Postharvest ripening and respiration of chilli (*Capsicum annum* Var. MI-2)

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Abstract

Effect of exogenous ethylene application on postharvest ripening and respiratory pattern of chilli (Capsicum annum Var.MI-2) harvested at different stages of maturity was examined. Chillies harvested at mature green and colour break stages were used for the ripening study. Pods were allowed to ripen at ambient conditions (32 ± 2 °C and 37 % RH) with 0, 100, 200, 300, and 400 ppm ethylene concentrations. Observations were made on colour development and weight of red ripe pods during storage period. Ethylene treatment had no significant effect on colour development of chilli harvested at both stages of maturity. Fruits harvested at different stages of maturity ranging from light green to full red were used for the respiration study at 12.2 °C and 83 % RH in a closed system. Respiration rates of chilli from light green to full red stage ranged between 12.7-24.2 mgCO_2/kg/h. The rate of respiration was low at light green stage and increased with maturity reaching a peak (24.2 mgCO_2/kg/h) at colour break stage. Respiration rate decreased with fruit ripening and increased with development of full red colour. The internal ethylene concentration of pods was ranged between 3.2-4.3 ppm. However, there was no ethylene peak observed with the maturity.

Keywords: Maturity; Ethylene; Colour development; Respiration; Chilli

Introduction

Chilli is an important vegetable and a spice crop having significant economic value, and one of the most important food ingredients in Sri Lankan diet. The best strategy to ensure maximum yield of red coloured fruit is to leave fruit on the bush until most fruits have reached a suitable colour and then separating insufficiently ripe fruits after harvest or harvest unripe fruits early and then ripening them using ethylene. Hence, one aim of the present study was to investigate the effect of application of ethylene on postharvest ripening of *Capsicum annum* Var. MI-2. There is a great need to promote the export of green chillies. Respiratory behaviour reflects the physiological conditions of fruits and vegetables. For this reason, it has been used as an index of the physiological response to the surrounding environment. Respiratory behaviour of capsicum is somewhat contradictory as it varies with cultivars. Hence, another aim of this study was to determine the postharvest respiratory pattern of Sri Lankan chilli *Capsicum annum*, Var. MI-2.

Materials and Methods

Effect of ethylene on postharvest ripening of chilli

Chilli samples at mature green and colour break stages were used. Samples placed in ripening chambers (4.75 l) and sealed with 0, 100, 200, 300 and 400 ppm ethylene concentrations. After 24 h, chilli was allowed to ripen in ambient conditions (32 °C and 67 % RH). Weight of pods was measured at each ripening stage and colour development of the pods were observed up to 9 days.

Determination of postharvest respiration rate and internal gas concentrations

Samples of chilli at light green, dark green, break, 30 % red, 70 % red, light red and dark red maturity stages were used for both experiments. Samples were put in respiration bottles, sealed and kept at 15.5 °C and 86 % RH. Gas samples (0.5 ml) were withdrawn from the bottles immediately after sealing (0 min) and three times at 2 h intervals. The respiration rates were calculated using an equation (Shiina, 1999). For internal gas analysis, 0.5 ml gas samples were withdrawn from each pod by inserting a needle of 1 ml syringe through the ovary wall into the fruit cavity. All gas samples were analyzed using gas chromatograph.

Results and Discussion

Effect of Ethylene on Postharvest Ripening of Chilli Harvested at Mature Green Stage

Based on the colour development of chilli pods, it is clear that the pods have not developed into the relevant red colour at day 9 (Figure 1). There is no significant difference among the final colour value of the pods that are harvested at mature green stage and treated with ethylene. Market sample gives the actual colour value (25 °H).

