7-30-2021

LOCAL HERBAL UTILITY IN SUPPORTING SOME PEOPLE HEALTH SUSTAINABILITY

Shinta Damerys Sirait

Quality Assurance for Food Industry Division, AKA Bogor Polytechnic, Bogor, 16154, Indonesia,
siraitshinta@gmail.com

Nicolas M. P. Hutasoit

Polytechnic of Furniture and Wood Processing Industry, Kendal, Central Java, Indonesia,
nicolashutasoit@gmail.com

Follow this and additional works at: <https://scholarhub.ui.ac.id/jessd>

Part of the [Life Sciences Commons](#), and the [Social and Behavioral Sciences Commons](#)

Recommended Citation

Sirait, Shinta Damerys and Hutasoit, Nicolas M. P. (2021). LOCAL HERBAL UTILITY IN SUPPORTING SOME PEOPLE HEALTH SUSTAINABILITY. *Journal of Environmental Science and Sustainable Development*, 4(1), 31-50.

Available at: <https://doi.org/10.7454/jessd.v4i1.1110>

This Original Research Article is brought to you for free and open access by the School of Environmental Science at UI Scholars Hub. It has been accepted for inclusion in Journal of Environmental Science and Sustainable Development by an authorized editor of UI Scholars Hub.

LOCAL HERBAL UTILITY IN SUPPORTING SOME PEOPLE HEALTH SUSTAINABILITY

Shinta Damerys Sirait^{1*}, Nicolas M. P. Hutasoit²

¹Quality Assurance for Food Industry Division, AKA Bogor Polytechnic, Bogor, 16154, Indonesia

²Polytechnic of Furniture and Wood Processing Industry, Kendal, Central Java, Indonesia.

*Corresponding author: siraitshinta@gmail.com

(Received: 10 May 2021; Accepted: 14 July 2021; Published: 30 July 2021)

Abstract

The efficacy of noni juice (*Morinda citrifolia* L) for health is very diverse, and has been known for thousands of years. Noni fresh juice contains a relatively high concentration of vitamin C (ascorbic acid) and scopoletin which is known as an important antioxidant and a herbal compound having many efficacies for health, respectively. Recently, many processed juice products have been widely offered in Indonesia either as medical products or nutritious drinks in liquid and solid forms stored at cold or room temperature for a relatively long period of time, however no one of these products could show the amount of active compound after storage. Vitamin C and scopoletin in noni juice could be changed during storage. This study was aimed at investigating the effects of storage temperature and time on the vitamin C and scopoletin concentration of noni juice. It was conducted at Food Laboratory, AKA Polytechnic Bogor, Indonesia, and the noni juice investigated was packed in plastic containers/cups and stored either at room temperature of 28 °C or in a refrigerator having a temperature of 6°C. The investigation was carried out for 3 (three) parameters i.e pH, vitamin C and scopoletin contents. From data obtained, it can be concluded that there were a decrease of scopoletin and vitamin C concentration remarkably, while pH value was relatively stable (between 4.5 to 6.2) during storage of noni juice, either at room temperature or cold temperature. However, there was still a remarkable amount of scopoletin concentration after 10 weeks of storage (14.21 mg/ liter), that was more than 50 percent of its origin (26,93 mg/liter), fresh noni juice, contrarily vitamin C was almost no more available in the juice after 4 weeks of storage either at room temperature or cold temperature. This vitamin C might not decrease only as a result of oxidation but mostly also because of its proton release and develop a buffer solution, as indicated by the pH stability during storage.

Keywords: Noni; vitamin C; scopoletin; storage.

1. Introduction

1.1. *Morinda* and its efficacy

Morinda citrifolia L which is also called as Noni is found with many local names in Indonesia as follows: eodu, mengkudu, bengkudu, (Sumatera); kudu, cengkudu, kemudu, pace (Java); wangkudu, manakudu, bakulu (Nusa tenggara); and mangkudu, wangkudu, or

labanan in Kalimantan (Wijayakusuma, 1992). Naturally, based on visual observation, the noni fruit has no smell unless after over ripe which is indicated by its soft texture and gray white in color. It is unpleasant in smell. However, some villagers, especially men staying in Bogor, West Java and surroundings get used to squeezing over ripe noni fruit to make fresh juice and drinking with some honey and lime juice for increasing their personal vitality.

Rani (2018) showed that the characteristics of noni juice with 10% lime juice added based on panelist assessment is yellowish-gray, slightly thicker texture, distinctive smell of citric acid and slightly sweet taste with total soluble solids 66% Brix, acidity (pH) 4.17 and antioxidant capacity of 66%. Whereas in Java generally, villagers men or women get used to consuming chopped or sliced very young noni fruit for salad, Indonesian salad. In some other areas, elder mostly have been practising this kind of noni juice making method since old time, and this juice is believed could reduce their blood pressure. Although, the efficacy of noni fresh juice has been well known since old time, only few local researchers were interested in investigating this juice.

Scientifically, noni juice is classified as non-toxic substances (Casarett, Doull, Amdur, & Klaassen, 1993; Pohan & Subagja, 2001). The efficacy of noni juice or extract as for health is very diverse, and has been known for thousands of years. Traditional medical practitioners in Hawaii and Polynesia have used *Morinda citrifolia* L. (Noni) for centuries to cure or prevent varieties of illnesses. Traditional medical practitioners in Hawaii and Polynesia have used *Morinda citrifolia* L. (Noni) for centuries to cure or prevent varieties of illnesses. The popularity of *M. citrifolia* as a dietary supplement, a food functional ingredient, or as a natural health enhancer is increasing throughout the world (Abou Assi et al., 2017).

