Inhibition on color changes of raja banana (*Musa sapientum*) peel using specific acid

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Abstract. Banana is a tropical fruit that has high nutritional contents such as carbohydrates, vitamins and minerals, but it is prone to enzymatic browning reactions due to polyphenol oxidase (PPO) activity. This research was conducted to inhibit the reduction of the lightness of banana flesh using Hypoiodous Acid (HIO) as specific acid. The banana peel was stored for 3 days at room temperature storage (27°C). The analysis was done on colour change based on the L* value. HIO was obtained using a reaction mixture between H₂O₂ and KI using peroxidase as a catalyst. The HIO was attached to the crown surface of the banana. The lightness was analysed using a digital colour meter within seven points of the area. The results showed that HIO could inhibit the lightness change of banana flesh resulting in a non-significant decrease in the lightness during 3 days of storage. This research might open the knowledge of the preservation of bananas by inhibition of its lightness change in the end-user banana consumer.

1. Introduction

Banana is one of the fruit commodities that has the largest production in Indonesia because it is a plant that can grow well in tropical climates and is easily cultivated in a sustainable manner [1]. It contains high nutrients and minerals which are very beneficial for health, consists of a high content of up to 15% of vitamin C, a familiar antioxidant, especially for commercial purposes because of its flavor, texture, nutritional value, and convenience [2]. One type of banana that is widely consumed in Indonesia is “Raja” bananas. Banana (*Musaceae*) is a climacteric fruit that is economically important for local and
export markets throughout the world. Bananas, including horticultural products that are not durable and easily damaged [3]. This is due to the high rate of fruit respiration during the ripening process after harvesting [4]. The respiration rate of bananas which increases sharply during the ripening period affects the decreasing in the colour, taste, and texture of the bananas [5]. Raja bananas are suitable to be consumed because Raja bananas contain more energy than other fruits. Raja bananas contain vitamin B, vitamin C and minerals that are good for the body, for example, calcium which plays a role in enzyme activation, bone growth and blood clotting [6]. Carbohydrates contained in Raja bananas are very good energy reserves and are quickly available to the body. Fructose in Raja bananas has a lower glycemic index than glucose because the metabolism is slow so it is good for energy storage. The characteristics of a good Raja banana are curved fruit shape with a round base, reddish-yellow flesh color without seeds, and sweet taste [7].

Depreciation of banana quality is influenced by high water vapor transmission rate and also affects the appearance of banana peel colour [8]. Research conducted by [9] found that the application of salicylic acid compounds in bananas by immersion method was able to maintain antioxidant content, phenol content, inhibition of polyphenol enzymes, weight loss and density of banana fruit. Application of Malic acid and Salic acid is also considered capable of delaying the ripeness of bananas, but it still has an adverse effect on health because it causes asthma and shows an allergic reaction, in addition, excessive use of sulfites can cause off-flavor in food products [10]. Hypoiodous acid (HIO) is an acid compound resulting from the reaction between hydrogen peroxide (H\textsubscript{2}O\textsubscript{2}) and potassium iodide (KI) with the peroxidase enzyme as a catalyst [11]. Hypoiodous acid (HIO) has the potential to be developed because it is effective in inhibiting the growth of pathogenic bacteria and fungi and can inhibit the browning reaction that occurs enzymatically due to the respiration rate of the fruit [12]. Hypoiodous acid (HIO) also doesn’t adversely affect human health because it includes non-toxic compounds and has stable properties during storage [13]. This research was focused on analyzing the comparison of physicochemical changes in Raja banana during storage with hypoiodous acid (HIO) treatment and without hypoiodous acid (HIO) treatment.

