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MATURATION OF MALAYSIAN FRUITS. IV. STORAGE CONDITIONS AND RIPENING OF PASSION FRUIT *(PASSIFLORA EDULIS* L. VAR. FLAVICARPA)*.

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RINGKASAN

Kajian pertukaran-pertukaran fisiologikal telah dibuat keatas sejenis buah markisa tempatan yang sedang masak. Cubaan telah dijalankan dalam suhu dan keadaan penyimpanan yang berbeza-beza. Perengkat pengeluaran ethylene dan carbon dioxide telah dicatitkan. Buah-buah markisa biasanya masak diantara 20°C–30°C. Pembuangan carbon dioxide mempercepatkan kemasakan dan kelembapan samada rendah atau tinggi akan merosakan buah-buah itu. Keadaan penyimpanan yang disyorkan adalah di suhu lebih kurang 20°C dan kelembapan (relative humidity) diantara 85%–90%.

INTRODUCTION

Passion fruit *(Passiflora edulis)* was introduced into Malaysia from tropical America over two centuries ago (ALLEN, 1975). The purple form *(P. edulis)* is a highland variety which does not thrive is the lowlands. Flavicarpa, the yellow form, was introduced from Australia and Hawaii in the 1960s, and now grows wild in open country especially in Singapore and Penang and is commonly cultivated in the lowlands. The juice contains about 12.4% sugar, 3.5% acids and a good amount of vitamin C (PRUTHI and LAL, 1955). Passion fruit cordials and squashes are popular beverage bases in Australia (RODRIGUEZ, RAINA, PANTASTICO and BHATTI 1973).

Although PRUTHI and LAL (1955) reported that the purple passion fruit could be kept for a long time without loss of flavour or quality, this communication attempts to elucidate storage and ripening conditions of the variety flavicarpa.

MATERIALS AND METHODS

Fruit – *P. edulis* forma flavicarpa (Family: *Passifloriaceae*) was obtained from the Malaysian Agricultural Research and Development Institute (M.A.R.D.I.) at Serdang, Selangor. Fruits were picked mature but in a green unripe stage. One fruit was used per replicate, and each experiment was replicated at least three times.

Effect of temperature. humidity, carbon dioxide and ethylene on storage and ripening

These were carried out exactly as described in the third paper of this series (see BROUGHTON, and LEONG, 1980).

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Determination of carbon dioxide and ethylene

These were assayed by titrimetry and gas chromatogtaphy as described previously (see BROUGHTON, *et al,* 1977). Fruits were placed in gastight containers (Fowler's No 31, Fowlers–Vacola, Hawthorn, Victoria, Australia) and stored at 11°C, 20°C 27°C and 30°C.

Determination of reducing sugar

Fruits at different stages of ripeness were used. Levels of reducing sugar in the fruits were assayed as described previously (see BROUGHTON *et al.,* 1977)

RESULTS

Just as the rate of respiration was higher at higher storage temperatures, the climacteric rise in respiration also occured earlier at higher temperatures *(Fig 1).* At 10°C there was no climacteric. On the other hand, temperature seemed to have a different effect on ethylene evolution. At higher temperatures, there was a lower rate of ethylene evolution, and the rate of production was highest at 20°C *(Fig. 2).* Ripening was fastest and storage life shortest at 30°C, while ripening did not occur below 11°C. At 20°C the fruit ripened gradually and remained ripe without deteriorating for long periods. Flavour and quality of the fruit were also good when ripened at this temperature. Subsequently, ways to reduce or increase the storage life of the passion fruit were performed at 20°C.

When ethylene was removed from the respiration chamber, the climacteric and ripening occured earlier than in control fruits *(Fig. 3).* Removal of carbon dioxide induced, the climacteric even earlier *(Fig. 4).* The climacteric in both the dry and wet treatments occured earlier than the control, being earliest in the dry treatment *(Fig. 5).* However, the fruits in both treatments failed to ripen normally. When ethylene or carbon dioxide was removed from the respiration chamber, the quality of the ripened fruits was not affected. Levels of reducing sugars increased during the ripening process, and did not decline during the post- ripening phase *(Fig 6).*

DISCUSSION

Like most fruits, passion fruit ripened and deteriorated earlier at higher temperatures, while low temperatures caused chilling injuries. If one considers the effects of temperature on storage life, eating quality and appearance, 20°C seems to be the optimal for both storing and ripening. Ripening was too fast at 30°C and abnormal at 11°C. To high or too low a relative humidity also resulted in abnormal ripening and so PANTASTICO, CHATTOPADHYAY, and SUBRAMANYAM (1973) advocate 85%–90% relative humidity for optimal ripening and storage of this fruit.