Because of these lots of efficacies for health, then recently, lots of processed juice products offered in Indonesia markets either as medical products or nutritious soft drinks, in liquid and solid forms stored at cold or room temperature for a relatively long period of time. However, no one of those products and research could ensure the availability of any active compound of the juice after such long storage time. Asmara and Amungkasi (2019) showed through their work that when apple fruits var. *M. sylvestris* were stored in room temperature (27 °C) and kept away from direct sunlight for 0,1,2 and 3 days there were significant differences between the level of vitamin C of the apple fruit juice statistically.

Some research had been conducted before this study, such as the extraction method of noni juice, the characteristics of noni juice in metal based packaging, its pH change and the metal migration during storage (Pohan, 2003); Determination of Scopoletin content of noni

fruits in Indonesia at various level of its maturity using HPLC (Wijaya, Aviana, Anwar, & Nishigaki, 2008) and The Effects of noni fruit maturity and extraction method on noni juice characteristics (Pohan & Subagja, 2001). This study tried to investigate how far the active compounds of noni juice could change during storage at cold and room temperature, especially the availability of vitamin C and scopoletin in it. It was assumed that during storage, there would be a concentration change of the chemical compounds.

1.2. Noni fruit ingredients

Some research had been conducted in several countries, especially those concerning with its product development, and the efficacy investigation of its active components especially on scopoletin. Sari (2015) said that Noni (*Morinda citrifolia* L) was able to reduce blood pressure. Scopoletin, an active substance contained in noni, is known as the potential of reducing peripheral resistance. Another active substance contained in noni was xeronin, which acts as diuretic that can increase urine volume. Noni is classified as non-toxic substance. Akbar and Rosyidin (2016) reported that doses and giving frequency of noni juice (*Morinda citrifolia* linn) in drinking water resulted in better effect in broiler body weight gained, and the best treatment was giving 4,5 ml noni juice (*Morinda citrifolia* linn) in 1 litre of the broiler drinking water

According to Wijayakusuma (1992) and Dalimartha (1999) the noni fruit is effective for relieving body moist air, enhancing bone strength, cleansing blood, for diuretics, menstrual decay, skin softener, as cough medicine, as well as for worming, laxatives and antisepses. Solomon (1999) said that noni plants can also reduce blood pressure, help digestion, facilitate urination, treat swollen kidney and liver and as an anti-cancer. Waha (2000) reported that noni juice can cure persistent headaches, pain in nerve muscles and joint. Noni fruit can detain tumour growth by stimulating immune system involving macrophage and or lymphocyte (Hirazumi et al., 1994).

In addition, Heyne (1987) reported that noni juice can be used to facilitate urination, for liver disease and cough, and with an addition of a little lime, it could kill roundworms and overcome vaginal discharge or pektay. Agustina et al., (2020) showed that noni juice in 30 mg/kg body weight could improve CD4 + TNF α and suggested that noni juice has anti cancer potencies by maintaining homeostasis of immune system and could become immune herbal supplement.

Noni fresh juice contains a relatively high concentration of vitamin C (ascorbic acid) and scopoletin which is known as an important antioxidant and a herbal compound having many efficacies for health, respectively. Recently, many processed juice products have been widely offered in Indonesia and other country markets either as medical products or nutritious drinks in liquid and solid forms sold at cold or room temperature for a relatively long period of time, but no one could show the availability of certain active compound of these products after the storage time. This study tried to investigate how far the active compounds of noni juice could change after storage at cold and room temperature, which especially the availability of vitamin C and scopoletin. It was assumed that during storage, there would be a concentration change of active chemical compounds including scopoletin.

Noni fruit contains several chemical compounds, in various forms of protein, carbohydrates, fat/lipid, vitamins, minerals, and other health compounds as shown in Table 1 below. Two of them i.e. vitamin C and scopoletin will be investigated in processed noni juice during storage.

Table 1. Noni Fruit Composition

No.	Composition	Compounds
1.	Protein	Amino acids and essential amino acids
2.	Carbohydrate	Carbohydrate, Polysaccharides, dietary fiber (pectin), monosaccharides (fructose, glucose)
3.	Fat/Lipid	MCFA (Medium Chain Fatty Acids): (caproic, caprylic, capric acids), other saturated / unsaturated fatty acids, B-sitosterol
4.	Vitamins	Vitamins B1, B2, B6, C, E, K, niacin, pantothenic acid, biotin folic acid, routine, cholin
5.	Mineral	Na, K, Mg, P, Fe, Mn, Ca
6.	Others	150 Neutraceuticals: scopoletin, umbelliferone, nicotianamine, asperuloside, others

In addition, (Bahalwan, Sjabana, & Rusdi, 2002; Dalimartha, 1999; Wijayakusuma, 1992) reported that *Morinda citrifolia* L (noni) fruit contained scopoletin, rutin, polysachharide,

ascorbic acid, β -karoten, 1-arginin, proxironin, proxeroninase, iridoid, asperolusid, iridoid anthraquinon, fatty acid, calsium, vitamin B, amino acids, glicoside, and also glucose. Whereas Bangun & Sarwono (2002) said that it also contained morindone, rubiadine, and flavonoid substances. Amrianto et al. (2017) conducted a piece of research on formulation of transdermal liposome cream from noni fruit extract. The result showed that the total phenolic content of the extract of noni fruit was as much as 180 μ g GAE/g extract.