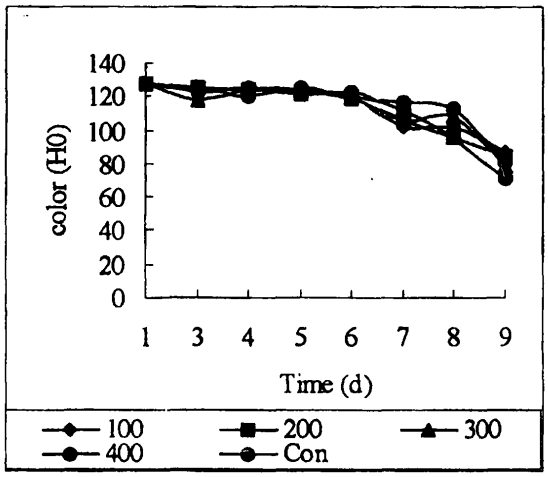

Fig. 1: Effect of ethylene conc. on colour development of mature green chilli

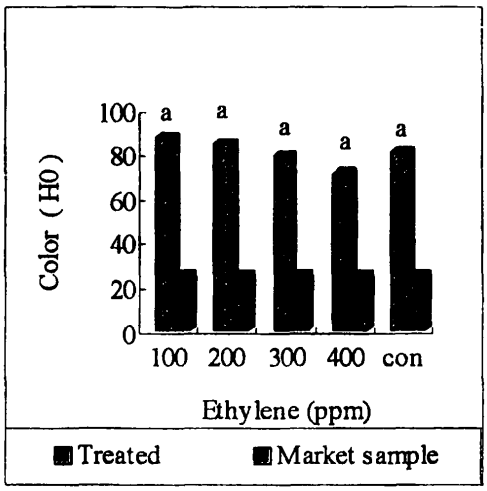

Fig. 2: Effect of ethylene conc. on final colour of mature green chilli after 9 days

Effect of ethylene on postharvest ripening of chillies harvested at colour break stage

The pods treated with ethylene started ripening after the 2nd day. However, the pods not treated with ethylene started ripening at the beginning of day 3 (Figure 3). Observations of the colour development and weight show that there was no significant difference among the treatments on the colour development of the pods (Figures 4,5). Colour value of pods, treated with ethylene, control, and the market sample are almost same (Figure 6). Therefore, exogenous ethylene treatment was not effective in inducing red colour development of chilli fruit under the condition of this study (32 ±2 °C and 67 % RH). Similar results were found in detached and either ethylene or ethephone treated paprika and cayenne chilli (Krajayklang *et al*, 2000). Ambient temperature (30-32 °C) was used for this experiment because higher temperature is observed in chilli grown areas (Dry Zone) in Sri Lanka. Ethylene may not be effective at this higher temperature due to inactivation of ethylene synthesizing enzymes. This may be a possible reason for less effectiveness of in postharvest ripening of chillies. Chilli behaves as non-climacteric fruit, which does not show a climacteric ethylene peak. It could be another reason for less responsiveness postharvest ethylene treatment.

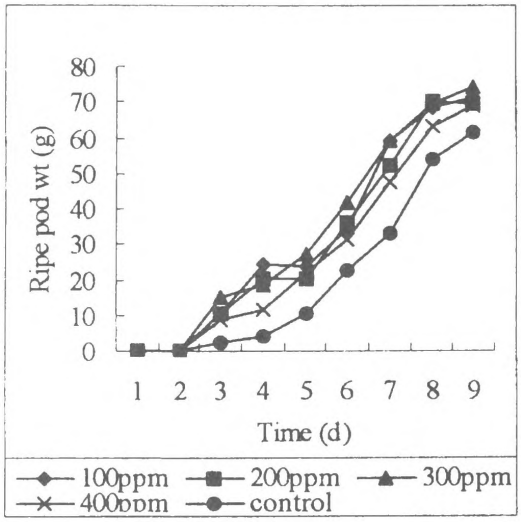

Fig 3: Effect of ethylene concentrations on weight of red ripe pods harvested at colour break stage

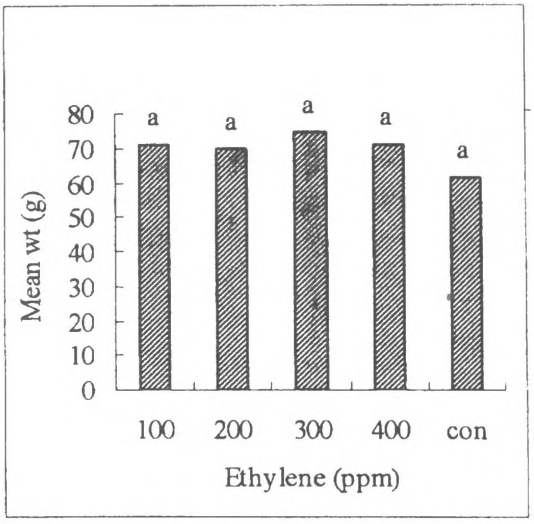

Fig 4: Effect of ethylene concentrations on weight of fully ripe pods after 9 days

