Effects of Ethrel application and packaging on mango fruit quality

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ABSTRACT

Experiments were conducted at the National Institute for the Promotion of Horticultural Exports, University of Gezira, Wad Medani, Sudan, during May 1997 and 1998 to investigate the effects of Ethrel and polyethylene packaging on mango fruit quality. Mango fruit quality, Mango fruits were harvested at the mature-green stage and treated with Ethrel or left as control. Fruits were packed in either intact or perforated polyetlhylene packages or left unpacked. The experiments were set up in a completely randomized design with three replications. Ethrel treatment accelerated the rate of fruit ripening as shown by an increase in total soluble solids, yellowing and a decrease in fruit firmness and starch content Fruits packed in intact polyethylene packages resulted in the lowest weight loss, followed by those packed in perforated films, whereas unpacked fruits showed the highest weight loss and lowest quality manifested in shriveling and deterioration.

INTRODUCTION

Mango fruits should be harvested at the mature green stage and not be allowed to ripen on the tree because tree-ripened fruits have a short shelf life, inferior taste and keeping quality and are subject to the problem of fruit drop (Lakshiminarayana *el al*, 1975). Several reports indicated that mango fruit ripening could be promoted by applying ethylene or ethylene-releasing compounds (Barmore, 1974; Barmore and Mitchell, 1975; Sargent et ale, 1992).

Exogenous application of ethylene or Ethrel to mature green mango fruits resulted in homogeneous ripeni ng and enhanced all quality characteristics such as colour, flavour, aroma, and taste (Baullar,1982).Lam and Wong, 1986; Lam, 1988).

Delaying deterioration of fruit quality requires the use of proper packing material in order to reduce physical injury and minimize transpiration and water loss (Straten and Oesthyse, 1994). Several packing materials have been used such as waxed paper, cellophane wrappers, and polyethylene films (Elkashif *et al*., 1983).

In experiments where mango fruits were packed in different materi- als, it was found that polyethylene packaging resulted in the best fruit quality (Arnaud, 1995). Similarly, Batagurki et al. (1995) reported that both perforated and intact polyethylene packaging of mango fruit improved quality as compared to the unpacked control.

However, research work presented by Straten and Oesthyse (1994) showed that when mature green mango fruits were sealed in semi- permeable polyethylene bags, they had poor colour development and taste, however, weight loss was greatly reduced. Similar results were reported by Gonzalez et al. (1990), who showed that modification of the in-package atmosphere delayed fruit ripening but reduced weight loss. These results showed some controversey regarding the use of polymeric film wrapping. Hence, the purpose of this research is to investigate the effectiveness of Ethrel and polyethylene packaging in improving mango fruit quality.

MATERIALS AND METHODS

Mango fruits of the cultivar Kitchener were harvested at the mature green stage on May 1997 and 1998. Fruits were washed in a solution of 150ppm sodium hypochlorite and then divided into two lots: one lot was treated with Ethrel and the other remained as control.

Ethrel treatment

Fruits were dipped for one minute in Ethrel solution (2-chloroeth- ane-phosphonic acid), at a concentration of I.0 ml/L which was equi- alent to 480 ppm ethylene. Control fruits were dipped in distilled water. Fruits were then dried and placed in the following package treatments:

l. Cartons lined with intact polyethylene bags.
2. Cartons lined with perforated polyethylene bags.
3. Cartons without bags.

The experiment was arranged in a completely randomize design with 3 replications. All cartons were placed at ambient conditions of temperature and relative humidity, and were allowed to ripen. The experiment was terminated when fruits reached the table ripe stage Data taken included total soluble solids, colour, firmness starch content and number of days required to reach the ripe stage.

Total soluble solids (TSS) were determined using a hand reftacto meter (Bellinghan and Stanley, England).

Colour was visually assessed using a scale of I to 5 as follows:

1: Green, 2: Light green, 3 : Yellowish green, 4: Light yel Yellow.

