then add 10 ml of acetone using magnifying glass to the beakers which are filled with the leaf.
5. Stir the solutions in beakers until they become homogenous.

6. Filter the homogenous solution using filter paper, then take 5 ml of each solution to each test tube.
7. Prepare acetone as blank solution then measure its absorbance and wavelength of each solution using UV-VIS spectrophotometer.

RESULTS AND DISCUSSIONS

The research aims to analyze the result of absorbance value and wavelength of certain color spectrum based on leaf ages in noni leaf samples. Green plants fill their energy by absorbing the visible light of blue and red spectrum. The results revealed that the leaf absorption of the tip of noni leaf, middle of noni leaf and yellow noni leaf ranges between 3,5 to 4,0 A in which the wavelength ranges between 400 to 450 nm. It indicated that the pigment in chlorophyll absorbs more in the blue of visible light ranges between 400 to 450 nm. According to [13], chlorophyll b absorbs photon energy of sunlight and is effective in absorbing sunlight in the short wave. Based on the observation of green spectrum, the wavelength ranges between 500 to 600 nm. The three samples had low absorption ranges between 0,5 to 1,5 A. According to [4] chlorophyll absorbs light in the green spectrum of the wavelength ranges between 500 to 600 nm, hence, it causes low absorption.

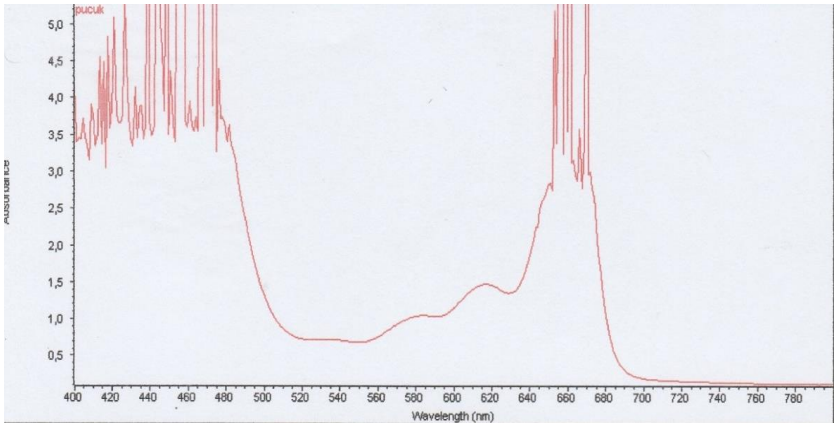

Fig 2. *Graph of Absorbance (A) and Wavelength (Λ) of Noni Shoot Leaves*

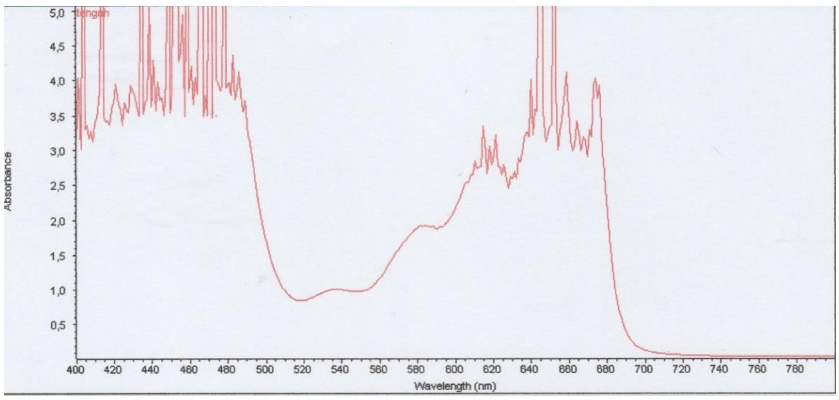

Fig 3. *Graph of Absorbance (A) and Wavelength (Λ) Middle Age Noni Leaf Sample*

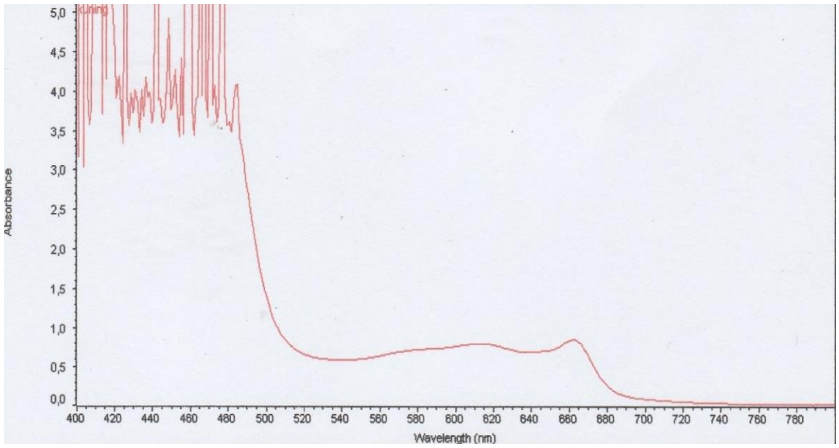

Fig 4. *Graph of Absorbance (A) and Wavelength (Λ) Yellow Age Noni Leaf Sample*

More importantly, the red spectrum in the wavelength ranges between 650 to 700 nm resulted different absorption. The maximum absorption occurred in the middle of noni leaf which ranges between 3,5 to 4,0 A of the wavelength distance ranges between 500-650 nm. The tip of noni leaf sample then had absorption ranges between 3,0 to 3,5 A in the wavelength ranges between 630 to 690 nm. However, the yellow sample had poor result in that the absorption ranges between 0,5 to 1,0 A in the wavelength ranges between 650 to 690 nm. According to [11] [12] the light spectrum has an important role in the process of photosynthesis as in this process, chlorophyll will transmit several specific colors of light, they are the color of blue light with the wavelength ranging from 450 up to 475 nm and the color of red light ranging from 630 to 675 nm. The more light absorbed, the higher the energy for photosynthesis. According to [14] the results proved that the ability of leaf to photosynthesize increases until the leaf completely grows, conversely, when the leaf becomes yellow the ability to photosynthesize decreases. Therefore, the lost function of chloroplast and the broken chlorophyll cause yellow and dying leaf not able to photosynthesize. Supported by [15] explains that the age of trees and leaves also affect the chlorophyll content. Leaves at a young age have higher light absorbance than the yellowed old leaves that have low light absorbance.

CONCLUSION AND SUGGESTION

Based on the results of observation, the following is the conclusion of this research.

