Response of Banana CV Mas Kirana (*Musa acuminata Colla cv.*) on Ethylene Treatments

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Abstract. Banana cv mas (*Musa acuminata, L.*) is one type of banana which is the superior fruit of Indonesia. Besides having a delicious taste of banana cv mas kirana has a very interesting appearance, but the simultaneous ripened fruit in large numbers becomes an obstacle in its trade. Ethylene treatment is the primary choice to overcome the trade obstacles. The treatments given for banana fruit were: (i) The concentration of ethylene are 0, 100, 150 and 200 ppm with 24 hours of exposure duration; (ii) Temperature of ripening room (ripening chamber): ambient (25-30°C) and (15-20°C) with RH in the range 80 – 95% and CO₂ observations / measurements performed periodically to keep the concentration not more than 1% in ripening room / chamber. Banana cv mas kirana look ripe simultaneously on ethylene treatment occurring on the fifth day in the room with ambient condition, while the skin color of banana control is still green. While the banana cv mas kirana simultaneously ripens after the seventh day. The concentration of ethylene at 100 ppm is effective and efficient for ripening the banana cv mas kirana.

1. Introduction

Banana production in Indonesia ranks sixth after India, Ecuador, Brazil, the Philippines and China. While the production of bananas in Indonesia is ranked first from the superior fruit produced. Banana production is as much as 90% for domestic consumption, while the remaining 10% is for export [1] Banana cv mas kirana (*Musa acuminata Colla*) is one of the banana cultivars that are widely cultivated in Indonesia because it has good taste with attractive colors. Banana cv mas kirana, is used and as a fresh fruit, given the relatively early harvesting age (8-10 months) with productivity of 11-13 kg / bunch and the size of the fruit is quite suitable for fresh fruit. Banana cv mas kirana has an attractive fruit color, sweet and fresh fruit flavor, with a crunchy texture [2]. Even so, the simultaneous, uniform and large quantities of bananas are one of the bases in the trade.

Curing becomes a very important activity in mingling with the goals and objectives of the banana cv mas kirana business. Various methods of ripening have been carried out by business people in the production centers, such as cementing and using carbide, but the quality of bananas is not as expected. Ethylene gas is the main alternative as a ripening booster which can be used technically. At present the gas is very easy to use and very effective, it needs to be treated as an ingredient in boosting the maturity of banana cv mas kirana. The purpose of this study was to take the technology of ripening of banana cv mas kirana in the form of appropriate ethylene dosing gas to accelerate its in the ambient conditions and conditions outside the berac (15-20 °C).
2. Metodology
Banana cv mas kirana fruit used in this study was obtained from Fruit Nutrients of PTPN VIII Parakansalak, Sukabumi (West Java) which was picked at 16 weeks of physiological age calculated from the appearance of banana flowers. The banana cv mas kirana was washed and packaged in a cardboard box with a net weight of 10 - 11 kg and then transported by car to the Laboratory of Indonesian Center for Agricultural Postharvest Research and Development. The equipment used in this study included ethylene gas cylinders equipped with regulators and flow meters, ripening chambers in the form of shelves to place banana cv mas kirana placed in a stainless steel tub (Figure 1), plastic sheaths and syringes. Banana cv mas kirana, five combs were put into each shelf and covered with plastic. The treatment of ethylene gas was tried 0, 100, 150 and 200 ppm with 24 hours exposure time and control treatment. Banana ripening and storage takes place in two conditions: ambient (25-30°C) and air conditioned room (15-20°C). The parameters observed included skin color measuring L, a and b using the Chromameter Minolta CR-300 every two days. Color measurement of banana turtle mas Kirana using Chromameter in 3 points and repeated three time. The color change value by measuring the brightness value (L *), croma and hue are calculated from the values of a and b. Color measurement data was analyzed for variance (ANOVA) and Duncan Test using SAS ves 9.13 portable program.

Figure 1. The ripening chamber consists of shelves filled with five banana combs

3. Results And Discussions
Banana business actors such as collectors and many farmers use calcium carbide to speed up the ripening of bananas. According to [3] the weakness of using fast-damaged fruit carbide stones is marked by brown spots on the surface of the skin. This damage is very incompatible with the high market requirement in bananas [3]. In addition, the use of calcium carbide has now been reduced, especially in developed countries because it can endanger health due to arsenic and phosphorus toxins contained therein [4].