Firmness was evaluated by measuring the resistance of fruit t pressure using a scale of I to 5 as follows :1:Very soft, 2: Soft, 3: Fairly soft, 4: Fairly firm, 5: Firm.

Determination of starch content

Alcohol insoluble solids were ground to a fine powder in a mortar and quantitatively transferred to a reflux flask to which 40 ml of 2N HCI was added and refluxed for 2½ hours to hydrolys polysaccharides to monosaccharides. Then it was neutralized with 20 ml NaOH and completed to 250 ml with distilled water. Charcoal was added to remove coloured substances and then the solution was filtered. Reducing sugars were estimated using Nelson's method (Nelson, 1944).

Determination of weight loss

Mature-green mango fruits were washed, disinfected in 150ppm sodium hypochlorite solution and then subjected to the previously mentioned packaging treatments but without adding Ethrel. Cartons were stored at ambient conditions of temperature and relative humidity. Cartons were initially weighed and then weighed everyday until the fruits were table ripe.

$$\text{Weight loss (\%)} \frac{\text{Initial weight final weight}}{\text{Initial weight}} \times 100$$

Data was subjected to the analysis of variance procedure. Means were separated using Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Ethrel-treated mango fruits showed significantly higher amount of TSS as compared to untreated fruits (Fig. l). Ethrel released ethylene honnone which triggered the ripening processes in fruits and resulted in early ripening as compared to the control. Similar results were obtained by Lam and Wong (1986) and Lam (1988).

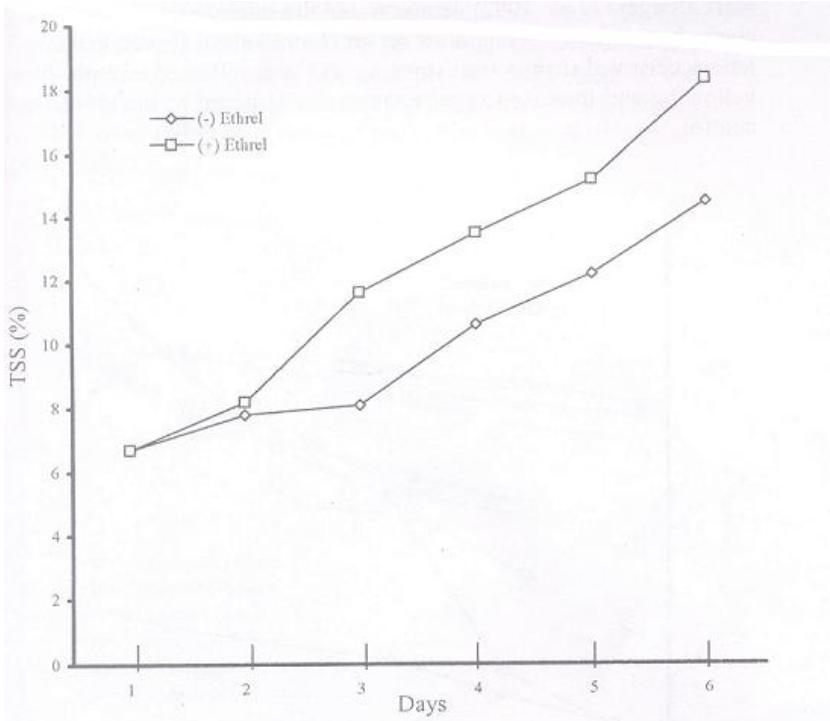

Fig. 1. Effect of Ethrel treatment on total soluble solids (TSS) content.

Ethrel treatment significantly increased total soluble solids (TSS) (Fig. l) and enhanced colour development (Fig. 2). Ethylene released from Ethrel caused the degradation of chlorophyll and induced the biosynthesis of cell wall hydrolases which accelerated the hydrolysis of cell wall components and hence resulted in increased TSS. These results were in agreement with those shown by Elkashif and Huber

(1983) who reported that exposure of fruit to exogenous ethylene resulted in the induction of hydrolytic enzymes such as cellulose and , pohygalacturonase which enhanced the hydrolysis of cellulose, hemicellulose and resulted in increased TSS. Relevant research work (Sargent et al., 1992) demonstrated the role of ethylene in climacteric fruit ripening, and another report (Lam, 1988) showed that ethylene accelerated mango fruit ripening and was reflected in rapid fruit control.

