# RUTAB INDUCTION IN HELALI DATE FRUITS BY ETHANOL FUMES

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## ABSTRACT

Induction of rutab development in Helali date is a main concern for producers. Many attempts have been made using the ripening enhancer Ethrel without success. Tremendous amounts of dates have been lost because they either abscise or unable to convert to the rutab stage. In this study, ethanol fumes were used at 50% v/v and were compared with the effect of Ethrel at 2000 ppm or hot water (at 50°C for 15 min). Helali dates at the early or full Khalal stage were sprayed with ethanol, sealed in thick plastic bags for 24 hrs, then incubated at 22°+2°C for 6 days. The results indicated that ethanol fumes were able to fully induce rutab development in Helali dates at the full Khalal after harvest. There was no added advantage by the addition of Ethrel to ethanol fumes in terms of their effect on rutab development at the full Khalal. Furthermore, Ethrel and hot water treatments were no effective in inducing rutab development in Helali either at the early or full Khalal. Responses of other parameters such as water loss, total soluble solids, acidity, vitamin C, and electrolyte leakage of the flesh were also reported. It could be concluded that ethanol fumes alone at 50% v/v could be used after harvest to fully induce rutab development (ripening) in Helali date fruits at the full Khalal stage.

## INTRODUCTION

Helali is one of the most important commercial cultivars in the Gulf region. It is known with the high quality of fruits and the very late maturity. Helali fruits, however, could not be consumed at the Khalal stage due to the presence of soluble tannins. Furthermore, the majority of fruits on the bunch don't convert to the rutab stage by the end of the season. This problem could be due to the noticeable reduction in temperature by this time. Induction of rutab development in Helali dates is a major concern for date producers. They apply high concencerations of ethephon to induce ripening, but complain about the negative response. It is desired to enhance rutab development in Helali dates either before or after harvest in order to reduce losses, harvest early, and increase growers

profits. Delaying harvest to obtain some rutab fruits results in increased abscission. Growers can only obtain very few rutab fruits collected in the plastic fishing net they used for bagging. After that, they give up obtaining more rutab fruits then they get rid of the bunches.
Traditional methods of ripening induction such as Khalal cooking or using salt and vinegar after harvest adversely affect fruit quality (Asif and Tahir, 1983).

Since soluble tannins are strong deproteinizing agents, they might hinder the action of ethylene which needs to bind to certain proteins to show a response. It is also desired to polymerize tannins to convert them from the soluble to the insoluble form to be able to consume the fruit.

The objectives of this study were to investigate new-safe means that induce rutab development in Helali dates and compare the response of Khalal dates to ethephon at high concentration with other chemicals. It is also crucial to gain more knowledge about the physiology of Helali date ripening at this stage in order to be able to have an effective formulation of Ethrel.

## MATERIALS AND METHODS

This study was conducted during the two consequitive seasons 1999 and 2000 using Helali dates. Helali bunches were harvested from the same tree in each season from Al-Kwaitat Experimental Station, Al-Ain, UAE. Bunches were sorted out to various stages of development. Fully colored fruits were divided into two groups, based on their specific density with water, early and full Khalal fruits. Early Khalal fruits float on water while full Khalal fruits sink. Dates at both groups were washed with tap water then surface sterilized with sodium hypochlorite (NaOcl) 0.5% v/v of 5% stock solution. Fruits were then rinsed in distilled water then left for air-drying. Fruits of each stage were divided into small groups randomly and each group had 15 fruits.

Treatments included the control (water), hot water (at 50°C for 15 min) using a water both provided with thermostat, Ethrel at 2000 ppm by dipping for 15 min, Hot water plus Ethrel, ethanol fumes (50%, V/V) by spraying the fruits then incubating in thick plastic bags for 24 hrs, and Ethrel at 2000 ppm plus ethanol fumes. Following the treatment, all fruits were incubated in thick planstic bags and tightly sealed for 24 hrs. fruits were then incubated in plastic trays at 22 + 2°C for 6 days after removing the plastic bags then the following parameters were taken: weight loss (%), rutab score according to an established scale (No rutab = 1; > zero to

less than 25% = 2; > 25 to < 50% rutab = 3; > 50 to < 75% rutab = 4; > 75 to < 100% rutab = 5 and finally 100% = 6); total soluble solids of the juice using hand Refractometer, vitamin C in the juice by titration against the endophenol dye (A. 0. A. C, 1984), electrolyte leakage of the flesh by the method of (Zhang and Willision, 1987) using the conductivity meter and flesh weight.

Three replicates were used with each treatment in a completely randomized design with 15 fruits in each replicate. Analysis of variance (ANOV A) and the least significant difference (LSD) at 0.05 level were obtained by the Mstat Computer software.

## RESULTS AND DISCUSSION

### I. Early Khalal treatments:

The data in Table 1 showed that used fruits at the early Khalal had generally similar flesh weight in both seasons. Furthermore, weight loss of control fruits was similar to that of hot water or Ethrel treated fruits. Fruits treated with hot water plus Ethrel or Ethrel plus ethanol fumes had higher water loss than the control in the two seasons.