Removal of carbon dioxide accelerated the onset of the climacteric and ripening. ABELES (1973) suggested that removal of carbon dioxide enhances the effect of ethylene while BURG (1967) contended that carbon dioxide was a competitive inhibitor of ethylene action. Surprisingly the removal of ethylene did not delay ripening as in most other fruits (see FORSYTH, EAVES and LIGHFOOT; 1969; SCOTT BLAKE, STRACHAN, TUGWELL, and Mc. GLASSON., 1971; NAZEEB and BROUGHTON, 1977), and under these conditions the fruits, ripened earlier than the controls. Perhaps the onset of the climacteric was already initiated in the fruits before or at harvest. Alternatively, ethylene may have no effect on the ripening of this fruit as was observed with *Annona squamosa* (BROUGHTON and TAN, 1979). In such

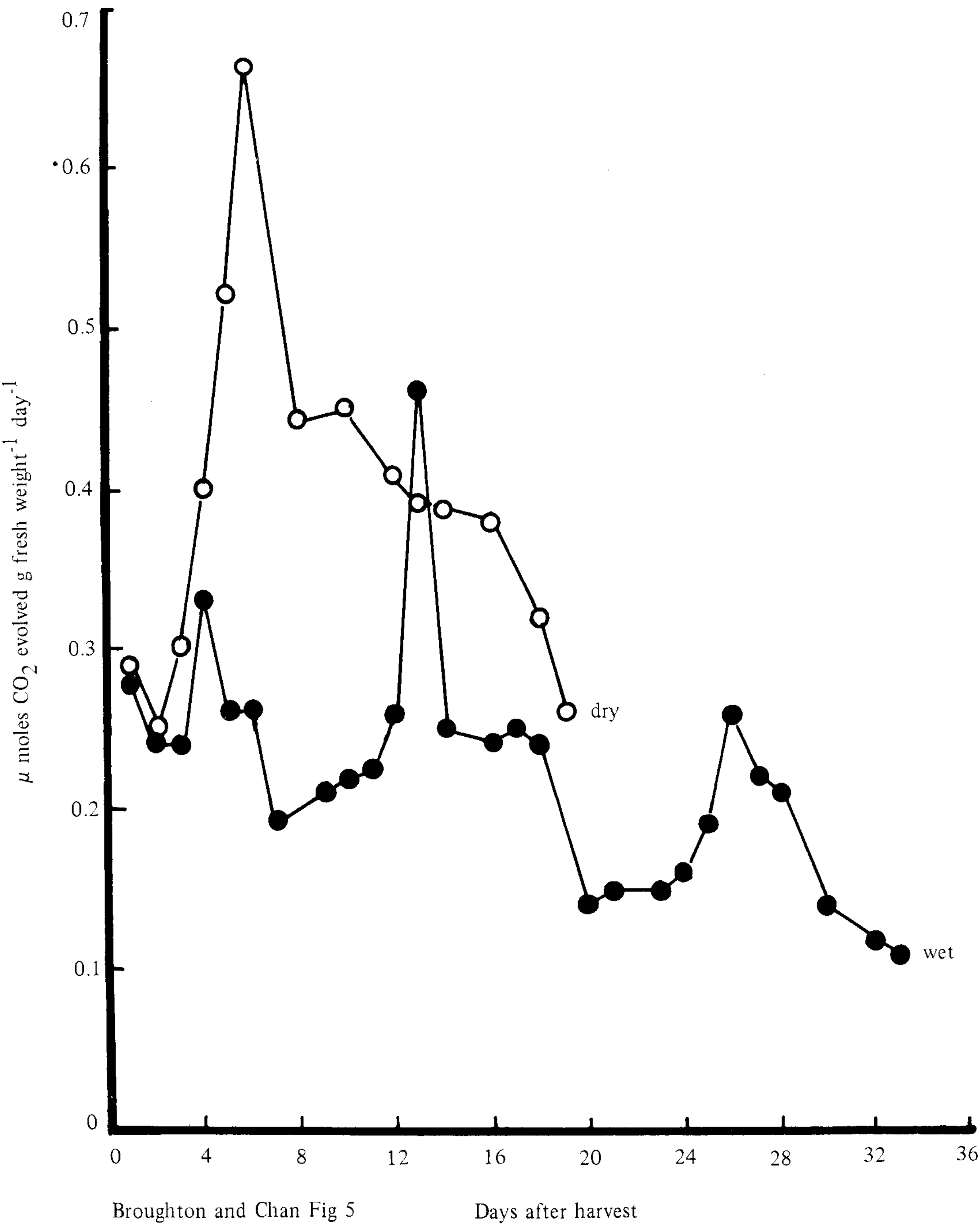

Figure 1. Rate of carbon dioxide evolution by passion fruits stored at different temperatures.

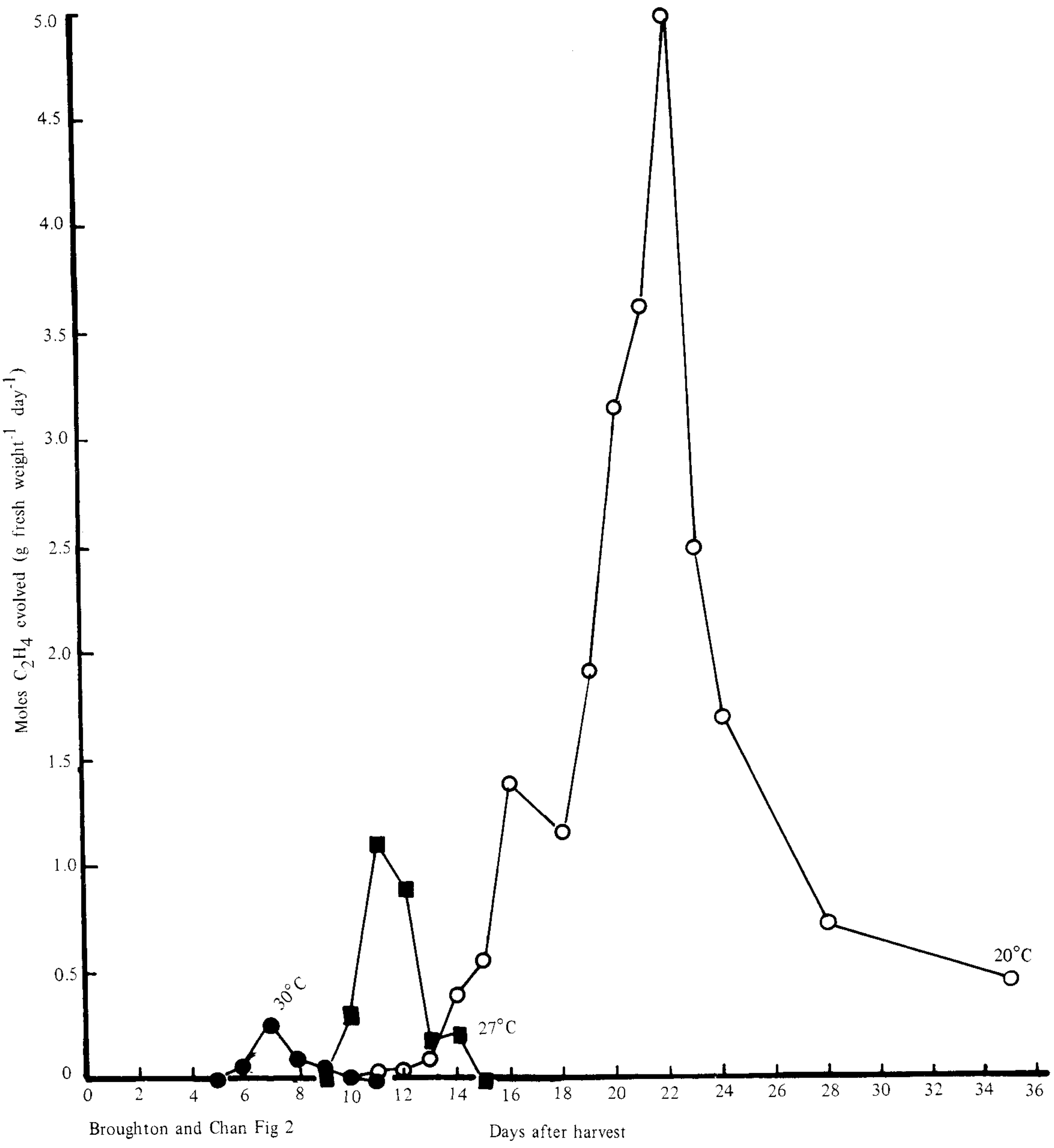

Figure 2. Rate of ethylene evolution by passion fruits stored at different temperature.

