ABSTRACT

A Study of Fruit Development and Postharvest Storage of Breadfruit grown in Barbados, West Indies

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A white flesh breadfruit [*Artocarpus altilis* (Parks) Fosb] cultivar, exhibited a biphasic growth pattern with respect to fresh and dry weight, with attainment of full size at 0.5-2 0 kg and horticultural maturity, 15-21 weeks after the female inflorescence was first detectable. Maturity indices which correlated well with growth were, the expansion and flattening of polygonal segments on the fruit surface, along with the timing of the appearance of natural latex exudation on the fruit skin. Compositional changes in starch and sugar content also gave good correlation with development, while colour and density gave poor indication of maturity changes At ambient temperature, ripening typically occurred 3-4 days after harvest. During ripening, early mature fruit exhibited higher peak levels of CO_2 (300 ml kg^{-1} h^{-1}) and C_2H_4 (1 4 µl kg^{-1} h^{-1}) during the climacteric than late mature fruit (200 ml kg^{-1} h^{-1} CO_2 and 0 8 µl kg^{-1} h^{-1} C_2H_4) When the storage temperature was reduced to 13°C, both the peak respiration and C_2H_4 emission rate fell to 45-70 ml kg^{-1} h^{-1} and 0 20-0.23 µl kg^{-1} h^{-1} respectively, while the time to attain the climacteric peak increased 3X over the ripening time at ambient

The optimum storage temperature of 13°C is recommended for the "white flesh" breadfruit examined in this study, since no softening was detectable for 10-14 days postharvest, although the fruit skin showed rapid browning Temperatures 1°, 2° or 3°C above this temperature did not retard softening significantly enough to be used as an optimum storage temperature Chemical treatments such as EDTA and ascorbic acid did not reduce browning, but submergence (whether at ambient or 13°C) did, suggesting that this may be a problem triggered by

dehydration of the fruit skin and that the presence of O_2 may be implicated in this browning response. Pre-cooling with cold water at 13°C or 4°C (ice/water bath), reduced core cooling time from 9 h with air-cooling to only 3.5 h and 2.5 h respectively. However, there was no significant improvement in the rate of softening of hydrocooled as compared with air-cooled fruit, perhaps due to the lag (2-3 h) between harvest and cooling. Comparison of a subjective finger rating (FR) textural assessment method with two objective methods using a penetrometer, revealed that whole firm fruit (FR=1) required a force of 8-10 kgf to yield, while fully soft fruit required only 0-4 kgf; and that internal assessment of fruit flesh gave no earlier indications of softening, than the subjective FR did.

Fruit were treated with four coatings (Semperfresh, Sta-Fresh MP, Chitosan, Nutri-Save), which in general reduced the rate of softening but had very little effect on weight loss or browning. At both ambient and 13°C, only Sta-Fresh MP consistently reduced weight loss and discolouration. The 3 other coatings on the other hand, encouraged fungal growth on the skin, increased browning, internal discolouration and development of alcoholic aromas at both ambient and low temperature. These observations were associated with generally variable, but relatively high (>8 %) O_2, CO_2 (>15%) and variable internal C_2H_4 concentrations, but with a climacteric being displayed by all coated fruit, at ambient. With a reduction in storage temperature to 13°C, the variability generally continued, with O_2 concentration generally remaining at or above 8%, while C_2H_4 generally accumulated and increased toward the end of the storage time. Starch content in coated fruit at ambient was reduced and there was a corresponding increase in sugars, though neither change occurred to the extent of control unwrapped fruit. This contrasted with a lack of corresponding decline in starch content concomitant with the increase in sugars accumulation observed at 13°C.

Sealing breadfruit in a range of 10 plastic films reduced water loss and softening dramatically, both at ambient and 13°C. In one experiment at ambient, fruit wrapped in the thin films (HDPE 25 µm, LDPE 30 µm and SealedFresh film)

portrayed anomalous behaviour by keeping perfect quality over 3 weeks of storage. Gaseous analyses revealed that these fruit maintained O_2 and CO_2 of 5-8% and 8-10% respectively, while fruit in those films which did not maintain quality had O_2 and CO_2 concentrations of 2-4% and 15-70%. Though C_2H_4 showed an early rise in the storage period, this declined to insignificant amounts over the last 2 weeks of the storage period. Storage of fruit in films at 13°C improved the maintenance of quality seen at ambient, with only 1-2% weight loss occurring, very little textural change, little fungal growth, and good maintenance of skin colour (40-50% discolouration) as compared with controls (90%). Increase in storage time from 1 to 3 weeks saw a corresponding increase in both the reducing and total sugars in film-wrapped fruit at 13°C, however, the magnitude of the increase did not correlate with the insignificant decline in starch content in these fruit. Taste tests of the fruit stored at 13°C in the films revealed that with increased storage time, the fruit generally became less palatable, an increased sweetness being one parameter. The LDPE films maintained most acceptable quality after 1 week of storage, while the HDPE 40/60 μm films maintained the most acceptable eating quality over the last 2 weeks of storage.

Exposure to 5, 50 and 500 ppm C_2H_4 showed that as maturity increased, fruit became more C_2H_4 sensitive. The use of C_2H_4 scrubbers in the films at ambient did not reduce the levels of C_2H_4, nor critically reduce softening or discolouration. At 13°C, however, scrubbers did reduce [C_2H_4] in 4 of the 6 films examined.

Trial shipments with film-wrapped fruit revealed that when all control fruit had softened, at least 50% of film-wrapped fruit were saleable, verifying laboratory findings that such treatments can provide real benefits. If fruit are maintained at 13°C for 1 or 2 weeks and then removed to ambient for retail sale, they should be kept bagged and preferably sold within 3 days.