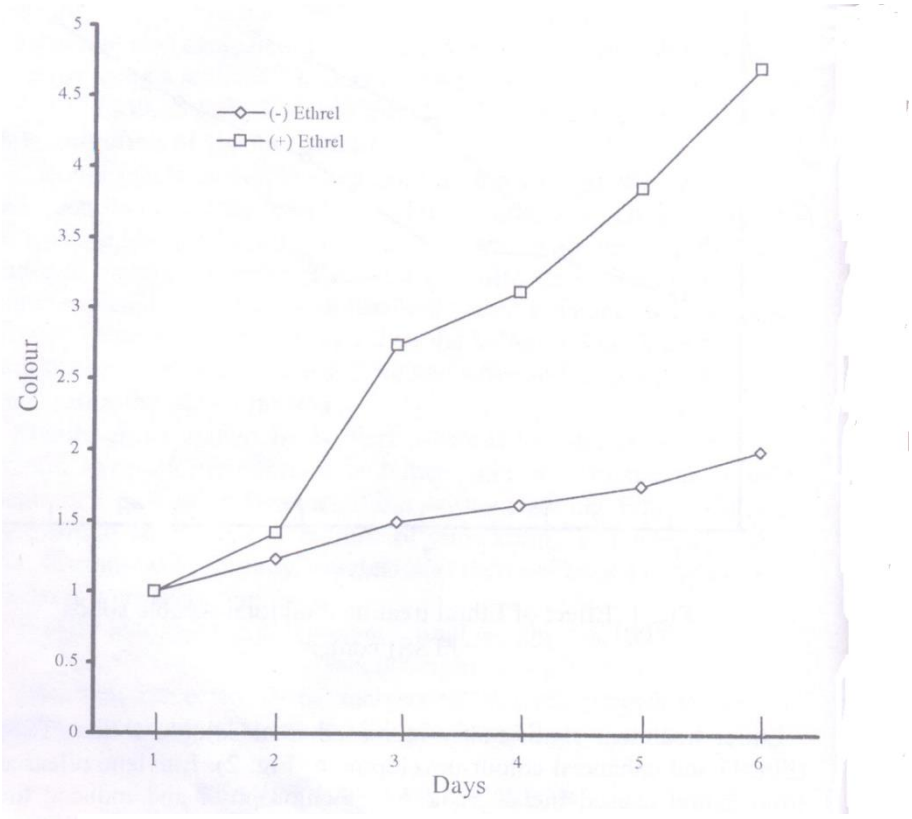

Fig.2 Effect of Ethrel treatment on colour development in mango fruit during ripening

There were significant interaction effects between Ethrel treatment and polyethylene packaging on fruit firmness (Fig. 3). Mango fruit treated with Ethrel and packed in intact polyethylene packages softened rapidly as compared to those packed in perforated packages or unpacked. This was due to the trapping effect of the intact polyethylene

package to ethylene gas which resulted in its high concentration and hence acceleration of ripening. Results presented by Straten and Oesthyse (1994) and Batagurki et al. (1995) supported this work and showed that intact nylon packaging of individual mango fruits improwed their quality.