1.3. Research purpose

The purpose of this research is to investigate the effect of storage temperature and time on pH, vitamine C and scopoletin content of noni juice during storage. In this study, the noni juice was firstly pasteurized, and packaged in plastic cups, stored in room or cold temperature. This research result is expected to give information for helping people to understand purchasing noni juice product from certain market, especially if expecting scopoletin, vitamin C; two active compounds which can be found relatively high in fresh noni juice.

1.4. Noni juice making

Noni juice was made through several steps, i.e. sorting, washing, draining and storing of noni mature fruit in a closed container for 5-7 days for natural fermentation to occur. Then the noni fruit was pressed using a filter cloth to get the noni juice or extract (Pohan, 2003).

Anthraquino is one of several most active compounds in noni extract benefits for health, however in this study this compound was not investigated as inavailability of its determination method and apparatus (TLC) at the Laboratory. Based on Liu (2011) silica gel TLC (Thin Layer Chromatography) was the most used for the isolation and identification of anthraquino. Then Wijaya, Aviana, Anwar, & Nishigaki (2008) said in his research that scopoletin has been recommended as Constituent for Quality Control of Noni. Therefore, the investigation of noni juice quality in this study was represented by scopoletin and vitamin C concentration available before or after certain storage time. In this case, pH was involved for only supporting data for discussion and evaluation where needed. Sholehah (2020), Wijaya, Aviana, Anwar, & Nishigaki (2008) and Wijaya, Has, Febriyanti and Anwar (2014) reported that scopoletin as one of major components of *Morinda citrifolia* L, could be made as a marker for anthraquinon.

2. Methods

This research was carried out through the two phase. Phase one is about preliminary research that consisting of

- a. Selection and preparation of noni fruit: Only oval shape noni fruits were used having been mature indicated by yellowish in color, as it was found that they have the highest content of scopoletin naturally. These fruits were soon washed using cleaned running water and clothing wiped for drying and ready for natural fermentation.
- b. Preparation of 60 pieces of plastic containers/cups with lid having capacity of 50 milli liter for each room and cold temperature storage.
- c. Fermentation of the clean dried noni fruit in a big plastic container with a lid having a capacity of about 30 liters, for 1 (one) week.
- d. Extraction of fermented noni fruit to obtain noni juice using a hydraulic expression.
- e. Pasteurizing the noni juice by boiling it using a stainless steel container prior to hot filling into each 50 ml plastic container/cup prepared previously.
- f. Storage of the noni juice (step e) either in a room or cold temperature for investigation periodically.

Phase two about further research is consisting of:

- a. Literature study to find out an appropriate temperature for cold and room temperature storage. Hence, cold temperature was set at 6 °C and room temperature was about 28 C, at a normal temperature at Food Laboratory at Bogor AKA Polytechnic.
- b. Determination of the scopoletin content periodically using HPLC, based on a Standard Operating Procedure applied at Testing Laboratory , CABI (Center for Agro Based Industry, Ministry of Industry), in Bogor, West Java.
- c. Determination of vitamin C concentration through titration method as research designed

Data collection was conducted through two processes. *First*, literature study (secondary data collection), consisting of information of the nature and efficacy of noni juice and various forms of noni processed products available especially at local market; noni juice processing steps and factors that affect its quality; regulations and standards related to noni processed products or other similar products. *Second*, primary data collection, was direct data obtained through the determination of active substances (scopoletin and vitamin C) as well as juice

pH measurement in laboratory, where scopoletin was determined using HPLC at CABI Testing Laboratory. The pH measurement used a digital pH meter and the analysis of vitamin C was carried out at AKA Bogor Polytechnic Laboratory, in Bogor, West Java.

2.1. Noni juice/Extract for laboratory testing

During this study, there were several processing equipments used for noni juice extraction, such as a hydraulic press made from stainless steel, a fermentation container with a lid on, a fermentation container, a washing container, filter clothings means to separate noni juice physically from solid part came out of the extraction process, stainless steel knives to cut rotten flesh fresh noni fruits before fermentation or chop the fermented noni fruit prior to hydraulic pressing and plastic containers/cups having volume of 50 mL. Whereas analysing apparatus, those laboratory equipments used for determination of the quality parameters of noni juice required to be investigated were a HPLC for determination of scopoletin content which was conducted at CABI Testing Laboratory, in Bogor; a digital pH meter for pH measurement and a set of apparatus for Vitamin C analysis which was conducted at Bogor AKA Polytechnic Laboratory, in Bogor, West Java

Measurement of the noni juice pH value was conducted based on standard analysis method (BSN, 2004). Apparatus needed for this measurement were a pH meter and its supporting aids, a magnetic or glass shaker, a beaker with a capacity of 250 mL, tissue paper, an analytic weigher, and a thermometer. Before the pH value was determined, the pH meter should be calibrated with a buffer solution based on working instruction.

The procedure for this measurement is as follows Firstly, an electrode which is part of the pH meter was wiped with paper tissue after washing up with aquadest which was then washed up with the sample. The electrode was then dipped into the sample in a glass baker until the pH meter showed a stable number representing the number or scale reading on the pH meter, which was finally recorded as pH value.

2.2. Determination of vitamin C levels (Iodometry Method)

A total of 400 mg of each sample was weighed and then grounded and dissolved with 100 mL of CO₂-free distilled water into an erlenmeyer, which was then added with 25 ml of H₂SO₄ solution and the starch indicator, then titrated with a standardized Iodine solution. The end point of the titration occurs when the color of the solution changes from white to dark blue.