The hot water treatment in addition to Ethrel did not result in a significant difference in water loss when compared with Ethrel alone in 1999 and 2000 seasons. However, the combination of Ethrel plus ethanol fumes led to higher weight loss than Ethrel alone in both seasons.

With regard to total soluble solids, the data, in Table 1 indicated that fruits of all treatments had similar values by the end of the experiment in both seasons. In a similar way, various treatments lead to similar values of fruit acidity in both seasons. Control fruits had similar acidity to that obtained with the treatments except with hot water or Ethrel treated fruits in the first seasons that had slightly lower acidity.

Data of vitamin Cat the early Khalal stage, showed that it was generally low for all treatments. Vitamin C content in the control fruits was similar to that obtained with Ethrel, ethanol fumes, and Ethrel plus ethanol fumes in both seasons. There was no significant difference in vitamin C content between Ethrel alone or in addition to hot water treatment or ethanol fumes in both seasons.

The response of fruits at the early Khalal to various treatments in terms of rutab b development, revealed that all treatments were not able

to induce rutab formation except Ethrel plus ethanol fumes in both seasons. Even Ethrel alone or plus hot water treatment were not able to induce rutab development when compared with the control.

The results of electrolyte leakage by the end of the study (Table 1) also support the findings of rutab score. It was found that all treatments had similar electrolyte leakage except the combination of Ethrel plus ethanol fumes in the first season. As the fruit tends to initiate ripening (the rutab stage) more leakage of electrolytes is expected from the cells. Similar trend was found in the second season. The highest value of electrolyte leakage was obtained with Ethrel plus ethanol fumes as compared with the control and all other treatments.

**II. Full Khala Treatments:**

The data of flesh weight in Table 2 showed uniformity of used fruits. As appeared in the data, the control and all other treatments did not vary significantly in flesh weight in both seasons.

With regard to weight loss (Table 2), Ethrel treatment resulted in similar weight loss to that obtained with Ethrel plus hot water or the combination of Ethrel and ethanol fumes. Furthermore, the control fruits had less weight loss than the combination of Ethrel plus ethanol fumes especially in the second season. However, Ethrel plus hot water treatment caused similar weight loss to that obtained with the control in both seasons.

Results of total soluble solids (TSS) by the end of the experiment are shown in Table 2. the data indicated that control fruits and other treatments had similar TSS values in both seasons. Hot water treatment alone or in combination with Ethrel did not result in different TSS when compared with the control in both seasons. There was a trend of higher TSS with Ethrel plus ethanol fumes when compared with the control but this difference was not significant.

Fruit acidity data is shown in Table 2. Fruits of the control and all other treatments did not vary significantly in their acidity in the first season.

Similar trend of results was obtained in the second season. Ethanol fumes alone or in combination with Ethnel did not result in a significant difference in fruit acidity when compared with the control in both seasons.

With regard to vitamin C, the data indicated that all treatments did not vary significantly from the control in the first season except ethanol fumes treatment that resulted in a significant reduction in vitamin C when compared with the control. Similar significant reduction in Vitamin C was obtained by ethanol fumes in the second season when compared with the control. However, Ethrel plus ethanol fumes also caused a significant reduction in vitamin C in the second season as compared with the control.

Trends of rutab score were similar in both seasons (Table 2). Ethanol fumes caused a significant increase in rutab development as compared with the control in both seasons. The rutab score values 5.27, 5.45 for the two seasons respectively meant that more than 75% to less than 100% of the fruit area was at the rutab stage. However, there was no added advantage on rutab development when Ethrel was added to ethanol fumes. That was clear from the rutab score values of ethanol fumes treatment that did not vary significantly from that obtained by Ethrel plus ethanol fumes. Furthermore, Ethrel alone was not able to induce rutab development in Helali dates even at the full Khalal stage in both seasons. Similarily, hot water treatment was not able to significantly induce rutab formation.

The date of electrolyte leakage from fruit tissues coinsided with the results of the rutab score. The highest values of electrolyte leakage was obtained with ethanol fumes alone or in combination with Ethrel when compared with the control. However, the addition of Ethrel to ethanol fumes did not result in additional increase in electrolyte leakage when compared with ethanol fumes alone. As more rutab development is obtained, more electrolyte leakage is expected. Hot water treatment did not cause a significant increase in electrlyte leakage when compared with the control in both seasons.