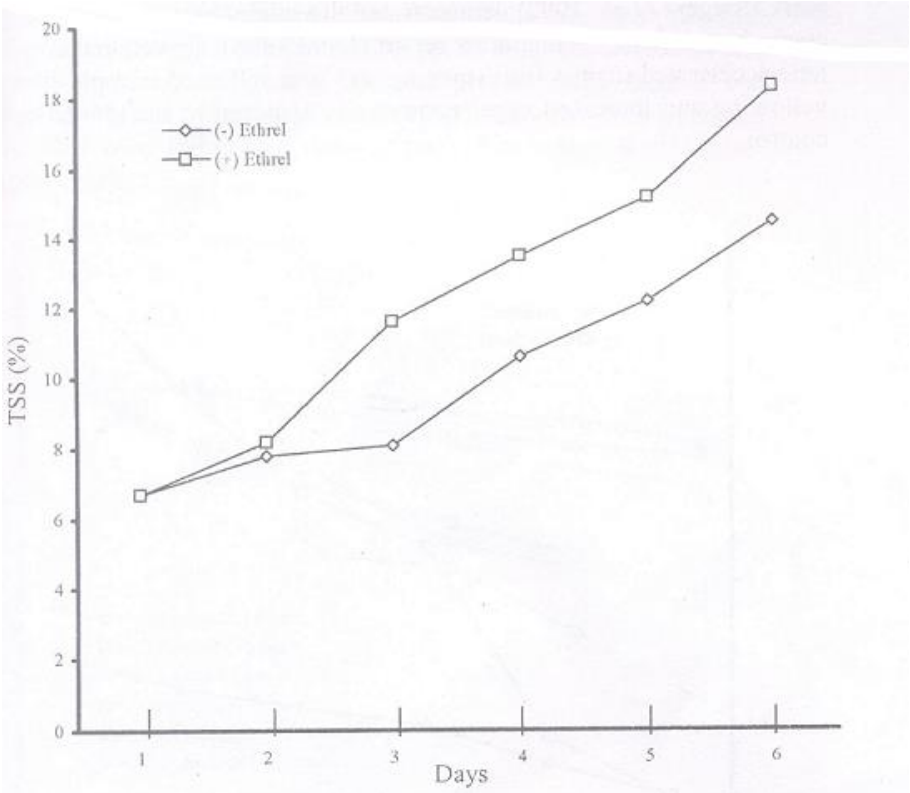

Fig. 1. Effect of Ethrel treatment on total soluble solids (TSS) content.

Ethrel application and packaging treatments significant interacted in their effects on starch percentage (Fig. 4). Ethrel-treated mongo fruits packed in intact polyethylene packages exhibited a significantly higher rate of starch degradation as compared to the other treatment However, untreated and unpacked fruits showed the lowest rate of starch degradation.

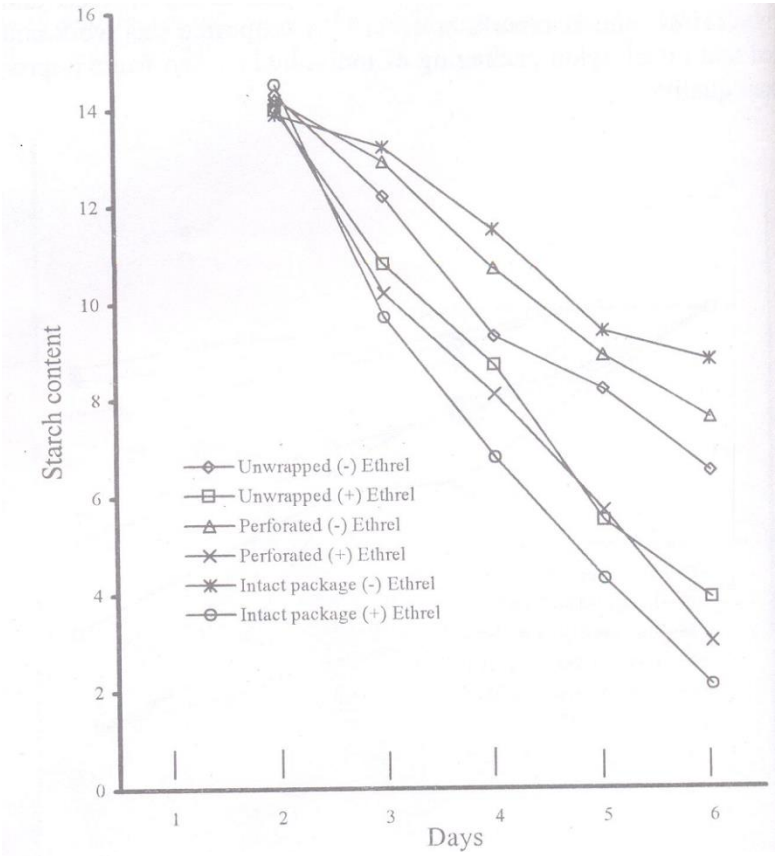

Fig. 4 Interactions effects of Ethrel and polyethylene] packaging on starch content