Calculation:

* Each mL of 0.1 N Iodine is equivalent to 8.806 mg of Ascorbic Acid (vitamin C) ($C_6H_8O_6$)

Vitamin C (mg/100 g) =

$$\frac{\text{mL Iod} * \text{N Iod} * 8,806 * 1000}{0,1 * \text{mg of sample}} * 100$$

0,1 * mg of sample

2.3. Scopoletin determination

The process of Scopoletin determination using HPLC (Wijaya, Aviana, Anwar, & Nishigaki, 2008). These process concern two things, such as the conditions and working instructions.

For the HPLC conditions this research must prepare some facilities such as:

- a. Pump, LC-6A (Shimadzu)
- b. Injector, 7725 type (Rheodyne)
- c. Injection volume, 20 μ L
- d. Column, Daisopak SP-120-5-ODS-P (250x4.6 mm i.d)
- e. Mobile Phase, 50 mM phosphate buffer (pH 5.0) –CH₃OH (=74:26, v/v)
- f. Flow rate, 1.0 mL/min
- g. Detector, 1100 series (Hewlwt Packard)
- h. Wavelength, Ex 360 nm, Em 450 nm

For the working instructions, this is are the instructions that need to fulfill for the Scopoletin determination, such as:

- a. Transfer 10 mL of noni juice
- b. Add proper amount of 50 % CH₂OH
- c. Sonicate for 30 minutes
- d. Dilute with 50 % CH₃OH to 50 mL
- e. Centrifuse for 15 minutes (2.500 g, 4°C)
- f. Filtrate through 0.45 micro meter membrane filter
- g. Inject onto HPLC
- h. Scopoletin content was obtained using a conversion chart and a scopoletin standard curve, as in next Figure 1 and Figure 2.

Figure 1. Chromatograms of Scopoletin Standard

Figure 2. Standard Curve of Scopoletin

3. Results and Discussions

3.1. Noni fruit used as raw material

Noni fruit used in this study was obtained from the Balitro, Balai Penelitian Tanaman Rempah dan Obat obatan (Indonesian Research Institute for Crops, Spices and Medicines in Cimanggu, Bogor, West Java). The fruit was picked yellowish, mature or just ripe which naturally and gradually becomes soft along with the change of its color from yellowish–yellowish green to white, pale and gray white having a soft texture, at when a less or unpleasant aroma arose which is the naturally distinctive odour of the noni.

In one noni tree, we can find some noni fruits in round shape as well as oval shape, but only noni fruit that was firm, oval in shape and yellowish in color was used for further research. This type of noni fruit contains the highest content in scopoletin, an active compound of noni juice having several efficacy for health.

Supporting information comes from research conducted by Diana, 2019, found that scopoletin concentration in noni fruit picked at 20, 45, 105 and 120 days flowering, was of $(10,72 \pm 0,45)$ ppm, $(19,19 \pm 0,68)$ ppm, $(57,94 \pm 0,79)$ ppm and $(14,11 \pm 0,39)$ ppm respectively, using TLC Method. The information is added by Wijaya, Aviana, Anwar, & Nishigaki (2008) saying that the highest scopoletin content was detected in yellowish mature fruits. It can be said that the highest scopoletin content in noni fruit is when the fruit at mature/ripe stage. Following Figure 3 shows that the noni fruit colour is different between immature, mature/just ripe and over ripe, and the yellowish colour fruit can be categorized as mature/ripe.

Figure 3. Fresh noni fruits based on its ripeness

In other words, it can be said that the highest scopoletin concentration can be obtained when the fruit is at stage 3 (105 days flowering), meaning about 3,5 months after flowering. This fruit is yellowish and firm, texturized, generally different from a ripen fruit which is in pail or gray white color and its texture was soft with an unpleasant smell. The process of making noni juice, in this study was as follows:

- a. The noni fruit which was just harvested and soon (less than 24 hours) was washed properly, drained or dried using clean cloth and cured using a knife to remove rotten noni fruit flesh.
- b. The fruit was then naturally fermented for a week in a plastic container prior to hydraulic pressing to get the juice;
- c. The noni juice was eventually allowed to settle down so that the insoluble part was settled down to the bottom of the container;
- d. Then the precipitated part was cloth filtered to obtain clear noni liquid (juice);
- e. The clear noni juice was then added with 3 (three) parts of clean water and finally pasteurized at boiling temperature for 5 (five) minutes.
- f. Then this juice was hot filled into plastic containers/cups for storage in either room (about 28°C) or cold (about 6 °C) temperature.

Before decided using a hydraulic press for pressing, firstly, there were 4 (four) ways introduced to extract traditionally the noni juice from the fermented noni fruit, i.e by (1). directly squeezing the noni fermented fruit by means of filter cloth manually; (2) chopping the fermented noni fruit before squeezing it in filter cloth; (3) using of a juicer to make noni pulp prior to squeezing it to produce noni juice; (4) Applying hydraulic expression of the chopped noni fermented fruit to get directly noni juice . The result showed that the first 3 (three) methods were very inefficient for the noni juice extraction, each of them could only produce a just like noni slurry instead of clear juice out of the noni fruit flesh. The noni slurry was in a form of foamy noni flesh which took very long time to just separate a small amount of clear noni juice.