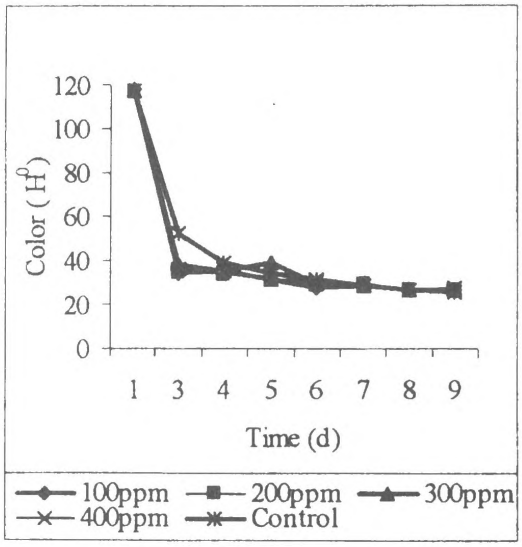

Fig 5: Effect of ethylene concentrations on colour development of pods

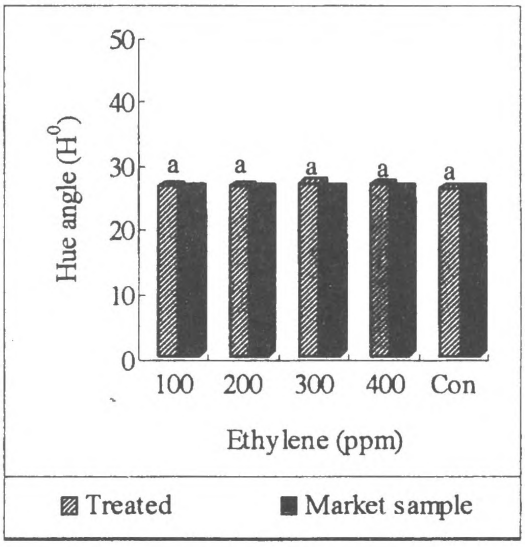

Fig 6: Effect of ethylene concentration on final colour of pods (after 9 d) harvested at colour breaker stage

Determination of respiratory behavior and internal gas concentrations

Light green chilli produced lower amount of CO_2 than other stages (Figure 7). The production of CO_2 increased with fruit maturity and reached a peak at the color break stage. When fruits are turning color, CO_2 production decreased gradually and then increased again when they reached red ripe stage. Maximum CO_2 production in chilli fruit at 15.5 °C was 54.2 mg CO_2/kg/h (1.23 mmol/kg/h) at color break stage. Krajayklang (2002) found that the maximum CO_2 production of chilli fruit at 22 °C was 2.3 mmol/kg/h. In this study, CO_2 production ranged 15.7-54.2 mg/kg/h. Similar results were observed by Angueira, *et al*, (2003). At the early stages of maturity, oxygen concentration decreased inside pods (Figure 8). When pods were getting red, it increased and came to its peak (24 %) at light red stage. With the maturity carbon dioxide concentration increased (Figure 9). The highest carbon dioxide concentration recorded is 1.183 %. This was observed when the pods are turning the color from green to red. Simultaneous decrease in oxygen level observed at the same stage indicates that respiration was high at this maturity level. There is a decrease in carbon dioxide when the fruits are almost red and increase again with fruit senescence.

Internal ethylene concentration is slightly high when the fruits are green but not detected at their coloring stages (Figure 10). No ethylene peak was observed.