1. There are variations of absorption and wavelength found in the red spectrum ranges between 650 to 700 nm. Maximum absorption of the leaf occurs in the middle of noni leaf followed by the tip of noni leaf, whereas the yellow leaf has poor absorption. Chlorophyll has the largest amount of main pigment in the leaf that assists in light reaction of photosynthesis.
2. The blue spectrum ranges between 400 to 450 nm occurs maximum absorption ranges between 3,5 to 4,0 A. Chlorophyll b has a function to absorb photon energy of sunlight.
3. Wavelength ranges between 500 to 600 nm occurs in the green leaf as also seen from the three samples that the absorption ranges between 0,5 to 1,5 A. Chlorophyll thus reflects the light in the green spectrum so it results low absorption.

ACKNOWLEDGMENTS

The author is pleased to thank my colleague Andi Asmar, and Mr. Heru Kuswanto as the supervisor of this project and all those who helped complete this project.

REFERENCES

[1] Solomon. (1999). *The Noni Phenomenon*. Utah: Direct Source Publishing.
[2] Suwardi. (2011). *The Miracle of Noni: Keajaiban Mengkudu dalam Mencegah dan Menyembuhkan Kanker*. Jakarta: Ufuk Press.
[3] Djauhariya, E., & Rahardjo, M. (2016). Karakterisasi Morfologi dan Mutu Buah Mengkudu. *Buletin Plasma Nutfah*, *12*(1): 1-8.
[4] Arrohmah, A., Supriyanto, A., & Kusumandari, K. (2007). Study of chlorophyll characteristic on leaves as photodetector organic material. *Biofarmasi Journal of Natural Product Biochemistry*, *5*(2): 67-72.
[5] Campbell, N. A., & Reece, J. B. (2000). *Biologi Jilid 1 Edisi ke-5*. Jakarta: Erlangga.
[6] Handoko, P., & Fajariyanti, Y. (2013, October). Pengaruh spektrum cahaya tampak terhadap laju fotosintesis tanaman air Hydrilla verticillata. In *Prosiding Seminar Biologi* (Vol. 10, No. 2).
[7] Kamble, P. N., Giri, S. P., Mane, R. S., & Tiwana, A. (2015). Estimation of chlorophyll content in young and adult leaves of some selected plants. *Universal journal of environmental research and technology*, *6*: 306-310.
[8] Mashud, N. (2018). Stomata dan Klorofil Dalam Hubungannya dengan Produksi Kelapa. *Buletin Palma*, (32): 52-59.
[9] Pertamawati, P. (2012). Pengaruh Fotosintesis Terhadap Pertumbuhan Tanaman Kentang (Solanum Tuberosum L.) Dalam Lingkungan Fotoautotrof Secara Invitro. *Jurnal Sains dan Teknologi Indonesia*, *12*(1).
[10] Loveless, A. R. (1991). *Prinsip-Prinsip Biologi Tumbuhan Untuk Daerah Tropik I*. Jakarta: PT Gramedia Pustaka Utama.
[11] Wang, Z., Tian, J., Yu, B., Yang, L., & Sun, Y. (2015). LED light spectrum affects the photosynthetic performance of Houttuynia Cordata seedlings. *Am. J. Opt. Photonics*, *3*: 38-42.
[12] Borowski, E., Slawomir, M., Rubinowska, K., Hawrylak-Nowak, B., Grudzinski, W., Michalek, S., ... & Slawomir, M. (2015). The effects of light quality on photosynthetic parameters and yield of lettuce plants. *Acta Scientiarum Polonorum-Hortorum Cultus*, *14*(5): 177-188.
[13] Darwis, D., Basri, S. A., & Mustamin, M. I. (2016). Pengawetan Klorofil Daun Katuk Sebagai Zat Pewarna Untuk Bahan DSSC (Dye Sensitized Solar Cell) Dengan Menggunakan Freeze Drying. *Gravitasi*, *15*(1): 1-6.
[14] Pratama, A. J. (2015). Analisis Kandungan Klorofil Gandasuli (Hedychium gardnerianum Shephard ex Ker-Gawl) pada Tiga Daerah Perkembangan Daun yang Berbeda. *Prosiding KPSDA*, *1*(1).
[15] Fossey, A., Mathura, S., & Beck-Pay, S. L. (2009). Effects of leaf and tree age on chlorophyll absorbance in diploid black wattle (Acacia mearnsii). *Southern Forests: a Journal of Forest Science*, *71*(1): 59-62.