However, by using a hydraulic expression, a clear noni juice was expressed easily, obtaining an average of 45.74 percent out of noni fruit weight as seen at the following Table 2. This is the reason why this method was used for further study. This method of extraction also made it to be different from a previous research finding which is a patented work, which used squeeze method to get noni juice or extract. Brennan, Butters, Cowell, & Lilly (1969) also states that there are 3 (three) methods of expressing liquid from solid-liquid matrix, and hydraulic presses are widely used in fruit juice processing.

Antara, Pohan, & Subagja (2001) said that the noni juice is safe for consumption with a toxicity level of $LD_{50} > 52.61$ ml concentrated juice/kg body weight which is equivalent to 480 gram of fresh fruit per kg body weight. Casarett, Doull, Amdur, & Klaassen (1993) explained that the material is not toxic if the dose is more than 15 mg per kg body weight, meaning that the noni juice is practically non-toxic. However, as there is no one of many references used in this work giving information on the right dose of scopoletin for curing certain illness, then it is also important to find it out through a further study. The mass balance of the noni juice extraction using the hydraulic press can be seen in Table 2.

Table 2. The Mass Balance of Noni Juice Extraction

Repetition	Fresh Noni Fruit (kg)	Noni Juice (litre)	Juice Percentage (%)
I	7.127	3.270	45.88
II	9.592	4.280	44.62
III	12.200	5.700	46.72
Average			45.74

Table 2 shows that each kg of fresh noni fruit produced an average of 45.7 percent of fresh noni fruit, ranged of 44.6 - 46.7 percent of noni juice. The data were obtained from 3 replications of the noni fruit extraction. In the amount of 3,270 mL of noni juice was obtained from 7.127 kg of fresh noni fruit; from 9.592 kg of fresh noni fruit, as much as 4,280 mL of noni juice was obtained; and from 12.200 kg of fresh noni was obtained 5.7 liters of noni juice. So the average of extraction was 45.74 percent. To investigate the effect of storage temperature and time on the active compounds in the juice, the noni juice was pasteurized and packaged in plastic cups.

And in this study there was no additional material or enzim for fermentation. Previously, noni juice was made from fermented noni with additional certain material such as sugar, which could contain alcohol and other substances. A study by Hardoko et al., (2003) also showed that noni juice was made involving submersion of noni fruit during fermentation which was also different from the fermentation method in this study which no water or other liquid, enzim, or microorganism addition for fermentation. Hence, it can be said that noni juice produced through this study was different from those noni juice based products.

3.2. The Noni juice laboratory testing results

The following Table 3 and Table 4 show the analysis results of pH, vitamin C and scopoletin in noni juice stored at Room Temperature (RT) or Cold Temperature (CT). The room or cold temperature used respectively was of 28°C or of 6°C respectively. Representative samples were taken for measuring pH, vitamin C and scopoletin contents for 0, 2, 4, 6 up to 12 weeks of storage, and recorded for further evaluation. In other words, the storage time was designed up to 3 months with an investigation interval of 0 week, 2 weeks, 4 weeks, 6 weeks, 8 weeks up to 12 weeks.

Table 3. Changes of pH and Vitamin C Content during Storage

No.	Storage Time (day/week)	Vitamin C (mg/100 mL)		Noni juice pH	
		RT*)	CT*)	RT*)	CT*)
1.	0 day (0 week)	178.16	-	4.5	-
2.	7 days (1 week)	192.66	-	4.5	5.2
3.	14 days (2 weeks)	169.87	-	5.2	6.2

No.	Storage Time (day/week)	Vitamin C (mg/100 mL)		Noni juice pH	
		RT*)	CT*)	RT*)	CT*)
4.	21 days (3 weeks)	153.30	-	5.5	5.5
5.	25 days (3.5 weeks)	41.40	41.40	5.6	5.5
6	28 days (4 weeks)	0.00	0.00	-	-

As vitamin C is naturally relatively sensitive to oxidation, especially during a room temperature storage, this substance was investigated more frequently which was in each 7 day period of storage (weekly), and the result in Table 3 showed that vitamin C gradually decreased during the storage, from 178.16 mg/liter at first day of storage decreased down to 41.40 mg/liter at the 25th day of storage which then at 4 (four) weeks of storage the vitamin C was no longer available in the juice either at room temperature or ~~not~~ at cold temperature storage. The vitamin C content tended to decrease as the longer the storage. Hence, it can also be said that the difference between room temperature and cold temperature could not significantly show the different oxidation effect on the vitamin C.

However, [Monika, Dziedzic, & Kaczmarczyk \(2017\)](#) showed that storage significantly reduced the vitamin C content in the fruit tested, by 20% on average after 2 weeks of storage. Mechanical treatment and preparation of sugar syrup decreased the vitamin content by nearly two-thirds when compared to the fruit at harvest. Pasteurisation and storage of the sugar syrup contributed to further losses of vitamin C, reducing it to a very low level. This may mean that the temperature level or difference between cold and room temperature of 6°C and 28°C was not significant.

Table 3 also shows that pH value seemed to be stable, the pH was not much changed or only slightly increased for about 1 month (4 weeks) storage, ranged of 4.5 to 6.2. In relation to with an increase of noni juice pH during storage, it was also found by Hardoko et al, in 2003 that during fermentation the noni juice pH tended to increase.

pH stability could be caused by a development of buffer condition, by means of vitamin C, an organic acid with ascorbate (its salt form), as some minerals such as Na, K, Mg, P, Fe, Mn and Ca, available in the noni juice as seen in Table 1. Data in this table could explain that the amount of vitamin C reducing gradually down to 41.40 mg/ 100 mL after 25 days of storage and even zero after 28 weeks storage. It was not only because of oxidation, but also as a result of releasing proton of the ascorbic acid (vitamin C) which then develop buffer

with sodium/Natrium ascorbate or Calcium ascorbate. A buffer keeps the pH of a solution constant by absorbing protons that are released during reactions or by releasing protons when they are consumed by reactions.