2. Materials and Methods

2.1. Chemicals and enzyme
This study used “Raja” bananas (Musa sapientum) from the same bunches that were obtained from the traditional market in the Banyumanik area, Semarang. HIO was obtained from the reaction between H\textsubscript{2}O\textsubscript{2} and KI, catalyzed by peroxidase enzyme (EC 1.11.1.7) extracted from the Horseradish obtained at the modern market in the Tembalang area, Semarang. Beaker cups, measuring cups, microtubes, and plastic knives were used as additional tools. A portable colourimeter was used to measure the lightness of the banana peel.

2.2. Banana preparation
Raja banana was prepared using the method of other researchers [14] with the following procedure. Bananas that are 4 months old are purchased and brought to the laboratory. The transportation of bananas is protected from sunlight and sharp objects. Bananas which are used as research objects are bananas in a bunch. Banana fruit in one mark cut each comb. Then, bananas were cut from each comb into pairs using a stainless steel knife.

2.3. HIO solution and comparative solution preparation
HIO solution preparation was referred to the method from another study [13] H\textsubscript{2}O\textsubscript{2} (20 mM), KI (20 mM), and peroxidase enzymes were mixed in a ratio of 4.5: 4.5: 1. The three solutions were mixed in a beaker. The mixture was sealed for 6 minutes to react in order to obtain the HIO solution. Sterile distilled water was used as the comparative solution. HIO, enzymes, and the comparative solution were prepared at room temperature and carried out aseptically.
2.4. *HIO* application

HIO solution was applied to the bananas using the method from [15] with modification. The pair of bananas were placed on the clean surface. The solution was poured at the sterile cotton then wrapped with wrapping plastic, using HIO as the treatment and sterile distilled water as the comparative solution. The cotton was changed every day during the observation period.

2.5. Lightness reduction testing

The lightness reduction of banana peels was observed using the method from another researcher [16] by storing the bananas at room temperature for 3 days and observed every day from day 0 by measuring the L* value at 7 different points using a digital colour meter.

2.6. Data analysis

The lightness value was obtained from 3 replications and calculated using Microsoft Excel 2016 to find the L* value average. This study used a qualitative descriptive analysis.

3. Results and Discussion

3.1. Changes in raja banana peel color

Banana fruit is included in the climacteric fruit, where the process of respiration and enzymatic reactions is still occurring, which is accompanied by a change in color.

![Banana samples on a. 0, b. 1, c. 2, and d. 3 days of observation.](image)

**Figure 1.** Banana samples on a. 0, b. 1, c. 2, and d. 3 days of observation.

Figure 1 shows the color changes of the Raja Banana’s peel during 3 days of storage. The quality of the banana fruit can be judged by the color of the banana peel because the color is one of the most important physical parameters that are first seen. One of the changes in color can be inhibited by adding HIO [13]. The results of the research show that the addition of HIO can inhibit the rate of ripeness of plantain, indicated by the slow green color change. The control of this research was carried out with the
addition of distilled water and the results showed that the color change from green to yellow was faster than that which was added with HIO.

![Graph showing the value of L* in banana during 3 days of storage after treatment with comparative solution and HIO.](image)

**Figure 2.** The value of L* in banana during 3 days of storage after treatment with comparative solution and HIO.

Objective assessment of fruit colour using colourimeters, where the luminosity coefficient, L*, ranges between 0 = black and 100 = white [16]. Bananas have a different colour depending on the variety, according to the time of maturity the ripe the banana fruit is, the bananas will be yellow or will increase in L* [17]. In the study that has been done, the increase in L* value indicates the level of maturity of the banana fruit. The higher the L* value, the greater the level of fruit maturity. From this study, it was proven that the use of HIO can inhibit respiration so that the speed of banana ripeness can be reduced as shown by the slowing of colour change in banana peels.

4. Conclusions
The research to inhibit the reduction of the lightness of banana flesh using Hypoiodous Acid (HIO) as specific acid has been conducted. From this study it can be concluded that HIO can inhibit on lightness reduction of Raja Banana (*Musa sapientum*). The use of HIO can inhibit respiration so that the speed of banana ripeness can be reduced as shown by the slowing of colour change in banana peels.

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