Improving Post-Harvest Ripening of Bananas

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Banana Information

- Family: Musaceae
- Genus: Musa
- Species: acuminata
- Cavendish is the most commonly eaten variety

Commercial Banana Production

- Grown in the tropics, not the US
- Harvested when mature, but unripe
- Shipped immediately under Modified Atmosphere conditions
  - Polyethylene bags containing an ethylene absorbent
  - Use ambient temperatures rather than refrigeration

Commercial Banana Production

- Sent to ripening rooms, after reaching the US
- Ethylene gas may be applied immediately or postponed several days
- Shipped to retailers within 4 – 8 days, depending on ripeness
  - Ripeness is determined by softness, or, more commonly, by peel color
    - Generally sent to retailers between color stages 3 and 4 – mid ripeness

Banana Information

- Bananas are climacteric fruit
  - produce low levels of ethylene at early development
  - dramatically increase ethylene synthesis during ripening
  - ethylene is a plant hormone that stimulates ripening

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The Problem
Bananas Ripen Early
Due to:
• Late harvesting
• Bruising during handling
  ❖ wounded tissue produces ethylene

A single ripening (or wounded) banana can cause an entire box to ripen

Potential Solution
• Determine the threshold amount of ethylene required to initiate ripening
• Ensure that level is not reached before the appropriate time, by using cyclopropenes to block ethylene receptor sites

Potential Solution
Blocking Ethylene Receptor Sites
Possible Compounds:
• 1 – methylcyclopropene (1-MCP)
• cyclopropene
• 3,3 - dimethylcyclopropene
Each of the cyclopropenes can irreversibly bind to an ethylene receptor site, therefore blocking ethylene

The Experiments
Materials
❖ Cavendish bananas were selected, separated, dipped in fungicide, and air dried
❖ All chemicals were prepared by published procedures

The Experiments
Methods – Ethylene Threshold
❖ Testing banana response to 10 ppm ethylene for times ranging from 2 – 28 hours
❖ Testing the response of 2 maturity grades of bananas to exposure to differing concentrations of ethylene

The Experiments
Methods – Cyclopropenes
❖ Tested the response of bananas to alternate applications of cyclopropenes and ethylene
❖ Tested the response of 1-MCP treated bananas to ethylene exposure after various lengths of time
❖ Tested the response of varying concentrations of 1-MCP treated bananas to ethylene exposure
### The Results

#### Ethylene Threshold
- At 10 ppm of ethylene, the threshold time for bananas is approximately 20 hours*
- Ethylene at .1 ppm shortens pre-climacteric time, but ripening will not initiate immediately*
- The threshold concentration of ethylene (to induce any response) is just below .015 ppm*

* The threshold will vary slightly according to fruit age

#### Cyclopropenes
- Cyclopropenes inactivate ethylene receptors
- 3,3 – dimethylcyclopropene has a shorter protection time than 1-MCP
- 1-MCP concentration and duration of application are correlated

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### The Results

#### Cyclopropenes
- High and low concentrations are equally effectual, if application time is sufficient
- Treated bananas will respond to ethylene again after 7 – 12 days, suggesting the synthesis of new binding sites

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### Relevance of Results

Establishing the approximate amount of ethylene required to initiate ripening can be coupled with the use of cyclopropenes, such as 1-MCP, that block ethylene binding sites to prevent early ripening of bananas.

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### Application of Results

- Commercial banana corporations can add cyclopropene to existing Modified Atmosphere Packaging to further inhibit early ripening
- Knowing the approximate threshold level, ethylene levels can be monitored to determine if additional cyclopropene will be necessary
- Now, the presence of a single ripening or wounded banana will not induce ripening among the other bananas in the box

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### References

References


Backgrounds and Animated Bananas can be found at:
- www.bananamuseum.com
- www.chiquita.com
- www.eatmorebananas.com
- www.photos.posters-prints.net/floral/c7033-banana.html?o=0
- www.turbana.com/distributors/ripechart.html

The End