There was a direct relationship between changes in fruit firmness (Fig. 3) and starch degradation (Fig. 4). Ethylene released from Ethrel and trapped in intact polyethylene packages induced the biosynthesis of hydrolytic enzymes which accelerated starch hydrolysis and other cell wall polysaccharides and hence resulted in a decrease in fruit firmness.

Polyethylene packaging treatments significantly affected mango Fruit weight loss during ripening (Fig. 5). Unpacked fruit showed a significantly higher weight loss, followed by those packed in perforated films, whereas those packed in intact packages showed the lowest weight loss. This was due to the high relative humidity inside the intact package which greatly reduced the rate of water loss from the fruits.

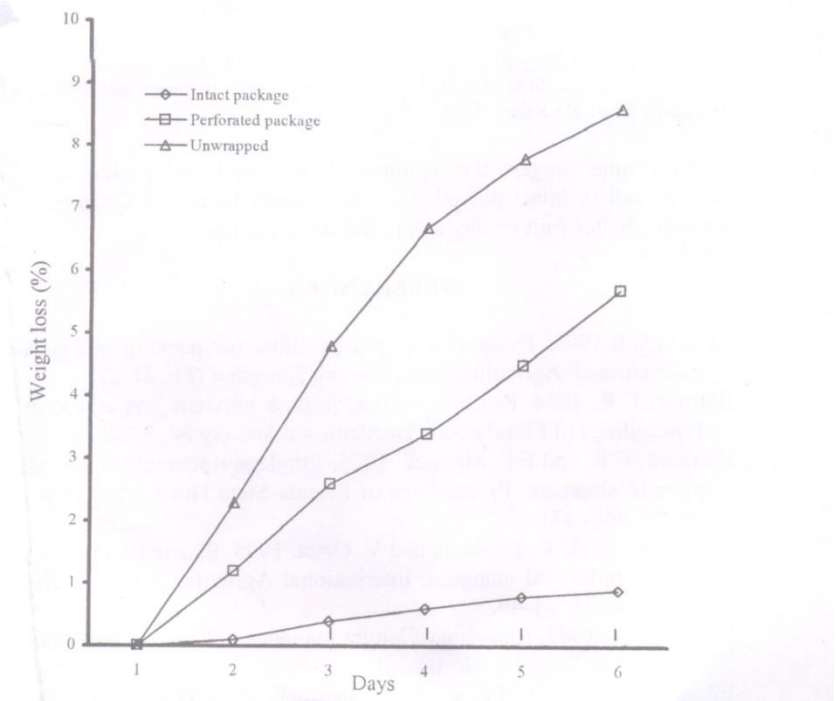

Fig. 5. Effect of polyethylene packaging on mango fruit weight loss.

These results were consistent with shriveling data presented in Table 1, where unpacked fruit showed a significantly higher shriveling percentage as compared to the other treatments. Similar research work on broccoli and cucumber (Elkashif et al., 1983) and graperfruit (Kawada and Albrigo, 1979) showed that packaging perishable com-
modities in intact films maintained their quality longer than those packed in perforated films or unpacked which showed signs of shriveling, ling, yellowing, senescence, and deterioration.

Table l. Effect of polyethylene packaging on shriveling of fruit.

Package	Shriveling(%)
Unwrapped	6.42a
Perforated package	1.56 b
Intact package	1.00 b

Means having the same letter (s) are not significantly different according to Duncan's Multiple Range Test.

Our results suggest that application of Ethrel and packaging of mango fruit in intact polyethylene film would be useful for uniform ripening, better fruit quality and reduced weight loss.

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