The present study provided evidence about the role of ethanol fumes in removing astringency and inducing rutab development in Helali Dates. Astringency is a major quality problem in Helali date fruits. This astringency is due to water-soluble tannins present in the tannin cells. Soluble tannins have a strong protein binding capacity and have been widely used as a deproteinzing agents. Polymerized tannins do not show astringency primarily, because they are insoluble in water (Taylor, 1993). It was also found that ethanol removed astringency in persimmon and fruits contained 13 times more insoluble tannic substances (Manabe, 1982). This information explains the insensitivity of Helali dates to Ethrel treatments that could be due to the binding of soluble tannins to proteins thus, hindering the action of ethylene released from Ethrel. Zaghloul date

fruits are none stringent at the Khalal stage and they postively responded to the application of ethephon in a formulation containing ethanel and urea (Farag and Kassem; 1998). These findings agree with our results where Helali dates at the early or full Khalal stage were not sensitive to Ethrel treatment while ethanol fumes were able to fully induce rutab development of the full Khalal dates and significantly increase rutab development in Helali dates of the early Khalal by the combination of ethanol fumes and Ethrel. Other attempts to induce rutab development by sodium chloride and acetic acid resulted in uracceptable salty taste (Asif and Tahir, 1983). Although date fruits were reported to be climacteric (Abbas and Ibrahim, 1996) and must be sensitive to exogenous application of ethylene sources, but soluble tannins may hinder the initiation of the ripening processes. Successful application of Ethrel were either obtained with none stringent cultivars at the Khalal stage (El-Hamady et al., 1983) or were accompanied with fruit thinning (El-Hamady et al., 1992). The basic information generated by this study could be utilized to formulate Ethrel in such a way that could produce a positive response by Helali dates in terms of rutab development before harvest.

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Table 1: Fruit quality characteristics, rutab development, and electrolyte leakage of Helali fruits treated at the early Khalal stage

| Treatments | Flesh weight (gm) | | Weight Loss (%) | | Total Soluble Solids (%) | | Acidity (%) | | Vitamin C (mg/100 ml) | | Rutab Score | | Electrolyte leakage (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 |
| Control | 10.68 A | 11.84 A | 13.42D | 11.81 C | 25.83 A | 22.50 A | 0.10 A | 0.11 A | 1.58 A | 2.00 A | 1.02 B | 1.00 B | 6.79 B | 12.70 C |
| Hot Water | 9.99 AB | 11.28 AB | 13.43 D | 13.03 B | 25.33 A | 23.50 A | 0.08 B | 0.11 A | 0.68 C | 1.60 A | 1.00 B | 1.00 B | 6.79 B | 13.90 B |
| Ethrel | 9.68 Ab | 11.36 AB | 13.86 CD | 12.97 BC | 24.00 A | 22.00 A | 0.08 B | 0.11 A | 1.35 AB | 1.80 A | 1.09 B | 1.00 B | 7.19 B | 13.80 BC |
| Hot Water + Ethrel | 10.11 AB | 11.28 Ab | 15.41 BC | 13.13 AB | 24.17 A | 22.50 A | 0.09 AB | 0.11 A | 1.13 B | 1.60 A | 1.00 B | 1.11 B | 7.21 B | 13.26. BC |
| Ethanol fumes | 8.90 B | 11.57 A | 16.72. AB | 12.10 BC | 25.00 A | 25.00 A | 0.09 AB | 0.11 A | 1.35 AB | 1.60 A | 1.00 B | 1.00 B | 8.27 B | 14.26 B |
| Ethrel + Ethanol Fumes | 10.30 A | 10.79 B | 17.26 A | 14.27 A | 23.33 A | 22.00 A | 0.09 AB | 0.12 A | 1.35 AB | 1.60 A | 2.64 A | 1.47 A | 19.06 A | 16.15 A |



740

Table 2: Fruit quality characteristics, rutab development, and electrolyte leakage of Helali fruits treated at the full Khalal stage

| Treatments | Flesh weight (gm) | | Weight Loss (%) | | Total Soluble Solids (%) | | Acidity (%) | | Vitamin C (mg/100 ml) | | Rutab Score | | Electrolyte leakage (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 |
| Control | 7.17 B | 11.06 C | 14.88 A | 11.90 A | 36.50 A | 42.00 AB | 0.11 A | 0.12 AB | 11.97 A | 17.20 A | 1.40 B | 1.20 C | 10.22 B | 16.79 E |
| Hot Water | 19.33 A | 13.20 ABC | 15.21 A | 11.93 A | 37.17 A | 36.00 B | 0.11 A | 0.13 AB | 13.26 A | 8.00 BC | 1.60 B | 1.73 BC | 13.11 B | 16.87 DE |
| Ethrel | 6.66 A | 12.46 BC | 15.34 A | 12.00 A | 36.67 A | 35.50 B | 0.10 A | 0.13 A | 11.18 A | 5.20 BC | 1.53 B | 1.51 BC | 10.59 B | 20.59 CD |
| Hot Water + Ethrel | 7.51 B | 13.47 ABC | 15.62 A | 12.01 A | 41.17 A | 39.50 AB | 0.13 A | 0.13 AB | 12.74 A | 9.40 B | 2.56 B | 2.47 B | 12.90 B | 23.24 BC |
| Ethanol fumes | 8.43 B | 15.55 A | 14.54 A | 11.41 A | 41.67 A | 40.50 AB | 0.09 A | 0.12 AB | 3.70 B | 2.70 C | 5.27 A | 5.45 A | 22.40 A | 26.71 AB |
| Ethrel + Ethanol Fumes | 9.32 B | 14.97 AB | 15.05 A | 11.42 A | 38.50 A | 44.50 A | 0.12 A | 0.11 B | 12.74 A | 6.40 BC | 4.02 A | 5.91 A | 22.96 A | 29.36 A |



741