Table 4 shows that, unlike vitamin C content, scopoletin content in noni juice which was packed in a plastic bottle was still at a remarkable amount up to 2 months of storage either at room temperature or in cold temperatures even though it also tended to decrease. The scopoletin content was more than a half of original amount, i.e. of 14.55 mg/liter and 14.21 mg/liter respectively at cold and room temperature storage. However, a further study is required to identify whether this amount (14,21-14.55 mg/liter) is an appropriate dose for health.

Table 4. Change of Noni Juice Scopoletin Content during Storage

No.	Storage Time	Scopoletin (mg/l)	
		RT*)	CT*)
1.	0 week	26,93	26,93
2.	2 weeks	-	-
3.	4 weeks	15,34	16,95
4.	8 week	15,34	16,95
5.	10 weeks	14.21	14.55

Note: *) RT = Room Temperature; CT= Cold Temperature

The scopoletin amount in Indonesia noni sample were in the range of 0.58 – 118 mg/liter (Wijaya, Aviana, Anwar, & Nishigaki, 2008). As seen at the table, the scopoletin content of the noni juice at 0 week storage was 26.93 mg/liter which was then decreased down to 14.21-14.55 mg/liter after 10 weeks of storage. In this case, samples for storage were made by diluting 1 part of noni fresh juice with 3 parts of clean water, meaning that the scopoletin content of the fresh noni juice was about 107.72 mg/l originally, which can be chatagorized high. The scopoletin contents was determined using an HPLC method. Scopoletin nomenclature is as follows (Wijaya, Aviana, Anwar, & Nishigaki, 2008):

Name : Scopoletin

Synonym :

- 7-Hydroxy-6-methoxycoumarin;
- 7-Hydroxy-6-methoxycoumarin;
- 7-Hidroxi-6-metoxicumarina;
- 7-Hydroxy-6-méthoxycoumarine;
- 6-Methoxyumbelliferone;
- 7-Hydroxy-5-methoxycoumarin;
- Gelseminic acid;
- Chrysotropic acid;
- Esculetin-6-methyl ether;
- 7-Hydroxy-6-methoxy-2H-1-benzopyran-2-one

MW	: 192.17
Formula	: C ₁₀ H ₈ O ₄
Physical State	: Yellow to beige crystalline powder
Melting point	: 200-207 °C
Water solubility	: Slightly soluble
pH	: Weak acidic
Stability	: Stable under normal condition

Whereas Riyanto & Rohman (2014) showed that scopoletin which was isolated from chloroform fraction of methanolic extract of noni fruit (*Morinda citrifolia* L), using infrared spectroscopy and mass spectroscopy, revealed a scavenging activity of 2,2-diphenyl-1-picrylhydrazil (DPPH) radical by IC 50 348.79 µg/mL, 35 times lower than that of vitamin E (IC 50 9.77 µg/mL). Furthermore, scopoletin also showed an antioxidant activity which was lower than that of vitamin E by using linoleic-thiocyanate method. Some research shows that noni juice can help in protecting and regenerating natural antioxidants in the body such as vitamin E and coenzyme Q10 which in turn helps get rid of free radicals. Vitamin C is also known as natural antioxidant.

Shaw et al., (2003) showed that scopoletin extracted from *Sinomonium acutum*, scavenged superoxide anion in the xhantine/xhantine oxidase. And the scopoletin may therefore responsible super oxide anion scavenging activity seen in *Sinomonium acutum* extract and may be of used in preventing super anion-induced damage in vivo. Adnyana et al., (2004)

tested the anti diabetic activity of noni (*Morinda citrifolia* L) fruit extract with the glucose tolerance method in alloxan-induced diabetic mice, using a dose of 500 mg/kg body weight in rats and a dose of 1000 mg/kg in mice. And the results showed a decrease of 62.1 percent and 74.1 percent respectively on day 4 after giving the extract.

Scopoletin in noni juice is in a very small content, then Junaidi, Hutajulu, Lestari, & Kustiarini (2019) increased the scopoletin concentration in noni juice (*Morinda citrifolia* L) using the elimination and concentration compound technique, involving two different ways, namely freeze drying and waterbath. Through freeze drying, it was found a scopoletin concentration of 40.58 ppm, whereas through waterbath technique, only obtained 0.308 ppm. The highest scopoletin content was obtained in DS noni juice of 0.308 ppm. This technology could be used to increase the scopoletin concentration, if needed for certain dose.

4. Conclusion

Based on this study, it can be summarized that there is a decrease of scopoletin and vitamin C content during storage of noni juice packed in plastic bottles, either at room temperature or cold temperature, while pH value was relatively stable. After 10 weeks of storage however, there is still a remarkable amount of scopoletin content in the juice, as there is more than 50 percent from its original availability, whereas vitamin C could not be expected available in the noni juice after 4 weeks of storage neither at room temperature nor at cold temperature storage. This vitamin C might not decrease only as a result of oxidation but could be also because of its proton release to form buffer condition as indicated by the pH stability during storage. Finally, as well as finding out the right dose of scopoletin for curing certain illness, it is also important to further investigate other active substances such as anthraquinone, beta sitosterol, essential fatty acids and other substances which are known available in noni fruit or juice which are also beneficial for health.