The use of ethylene gas as a booster for ripening banana cv mas kirana refers to the results of research on the ripening of Cavendish, Maeo, Thanjavur, and Brazilian bananas using ethylene gas with a dosage range between 100 - 500 ppm with a duration of exposure between 12-24 hours [5], [6], [7], [8], [9], [10], [11].

a. Visual Color Changes
Color change is the most visible change in the ripening process of bananas because of the synthesis of certain pigments such as carotenoids and flavonoids in addition to the occurrence of chlorophyll remodeling. The uniformity in harvest age becomes an obstacle to the consumer quality in ripening of banana cv mas kirana. Efforts to homogenize the maturity of the banana are done through ripening using ethylene gas. The ripening of banana cv mas kirana exposed to various ethylene gas was presented based
on changes in skin color (Figure 2). The ripening of the banana cv mas kirana faster in ambient conditions than in the air conditioned room. In ambient conditions, banana cv mas kirana ripens on the fifth day (5) for all treatments of ethylene gas doses, while the control fruit is ripe after day 13. While in the air conditioned room, banana cv mas kirana ripens after 11 days for all treatments dosage of ethylene gas, and control fruit ripe on day 17th. The interesting thing from Figure 2 shows that the maturity level of banana cv mas kirana depends on the ripening treatment and ripening conditions of the fruit. In ambient conditions, normal mature banana cv mas kirana has eight (8) levels of maturity. While those treated with ethylene gas have five (5) levels ripening.

Whereas in the condition of the ac room, normal mature banana cv mas kirana fruit has 10 maturity levels, while those treated with ethylene gas have 7 maturity levels. It also implies that the curing treatment will result in a smaller shelf life of banana cv mas kirana as found [12]. Maturation of bananas, cv mas kirana is a complex process involving reform and synthesis processes, in addition to observing in the form of color changes, texture changes occur, arising from the formation of volatile compounds and changes in tastes favored by humans and other creatures.

3.1 Color change measurement with chromameter
In the ripening process, there is a change in color from green to yellow. This change is due to reduced chlorophyll content caused by the activity of the chlorophyllase enzyme and this occurs at the climatic peak. The reduced amount of chlorophyll causes carotenoid pigments (especially xanthophyll and carotene) to be seen [13], [10].

| Days | Treatment in non AC rooms (ambient) | The treatment in the air conditioned room |
|------|------------------------------------|------------------------------------------|
|      | Control 0 ppm 100 ppm 150 Ppm 200 ppm | Control 0 ppm 100 ppm 150 ppm 200 ppm    |
| 1    | ![Image](image1.png)                | ![Image](image2.png)                     |
| 3    | ![Image](image3.png)                | ![Image](image4.png)                     |
| 5    | ![Image](image5.png)                | ![Image](image6.png)                     |
| 7    | ![Image](image7.png)                | ![Image](image8.png)                     |
| 9    | ![Image](image9.png)                | ![Image](image10.png)                    |
| 11   | ![Image](image11.png)               | ![Image](image12.png)                    |
| 13   | ![Image](image13.png)               | ![Image](image14.png)                    |
| 15   | ![Image](image15.png)               | ![Image](image16.png)                    |
### Days | Treatment in non AC rooms (ambient) | The treatment in the air conditioned room
--- | --- | ---
17 | Control 0 ppm 100 ppm 150 Ppm 200 ppm | Control 0 ppm 100 ppm 150 ppm 200 ppm
18 | X X X X | X X X

**Figure 2.** Skin color changes of Banana cv mas kirana fruit (a) in ambient conditions and (b) the condition of the air conditioned room (X = the condition of the banana has been severely damaged and not presented)

**Figure 3.** Brightness value (L *) of banana cv mas kirana during ripening in ambient conditions (a) and condition of air-conditioned room (b)
Figure 4. Hue value (h *) banana cv mas kirana during ripening at ambient conditions and air-conditioned room.

Figure 5. Chroma value (c *) banana cv mas kirana during ripening in ambient conditions and air conditioned rooms.
The change in the color of banana cv mas kirana peel during objective maturation is measured by Chromameter based on brightness (L) indicating the bright dark color. The greater the L value, the brighter the color of the banana skin and the lower the value of L, the darker the color of the skin produced. Figure 3 shows that the treatment of curing with ethylene gas gives a brightness effect on the skin color of banana cv mas kirana, but along with the storage time the brightness of the color fades both in ambient conditions and in air-conditioned rooms. The value of banana cv mas kirana hue presented in Figure 4 & 5 shows that ripening using ethylene gas increases in concentration will increases the value of chroma.

Bananas are inhibited by a yellowing process characterized by the surface of a banana skin that is still green. In addition to using the color index scale directly, the determination of color can be done by determining the value of "Hue. The color change or decrease in the oHue index is due to the chlorophyll degradation process in the skin of the banana cv mas kirana. Chlorophyll degradation is an important process in picking bananas. This process is related to blood separation which will increase plastoglobulence and damage the chloroplast membrane [14]. Color pigments in fruit when ripe are produced through a series of processes which also involve the results of the respiration process.

4. Conclusion

The conditions of ripening space affect the maturation rate and color characteristics of the Kirana banana fruit and the maturity level of the banana cv mas kirana. The effective and efficient dose of ethylene gas to ripen the banana cv mas kirana is 100 ppm. The banana cv mas kirana cooked perfectly 8 days faster when pressed with 100 ppm of ethylene gas in ambient conditions and the condition of the air conditioned room. Banana cv mas kirana is perfectly cooked in ambient conditions four (4) days faster than that which is pressed on the condition of the air conditioned room. Banana cv mas kirana ripe perfectly ripened with 100 ppm ethylene has a shorter shelf life than normal perfectly cooked.

5. References

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