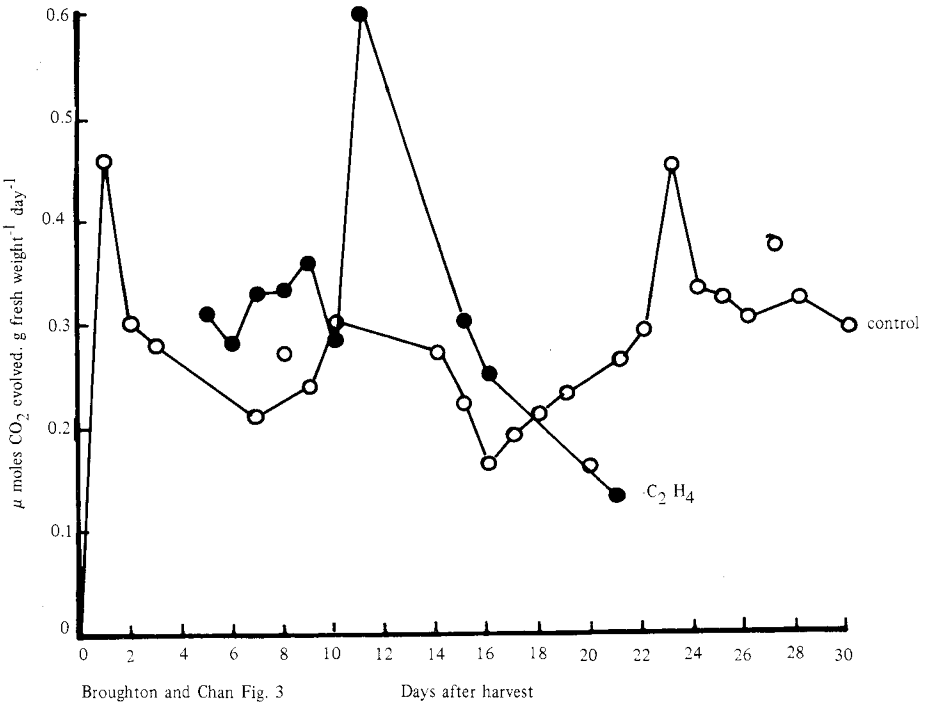

Figure 3. Effect of removal of ethylene from the respiration chamber on the rate of carbon dioxide evolution by passion fruits.