Acknowledgment

Through this chance, we would thank to:

1. Ms. Henny Rochaeny, Director of Bogor AKA Polytechnic, Ministry of Industry, Republic of Indonesia, supporting this study financially and facilitating for laboratory testing, so that it is ready to be published.

2. Mr. Helmud P. S; Ms.Neneng D. D, Mr. Syaiful A and Ms. Maghfira, those carried out technical and laboratory works,either at Bogor AKA Polytechnic or the Agro-based Industry Laboratory.
3. My husband and all family members, those who love and understand if I must stay up working untill very late night on revisions and finalization of this article.
4. All lecturers and colleagues encouraging this article to be published in an international journal.

Author Contribution

Shinta Damerys Sirait was the one to design the research, adviced testing methods to be used, evaluated data and information obtained comprehensively. Whereas Nicolas M. P. Hutasoit assisted me to develop this assignment to be more appropriate for publication in an international journal, to cite several references to enrich several paragraphs. Nicolas M. P. Hutasoit also assisted in selecting an appropriate topic to JESSD scope and review overal my revision to make sure it is already as asked by reviewers substansially prior to sending it for publication. Both of authors through a discussion, identified findings for conclusion.

References

- Abou Assi, R., Darwis, Y., Abdulbaqi, I. M., Khan, A. A., Vuanghao, L., & Laghari, M. H. (2017). *Morinda citrifolia* (Noni): A comprehensive review on its industrial uses, pharmacological activities, and clinical trials. *Arabian Journal of Chemistry*, 10(5), 691–707. <https://doi.org/10.1016/j.arabjc.2015.06.018>
- Adnyana, I. K., Yulinah, E., Soemardji, A. A., Kumolosasi, E., Iwo, M. I., Iskendarso, J., & Sigit, S. (2004). *Uji Aktivitas Antidiabetes Ekstrak Etanol Buah Mengkudu (Morinda citrifolia L.)* [Institut Teknologi Bandung]. <https://adoc.pub/uji-aktivitas-antidiabetes-ekstrak-etanol-buah-mengkudu-mori.html>
- Agustina, D. W., Wahyuningsih, M. D., Widyarti, S., Soewondo, A., Tsuboi, H., & Rifai, M. (2020). *Noni Juice (Morinda citrifolia) to Prevent Cancer Progression in Mice Induced DMBA and Cigarette Smoke Exposure*. *Pharmacognosy Journal*, 12(5), 946–951. <https://doi.org/10.5530/pj.2020.12.134>

- Akbar, M., & Rosyidin, C. (2016). [PENGARUH PEMBERIAN SARI BUAH MENGKUDU \(Morinda citrifolia linn\) DALAM AIR MINUM DAN FREKUENSI PEMBERIANNYA TERHADAP PERFORMA AYAM BROILER](#). *Jurnal Ilmiah Fillia Cendekia*, 1(2), 15-24.
<https://ejournal.uniska-kediri.ac.id/index.php/FilliaCendekia/article/view/46>
- Amrianto, A., Mukarramah, M., Sukmana, D. D., Nahda, N., & Permana, A. D. (2017). [Formulasi ekstrak buah mengkudu \(morinda citrifolia\) dalam bentuk sediaan transdermal liposome cream](#). In *Prosiding Seminar Nasional Biologi* (Vol. 3, No. 1).
<http://journal.uin-alauddin.ac.id/index.php/psb/article/view/4679>
- Antara, N. T., Pohan, H. G., & Subagja, D. (2001). [Pengaruh tingkat kematangan dan proses terhadap karakteristik sari buah mengkudu](#). *Warta IHP. J. Of Agro-Based Industry*, 18(1-2), 25-31. <http://ejournal.kemenperin.go.id/ihp/article/download/2489/1927>
- Asmara, A. P., & Amungkasi, H. K. (2019). [Kajian Kinetika Pengaruh Lama Penyimpanan Terhadap Kadar Vitamin C Pada Buah Apel Malang \(Malus Sylvestris\)](#). *Al-Kimia*, 7(2), 136-146. <http://journal.uin-alauddin.ac.id/index.php/al-kimia/article/view/8125>
- Bahalwan, Sjabana, D., & Rusdi, R. (2002). [Pesona Tradisional dan Ilmiah, Mengkudu, Morinda Citrifolia, seri referensi herbal](#). *Pesona Tradisional Dan Ilmiah, Mengkudu, Morinda Citrifolia*. Seri Referensi Herbal.
http://library.poltekkespalembang.ac.id/ucs/index.php?p=show_detail&id=1673
- Bangun, A. P., & Sarwono, B. (2002). *Healthy with Traditional Ingredients: Efficacies and Benefits of Morinda citrifolia L.* Jakarta: Agromedia Pustaka.
- Brennan, J. G., Butters, J. R., Cowell, N. D., & Lilly, A. E. V. (1969). [Food engineering operations](#). *Food engineering operations*.
<https://www.cabdirect.org/cabdirect/abstract/19690402358>
- BSN. (2004). *SNI 06-6989.11-2004: Air dan Air Limbah- Bagian 11: Cara Uji derajat Keasaman (pH) dengan menggunakan alat pH meter*. Badan Standardisasi Nasional, ICS 13.060.50.
- Casarett, L. J., Doull, J., Amdur, M. O., & Klaassen, C. D. (1993). [Casarett and Doull's toxicology : the basic science of poisons](#). New York.
- Dalimartha, S. (1999). [Atlas tumbuhan obat Indonesia](#). Trubus Agriwidya.
- Hardoko, Parhusip, A., & Kusuma, I. P. (2003). [Characteristic of Noni \(Morinda citrifolia Linn\) Fruit Juice Produced by Fermentation](#). *Jurnal Teknologi Dan Industri Pangan*, 14(2 SE-Research Paper), 144. <https://journal.ipb.ac.id/index.php/jtip/article/view/756>