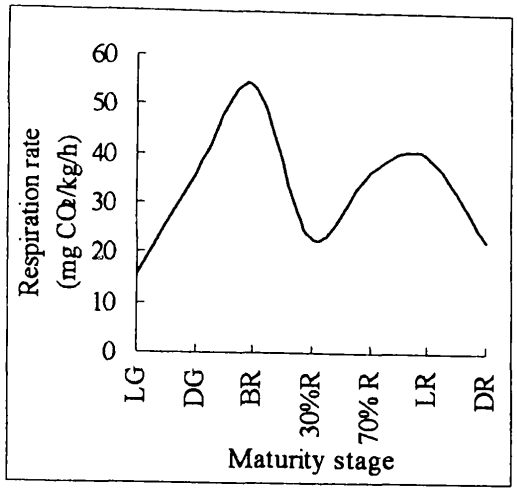

Fig 7: Respiration rate (mg CO_2/ kg of chilli/h) of chilli harvested at different maturity stages

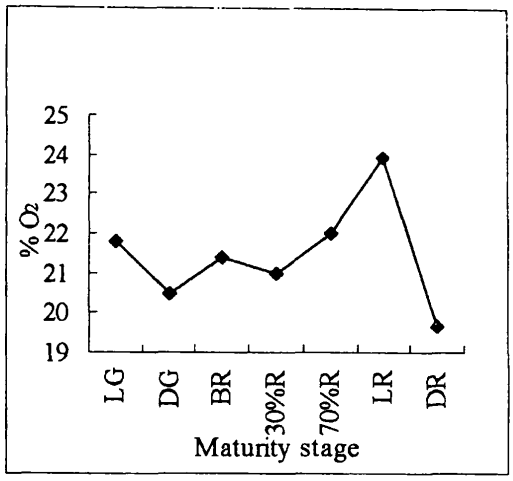

Fig 8: Internal oxygen percentage of pods at different maturity stages

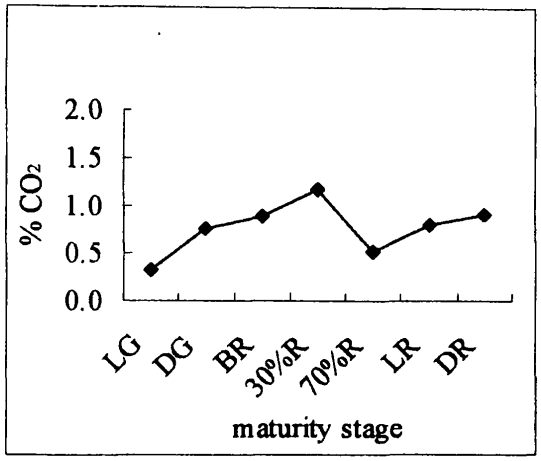

Fig 9: Internal carbon dioxide dioxide of pods at different maturity stages

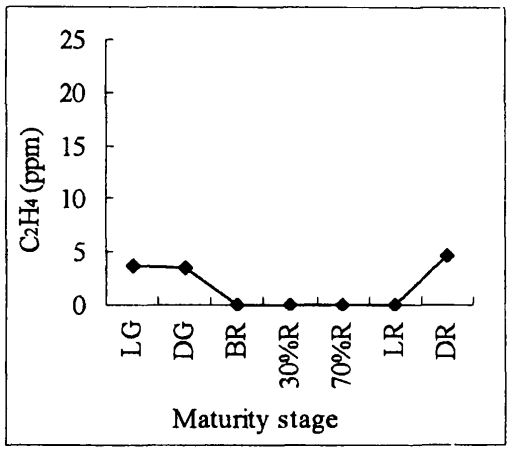

Fig 10: Internal ethylene percentage of pods at different maturity stages

Conclusions

There was no effect of exogenous application of ethylene on postharvest ripening of chilli that are harvested at either mature green or color break stage. Whether ethylene treated or not, mature green pods failed to ripen while pods at color break stage completed ripening within 8-9 days. Hence, pods harvested above the color break stage can be used for dry chilli production. Pods that are in light or mature green color should be culled before processing, as they will not develop into full red color. Chilli (*Capsicum annum*, MI-2) shows a postharvest respiratory climacteric. However there is no ethylene peak.

References

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