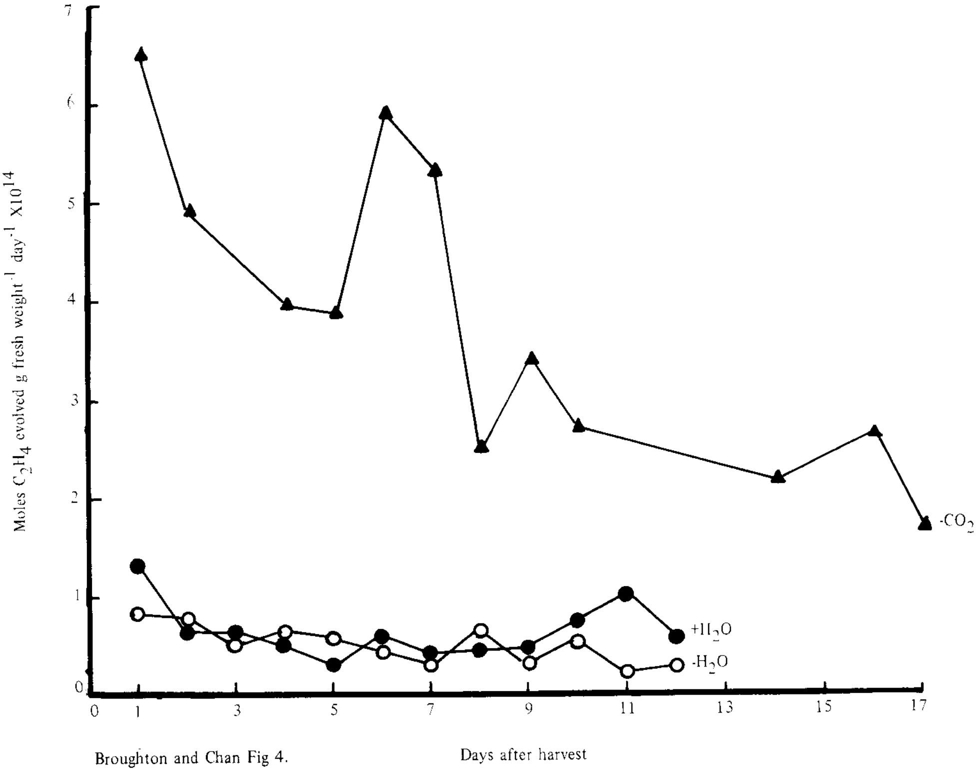

Figure 4. Effect of removal of carbon dioxide on ethylene evolution by passion fruits stored at 20°C.

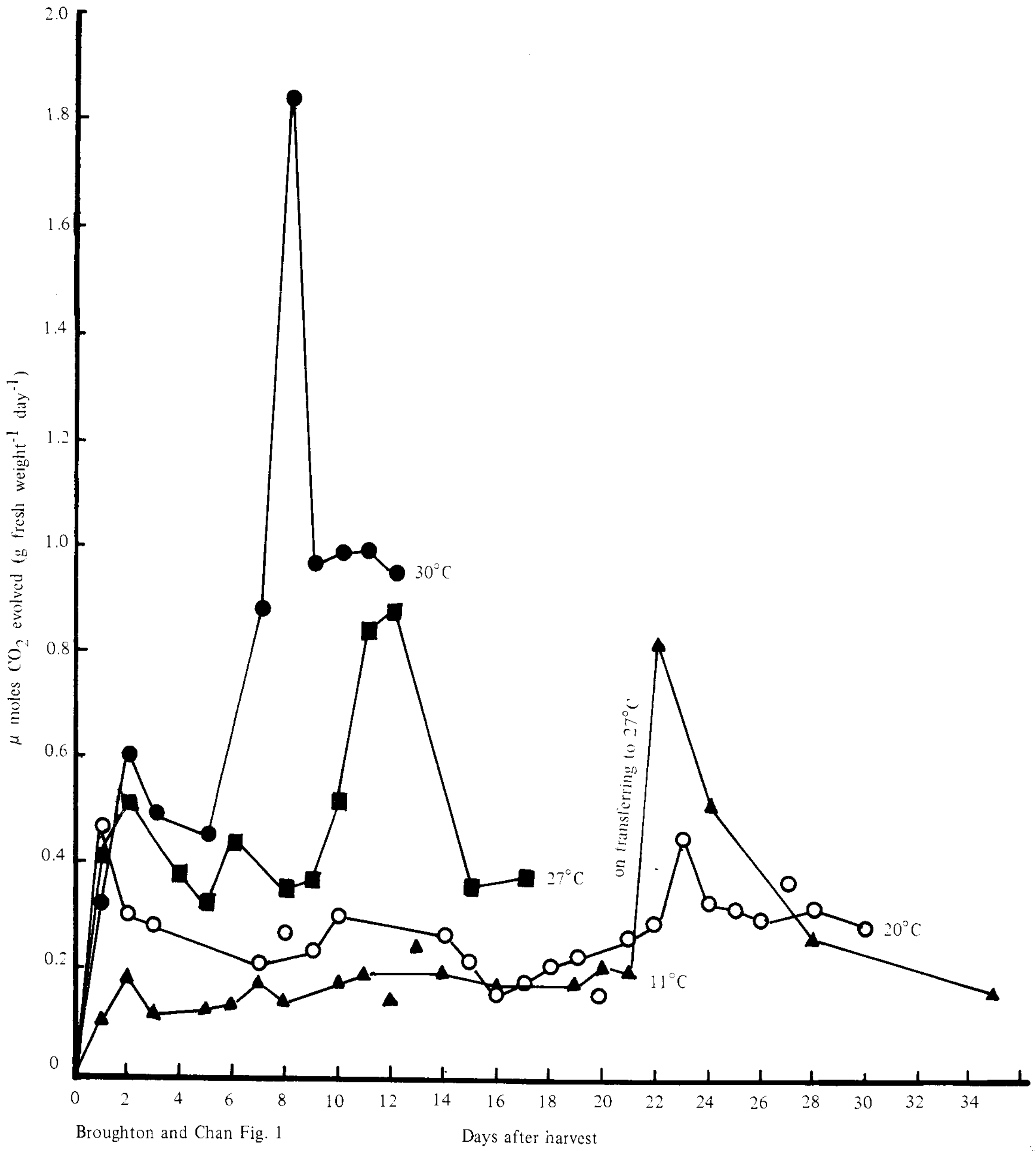

Figure 5. Effect of different humidities in the respiration chamber on the rate of carbon dioxide evolution by passion fruit stored at 20°C.