- Heyne, K. (1987). *Tumbuhan Berguna Indonesia jilid 3*. Saint Joseph's University.
http://library.ukdw.ac.id/main/opac/index.php?p=show_detail&id=40496
- Hirazumi, A., Furusawa, E., Chou, S. C., & Hokama, Y. (1994). *Anticancer activity of Morinda citrifolia (noni) on intraperitoneally implanted Lewis lung carcinoma in syngeneic mice*. *Proceedings of the Western Pharmacology Society*, 37, 145–146.
- Junaidi, L., Hutajulu, T. F., Lestari, N., & Kustiari, D. A. (2019). *Peningkatan Konsentrasi Skopoletin dalam Jus Mengkudu (Morinda citrifolia L.) dengan Teknik Eliminasi dan Pemekatan Senyawa*. *Warta Industri Hasil Pertanian*, 36(1), 48-55.
<https://core.ac.uk/download/pdf/230024050.pdf>
- Klaassen, C. D. (1975). *Casarett and Doull's toxicology: the basic science of poisons*. In *Casarett and Doull's toxicology: the basic science of poisons*. Macmillan.
- Liu, W. J. H. (2011). *Traditional herbal medicine research methods : identification, analysis, bioassay, and pharmaceutical and clinical studies*. John Wiley & Sons.
<http://site.ebrary.com/id/10577650>
- Monika B., Dziedzic, E., & Kaczmarczyk, E. (2017). *The effect of storage and processing on vitamin C content in Japanese quince fruit*. *Folia horticulturae*, 29(1), 83-93.
<https://doi.org/10.1515/fhort-2017-0009>
- Pohan, H.G., & Subagja. (2001). *The Effects of Maturity and Processing Method on Noni Juice Characteristics*. *Warta Industri Hasil Pertanian*, 18(1–2), 25–31.
- Pohan, H. G. (2003). *The Effect of Type of Container and Storage on the Change of pH and Heavy Metal Migration on Moni Juice (Morinda Citrifolia L.)*. *Warta Industri Hasil Pertanian*, 20(1–2). 25-31
<https://doi.org/http://dx.doi.org/10.32765/warta%20ihp.v20i1-2.2507>
- Rani, D. M. A. A. (2018). *KARAKTERISTIK SELAI MENGGUDU (Morinda citrifolia) BERDASARKAN PENAMBAHAN AIR JERUK NIPIS (Citrus aurantifolia S.)* (Doctoral dissertation, JURUSAN GIZI). <http://repository.poltekkes-denpasar.ac.id/1129/>
- Riyanto, S., & Rohman, A. (2007). *Isolasi Skopoletin dari Buah Mengkudu (Morinda citrifolia L) dan Uji Aktivitas Antioksidannya*. *agriTECH*, 27(3).
<https://journal.ugm.ac.id/agritech/article/view/9598>
- Sari, C.Y. (2015). *Penggunaan Buah Mengkudu (Morinda citrifolia L.) untuk Menurunkan Tekanan Darah Tinggi*. *J MAYORITY*, 4(3), 34-40.
<https://juke.kedokteran.unila.ac.id/index.php/majority/article/viewFile/547/548>

- Shaw, C.-Y., Chen, C.-H., Hsu, C.-C., Chen, C.-C., & Tsai, Y.-C. (2003). [Antioxidant properties of scopoletin isolated from *Sinomonium acutum*](#). *Phytotherapy Research*, 17(7), 823–825. <https://doi.org/10.1002/ptr.1170>
- Sholehah, D. N. (2020). [Pengukuran Kandungan Skopoletin Pada Beberapa Tingkat Kematangan Buah Mengkudu \(*Morinda Citrifolia* Linn\) Dengan Metode Klt Densitometri](#). *Agrovigor: Jurnal Agroteknologi*, 3(1), 1-9. <https://journal.trunojoyo.ac.id/agrovigor/article/view/251>
- Solomon, N. (1999). [Noni Phenomenon: Discover the Powerful Tropical Fruit Healer That Fights Cancer, Lowers Blood Pressure, and Relieves Chronic Pain](#). Utah: Direct Source Publishing. <https://www.iberlibro.com/9781887938877/Noni-Phenomenon-Neil-Solomon-1887938877/plp>
- Waha, M. G. (2000). *Sehat Dengan Mengkudu*. Jakarta: MSF Group.
- Wijaya, H., Aviana, T., Anwar, C., & Nishigaki, T. (2008). *Scopoletin in Indonesia Noni Fruits (*Morinda citrifolia* L.)* [Research presentation]. Jakarta: Gapmmi Office.
- Wijaya, H., Has, D. R. N., Febriyanti, E., & Anwar, C. (2014). [Identifikasi Kandungan Skopoletin dalam Berbagai Jenis Umbi-Umbian](#). *Warta Industri Hasil Pertanian*, 31(01), 11-15. <http://ejournal.kemenperin.go.id/ihp/article/download/2598/2027>