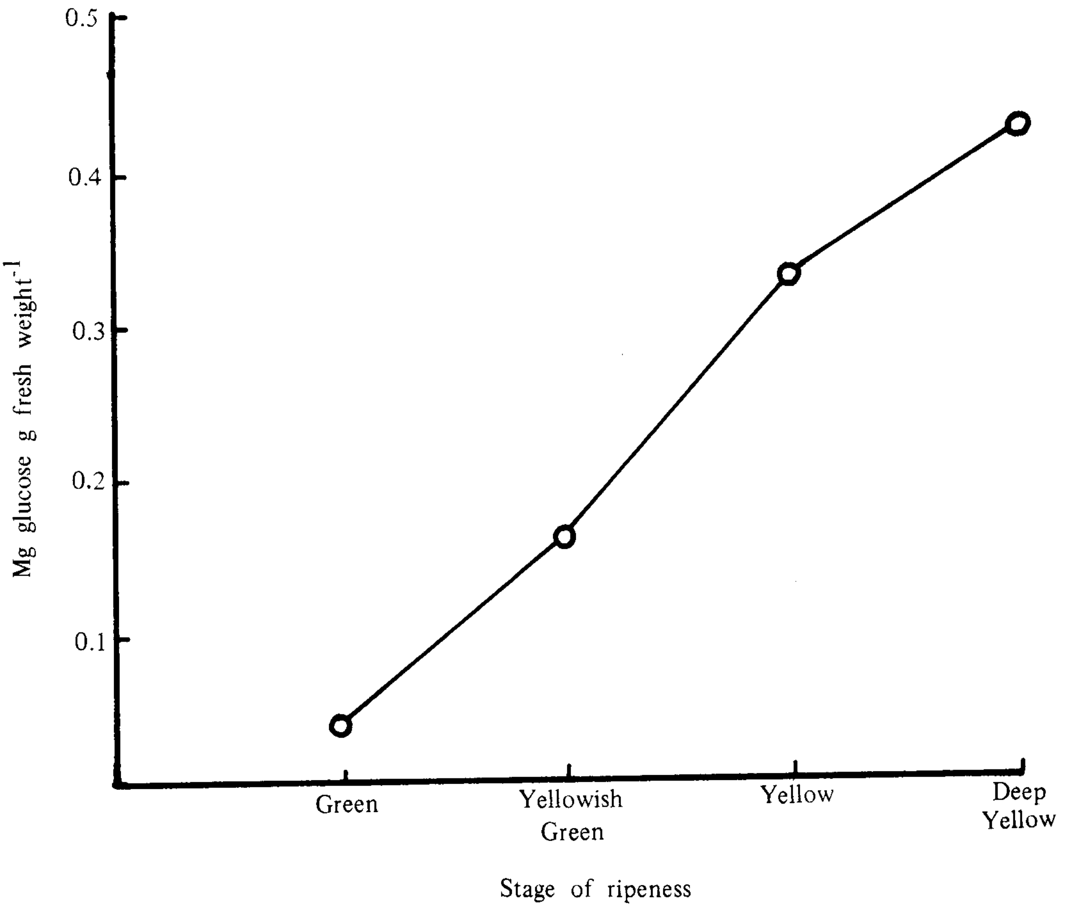

Figure 6. Changes in the reducing sugar content of ripening passion fruits.

cases, the removal of ethylene would not abort the process (BURG and BURG, 1965). Recommended storage conditions are; temperature about 20°C at 85%–90% relative himidity.

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SUMMARY

Physiological changes were measured during the ripening and storage of a Malaysian variety of passion fruit. The fruits were subjected to different temperatures and storage atmospheres, and their rate of ethylene and carbon dioxide evolution measured. Passion fruits ripened normally between 20°C–30°C. Removal of carbon dioxide accelerated ripening, while low or high himidities were detrimental to the fruit. Recommended storage conditions are; temperatures about 20°C at 85%–90% relative himidity.

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